No. 770,984. PATENTED SEPT. 27, 1904.

J. S. ROAKE.

BOILER FURNACE.

APPLICATION FILED DEC. 12, 1903.

NO MODEL.

Fig. 1.

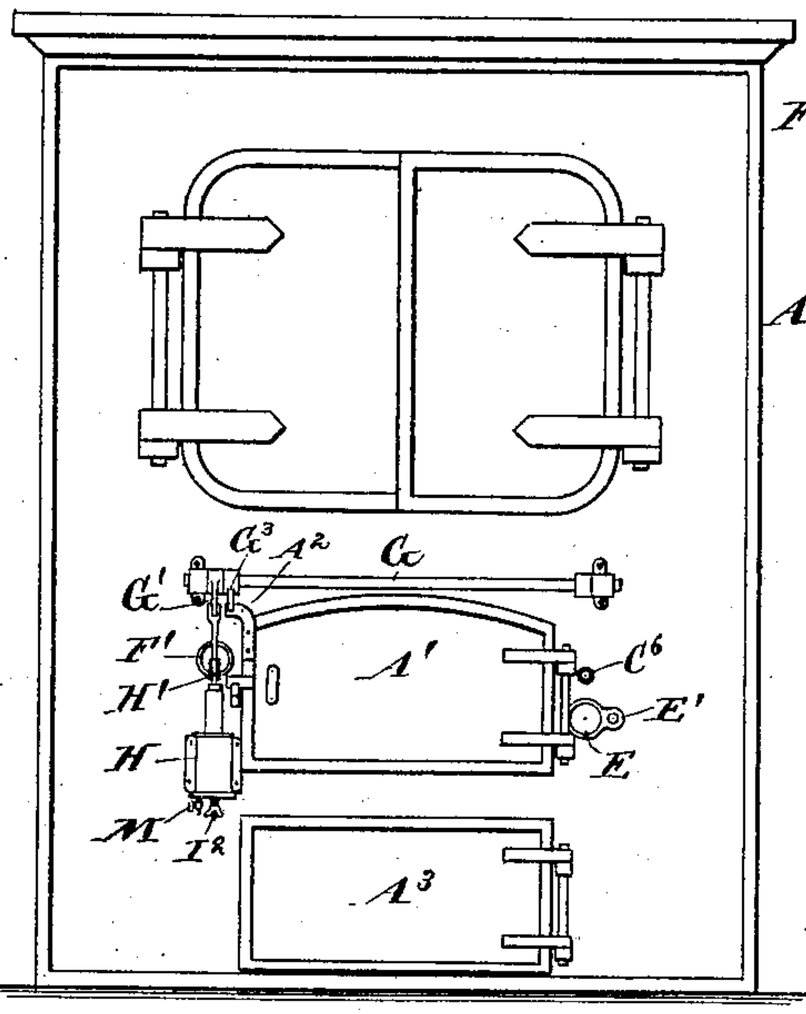


Fig. 6.

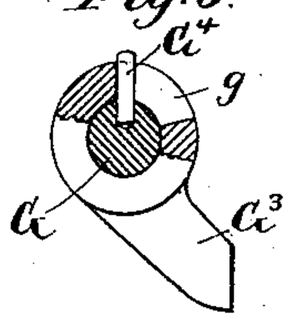


Fig. 7.

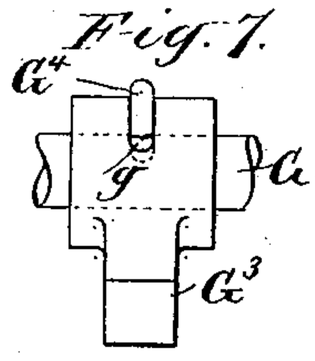


Fig. 5.

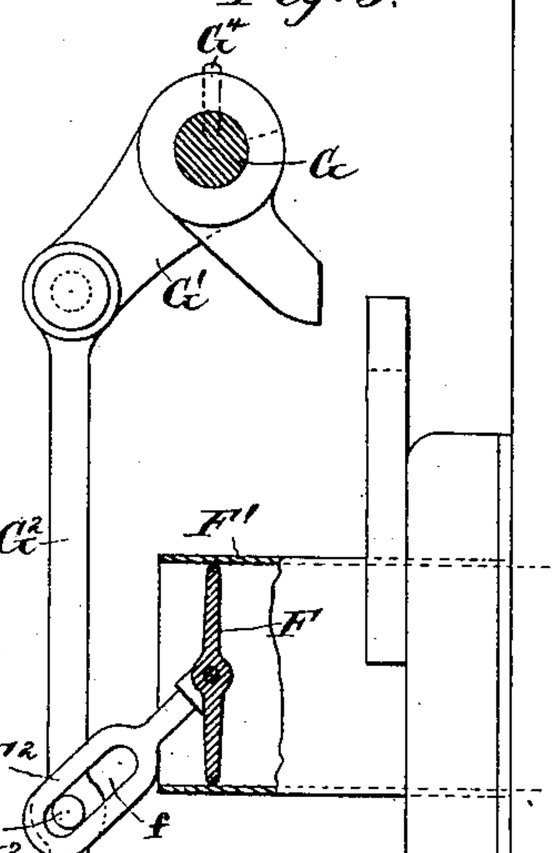


Fig. 2.

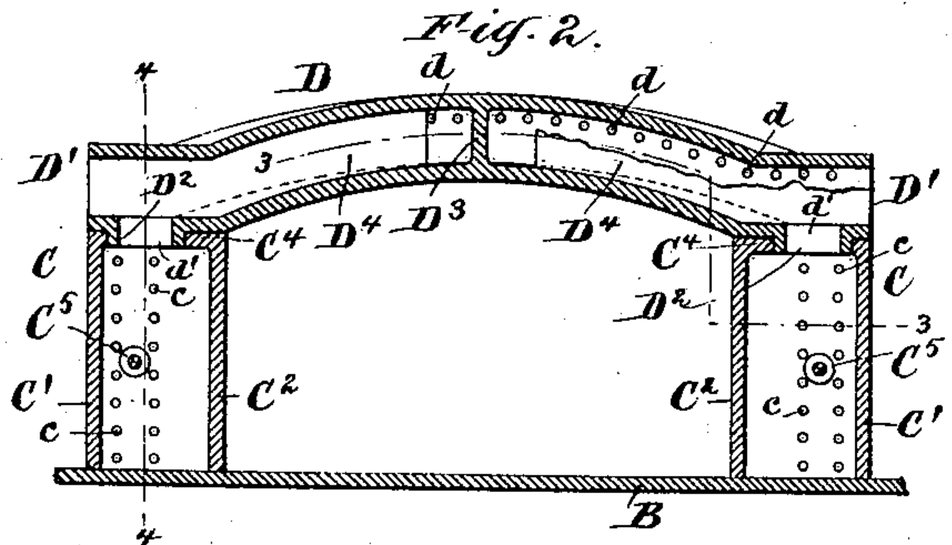


Fig. 3.

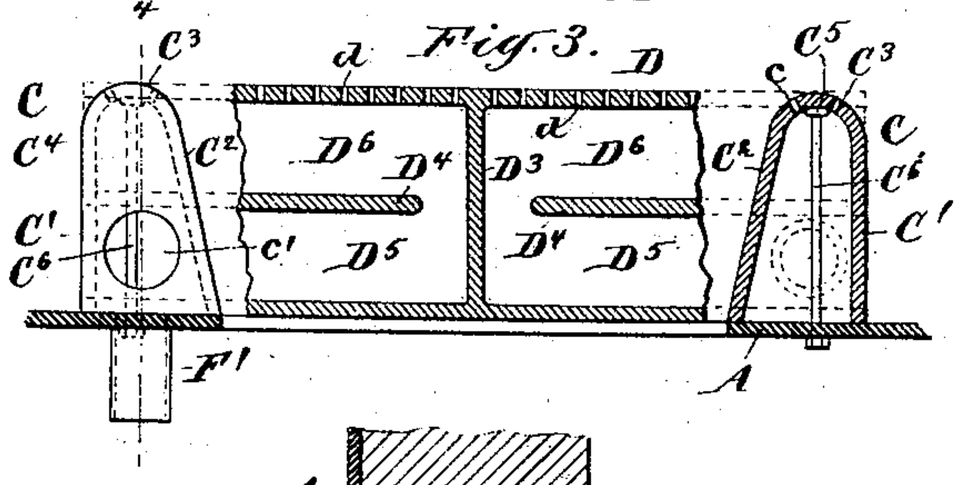
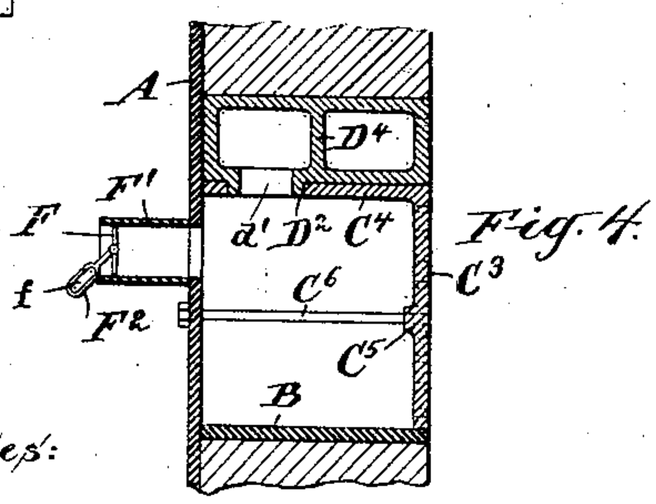


Fig. 4.



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No. 770,984. Patented September 27, 1904.

UNITED STATES PATENT OFFICE.

JOHN S. ROAKE, OF NEW YORK, N. Y.

BOILER-FURNACE.

SPECIFICATION forming part of Letters Patent No. 770,984, dated September 27, 1904.

Application filed December 12, 1903. Serial No. 184,874. (No model.)

To all whom it may concern:

Be it known that I, JOHN S. ROAKE, a citizen of the United States, residing in the city of New York, borough of Brooklyn, in the county of Kings and State of New York, have invented a certain new and useful Improvement in Boiler-Furnaces, of which the following is a specification.

The invention relates to the construction and arrangement of the arch and cheek-pieces and to means for supplying air therethrough to the interior of the furnace.

The object of the invention is to preserve the arch and cheek-pieces from failure due to excessive heat and to improve combustion in the furnace by the admission of heated air to the unburned gases therein.

The invention consists in certain novel features of construction and arrangements of parts and passages by which the above objects are attained, to be hereinafter described.

The accompanying drawings form a part of this specification and show the invention as it is proposed to carry it out.

Figure 1 is an elevation of a boiler-front equipped with my invention and shown as provided on one side of the fire-door with an automatic controlling device for the admission of air and on the other side with a simple swing-cover to be operated by the fireman for the same purpose. Fig. 2 is a vertical section through the arch and cheek-pieces, on a larger scale, a portion being broken away to show the parts beyond. Fig. 3 is a corresponding horizontal section, partly in plan view, with the ends of the arch broken away, the line of section being approximately that indicated by the broken line 3 3 in Fig. 2. Fig. 4 is a corresponding vertical section on the line 4 4 in Fig. 2. The remaining figures are on a still larger scale and show the device for automatically controlling the admission of air to the arch and cheeks. Fig. 5 is a vertical section partly in elevation. Fig. 6 is a vertical section, partly in elevation, showing a detail; and Fig. 7 is an elevation at a right angle to the preceding figure.

Similar letters of reference indicate like parts in all the figures.

A represents the front of a brick-set boiler and furnace and may be understood to be of any ordinary or approved design and construction.

A′ is the fire-door, and A^3 the ash-pit door.

B is a plate supported in the brickwork and forming the bottom or floor of the fire-door opening, and C C are hollow castings resting on the plate B, forming the cheek-pieces or sides of the opening. The top is formed by an arched casting D, hollow and provided with peculiarly-arranged passages resting on the cheeks C C and supporting the front end of the boiler. (Not shown.)

A weak point in boiler-furnaces as commonly set is the arch. If constructed of brick, it is rapidly disintegrated by the radiant heat, and if of iron it becomes weakened by the same cause, so that it is rendered unsafe. In both forms constant care and rebuilding at short intervals is necessary to avoid accident. In my improved construction the arch and cheeks are kept cool by currents of air continually passing through them, and the heat thus absorbed is utilized in conditioning the air to unite with the unburned gases in the furnace and insure their combustion.

The cheek-pieces C are counterparts. A description of one will suffice. Each is an open casting of general U form in horizontal section, set with the open side against the inner face of the boiler-front and having its outer side C′ at a right angle thereto, while the inner side C^2 flares rearwardly toward the furnace. The rear face or angle at C^3 is rounded and carries an interior boss C^5 at about the mid-height, drilled and tapped to receive a bolt C^6, passing through the boiler-front, by which the cheek is secured to the latter. The bottom is closed by the plate B, upon which it rests. The top C^4 is provided with an opening *c*′, as indicated in the figures. The angle C^3 is provided with one or more vertically-arranged series of small openings *c*, extending from the interior to the furnace and preferably divergent in direction.

The arch D is provided with straight or plane end portions D′ D′, having each a circular opening *d*′, surrounded by an annular depending flange D^2, matching to and received in the corresponding opening or socket *c*′ in

the top of the cheek C, and thus held in proper relation thereto and with their interiors in communication. The arch is divided transversely by a vertical central partition D^3, and the portions thus formed are each again divided by a vertical partial partition D^4, extending from the end D′ nearly to the cross-partition D^3. The open ends D′ are closed by the adjacent brickwork, (not shown,) and a series of small holes *d*, provided in the rear face near the top and following the outline of the arch and ends permit air received from the cheeks to pass to the furnace.

Openings through the boiler-front to the cheeks supply the air drawn in by the draft of the furnace. I have shown two differently-equipped openings. The one at the right of the fire-door is provided with a simple rotating door E, pivoted at E′, preferably with sufficient friction to remain in the open or any partly-open position. Air entering this opening absorbs heat immediately from the hot interior faces of the cheek, thus serving to reduce the temperature of the latter, and a portion escapes through the holes *c* in jets to the furnace. Another portion passes through the hole *d*′ to the arch, traverses the passage D^5 on the front side of the partition D^4, and thence along the passage D^6 in the reverse direction, absorbing heat from the arch, and is finally delivered in jets to the furnace through the series of openings *d*. This arrangement is simple and inexpensive and is designed more particularly for service in burning anthracite coal, in which the supply of air required is less variable. The door E may be set partly open and its position changed only as the condition of the fire requires more or less air for surface burning or may be completely closed to avoid affecting the draft in adjacent furnaces when one of a battery of boilers is temporarily out of service.

It is now generally accepted that the best results in burning coal are attained by bottom burning, with a certain proportion of surface burning. Theoretically the combustion of one pound of coal or its transformation by heat to carbonic acid yields fourteen thousand and forty heat units and requires two atoms of oxygen with each atom of carbon. If the combination takes place with but one atom of oxygen, the result is a transformation into carbonic oxid with a yield of only four thousand four hundred and fifty-three heat units. The latter result is that generally attained in ordinary practice. The air enters the ash-pit and passes through the grate to the fire, becoming somewhat heated in its passage. As it strikes the hot coals the oxygen unites with the carbon and free carbonic-acid gas is formed; but in going through the strata of hot coal one atom of oxygen is absorbed, so that the gas arising from the surface of the fuel is principally carbonic oxid. The carbonic oxid, however, flames very readily if mingled with heated air. Cold air entering at the fire-door is likely to be carried up by the currents from the fire against the crown-sheet, along which it travels, and by reducing the temperature causes a loss of evaporation in the boiler. By delivering air in a heated condition in the form of jets over an extended area a complete and intimate intermingling is produced in which the carbonic oxid and oxygen combine easily, and perfect combustion results.

Three important results are attained by my improvement. The incoming air cools the cheeks and arch, thus preserving those portions of the furnace. Oxygen is supplied above the fire in a heated condition favorably presented for rapid combination with the carbonic oxid, and the entrance of cold air, tending to cool the crown-sheet and retard the transmission of heat to the boiler, is avoided.

I attach importance to the transverse partition D^3 at the center, for the reason that it strengthens the arch at the point of greatest strain, where it supports the front end of the boiler and at which the intense heat induces the first indications of failure, and also for the reason that it serves to prevent the formation of direct air-currents from the air-admission apertures through certain of the discharge-orifices, and, on the contrary, compels the air entering one cheek to be delivered on the same side, thus insuring equable warming and distribution of the air through the arch and cheeks and prevents unequal temperatures in different portions of the castings.

At the left in Fig. 1 and in detail in Figs. 5, 6, and 7 is shown an automatic device for controlling the admission of air, intended more particularly for service in burning bituminous coal, in which it is desirable to supply air in considerable volume when fresh coal is added to the fire and gradually to diminish the supply until it reaches a minimum at the time the coal becomes coked, usually a period of from seven to ten minutes, depending upon the quality of the fuel and the condition of the fire. The device comprises a damper F of the butterfly type, mounted in a tube F′, communicating with the interior of the cheek, and means for automatically turning it to admit air by the act of opening the furnace-door, with means analogous to a dash-pot for automatically inducing a slow-closing movement. G is a horizontal shaft mounted in bearings above the fire-door, having a crank-arm G′, to which is attached a pitman G^2, knuckled at the lower end to a piston-rod H′ in a cylinder H. The piston H^2 is tight and serves on the upstroke to draw in air through a self-closing valve I in the bottom of the cylinder and imprison it, the air above the piston entering and escaping freely through apertures *h*, provided for the purpose and preferably protected against the entrance of dust by a skirt J, of leather or other flexible mate-

rial, loosely inclosing the upper portion of the cylinder. A pin H^3 on the piston-rod is engaged in a slot *f* in an arm F^2 on the damper, so arranged that the full upstroke of the piston turns the damper to the fully-open position. The upstroke is produced by an arm or lug A^2 on the furnace-door A′ striking a pawl or swinging dog G^3, encircling the shaft G and secured thereto by a radial pin G^4, extending through a segmental slot *g*, permitting the dog to swing idly as the lug A^2 passes in the act of closing the door and engaging the lug when the door is swung open, continuing the engagement until the shaft has made the required partial revolution. The downstroke is induced by the expansive force of a helical spring L, encircling the piston-rod and abutting at one end against a collar H^4 thereon and at the other against the inner face of a tubular extension H^5 on the cylinder-head. The rate of descent is determined by the slow escape of the imprisoned air below the piston through a petcock M, by which the area of the escape-passage is controlled. The self-closing valve I is provided with a spring I′ and thumb-nut I^2, by which it may be adjusted. Thus arranged the act of opening the furnace-door to supply fuel turns the damper F′ to admit air freely and gradually turns it to the closed position. It will be understood that the damper should not fit closely or should be provided with openings to insure the admission of sufficient air to cool the cheeks and arch and to maintain a constant minimum supply of hot air above the fire.

Modifications may be made in the forms and proportions within wide limits, and parts of the invention may be used without the whole.

It will be understood that both cheeks may be equipped with the automatic controlling device or with the simple rotating door shown or other analogous means.

Although I have described the invention as applied to boiler-furnaces, it will serve successfully with reverberatory and other furnaces.

I claim—

1. A hollow arch having a transverse partition dividing its interior into two portions, a longitudinal partial partition in each of said portions extending from the end nearly to said transverse partition and forming longitudinal front and rear passages in said portions, the said arch having air-admission apertures leading to said front passages, and having air-discharge orifices leading from said rear passages, means for supporting said arch at the ends, and means for supplying air to said admission-apertures.

2. A pair of cheek-pieces each comprising a hollow casting open at the front and closed at the rear and having an air-discharge opening at the top, in combination with a boiler-front having air-admission openings leading to the interior of said cheek-pieces, bolts extending through said boiler-front and cheek-pieces into the closed rear thereof, and a hollow arch having air-admission apertures matching to said air-discharge openings, the said arch and cheek-pieces having air-discharge orifices in their rear faces.

3. A hollow arch comprising a casting having a curved main portion and plane ends, a central transverse partition in said curved portion dividing the interior of said arch into two parts, a longitudinal partial partition in each of said parts extending from said ends nearly to said transverse partition and forming longitudinal communicating front and rear passages in said parts, the rear wall of said arch having air-discharge orifices leading from said rear passages, and having an air-admission aperture in the under face of each of said ends leading to said front passages, and a depending flange surrounding each of said apertures, in combination with a pair of cheek-pieces, each comprising a hollow casting supporting one of said ends and having an air-discharge opening matching to and receiving said flange, a boiler-front having air-admission openings leading to the interior of said cheeks, and means for securing said cheeks to said boiler-front.

4. A hollow arch having a transverse central partition dividing the interior into two parts, a longitudinal partial partition in each of said parts forming communicating front and rear passages therein, each end of said arch having an air-admission aperture in its under face communicating with said front passage, and a depending flange around each of said apertures, in combination with a boiler-front, a pair of cheeks supporting the ends of said arch, each comprising a hollow casting closed at the front by said boiler-front and having an air-delivering opening at the top matching to and receiving one of said flanges, and a bolt extending from the closed rear wall of each cheek through said boiler-front, the latter having air-admission openings leading to the interior of said cheeks, and the said cheeks and arch having air-delivering orifices in their rear walls.

5. A hollow arch having a curved main portion and plane ends, a central transverse partition in said curved portion dividing the interior of said arch into two parts, a longitudinal partial partition in each of said parts forming longitudinal front and rear passages therein, each of said ends having an air-admission aperture in its under face leading to the interior of said front passages, a depending flange surrounding each of said apertures, a pair of cheek-pieces supporting said ends, each comprising a hollow casting having an air-discharge opening at the top matching to and receiving said flange, the rear faces of said arch and cheeks having each a series of air-discharge orifices toward the furnace, in com-

bination with the latter and with a boiler-front having air-admission openings leading directly to the interior of said cheeks.

6. A furnace-door, a lug thereon, a shaft, a crank thereon, and a swinging dog arranged to be engaged by said lug and partially rotate said shaft by the act of opening said door and to allow said lug to pass idly in the act of closing said door, a pitman connected at one end to said crank and at the other to a piston-rod, a pin on said pitman, a piston on said rod and a cylinder receiving said piston, an inwardly-opening valve in said cylinder below said piston, and a spring above said piston tending to force the latter toward said valve, in combination with a hollow furnace-arch having air-discharge orifices leading to a furnace, a boiler-front having an air-admission passage leading to the interior of said arch, a damper in said passage, a slotted arm thereon engaging said pin, and an adjustable discharge-cock in said cylinder below said piston.

7. A furnace-door, a shaft, a crank thereon, and a swinging dog arranged to be engaged by said door and partially rotate said shaft by the act of opening said door and to allow said door to pass idly in the act of closing, a dash-pot cylinder and a piston therein connected to said crank, arranged to induct air by the rapid movement in one direction and to move slowly in the opposite direction by the escape of such air, in combination with a hollow arch having air-discharge orifices leading to a furnace, a boiler-front having an air-admission passage leading to the interior of said arch, a damper controlling said passage and connections from said damper to said piston, whereby the movement of said piston in one direction admits air to said arch through said passage and the movement in the opposite direction slowly turns said damper to close said passage.

In testimony that I claim the invention above set forth I affix my signature in presence of two witnesses.

JOHN S. ROAKE.

Witnesses:
CHARLES R. SEARLE,
HENRY WAGNER.