HEAT CONDUCTING ELEMENT

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Fig. 1

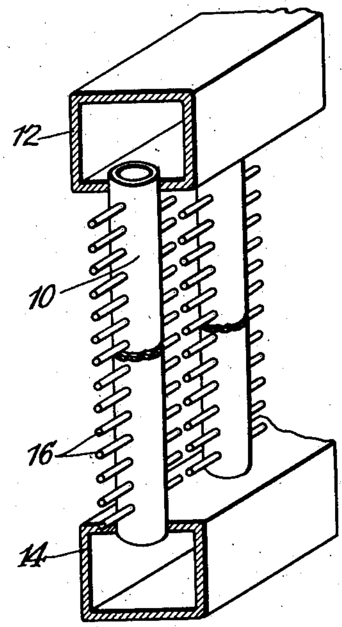


Fig. 2.

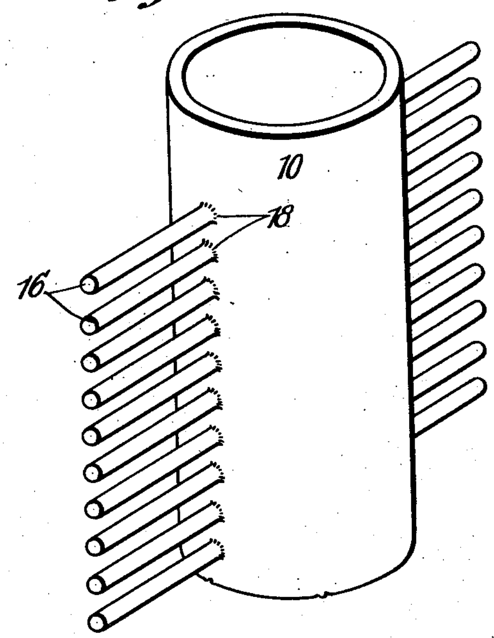


Fig. 3.

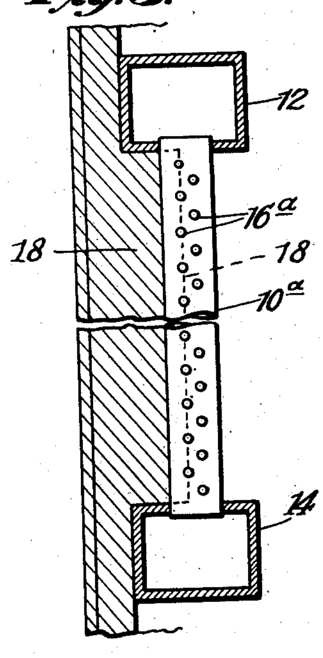
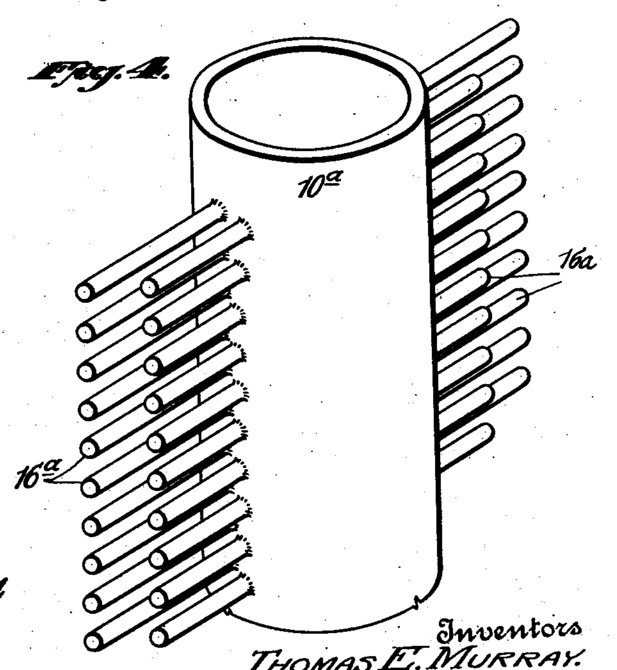


Fig. 4.



Inventors
THOMAS E. MURRAY.
JOHN H. LAWRENCE.
By Their Attorneys
Usina + Rauber

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Fig. 5.

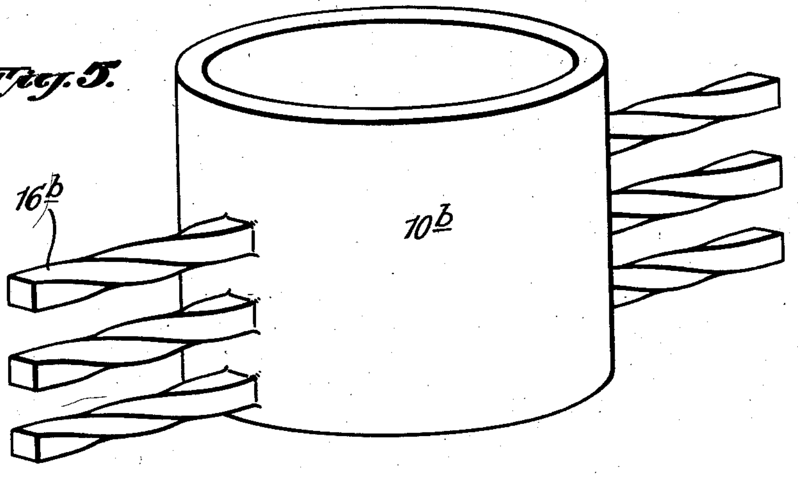


Fig. 8.

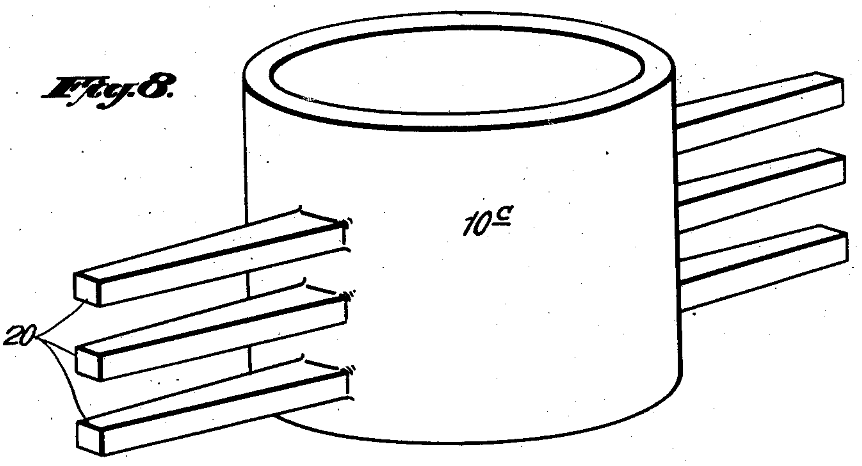


Fig. 6.

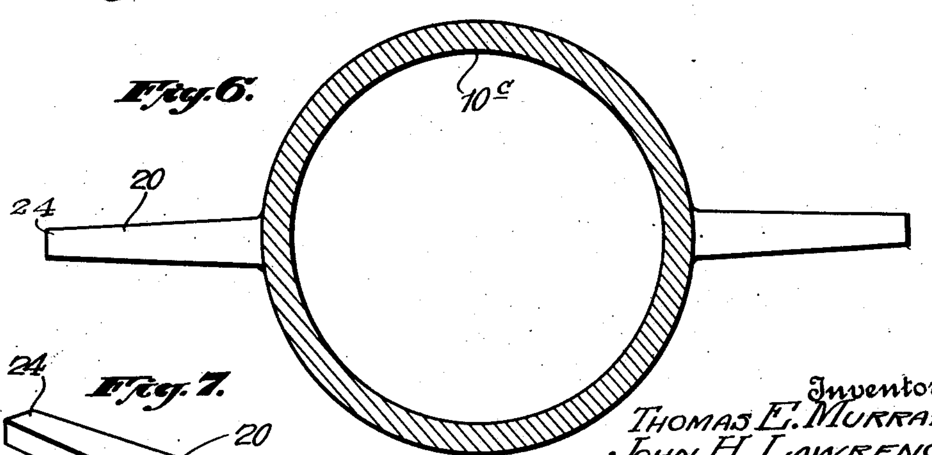
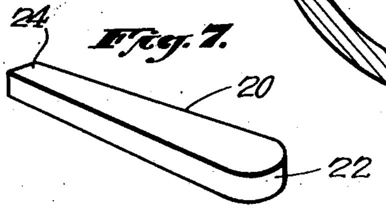


Fig. 7.



Inventors
THOMAS E. MURRAY.
JOHN H. LAWRENCE.
By Their Attorneys

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Fig. 9.

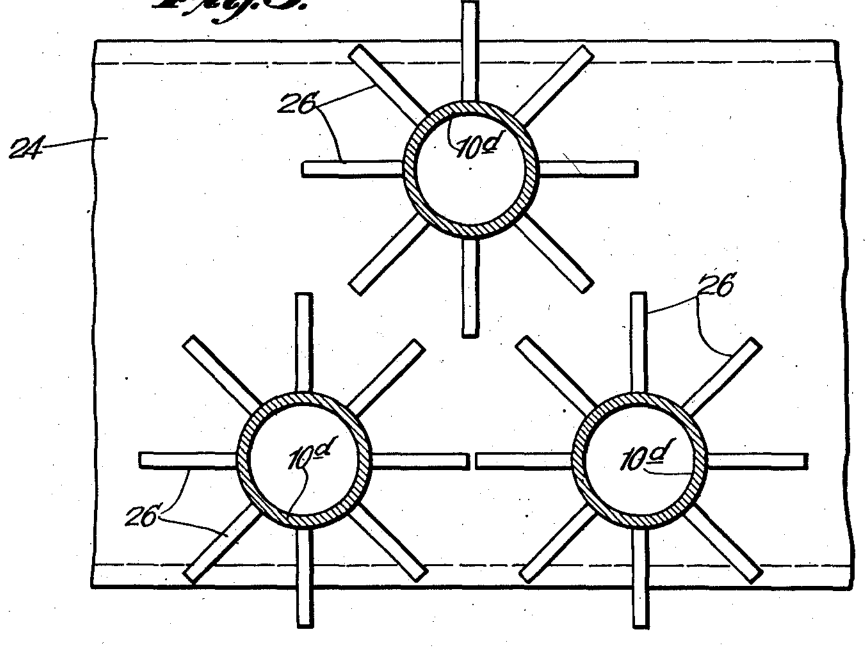
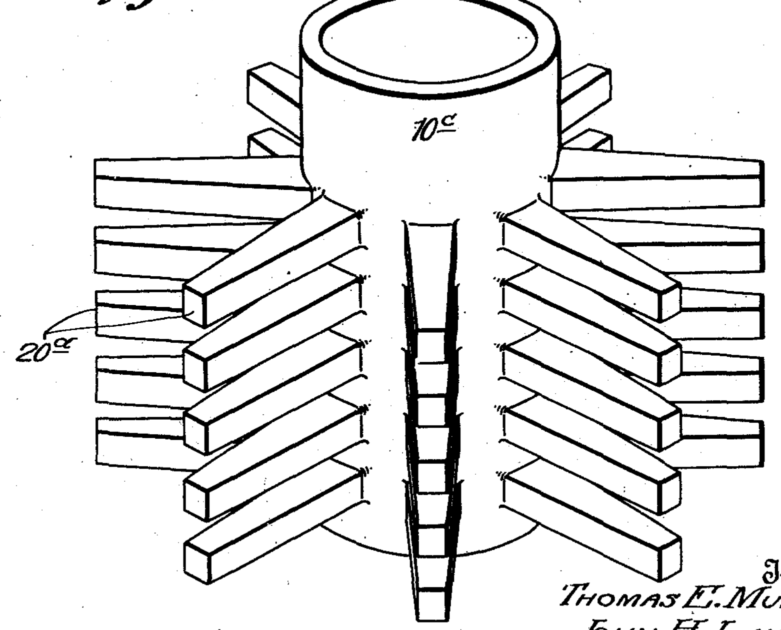


Fig. 10.



Inventors
THOMAS E. MURRAY
JOHN H. LAWRENCE.
By Their Attorneys
Usina & Rauber

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Fig. 11.

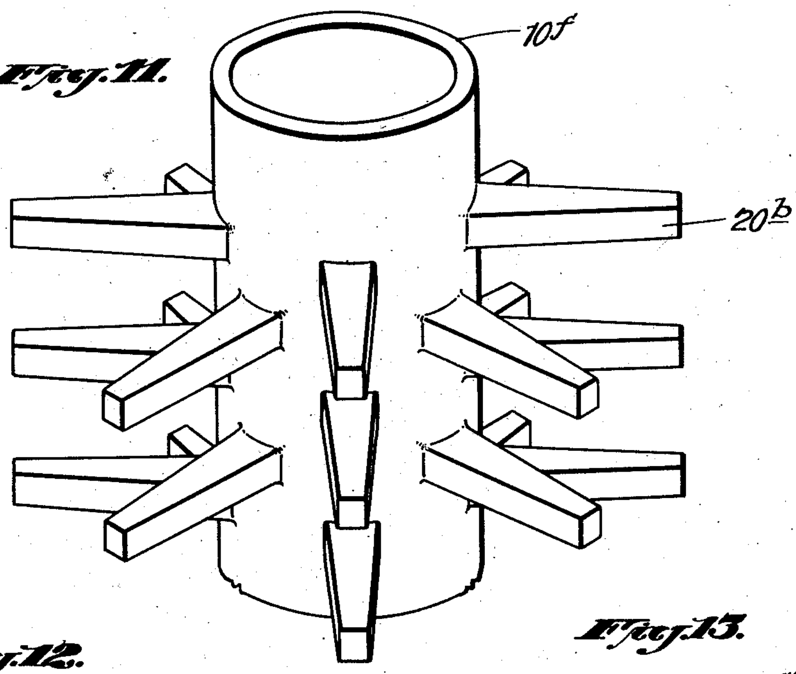


Fig. 12.

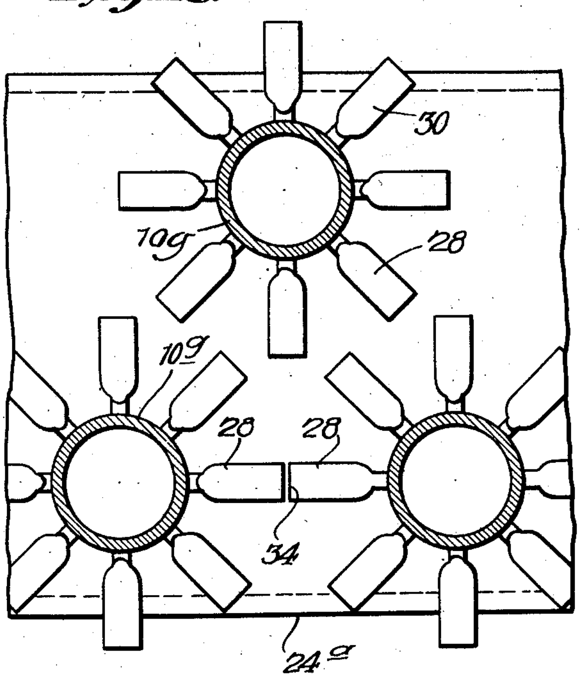


Fig. 13.

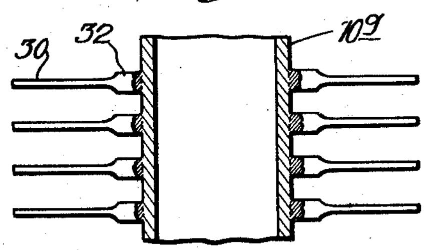
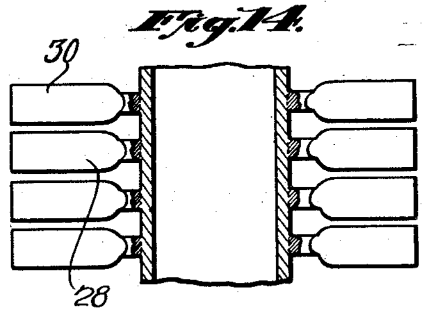


Fig. 14.



Inventors
THOMAS E. MURRAY.
JOHN H. LAWRENCE.
By Their Attorneys
Kraina + Rauber

Patented Oct. 10, 1933

1,929,444

UNITED STATES PATENT OFFICE

1,929,444

HEAT CONDUCTING ELEMENT

Thomas E. Murray, Brooklyn, and John H. Lawrence, New York, N. Y.; said Lawrence assignor to said Murray; 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

Application July 17, 1929. Serial No. 378,888

6 Claims. (Cl. 257—262)

This invention relates to improvements in heat conducting elements which while not limited thereto are suitable for use in building boiler walls, heat economizers and the like.

An object of the invention is to provide an extended surface element adapted to conduct heat to a fluid circulating through a tubular member. Tubes having continuous ribs or fins secured thereto may be and have previously been used to advantage for conducting heat to water circulated through the tubes.

In devices of this character a temperature gradient will exist in various parts of the metallic structure. Where the extended surface elements are in the nature of continuous ribs integrally united to the tube structure there exists a possibility that because of the temperature gradient in different parts of the structure certain parts thereof are stressed to a greater extent than other parts.

This condition is apt to transfer stresses from the extended surface element such as an integral rib or the like to the fluid carrying element or tube. This may result in a weakening or fracture of the tube adjacent the point where the rib is united thereto.

Our present invention aims to overcome this condition by forming the extended surface elements of a plurality of rod-like extensions each of which is adapted to expand and contract independently of the others so that there is no additive effect due to expansion or contraction throughout the length of the tube.

The invention may be embodied in a variety of structures, a number of which are illustrated in the accompanying drawings to which reference may be had in connection with the following specification for the full disclosure of various detailed features of the invention which will be defined with particularity in the appended claims.

In the drawings:

Fig. 1 is a vertical section through a portion of a boiler wall including heat conducting elements embodying our invention;

Fig. 2 is an enlarged perspective detail view illustrating one form of heat conducting element;

Fig. 3 is a vertical section of an alternative form of boiler wall embodying the invention;

Fig. 4 is a perspective view at an enlarged detail illustrating the heat conducting element shown in boiler wall of Fig. 3;

Figs. 5 to 14 inclusive are views illustrating various modifications of the invention.

Referring first to Figs. 1 and 2, 10 is a heat conducting element which is connected at top and bottom respectively with headers 12 and 14 adapted to have water or steam circulated therethrough. The structure shown is suitable for use as a boiler wall of the so-called water wall type.

For rapidly and efficiently transferring heat to the water or fluid circulating through the tube 10, we provide a plurality of rod-like extensions. As shown in Figs. 1 and 2 these extensions are short lengths 16 of rod or bar stock which are welded as indicated at 18 at spaced intervals along the lengths of the tube. In the arrangement of Fig. 2 the element 10 is a tube about four inches in diameter provided with diametrically opposite rows of ¼ inch rods spaced about ½ inch apart on centers so as to leave spaces of about ¼ inch between adjacent rods. The several rods are preferably butt-welded electrically to the tube wall so as to make a good heat conducting joint. With this arrangement each rod acts as an individual heat conductor to the fluid flowing through the tube and further that the several rods can expand and contract independently of one another without transmitting any additive stresses to the tube wall.

Fig. 3 illustrates an alternative embodiment of the invention wherein each heat conducting element 10^a is provided at its opposite sides with a double row of rods 16^a. The rods 16^a as shown in Fig. 3 may be arranged in staggered relationship. The tubes will be connected with headers 12 and 14 as in Fig. 1. In this embodiment of the invention we have illustrated an outer layer of heat insulating material 18 which may come about flush with the center of the outer row of rods as shown by the dotted line. The rods 16^a as shown in detail in Fig. 4, may be either staggered or arranged in pairs which line up with one another.

Fig. 5 illustrates a modified form of heat conducting element wherein the rods 16^b are square in cross section and are twisted, these being butt welded to the tube.

Figs. 6 to 8 show a further modification wherein the tube 10^c has welded to diametrically opposite sides thereof a plurality of stampings which are tapered from the point where they join the tube to their outer ends. One of these stampings is illustrated at 20 in Fig. 7. Before welding it is usually rounded on the end as indicated at 22 so as to give a restricted area to facilitate the electric welding operation. The outer end as indicated at 24 is much narrower than the end 22.

Fig. 9 shows a horizontal section wherein a number of tubes 10^d are connected with suitable headers indicated at 24, the several tubes being arranged in staggered relationship with one another and each tube being provided with a plurality of radial rows of rods as indicated at 26.

Instead of the arrangement shown in Fig. 9, in some cases, we may use stampings like that of Fig. 7 arranged in radial arrangement as indicated by the members 20^a shown as welded to the tube 10^c in Fig. 10.

Fig. 11 illustrates a slight modification of Fig. 10 wherein the tube 10^f is provided with a multiplicity of stampings 20^b. As here shown, the stampings in one plane are staggered with respect to those in plane next below.

Fig. 12 is a view similar to Fig. 9 illustrating a plurality of tubes 10^g arranged in staggered relationship and communicating with common header 24^a. Radial extensions 28 are welded to the several tubes. As shown in Fig. 13 these extension members are in the form of rods which have been flattened as indicated at 30 so as to dispose relatively wide surfaces 30 in a horizontal plane. The shank portions 32, of the members 28 are of cylindrical or rod-like form and are welded electrically to the wall of the tube, as shown in Fig. 13.

Instead of disposing the flat surfaces 30 in a horizontal plane they may be disposed in a vertical plane as shown in Fig. 14. The arrangement of Fig. 14 will substantially close the spaces between adjacent members 28 as shown and when the ends of adjacent members 28 come into substantial abutment, as shown at 34 in Fig. 12, the members 28 will in effect form a substantially closed wall.

The heat conducting element of our invention can be used to advantage in boiler wall and economizer construction. In such structures the tubes will usually be of great length. By providing rod-like extensions in rows extending lengthwise of the tubes, each rod is free to expand and contract individually. Hence there will be no additive effect tending to elongate or shorten the tube due to temperature changes. Moreover, the rod-like extensions, unlike ribs or flanges, are free to move in universal directions relatively to the tube under influence of expansion or contraction. This freedom minimizes the transmission of stresses to the tube wall. The rods may be of ordinary rolled steel stock cut to suitable length. Such rods can be conveniently handled in an electric welding machine and an extremely tight joint can be secured between the tube and the end of the rod. It is important to secure a good heat conducting joint and such a joint is readily secured by electrically welding the extensions to the tube walls.

For use in the vertical water walls of the Murray type of boilers, as in Figs. 1 and 3, the extension members are in two groups, single line groups in Fig. 1 and double line groups in Fig. 3. These groups are opposite to each other and are separated from each other by approximately half the circumference of the tube so that when erected, as shown, they will extend into the spaces between the parallel tubes and provide lateral extensions of the heating surface to cover practically the entire projected area of the wall. For such use, extensions on the intermediate portions of the circumference of the tubes would add nothing to the projected area exposed to the radiant heat of the fire, and it is preferable to leave these portions of the circumference bare, leaving a minimum thickness of metal (the wall of the tube) through which the heat is transmitted to the water or other liquid within the tubes.

The length of the welded joint parallel to the axis of the tube is so short as to avoid transmitting destructive heat-distortion strains to the tube at the point of connection.

The tube of Fig. 2 has an outside diameter of 4 inches and a wall thickness of about ¼ of an inch and the length of the welded joint is about ¼ of an inch. For such tubes the length of the joint should not be over 1 inch, and for the largest tubes used in this class of work the length should not be more than 2 inches; that is to say, as a general rule, the length should be less than four times the wall thickness of the tube.

The extension members should be spaced close to each other to secure the maximum absorption of heat and transmission thereof to the tubes. For this purpose the space between the bases of these members should, for maximum effectiveness, be not much more than the length of the welded joint.

The length of the extension members is limited by their conductivity and their resistance to heat. Except for the cooling effect of the water or other liquid within the tube, the ends of the extension members would burn off rapidly. Their length should be within a limit at which the cooling and heating forces are balanced. If made longer they would soon be shortened by burning off. If made shorter we would not secure the maximum effectiveness in catching and transmitting heat to the tubes.

In boiler installations experience has shown that they should project from the tube a distance somewhat less than the diameter of the latter.

In a previous application of Thomas E. Murray, Ser. No. 550,903, filed July 15, 1931, there is described and claimed a tubular unit having projecting members welded to a tube, these members being in the form of flat plates with their welded edges of substantially the full length of the plate and of a thickness which is only a fraction of their length. The present application refers specifically to an improved form of welded projection of which the length (that is, the direction parallel to the length of the tube) of the welded end is reduced to about equal its thickness or less; being circular as in Figs. 1 to 4 and 12 to 14 or rectangular as in the other figures. A better heat-conducting joint can be made with this shape of the joint end. Also these joints, of the minimum feasible length, put less strain on the wall of the tube in the making of the joints. It has been found that the welding of the projections to the tubes sets up very serious contractile stresses in the tube wall which are liable to rupture it under the strains of use, and that such stresses are diminished by the localizing of the joints to as small a portion of the length of the tube as practicable.

While we have described quite specifically certain details of construction in the various embodiments of the invention herein illustrated it is not to be construed that we are limited thereto since various modifications may be made by those skilled in the art without departing from the invention as defined in the appended claims.

What we claim is:

1. A tubular unit of the character described adapted to be exposed externally to high temperatures and to carry a liquid to be heated, consisting of a long steel tube of small diameter compared to its length and of small wall thickness compared to its diameter and a plurality of heat-conducting extension members welded to

the outside of the tube and adapted to transmit heat to the tube and thence to the liquid within, said extension members being in two groups separated from each other by approximately half the circumference of the tube, the circumference being bare between said groups and each member having its welded end of a length about equal to its thickness.

2. A tubular unit of the character described adapted to be exposed externally to high temperatures and to carry a liquid to be heated, consisting of a long steel tube of small diameter compared to its length and of small wall thickness compared to its diameter and a plurality of heat-conducting extension members welded to the outside of the tube and adapted to transmit heat to the tube and thence to the liquid within, said extension members being in two groups separated from each other by approximately half the circumference of the tube, the circumference being bare between said groups and each member having its welded end of a length about equal to its thickness and its outer portion in the form of a flat comparatively thin plate.

3. A tubular unit of the character described adapted to be exposed externally to high temperatures and to carry a liquid to be heated, consisting of a long steel tube of small diameter compared to its length and of small wall thickness compared to its diameter and a plurality of heat-conducting extension members welded to the outside of the tube and adapted to transmit heat to the tube and thence to the liquid within, said extension members having welded ends of a length about equal to their thickness and having outer portions in the form of flat comparatively thin plates.

4. A tubular unit of the character described adapted to be exposed externally to high temperatures and to carry a liquid to be heated, consisting of a long steel tube of small diameter compared to its length and of small wall thickness compared to its diameter and a plurality of heat-conducting extension members welded to the outside of the tube and adapted to transmit heat to the tube and thence to the liquid within, said extension members having welded ends of a length about equal to their thickness and having outer portions in the form of flat comparatively thin plates which extend in the general direction of the length of the tube.

5. A tubular unit of the character described adapted to be exposed externally to high temperatures and to carry a liquid to be heated, consisting of a long steel tube of small diameter compared to its length and of small wall thickness compared to its diameter and a plurality of heat-conducting extension members welded to the outside of the tube and adapted to transmit heat to the tube and thence to the liquid within, said extension members having comparatively broad outer ends and comparatively narrow inner ends welded to the tube.

6. A unit constituting part of a water tube boiler, said unit adapted to be exposed externally to high temperatures and to carry water to be vaporized and consisting of a long steel tube of the order of four inches diameter and of small wall thickness compared to its diameter and a plurality of heat-conducting extension members welded to the outside of the tube and adapted to transmit heat to the tube and thence to the water within, said extension members comprising substantially straight rods having their welded ends of a length about equal to their thickness and being spaced apart along the length of the tube by distances about equal to the length of the welded joints, each of said rods being welded at one end to the tube and free at the other end so that it may expand endwise without strain on the tube and so that it ensures a minimum transmission of stresses between the rods and the tube.

THOMAS E. MURRAY.
JOHN H. LAWRENCE.