June 21, 1932. T. E. MURRAY 1,864,366

BOILER

Filed July 19, 1927 3 Sheets-Sheet 1

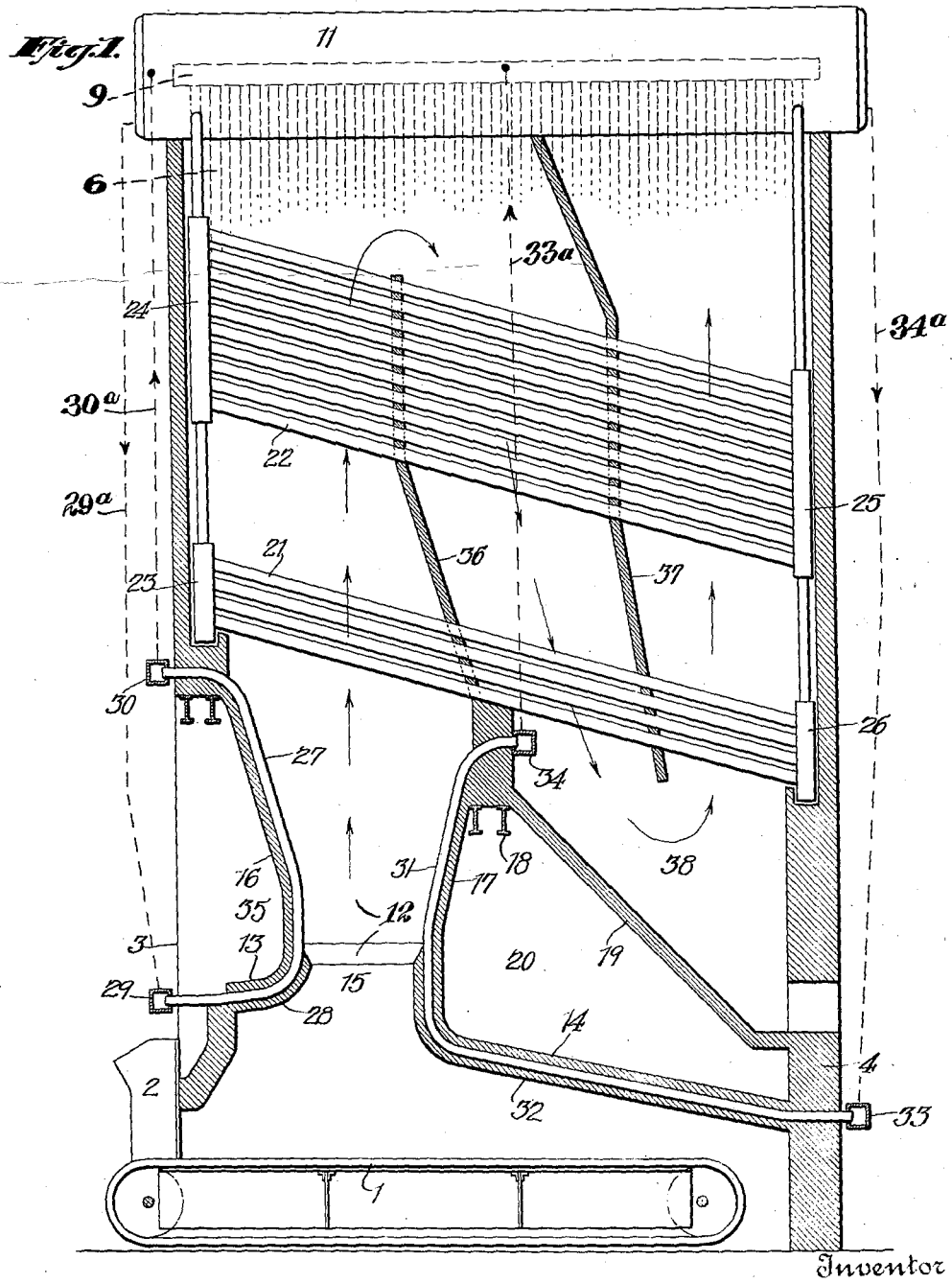

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Fig. 3.

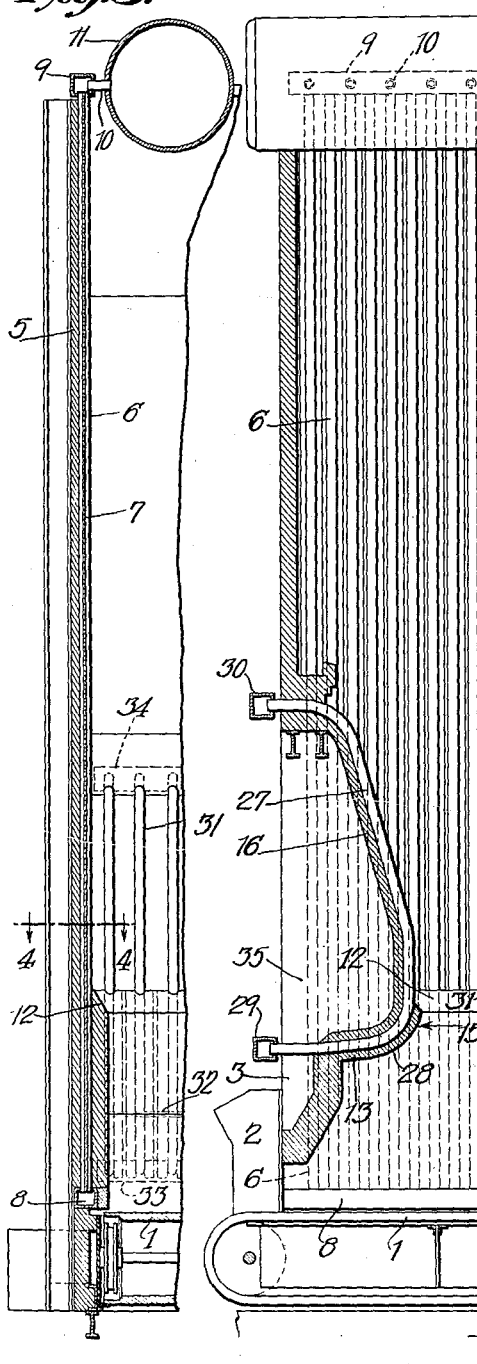

Fig. 2.

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Fig. 4.

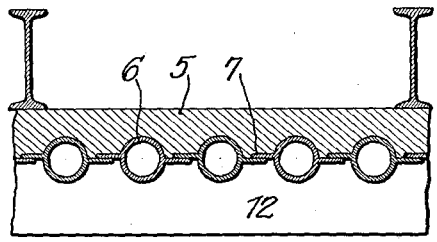


Fig. 5.

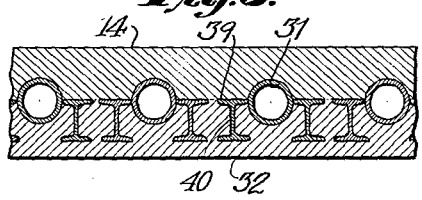


Fig. 6.

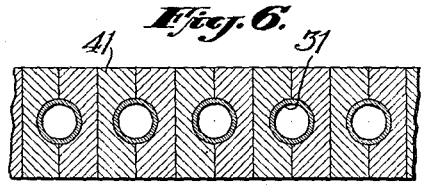
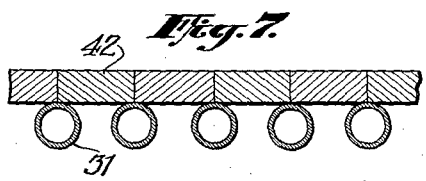


Fig. 7.



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UNITED STATES PATENT OFFICE

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BOILER

Application filed July 19, 1927. Serial No. 206,903.

The invention aims to provide certain improvements in boilers by which extremely high steam generating capacity and other advantages may be obtained.

The accompanying drawings illustrate an embodiment of the invention.

Fig. 1 is a longitudinal section showing in part only the vertical tubes which are fully illustrated in Figs. 2, 3 and 4;

Fig. 2 is a similar view omitting the horizontal tubes in the upper part of Fig. 1;

Fig. 3 is a partial transverse vertical section approximately on the line 3—3 of Fig. 2;

Fig. 4 is a section on the line 4—4 of Fig. 3;

Fig. 5 is a section on the line 5—5 of Fig. 2;

Figs. 6 and 7 are sections similar to Fig. 5 illustrating modified constructions.

The embodiment of the invention illustrated is designed particularly for stoker fired furnaces and the stoker illustrated is of the type generally used for anthracite coal or coke. The stoker is an endless grate 1 the forward end of which receives coal from a hopper 2 near the front wall 3 of the boiler. The cinders and ashes are dumped between the rear end of the grate and the rear wall 4.

The traveling grate extends in width between the side walls 5 (Fig. 3) which extend clear to the top. The side walls include or are lined with vertical water tubes 6 having flanges 7 which close the space between them. These tubes connect at their lower ends with headers 8 and at their upper ends with headers 9 which lead through pipes 10 to steam drums 11 extending from front to back. The circulation is continued in the usual way by water tubes (not shown) leading from the drums to the lower headers 8. In order to limit the cooling effect of the water in the tubes upon the burning fuel, the lower portions of the tubes are preferably shielded by a layer of refractory material 12, though this may be dispensed with.

The furnace is also provided with flat arches 13 at the front and 14 at the rear extending across the furnace. The arch 14 is inclined downwardly toward the back where the combustion is less active and lies close above the grate. The arch 13 is located somewhat higher so as to leave a good space for combustion at the front, and the products of combustion pass upward through the passage 15 between these two arches. The arches are continued above the passage 15 in walls 16 and 17 extending obliquely upward and flaring away from each other. The upper end of the wall 16 is located at the front of the furnace. The upper end of the wall 17 is carried on cross-beams 18. A supplemental wall 19 extends from the upper end of the wall 17 downward to the rear wall 4, leaving a dead space 20 between the arch 14 and the walls 17 and 19.

Above the transverse walls 16 and 17 there are arranged the inclined, approximately horizontal banks of tubes 21 and 22 connected by headers 23 and 24 at their outlet ends to the steam drum overhead which in turn is connected by headers 25 and 26 to the lower inlet ends of these overhead tubes. The tubes 21 and 22 are heated by convection from the combustion gas and any one of various known arrangements may be adopted for such tubes. The vertical tubes in the furnace proper are heated chiefly by the direct radiant heat of the burning fuel and serve to greatly increase the capacity of the boiler.

In addition, the vertical tubes at the side are supplemented by similar water tubes which line or are incorporated with the transverse arches and walls. Tubes 27 are arranged as a lining at the face of the wall 16. They extend downward through the arch 13 where they are covered with refractory material 28 for protection of the fuel against excessive cooling. Their lower ends communicate with a header 29 and their upper ends with a header 30, these headers communicating with the drum over head in the usual way as indicated in Fig. 1 by the upgoing line 30^a and the downgoing line 29^a. Similarly tubes 31 line the face of the wall 17 and are continued over the arch 14, where they are covered with refractory material 32 to protect the fire. They communicate at their lower ends with a header 33 and at their upper ends with a header 34, which headers are also connected with the steam drum over head as usual as indicated in Fig. 1 by the lines 33^a and 34^a. The contour of the protecting material 12 at the sides corresponds

with that of the arches 13 and 14, since the flame is not exposed to the tubes in the dead space 20 above the arch 14 nor to those in the similar dead space 35 at the front. By this arrangement the heating gases, which are in a state of combustion from the time they leave the grate until they have passed approximately through the passage between the walls 16 and 17, are substantially surrounded by water tubes which are thus heated most efficiently. The combustion chamber, roughly defined, extends from the grate to the upper end of the passage between the walls 16 and 17. The residual heat of the gas is then utilized in the overhead tubing 21 and 22. The gases are caused to circulate in a sinuous direction by baffles 36 and 37, the gases passing upward through the forward ends of the tubes, downward through their middle portion, thence through the space 38 at the back, where there is a further heating effect on the vertical tubes along the side walls, and finally upward through the rear ends of the overhead tubes and out to the stack.

The arches may be variously constructed. Fig. 5 illustrates a suitable cross-section. The tubes 31 in this case have lateral flanges 39 to the sides of which are welded T-shaped pieces 40 which are embedded in the facing 32 of refractory material so as to hold the weight of the latter.

Fig. 6 illustrates a modification in which the tubes 31 are carried between molded blocks 41 of refractory material extending through the entire depth of the arch.

The protecting wall 12 at the sides, and the protecting facings at the undersides of the arches are not essential in all cases. The tubes may be exposed where the character of fuel and the conditions of combustion make this desirable. Also tubes without fins may be used, leaving a part of the wall or the arch exposed between the tubes. Fig. 7 illustrates these modifications. The tubes 31 are without fins and they support the arch consisting of blocks 42 of refractory material laid on the tubes and across the spaces between them.

While the arrangement described is particularly useful for grate fired furnaces, the invention may be adapted to boilers heated by jet fuel such as coal dust, oil or gas.

With the arrangement shown, the naked upper portions of the tubes 27 and 31 are exposed to the direct radiant heat of the fire so that the generation of steam therein is extremely rapid. The horizontal portions of these tubes, extending under the arches, are shielded by the refractory facings 28 and 32 chiefly to protect the fire from the cooling effect of the tubes. Where these refractory facings are omitted, the firing arrangements permitting, there will be a correspondingly increased exposure to direct radiant heat and a correspondingly increased capacity or rating for the boiler.

The general type of boiler herein illustrated, with vertical tubes lining the combustion chamber and supplementary tubes over head, is illustrated and claimed in certain previous applications of mine, particularly Nos. 642,725 of June 1, 1923, patented Feb. 11, 1930, Patent No. 1,746,711, and 43,433 of July 14, 1925, patented Sept. 2, 1930, Patent No. 1,774,810.

Various other 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 having a combustion chamber with side walls and having tubes above the combustion chamber heated by convection from the combustion gases, a grate for the fuel, an arch extending inward from the rear wall shortly above the grate and inclined downward toward the rear where the combustion is least active and forming above it a dead space, supports in said space for said arch and upright water tubes lining the side walls, having their upper portions uncovered and having their lower portions extended downward through said dead space into the zone below said arch and exposed in said dead air space so as to cool the same and shielded in said zone to limit their cooling effect on the flame.

2. A boiler having a combustion chamber with side walls and having tubes above the combustion chamber heated by convection from the combustion gases, a grate for the fuel, arches extending inward from the front and rear walls shortly above the grate with a space between their inner ends and forming dead spaces above the arches, the front arch being higher than the rear arch so as to leave more space for combustion at the front, supports in said space above the rear arch and upright water tubes lining the side walls extending down through said dead spaces and through the space between the ends of the arches into the zone below said arches, said tubes being exposed in the dead air space above the rear arch so as to cool said space and the supports therein.

3. A boiler having a combustion chamber with side walls and having tubes above the combustion chamber heated by convection from the combustion gases, a grate for the fuel, arches extending inward from the front and rear walls shortly above the grate with a space between their inner ends and forming dead spaces above the arches, the front arch being higher than the rear arch so as to leave more space for combustion at the front, supports in said space above the rear arch and upright water tubes lining the side walls extending down through said dead spaces and through the space between the ends of the

arches into the zone below said arches, the lower ends of said upright tubes being shielded in said zone to limit their cooling effect on the flame, said tubes being exposed in the dead air space above the rear arch so as to cool said space and the supports therein.

4. A boiler having a furnace in which are arches extending inward from the front and rear walls of the furnace and comprising water tubes to be heated by the radiant heat of the burning fuel, said arches being lined on their undersides with refractory material to limit the cooling effect on the flame, upwardly extending walls at the inner ends of said arches forming a passage for the burning gases which walls also include upwardly extending water pipes directly exposed to the radiant heat of the burning gases and forming continuations of the arch tubes, each set of arch tubes and the upwardly extending continuations thereof at the front and rear having a common header at their upper ends and a common header at their lower ends which are connected into the steam generating circulation of the boiler, and upright water tubes lining the sides of the furnace, extending through the space between the inner ends of said arches and also through the dead spaces above said arches and downward into the zone below the arches, and shielded in the latter zone to limit their cooling effect on the flame, supports for the rear arch located in the dead space above it, the water tubes being exposed in said space so as to have a cooling effect on the air therein.

In witness whereof, I have hereunto signed my name.

THOMAS E. MURRAY.