

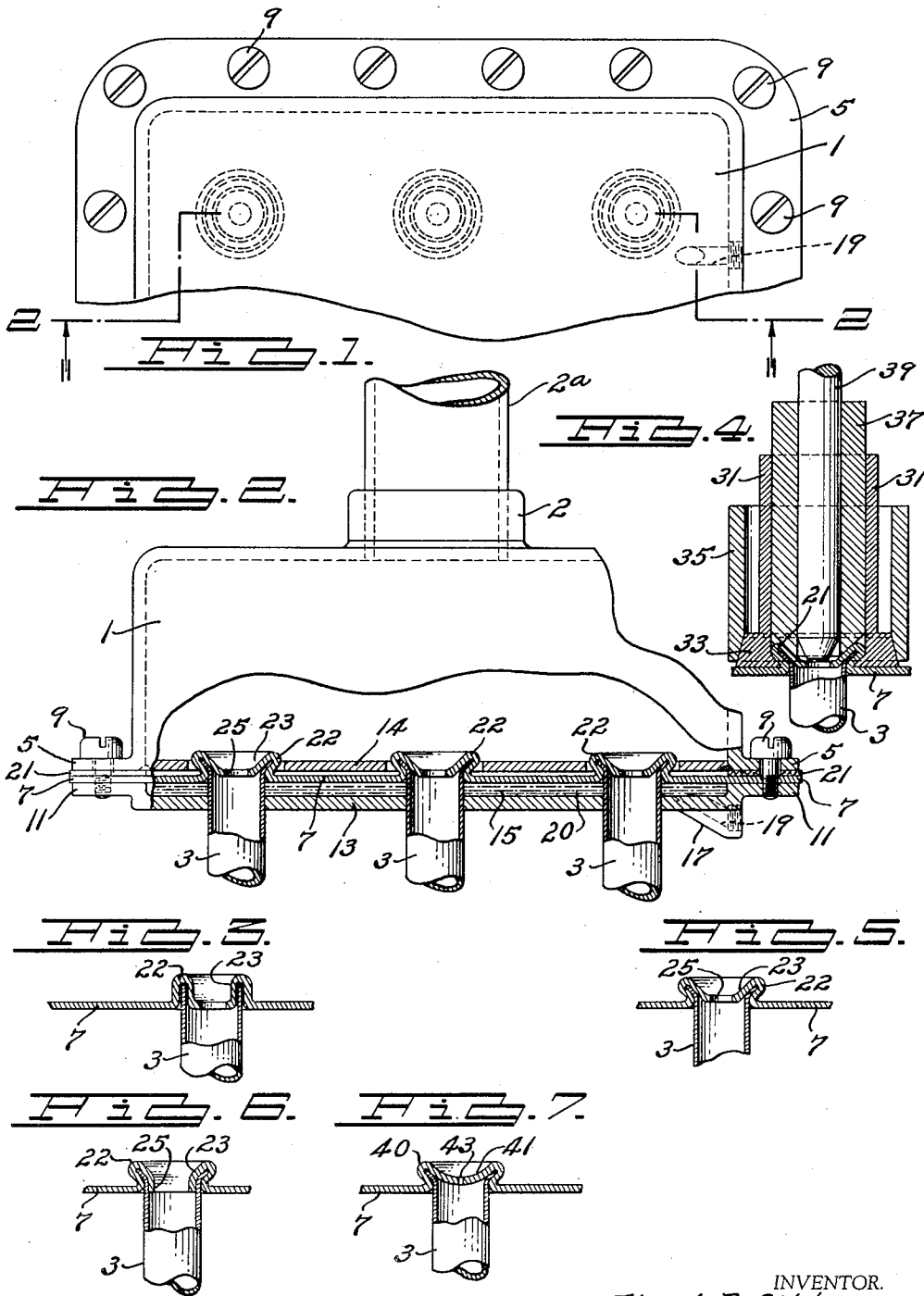
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RADIATOR HEADER WITH METERING ORIFICE NIPPLES AND METHOD OF MAKING SAME

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RADIATOR HEADER WITH METERING ORIFICE NIPPLES AND METHOD OF MAKING SAME

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4 Claims. (Cl. 113—118)

My invention pertains to an improved radiator header construction and a method of making the same.

It is an object of my invention to provide a radiator header comprising a radiator casing, which is open at one side, a tube sheet secured across the open side of the casing, a plurality of heat exchanger tubes connecting through the tube sheet for conducting fluid from the radiator casing, and means for securing one end of each of the tubes into the tube sheet comprising a flared nipple and a metering orifice which is suitably formed for regulating fluid flow there-through.

It is also an object of my invention to provide such a radiator construction wherein the means for fastening the end of each heat exchanger tube into the tube sheet comprises a tubular sleeve extending from one side of the tube sheet and having an intumed portion of smaller diameter extending back into the sleeve, the end of the tube being inserted and snugly compressed in concentric relation between the sleeve and the intumed portion, and the concentric portions of the sleeve and the tube being flared outwardly at the outer end.

It is a further object of my invention to provide an improved method of securing tubes in a tube sheet in the arrangement above set forth.

Further objects and advantages are within the scope of my invention such as relate to the arrangement, operation and function of the related elements, to various details of construction and to combinations of parts, elements per se, and to economies of manufacture and numerous other advantages as will be apparent from a consideration of the specification in conjunction with the drawing disclosing my invention, in which:

Fig. 1 is a plan view of my radiator header, partially broken away, and internal details of construction being represented by broken lines;

Fig. 2 is a side elevational view thereof, partially broken away and sectioned to show the internal construction;

Fig. 3 is a cross sectional view showing the first step of inserting one of the heat exchanger tubes into the tube sheet preparatory to forming a flaring nipple and metering orifice of the desired size;

Fig. 4 is a similar cross sectional view showing the tool in its associated relation for forming the nipple to secure the tube and regulate fluid flow therein;

Fig. 5 shows the tube fastened into a tube

sheet with a flaring nipple and metering orifice after the tool has been removed;

Fig. 6 shows a flaring nipple in which the metering orifice has been opened widely; and

Fig. 7 shows a tube securing nipple comprising a modified embodiment which has a drilled metering orifice.

Referring more particularly to Figs. 1 and 2 of the drawing, my improved radiator header comprises a radiator casing 1 having a dish shaped conformation open at one side and provided with a pipe coupling fixture 2 opening through a closed side for convenient connection with a pipe line 2a for the conduction of the heat emitting or absorbing medium which is to be passed through heat exchanger tubes 3 for heating or cooling, as the case may be.

A flat flange 5 extends laterally outward around the open edges of the header casing for receiving a tube sheet 7 which is clamped firmly thereon by screws 9 which pass through the flange and the edge of the tube sheet into a flange 11 of an outside cover 13. To support the tube sheet and prevent it collapsing inwardly when a partial vacuum occurs in the header casing 1, I provide an apertured abutment plate 14 disposed in and extending across the open side of the casing where it may be welded or otherwise secured.

The outside cover 13 is offset from its flange 11 and it encloses a cavity 15 adjacent the outermost side (or atmospheric side) of the tube sheet 7. Projecting from the cover 13 is a lug 17 through which a passage 19 extends for injecting a spongy balancing material 20 in the cavity 15 for floating the tube sheet 7 against the pressure in the radiator casing. A gasket 21 is inserted between the flanges 9 and 11. In my copending patent application Serial No. 182,211, filed concurrently herewith, I have fully disclosed and claimed my arrangement and method of balancing and floating a tube sheet on a spongy material.

The heat exchange tubes 5 pass slidably through the outside cover 13 in snug fitting relation through suitably spaced apertures therein. At the inner ends the heat exchanger tubes 3 are inserted into nipples 22 in the tube sheet 7. The nipples 22 are flared to squeeze and secure the ends of the tubes 3 while forming a flaring nozzle 23 and a metering orifice 25 to regulate the flow of fluid therethrough.

In making my improved radiator header the tubes 3 are first secured in the nipples in the tube sheet 7, which nipples are previously formed in the sheet by progressive die pressing operations in a well known manner. The ends of the heat

exchanger tubes 3 are inserted into the nipple sleeves 22 in concentric relation between the outer portion and the inturned portion thereof, as shown in Fig. 3. The outside of the nipple sleeve 22 is then reinforced by a tool comprising a sleeve 31 having a thick rim 33 around its lower edges, as shown in Fig. 4. A thicker cross section is provided across the lower portion of the rim 33 than across the upper portion of the rim and, as shown, this forms a bevelled edge enclosing the nipple sleeve 22 around its base adjacent the tube sheet 7. A tapered surface is similarly provided around the outside of the rim 33.

The sleeve 31 and the rim 33 are split axially into a plurality of separate elements, or fingers, and a tool sleeve 35 of larger diameter is disposed down over the fingers 31 to slide down over the bevelled outer surface of the rim 33. The lower end of the sleeve 35 is preferably provided with a bevelled surface to bear on and slide smoothly over the outer bevelled surface of the thick rim 33. The converging movement of the fingers 31 to squeeze the outside of the nipple sleeve 22, is limited by a flaring tube 37 which is of a suitable diameter for sliding in between the fingers, and has a tapered lower edge.

After the nipple sleeve 22 has been thus reinforced on the outside, the flaring sleeve 37 of the tool is forced down as by pneumatic or hydraulic pressure or by hammering if desired. This forces the tapered lower edges of the flaring tube 37 into the nipple sleeve and flares outwardly together the inturned portion of the sleeve and the inserted end of the heat exchanger tube 3, thus firmly clamping and securing the end of the tube while also providing a flaring nipple 23 opening into the tube.

Slidably disposed inside of the flaring tube 37 I provide a metering orifice rod 39 which is tapered at its lower end. To open a metering orifice of the desired diameter the rod 39 is forced down to move its tapered point between the edges of the nipple sleeve 22 which have been turned down into the tube. The force applied to the rod 39, and its resulting movement determine the size of the metering orifice 25 opening into the heat exchanger tube.

The operation of forming the flaring nipple sleeves having been completed to secure the end of the heat exchanger tube 3 into the tube sheet 7, and to provide a flaring nozzle or nipple 23 and a metering orifice 25 of a predetermined size opening therein, the outer tool sleeve 35 is withdrawn to release the fingers 31 and remove the tool. The completed flaring nipple 22, after tool has been removed, is shown more clearly in Fig. 5.

My method of securing the tubes in the tube sheet while simultaneously forming flaring metering orifices therein, is very effective not only because the tubes are firmly secured, but also because the operation can be conveniently stopped at various stages to provide the desired conformation of the nipple and the orifice. If it is desired, the orifice can be opened to its widest possible extent, as shown in Fig. 6, by forcing the metering orifice rod 39 of the tool fully into the end of the heat exchanger tube 3, or the orifice may be made any intermediate size by stopping the operation at a suitable state.

In accordance with my method of attaching the heat exchanger tubes 3 into the tube sheet, it is convenient to open the metering orifices of the different tubes of a radiator or cooling unit to different sizes. This is a very useful feature

because it is thus possible to make a unit in which the greatest flow of heat emitting or absorbing fluid occurs in the tubes which are to be exposed directly to the blast of air which is usually blown directly thereon. This eliminates, or largely minimizes, the maintenance troubles caused by the unequal contraction and expansion of the tubes pulling the tubes loose at one end and causing leaks to develop.

In cooling units and refrigerating apparatus it is sometimes desirable to provide a very small metering orifice for regulating the admission of refrigerant to the tubes 3. As shown in Fig. 7, this is readily accomplished by utilizing cup nipples 40 of thimble or cup shape, extending from the tube sheet 7 and comprising a closed inner end 41 instead of an open inturned portion. After the end of the tube 3 is inserted, the nipple is flared for securing the end of the heat exchanger tube by the same method which, having been previously described, will not be repeated. In this operation the point of the flaring sleeve 37 of the tool, shown in Fig. 4, deforms or bashes in the bottom 41 of the cup nipple, while deforming and squeezing together the outer edges of the bottom 41 and the adjacent edges of the side walls of the cup nipple. This causes the inserted edges of the heat exchanger tube 3 to be secured and squeezed snugly therebetween, as shown in Fig. 7. When performing this operation, the orifice rod 39 of the tool is not used, and after the cup nipple 40 has been flared for securing the tube 3, and the tool has been removed, a very small metering orifice 43 is formed by drilling through the closed end 41 of the flared nipple which is accomplished by using a conventional drill of a suitable size. In this operation the drill is preferably located accurately in the center by means of a suitable jig (not shown).

It is not my intention to limit my invention to the exact steps of the method herein described nor to the exact proportions and arrangements of the structural elements, and the present disclosure is illustrative merely, the invention comprehending all variations thereof.

I claim:

1. The method of securing cylindrical tubes to a tube sheet which consists in, forming an annular recess in the tube sheet, said recess being formed with concentric cylindrical walls to snugly embrace the cylindrical end of said tube, inserting the end of said tube in said recess, and flaring the inner wall of said recess outwardly with sufficient pressure to correspondingly flare outwardly the end of said tube and the outer wall of said recess to form a flaring nipple and to clamp the end of said tube between the walls of said recess.

2. The method of securing cylindrical tubes in a tube sheet having a cylindrical sleeve extending from one side and including a cylindrical re-entrant portion of smaller diameter which consists in, inserting the end of a cylindrical tube into the sleeve in concentric relation between the sleeve and the re-entrant portion thereof, reinforcing the outside surface of the sleeve at the base thereof, and outwardly flaring the re-entrant portion of the sleeve, the inserted end of the tube and the outer portion of the sleeve together in firmly clamped relation to secure the tube in firm sealed relation in the tube sheet while also providing a flaring nipple in the end of the tube.

3. The method of securing cylindrical tubes

in a tube sheet having a cylindrical sleeve extending from one side and including a cylindrical re-entrant portion of smaller diameter which consists in, inserting the end of a cylindrical tube into the sleeve in concentric relation between the sleeve and the re-entrant portion thereof, reinforcing the outside surface of the sleeve at the base thereof, and outwardly flaring the re-entrant portion of the sleeve, the inserted end of the tube and the outer portion of the sleeve together in firmly clamped relation to secure the tube in firm sealed relation in the tube sheet while also providing a flaring nipple in the end of the tube, and opening a metering orifice of the desired diameter between the edges of the re-entrant portion of the sleeve.

4. A joint construction between a tube sheet

and a cylindrical tube comprising, a cylindrical tube of uniform thickness having an outwardly flaring conical flange at one end thereof, a tube sheet having an aperture formed therein with its inner edge in substantial contact with the cylindrical part of said tube at the base of said flange, said tube sheet having an integral ring portion extending from the inner edge of said aperture in contact with the outer surface of said flange and having a re-entrant portion extending around the end of said flange and having contact with substantially the entire inner surface of said flange, said ring portion and said re-entrant portion comprising integral extensions of said tube sheet and being of substantially the same thickness as said tube sheet.

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