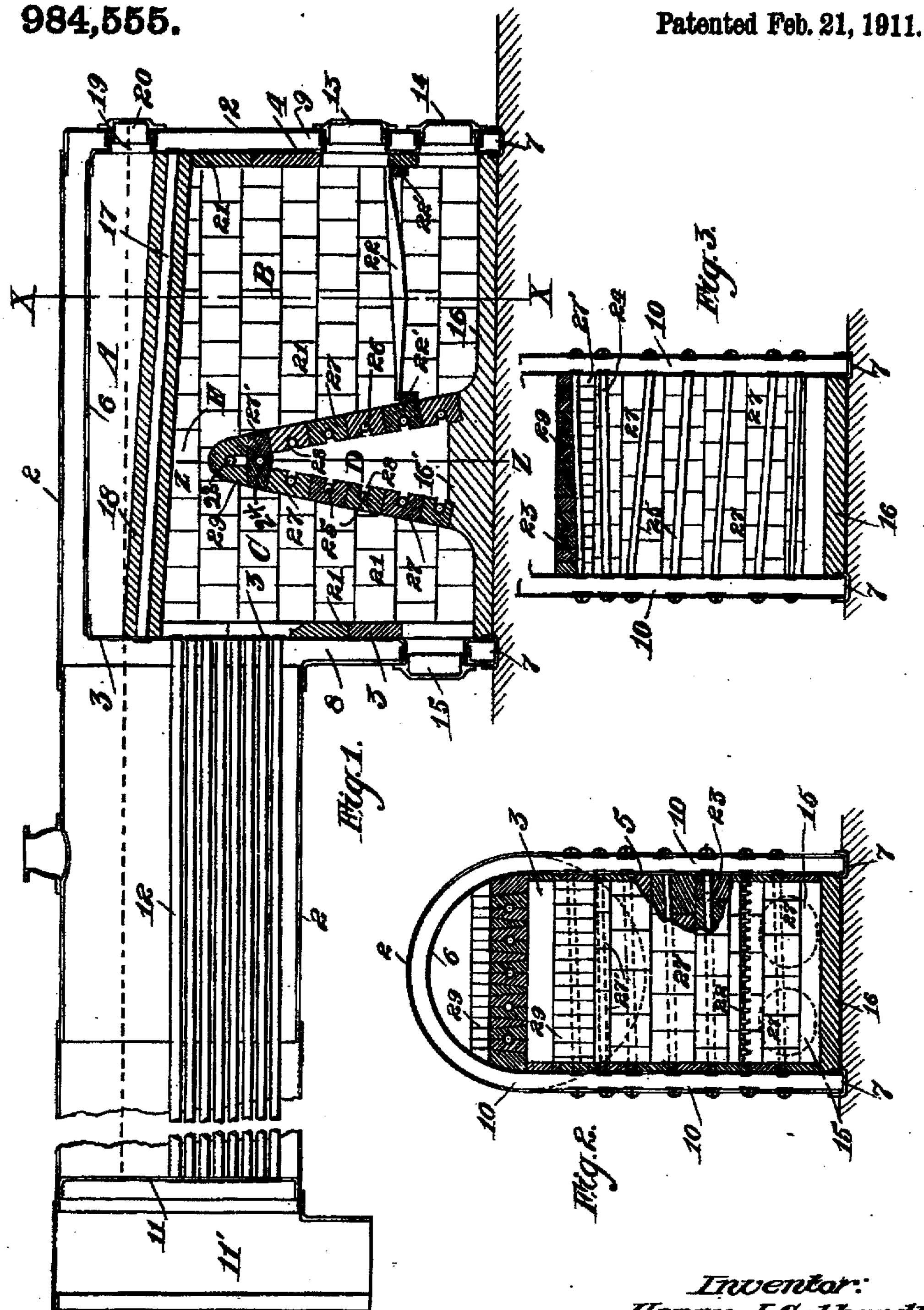
H. J. GEBHARDT.

LOCOMOTIVE BOILER FIRE BOX.

APPLICATION FILED OCT. 21, 1908. RENEWED JULY 6, 1910.

984,555. Patented Feb. 21, 1911.



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UNITED STATES PATENT OFFICE.

HENRY J. GEBHARDT, OF CHICAGO, ILLINOIS.

LOCOMOTIVE-BOILER FIRE-BOX.

984,555. Specification of Letters Patent. Patented Feb. 21, 1911.

Application filed October 21, 1908, Serial No. 458,786. Renewed July 5, 1910. Serial No. 570,395.

To all whom it may concern:

Be it known that I, HENRY J. GEBHARDT, a citizen of the United States, and a resident of Chicago, Cook county, Illinois, have invented certain new and useful Improvements in Locomotive-Boiler Fire-Boxes, of which the following is a full, true, clear, and exact description, such as will enable others skilled in the art to make and use the same.

My invention relates to improvements in boilers and boiler furnaces and has particular reference to improvements in stationary boilers of the locomotive type.

The object of my invention is to increase the efficiency of such boilers and to improve the combustion of fuel in the fireboxes thereof.

A special object of my invention is to provide a substantially smokeless locomotive boiler furnace.

My invention consists primarily in a boiler of the locomotive type and a firebox therein which is lined with refractory material, in combination with a wall of refractory material rising from the bottom of the firebox and positioned intermediately in the firebox and a grate arranged between the said wall and the rear end of the firebox, said wall dividing the firebox into fire and combustion chambers.

My invention also consists in various details of construction and in combinations of parts, all hereinafter described and particularly pointed out in the claims.

My invention will be more readily understood by reference to the accompanying drawings forming a part of this specification and in which;

Figure 1 is a vertical longitudinal section of a boiler and furnace embodying my invention; Fig. 2 is a vertical section thereof, on the line X—X of Fig. 1; Fig. 3 is a similar section on the line Z—Z of Fig. 1.

In the drawings, 2, represents the "locomotive" boiler shell. This is enlarged at the rear end and contains the firebox. The firebox conforms to the shape of the rear portion of the shell, but is smaller than the same. The walls of the firebox are constituted by the flue sheet, 3, the rear end sheet, 4, the side sheets, 5—5, and the crown sheet, 6. As a rule the crown and side sheets are formed from one sheet of metal. The firebox sheets are joined to the shell by the usual stay bolts but these being common are not shown herein. The mud ring, 7, unites the shell and the firebox sheets at the lower edges and the firebox, being smaller than the shell, is inclosed by the usual front, rear and side water legs, 8, 9 and 10—10.

11 represents the front flue sheet of the boiler and 12—12, the flues which extend between the flue sheets, 3 and 11; these forming the smoke outlet of the firebox. The smoke box, 11′, at the front end of the boiler is of ordinary form.

13 represents a fuel door and 14 an ash pit door, both in the rear end of the boiler.

15—15 are two doors in the front wall of the fire box, the use of which will be explained hereinafter.

The bottom of the firebox is formed by a concrete bed, 16, having a raised portion, 16′. The upper part of the firebox contains a group of water circulating tubes, 17. These are slightly inclined from the rear toward the front of the firebox and extend from the rear sheet, 4, to the upper part of the flue sheet, 3. The tubes support a substantially horizontal wall or roof, 18, composed of refractory bricks. This roof or firebox top extends from flue sheet to end sheet and from one side sheet to the other, completely closing off the upper part of the firebox and protecting the crown sheet from the direct heat thereof. The space, A, between the crown sheet and the refractory roof, 18, is reached through a door opening, 19, in the rear end of the boiler, normally closed by the door, 20.

As shown I line the interior of the firebox with bricks, 21. These bricks are made of refractory material and are suitably secured in place against the side sheets and those portions of the flue sheet and the rear sheet which are not occupied by the flues and the door openings. I divide the firebox into two parts, B and C, by means of a bridge wall, D, the part, B, being the fire chamber and the part, C, the combustion chamber of the furnace. The bridge wall, D, is built upon the raised portion, 16′ of the bed, 16, and rises to a point close beneath the refractory roof, 18, and hence nearly to the level of the upper flues, 12. The opening, E, remaining between the top of the bridge wall and the roof, 18, is termed the throat of the furnace and its area closely corresponds to the combined areas of the flues, 12. The bridge wall is in some cases arranged nearer the flue sheet, than the rear sheet of the firebox, as shown in the drawings, but in other

cases I place the bridge wall substantially at the middle of the firebox and make the fire chamber of substantially the same size as the combustion chamber, C. The fuel grate, 22, instead of extending from the rear of the firebox to the flue sheet, as in other locomotive boilers is of about half the length of the firebox, terminating at the bridge wall, D. The grate is supported on suitable transverse members, 22′.

I will now describe in detail the bridge wall, D, which constitutes an essential feature in my invention.

In the upper part of the firebox are two water tubes, 23 and 24. These extend through and between the side sheets, 5. One is placed directly above the other. Beneath these tubes are two relatively inclined series or rows of tubes, 25 and 26. These tubes promote the circulation of water in the water legs, 10, and all of the tubes, (24, 25, 26) are slightly inclined to insure the free and rapid circulation of water. I prefer that the tubes, 25 and 26, shall be inclined in opposite directions as the contrary circulation currents produced thereby set up a most desirable agitation of the contents of the side water legs. These tubes, 25 and 26 serve to support the rows of bricks, 27, 27, the inner sides of which are provided with grooves, 28, to fit the tubes. The lowermost bricks, 27, rest upon the floor, 16. The uppermost bricks, 27, rise to a point close beneath the tube, 24, and therewith support the rows of wedge shaped bricks, 27′—27′. Inverted U shaped bricks, 29, cover and rest upon the tubes, 23, and form the top of the bridge wall. All of the bricks which are used are capable of withstanding the high temperature which is attained in the firebox and when in use the bricks attain an almost incandescent condition. The space between the relatively inclined walls, composed of bricks, 27, is preferably filled with refractory material, also having large capacity for heat.

The operation of my invention is as follows: When a fire is built upon the grate the gases and combustible particles liberated from the fuel rise in the fire chamber. As a partial vacuum exists in the fire chamber the gases tend to move directly toward the flues or smoke outlet of the firebox, but are prevented from so doing by the bridge wall. Impact of the currents of gas and air upon the walls, the roof and the bridge wall causes the deflection of the gases and results in the thorough admixture of gaseous substances and vapors at the throat, E. Vigorous combustion is thus promoted and caused to occur in proximity to the throat and on passing the throat the gases enter the combustion chamber. The gases on entering the large combustion chamber lose velocity and therefore are given ample time in which to combine and burn. As a result, substantially perfect combustion occurs before the gases enter the flues of the boiler. The bridge wall as here described, co-acts with the roof to deflect and admix the firebox gases and it has a further function which is best expressed in a term which I apply thereto, to-wit, the term combustion stabilizer. The large body of refractory material which composes the bridge becomes intensely hot and being located in the middle of the combustion space it tends to maintain the temperature therein and in a large measure prevents sudden fluctuations of temperature which might cause poor combustion. Thus at times that the fuel door is opened and when cold air rushes into the firebox, the temperature of the gases therein is reduced, but the refractory body or bridge gives off so much heat as to approximately and quickly restore the gases to normal temperature. The refractory linings and roof of the firebox assist in this control, or regulation of temperature. It will be obvious also that although the travel of the gases between the grate and the flue sheet is longer than usual, the conditions for combustion in the chamber, C, are such as to insure substantially complete combustion for the reason that the temperature in the chamber, C, is practically constant due to the alternate absorption and radiation of heat by the large mass which is interposed between the chambers, B and C. It follows therefore that the opening of the fuel door has but slight effect upon the temperature in the combustion chamber and even when the fire chamber, B, is filled with a non-burning smoky body of gas, these gases on passing into the combustion chamber are immediately ignited. The combustion chamber possesses all of the advantages of a cinder and ash well; and because of the expansion of the burning gases in the combustion chamber, such solids are precipitated therein and not allowed to pass into the flues. The cinders and ashes which accumulate in the bottom of the combustion chamber may be readily removed through the cleanout doors, 15, and these doors may be opened for that purpose at any time.

As various modifications of my invention will readily suggest themselves to one skilled in the art, I do not confine the invention to the specific structures herein shown and described.

Having thus described by invention, I claim as new and desire to secure by Letters Patent:

1. A locomotive firebox having a lining of refractory material and closed at the bottom, in combination with a plurality of transverse circulating tubes connecting the sides of the firebox, a plurality of refractory bricks lodged upon and supported by said

tubes constituting a bridge wall which rises from the bottom of the firebox to a point close to the roof thereof, a grate arranged above the bottom of the firebox and between said bridge wall and the rear end of the fire-box and suitable fuel and ash pit doors, substantially as described.

2. A locomotive boiler and its fire-box, in combination with a lining of refractory material in said fire-box, a bed or base closing the bottom of said fire-box, a plurality of series of circulating tubes connecting the side legs of the boiler and inclined within the fire-box, a plurality of rows of refractory bricks supported by said tubes constituting a bridge wall which rises from said body or base to a point close to the top of the firebox, a grate in the rear part of the fire-box, suitable fuel and ash doors and a clean-out door or doors in the front end of the firebox, substantially as described.

3. A locomotive boiler and its firebox, in combination with two vertical series of transverse water tubes connecting the side water legs of the boiler, said tubes being inclined and certain thereof being oppositely inclined with relation to others, a refractory bridge wall supported by said tubes and rising from the bottom of the firebox to a point near the roof thereof, a grate between the bridge wall and the rear end of the furnace and suitable fuel and ash doors, substantially as described.

4. A locomotive boiler and its firebox, in combination with two relatively inclined series of circulating tubes connecting the side water legs of the boiler and arranged midway of the ends of the firebox, the tubes in said series being oppositely inclined to promote the agitation of the water in said legs and rows of refractory bricks arranged between and supported by said tubes and forming a bridge wall which is substantially triangular in cross section, substantially as described.

In testimony whereof, I have hereunto set my hand, this 16th day of October, 1908, in the presence of two subscribing witnesses.

H. J. GEBHARDT.

Witnesses:

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