Nov. 5, 1940. T. E. MURRAY 2,220,579

METHOD OF MAKING BOILER TUBES AND THE LIKE

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Fig. 1.

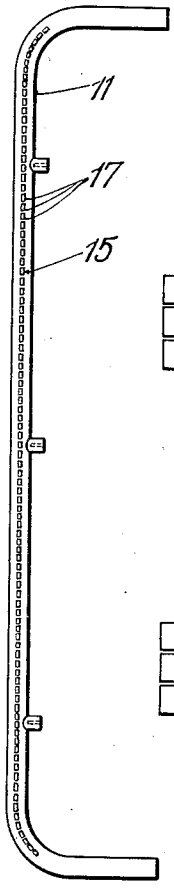


Fig. 2.

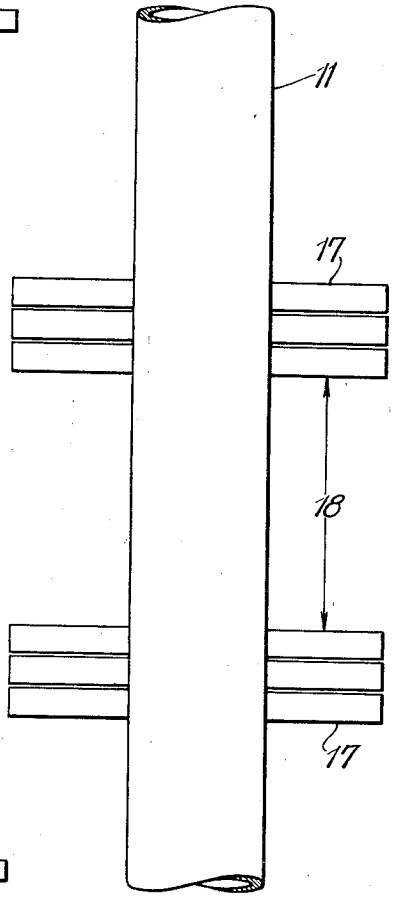


Fig. 3.

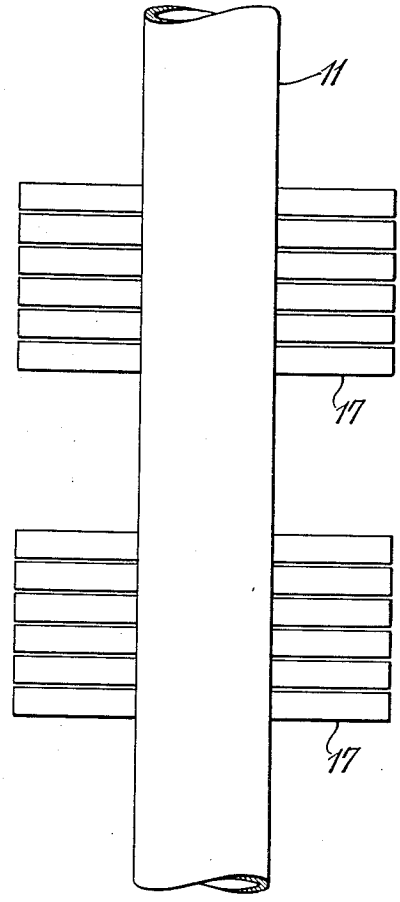


Fig. 1a.

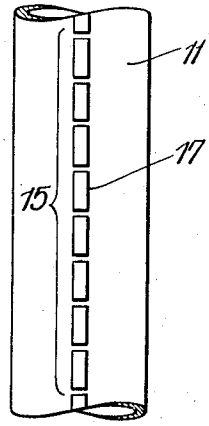


Fig. 4.

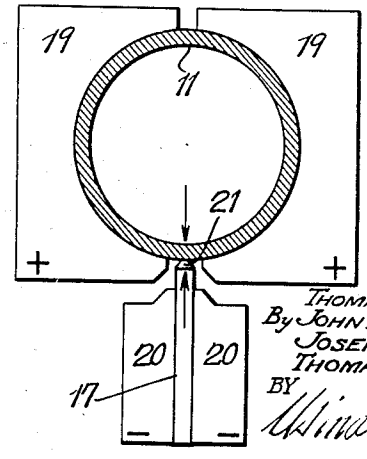
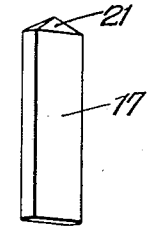


Fig. 5.



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Fig. 6.

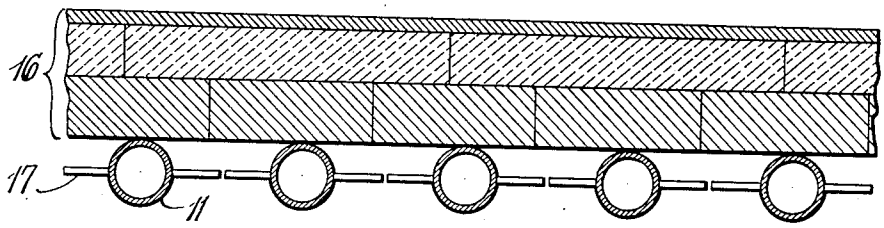


Fig. 7.

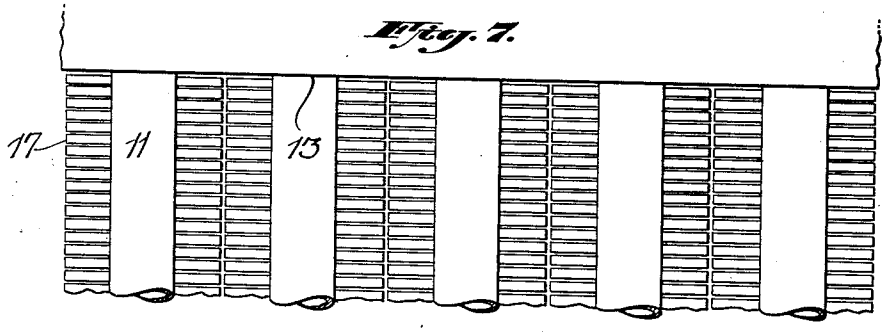


Fig. 9.

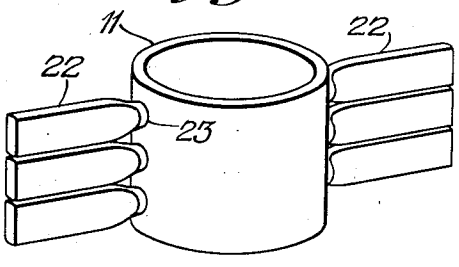
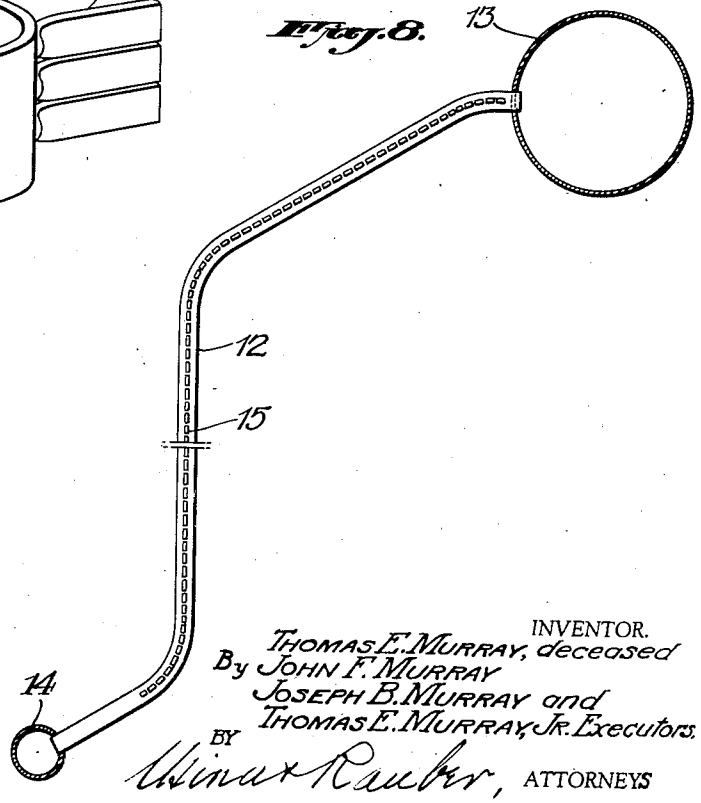


Fig. 8.



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Patented Nov. 5, 1940

2,220,579

UNITED STATES PATENT OFFICE

2,220,579

METHOD OF MAKING BOILER TUBES AND THE LIKE

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Application December 28, 1934, Serial No. 759,459

12 Claims. (Cl. 219—10)

In certain prior patents (for example, No. 1,844,407, February 9, 1932) there are disclosed boiler furnace walls composed of finned tubes; that is to say, tubes with flanges extending continuously over the exposed portions, the tubes being erected alongside of each other with the flanges filling the spaces between them and forming a wall which is practically closed to prevent the passage of gases or any substantial quantity of radiant heat from the combustion within. Such boiler furnaces are fired most frequently with coal dust, or it may be oil or gas, producing an intense degree of heat.

In actual practice such flanges have been welded continuously along the length of such tubes by arc welding (that is, by depositing along the joint welding metal melted by the electric arc) and this method has introduced internal strains in the tube and also in the flange. A measurement of such a tube about 20 feet long would show a contraction of a considerable fraction of an inch in length after the application of the flanges, indicating a very high degree of strain. Such strains have caused the tubes in some cases to split in use and have rendered the free edges of the flanges more susceptible to oxidation at the high temperature prevailing, so that they have burned off rapidly and could not be made in the beginning of the desired width.

The disadvantages of the continuous flange are set out more fully in application Serial No. 550,903, filed July 15, 1931, disclosing the substitution for the continuous fin of a number of separate projections spaced slightly apart and providing a substantially unbroken wall.

The present application is directed to the process of producing such units, that is, boiler tubes and the like with flanges which for all practical purposes form a complete wall, without the strains involved in the application of a continuous fin welded along its entire length to the tube.

The accompanying drawings illustrate designs of boiler tubing and methods of production.

Fig. 1 is a side elevation of a fin tube for the wall of a Murray type of boiler.

Fig. 1*a* is an enlargement of a portion thereof to illustrate the separation of the fin into a number of small separate projections.

Figs. 2 and 3 are elevations of a tube in process of application of projections thereto.

Fig. 4 illustrates diagrammatically the welding operation.

Fig. 5 is a perspective of one of the projections before welding it to the tube.

Figs. 6 and 7 are, respectively, a horizontal section and an elevation of the upper part of a water wall.

Fig. 8 is a view similar to Fig. 1 of another wall of a boiler tube.

Fig. 9 is a perspective of the upper end of a tube showing a different design of the projections.

Tubes for boilers, super-heaters, economizers and various other heat exchange apparatus are sometimes straight from end to end and are often curved in various ways along their length. The present invention is applicable to all such shapes and has particular advantages in connection with tubes that are curved. In Fig. 1, for example, there is a tube 11 having the main portion of its length straight and having its two ends bent in the same direction at a right angle for connection to drums or headers. The tube 12 of Fig. 8 has a slight bend at its upper end for connection to a steam drum 13, and its lower end bent in the opposite direction for connection to a header 14; the intermediate portion may also be bent at about the middle. Both these tubes are provided with fins, designated as a whole by the numeral 15, extending over the portions of their length which are exposed to the heat.

In making up tubes of this character into boiler walls (Figs. 6 and 7) they are arranged side by side, spaced apart from each other and with their fins abutting or overlapping so as to practically close the space between the tubes against the passage of heat to the outside wall 16, or to any outside insulation that may be provided.

It has been found that where such fins are welded in a continuous strip over the whole or any substantial length of the tube, there are strains set up in the tube and in the strip which weaken them and sometimes cause cracks in the fin or in the tube under the conditions of use as above explained. It is proposed, therefore, to weld each fin in a succession of steps along the length of the tube applying the fin in separate sections of such short length as to avoid the previous difficulties. They may be spaced so closely to each other as to constitute in effect a complete wall without losing the advantage of applying them separately. Therefore, the fins 15 are composed of separate projections or segments 17 spaced as closely together as possible without interfering substantially with each other when they are distorted by the heat of the furnace and by the differences in temperature be-

tween the welded ends and the free ends thereof. It has been found in practice that projections of this sort can be made to extend farther outward from the tube than the old continuous fins and that they have a longer life and impose less strain upon the tubes than in the old arrangement. They are also advantageous in the making of bent tubes of the shapes illustrated, for example, in Figs. 1 and 8. A continuous fin would have to be bent with the tube, of course. It is much easier to bend a fin made up with a line of separate small segments and imposes less strain on the parts.

In the case illustrated in Figs. 1 and 1*a* there is assumed a steel boiler tube of 4 inches outside diameter and about $\frac{5}{16}$ of an inch in thickness and projections which are 3 inches wide (the radial direction), 1 inch long (the direction lengthwise of the tube) and ¼ inch thick, spaced apart from $\frac{1}{16}$ inch to ⅛ inch. Such tubes are fairly described as long, small-diameter thin-walled tubes. The invention is applicable, however, to various other kinds and sizes of tubing and to projections of various other dimensions and spacing. See for example, Murray & Lawrence Patent 1,929,444, October 10, 1933, illustrating variations in structure, and Hoffer Patent 1,968,079, July 31, 1934, illustrating an automatic machine for applying the projections.

The electric resistance methods of welding, which are probably the most convenient in this particular work, involve the passage of a current through the tube and the end of the projection. In such methods there is a softening of the tube at the joint. For this reason, as well as for the considerations stated above, it is desirable to limit the total length of the tube covered by one welding operation. It is preferable to keep within a three inch length of the tube, assuming the ordinary boiler tube above described. Within this length there may be applied at one operation either a single projection or fin-segment of about three inches length, or several such segments totaling about three inches.

The projections, therefore, are applied either one at a time along the line (simultaneously at opposite sides of the tube where two such fins are desired), or in groups of such a small number as not to exceed the length of tubing which will retain its form under the conditions of heat and pressure.

For example, in Fig. 2, the projections 17 are applied in groups of three at a time which, assuming the particular dimensions above stated, would involve a length of tubing of slightly over three inches. The operation may be performed simultaneously at two or more points in the length of the tube as illustrated by a second group of three projections. The space 18 must be maintained at such length that the heat applied at the two working points shall not be transmitted in any substantial degree from one to the other. Fig. 3 shows a second group of three projections applied following each of the two starting points. These operations are continued until the entire desired length is covered as in Figs. 1 and 8.

Fig. 4 illustrates a suitable electric resistance welding method. The tube 11 is held clamped in the two parts 19 of a positive electrode. The projection 17 (or group of such projections) is clamped between the two parts 20 of the negative electrode. The parts are brought into contact, as illustrated, and the current passed between them. They may be slightly separated to form sparks, as in the ordinary flash method, and thus softened or may be softened by the use of a high volume of current passed for a very brief time as in the Murray method. When they are sufficiently heated the current is cut off and the parts pressed together in the direction of the arrows and thus welded.

In these welding methods the inner end of the projection 17 is usually formed with a tapered portion 21 which is taken up or extruded or squeezed out in the welding operation, leaving the welded contact area equal to or greater than that of the welded end of the projection.

Fig. 9 illustrates a different style of projection 22 which has a flat outer portion and a rounded tapered end portion 23 which forms a weld of less length (parallel to the length of the tube) than the corresponding dimension of the projection 22. Various other known or suitable shapes may be used.

In making bent tubes, the projections are applied throughout the whole or the desired portion of the length of the tube while the latter is straight. When the heat of welding is dissipated the tube is bent. The interrupted fin offers no substantial resistance to bending in the plane transverse to the fin. In the few cases where the tube requires bending in the plane of the fin, the projections may be spaced or shaped so as not to contact with each other within the desired degree of curvature of the tube.

What is claimed is:

1. A process for making tubes for boiler walls with practically continuous fins secured thereto which consists in separately welding to the tube fin-segments spaced slightly from each other to compensate for irregularities of expansion and contraction in portions of said segments adjacent to the tube as compared with portions remote from the tube, with the segments in line and in sufficient proximity to each other lengthwise of the tube to provide a substantially unbroken wall when used in connection with other similar tubes.

2. A process for making tubes for boiler walls with practically continuous fins secured thereto which consists in separately welding to the tube fin-segments spaced slightly from each other to compensate for irregularities of expansion and contraction in portions of said segments adjacent to the tube as compared with portions remote from the tube, with the segments in line and in sufficient proximity to each other lengthwise of the tube to provide a substantially unbroken wall when used in connection with other similar tubes, said process comprising the welding of the segments to the tubes by an electric resistance method involving the passage of a heating current through the tube and the segments and the pressing of them together, the segments being applied in a succession of steps, each step embracing such a short portion of the length of the tube as to avoid heating the wall thereof sufficiently to permit substantial distortion under the pressure applied.

3. The process of claim 1, the segments being applied in a succession of steps along the length of the tube one at a time so as to avoid heating the tube over such a length as to permit substantial distortion under the pressure applied.

4. The process of claim 1, the segments being applied in a succession of steps not greater than about three inches in length.

5. The process of claim 1, applying said seg-

ments simultaneously at opposite sides of the tubes.

6. The process of claim 1, applying the segments simultaneously at points in the length of the tube so far apart as to avoid the transmission of any substantial quantity of heat from one to the other.

7. The process of claim 1 applied to a steel boiler tube of the order of about four inches diameter and $\frac{5}{16}$ of an inch in thickness, and the segments being applied over a continuous length of not more than about three inches.

8. The process of claim 1 applied to the tube while it is straight, and thereafter bending the tube.

9. The process of claim 1 applied to the tube while it is straight, and thereafter bending the tube in a plane at right angles to that of the projections.

10. A process for making tubes with separate projections secured thereto, said process comprising the welding of the projections to the tubes by an electric resistance method involving the passage of a heating current through the tube and the projections and the pressing of them together without an internal mandrel but solely against the resistance of the tube wall, the projections being applied in a succession of steps along the length of the tube, each embracing such a short portion of the length of the tube as to avoid heating the wall thereof sufficiently to permit substantial distortion under the pressure applied.

11. A process of making tubular units for boiler walls and the like comprising a long, small-diameter thin-walled steel tube with separate projections secured thereto, said process comprising the welding of the projections to the tubes by an electric resistance method involving the passage of a heating current through the tube and the projections and the pressing of them together, applying the projections in a succession of steps along the length of the tube not greater than about three inches in length.

12. A process of making tubular units for boiler walls and the like comprising a long, small-diameter thin-walled steel tube with separate projections secured thereto, said process comprising the welding of the projections to the tubes by an electric resistance method involving the passage of a heating current through the tube and the projections and the pressing of them together, applying such projections simultaneously at opposite sides of the tube.

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