March 25, 1941. T. E. MURRAY, JR 2,236,186

HEAT EXCHANGER

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Fig. 1.

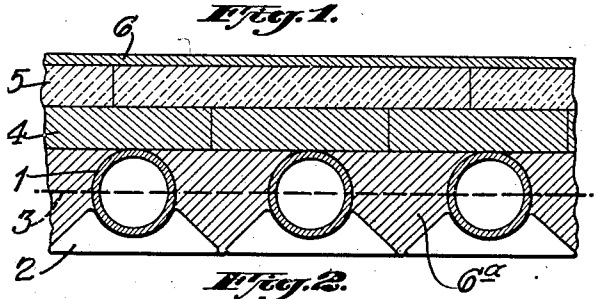


Fig. 2.

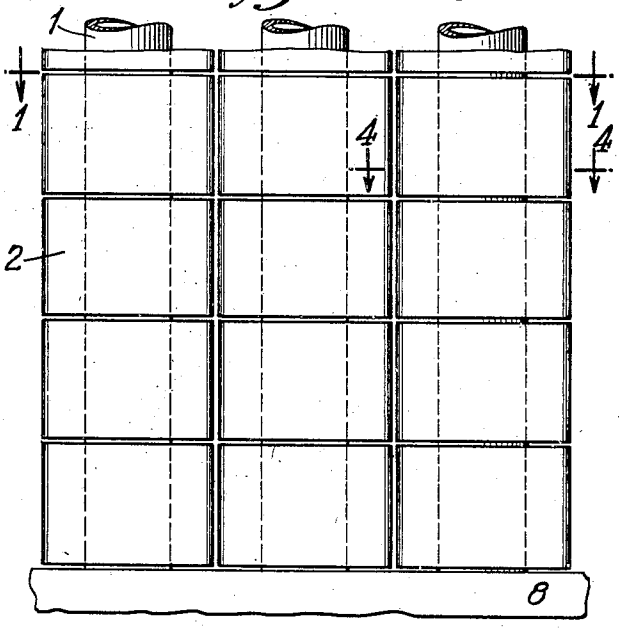


Fig. 3.

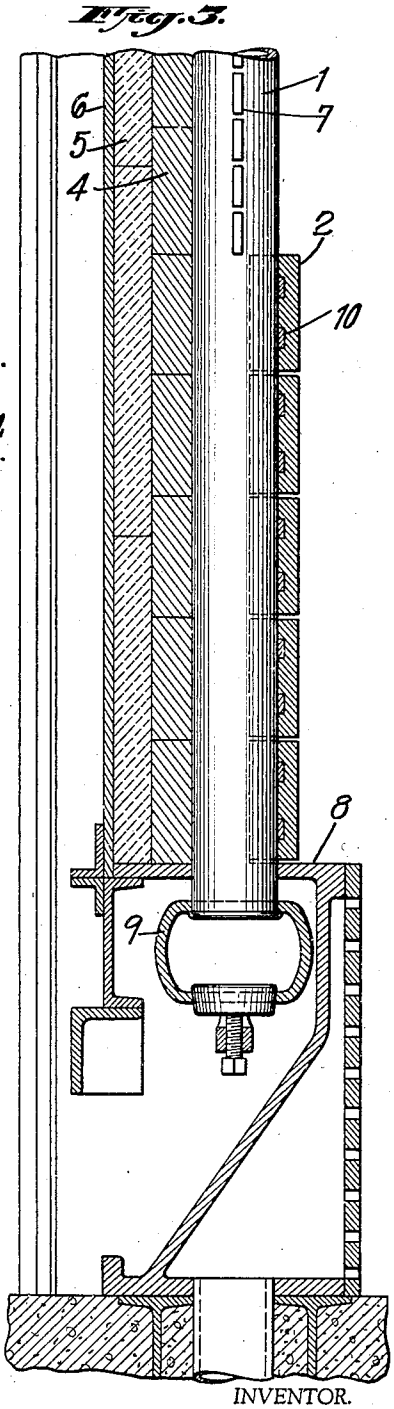


Fig. 4.

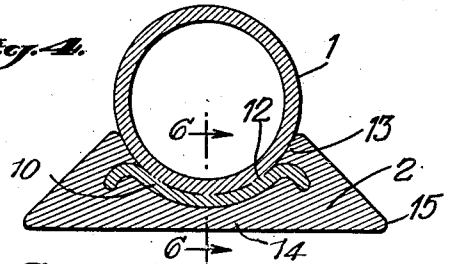


Fig. 6.

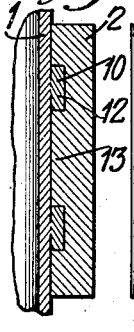


Fig. 5.

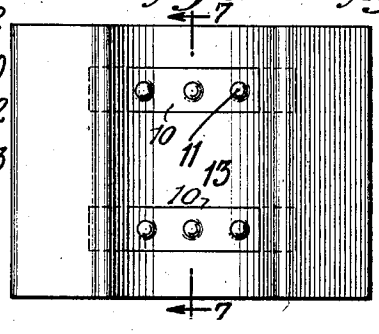
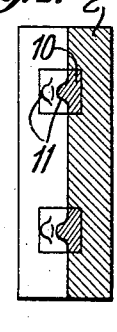


Fig. 7.



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Fig. 8.

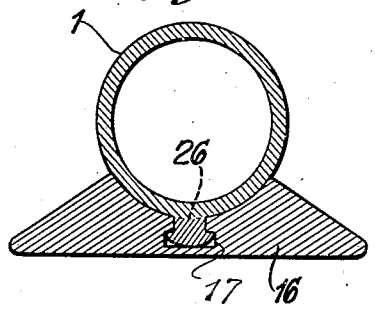


Fig. 11.

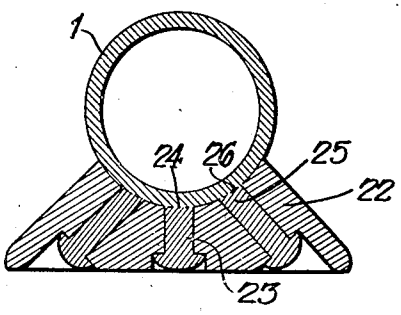


Fig. 9.

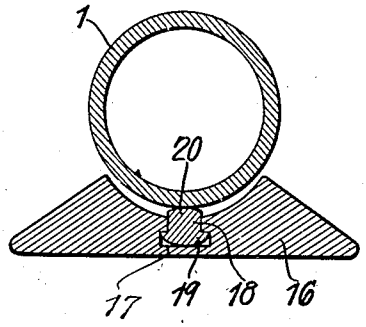


Fig. 12.

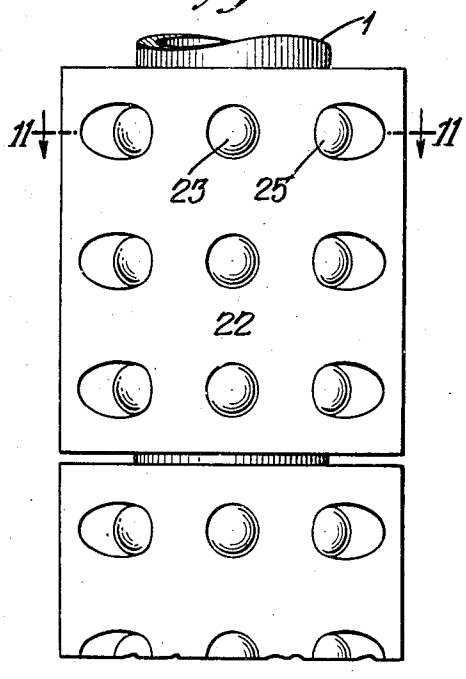
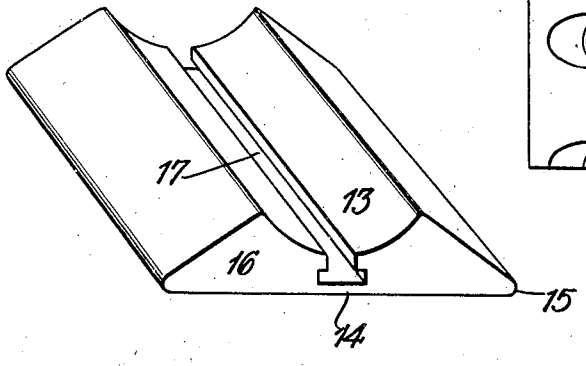


Fig. 10.



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Fig. 13.

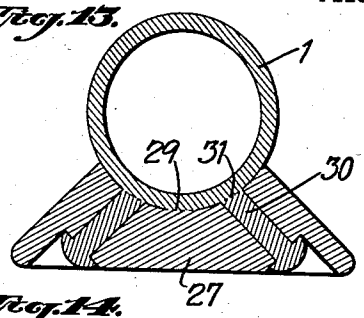


Fig. 16.

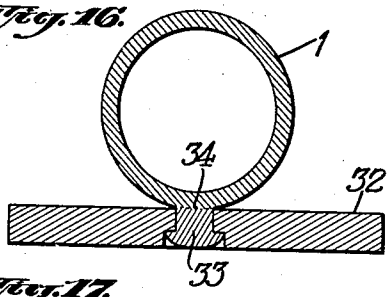


Fig. 14.

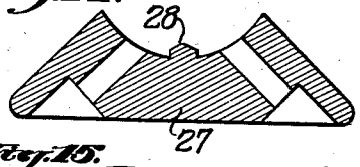


Fig. 17.

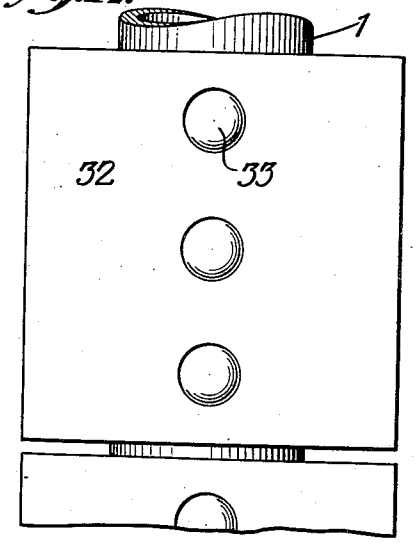


Fig. 15.

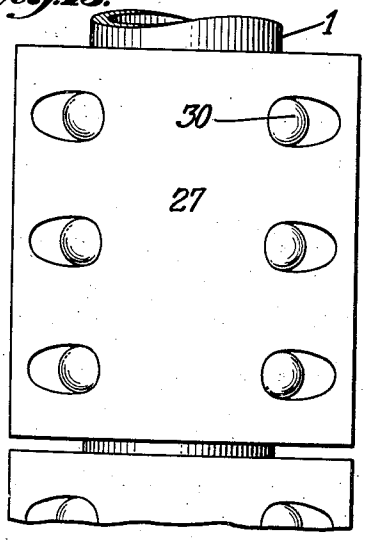
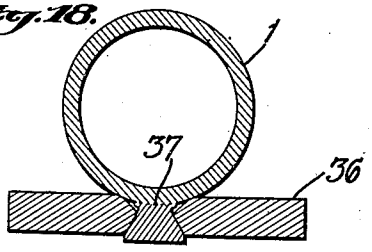


Fig. 18.



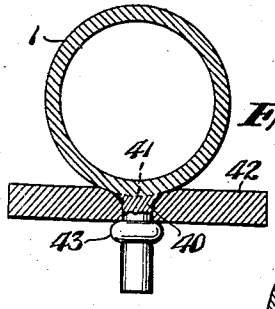
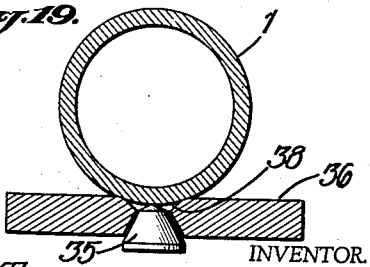


Fig. 20

Fig. 19.



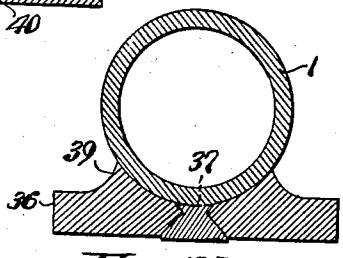


Fig. 18a

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Patented Mar. 25, 1941

2,236,186

UNITED STATES PATENT OFFICE

2,236,186

HEAT EXCHANGER

Thomas E. Murray, Jr., Brooklyn, N. Y.

Application February 20, 1937, Serial No. 126,761

17 Claims. (Cl. 122—6)

In a Murray Patent No. 2,029,437 granted February 4, 1936, there is described a wall for boilers or heaters and a tubular unit adapted to be used therein; similar walls and tubular units therefor being described also in other patents of Murray, and others.

The present invention is directed to certain improvements in such boiler walls and similar heat exchangers and in tubular units therefor.

The accompanying drawings illustrate embodiments of the invention.

Figs. 1 and 2 are respectively a horizontal section (on the line 1—1 of Fig. 2), and an elevation of the lower end of a portion of a water wall; Fig. 3 is a longitudinal transverse section of such a wall; Fig. 4 is a cross-section of one of the tubular units on the line 4—4 of Fig. 2; Figs. 5, 6 and 7 are respectively a rear face elevation of one of the projection pieces, a section on the line 6—6 of Fig. 4, and a section on the line 7—7 of Fig. 5; Figs. 8 and 9 are cross-sections of an alternative scheme after and before welding respectively, and Fig. 10 a perspective view of one of the projection pieces; Figs. 11 and 12 are respectively a horizontal section on the line 11—11, Fig. 12, and a front elevation of part of an alternative arrangement; Figs. 13, 14 and 15 refer to another alternative; Fig. 13 being a section after production, Fig. 14 a section of one of the cast blocks and Fig. 15 a front elevation of part of a completed unit; Figs. 16 and 17 are respectively a horizontal section and a front elevation of part of another unit embodying the invention; Fig. 18 is a cross-section after welding and Fig. 19 a cross-section before welding, illustrating still another type; Fig. 18a is a modification of Fig. 18; Fig. 20 is a cross-section illustrating still another type.

Referring first to Figs. 1 to 7, the boiler wall is made with an inner lining or screen comprising tubes 1 with projection-pieces 2 on their front faces; that is, the faces exposed to the fire. These projection-pieces increase the effective thickness of the tubes on the front or fire side. Preferably the tubes are spaced apart and the projection-pieces 2 extend laterally over the whole or a great portion of the width of the spaces between the tubes; thus protecting the outer portion of the wall from the heat of the fire and also providing an increased projected area (compared with the diameters of the tubes) exposed to the fire so as to absorb the heat thereof and transmit it to the water or steam within the tubes. The tubes are connected into the circulation of the boiler so as to utilize the heat in the rapid generation of steam, or in superheating steam or in economizers and other accessories. Such tubes are useful in various other heat exchange apparatus, though particularly designed for water walls of this type.

The center line or plane of the tubes is indicated in the dotted line 3, Fig. 1. The projection-pieces are preferably located in front of the center line and are applied by fasteners hereinafter described which are welded to the tubes also at the front. Thus we avoid cumbering the rear parts of the tubes with means such as have been used heretofore for supporting auxiliary blocks.

Outside of the wall or screen formed by the water tubes described most boilers are provided with a structure of refractory material such as is illustrated in Figs. 1 and 3 comprising refractory blocks or bricks 4 outside of which are tiles 5 of non-conducting material and an outer shell 6 of sheet metal. Generally it is preferred to use also a plastic filling 6a between the tubes to prevent the passage of hot gases into this space; and thus to retard the burning away of the edges of the blocks 2.

The projection-pieces may be applied throughout the exposed lengths of the tubes or may be limited to any special portions thereof. In Fig. 3, for example, the tubes 1 are provided, from their upper end downward for the greater portion of their length, with flanges or fins 7 overlying the spaces between them, and only over the lower portion of the wall are the tubes protected by blocks 2 which serve both to bridge the spaces between the tubes and also to protect the faces of the tubes. This construction is adapted to grate fired furnaces and any others in which the heat might be greatest in the lower part of the combustion chamber.

The tubes in Fig. 3 are supported from their upper ends. Their lower ends pass freely into a portion 8 of the casing and are connected into a bottom header 9; other features of this construction being illustrated in Murray Patent No. 1,953,768 granted April 3, 1934.

The tubes are made of the ordinary three or four inch diameter boiler tubing, generally seamless but not necessarily so. In any case they are made of worked steel, that is steel which has been rolled or drawn. The blocks 2 may be of various materials. Cast steel (including iron and its other alloys) is best adapted for the purpose. The uniting of the cast metal to the tube with a good heat conducting union presents difficulties however. If it be cast thereon, it melts away part of the wall of the tube which is depended on chiefly for strength to resist the steam pressure. It cannot well be electrically

welded because of the different heat characteristics of the two kinds of metal and the necessity of using welding conditions which are better for one metal than for the other. Blocks fastened on mechanically cease to make first-class contact with the tubes after the wall has been in use for a time owing to the warping of the parts under high temperature.

Instead of blocks of cast metal, there may be used blocks or plates of common refractories which do not have the heat conducting property of metals but which are useful in that they permit the maintenance of a very hot fire, being themselves protected by the cooling effect of the water from too rapid destruction.

The blocks of the present invention are provided with fasteners of worked steel which being substantially the same as that of the tubes achieves a practically perfect welded union therewith and holds the blocks of cast metal or refractory in close and good heat conducting contact with the tubes. The use of blocks of short length closely spaced serves to constitute in effect a continuous line of cast metal; while allowing for considerable distortion under heat without any such cumulative effect as would occur with long flanges or blocks.

According to Figs. 1 to 7, the blocks 2 are of cast iron or malleable iron. Imbedded in each block are strips 10 of rolled steel of a composition similar to that of the tubes 1. The strips have bent ends and the blocks are cast on them in the position shown so that the latter are firmly fastened. The exposed portion of each strip is provided with projections 11. The blocks and tube are then placed together, an electric welding current is applied and the parts pressed into engagement resulting in resistance or projection welds as indicated at 12, Fig. 4.

Each block has a cylindrical inner face 13 which fits closely the outer face of the tube. This contact extends over as much of the front half of the tube as is required for efficiency in conducting the heat of the fire to the tube. The welding brings the face 13 in close contact throughout its extent. The thickness of the block at the front 14 provides protection for the tube. Its extending wings 15 nearly bridge the spaces between the tubes in the finished wall, leaving only a little clearance under the expansion and contraction which take place in use. Thus they seize practically all the heat units available and at the same time shield the structure at the rear.

Figs. 8 and 9 illustrate another method of production. The block 16 is similar in external shape to the block 2 of the previous figures. It is provided along the center of its inner face with a T-slot 17 open from end to end. Into this are forced rivets 18, Fig. 9, which have heads 19 engaged in the slot and projecting rounded ends 20. When the parts are pressed together as in Fig. 8 and a proper electric current passed through them, the ends of the rivets 18 are welded along the line 21 to the tube so as to hold the block firmly thereto.

The rivets of Fig. 9 may be cast in position in the block 16 instead of being fastened therein mechanically.

According to Figs. 11 and 12, a block 22 of practically the same outer configuration is used. But it is provided with three lines of rivet holes extending radially clear through its thickness. In welding the block to the tube, the center line of rivets 23 is first forced against the tube and the current applied so as to form welds 24. This holds the parts firmly in place with good contact. For further security the two side lines of rivets 25 are then pressed radially against the tube and the current passed to form welded joints 26. It is desirable that the pressure used in riveting be radial and is, therefore, easier to first apply the center line of rivets and then the two side lines. The product in this case does not present a perfectly flat face of cast steel to the fire as in the designs of Figs. 1 to 10; but its projected area is the same as in those other figures.

According to Figs. 13 to 15, the block 27 is cast on its inner face with small projections 28 which are first welded as indicated at 29 and thus hold the parts firmly together while two lines of rivets 30 at the sides are forced radially against the tube to form welds 31.

The blocks of the designs above described may be of common non-metallic refractories as stated above. But where the invention is applied to such refractories they may be made in simpler shapes, as hereinafter described. These simpler shapes may be used also for cast steel and the like. The chief purpose in these cases is to form a fire resistance shield over the wall which protects the tubes while permitting the use of a very hot fire.

In Figs. 16 and 17 refractory blocks 32 are illustrated which are of flat rectangular shape and are fastened along their middle lines to the tube by rivets 33 welded to the tube as at 34.

According to Figs. 18 and 19, conical steel pins or rivets 35 are used in practically the same way in order to press a block or plate 36 against the tube, and is welded to the tube at 37. The block 36 is countersunk as at 38 to allow a greater degree of contact with the tube than in the case of Fig. 16, at the same time allowing space for the extrusion of the end of the pin in welding. Where these blocks are made of cast iron instead of non-metallic refractories, they are usually shaped to provide a greater contact with the tube as indicated, for example, at 39, Fig. 18a.

Fig. 20 illustrates another method. Straight pins 40 are united by end welds 41 to the tube. A cast iron or non-metallic refractory block 42 is provided with openings by which it is forced over the ends of the pins and into contact with the tube. The pins are then upset as at 43 by pressure which forces the parts closely together. The outer ends of the pins may be removed, or forced into countersunk openings in the blocks if desired to form a smooth face.

Various other modifications may be made by those skilled in the art as defined in the following claims.

What I claim is:

1. A tubular unit of the character described comprising a tube, projection-pieces applied to one side of the tube and preformed fasteners welded to the tube and directly engaging the projection-pieces so arranged that the fasteners draw said blocks into pressure contact with said tube.

2. A tubular unit of the character described comprising a tube, projection-pieces applied to one side of the tube and preformed fasteners welded to the same side of the tube and so arranged that the fasteners draw the projection pieces into pressure contact with the tube.

3. A tubular unit of the character described comprising a tube, projection-pieces with a com-

paratively large cylindrical face engaging the tube and preformed fasteners engaging the projection-pieces and having comparatively small inner portions welded to the tube so arranged that the fasteners draw said blocks into pressure contact with said tube.

4. A tubular unit of the character described comprising a tube of worked metal and provided with blocks of cast metal on one side fastened individually and tightly thereon by preformed fasteners of worked metal welded to the tube on the same side and so arranged that the fasteners draw said blocks into pressure contact with said tube.

5. A tubular unit of the character described comprising a metal tube provided with blocks comprising non-metallic refractory material on one side fastened thereon by preformed fasteners welded to the tube on the same side so arranged that the fasteners draw said blocks into pressure contact with said tubes.

6. A boiler tube of worked metal having a covering block of cast metal, and a fastening piece of worked metal secured in said block and autogenously welded to said tube and so arranged that the fastening piece draws the block into pressure contact with the tube.

7. A boiler tube of worked metal having a covering block of cast material, an opening through said block, and a fastening piece of worked metal extending through said opening and autogenously welded to said tube so arranged that the fastening piece draws the block into pressure contact with the tube.

8. A heat exchanger of the character described comprising a wall of parallel tubes provided on one face of the wall with blocks serving to increase their effective thickness on that side and preformed fasteners for said blocks welded to the front of said tubes so arranged that the fasteners draw said blocks into pressure contact with said tubes.

9. A heat exchanger of the character described comprising a wall of parallel tubes spaced apart and provided on one face of the wall with blocks serving to increase the thickness of the tubes and extending over the spaces between the tubes and preformed fasteners for said blocks welded to the same face of the tubes so arranged that the fasteners draw said blocks into pressure contact with said tubes.

10. A heat exchanger of the character described comprising a wall of parallel tubes spaced apart and provided on one face of the wall with blocks serving to increase the thickness of the tubes and preformed fasteners for said blocks welded to the same face of the tubes so arranged that the fasteners draw said blocks into pressure contact with said tubes, said blocks being of short length and so closely spaced as to constitute in effect a continuous line of blocks fastened to the tube.

11. A water wall for boiler furnaces comprising upright tubes connected into the circulation of the boiler and provided on the front with blocks serving to increase their effective thickness on that side and preformed fasteners for said blocks welded to the front of said tubes so arranged that the fasteners draw said blocks into pressure contact with said tubes.

12. A water wall for boiler furnaces comprising upright tubes connected into the circulation of the boiler and provided on the front with blocks serving to increase their effective thickness on that side and preformed fasteners for said blocks welded to the front of said tubes so arranged that the fasteners draw said blocks into pressure contact with said tubes, said tubes being spaced apart and said blocks having greater width than the tubes so as to extend over the spaces between them.

13. A water wall for boiler furnaces comprising upright tubes connected into the circulation of the boiler and provided on the front with blocks serving to increase their effective thickness on that side and preformed fasteners for said blocks welded to the front of said tubes so arranged that the fasteners draw said blocks into pressure contact with said tubes, said blocks being of short length and so closely spaced as to constitute in effect a continuous line of blocks fastened to the tubes.

14. A water wall for boiler furnaces comprising upright tubes connected into the circulation of the boiler and provided on the front with blocks serving to increase their effective thickness on that side and preformed fasteners for said blocks welded to the front of said tubes so arranged that the fasteners draw said blocks into pressure contact with said tubes, substantially the entire thickness of the blocks being located in front of the centers of the tubes.

15. A water wall for boiler furnaces comprising upright tubes connected into the circulation of the boiler and provided on the front with blocks serving to increase their effective thickness on that side and preformed fasteners for said blocks engaging them at points in front of the centers of the tubes so arranged that the fasteners draw said blocks into pressure contact with said tubes.

16. A water wall for boiler furnaces comprising upright tubes of worked metal connected into the circulation of the boiler and provided on the front with blocks of cast metal serving to increase their effective thickness on that side and preformed fasteners for said blocks welded to the front of said tubes so arranged that the fasteners draw said blocks into pressure contact with said tubes.

17. A water wall for boiler furnaces comprising upright metal tubes connected into the circulation of the boiler and provided on the front with blocks comprising non-metallic refractory material serving to increase their effective thickness on that side and preformed fasteners for said blocks welded to the front of said tubes so arranged that the fasteners draw said blocks into pressure contact with said tubes.

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