Aug. 15, 1933. T. E. MURRAY 1,922,599

BOILER CONSTRUCTION

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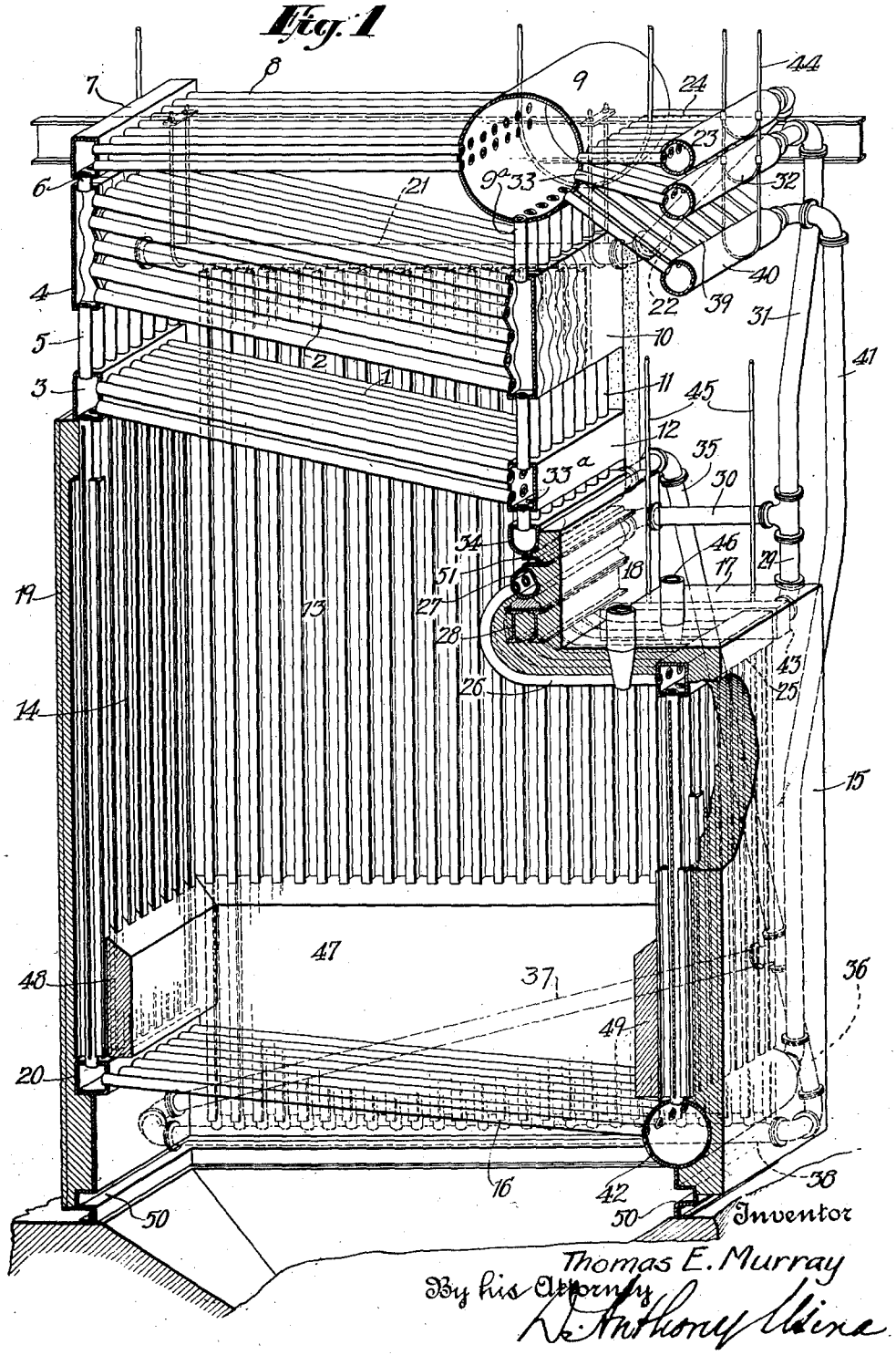
Fig. 1



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BOILER CONSTRUCTION

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Fig. 2.

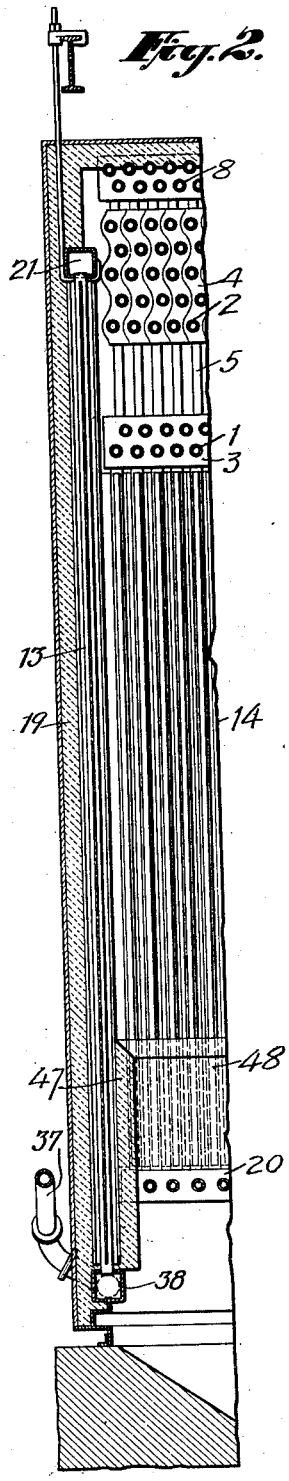


Fig. 3.

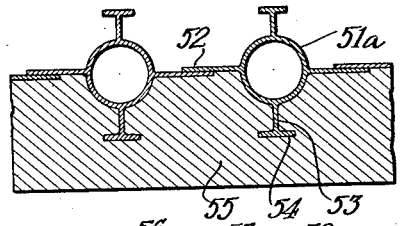


Fig. 4.

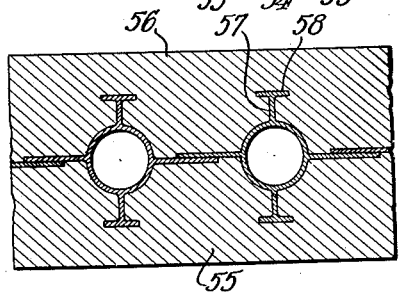


Fig. 5.

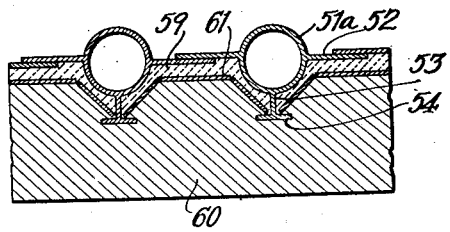


Fig. 6.

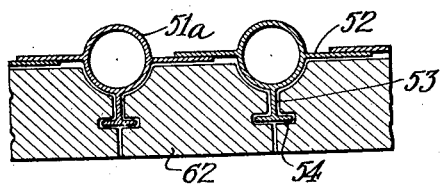


Fig. 7.

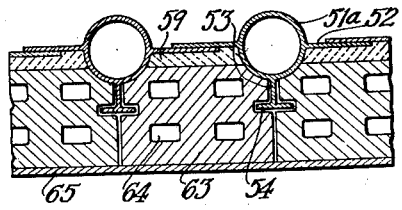
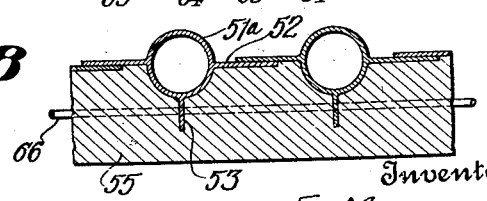


Fig. 8



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BOILER CONSTRUCTION

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Fig. 9.

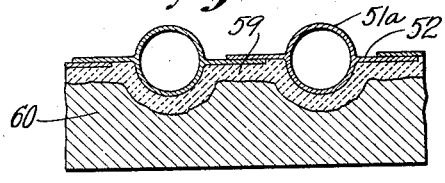


Fig. 14.

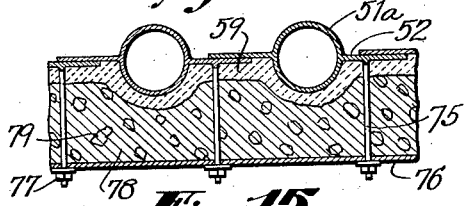


Fig. 10.

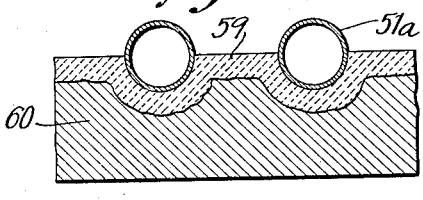


Fig. 15.

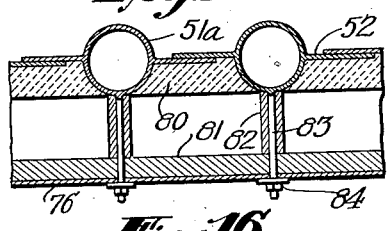


Fig. 11

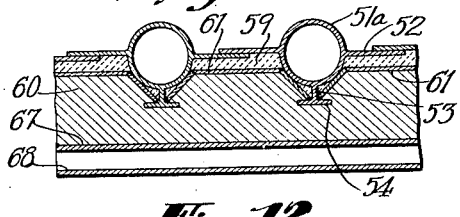


Fig. 16.

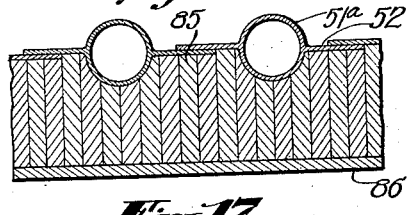


Fig. 12.

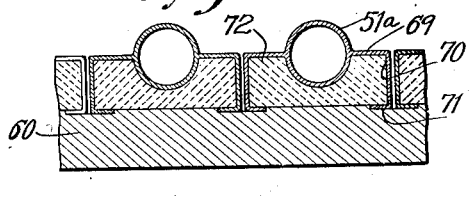


Fig. 17.

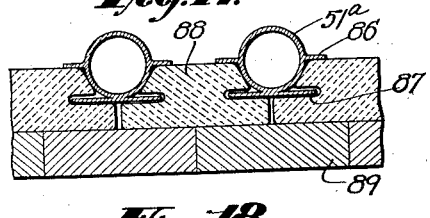


Fig. 13.

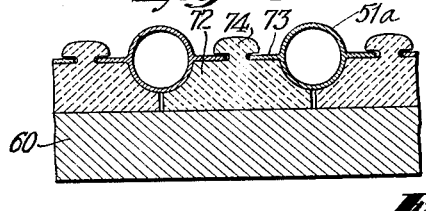


Fig. 18.

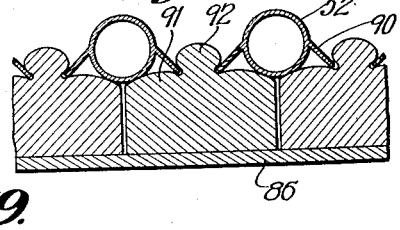
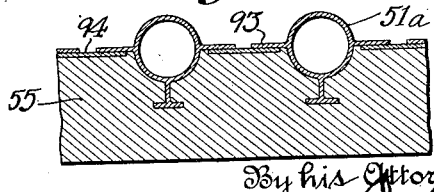


Fig. 19.



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BOILER CONSTRUCTION

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Fig. 20.

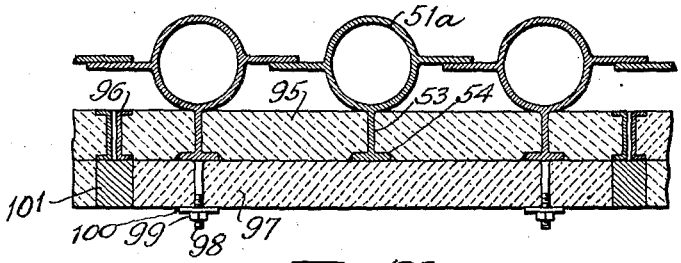
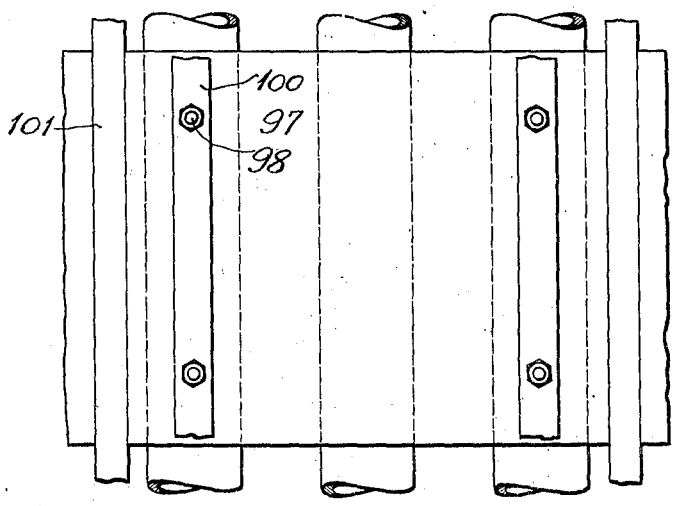


Fig. 21.



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BOILER CONSTRUCTION

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Fig. 23.

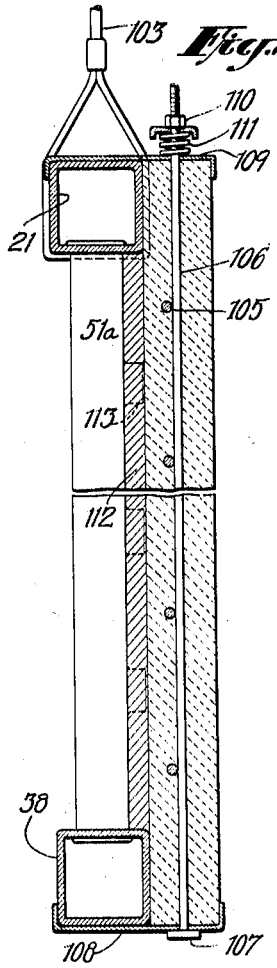


Fig. 22.

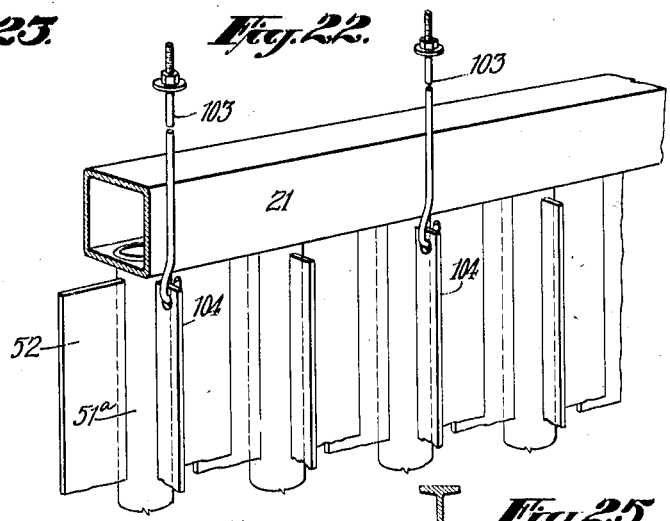


Fig. 24.

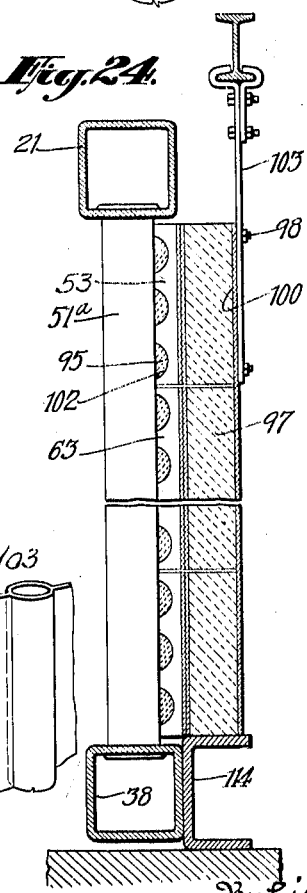


Fig. 25.

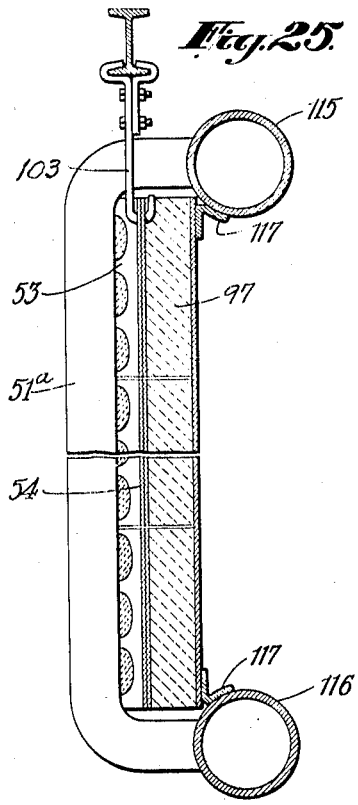
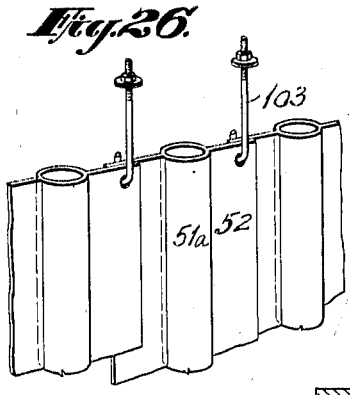


Fig. 26.



Inventor

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Patented Aug. 15, 1933 1,922,599

UNITED STATES PATENT OFFICE

1,922,599

BOILER CONSTRUCTION

Thomas E. Murray, Brooklyn, N. Y.; Joseph Bradley Murray, Thomas E. Murray, Jr., and John F. Murray, administrators of said Thomas E. Murray, deceased, assignors to Metropolitan Engineering Company, a Corporation of New York

Application October 9, 1925. Serial No. 61,387

18 Claims. (Cl. 122—235)

In a previous application, No. 678,443, filed December 4, 1923, I have described a boiler having a furnace with a tubular water wall, on the outside of which is a wall of refractory material; the latter supported at its lower end and the water wall supported at its upper end, and free to expand downward.

In another application, Ser. No. 61,386, filed Oct. 9, 1925, I have described a similar construction, in which, however, the tubes of the water wall and the refractory material are tied or bonded together.

In other applications Nos. 642,427, filed May 31, 1923 and 642,725, filed June 1, 1923, patented Feb. 11, 1930, Patent No. 1,746,711, I have described other constructions employing walls comprising or composed of water tubes, generally spaced apart with overlapping flanges between them.

The present application is directed to a boiler of the same general class with certain improvements in the method of constructing and supporting the walls, and in other features referred to hereinafter.

The accompanying drawings illustrate embodiments of the invention.

Fig. 1 is a vertical longitudinal sectional view in perspective of the principal parts of the boiler;

Fig. 2 is a vertical section of one of the side walls;

Figs. 3 to 20 respectively are horizontal sections illustrating different methods of bonding the water tubes with the refractory material;

Fig. 21 is a face elevation of part of the wall of Fig. 20;

Fig. 22 is a perspective detail of a method of supporting the wall;

Figs. 23, 24 and 25 are vertical sections of alternative methods of support.

Fig. 26 is a perspective detail of another alternative.

Referring first to Figs. 1 and 2, there are carried above the combustion chamber approximately horizontal tubes of the ordinary style in two banks 1 and 2, slightly inclined downward at their forward ends. Headers 3 and 4 at their higher ends are connected by pipes 5 to each other and by pipes 6 to a header 7 which communicates through tubes 8 with a steam drum 9 at the front. The steam is taken off by any usual connections. The water passes down by pipes 9^a to headers 10 at the lower ends of one bank and thence by pipes 11 into headers 12 at the lower end of the next bank; thus maintaining circulation in the usual way.

In addition to the tubular system described above the furnace, the several walls of the furnace, that is, side walls 13, rear and front end walls 14 and 15 and the bottom wall 16 comprise a series of water tubes. Those of the side and end walls are arranged vertically and those of the bottom wall horizontally or slightly inclined so as to aid circulation. The front wall has its lower portion offset and connected by a roof or arch 17 with an upper portion 18. The furnace walls described comprise also refractory material indicated generally at 19 and described in detail hereinafter. The refractory material extends to the tops of the tubes which surround the furnace or combustion chamber. The horizontal tubes and headers above the combustion chamber may be left unprotected on the outside as illustrated, or may be covered in various known or suitable ways.

The circulating connections for the lower set of tubes are the following. The bottom tubes 16 at their higher ends communicate with a header 20 which communicates with the lower ends of the tubes in the rear end wall 14, the latter leading at their upper ends into the header 3. The tubes of the side walls 13 enter a header 21 at their upper ends, one header for each side, and these headers at their front ends are connected by upwardly inclined pipes 22 to the ends of a drum 23 from which the wet steam is carried by tubes 24 to the main steam drum 9. The tubes of the front wall 15 lead at their upper ends into a header 25 which leads into horizontal tubes 26 forming the underface of the arch 17 and which are bent around at their inner ends and lead into a header 27 which is supported on a girder 28 extending across the lower part of the wall 18. The header 25 is connected at its opposite ends to pipes 29 and the header 27 to pipes 30, and these two pipes at each side lead by a pipe 31 to a drum 32 which communicates by tubes 33 with the steam drum 9. Thus the wet steam from all the lower series of tubes is carried to the main drum 9.

The return of the water to these tubes is through the following connections. The header 12 leads by way of tubes 33^a to a mud drum or header 34 to the ends of which are connected outlet pipes 35; each pipe 35 has branches 36 and 37 leading to the ends of a header 38 which communicates with the lower ends of the tubes of one of the side walls 13. The arrangement shown in Fig. 1 is repeated for the opposite side wall. Additional water from the steam drum passes down through tubes 39 to a drum or header 40. From

each end of this drum a pipe 41 leads down to an end of a drum 42 communicating with the lower ends of the vertical tubes of the front wall 15 and communicating also with the lower ends of the bottom set of inclined tubes 16. The front portion of each side wall is shortened by the offset arch 17. The upper ends of the tubes for this portion of the wall lead into a header 43 which is in communication with the header 25 and the pipes 29 at opposite sides.

The supplementary drums 23, 32 and 40 are outside of the boiler proper, and are supported by hangers 44 leading to girders or similar supports overhead. Similar hangers 45 carry the short side headers 43. And various other parts are carried by the other hangers illustrated or by other usual or suitable supporting means.

Powdered coal or other jet fuel is preferably used and is introduced through nozzles 46 extending downward through the arch 17 so as to cause the products of combustion to circulate throughout the combustion chamber before passing upward through the spaces between the horizontal tubes 1 and 2. The lower ends of the tubes for the side and end walls 13, 14 and 15 may be shielded by inner walls 47, 48 and 49 of refractory material, extending upward a short distance from their lower ends in order to avoid excessive cooling of the burning fuel.

The furnace walls each comprising tubes and refractory material tied thereto are supported from overhead as described in detail below so as to be practically curtain walls adapted to be expanded downward when heated. To close the furnace at the lower edges of these walls, I may use an expansion joint 50 comprising a strip of bent metal. A similar expansion joint 51 is used between the header 34 properly belonging to the upper structure and the header 27 of the lower structure. These joints constitute no part of the present invention, being more fully described and claimed in an application of Murray and Lawrence, Serial No. 72,456, filed Dec. 1, 1925. Patented April 7, 1931, Patent No. 1,799,633.

The tying of the tubes to the refractory material stiffens the latter against transverse or beam stresses, and the tying of these parts together may be by mechanically interlocking, by cementing them or by various other means. And while the invention is particularly useful with tubes having lateral fins, it is applicable also with plain tubes.

Various methods of tying or bonding the tubes with the refractory material of the walls are illustrated in Figs. 3 to 21, and several methods of supporting the walls from overhead are shown in Figs. 22 to 26. It will be understood that these are illustrative only, and the details may be of various other constructions.

Figs. 3 and 4 illustrate a construction which is covered in the previous application Ser. No. 61,386, filed Oct. 9, 1925, above referred to. In Fig. 3 the tubes 51ª are provided with lateral flanges 52 overlapping in the space between the tubes. Also fins or projections 53 are provided on the outer side of the tubes with flanges 54 on their edges locking the tubes firmly into the plastic refractory material 55 which is applied to the outside. Where a layer of plastic material 56 is to be located on the inside face of the wall also as in Fig. 4, this is applied so as to embed the fins or projections 57 with locking flanges 58.

It is preferred to provide a layer of very highly refractory insulating material immediately next to the tubes on their outer sides, and a second layer of less expensive and less highly refractory material outside of the first layer to the thickness desired for stiffening the wall and protecting the tubes. For example, Fig. 5 shows the tubes 51ª with overlapping flanges 52 and on their outer faces fins 53 with lateral flanges 54; in combination with a layer of high temperature insulation or cement 59 immediately back of the tubes, and an outer layer 60 of ordinary refractory material. Steel mesh or plates 61 are first applied as shown behind the tubes, and the two refractory insulating layers 59 and 60 built up on opposite sides of the plates. The complete construction is well locked together by the fins and flanges on the tubes.

Fig. 6 shows a construction similar to Fig. 3, except that the backing of refractory material is made of molded blocks 62 which fit the outer sides of the tubes and the flanges 54. Fig. 7 illustrates a construction similar to that of Fig. 5, except that the outer less refractory material is made of blocks 63 with air spaces 64 therein, and the outer face of the wall has a finish coat 65 plastered thereon.

According to Fig. 8, the fins 53 on the backs of the tubes are not flanged but are apertured and carry a rod 66 passing in succession through the several fins and embedded in the plastic material 55 so as to tie it to the tubes. This method may be applied with any of the various arrangements of the refractory materials.

According to Fig. 9, the tubes 51ª have only the lateral fins 52 which close the spaces between them. The highly refractory material 59 at the backs of the tubes is of a character to cement itself thereto and the outside layer 60 of less refractory material is cemented to the inner layer 59.

According to Fig. 10, the tubes 51ª are perfectly plain, and the refractory material 59 is exposed directly to the heat of the furnace between the tubes. It is cooled to some extent by contact with the tubes in which water is circulated, and is thus aided in withstanding the heat.

Fig. 11 illustrates a construction similar to that of Fig. 5, except that the outer layer of refractory material 60 is protected on its outer face by a pair of steel or asbestos plates 67 and 68 which are spaced apart to permit the circulation of air for better insulation. The air may also be thus pre-heated and used for combustion.

According to Fig. 12, the tubes 51ª have short lateral fins 69 with flanges 70 bent back from their edges, the latter being further bent inward at their edges to provide flanges 71. Thus a sort of box is provided for each tube, which encloses a body 72 of highly refractory material. The structure is backed by a layer of ordinary refractory material 60. Each of the units which comprises a tube with its flanges and refractory back is separate at its edges from the next unit, with a slight space between them as shown to permit lateral expansion.

Fig. 13 illustrates the use of blocks 72 of highly refractory material grooved on their front edges to receive the tubes 51 and on their front faces to receive the edges of the short fins 73. Thus the spaces between the tubes are closed partly by a projecting portion 74 of the highly refractory blocks and partly by the fins 73. This arrangement protects the edges of the fins which ordinarily are burned out most rapidly.

Fig. 14 illustrates another method of tying the parts together; that is, by means of rods 75 welded or riveted to the backs of the fins 52 and passing

through a steel plate or asbestos board 76 on the outer face of the wall, where the rods are threaded and held by nuts 77. This figure illustrates also a backing 78 of plastic refractory material such as fire-clay in which are embedded irregular pieces 79 of fire-brick.

According to Fig. 15 a hollow wall is provided consisting of an inner layer of blocks or plastic material 80 and an outer layer 81 spaced apart by hollow spacers 82 through which pass rods 83 welded at their inner ends to the tubes and fastened by nuts 84 on their outer ends.

According to Fig. 16 the wall is composed of thin deep blocks 85 cemented to the backs of the tubes and fins with a plate or coating 86 on the outside face.

In Fig. 17 the tubes 51ª are provided with short fins 86 at the sides and with parallel fins 87 welded at their outer sides. And the refractory material comprises blocks 88 grooved to fit the tubes and fins and exposed on their inner faces between the short fins 86; and faced on the outside by blocks 89.

In Fig. 18, the lateral fins 90 on the tubes are inclined backward so as to fit into grooves in blocks 91 which have projections 92 exposed on the inner face between the fins.

In Fig. 19 the tubes 51ª are provided with short flanges 93 extending only partly across the space between the tubes; and plates 94 are arranged back of these fins so as to bridge the space between them. The plastic material at the rear, 55, is the same as in Fig. 3; or it may be similar to that of various other constructions illustrated.

Instead of forming each tube with its backing tied thereto as a separate unit, we may include several tubes with their backing in a single unit as shown in Figs. 20 and 21. According to Fig. 20, three tubes 51ª are provided at the rear with fins 53 and flanges 54 as in Fig. 3. A block of highly refractory material 95 embeds the fins 53 and is locked by the flanges 54. The edges of the block are held in channels 96. Such a unit may be of the full height of the wall, or the plastic material may be made with horizontal joints at intervals. On the outside is a layer 97 which may be of less refractory material, tied in by bolts 98 projecting from the fins 53 at intervals and carrying nuts 99 on their outer ends bearing against vertical strips 100. The layer 97 is of less than the full width of the inside unit. The wall is built up by first erecting the tubes with the block 95 tied thereto, and then applying blocks 97 on the outside and fastening them by the nuts 99. The spaces between the outside blocks are finally closed by means of keys 101, which may be cemented in place. The fins 53 may have their entire inner edges welded to the tubes. Preferably however such edges are scalloped or cut away at intervals as at 102, Fig. 24, so that the plastic material 95 may pass between the fins and the tubes so as to be locked more firmly.

A great variety of refractory materials are available in either brick or plastic form. Fire brick and fire clay are the basis of the more refractory compositions, and ordinary clay of the less refractory; and mixtures are made commercially for use in situations requiring different properties.

Whatever construction of the wall be adopted, it is important that the supporting means overhead be connected to the tubes, either directly or through some intermediate metal part which is in turn connected to the tubes. And the supporting connection is at or near the upper portion of the wall in order to permit downward expansion.

Fig. 22 illustrates hangers 103 which may be attached to a girder or other structural member above, hooked at their lower ends into fins 104 on the rear faces of the tubes, which may be any of the fins or rearward projections shown in Figs. 3 to 20. The connection is made at the upper ends of the tubes directly below the points where they enter the header 21.

In Fig. 23 the hangers 103 are looped directly around the header 21. This figure illustrates also another method of tying the refractory material to the tubes. A block of refractory material is cast with embedded horizontal reinforcing rods 105 and vertical rods 106. The latter project beyond the edges of the block and have heads 107 at their lower ends engaging channels 108 which embrace the block and the lower header 38. At the upper edge the block and upper header are held in a similar channel 109 which is fastened down by nuts 110 on the vertical rods, bearing against washers which through springs 111 clamp the parts together. Preferably before applying the outside block of refractory material, an inside layer 112 is applied which may be keyed to the tubes by means of short fins 113 mounted on the latter at intervals in their length.

Figs. 24 and 25 illustrate methods of suspending a wall built in accordance with Figs. 20 and 21. According to Fig. 24, the ends of the tubes run straight into headers 21 and 38. The hangers 103 pass down on the outer face of the wall and are fastened to the strips 100 by means of the same rods or bolts 98 which fasten the parts of the wall together. A channel shaped yielding joint 114 at the bottom serves to prevent any outward lateral movement of the header 38 or the lower edge of the wall.

According to Fig. 25 the tubes 51ª are bent outward at their ends above and below the refractory material of the wall and are connected to a different type of headers 115 and 116. These headers have spacers 117 welded on them and bearing against the top and bottom edges of the structure. In this case it is more convenient to have the hangers 103 hook at their lower ends into the flanges 54 on the outwardly projecting fins.

Where it is desired to use fins with lateral flanges 52 only, as in Fig. 26, the hangers 103 may hook directly into said flanges.

Various modifications may be made by those skilled in the art without departing from the invention as defined in the following claims.

What I claim is:

1. A boiler wall comprising vertical water tubes and having an inner face exposed to the direct radiant heat of the flame in combination with a layer of highly refractory insulating material at the outer side of said tubes and a second layer of less highly refractory material outside of the first layer, means for tying the whole together and means for supporting the same from the top with freedom to expand downward.

2. A boiler wall comprising vertical water tubes and having an inner face exposed to the direct radiant heat of the flame, in combination with a layer of highly refractory insulating material at the outer side of said tubes and a second layer of molded refractory blocks outside of the first layer, means for tying the whole together and means for supporting the same from the top with freedom to expand downward.

3. A boiler wall comprising vertical water tubes and having an inner face exposed to the direct ra-

diant heat of the flame in combination with a layer of highly refractory insulating material at the outer side of said tubes and a second layer of less highly refractory material outside of the first layer, means for tying the whole together and means for supporting the same from the top with freedom to expand downward, the tubes being spaced apart and having metal extensions between them overlying the inner face of the layer of highly refractory material.

4. A boiler having a set of water tubes heated by a convection from the heating gases and having a furnace with a combustion chamber in advance of said tubes, a side wall of said furnace comprising a set of upright water tubes and refractory material tied thereto and substantially coextensive therewith and terminating at the upper ends of said upright tubes, said wall being supported from above and without substantial support at its lower end and being free to expand downward.

5. A boiler furnace wall comprising upright water tubes and refractory material tied to the inner and outer faces thereof, the outer layer of refractory material extending over substantially the full length of said tubes and the inner layer extending over only the lower portions of said tubes, said wall being supported from above and without substantial support at its lower end and being free to expand downward.

6. A boiler furnace wall comprising spaced upright tubes with metal extensions substantially closing the spaces between them and providing a structure exposed on its inner face to the direct radiant heat of the burning fuel and refractory material tied to the outer face of said structure, said wall being supported from above and without substantial support at its lower end so as to constitute a curtain wall free to expand downward.

7. In a boiler having overhead water tubes heated by convection from the heating gases and having a furnace with a combustion chamber below said tubes, a side wall of said furnace comprising a set of upright water tubes with refractory material tied thereto, said wall being supported from above independently of said overhead tubes and being without substantial support at its lower end and being free to expand downward.

8. In a furnace, an upright wall including an inner section composed of a row of upright tubes, a metallic sheathing carried by said tubes and spaced therefrom, a filling between the tubes and said metallic sheathing and carried therewith, and means outside the furnace from which said tubes are suspended.

9. In a boiler having overhead water tubes heated by convection from the heating gases and having a furnace with a combustion chamber below said tubes, a side wall of said furnace comprising a set of upright water tubes, a header from which said tubes depend, a support for said header, said header and its support being disposed outside of said combustion chamber, and heat-resistant material applied to said tubes and secured thereto, said wall being without substantial support at its lower end and free to expand downwardly.

10. In a furnace, an upright wall including an inner section composed of a row of upright tubes, a metallic sheathing outside of and spaced from said tubes, a filling between the tubes and said metallic sheathing and carried therewith, and means outside the furnace from which said tubes are suspended.

11. In a furnace, an upright wall including an inner section composed of a row of upright tubes, a metallic sheathing outside of and spaced from said tubes, a filling between the tubes and said metallic sheathing and carried therewith, and means outside the setting of the furnace from which said tubes are suspended.

12. In a boiler having overhead water tubes heated by convection from the heating gases and having a furnace with a combustion chamber below said tubes, a side wall of upright water tubes, a header from which said tubes, depend, a support for said header, said header and its support being disposed outside of said combustion chamber, and heat-resistant material applied to said tubes.

13. A boiler having a combustion chamber with a wall of upright water tubes, which are without substantial support at their lower ends so as to be free to expand downward, said tubes having metal extensions on the outside and hangers engaging said metal extensions and supporting said tubes.

14. A boiler having overhead water tubes heated by convection from the heating gases and having a furnace with a combustion chamber below said tubes, a side wall of said furnace comprising a set of upright water tubes and a refractory sheathing on the outside, said tubes having metal extensions on the outside from which they are supported and said outside sheathing being tied to the tubes.

15. In a furnace, an upright wall including an inner section composed of a row of upright tubes, a sheathing carried by said tubes and spaced therefrom, a filling between the tubes and said sheathing and carried therewith, and means outside the furnace from which said tubes are suspended.

16. A furnace wall structure comprising a water wall composed of a block of upright tubes and a covering carried by said tubes on the outside, and means outside of the furnace and not exposed to the heat therein from which the water wall is suspended with freedom to expand downward.

17. The furnace wall structure of claim 16, the water wall including also a header for said upright tubes, which header is located outside of the furnace and not exposed to the heat therein.

18. The furnace wall structure of claim 16, said water wall including top and bottom headers for said upright tubes both of which headers are outside of the furnace and not exposed to the heat therein.

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