W. G. CROSTHWAITE.

FURNACE.

APPLICATION FILED SEPT. 26, 1905.

955,387. Patented Apr. 19, 1910.

2 SHEETS—SHEET 1.

Fig. 1.

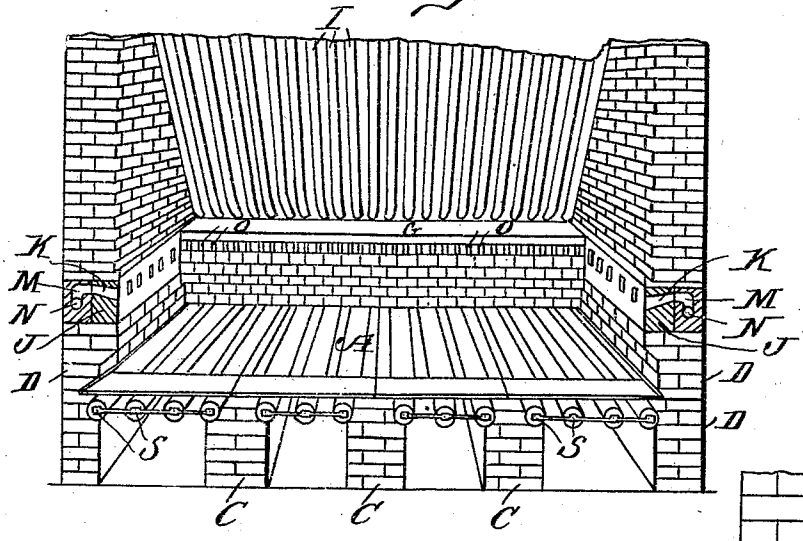


Fig. 2.

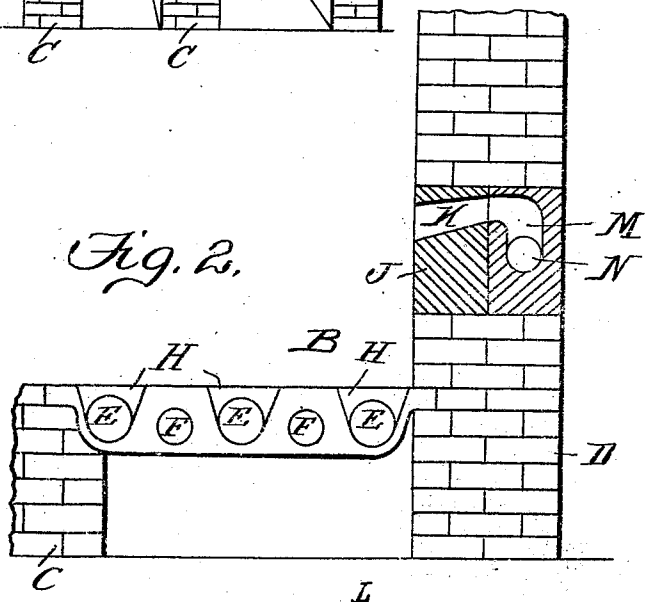
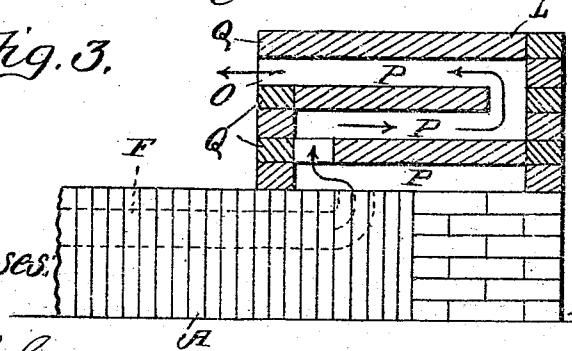


Fig. 3.



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2 SHEETS—SHEET 2.

Fig. 5.

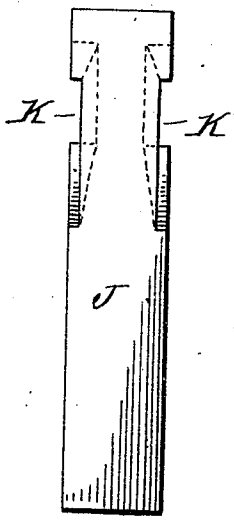


Fig. 4.

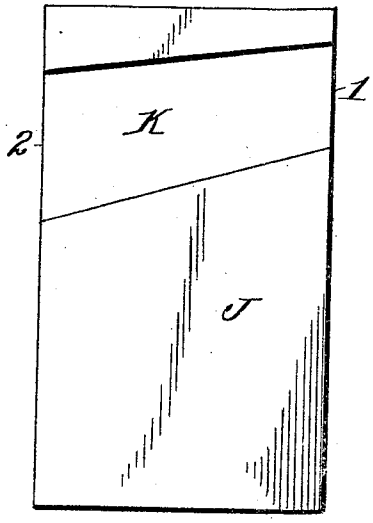


Fig. 6.

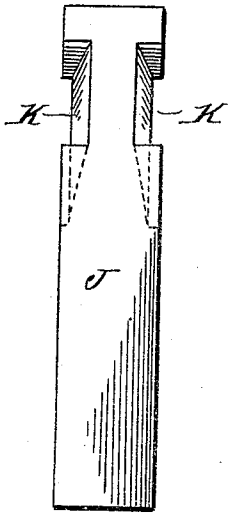


Fig. 7.

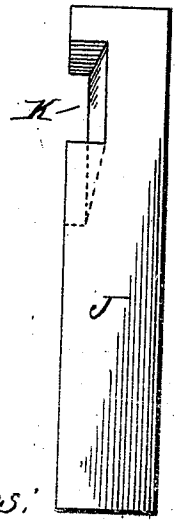
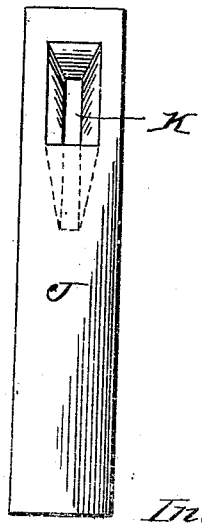


Fig. 8.



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FURNACE.

955,387. Specification of Letters Patent. Patented Apr. 19, 1910.

Application filed September 26, 1905. Serial No. 280,160.

To all whom it may concern:

Be it known that I, WALTER G. CROSTHWAITE, a subject of the King of England, residing at Leeds, in the county of York, England, have invented new and useful Improvements in Furnaces, of which the following is a specification.

This invention relates to improvements in the furnaces of steam boilers, such as tubular water, Lancashire, and other like boilers, as well as in furnaces of other kinds in which grate bars are used, such as, for example, say, brewers', coppers, plate heating, ingot heating, or the like.

The object of the present invention is to provide means whereby air, at atmospheric pressure, or above such pressure, may be introduced through either the sides, or at the end or bridge of the furnace, or both, above the level of the fire or fuel being consumed to promote combustion thereof.

By the use of this invention an increased amount of heat may be obtained from a given quantity of fuel, and consequently a greater amount of steam may be generated at a diminished cost; and, furthermore a fuel of low quality and heretofore inferior steam-producing value may be used.

This invention consists in building into the sides of the furnace of the boiler a number of bricks or tiles, hereafter termed "bricks." Each brick is constructed and arranged as hereafter described, and it has formed in one or both of its sides a recess or interstice for admitting atmospheric air, or a forced draft, to the furnace from a cavity formed in the sides of the furnace at the rear of the bricks. A similar set of air passages may be provided in the rear of the furnace or the fire bridge by means of the said bricks; or by a specially constructed bridge as shown in the drawings. In either case the air to the rear of the furnace or the fire bridge is conveyed to the air passages in the latter, say, by means of air passages arranged in the fire bars. The fire bars it is preferred to employ, but not necessarily so, in combination with the said bricks and fire bridge, are constructed according to the specification of Reissue Letters Patent granted to Thomas Westerby and Walter George Crosthwaite on the twenty-third day of May A. D. 1905 Re. No. 12,351.

In the drawings hereunto annexed I have illustrated one embodiment of my invention, and in said drawings:—Figure 1. is a perspective view from the front, furnace portion of a tubular water boiler with this invention applied. Fig. 2. a part transverse sectional elevation of the portion of the furnace of a tubular water boiler on an enlarged scale, showing the bricks in position. Fig. 3. a longitudinal section of the fire bridge and a portion of the fire bars. Fig. 4. a side elevation of one of the bricks. Fig. 5, an end elevation of the front edge of the brick. Fig. 6. an end elevation of the back edge of the brick. Fig. 7. is a view in end elevation of the back edge of a modified form of brick. Fig. 8. is a view, similar to Fig. 7. of still another construction of brick.

In the drawings hereunto annexed the invention is shown applied to the furnace portion of what is known as a "Stirling" tubular water boiler, but it will be understood that it may also be applied to the furnace of any other form or make of tubular water boiler, or to a Cornish, or a Lancashire, or other boiler, or to any other furnace in which grate bars are used, say for brewing purposes, or for plate heating, ingot heating, or the like purposes.

The grate bars A shown in the drawings are constructed according to the specification of Westerby and Crosthwaite's said Letters Patent, but any other grate bars may be used.

The grate bars A shown in the drawings are arranged transversely in the furnace B side by side, and their ends are supported upon brickwork piers C with or without iron girders or bearers (not shown in the drawings) arranged longitudinally thereon. The walls D of the furnace are employed for supporting the outer ends of the grate bars A. As described in Westerby and Crosthwaite's hereinbefore mentioned specification, the grate bars are provided with a number of holes E and F, which holes, when the grate bars are placed transversely side by side in the furnace, form longitudinal passages for conveying air or a forced draft respectively to the fuel in the furnace and to the rear of the furnace or to the bridge G. The holes E communicate with fan-shaped openings H which increase in width, as shown, as they ascend from the air passage to the upper surface of the grate bars. In cross section the said recesses are also made to taper, being larger at the air passage than at the upper surface of the bars A. This enables the air to enter the said

recesses at the lower part where there is comparatively larger area and by reason of the recesses gradually contracting in area toward the narrow openings at the upper surface of the bars A, the passage is relatively contracted in volume, which causes the air to rush through the openings at an augmented velocity.

The passages E may be closed at the end farthest from the door by the brickwork at the rear of the furnace, or by omitting making the holes E in the rearmost bar. The passages F are made to communicate with the openings and air passages arranged at the rear of the furnace, or in the bridge G for conveying, say, air thereto. The holes E and F are provided with nozzles S, which latter are connected with any suitable forced draft apparatus.

I are the tubes of a tubular water boiler, and they are of the usual construction, and arranged in the ordinary manner at the rear of the furnace.

Along the inside of each of the outer walls D of the furnace is arranged and fixed a number of bricks J, formed say, of fireclay or like material, and they are made of any suitable height, breadth, and thickness, convenient dimensions for these bricks being about fifteen inches in height, by nine inches in width, and three inches thick. Each brick J has a recess K formed in one or both of its sides, recesses being shown in two sides in the drawings herewith, at a suitable distance from the top. The recess K is made to taper from the back to the front of the brick, and it increases in depth, as well as diminishes in width, as it approaches the inner face of the brick. That is to say, the recess in the side of each brick at its rear face 1 is about three inches wide by about three-fourths of an inch in depth, and on the inner face 2 of the brick, the recess increases in width to four inches and a half, and in depth decreases to one-fourth of an inch. This forms, when two bricks J are placed side by side, as shown at Fig. 1, a fan shaped opening very similar in construction to the fantail recesses in the grate bars. The dimensions of the bricks, and also of the recess or recesses therein may of course, be varied as circumstances require. The recess K is farther from the top of each brick on its inner face 2 than at its back 1 in order that a downward inclination may be given to the draft.

When the bricks are placed together, side by side in a line, as at Fig. 1, with the recesses facing each other, a series of openings is thereby formed in the side of the furnace for the admission of air into its interior above the fuel in process of consumption. The bricks are arranged side by side in a row on each side of the furnace, and in some cases, when so desired, but not necessarily so, at the end or bridge portion L which is opposite to the door of the furnace as well At the rear of each row of bricks a cavity M is provided in the outer wall D, to which air, steam, or air and steam are admitted under pressure by any similar means as pipe N. The air conveyed to the cavity M by the pipe N is allowed to enter the fan shaped passages K in the bricks J at the part where there is comparatively large area, and by reason of the recesses, gradually contracting in area toward the openings on the inner surfaces 2 of the bricks, the passage is relatively contracted in volume, which causes the air which is heated in passing through the furnace walls to rush through the said openings at an augmented velocity. The air is thus delivered on to the fire, thereby causing the heat to impinge against the top of the furnace or water tubes passing through the same, which produces a fire of great heat and uniform intensity.

In some cases, but not necessarily so, instead of using the herein described bricks, the back of the furnace, or the bridge when such is used is provided with openings O, and an air passage P by constructing the said back or bridge as follows:—A zig-zag course or passage P is formed say, either in the brickwork at the back of the furnace, or in the bridge as shown at Fig. 3, by arranging a number, say, one, two, or more, of slabs Q, formed, say of fireclay of the same or varying widths, and of suitable length and thickness, horizontally one above the other with a space between them to form the air passage P. The said slabs are arranged at suitable distances apart so that the air or forced draft is made to pass over the horizontal surface of one slab and is then carried upward and made to pass over the end and horizontal surface of a second slab, and so on until it issues through suitable fan shaped or other passages O into the furnace or flue above the fire at the rear and at a point opposite to the door of the furnace.

The air or forced draft is conveyed to the air course or passage formed as described in the back of the furnace, or the bridge G, either through the openings F in the fire bars themselves as shown, or by means of one or more separate tubes (not shown) arranged to run underneath the fire bars and to communicate at its or their inner end or ends with the air course or passage P formed in the bridge or at the back of the furnace.

When the bricks J are applied to the flue of, say, a Cornish or Lancashire boiler, the bricks will require to be arranged at a suitable distance from the inner periphery of the flue to form the cavity M. The top of the cavity will be formed by a flat slab or brick being placed upon the top of the bricks J and allowed to overhang the face 1 of the

same a sufficient distance to touch the said periphery of the flue.

Although the hereinbefore mentioned fan shaped recess K is described and shown as being formed partly in the sides of each of two bricks J, which when placed side by side form a complete fan shaped recess,—this being an easy way of manufacturing the same,—yet I would have it distinctly understood that the said fan-shaped recess may be formed, if desired, wholly in the side of one brick as shown in Fig. 7. When this is done the flat side of the brick placed next to it would form the second vertical side wall of the said recess. The recess would in this instance only have one of its vertical side walls tapering from back to front, instead of both vertical side walls doing so as shown in the drawings. Further, if so desired, instead of forming the fan shaped recess by either of the above described methods, it may be formed in, say, about the center of the main portion of the brick, as shown in Fig. 8. By this method each brick would then be complete in itself and would contain a cut away portion with all of its boundaries or walls made to taper in each of the directions hereinbefore described and as illustrated in the drawings.

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 in fan shaped currents by the grate bar passages E, upward between the bars all over the grate surface with a vertical upward motion, is also delivered through the passages K in fan shaped currents at each side of the furance over the fire, and with a downward tendency. Air is also admitted at the rear of the furnace on to the fire through the openings O from the passage P. By these arrangements provision is made for admitting air to the fuel under consumption not only from beneath but also above it at three separate portions of the furnace above the level of the fire. This arrangement of admitting air to the furnace not only permits of a fuel of a low quality being employed, but at the same time an increased amount of heat is obtained from a given quantity of fuel, as provision is thereby made for igniting and utilizing the gases arising from and during the consumption of the fuel. Consequently a greater amount of steam can be generated at a diminished cost.

Having fully disclosed my invention, I claim:

1. A brick for furnace construction having a tapered recess formed in one face thereof, said recess being relatively wide and shallow at one end and deep and narrow at the other, and adapted to coöperate with the recess in an adjacent brick, to form a port with a flaring mouth.

2. A brick for furnace construction having tapered recesses formed in opposite faces thereof, said recesses being relatively wide and shallow at one end and deep and narrow at the other, and adapted to coöperate with the recesses in adjacent bricks, to form ports each having a flaring mouth.

3. In a furnace, a wall structure, a row of bricks therein, each brick having recesses formed in opposite faces thereof, each recess being relatively wide and shallow at one end and deep and narrow at the other, the recesses in adjacent bricks forming a port relatively wide and shallow at one end and deep and narrow at the other.

4. A brick for furnace construction having a tapered cut away portion formed therein, said portion being relatively wide and shallow at one end and deep and narrow at the other.

In testimony whereof I have hereunto set my hand in presence of two subscribing witnesses.

WALTER GEORGE CROSTHWAITE.

Witnesses:
W. FAIRBURN-HART,
CHAS. GILLIARD.