Feb. 9, 1932. T. E. MURRAY 1,844,407

HEAT CONDUCTING TUBE

Filed May 23, 1924

Fig.1.

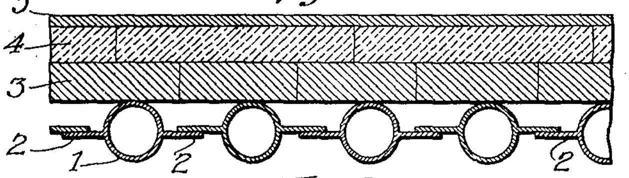


Fig.2.

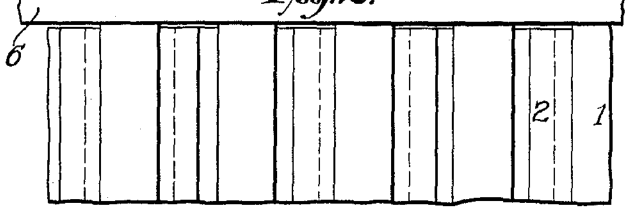


Fig.12.

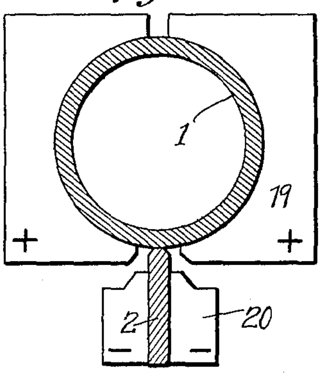


Fig.3.

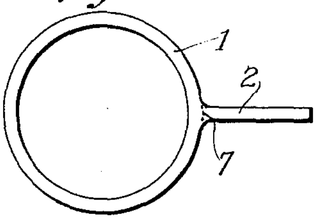


Fig.4.

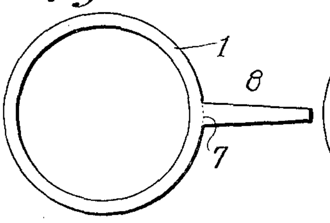


Fig.5.

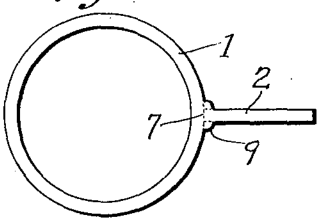


Fig.6.

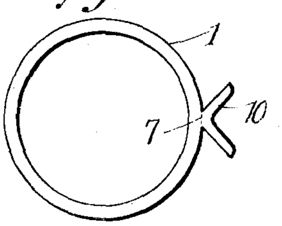


Fig.7.

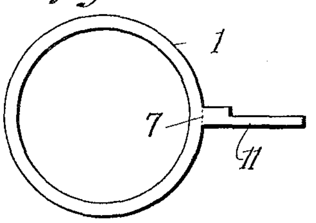


Fig.8.

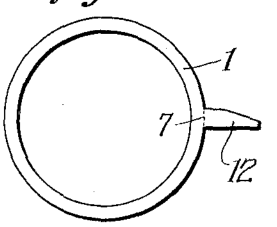


Fig.9.

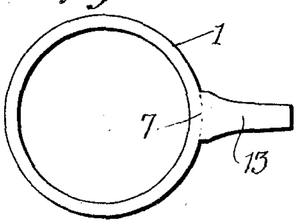


Fig.10.

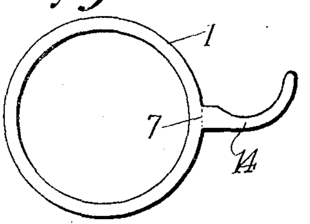
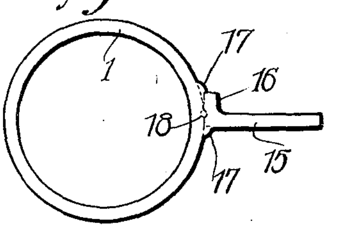


Fig.11.



INVENTOR
Thomas E. Murray
BY D. Anthony Usina
ATTORNEY

Patented Feb. 9, 1932 1,844,407

UNITED STATES PATENT OFFICE

THOMAS E. MURRAY, OF BROOKLYN, NEW YORK; JOSEPH BRADLEY MURRAY, THOMAS E. MURRAY, JR., AND JOHN F. MURRAY, EXECUTORS OF SAID THOMAS E. MURRAY, DECEASED, ASSIGNORS TO METROPOLITAN ENGINEERING CORPORATION, A CORPORATION OF NEW YORK

HEAT CONDUCTING TUBE

Application filed May 23, 1924. Serial No. 715,369.

In certain prior applications, Nos. 642,427 filed May 31, 1923 and 642,725 filed June 1, 1923, which has since matured into Pat. No. 1,746,711 dated Feb. 11, 1930, I have described a certain hollow construction for walls and other parts of boilers or heaters and made up of tubes of rectangular, circular or irregular cross-section with fins or flanges extending lengthwise thereof so as to provide a heating surface exposed to the heating gases greater than the surface which is in contact with the water or other fluid in the tube.

The present invention provides a unit from which such boiler walls and the like may be built. The accompanying drawings illustrate embodiments of the invention.

Fig. 1 is a horizontal section of a side wall of a boiler built with the tubular units of the invention;

Fig. 2 is an inside elevation of the same showing the upper ends of the tubes;

Figs. 3 to 11 inclusive are plans of various forms of unit made in accordance with the invention;

Fig. 12 is a diagram illustrating a method of production of the finned tubes.

Referring to Fig. 1, the boiler wall is made with an inner lining or screen comprising tubes 1 with lateral flanges 2 extending across the spaces between the tubes and overlapping each other. On the outside of this screen is the wall of the boiler structure which may be of any usual or suitable material and which as illustrated comprises refractory blocks or bricks 3 outside of which are tiles 4 of non-conducting material and an outer shell 5 of sheet metal. The longitudinal fins extend throughout such portions of the length of the tube as may be desired according to the design of the boiler and preferably throughout the zone of radiant heat where their conducting effect is of greatest value. As shown in Fig. 2, they extend substantially up to a header 6 into which the upper ends of the tubes are introduced, leaving the tubes without flanges for a sufficient length to facilitate the making of the joints with the header. The flanges may extend clear down to a similar header below; or may be omitted at the lower end where their cooling effect on the fire bed might be objectionable as illustrated, for example, in my application No. 678,443 filed December 4, 1923 and illustrating a boiler wall made with such tubes.

The fins on the tubes serve to transmit heat to the tubes and the water or other fluid therein, and also to protect the masonry or other backing of the wall from the heat of the flame. There is naturally a considerable expansion of the metal by the heat and it varies at different points in the wall. The flanges therefore, while they preferably close the spaces between the tubes by overlapping at their edges, are not secured together but are free to permit relative movement and also to facilitate the repair of the wall in case one or more of the tubes or flanges may be damaged. To conduct the heat more efficiently to the tubes, and to prevent their partial separation from the tubes under the distortion produced by the high temperature, the flanges should make as strong a connection as possible to the tubes and the area of the connection should be fully equal to the section of the flanges. For this purpose I propose to weld the edges of the tubes and to provide a welded area at least equal to and preferably greater than that of the longitudinal section of the flanges. Preferably a butt-weld is made according to the welding method described in the Murray Reissue Patent No. 15,466 of October 10, 1922 in which a current of extremely high ampere strength for a very brief regulated period of time is passed through substantially the entire surface in contact, while the parts are pressed together.

Figs. 3 to 11 show a single flange on each tube, and the invention may be applied in this way with the single flange arranged to extend over all or any desired part of the space between two tubes. But, for a given spacing of the tubes, a flange on each side is preferable since it does not have to be so wide as a single flange would and since it provides a shorter distance for conduction of heat through the flange to the tube. Also, besides the side flanges illustrated, there may be one or more flanges arranged along the front of each tube, that is, the side of it which is exposed to the furnace gases. And, instead of having a flange which is continuous from end to end, we may, particularly for units of considerable length, have a flange which is interrupted at intervals in its length for greater convenience in application to the tube and to permit distortion without excessive strain on the welded joints.

The flanges may be of various shapes in cross-section. There are a number of standard rolled shapes which are suitable. All those illustrated, in fact, are standard rolled shapes commonly used for various purposes. In Fig. 3, the flanged tube is a common rolled bar or strip of rectangular cross-section and of about the same thickness as the tube and is united by butt-welding at the joint 7. In the welding operation the root area may be increased as shown. The tube is assumed to be ordinary seamless boiler tubing. In Fig. 4, the flange 8 is made of a bar tapered in cross-section with its wider edge butt-welded at 3. This is advantageous in that the increased width tends to compensate for the increased amount of heat that the plate must carry as it approaches the tube and gives greater resistance against sidewise distortion strains at the joint.

In Fig. 5, the flange 2 is made of a bar similar to that in Fig. 1. Instead of butt-welding, however, the arc-welding method is applied to the joint. Metal 9 is deposited by the electric arc and welded to the flange and to the tube over areas which are at least equal to the longitudinal section of the flange and preferably greater to allow for any imperfections. This figure may be taken to illustrate also a butt-weld 7 as in Figs. 3 and 4, supplemented by the arc-welds 9.

According to Fig. 6, the flange is formed by using a rolled angle 10 and uniting its outer corner to the tube by a butt-weld at 7. This weld may be made of greater or less width by varying the extent of take-up or movement of the angle toward the tube in the welding operation.

According to Fig. 7, a common rolled shape 11 is used which is stepped in cross-section, and its wider portion is butt-welded at 7 to the tube. Similarly for Fig. 8 we have a flange composed of a shape 12 which is rectangular for a portion of its width and tapered over the other portion, its wider edge being butt-welded at 7 to the tube. Similarly again for Fig. 9 we have a flange made of a shape 13 with a narrower outer portion tapering to the wider inner portion which is butt-welded at 7 to the tube. The inner edge of this shape is commonly convex, so that the area of the joint can be regulated by varying the take-up, the same as for Fig. 6.

Where a flange of bent shape in horizontal section is desired, we may use the known rolled shape 14 of Fig. 10. The outer edge of this is bent to form a sort of hook, and the inner edge is thickened so as to give a wide welded joint 7.

Another method of securing an increased area at the root of the fin is illustrated in Fig. 11. The fin 15 is a rolled section of L-shape with a short flange 16 at one edge. This flanged root of the fin is united to the tube 1 by the arc or acetylene welding process, the deposited welding metal being indicated at 17. In addition, or preliminarily to the arc-welding, a projection weld 18 may be made between the tube and the face of the flange. This is accomplished by forming projections along the face of the flange and butt-welding the latter to the tube. Any one or both of these methods of attachment may be used.

The method of butt-welding a simple flange is indicated in Fig. 12. The tube 1 is clamped between a pair of positive electrodes 19. The plate 2 is clamped into negative electrodes 20. The plate has its edge which is in contact with the tube slightly beveled. The welding current is passed as explained and the parts are welded firmly with a take-up sufficient to bring the joint to a greater thickness than that of the plate, as shown at 7 in Fig. 3.

Fig. 12 represents a new principle in the welding of an end or a narrow edge to the broad surface of a plate or the like, such as the surface of the tube 1. In attempting to make a weld of this sort, the conductivity of the surrounding metal of the plate has always presented a difficulty because it conducts away and radiates the heat from the welding point very rapidly. It is a common expedient to raise a projection on the plate corresponding to the area of the weld in order to overcome this difficulty, the heat being better concentrated at the welding point by this projection. The difficulty has been to avoid loss of heat generated in the larger mass. In the process of Fig. 12, however, the common scheme of a projection on the extended surface has been in a sense reversed. The edge of the plate 2 is reduced in width so as to provide such a small area of contact with the surface of the tube as by the forming of an arc or a greatly increased resistance at this point, to generate enough heat to raise the temperature of the tube surface to such an extent that in spite of radiation, there will be all the heat required for welding. This method is not claimed in the present application, but is covered in a divisional application.

I have shown and described but a single tube in each of the units, but the invention may be equally embodied in units provided with two or more tubes or passages.

The tubes, as I have said, may be ordinary seamless boiler tubing made of low carbon steel, or they may be of lap-weld or butt-weld tubing. And, particularly where non-circular cross-sections are desired such as are illustrated in my previous applications above referred to, they can be made of sheet metal lengths stamped into segments and welded together at their edges.

Tubes of the character described are generally of considerable length and of comparatively small diameter, the length being measured in feet and the outer diameter being a few inches, 3 to 5 inches in large installations. The wall thickness is slight compared with the diameter so as to effect a rapid transfer of heat.

The drawings illustrate tubes with a wall thickness about one-twelfth of the diameter. In practice boiler tubes are made even thinner. Standard 4-inch boiler tubes have a wall thickness of one-fourth of an inch or less and the thickness is in increased proportion for larger tubes. The steel used for such tubes is of a certain composition designed to meet the pressures and strains of use and also to permit manufacture of piercing, drawing and rolling in the case of seamless tubes and bending and welding in the case of tubes made from skelp or strips.

The flanged tube of this invention is so constructed as to preserve the original strength and tightness of the tube against leakage under the prevailing conditions of internal pressure. With this aim, the construction is such as to maintain the wall of the tube intact.

The flange is a separate rolled strip or shape which does not involve any break in the continuity of the wall of the tube. The inner edge of the flange member is abutted against the continuous outer surface of the tube. The desired wall thickness is not reduced at any portion of its circumference.

The flanges may be made of ordinary rolled steel. But where they are to be subjected to very high temperatures it is advantageous to use a metal which is better adapted to resist deterioration by oxidation at such tempertures. A number of such metals are known, largely alloys of iron with nickel, chromium and the like. There are also known methods of providing a surface or skin on steel which will resist oxidation, generally by impregnating the surface of the steel with some other metal or alloy. A good example of such a process is that known commercially as calorizing, in which the surface of the steel is given a thin but continuous and very adherent coating or impregnation of aluminum, which is partially alloyed with the steel. Under heat, the aluminum is oxidized, forming a thin continuous adherent coating of alumina which is very effective in resisting further oxidation. This method applies best to rolled steel, but is applicable to almost all other metals. Such a method has this advantage, that the body of the steel retains its original heat conductivity, which is greater than that of most of the resistant alloys of nickel or chromium.

The thickness of the flange should be increased toward the root roughly in proportion to its width in order to theoretically take care of the quantity of heat to be conducted. The actual extent and rate of such increase in thickness would vary with different conditions.

Though I have described with great particularity of detail certain embodiments of my invention yet it is not to be understood therefrom that the invention is restricted to the particular embodiments disclosed. Various modifications may be made by those skilled in the art without departure from the invention as defined in the following claims.

What I claim is:—

1. A steam boiler tube constituting a complete unitary article of manufacture and consisting of a long, small diametered, thin walled, soft steel boiler tube with a longitudinal flange having a free outer edge, being thicker at the root than at the outer edge and being welded at its root to the tube so as to constitute a practically integral connection substantially equal in area to the area of the root edge of the flange.

2. A tubular unit of the character described adapted to be exposed externally to high temperatures and to carry a liquid to be heated, constituting a complete unitary article of manufacture and consisting of a long steel tube of small diameter compared with its length and of small wall thickness compared with its diameter and a longitudinal flange having a free outer edge, being thicker at the root than at the outer edge and being welded at its root to the tube.

3. A tubular unit of the character described adapted to be exposed externally to high temperatures and to carry a liquid to be heated, constituting a complete unitary article of manufacture and consisting of a long steel tube of small diameter compared with its length and of small wall thickness compared with its diameter and a longitudinal flange welded at its root to the tube, the thickness of the welded unit at the root of the flange being greater than at the outer edge of the flange.

In witness whereof, I have hereunto signed my name.

THOMAS E. MURRAY.