

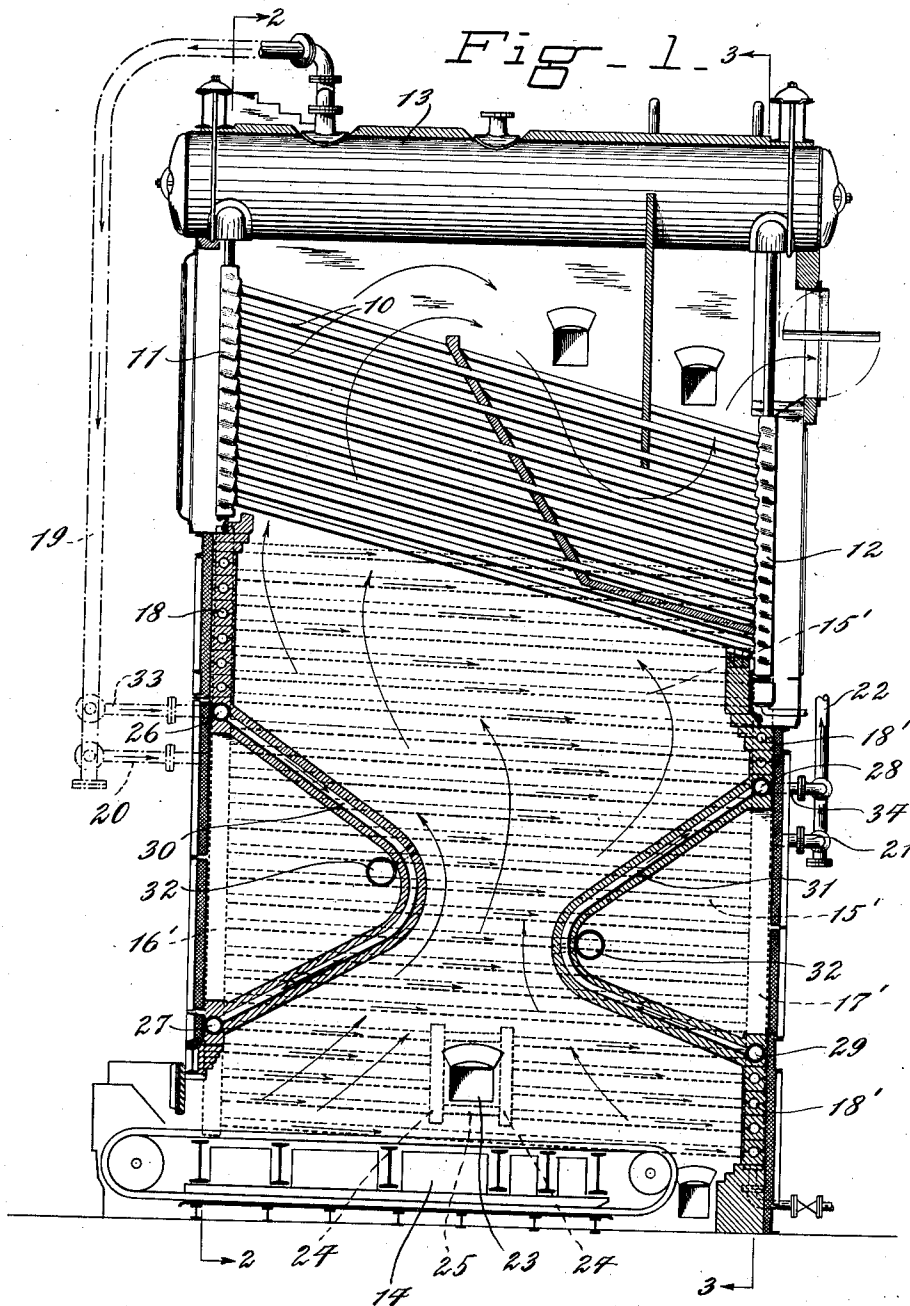
April 11, 1933.

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1,903,521

FURNACE

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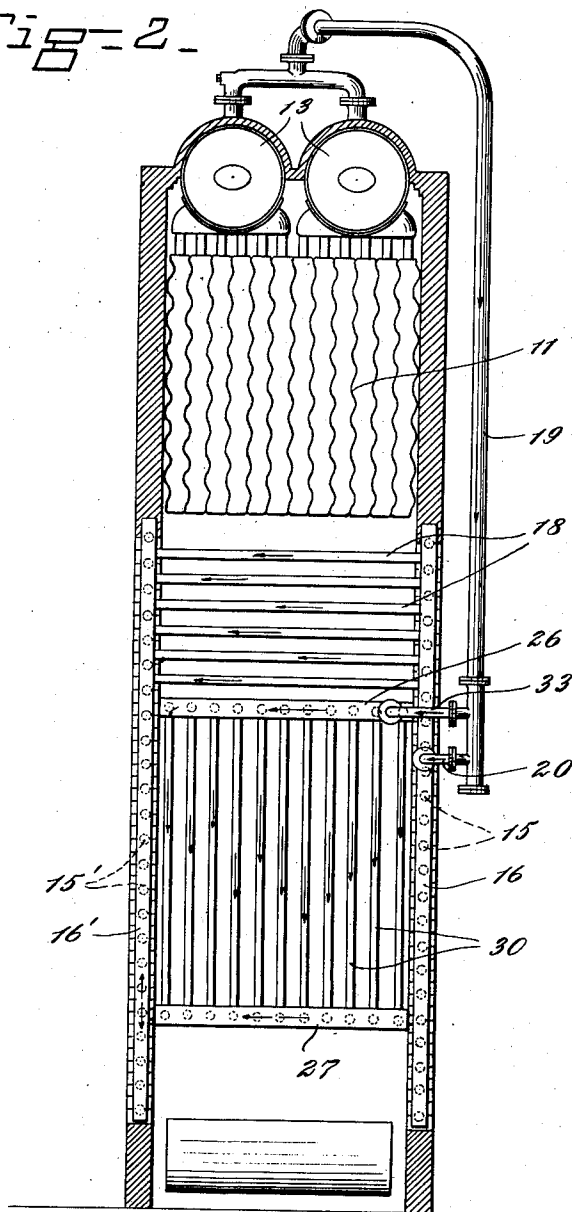
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Fig-2-



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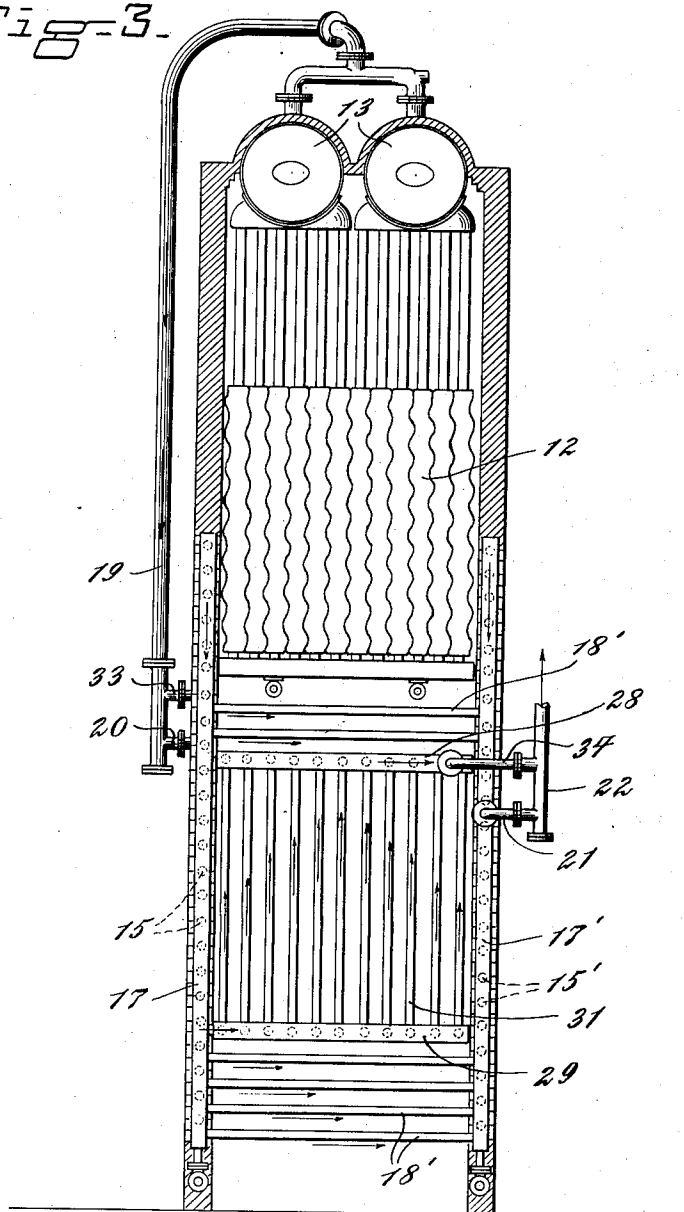
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Fig-3.



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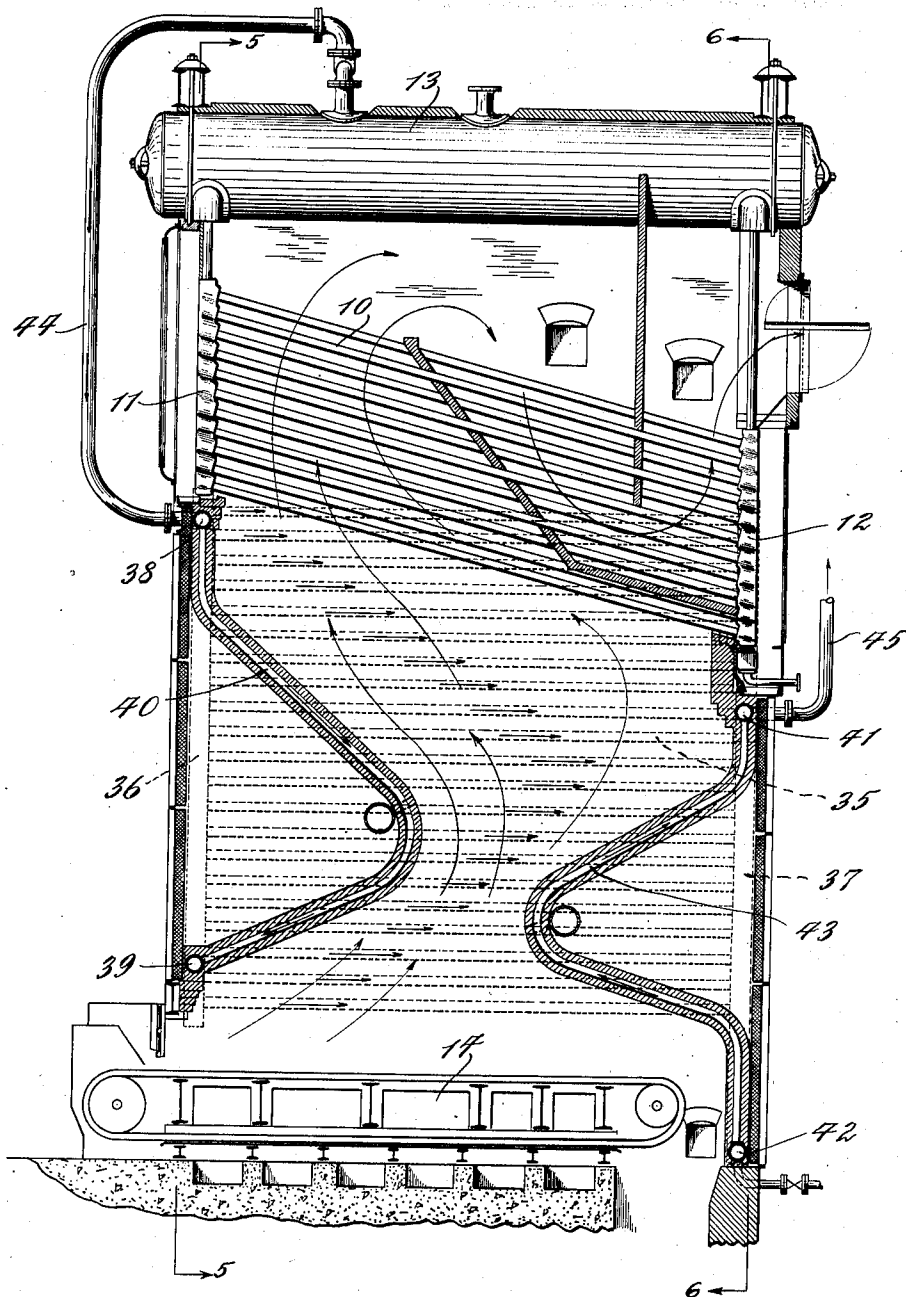
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Fig-4-



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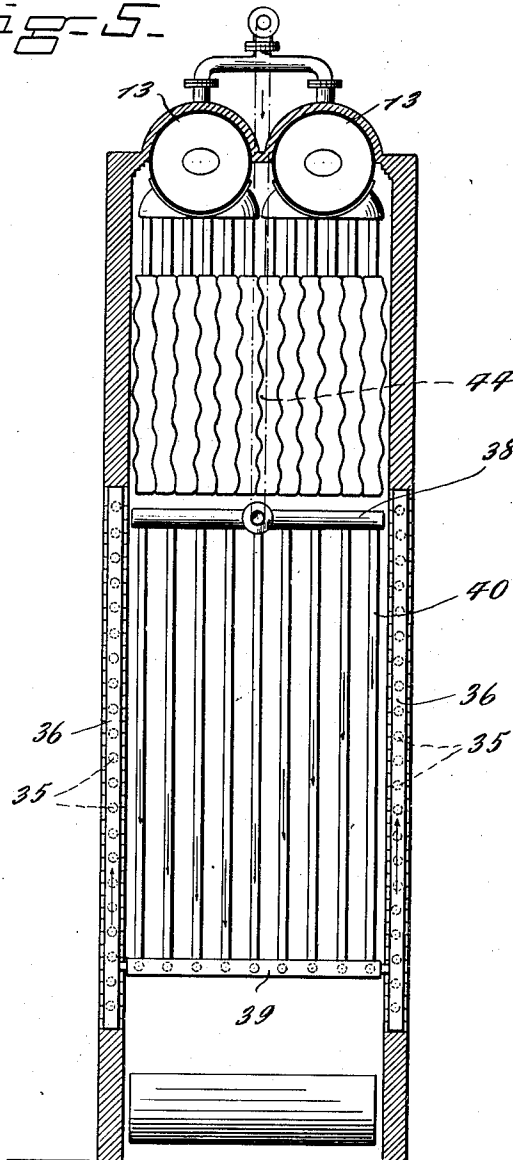
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Fig-5-



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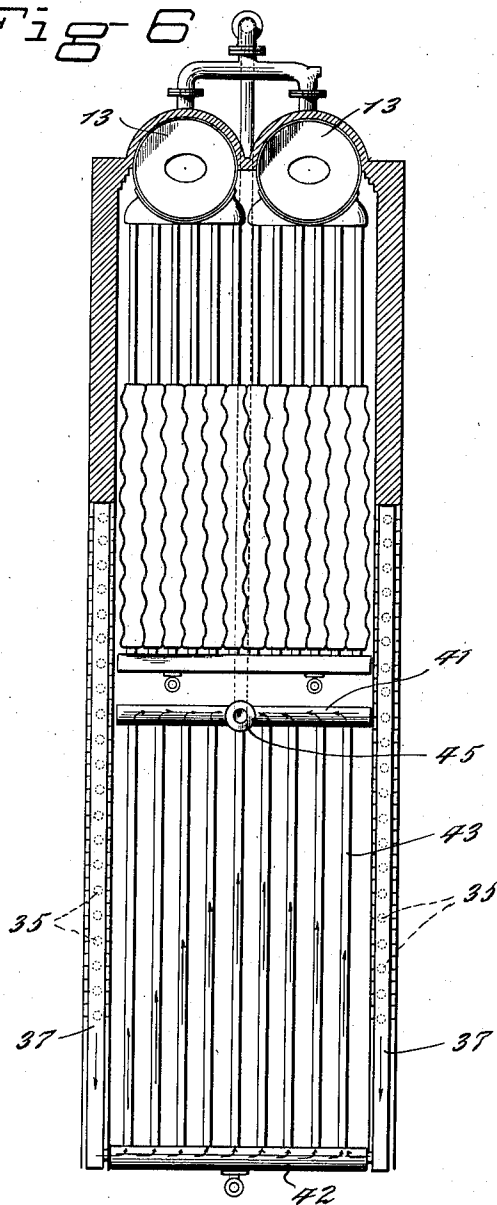
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Fig 6



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UNITED STATES PATENT OFFICE

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FURNACE

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My present invention relates to furnaces, and particularly to means, including superheaters, for cooling the walls of furnaces and, at the same time, effectively utilizing the heat taken from such walls, and will be best understood from the following description and the annexed drawings, in which Fig. 1 is a vertical longitudinal section of an illustrative form of steam boiler and its furnace embodying my invention; Fig. 2 is a section on the line 2—2 of Fig. 1; Fig. 3 is a section on the line 3—3 of Fig. 1; Fig. 4 is a view similar to Fig. 1, but showing a modification of my invention; Fig. 5 is a section on the line 5—5 of Fig. 4, and Fig. 6 is a section on the line 6—6 of Fig. 4.

Like reference characters indicate like parts in the several views.

In the drawings for purposes of illustration of an embodiment of my invention, I have shown a known form of a horizontal water tube boiler with longitudinal steam and water drums, in which the tubes 10 are connected to uptake headers 11 and down-take headers 12 which, in turn, are connected to upper steam and water drums 13, the bank of tubes 10 being provided with baffles of a known form.

Referring now to the embodiment shown in Figs. 1, 2 and 3, the boiler is provided with a furnace chamber which is substantially rectangular in cross-section and with substantially vertical walls. A chain grate stoker 14 is shown located at the bottom of the furnace chamber. Preferably, each of the walls of the furnace chamber is provided with a row of horizontally disposed tubes. In the side walls, the set of tubes 15 are connected at their ends to vertically disposed headers 16 and 17. The set of tubes 15' are connected between the vertical headers 16' and 17'. The horizontal tubes 18 in the front wall are also connected to the headers 16 and 16', and the tubes 18' in the rear wall are connected to the headers 17 and 17'.

The steam spaces of the drums 13 are connected through a pipe 19 and a branch 20 with the header 16, preferably at a point remote from either end thereof, and the header 17' is connected through a branch 21 to a su-

perheater steam outlet 22. Steam from the drums 13 flows through the pipes 19 and 20 into the header 16. This steam is distributed by the header 16 to the several tubes 15 and also to the tubes 18. The steam flowing through tubes 15 enters the rear header 17 by which it is distributed to the tubes 18', through which it flows to the header 17', and from thence to the superheated steam outlet 22. Another portion of the steam in header 16 flows through the tubes 18 to the other header 16' and from there through the tubes 15' to the header 17' and the branch 21 and superheated steam outlet 22. In this manner, the steam flows through the tubes which surround the combustion chamber and this not only cools the walls of the furnace chamber, but superheats the steam in an efficient manner and one which is more nearly independent of the rating at which the boiler is operating than would be the case if the superheater were located in the usual position above the boiler. It will be understood that the tubes 15, 15', 18 and 18' are preferably sloped in the direction of the steam flow therein, so that any water carried in with the saturated steam from the drums 13 will flow along with the steam until it itself is converted into steam.

In the preferred form shown, the tubes 15, 15', 18 and 18' are enclosed in tile, but it will be understood that, if desired, these tubes may be exposed on the inner faces of the furnace walls and that, when in the appended claims I describe the tubes as being "in" the walls, it will be understood that, unless otherwise limited, this expression includes not only the illustrated arrangement in which the tubes are positioned between the inner and the outer faces of the walls, but also arrangements in which the tubes are either against the inner face of the wall or against the outer face of the wall.

As shown in Fig. 1, an opening 23 in the furnace wall may be framed in headers 24, 24, which, in turn, are connected by short tubes 25 above and below the opening, the tubes 15' entering these headers 24, so that the flow of steam through the tubes along

this portion of the wall is not interfered with by such an opening.

In certain forms of furnaces, it is desirable to have the furnace space restricted above the fuel feeding apparatus and then expanded and, as a means for accomplishing this, I have omitted, in the form shown in Fig. 1, the horizontal tubes 18 and 18' over a portion of the front and the rear walls, respectively, of the furnace chamber and have provided in the front wall, an upper horizontal header 26 and a lower horizontal header 27 and in the rear wall, an upper horizontal header 28 and a lower horizontal header 29. A row of tubes 30 have their ends connected respectively to the headers 26 and 27 and have their body portions bent inward to form a reversed arch, as shown best in Fig. 1, the tubes 30 preferably being surrounded by tile in the same manner as shown for the tubes 15 and 18. Similarly at the rear of the furnace, a row of tubes 31 have their ends entered respectively into headers 28 and 29 and with their body portions forming a reversed arch, the tubes 31 also being covered with protecting tile. If desired, combustion air pipes 32 may be provided to supply jets of combustion air between the arches formed by the tubes 30 and 31.

The upper header 26 is connected to the saturated steam supply pipe 19 by a branch 33 and the lower header 27 is nipped at one end to the vertical header 16'. Similarly the lower header 29 is nipped at one end to the vertical header 17 and the upper header 28 is connected through the branch 34 to the superheated steam outlet 22.

With the arrangement described, it will be obvious that the saturated steam from the branch 33 will enter the header 26, flow down through the tubes 30 to the header 27 and from there will flow into the header 16', which, in turn, will supply the steam to the tubes 15'. Similarly steam from the header 17 will flow into the header 29 and then upward through the tubes 31 to the header 28 and from thence to the superheated steam outlet. With this arrangement, the arches are not only kept cool, but the heat therefrom superheats the steam passing through the tubes.

In the arrangement shown in Figs. 4, 5 and 6, each of the side walls is provided with a row of horizontally disposed tubes 35 connected to vertical front headers 36 and rear headers 37, these tubes preferably being surrounded by tile, as heretofore described.

In the front wall of the furnace is an upper horizontal header 38 and a lower horizontal header 39 connected by a row of tubes 40 having a portion thereof bent outwardly to form a reversed arch and the remainder extending vertically, as best shown in Fig. 4. In the rear wall of the furnace is an upper header 41 and a lower header 42 con-

nected by a row of tubes 43, also bent to form a reversed arch over the stoker 14 and with portions of the tubes 43 vertically disposed. A saturated steam pipe 44 connects the steam spaces of the drums 13 with the middle portion of the header 38 and the header 39 is nipped at each end to one of the vertical headers 36. Similarly the lower header 42 is nipped at each end to one of the vertical headers 37 and the upper header 41 has a superheated steam outlet 45 connected at the middle portion thereof.

In the arrangement just described, the saturated steam enters the header 38, flows through the tubes 40 into the header 39 and from there it divides, some of it flowing into one and some of it into the other of the headers 36, from which it flows through the tubes 35 to the headers 37, from which, in turn, it flows through the header 42, the tubes 43 and the header 41 to the outlet 45.

While I have shown a chain grate stoker as the preferred form of fuel feeding apparatus, it will be understood that any other method of supplying fuel to the furnace chamber may be utilized.

While I have shown the cooling tubes in each of the furnace walls, it will be understood that such arrangement may be provided for some of the walls only, the other walls, in such case, having any other type of construction.

It will also be understood that the cooling vapor may be supplied to the cooling tubes from any source and that my cooling arrangement may be used in furnaces other than those supplying hot gases to boilers and particularly to the boiler which is the source of the cooling steam.

By my arrangement, difficulties experienced with water-cooled walls are obviated. In such water-cooled walls, the tubes are liable to become clogged from scale and the like deposited from the water and, at low loads particularly, corrosion of the cooling tubes may occur because of the sluggish circulation of the water. When steam is used as the cooling medium, there are practically no impurities carried into the tubes, so that the possibility of clogging and corrosion is negligible. By maintaining a relatively small pressure drop through the tubes, high steam velocities occur and this will provide sufficient heat absorption to cool the walls. Furthermore, since differences in static head, which occur when water is used as the cooling medium, are not found when steam is used as the cooling medium, the steam may be caused to flow downward in a set of tubes, if desired, without causing difficulties in circulation or distribution of the steam between the several tubes of such a set.

I claim:

1. A furnace having a combustion chamber with a substantially rectangular cross

section, horizontally disposed tubes in the side walls of the furnace, vertically disposed headers connected to the ends of said horizontally disposed tubes, vertically disposed bent tubes at the front and back of the furnace with their ends in the furnace wall and with at least a portion of the body portions of said bent tubes extending into the furnace space, a steam inlet and a steam outlet connected to all said tubes, and a source of steam supply connected to said inlet.

2. A furnace having a combustion chamber with a substantially rectangular cross section, horizontally disposed tubes in the side walls of the furnace, vertically disposed headers connected to the ends of said horizontally disposed tubes, horizontal upper and lower headers outside of the furnace faces of the front and rear furnace walls with each of the lower horizontal headers connected at each end to one of said vertical headers, vertically disposed tubes connecting said upper and lower horizontal headers, and means for passing a fluid through said vertically disposed tubes.

3. A furnace having a combustion chamber with a substantially rectangular cross section, horizontally disposed tubes in the side walls of the furnace, vertically disposed headers connected to the ends of said horizontally disposed tubes, horizontal upper and lower headers outside of the furnace faces of the front and rear furnace walls with each of the lower horizontal headers connected at each end to one of said vertical headers, vertically disposed bent tubes connecting said upper and lower horizontal headers with at least a portion of the body portions of said bent tubes extending into the furnace space, and means for passing a fluid through said vertically disposed tubes.

4. A furnace chamber substantially rectangular in cross section, a vertical header at each corner of the furnace, horizontally disposed tubes in the walls of the furnace and connecting said headers, an inlet pipe connected with one of said headers at a point remote from either end of the header, an outlet pipe connected to another of said headers at a point remote from either end of the header, and a source of steam supply connected to said inlet.

5. A furnace having a combustion chamber with a substantially rectangular cross section, horizontally disposed tubes in the side walls of the furnace, vertically disposed headers connected to the ends of said horizontally disposed tubes, horizontal upper and lower headers in the front and rear furnace walls with each of the lower horizontal headers connected at each end to one of said vertical headers, vertically disposed bent tubes connecting said upper and lower horizontal headers with at least a portion of the body portions of said bent tubes extending into

the furnace space, a steam inlet connected to the upper one of said horizontal headers in one of said walls, a steam outlet connected to the upper one of said horizontal headers in the other of said walls and a source of steam supply connected to said inlet.

6. A furnace having a combustion chamber with a substantially rectangular cross section, horizontally disposed tubes in the side walls of the furnace, vertically disposed headers connected to the ends of said horizontally disposed tubes, horizontal upper and lower headers outside the furnace faces of the front and rear furnace walls with each of the lower horizontal headers connected to one of said vertical headers, vertically disposed bent tubes connecting said upper and lower horizontal headers with at least a portion of the body portions of said bent tubes extending into the furnace space, and means for passing a fluid through said vertically disposed tubes.

7. A furnace having a combustion chamber with a substantially rectangular cross section, horizontally disposed tubes in the side walls of the furnace, vertically disposed headers connected to the ends of said horizontally disposed tubes, horizontal upper and lower headers in the front and rear furnace walls with each of the lower horizontal headers connected to one of said vertical headers, vertically disposed bent tubes connecting said upper and lower horizontal headers with at least a portion of the body portions of said bent tubes extending into the furnace space, a steam inlet connected to the upper one of said horizontal headers in one of said walls, a steam outlet connected to the upper one of said horizontal headers in the other of said walls and a source of steam supply connected to said inlet.

8. A furnace having a combustion chamber with two walls disposed substantially opposite each other, said walls comprising arches extending inwardly toward each other and disposed intermediately of the height of said wall, each arch comprising a row of steam superheating tubes, and tile carried by said tubes and extending substantially throughout the lengths of the arches.

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