

W. G. CROSTHWAITE.
FURNACE OF STEAM BOILERS AND THE LIKE.

APPLICATION FILED SEPT. 27, 1905.

957,310.

Patented May 10, 1910.

2 SHEETS—SHEET 1.

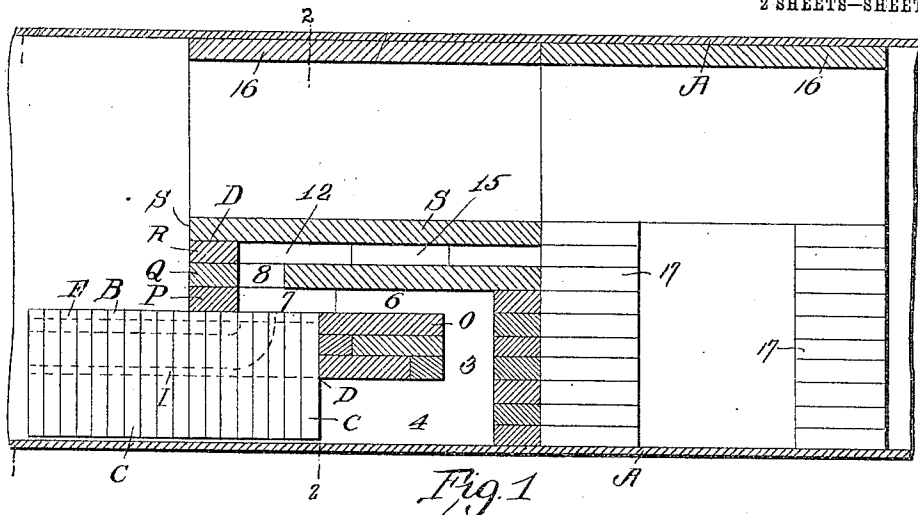


Fig. 2.

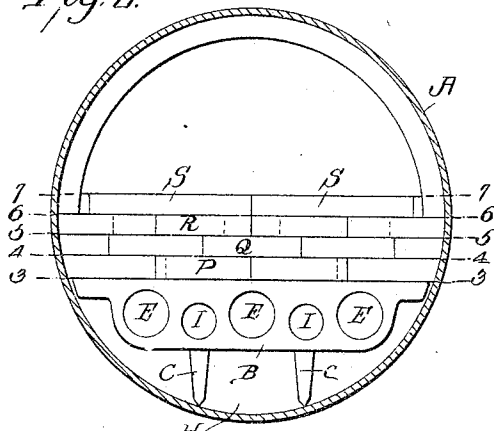


Fig. 3.

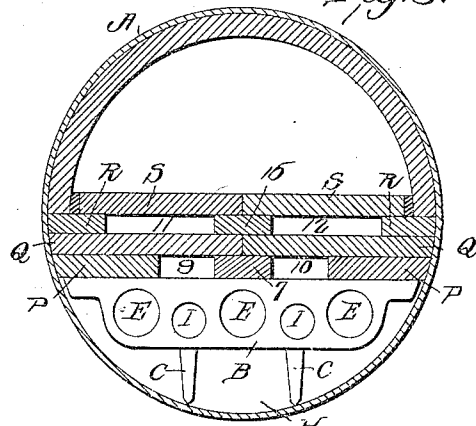
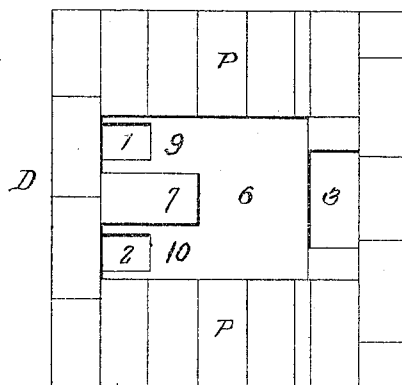
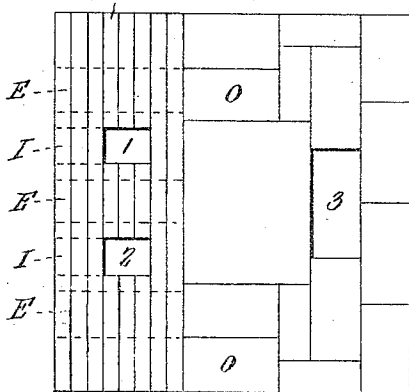


Fig. 4.

Fig. 5.



Witnesses

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2 SHEETS—SHEET 2.

Fig. 6.

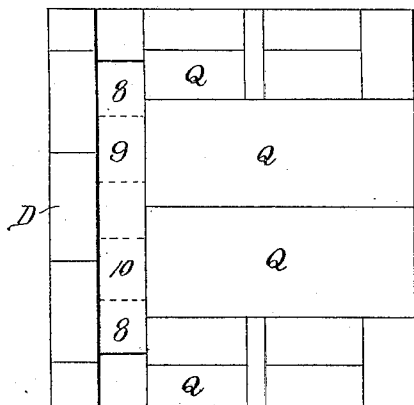


Fig. 7.

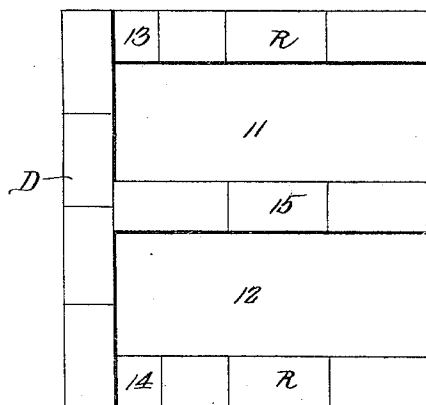


Fig. 8.

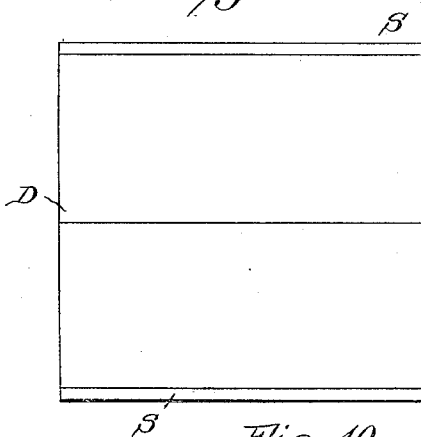


Fig. 9.

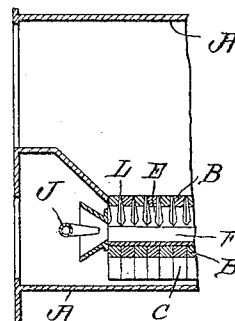


Fig. 10.

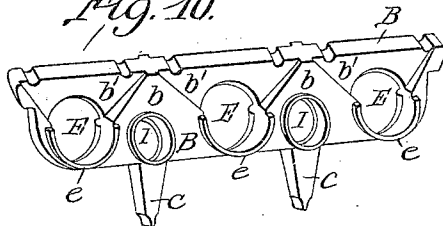


Fig. 11.

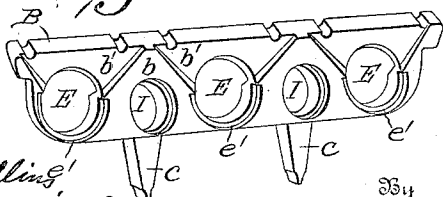
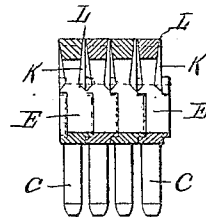


Fig. 12.



Inventor

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Attorney

UNITED STATES PATENT OFFICE.

WALTER GEORGE CROSTHWAITE, OF LEEDS, ENGLAND, ASSIGNOR, BY MESNE ASSIGNMENTS, TO THE UNITED CIGARETTE MACHINE COMPANY, LIMITED, OF LONDON, ENGLAND, A CORPORATION OF GREAT BRITAIN.

FURNACE OF STEAM-BOILERS AND THE LIKE.

957,310.

Specification of Letters Patent.

Patented May 10, 1910.

Application filed September 27, 1905. Serial No. 280,335.

To all whom it may concern:

Be it known that I, WALTER GEORGE CROSTHWAITE, a subject of the King of Great Britain and Ireland, residing at York Street Mills, York street, Leeds, in the county of York, England, have invented new and useful Improvements in or Relating to the Furnaces of Steam-Boilers and the Like, of which the following is a specification.

This invention relates to improvements in the furnaces of Cornish, or Lancashire or other like boilers employed for generating steam.

The invention has for its object a furnace grate constructed in the flue of firebars so as to constitute not only a grate for the fire, but also to provide air conduits for conveying forced or natural draft to the burning fuel, and also forced or natural draft to a bridge of special construction for smoke consumption by separate passages all formed in the bars themselves.

In the drawings hereunto annexed:—Figure 1. is a part longitudinal section of the flue of a boiler with this invention applied. Fig. 2. a transverse section on line 1, 1, Fig. 1. Fig. 3. a transverse section on line 2, 2, Fig. 1. Fig. 4. a horizontal section on line 3, 3, Fig. 2. Fig. 5. a horizontal section on line 4, 4, Fig. 2. Fig. 6. a horizontal section on line 5, 5, Fig. 2. Fig. 7. a horizontal section on line 6, 6, Fig. 2. Fig. 8. a horizontal section on line 7, 7, Fig. 2. Fig. 9. a detail view of air tube and grate bars. Figs. 10. and 11 perspective views of opposite sides of a grate bar. Fig. 12. a vertical section of four grate bars arranged as in position.

A is the flue shell or casing of, say, a Lancashire boiler, the firebars B,—forming the fire grate,—arranged transversely within the flue on longitudinal bearers not shown in the drawings. The firebars B hereinafter described and illustrated are constructed similar to those described and illustrated in the specification of United States Letters Patent granted to Thomas Westerly and Walter George Crosthwaite reissued May 23, 1905, No. 12,351. The firebars so constructed are shown at Figs. 10 to 12 of the accompanying drawings, and they possess the following essential features.

The firebars B are shown provided with feet C which rest on the bottom of the flue.

In each bar B are formed holes E which, when the bars are placed side by side in the flue to form the grate, constitute continuous passages longitudinally of the grate for the air blast. The holes E are closed at the rear end of the grate by omitting the said holes from the rearmost bar, or by the fire bridge D itself, so as not to deliver air to the bridge. The firebars abut against each other at their surfaces *b*, but at *b*¹ they have fan-shaped recesses communicating directly at their lower ends with the upper parts of the air passages E,—that is to say, the recesses are made to increase in width from the air passages E to the upper surface of the firebars,—so as to deliver a blast from the passages E in an upward direction through said recesses *b*¹ in a fan shaped current into the fire, the flat abutting faces preventing any escape of air from passages E downward toward the ashpit H. The fan shaped recesses *b*¹ are inclined or formed wedge shaped vertically. The recesses *b*¹ are wider at the base than at the top as shown, providing when the bars are placed side by side a number of channels K between contiguous bars which gradually narrow toward the top and finally terminate in narrow openings L at the surface of the grate. The uprising air is thus made to enter the channels K at the lower part where there is comparatively large area, and by reason of the channels gradually contracting in area toward the narrow openings L, the air passage is relatively contracted in volume which causes the air to rush through the openings L with a greatly augmented velocity and this rush of air through the bars tends to keep the grate cool.

The air is prevented from leaking out between the bars at their abutting faces *b*, should said faces be cast not quite true, by the projecting flanges *e* which partially project around the lower half of the holes E on one side, and by corresponding annular recesses *e*¹ (also around the lower half of the said holes E which form grooves or seats corresponding to the contour and dimensions of the said flanges *e*) in the other side of the bar, so that when the bars are placed together to form the grate they interlock at the holes E and leakage of air at their abutting faces is thereby minimized. The blast of air is delivered in a fan shaped current

upward through the bars which causes the heat to impinge against the top of the furnace portion of the flue and produce a fire of great heat and uniform intensity. I are
 5 separate air passages in the bars and through the bridge so arranged as to deliver forced or natural draft at will into the air chamber 6 (to be presently described) at the bridge. The passages I are shown
 10 smaller,—but not necessarily so,—in size than holes E, and they may also be provided with rings and annular grooves so as to interlock in the same manner as the air passages E. J is the steam jet at the entrance
 15 to the air passages for introducing the forced draft.

No claim is made in this specification to the above described firebars, except when used in combination with a bridge D constructed as hereinafter described.

The bridge D is shown built over a portion of the rear of the bars B, and a portion of the bridge is employed for blocking the holes E so as to prevent the passage of air
 25 therefrom to the chamber 6, or the holes E may be omitted from the rearmost bar. The bridge D is built of bricks, made of fireclay, in a number of layers or courses, hereafter termed "courses." In the drawings five
 30 courses lettered O, P, Q, R, S, are shown. In each course one or more air chambers or passages is or are formed and arranged as hereafter described, and they respectively
 35 communicate with the course immediately above it. The course O, level at its top with the top of the fire-bars, is shown to consist of more than one (three are shown) layer of bricks, and its front end will be carried on
 40 one or more bearers not shown in the drawings. A passage 3 is shown at or near the rear of this course, but it may be arranged in any other convenient position. The passage 3
 45 communicates at one end with passage 4 which runs under and beyond the rear end of the grate to the front of the same and at the other end with the air chamber 6 formed in the second course P. In the second course P an air chamber 6 is formed at or about the
 50 center of the course, and it is provided with a longitudinal division piece 7 (see Fig. 5) extending for a portion of the length of the chamber from its end nearest to the front of the bridge rearward. To either side of the
 55 divisional wall 7 is an air-passage numbered 9 and 10, respectively. The outlets 1 and 2 of the passages or air conduits I, I are arranged to communicate with the passages 9 and 10 near the end at the front portion of the bridge to either side of the division piece
 60 7. Passage 3 is also in communication with the same air chamber 6 at a suitable distance from the rear of the bridge, and by means of the passage 4, said passages 3 and 6 communicate with the air space or passage-way
 65 under the grate. The third course Q which

may be formed of one or more slabs or quarries,—two are shown at Fig. 6,—forms the top or covering for the said air chamber. In the third course Q a transverse air passage 8 is formed at a suitable distance from the front of the bridge. The passage 8 communicates with the air chamber 6 below, by means of air passages 9, 10, of the course P. The passage 8 also communicates with the two air chambers 11, 12, in the fourth course R at each of its ends by means of the air passages 13 and 14.

The two air chambers 11 and 12 are formed at or about the center of the course R (see Fig. 7) and they are divided from each other by means of a central division piece 15 (see Figs. 1 and 3). The chambers 11, 12, are covered by the fifth course S (see Fig. 8) which forms the top of the chambers, and they are open to the flue at the rear of the bridge. The passage of the air within the bridge-wall is as follows: from passages I, 4 and 3 into the chamber 6, thence by way of passages 9 and 10, through passages 8, 13, and 14 into chambers 11 and 12 and out into the flue and commingles in a warm or heated state with the gases and other products of combustion arising from the consumption of the burning fuel on the fire-bars and passing over the bridge.

The flue shell or casing A may be suitably lined at the crown with an arching of fire-brick 16 from the front of the bridge to a suitable distance beyond its rear, as shown at Fig. 1. The arching may be suitably supported by brickwork 17 located back of the bridge-wall and arranged to follow the contour of the flue.

The fifth course S may be formed of one or more slabs or quarries. Two are shown in the drawings.

The transverse air passages 8, 13, and 14, formed in both the third and fourth courses permit of the air freely circulating across the bridge, whereby it may become thoroughly warmed before mingling with the products of combustion at the rear of the bridge.

The mode of action is as follows:—The fuel is thrown on the grate either by hand or mechanical stoker, and the air, besides being delivered out beyond the bridge with its passages in communication with the passages I for secondary combustion, is also delivered in fan shaped currents from the passages E upward between the bars all over the grate surface with a vertically upward motion through the grate which being well ventilated will not get so hot as would otherwise be the case, and the adhering of clinker is entirely prevented. The air rises through the fuel vertically and the flame strikes directly upward or nearly so, forming an intense flame bearing right against the crown of the furnace and passing over the bridge

with a considerable amount of carbon unconsumed. This flame meets the hot air issuing through the bridge and the remaining carbon hydrogen and other combustibles are at once consumed. The attendant in charge of the furnace can at any moment increase or decrease the forced air current by regulating the steam jets J and thus the draft can be controlled to a nicety. The grate is well suited for burning small coal, coal dust, sawdust, and rubbish, and applied to destructors and marine boilers is unequalled for economy and efficiency.

The air admitted to passages I and from under the firebars to the passages and chambers formed in the various courses in the bridge is made to take a zig-zag or tortuous course before it issues from the rear of the passages 11 and 12 and commingles with the gases and other products of combustion that pass over the bridge and along the flue. By this means they become thoroughly heated before the mingling process is allowed to take place, whereby any cooling of the flue or gases therein is prevented.

What I claim as my invention, and desire to secure by Letters Patent, is:—

1. In a furnace having an ash pit, a grate formed of fire-bars provided with openings therethrough extending the length of the grate, whereby to pre-heat the air passing therethrough, a bridge having a number of chambers therein one above another and which communicate with one another out of line to form a tortuous passage, the lowermost of said passages being open at its base to the air passages in the grate of the furnace and with its ash pit, and also having an opening near the top of the rear of the bridge, an arch extending from the front of the bridge to a distance beyond the rear of the same, and supports for said arch beyond the bridge.

2. In a furnace having an ash pit, fire-bars provided with air conduits therein, a bridge comprising courses horizontally disposed to form chambers therein one above the other, said chambers communicating with each other out of line to form a tortuous passage open at its base to the air passages in the fire-bars of the grate and to the ash pit, and also having an opening near the top of the rear of the bridge, supports on each side of the furnace beyond the bridge, and an arch extending from the front of the bridge to a distance beyond its rear and supported partly by the bridge and partly by said supports.

3. In a furnace, a fire flue containing a grate formed of transverse fire-bars provided with air conduits therein and having an ash pit below the fire-bars, a bridge comprising courses horizontally disposed to form chambers therein one above the other, said chambers communicating with each other out of

line to form a tortuous passage open at its base to the air conduits in the fire-bars of the grate and to the ash pit, and also having an opening near the top of the rear of the bridge, supports on each side of the furnace beyond the bridge and arranged to follow the contour of the flue, and an arch extending from the front of the bridge to a distance beyond its rear and supported partly by the bridge and partly by said supports.

4. In a furnace, a grate composed of bars placed close together and having transverse openings therethrough forming a series of air conduits, a second series of air conduits through said bars intermediate the first series, said second series terminating in upwardly disposed openings in the rearmost of said bars, a bridge partially overlying the grate and covering said openings and having formed therein a tortuous passage communicating with said air conduits, and an air conducting passage beneath the grate also communicating with said tortuous passage.

5. In a furnace, a grate composed of bars placed close together and having transverse openings therethrough forming a series of air conduits, a second series of air conduits through said bars intermediate the first series, said second series terminating in upwardly disposed openings in the rearmost of said bars, a bridge partially overlying the grate and covering said openings and having formed therein a tortuous heating passage communicating with the said second series of air conduits in the bars and with an air conducting passage beneath the grate, and provided above with an outlet for the heated air.

6. In a furnace, fire-bars provided with a series of air conduits therein and having ducts leading therefrom, an ash pit, a bridge wall having an opening thereunder communicating with said ash pit, said air conduits leading to and closed by said bridge wall, said bridge wall comprising a plurality of alternately disposed courses superposed and spaced to provide therein a tortuous air passage-way in communication with the opening thereunder, said fire-bars provided with a second series of air conduits intermediate said first-named series and communicating with the passage-way in the bridge wall, supports on either side of said furnace beyond the bridge wall and an arch extending from the front of the bridge to a distance beyond its rear and upheld by said bridge wall and supports.

7. In a furnace having an ash pit, fire-bars provided with a series of air-conduits therein, and having ducts leading therefrom, a bridge-wall, said air-conduits leading to and closed by said bridge-wall, said bridge-wall comprising a plurality of alter-

nately disposed courses superposed and
spaced to provide a tortuous air passage-
way, each of said courses comprising a
plurality of slabs, said fire-bars provided
5 with a second series of air-conduits inter-
mediate said first named series, said second
series of conduits communicating with the
bridge-wall passage-way, and piers of brick-
work on either side of said furnace, said
10 bridge-wall having a passage-way therein

communicating with the ash-pit and the
tortuous passage-way.

In testimony whereof I have signed my
name to this specification in the presence of
two subscribing witnesses.

WALTER GEORGE CROSTHWAITE.

Witnesses:

W. FAIRBURN-HART,
WILLIAM SADLER.