Dec. 10, 1963 H. D. HUGGINS 3,113,615

HEAT EXCHANGER HEADER CONSTRUCTION

Filed May 8, 1961

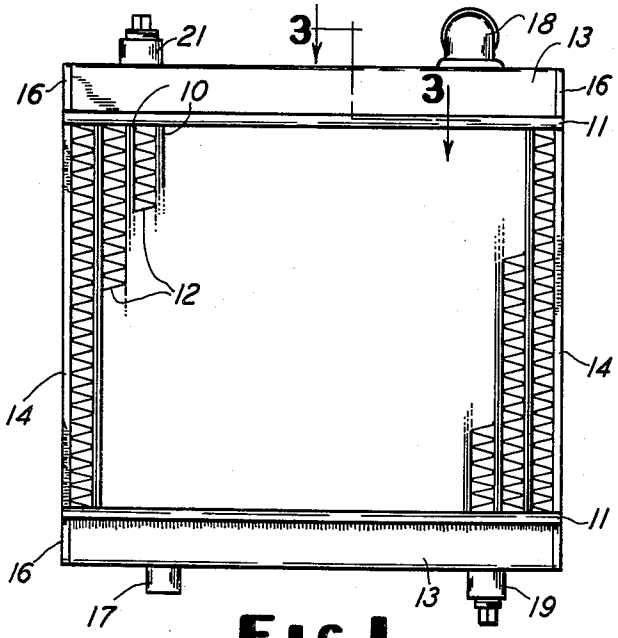


FIG. 1

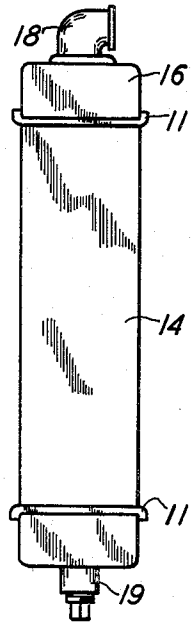


FIG. 2

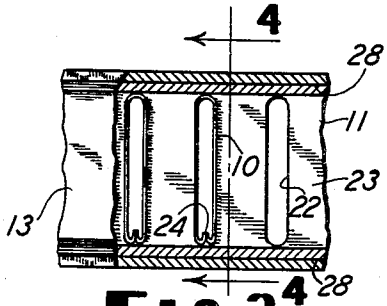


FIG. 3

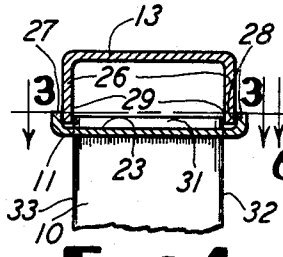


FIG. 4

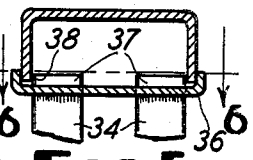


FIG. 5

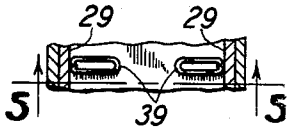


FIG. 6

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United States Patent Office 3,113,615 Patented Dec. 10, 1963

3,113,615

HEAT EXCHANGER HEADER CONSTRUCTION

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Filed May 8, 1961, Ser. No. 108,524
5 Claims. (Cl. 165—149)

This invention relates to a heat exchanger, and more particularly it relates to an improved construction of the exchanger tube and header joint.

In the conventional air to liquid heat exchanger, such as automobile radiators and oil coolers, it is often necessary to provide a sufficient overhang between the point where the tube tank is secured to the header and the leading or trailing edge of the tube. This overhang serves two purposes: First, it acts as a diaphragm which serves as a thermal expansion joint to prevent excessive stress on fluid tubes; and, second, this overhang is necessary to permit production dies to be provided with sufficient reinforcing metal to give durability for high speed and long run production rates. Both of these features have been considered to be important for heat exchanger construction where light gauge metals are used and structural features are insufficient to retain stresses due to thermal expansion.

Even though the diaphragm is often desirable, there are times when both radiators and oil coolers are subjected to high static and cyclic pressures of sufficient magnitude to cause failure at the tube-to-header joint when the overhang or cantilever construction is used. These pressures are experienced most frequently in hydraulic systems for farm machines, reversing mechanisms, transmissions, etc. It has been found that the shorter the so-called cantilever or overhang, the more resistant the exchanger is to failure at the tube-to-header joint.

It should be pointed out that tube failures caused by the so-called cantilever effect are only partially caused by the tank reactive forces applied to the tank ends. The major cause of failure is a result of the flat header and tank sides tending to form a cylindrical shape under the internal fluid pressure. The construction described in this application prevents the tendency of a flat plate taking a round shape since the flat area is eliminated by the close proximity of the tank wall to the tube.

Accordingly, it is an object of this invention to provide an improved tube-to-header joint, and particularly to provide the joint so that it is stronger and more resistant to deformation under internal fluid pressure.

Still another object of this invention is to provide a tank and tube header joint which is disposed for and is metallurgically bonded together for increased strength, and this object is particularly accomplished when it is necessary to use heavy gauge metals in the part mentioned.

Still another object of this invention is, in conjunction with the foregoing objects, to provide a tube-to-header joint wherein the fluid pressure applied to the header is partly resisted by the tube and particularly the tensile strength of the tube to thus minimize the failure of the header and the joint by a fracture under the fluid pressure mentioned.

Other objects and advantages will become apparent upon reading the following description in light of the accompanying drawings, wherein:

FIG. 1 is a side elevational view of a fragment of an exchanger incorporating a preferred embodiment of this invention.

FIG. 2 is an end elevational view of FIG. 1.

FIG. 3 is an enlarged sectional view taken along the line 3—3 of FIG. 1 and with a tube removed therefrom for descriptive purposes, and also taken along the line 3—3 of FIG. 4.

FIG. 4 is a sectional view taken along the line 4—4 of FIG. 3.

FIG. 5 is a sectional view similar to that of FIG. 4 but showing two tubes instead of the one tube in FIG. 4, and the view is taken along the line 5—5 of FIG. 6.

FIG. 6 is a sectional view taken along the line 6—6 of FIG. 5.

The same reference numerals refer to the same parts throughout the several views.

FIG. 1 shows a fragmentary view of an exchanger or cooler which embodies this particular invention, and it will here be noted that a plurality of fluid-conducting tubes for liquid are generally designated 10 and they extend between the headers indicated 11 at the upper and the lower ends of the exchanger. Also, conventional fins 12 are of a serpentine configuration and are disposed between the tubes 10 in the usual arrangement of liquid tube and air fin type of heat exchanger. Of course these parts constitute the core of the exchanger and the central portion of the core is omitted from the drawing for simplicity sake and in order that the inventive feature can be more clearly disclosed.

The general construction of the exchanger also includes tanks 13 at the upper and lower ends of the exchanger, and these tanks are of course fluid tight with the respective headers 11 in a manner more fully described hereinafter. End plates 14 are also bonded or otherwise attached to the exchanger as a part thereof and tank ends or end plates 16 are also included in the exchanger. Further, an inlet pipe 17 and the fluid outlet pipe or connection 18 are shown respectively at the bottom and top of the exchanger to be in communication with their respective tanks 13. Further, a drain 19 and a vent 21 are also in fluid communication with the lower and upper tanks 13 respectively. With this general description, it will of course then be understood that the construction thus far described is similar to the general arrangement of a heat exchanger and the following description will be directed at the inventive feature.

FIGS. 3 and 4 show the header 11 to have an oblong opening 22 therein, and of course it will be understood and noted that the opening 22 is aligned with and of the same shape as and therefore snugly receives the end of the tube 10. Thus, a plurality of openings 22 are provided along the header 11 in order that the ends of the tube 10 can pass through the openings and slightly above the upper surfaces 23 of each of the headers 11.

While a so-called oblong shaped opening 22 is shown, it will of course be understood that a different shape of opening and therefore a different cross-sectional shape of tube 10 could be employed. Further, it will be noted that the tubes 10 are shown to be of course of a thin gauge material of one continuous piece folded in a manner so that the otherwise free ends 24 are joined together as clearly shown in FIG. 3 and these ends are of course bonded so that the tubes 10 are fluid tight under pressure. Also, the opening 22 shown on the right in FIG. 3 has been shown without its tube 10 extending therethrough in order that the opening can be clearly shown and described, but it will of course be understood that a tube would also be disposed in that particular opening on the right.

Particularly, FIG. 4 shows the tank 13 to be of a U-shape to include legs or ends 26 which extend into oppositely directed legs or ends 27 of the header 11. In this manner, the ends 26 and 27 overlap along the surfaces designated 28, and they are fluid tightly bonded together along the surfaces 28 for the entire length of the header 11 and the tank 13. With this overlapping arrangement, the header 11 and tank 13 can be firmly bonded together through a height of surface 28 selectable for the determined fluid tightness or firmness required rather than

simply bonding the thickness of say the edges of the tank 13 to the surface 23 of the header 11.

An important feature of the invention is that the openings 22 in the headers 11 extend for virtually the entire width of the headers 11 so that the amount of projection or overhang of the header 11 beyond the ends of the openings 22 is of a minimum and there is therefore no surface available for a cantilever force acting on the headers 11 to fracture the same, as mentioned at the outset of this application. In conjunction with the arrangement of the openings 22 in the headers 11, it will of course be seen that the tubes 10 extend for the identical width of the openings 22, that is, they extend between the inner surfaces 29 of the tank legs 26. Thus the tubes 10 are shown to be in contact with the legs 26 of the tank 13 in the end portions 31 of the tubes 10 where these ends 31 project through the headers 11 and into the tank 13 as clearly shown in FIG. 4, for instance. Subsequently, the tube ends 31 can be bonded to the tank legs 26 for the required structural strength therebetween. Thus, the opposite surfaces designated 32 and 33 on the tube 10 are bonded to the tank surfaces 29 at the tube ends 31.

It will therefore be understood that internal pressure in the tank 13 will be transmitted to the tubes 10 and of course the areas of contact and bonding between the tubes 10 and the tank surfaces 29 and thus the structure is sturdy and able to withstand the pressures which heretofore have caused failures in the exchanger at this particular location in both the tank 13 and the headers 11.

FIGS. 5 and 6 show a slight variation of the aforementioned structure in that two tubes 34 are utilized in place of the one tube 10, but here also it will be noted that the tube 34 extends through the header 36 in the tube ends 37 and the tube surfaces 38 are in abutment with the tank inner surfaces 29. And then of course the tube outer surfaces 38 and the tank inner surfaces 29 can be bonded together to acquire the structural strength desired. Of course it will also be understood that the tube ends 37 project through the openings in the header 36, which openings of course conform to the shape of the tubes 34 as shown in FIG. 6, and the tube ends 37 are fluid tightly bonded to the header 36 at the periphery of the openings indicated 39 in the header 36. The same bonding of tubes 10 to the periphery of the openings 22 in the headers 11 would of course be prevalent in that particular construction.

The header 11 and the tank 13 constitute a reservoir for containment and guidance of liquid with respect to the tubes 10, and the legs of the tank and header comprise the side walls of the reservoir, and the projecting or free ends of the tubes are therefore bonded to the reservoir for the structural strength described.

While a particular description has been given, it will of course be understood that changes could be made therein and therefore the invention should be limited only by the scope of the appended claims.

What is claimed is:

1. A heat exchanger of the fin and tube type comprising a header having a plurality of openings through and beyond which the tubes project in free ends and with said header and said tubes being in fluid-tight and fluid-flow communication, a tank fluid-tightly bonded to said header and forming a reservoir therewith for containment and guidance of fluid flow between said tubes and said reservoir, said reservoir including side walls with portions thereof disposed in flanking and overlapping position with respect to the projection of said free ends, said free ends of said tubes being affixed along the lengths thereof to the overlapping portions of said side walls for transmitting to said tubes the forces created by internal fluid pressures in said reservoir.

2. A heat exchanger of the fin and tube type including a reservoir with one wall thereof having a plurality of openings through and beyond which the tubes project in free ends and with said one wall and said tubes being in fluid-tight relation and with said tubes being in fluid-flow communication with said reservoir, said reservoir including side walls disposed in flanking position with respect to said one wall, the lengths of said free ends of said tubes projecting beyond said one wall and being affixed along said lengths to said side walls for transmitting to said tubes forces created by internal fluid pressures in said reservoir.

3. A heat exchanger of the fin and tube type comprising a header including a wall having a plurality of openings through and beyond which the tubes project in free ends and with said header and said tubes being in fluid-tight communication and with said header including spaced-apart legs, a tank including spaced-apart legs fluid-tightly bonded to said legs of said header and forming a reservoir with said header for containment and guidance of fluid flow between said tubes and said reservoir and presenting opposite side walls of said reservoir, said openings in said wall of said header extending the distance between the inner surfaces of said side walls of said reservoir for eliminating the overhang of said wall from said tubes to the plane of said inner surfaces.

4. A heat exchanger of the fin and tube type comprising a header including a wall and spaced-apart legs flanking said wall and disposed perpendicular thereto and said wall having a plurality of openings through and beyond which the tubes project in free ends and with said header and said tubes being in fluid-tight communication, a tank including spaced-apart legs disposed within said legs of said header and being parallel thereto and overlapping therewith and fluid-tightly bonded thereto and overlapping with said free ends of said tubes and forming a reservoir with said header for containment and guidance of fluid flow between said tubes and said reservoir, the projecting lengths of said free ends of said tubes being bonded to the overlapping lengths of said legs of said tank to structurally connect said header and said tank through said tubes for transmitting to said tubes forces created by internal fluid pressures in said reservoir.

5. A heat exchanger of the fin and tube type comprising a header including a wall and spaced-apart legs flanking said wall and disposed perpendicular thereto and said wall having a plurality of openings extending in spaced relation along said wall and only a slight space short of extending completely between said legs of said header, said tubes projecting through and beyond said openings in free ends and with said header and said tubes being in fluid-tight communication, a tank including spaced-apart legs disposed within said legs of said header and being the thickness of said slight space and being parallel to said legs of said header and overlapping therewith and fluid-tightly bonded thereto and forming a reservoir therewith for containment and guidance of fluid flow between said tubes and said reservoir and said legs of said tank overlapping the projecting lengths of said free ends of said tubes, said lengths of said free ends of said tubes being bonded to the overlapping portions of said legs of said tank to structurally connect said header and said tank through said tubes for transmitting to said tubes forces created by internal fluid pressures in said reservoir.

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