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R. S. BROWN

1,870,670

TUBE FOR BOILERS, HEAT EXCHANGERS, AND THE LIKE

Filed July 9, 1930

Fig. 1.

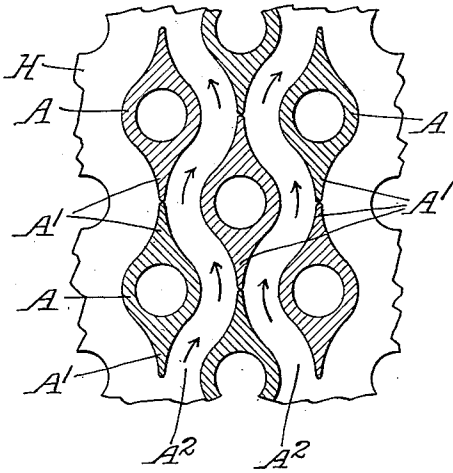


Fig. 2.

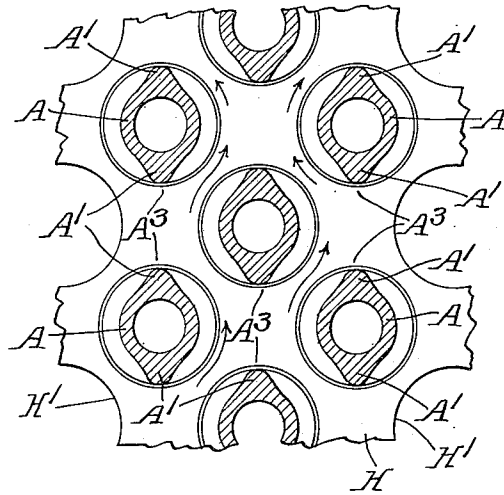


Fig. 4.

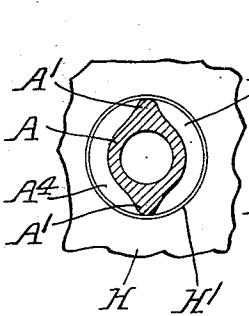


Fig. 3.

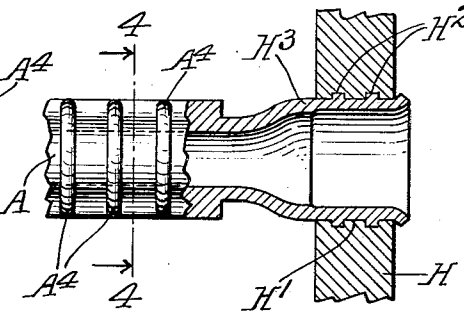
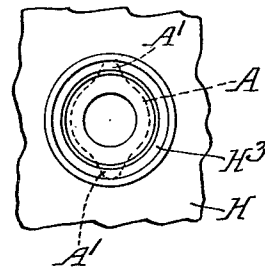


Fig. 5.



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UNITED STATES PATENT OFFICE

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TUBE FOR BOILERS, HEAT EXCHANGERS, AND THE LIKE

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This invention relates to improvements in tubes used in boilers, superheaters or other heat exchangers for heating or cooling various liquids, gases or solid media. It will be realized that I do not wish to limit myself, except so far as set out specifically in the claims, to any particular use of my invention, it being adaptable to a wide variety of uses. However, I have herein illustrated it chiefly in connection with boiler tubes, which disclosure will be at least illustrative of the applications to which the invention may be put.

One object of the invention is to obtain a greater heat transfer per square foot of tube surface, thereby obtaining a greater capacity from apparatus of a given size or area of tube surface. Another object is to lessen or minimize draft resistance, for example by stream lining the exterior of the tubes, or by eliminating tortuosities of the passage or path traveled by the fluid. For example by stream lining the exterior of tubes at a given velocity of the medium, for instance furnace gases, such medium is circulated across a bank of tubes at more uniform speed and with less sharp turns.

A further object attained in some applications of my invention is the maintenance of a considerable reservoir of heat, as by the employment of large amounts of metal which may be held at relatively high temperatures, thus enabling a boiler better to meet fluctuating demands upon it.

Various other objects of my invention will appear from time to time in the course of the specification and claims.

I illustrate my invention more or less diagrammatically in the accompanying drawing, wherein—

Figure 1 is a transverse section through a bank of tubes;

Figure 2 is a similar section illustrating somewhat different tubes;

Figure 3 is a longitudinal section through one of the tubes shown in Figure 2;

Figure 4 is a section on the line 4—4 of Figure 3; and

Figure 5 is an end view of the connection shown in Figure 3.

Like parts are indicated by like symbols throughout the specification and drawing.

Referring to Figures 1 and 2 I illustrate a bank of tubes, for example tubes for a boiler, which are staggered across the path of movement of the hot gases, and which are stream lined in section, the stream lining and the staggering being so arranged as to provide passages of generally constant cross-sectional area, with the turns limited to a minimum and with an elimination of projections and bends, which tend to delay the circulation of the medium or to cause eddies or disturbances in the movement of the medium. The staggering of tubes across the path of flow of the heating medium increases the resistance to the flow, but such staggering is in many cases helpful or essential. It is to minimize the unfortunate results of such staggering that I have developed the stream lining and uniformity of cross-section in passages above referred to.

For purposes of illustration I am describing the invention as applied to a water tube boiler with the water inside the tubes and the product of combustion from the furnace circulating around and between the tubes. It will be understood that my invention may be employed regardless of what medium is inside and what outside the tubes, and regardless of which medium is the hotter.

Referring, for example, to Figure 1, I illustrate tubes A A, each such tube having at diametrically opposed points a member or projection A¹, which is stream lined, as shown in the figure. In Figure 1 the tubes are so arranged that the opposite edges of the members or projections A¹ abut, thereby forming separate passages A². Note that the distance between the opposed walls of adjacent tubes is substantially uniform, and that the path of movement of the fluid is, through such uniform width, obtained in a series of gently flowing arcs.

Referring to Figure 2, the projections A¹ are separated, as to adjacent tubes, by an interval A³. In practice this interval or gap has little effect, and the eddying of or interference with the flow of the fluid is slight,

while a saving in material may be effected. Such a tube is easier to manufacture.

Figure 3 illustrates the connection of the tube to the header H. The header may be provided with an aperture H^1 of somewhat greater diameter than the maximum diameter of the tube, to permit its ready insertion or withdrawal through the aperture. The aperture H^1 may be provided with a plurality of channels H^2 whereby the expanded and thin end H^3 of the tube may be rolled or expanded into the position in which it is shown in Figure 3, thereby securing the end of the tube in place in the header.

It will be observed that I employ a tube the interior aperture of which is circular in cross-section, whereas the exterior is distorted or formed in the stream-line formation above described, having at close intervals throughout its length the transverse ribs A^4 , A^4 .

It will be realized that whereas I have described and shown a practical and operative device, and have illustrated various modifications and applications thereof, that I do not wish to be limited specifically to the forms herein described and shown, except so far as I limit myself by the language of my claims. I wish my description and drawings to be taken as in a broad sense illustrative and diagrammatic, rather than as limiting me precisely to the details indicated.

The use and operation of my invention are as follows:

In current practice it is customary to stagger tubes across the path of movement of a fluid. My invention, when applied for example to water tube boilers, has for purpose to minimize the interference to the flow of the heated gases between and past the tubes and to increase the heat-absorptive surface. One phase of my invention is the provision of means or surfaces for confining the gases, as they pass between the tubes, to passages of relatively constant cross-sectional area. Where the tubes are staggered to obtain this result, as shown in Figures 1 and following, by stream lining the tubes in cross-section and by arranging tubes, so stream lined, in such fashion that the distance between opposed tubes is constant, the result is an easy passage for the gases along a series of successions of flowing curves without sharpened points or angles or restrictions in the passage or expansion chambers, or any means or method likely to delay the flow of the heated medium. The stream lining of the tube is obtained without a weakening of the tube, since the interior aperture is circular. Therefore, the tube has the strength of an ordinary cylindrical pipe, and a resistance to pressure, interior or exterior. The thickness of the wall, however, is varied to provide the desired stream lining effect.

I claim:

1. For use with heat exchangers and the like, a plurality of tubes arranged in staggered relation, the exteriors of said tubes being stream-lined in transverse cross-section, said tubes being arranged to provide passages therebetween of substantially uniform cross-sectional area, the interior surfaces of said tubes defining a cylinder.

2. For use with heat exchangers and the like, a plurality of tubes arranged in staggered relation, the exteriors of said tubes being stream-lined in transverse cross-section, said tubes being arranged to provide passages therebetween of substantially uniform cross-sectional area, the walls of the passages thus formed defining a succession of reversed curves, the interior surfaces of said tubes defining a cylinder.

3. For use with heat exchangers and the like, a plurality of tubes arranged in staggered relation, the exterior walls of which, when taken in transverse section, are bounded by reverse curves, the passages between adjacent tubes, bounded by said curves, being of substantially uniform width between opposed surfaces of adjacent tubes, the interior surfaces of said tubes being generally circular in transverse cross-section.

4. A tube and header structure which includes an apertured header and a tube aligned with said aperture, the cross-section of the tube being less than the cross-section of said aperture, the tube being adapted to be inserted through and withdrawn through said aperture, and a securing member, associated with said tube, adapted to engage the inner walls of said aperture and to position the tube in relation to said header, the exterior cross-section of said securing member being greater than the maximum exterior cross-section of the tube.

5. A tube and header structure which includes an apertured header and a tube aligned with said aperture, the cross-section of the tube being less than the cross-section of said aperture, the tube being adapted to be inserted through and withdrawn through said aperture, and a securing member, associated with said tube, adapted to engage the inner walls of said aperture and to position the tube in relation to said header, the exterior cross-section of said securing member being greater than the maximum exterior cross-section of the tube, the tube and the securing member being integral.

6. In a heat exchanger, a plurality of tubes, the inner surfaces of which are circular in cross section, the exterior surfaces of which are stream lined, the tubes being grouped to form gas passages about the tubes of generally uniform cross section.

7. In a heat exchanger or the like, a tube the inner wall of which is circular in transverse section, the exterior of a substantial

portion of which is stream lined, said tube being provided with one or more terminal portions generally circular in exterior cross section, and of a diameter greater than the maximum diameter of the stream lined portion of the tube.

8. A tube adaptable for use with heat exchangers and the like, the exterior of which is stream-lined, when taken in transverse section, said tube being provided with a terminal portion of generally circular cross-section, the diameter of said terminal portion exceeding the maximum diameter of the stream-lined portion.

9. For use with heat exchangers and the like, a plurality of tubes arranged in staggered relation, the exteriors of said tubes being stream-lined in transverse cross-section, and a plurality of spaced parallel ribs on each of said tubes, said ribs extending transversely of the axis of the tubes, said tubes being spaced and arranged to provide passages therebetween, the portions of said passages defined by the adjacent surfaces of the tubes between the ribs being of substantially uniform cross-sectional area, the interior surfaces of said tubes defining a cylinder.

10. For use with heat exchangers and the like, a plurality of tubes arranged in staggered relation, the exteriors of said tubes being stream-lined in transverse cross-section, and a plurality of spaced parallel ribs on each of said tubes, said ribs extending transversely of the axis of the tubes, said tubes being spaced and arranged to provide passages therebetween, the portion of said passages defined by the adjacent surfaces of the tubes between the ribs being of substantially uniform cross-sectional area, the walls of the passages thus formed defining a succession of reversed curves, the interior surfaces of said tubes defining a cylinder.

Signed at Chicago, county of Cook and State of Illinois, this 2nd day of July, 1930.

ROGER STUART BROWN.