No. 649,664. Patented May 15, 1900.

W. R. HINES.

FURNACE FOR STEAM BOILERS.

(Application filed Sept. 15, 1899.)

(No Model.) 2 Sheets—Sheet 1.

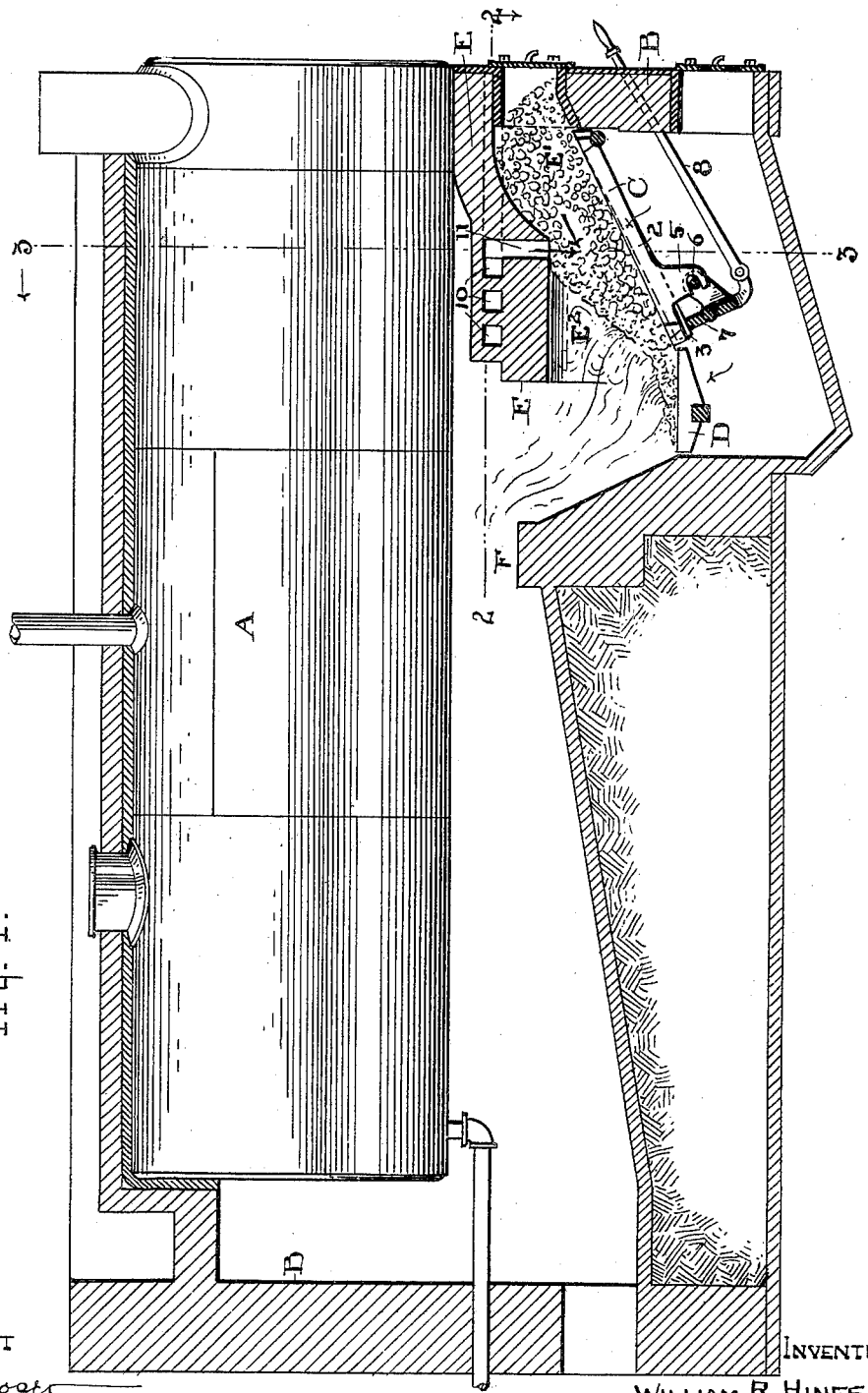

Fig. 1.

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Fig. 2.

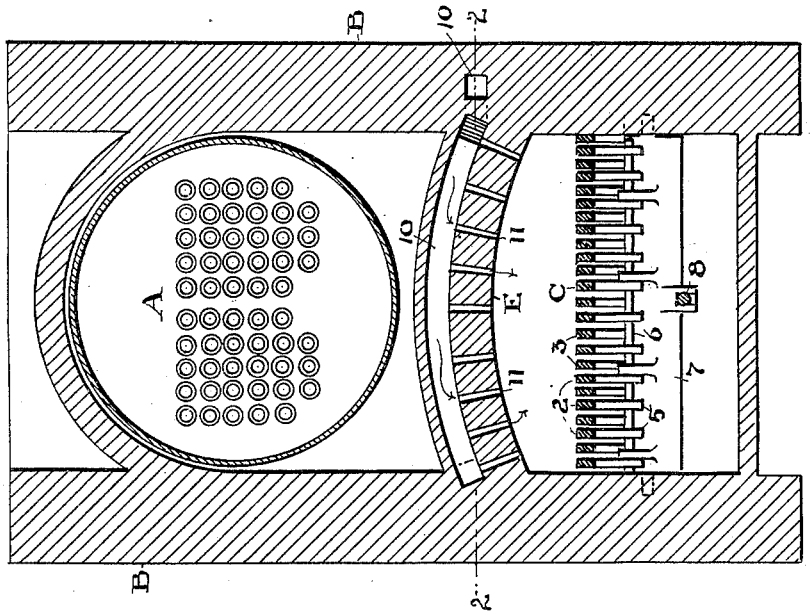
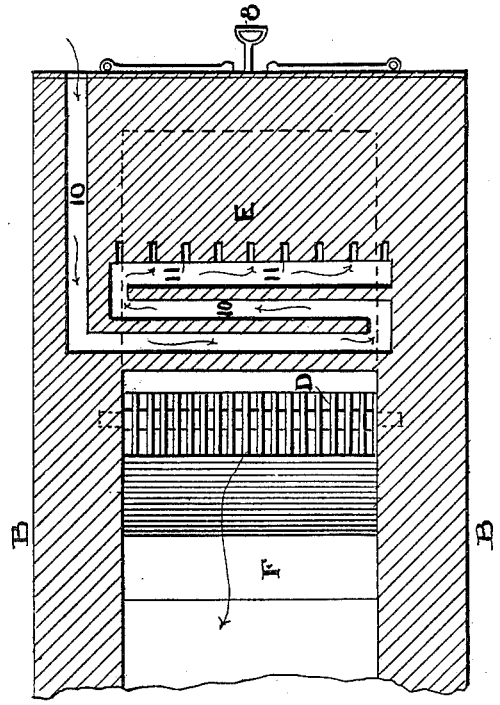


Fig. 1.



ATTEST
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UNITED STATES PATENT OFFICE.

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FURNACE FOR STEAM-BOILERS.

SPECIFICATION forming part of Letters Patent No. 649,664, dated May 15, 1900.

Application filed September 15, 1899. Serial No. 730,586. (No model.)

To all whom it may concern:

Be it known that I, WILLIAM R. HINES, a citizen of the United States, residing at Cleveland, in the county of Cuyahoga and State of Ohio, have invented certain new and useful Improvements in Furnaces for Steam-Boilers; and I do declare that the following is a full, clear, and exact description of the invention, which will enable others skilled in the art to which it appertains to make and use the same.

My invention relates to gas-producing furnaces for steam-boilers; and the object of the invention is to provide a most simple and improved construction whereby perfect combustion is obtained and all smoke is prevented, as well as economizing fuel and lengthening the life of the furnace.

My invention therefore consists in the construction of a gas-producing furnace for steam-boilers and in the combination of parts, substantially as shown and described, and more particularly pointed out in the claims.

In the accompanying drawings, Figure 1 is a vertical central sectional elevation of my improved furnace. Fig. 2 is a longitudinal sectional view in plan taken on line 2 2 of Fig. 1. Fig. 3 is a cross-section on line 3 3, Fig. 1.

A represents a steam-boiler of any common form which is supported in a convenient manner within the usual brick or masonry setting B. These parts may be considered as of any preferred construction, the boiler being either of the form as shown or of the water-tube or tubular form and being either horizontal or upright.

The grate-bars C are preferably of the feed type, with the dumping-grate D at their inner ends, and, as shown, comprise a series of rock-bars 2 and 3, which lie on an inclined plane and are pivotally supported at their upper ends by a cross-bar 4. Each alternate bar 2 has a depending lug 5, slotted to receive a cross-rod 6, mounted on suitable arms of the vibrating plate 7. The lower ends of the grate-bars 2 and 3 normally rest on the top edge of this plate, which is pivotally supported in the side walls. When vibrated by means of the connecting-lever 8, the bars 2 are raised and lowered by the cross-rod 6, riding in the slot of their depending lugs 5. This movement breaks up the coal and feeds the same along, and it will be readily seen that the greatest movement is at the lower end of the grate-bars, where it is most needed, the coal at this point becoming more or less amalgamated or united and which must be broken up to allow a proper feeding from above. The coal at the top of the grate-bars is fresh and requires little or no movement to break it up and feed it along other than by its own gravity, and with this arrangement of pivoted grate-bars a most equal and steady feed can be obtained. The vibrating movement of plate 7 can be either an intermittent or continuous operation controlled by hand or mechanical power.

Having the means to properly break up and feed the coal in a uniform manner, the next and most important step is to provide for the proper combustion of the same, and to that end I construct a compound arch E directly over the entire surface of the grate-bars, and this arch forms two distinct chambers E′ and E^2. The chamber E′, located at the front end of the furnace, forms a magazine for fresh fuel, as well as a coking-chamber for the coal, and the fact that it is entirely within the walls of the furnace and is formed by the grate-bars beneath and the arch above simplifies the construction of the furnace to the extent that no outside coal-hopper, coal-pushing mechanism, and coking-plates are required. The construction of the arch E in combination with the inclined grate-bars contributes mainly to this result, as well as giving other advantages, as hereinafter more particularly specified.

The arch E, forming the roof of the chamber or magazine E′, slants or curves downward to the rear, where it meets the roof of the second chamber E^2, forming a throat or passage above the grate-bars narrower than either of the chambers E′ E^2. This throat substantially divides the arch into two parts and forms the separate chambers E′ E^2, the chamber E′ becoming a coking-magazine for the coal held back by reason of the throat and chamber E^2 becoming a mixing and combustion chamber for the gases liberated from the coal in the magazine.

To promote proper combustion and prevent smoke and loss of fuel, superheated air is brought to the exact place where the gases from the coal are liberated, and this point is directly at the throat, the air passing through an air-duct 10, leading from the outside of the furnace, through the walls and arch E, to the discharge-openings 11, where the air is drawn or forced downward through and into the coal, thoroughly mixing at this point, and within the mixing-chamber E^2; but to the end that an immediate and thorough mixing of the air and gases can be had I find that a much better result is obtained if the air be superheated to a high degree before it comes into contact with the gases, and I provide for this result by running the air-duct 10 back and forth several times through arch E above the mixing and combustion chamber E^2. This circuitous course of the air passing through the arch E over a long stretch and comparatively-wide area of heated brick which is directly exposed to the hottest fire serves two important purposes, the first of which consists in heating the air to such a high degree that when discharged through openings 11 it is in the best condition to mix easily with the liberated gases from the coal coked in chamber E'—in fact, is discharged practically in a burning condition—and the second consists in keeping the temperature of the arch below what it would be if no cool air were allowed to pass through the same, thereby lengthening the life of the arch to that extent. In other words, though the arch primarily serves to form a mixing and combustion chamber and is utilized to heat the incoming air passing through the same it is nevertheless also true that the cold incoming air serves to reduce the temperature of the arch and protect and prolong the life thereof. This is more readily understood when the circuitous route of the air through the arch is taken into consideration, it being necessary to have this length of travel before the air can be heated to the high degree desired before discharging the same. This current of air can be either a forced draft or an induced one, as occasion may demand.

The advantage of heating the air to the temperature as described and discharging it at the throat, as shown—say substantially midway between the coking-magazine and the mixing and combustion chamber—is that this point is the natural place where the gases from the magazine are liberated and that both the air and gases will be at about the same temperature, making the mixing of the two more complete and certain. With the construction as described the mixing of the two elements is practically instantaneous, and immediate ignition and combustion occur while the product is still within the mixing and combustion chamber. Having obtained perfect combustion at this point, the heat thus generated passes off to the boiler and over the bridge-wall F to the rear with a total absence of smoke or waste product, the coke being consumed upon the lower end of the grate until reduced to very fine ashes.

Among other advantages an important one is that this furnace can burn any grade of coal from slack to lump without any change in grates or construction.

The discharge-openings 11, located at the throat, cause the air to pass downward and into the coal, the top line of the coal coming flush with the opening. This arrangement makes the mixing of air and gases more thorough and spreads it over a large area within the bed of coal itself, the superheated air penetrating below the surface and mixing there with the gases, as well as upon the surface. The superheated air being lighter than the coal-gases, I have found that if it is discharged at even a slight distance above the surface of the coal the air will merely remain on top and not mix as thoroughly as with the present construction, where it is forced or drawn practically into the bed of coal itself.

It will be noticed that the compound arch covers the entire area of the main grate-bars; that the air-outlets are midway between the two chambers formed by the compound arch and at a point where the arch is nearest to the grate-bars; that the flow of air from the arch is downward and into the coal and at about right angles to the natural flow of the liberated gases and travel of the coal; that the main grate-bars form the bottom of the coking-magazine as well as the bottom of the mixing and combustion chamber; that the inner end of the combustion-chamber is entirely open for the passage of heat to the boiler, and that the arch above the combustion-chamber, where the fire is hottest, is provided with the circuitous air-duct for the reasons as hereinbefore specified.

In addition to the points of construction heretofore outlined there are other features of construction which aid in making a thoroughly-practical furnace and which contribute to the proper coking of the coal, as well as to the proper heating of the air and gases to a temperature whereby thorough mixing and complete combustion are obtained. Thus it is seen that the arch E extends underneath the boiler in a parallel line therewith to a point considerably to the rear and for almost its entire length is separated from the boiler by an air-space, except at its immediate front, where the boiler extension into which the flues open and which contains no water rests upon the arch and is protected from the direct action of the flames and heat which travel over the top of the arch and heat the boiler where there is water up to the said extension. The outlet-passage between the bridge-wall F and the boiler is made about half the size of the combustion-chamber mouth or outlet located between the top of the bridge-wall F and the end of arch E, and the heat is thus restricted at the narrowed outlet and caused to partially flow back over

the arch and toward the forward end of the boiler. The object of this is twofold—first, to heat the boiler uniformly, and, second, to heat the arch on top, so that the circuitous air-duct is doubly exposed to the heat, and also to heat the arch itself, especially at the front above the coking-chamber, so that the coal therein is directly exposed to a radiated heat and coking is made thorough enough to release the gases at a high temperature. The arch being located entirely within the boiler-setting and having the space described below the boiler, no loss by radiation is had and better coking is obtained, owing to the deflection of the heat from the arch upon the entire body of coal. The boiler is materially benefited by the radiation of heat from the top of the arch, and the arch being made of fire-brick and having the circuitous air ducts or flues therein long life is assured, making a cheap and thoroughly practical and successful furnace.

What I claim, and desire to secure by Letters Patent, is—

1. The boiler and boiler-setting and a furnace at the front end of said boiler having grate-bars, and a fire-brick arch above said bars forming separate coking and combustion chambers, said arch extending from the front of said boiler-setting to the rear and substantially on parallel lines but separated from said boiler, and a bridge-wall beneath said boiler forming the inner end wall of said furnace and having an outlet-passage for the products of combustion above said wall and beneath said boiler of less area than the outlet-mouth of the combustion-chamber, substantially as described.

2. The boiler and boiler-setting and the furnace beneath the front end of said boiler entirely within said boiler-setting, said furnace having a compound arch and grate-bars beneath said arch forming separate coking and combustion chambers, said arch extending from the front of said boiler-setting to the rear and having an open space above the same and below said boiler, a bridge-wall forming the end wall of said furnace and having a passage for the heat beneath said boiler of less area than the outlet from the combustion-chamber at the end of said arch, and air-ducts leading to said combustion and coking chambers, substantially as described.

3. A boiler and boiler-setting and the furnace beneath the front end of said boiler entirely within said setting, said furnace comprising the inclined grate-bars and a compound arch above said grate-bars having a central throat forming separate coking and combustion chambers, said arch extending to the rear from the front of the boiler-setting and separated from said boiler to form a heating-space between the arch and boiler, a circuitous air-duct through said boiler-setting and arch leading to said chambers, and a bridge-wall located beneath said boiler and at the end of said arch and constructed to back up a portion of the heat over the arch and under the front end of the boiler, substantially as described.

4. The boiler and a boiler-setting therefor having a furnace located beneath the boiler within the front end of the setting, grate-bars for said furnace, a compound arch between said bars and boiler inclined downward away from the boiler at the front water-line thereof and extending thence on a parallel line with said boiler to the rear, said inclination of the arch forming a coking-chamber and the parallel portion a combustion-chamber with a throat at their intersection above said grate-bars, a circuitous air-duct in the arch having discharge-openings into said chambers, means to feed the coal from the coking-chamber to the combustion-chamber, and a bridge-wall beneath the boiler and at the end of said arch located at such relative distances therefrom as to restrict the heat passing over said wall and to back a portion of the same over the arch and under the front end of the boiler, substantially as described.

5. The boiler and its setting having a furnace located beneath the forward end of the boiler, inclined grate-bars C for said furnace, a compound arch E above said grate-bars having an inclined portion at the front beginning at the front water-line of the boiler and joining a horizontal portion parallel with but separated by a space from the boiler, said portions of the arch forming separate coking and combustion chambers with a throat above said bars, circuitous air-ducts in the top of said arch having discharge-openings near said throat, means to feed the coal from the coking-chamber to the combustion-chamber, and a bridge-wall F located beneath the said boiler and at the inner end of said furnace and separated from each with a relative smaller area between the top of the wall and the boiler than between said wall and end of the arch, substantially as described.

Witness my hand to the foregoing specification this 30th day of August, 1899.

WILLIAM R. HINES.

Witnesses:

H. T. FISHER,

R. B. MOSER.