Feb. 5, 1935. R. MAUTSCH 1,989,996

HEAT EXCHANGE UNIT

Filed Jan. 5, 1932

Fig. 1.

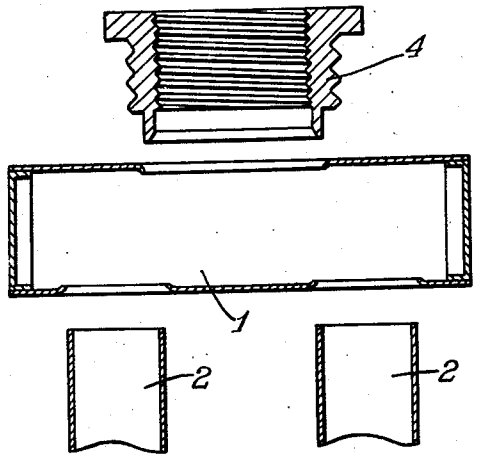


Fig. 5.

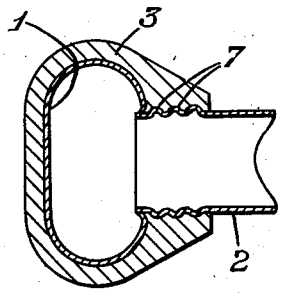


Fig. 2.

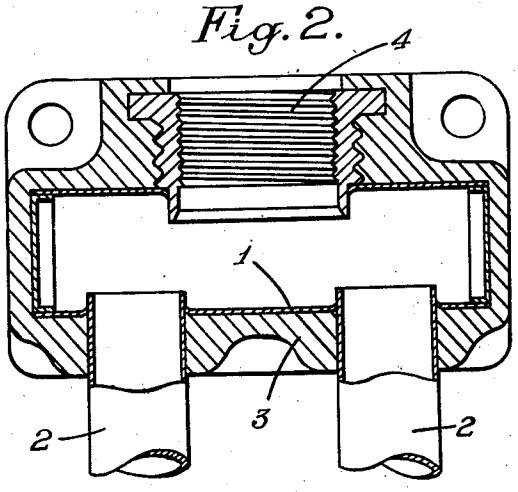


Fig. 6.

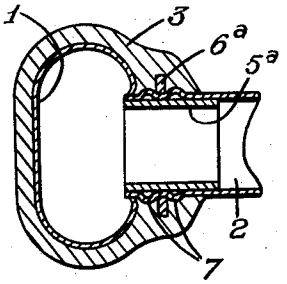


Fig. 3.

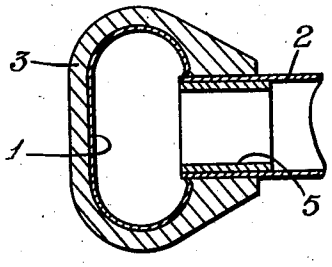
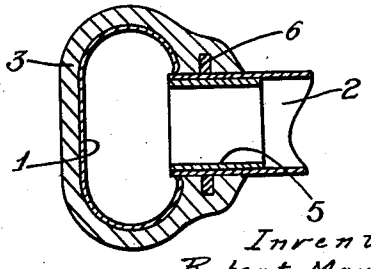


Fig. 4.



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UNITED STATES PATENT OFFICE

1,989,996

HEAT EXCHANGE UNIT

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Application January 5, 1932, Serial No. 584,866
In Belgium February 26, 1931

5 Claims. (Cl. 257—248)

This invention relates to the headers of tubular heat exchange apparatuses such as heating or cooling radiators, evaporators or the like, whose units are assembled of tubes connected with headers. To ensure requisite strength and tightness, said headers usually consist of a casting whilst, in many cases, the tubes are formed of spun or drawn metal.

For reasons of economy, or because the metal used for forming the tubes is difficult to cast, it is usual to manufacture said tubes of a metal other than that of the headers, said headers being made of cast iron or of an alloy of aluminium, for example, whilst the tubes are of copper or other metal having a low resistance to the flow of heat and good anticorroding properties, but being unsuitable for casting or of prohibitive cost. For many purposes it would however be desirable that the headers, or at least those portions thereof which come into contact with the fluid flowing through the apparatus, be made of the same metal as the tubes, or of some metal possessing properties considered requisite for the efficient operation of the apparatus. By this means it would be possible to obviate oxidization or corrosion of the headers and the effect thereof upon the fluid flowing through the heat-exchange apparatus, as well as to preclude certain electrolytical phenomena liable to cause serious damage, due to the formation of electric cells at the points where tubes and headers consisting of different metals are joined together, and to the presence of a liquid in the apparatus.

The present invention supplies simple means for attaining this end without increasing the cost of the heat exchange units appreciably, by providing a header-box whereof the walls consist of thin sheets of the metal selected for use, said header-box being strengthened by means of a metallic outer jacket or casing which may be continuous and enclose the sheet metal header-box completely, or be formed to enclose only certain portions of the same, the joints for example, the remainder of the header-box being left bare if it is not intended to withstand high pressures. Preferably, the header box itself is used as a casting core, and the metal of the jacket or casing is cast directly around the same.

Many known means are available, such as threaded nipples, soldering, welding, expanding and the like, for securing tubes to headers. It is often difficult however to obtain by any of these means joints adapted to remain fluidtight at high pressures and, according to the invention, the ends of said tubes are therefore preferably embedded in and rendered integral with the metal of the casing surrounding the header, when said casing is cast. For this purpose, the tubes are joined to the header-box, said header-box is placed in the casting mould to act as a casting core therein, and metal is then cast into said mould around the ends of the tubes at the same time as it is cast around the header-box or those portions thereof which it is desired to strengthen. The tube-ends anchored within the header-box may be smooth, may be provided with a ring shrunk thereon, or may be corrugated and be provided with said shrunk ring or not, but they are preferably strengthened to withstand the shrinkage stresses of the metal cast to form the casing, by being provided with an inner liner. Said tube ends are preferably fitted into openings in the header-box previous to casting, and plain or threaded nipples fitted into openings in the header-box in the like manner likewise become embedded in the metal, when the same is cast to form a casing or jacket.

In order that the invention may be clearly understood and readily carried into effect, the same will now be described more fully with reference to the accompanying drawing which illustrates, by way of example, a few constructional embodiments thereof and in which:

Fig. 1 is a horizontal section of a header-box and of the separate members to be assembled therewith, before casting,

Fig. 2 shows, likewise in horizontal section, the same members assembled with the header-box and embedded, together with the same, in a cast iron casing.

Figs. 3 to 6 show modifications of the invention.

In all of the figures, 1 indicates the thin metallic header-box, to which the tubes 2 of the heat exchange apparatus are secured by expansion or by other suitable means, and 3 indicates the metal casing cast around said header-box 1 which is used as a casting core, and around the ends of tubes 2. An internally threaded nipple 4, expanded or otherwise secured in header-box 1, is likewise embedded in the metal of casing 3 by the casting thereof.

In the constructional embodiment shown in Fig. 2, the ends of tubes 2 are smooth, devoid of any reinforcement, and are gripped in the metal of casing 3 solely by the pressure of said metal due to the shrinkage thereof after casting. When said tubes are thin, as is usually the case, their ends are preferably reinforced by means of an inner liner 5 (Fig. 3) adapted to prevent the collapse of the side wall of said tubes under the

pressure set up by the shrinkage of the cast metal, and thus to assist in providing a solid anchorage for the tube ends. The strength of said anchorage may further be enhanced by shrinking upon the tube ends a ring of comparatively large diameter 6 (Fig. 4), adapted to resist still better the shrinkage stresses of casting 3 and to provide a joint the tightness of which is all the greater that said stresses act upon a large diameter. Should the metal of said casing not surround the tube in a perfectly fluidtight manner and some of the fluid contained in the header therefore coze along tube 2, ring 6 will force said fluid to follow a path so circuitous as to be alone sufficient, in most cases, to arrest said oozing.

Instead of being smooth, the end of tube 2 may be roughened, threaded or corrugated as at 7 (Fig. 5), to afford the cast metal of the casing a better grip upon said tube and likewise to force any fluid oozing along said tube to travel a circuitous path.

The greatest possible degree of resistance to mechanical stresses and a joint adapted to remain tight irrespective of the pressure of the fluid within the header and tube, may be obtained by providing within the corrugated tube end a smooth or corrugated strengthening liner 5a (Fig. 6), and by shrinking an outer ring 6a upon said tube end between two of said corrugations 7.

Whichever of these methods of securing the tubes may be selected, the casing is cast in a substantially like manner, by connecting with the header box 1 the tubes 2 and, if desired, one or more threaded nipples 4, by placing said header box in a casting mould, and by casting the metal of the casing therein, in any suitable manner. Should the header not be intended to undergo high pressures, certain portions of box 1 may be left bare, said casing 3 being then cast to enclose only those portions of header-box which are to be reinforced or made tight. This modification may be met, according to circumstances, by a suitable arrangement of the mould.

The invention is not however limited to the use of a cast jacket or casing and in certain cases this member may be formed merely of a jacket mechanically cold fitted or hot shrunk around header-box 1, tubes 2 and nipples 4 being then assembled with said header-box in a fluid tight manner, by being expanded or soldered therein, for example. Neither is the invention restricted to any of the further constructional details hereinbefore described, which might be modified widely without departure from its scope, said invention being limited only by its essential features as set forth in the appended claims.

I claim:

1. In a heat exchange unit, the combination of an apertured header member formed of sheet metal of high thermal conductivity, with a plurality of tubes having lateral projections formed at the ends thereof, said tubes being formed of a metal analogous to that of said header member and being each secured by one end in one of said apertures, a pressure resisting liner within each said tube end, and an outer stress-resisting casing of cast metal around said header member and said tube ends, and rigidly gripping said projections on said tube ends.

2. In combination in a heat exchange unit, an apertured header member formed of sheet metal, a plurality of tubes each secured by one end within said header member through one of said apertures, a connection nipple secured within said header member through one of said apertures, a ring of comparatively large diameter shrunk outwardly upon each of said tube ends, and a casing of cast metal extending around in immediate contact with said header member, tube ends, shrunk rings and connection nipple, to hold the same in fluidtight relationship for the purpose set forth.

3. In combination in a heat exchange unit, an apertured header member formed of heat conducting sheet metal, a plurality of tubes formed of an analogous metal and each anchored by one end within said header member through one of said apertures, a threaded connection nipple anchored within said header member through another of said apertures, a pressure-resisting liner inserted in each said tube end, lateral projections upon each said tube end formed outwardly of the periphery thereof, a ring of comparatively large diameter shrunk upon said lateral projections of said tube ends, and a metal casting formed in contact with and around said assembled header member, tube-ends, nipple, liners, projections and rings and enclosing and gripping the same.

4. In combination in a heat exchange unit, an apertured header member formed of thin heat-conducting metal, a plurality of tubes formed of a cognate metal and each secured by one end within said header member through one of said apertures, a threaded connection nipple secured within said header member through another of said apertures, a stiffening liner within each said tube end, lateral projections formed outwardly of said tube ends, a large-diameter ring shrunk outwardly upon each said tube end, and a metal jacket fashioned and secured around and in contact with said header member, tube ends, nipple, projections and rings, said jacket enclosing and gripping the same in fluidtight relationship.

5. A jointed, two-part heat exchange device, consisting of means for the almost instantaneous exchange of heat between the device and the fluid to be acted upon while avoiding electrolytic action at the joint between the said two-parts and the occurrence of detrimental oxides, at the same time imparting sufficient strength to the device to withstand the high mechanical stresses normally encountered in heat exchange use while enabling the maintenance of first-cost at a minimum, the said means comprising a complete box-shaped header member, comprising one of the said two-parts, formed of thin sheet metal of high thermal conductivity, said header being too weak in itself to withstand the stresses prevailing when it is in operation, said header member having apertures therein, a plurality of tubes capable of directly contacting with and entering into intimate heat exchange relation with the fluid to be acted upon, and formed of the same metal as the header, and comprising the other of the said two parts, jointed to the first part, said tubes being sufficiently thin to enter into almost instantaneous heat exchange with said fluid, said tubes each having one end engaged in an aperture of said header member, and an outer casing strong enough to resist the mechanical stresses which prevail, and formed of an inexpensive metal cast in substantially fluid tight manner about only the ends of said tubes and about the joint between the ends of the tubes and the adjacent portions of said sheet metal header member, and at least partly surrounding the remaining portions of said header member, said tubes projecting outwardly from said casing.

ROBERT MAUTSCH.