Oct. 9, 1934. F. M. YOUNG ET AL 1,976,102

HEAT TRANSFER DEVICE

Filed Feb. 20, 1933

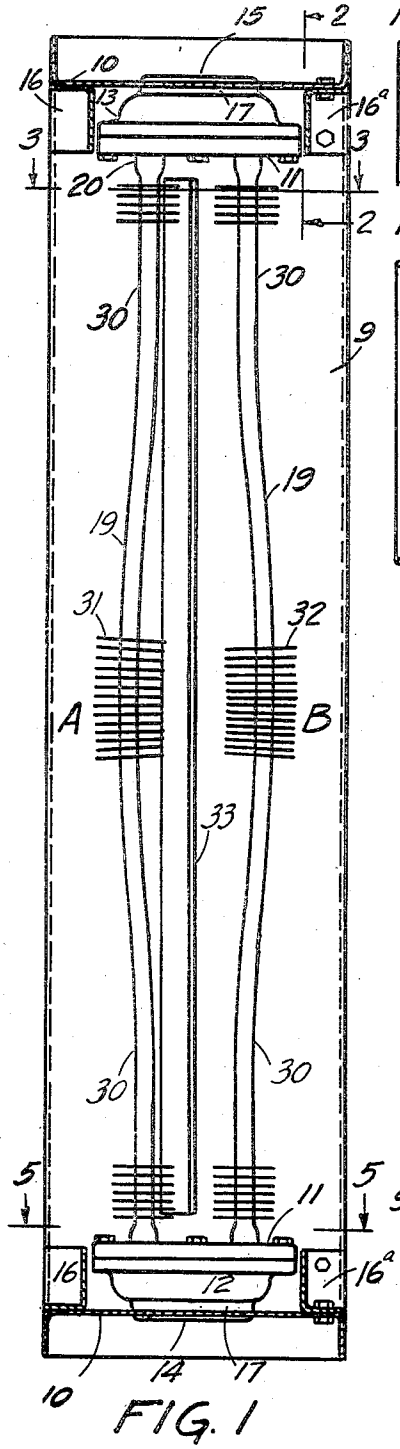


FIG. 1

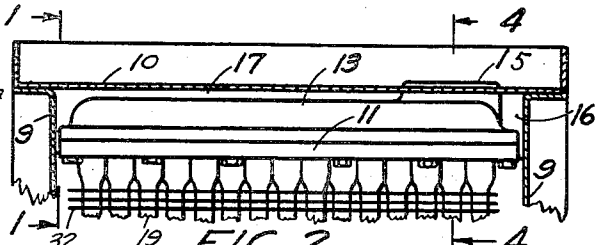


FIG. 2

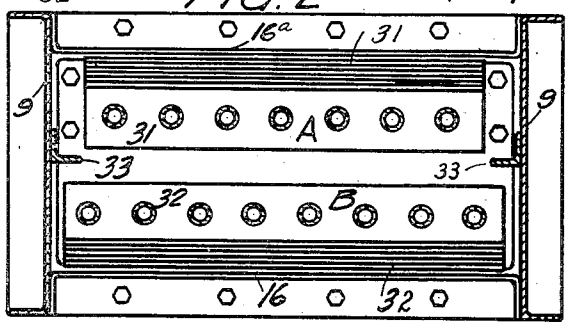


FIG. 3

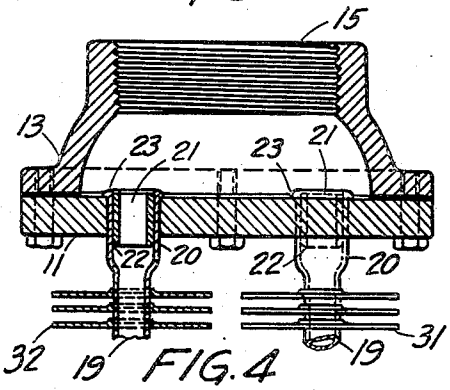


FIG. 4

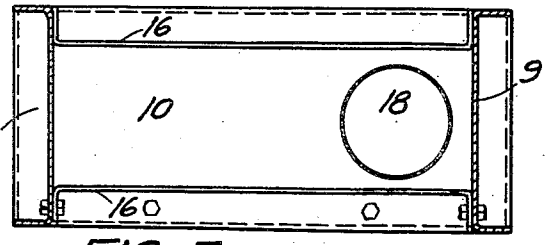


FIG. 5

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HEAT TRANSFER DEVICE

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Application February 20, 1933, Serial No. 657,648

5 Claims. (Cl. 257—227)

Our invention relates to the class of heat transferring devices commonly termed "radiators" or "blast heaters." Our invention, however, in its broadest sense is adapted to be used for process work: heating, cooling and tempering air for schools, theatres, factories, etc., wherein the device is used for transferring heat to circulating air, or where brine, cold water or other liquid or gas is used for cooling the circulating air.

The object of our invention is to provide a device of the class at low cost, simple in construction, efficient in operation and reliable in that it is self-contained and capable of adapting itself to every condition of severe service for an extended number of years without attention or injury.

We accomplish these objects by means of a novel housing, a novel means for connecting the tube ends into the header plate, a novel means to permit expansion and contraction and a novel form and grouping of tubes and fins.

A specific object of our invention is to provide tubes with enlarged ends which protrude through the header plate and are secured therein by means of a ferrule or sleeve pressed or rolled into the enlarged tube opening.

Another object of our invention is to provide tubes having three single curves for the greater part of their length and by arranging the tubes in two rows forming two individual sections of the tube bundle the centers of which are a greater distance apart than their ends, thus to permit accordion-like action of the sections when they expand or contract or when the distance between headers is changed by expansion or contraction of the connecting pipes.

A further object of our invention is to protect the tube ends against fracture and loosening by providing a short, straight portion adjacent the ends thereof.

A still further object of our invention is to provide a housing wherein the headers are slidably mounted but held in parallel relation.

Another object is to provide an outlet connection whereby all of the liquid may be drained from the unit when positioned other than vertical.

To these and other useful ends our invention consists of matter hereinafter set forth and claimed and shown in the accompanying drawing in which:

Figure 1 is a side view of our improved device showing the tube sections and headers in elevation, and the casing in section on line 1—1 of Figure 2.

Figure 2 is a fragmentary sectional view taken on line 2—2 of Figure 1.

Figure 3 is an end sectional view taken on line 3—3 of Figure 1.

Figure 4 is a section taken on line 4—4 of Figure 2.

Figure 5 is a section of the housing only taken on line 5—5 of Figure 1.

As thus illustrated, 9 designates the sides of the housing and 10 designates the ends thereof. The sides 9 are preferably formed in the shape of a shallow pan having side and end flanges which extend outward. The ends 10 are similarly formed with flanges which extend outward. The ends of side members 9 are made fast to the ends of members 10 to thus form a rectangular enclosure for the radiator core and a support for the same as will hereinafter appear: The tube plates are designated by the numeral 11. Numeral 12 designates the inlet header cap and 13 designates the outlet header cap. These caps are attached to their respective tube plates by means of cap screws with an intervening gasket in a well known manner.

An inlet opening 14 is provided in a nipple projecting from the header cap 12 and an outlet 15 is provided in a nipple on header cap 13. It will be noted that outlet opening 15 is positioned at one end of header cap 13. Thus when the unit is placed in a horizontal and edgewise position, all of the liquid can be drained from the unit.

The housing is adapted to slidably support the headers in the following manner: Plates 16 and 16^a are positioned transversely between the ends of the housing members 9 and on opposite sides thereof, thereby to form front and rear guides for the headers, the ends and outer surfaces being flanged, forming means by which the members 9 and 10 are attached thereto, as indicated in Figures 1 and 5. The housing members 9 and 10 are preferably spot welded together. Plates 16 on one side of the housing are also preferably spot welded to members 9 and 10 and the two plates 16^a on the other or front side of the housing are preferably attached by means of bolts as indicated in Figure 1. The housing is made slightly longer than the radiator unit, thereby to provide a space between the header caps 12 and 13 and the housing ends 10 as at 17. Large openings 18 are suitably positioned in the ends 10 through which the inlet and outlet nipples 14 and 15 protrude slightly. Thus it will be seen that the headers are free to move endwise but will be held in parallel relation by the housing structure.

Our improved housing prevents twisting the headers out of parallel relation when screwing the supply and drain pipes into position and thus insure against injury to the tubes during or after installation.

We provide preferably two independent sections in the tube bundle designated in their entirety by reference characters A and B, each consisting preferably of a single row of tubes 19. The tubes in one section are preferably positioned in staggered relation to the tubes in the other section, as indicated in Figure 3.

The ends of tubes 19 are enlarged as at 20 (see Figure 4). These enlarged portions are longer than the thickness of the plates 11 and are adapted to fit tightly into corresponding openings in plates 11, the ends protruding.

The ferrule 21 is preferably made from very hard copper thereby to provide strength and equal expansion to the tubes 19 which are also preferably made from copper. This ferrule 21 is slightly rounded as at 22, leaving a straight portion which is longer than the thickness of the plates 11, whereby the ends protrude on opposite sides of the plates 11. After the tube ends 20 are in position and preferably made tight by rolling, boiler tube fashion, the ferrules 21 are pressed into the tube ends and then rolled or expanded in a manner similar to boiler tube practice, to thus firmly hold the tube ends in their respective openings.

Since the tube ends and ferrules protrude, there will be formed slight depressions in the tubes by the plate openings thus to lock the tubes against end movement. The edges of the openings in the plates are preferably slightly rounded in order to avoid a sharp offset in the tube.

Obviously, the protruding inner end of the ferrule 21 will act as a stiffening and strengthening means at the point where the tube protrudes inwardly past the plate 11. The outer ends 20 of the tubes are preferably beaded over as at 23, as in boiler tube practice. Thus a very strong and simple joint is provided especially suitable for this class of device which is subjected to extreme and sudden changes in temperature, water hammer, expansion, contraction, etc.

As illustrated in Figure 1, the ends of tubes 19 are preferably straight for a short distance. These straight portions are indicated as terminating at 30 or a distance which is preferably substantially ten per cent of the distance between headers. The remainder of the tube length is in the shape of three long easy single curves, the two end curves of opposite sections extending preferably concave outward and the center curved in the opposite direction, the adjacent curves in opposite sections therefore being curved in opposite direction.

Each row of tubes is provided preferably with strip fins 31 and 32 closely spaced substantially the full length of the tubes, thus forming two oppositely curved independent finned sections, the centers of which are a greater distance apart than the ends.

Thus it will be seen that when the tubes expand from heat if the headers are held from moving outward by the supply pipes, the cores will bend outward accordion-like at their centers. This same action would take place if the headers were forced together by expansion of the supply pipes or otherwise.

The action of the curved part of the tubes in combination with the straight ends is to counteract any tendency to bend the tube ends. In other words, there is less bending of the tube close to the headers than if the curves began close to the headers. Therefore, the combination of the enlarged ends, the ferrule, the straight portion and long easy single curves insures against fractures or loosened joints.

Referring to Figure 3, it will be seen that fins 32 on section B are longer than the fins 31 on section A. We, therefore, provide a baffle 33 in the form of an angle which is attached to the side walls 9 to thus form a wall or deflector for the purpose of directing the air into the section A which has short fins.

Obviously, if the tubes 19 were equipped with individual fins, their center portion would not remain in spaced relation. We, therefore, preferably provide the strip fins 31 and 32, which enclose all of the tubes in the row, in order to hold the entire row of tubes in parallel relation and further to simplify and strengthen the section.

One of the novel features as already outlined is the housing and manner of supporting the tube bundles therein. A special object of our invention is to avoid unnecessary strain on the tubes. It will be seen that the headers are free to move endwise but act as a sole support for the tube bundle. Obviously, the entire bundle is also free to move endwise relative to the housing. Therefore, after the housing has been atttached to its support, the bundle is supported but left free to move endwise in its entirety. Thus any movement of the feed pipes because of expansion or otherwise, is provided for without causing undue strain on the tubes or their fastenings in the header. While we show the sections A and B as having opposite curves we also contemplate two or more rows of tubes in each section which curve in the same direction in both sections. In either event the form of housing, headers, fins, tube ends, etc., may be in exactly the same form as shown. Neither do we wish to be limited to the use of a single row of tubes in each section tied together by fin strips. Under certain conditions we contemplate the use of two rows of tubes in each section all curved in the same direction and passing through fin strips forming a single section having three single curves.

Obviously when plates 16a are removed and the entire core assembly is moved in the direction of header cap 12, header cap 13 and its nipple will clear member 10 so the core may be tipped forward and removed from the housing.

In practice, devices of the class described range in length from two to ten feet. They are frequently installed in inaccessible places where continuous service is required. Every detailed feature shown cooperates to supply the kind of service required. However, many minor changes and arrangement of parts can be made without departing from the spirit and scope of our invention.

Having thus shown and described our invention, what we claim as new and desire to secure by Letters Patent is:

1. In a device of the class described, comprising two headers, a housing, two rows of tubes the ends of which are connected to said headers, whereby liquid or gas may pass from one header to the other, the ends of said tubes being straight for a considerable distance from said headers, the remainder of said tubes being formed by three single curves of substantially the same length and radius two of which bend outward on opposite rows and the other or reverse curve forming

the center portion of said tubes, whereby the space between the center of said rows is greater than at the ends thereof, said housing adapted to slidably support and hold said headers in parallel relation.

2. In a device of the class described, comprising a housing, two headers slidably mounted in the ends of said housing but held in parallel relation, two cores comprising fins and a transverse row of tubes the ends of which are enlarged and adapted to fit into openings in said headers, said enlarged ends protruding through said openings, said tubes having straight portions for a considerable distance from said headers, the remainder of said tubes being in the form of three single curves, the end curves extending outwardly and the center in a reverse direction.

3. In a device of the class described comprising a housing a rectangular radiator core having headers and a plurality of connecting tubes whereby liquid or gas may pass from one header to the other, said housing comprising side members and end members each having outwardly extending flanges on their four edges forming a rectangular enclosure for the sides and ends of said core, but somewhat longer whereby said core may move endwise, retainer plates adapted to form a front and rear enclosure for said headers, two of said plates adapted to be removable whereby said core may be removed from said housing.

4. A device of the class described, comprising two headers, a plurality of circulating tubes in a row in spaced relation the ends of which are connected to said headers whereby liquid or gas may pass from one header to the other, a multiplicity of closely spaced fins through which said tubes extend forming a core, said tubes having relatively short straight ends, the centers of which comprise three single curves of about the same length and radius, whereby said core comprises straight ends and three single curves therebetween.

5. A device of the class described, comprising a housing, a radiator unit, said unit having two common headers and two cores, each consisting of a transverse row of tubes and a multiplicity of strip fins through which said tubes extend, one core having two less tubes and centrally positioned in staggered relation to the tubes of the other core, stopping short of the width thereof, said housing comprising side and end members adapted to surround the sides and ends of said unit, and having holding members positioned in front and rear of said headers and adapted to detachably hold said unit in said frame and slidably hold said headers in parallel relation, projections attached to said side members adjacent said narrow core thereby to force the air between the fins thereof.

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