

(No Model.)

3 Sheets—Sheet 1.

J. C. KEYS & C. L. PAGENHART.
SMOKE AND GAS CONSUMER FOR FURNACES.

No. 542,933.

Patented July 16, 1895.

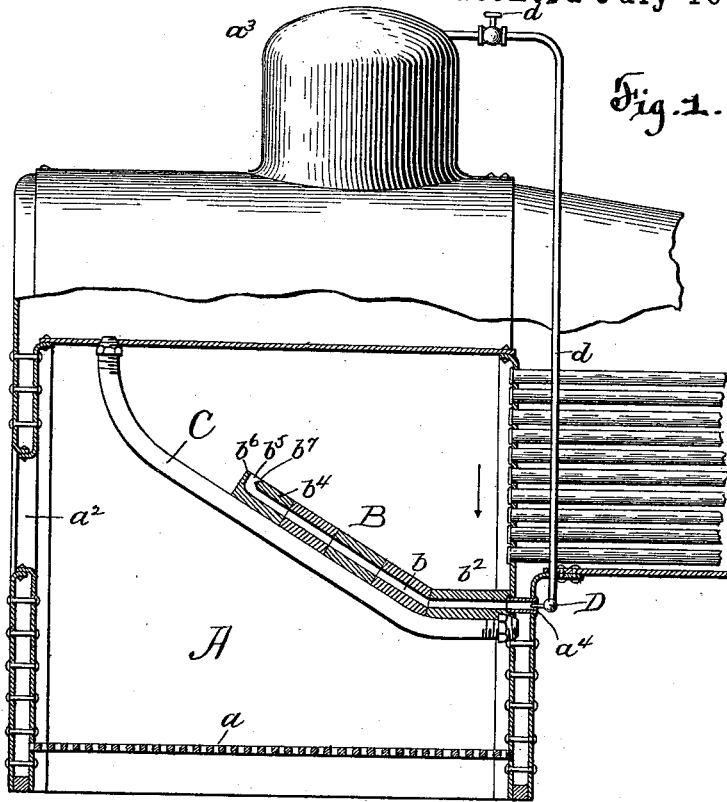


Fig. 1.

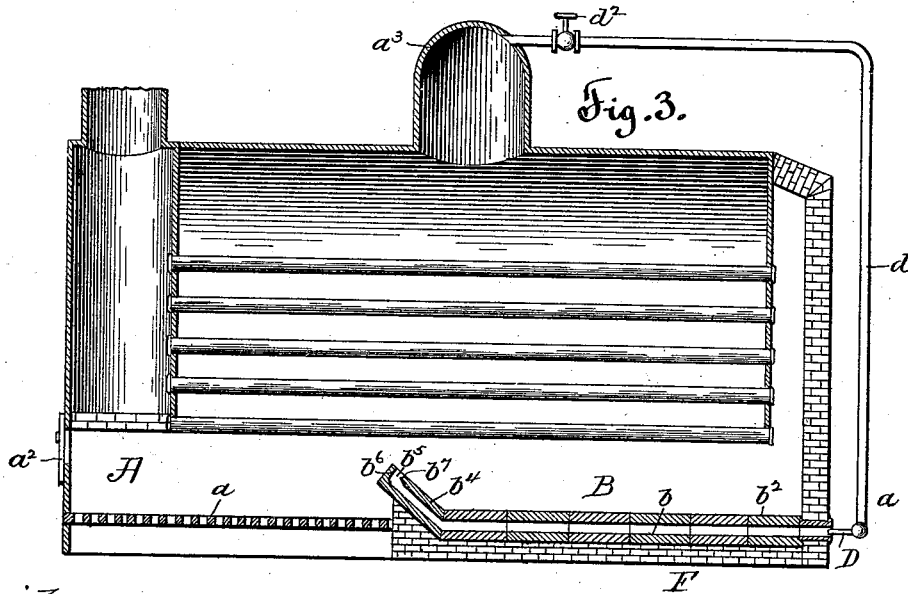


Fig. 3.

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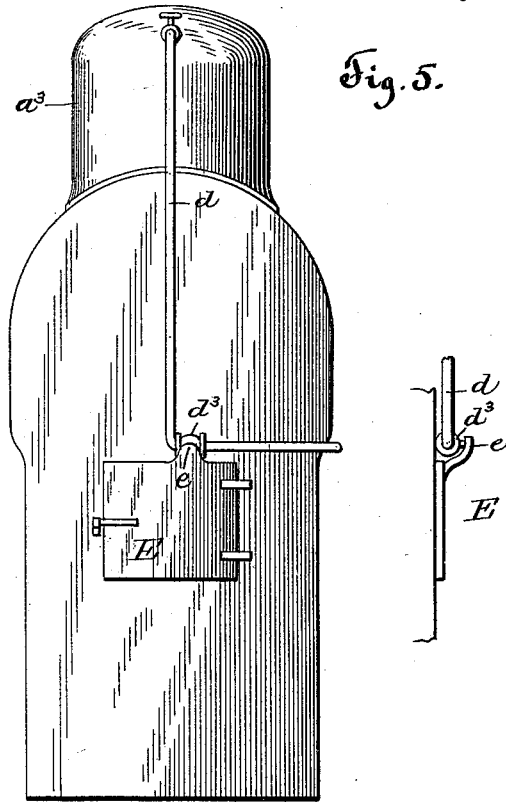
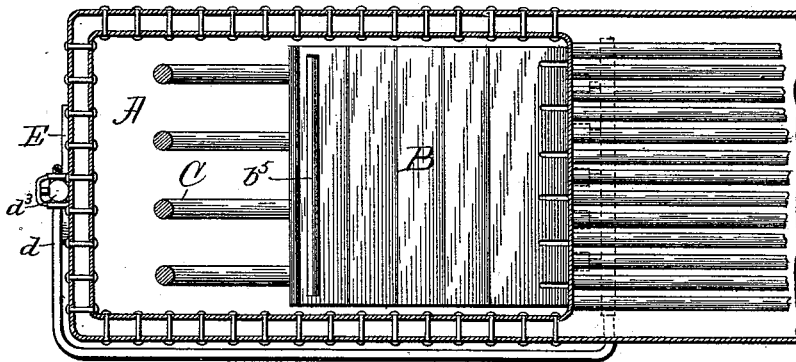


Fig. 2.



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Fig. 4.

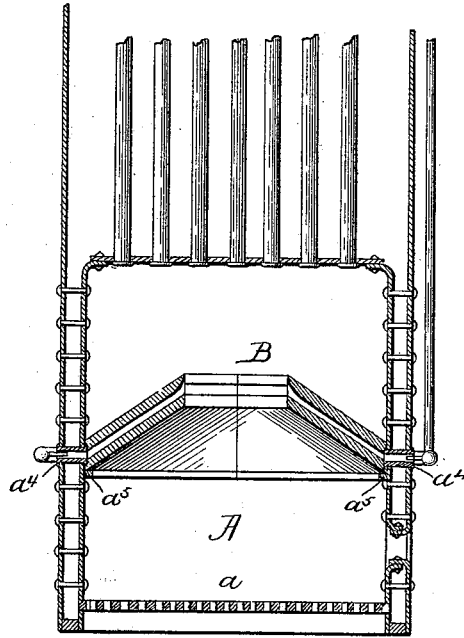


Fig. 6.

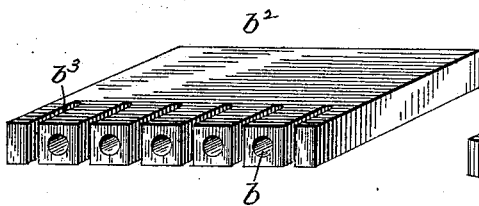


Fig. 7.

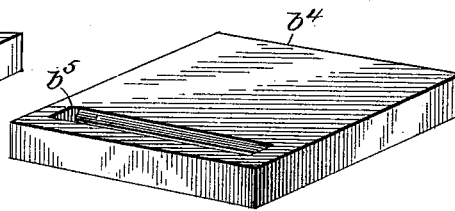
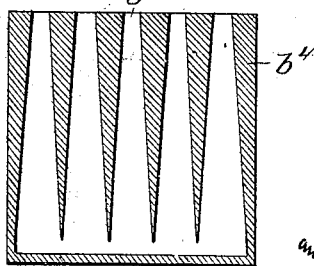


Fig. 8.



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UNITED STATES PATENT OFFICE.

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SMOKE AND GAS CONSUMER FOR FURNACES.

SPECIFICATION forming part of Letters Patent No. 542,933, dated July 16, 1895.

Application filed February 23, 1895. Serial No. 539,498. (No model.)

To all whom it may concern:

Be it known that we, JAMES C. KEYS, residing at Blackville, in the county of Barnwell and State of South Carolina, and CHARLES L. PAGENHART, residing at Augusta, in the county of Richmond and State of Georgia, citizens of the United States, have invented certain new and useful Improvements in Smoke and Gas Consumers for Furnaces; and we do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

This invention relates to improvements in smoke and gas consumers for furnaces.

The object of the invention is to effect the complete combustion and utilization of practically the entire amount of fuel fed to a furnace, together with the gases and coal-dust, the latter usually escaping from the furnace in the form of a dense black smoke, such consumption of the entire body of fuel resulting in an increase in the volume of heat units for a given bulk of fuel, with a proportionate gain in the output of power; furthermore, to effect the complete combustion of gases liberated and resulting from the combustion of fuel in the usual burning thereof, which gases would otherwise escape unutilized; furthermore, to provide means for introducing superheated steam, together with heated air, into the furnace at a point to effect the complete consumption of the liberated gases; furthermore, to provide a furnace with an arch having air-ducts there-through constructed at their outlet in such a manner as to present a broad sheet of heated air and superheated steam, the escape from the flues being such as to prevent interference with the draft from the grate-bars; furthermore, to provide a furnace with a flue-arch having a steam-supply connected therewith, and means operated by the opening and closing of the furnace-door to regulate the supply of steam and air to the arch; furthermore, to provide a furnace with an arch having a series of air-inlets arranged adjacent to its point of contact with the flue-sheet or the boiler, and also side drafts, whereby the draft through the grate-bars will not be closed—that is to say, the heaviest draft will

not be at the point farthest removed from the flue-sheet—which would be the fact if the flue-arch closely fitted against the side of the fire-box and the flue-sheet, and, finally, in various novel details of construction of a smoke and gas consumer, as will be hereinafter fully described.

In constructing a smoke and gas consumer in accordance with our invention we provide a series of hollow arch-tiles constructed preferably of a refractory material, such as fire-brick, and supported in any preferred manner within the fire-box. The openings through all the tiles, with the exception of the rear one, are arranged, by preference, in parallel lines; but the openings in the rear tile diverge from their front end and open into a transverse slot or recess on the upper side of the said tile. The inner face of the slot or recess is beveled or cut away to form a flaring mouth, the function of which is to direct the incoming steam and air in a curved line toward the flue-sheet, so as not to interrupt or conflict with the direct draft coming through the fire-door and through the grate-bars.

As a matter of further improvement, we provide a steam-supply for the arch-flue, comprising, in this instance, a transverse pipe having a series of jet-orifices or jet-nozzles, one for each of the openings in the arch-flue, supplying steam to the whole from a pipe tapped into the steam-dome. If desired, the supply of steam to the arch-flue may be regulated by hand by an engineer or fireman; but as a matter of specific improvement we provide an automatic device for regulating the supply of steam to the arch-flue, such device being controlled by the fire-door—that is, by its opening and its closing.

Further and specific details of construction will be fully pointed out in the specification.

In the accompanying drawings, forming part of this specification, and in which like letters of reference indicate corresponding parts, we have illustrated one form of embodiment of our invention applied to several different forms of furnaces and boilers, it being understood that other embodiments may be employed without departing from the spirit thereof.

In the drawings, Figure 1 is a view in sec-

tional elevation of the rear portion of a locomotive-boiler, showing the arch-tiles suitably supported within the fire-box by means of arch-pipes, the ends of which open into the water-space of the boiler to permit of a circulation of water therethrough to prevent burning away of the pipes. Fig. 2 is a plan in horizontal section, looking in the direction of the arrow, Fig. 1, showing more particularly the manner in which the arch-tiles are disposed within the fire-box. Fig. 3 is a similar view showing the invention applied to a return-flue tubular boiler, the arch-tiles in this instance being supported on a foundation approximately in the same plane with the grate-bars, with the rear arch-tile projecting upward at an angle to the remaining tiles and forming a deflector which operates to prevent the too rapid escape of the heated products of combustion from the grate-bars. Fig. 4 is a view in sectional elevation showing the arch-tiles applied to a vertical boiler. Fig. 5 is a view in elevation of the rear portion of a locomotive-boiler, showing the mechanism for automatically opening and closing the steam-pipe leading to the arch-tiles. Fig. 6 is a perspective detail view of the front arch-tile, showing the same provided with a series of draft openings or recesses and also the flues through which the steam and heated air pass to the fire-box. Fig. 7 is a similar view of the rear arch-tile, showing more particularly the discharge-mouth and its peculiar contour; and Fig. 8 is a horizontal sectional view through the rear arch-tile, showing the disposition and arrangement of the flues through the same.

Referring to the drawings, and to Figs. 1 and 2 thereof, A designates the fire-box of an ordinary locomotive-boiler, provided with the usual grate-bars a , fire-door a^2 , and steam-dome a^3 . Arranged within the fire-box are the arch-tiles B, which are held in the proper position by means of arch-pipes C, which latter open at their ends into the water-space of the boiler, so as to permit of a circulation of water through the pipes to prevent their rapid burning away.

The arch-tiles B are provided each with a series of flue-openings or conduits b , the openings of the front end of the front tile b^2 being engaged by hollow stay-bolts a^4 , which not only serve to retain the said tile in operative position, but also serve as a flue for the passage of atmospheric air to the arch. The front tile b^2 is further provided at its front side and between the flue-openings b with a series of slots or recesses b^3 , which are designed to permit of the passage of draft between the front tile and the flue-sheet, thereby operating to effect an equalization of the draft within the fire-box, so that a portion of the heated productions of combustion will be permitted to pass against the flue-sheet and between the front tile. The rear tile b^4 has its openings gradually enlarged from front to rear, as clearly shown in Fig. 8, and at a point

slightly removed from the rear wall the flue-openings merge into a common opening b^5 , which forms a discharge-mouth extending transversely nearly across the tile. The rear wall b^6 of the mouth is straight, and the front wall b^7 is beveled outward, thereby forming an approximately flaring mouth, with the flared portion extending toward the flue-sheet, such construction causing the heated products which pass through the arch-tiles to be deflected in a forward direction toward the flues, and thereby prevent any conflict or interruption of the incoming draft from the fire-door and from the grate-bars, which would inevitably result if the heated products passing through the arch-tiles were projected in a straight line therefrom.

In order to accomplish a thorough and rapid consumption of the liberated gases within the fire-box without any possibility of their escape through the flues to the smoke-stack, we provide, in conjunction with the air-supply, a superheated steam-supply, which enters the fire-box with the air-supply and produces a combustion analogous to or approximately the same as that produced by an oxyhydrogen flame. This is effected by introducing steam through the agency of jet-nozzles D, which enter the hollow stay-bolts a^4 and supply dry steam through a pipe d from the steam-dome a^3 . As the arch-tiles are heated to incandescence when the engine is in operation, it follows that the steam in contacting with the intensely-heated walls of the arch-tiles is decomposed into its constituent elements and supplies hydrogen with the incoming oxygen of the air to form an intense heat at the discharge-mouth of the arch-tile.

As shown in Figs. 1 and 3, the supply of steam to the jet-nozzle is regulated by means of an ordinary globe-valve d^2 ; but in order to render the operation of the steam-supply automatic, so that it will only operate when the engine is under way, at which time an induced draft through the arch-tiles is necessary, we extend the pipe d through the cab of the locomotive down in front of the fire-box to a point near the fire-door, and then bend it at right angles and extend it in the manner shown in Fig. 2 to the arch-tiles. At a point upon the lower limb of the pipe d and at a point contiguous to the door we locate a valve d^3 , having its valve-stem projected outward through the casing of the valve and in a position to be engaged by an offset or lug e on the fire-door E. The port of the valve is so arranged that the valve is unseated when the door is closed, and thereby permits of the passage of the steam from the steam-dome to the arch-tiles; but immediately upon the release of the door, either for the purpose of supplying fresh coal to the furnace or when the engine is stopped, the pressure of the steam drives the valve to its seat, and thereby shuts off the supply of steam to the arch-tiles. In this manner the steam is automatically

regulated to the arch-tiles and requires no attention from either the fireman or the engineer.

The manner of operating the valve shown in Fig. 5 is a simple and effective one; but it is to be understood that other means may be employed for accomplishing the same result, and as such modification in the manner of operating the valve is obvious any further illustration of the embodiment of the idea is thought to be unnecessary. It is also obvious that, if desired, instead of supplying steam under pressure from the dome to the flues in the arch-tiles air under pressure from the air-brakes, or from other source under pressure, may be employed in some instances and be found to answer the requirements of the case.

In Fig. 3 we have shown the arch-tiles in connection with a return-flue tubular boiler, and as their construction and operation, with the exception of the arrangement of the arch-tiles, which are arranged on a horizontal foundation F, are the same as that shown in Fig. 1 further description is thought to be unnecessary.

In Fig. 4 the arch-tiles are shown applied to a vertical boiler. In this case the tiles are made to form a truncated cone suitably supported upon lugs a^5 within the fire-box. The steam or air under pressure, if preferred, is supplied to the flues in the same manner as that described in connection with Fig. 1.

By having the discharge-mouth of the rear tile in the form of a slot a much larger and consequently more effective flame can be produced than if the steam and heated air were projected through a series of individual flues. In other words, the mouth operates somewhat in the nature of a mixing or equalizing chamber, so that the pressure is uniform within the rear tile and the flame of equal intensity through its area, whereas if the heated products were projected from the individual flues the flames thereof would not be of equal intensity, owing to irregularity in the supply of air and steam. Moreover, the space between the individual jets would permit of the escape of certain of the gases and of the dust; but by projecting a flame in a continuous sheet in the manner described the escape of the gases and of the dust is practically impossible.

To prevent condensation the steam-supply pipes passing to the arch-flue may be covered with suitable non-conductive material.

Having thus described our invention, what we claim, and desire to secure by Letters Patent, is—

1. A smoke and gas consumer for furnaces, comprising a hollow arch-flue having a series of conduits and a discharge mouth into which

all the conduits open, said mouth operating to deflect the products of combustion toward the flue-sheet, substantially as described.

2. A smoke and gas consumer for furnaces, comprising an arch-flue having a series of conduits and a transversely arranged discharge-mouth into which the conduits open, in combination with means for supplying steam to each of the conduits substantially as described.

3. A smoke and gas consumer for furnaces, comprising an arch-flue having a series of conduits and a transversely arranged discharge-mouth into which the conduits open, in combination with a steam-supplying device connecting with the flue, and automatically operating mechanism for controlling the feed of steam to the flue, substantially as described.

4. A smoke and gas consumer for furnaces, comprising a hollow arch-flue having its front end provided with a series of draft-openings arranged next to the flue-sheet, and its rear portion with a transversely arranged discharge-mouth, substantially as described.

5. In a smoke and gas consumer for furnaces, an arch-flue having a series of conduits extending from the front to a point near the rear thereof and opening into a transversely arranged discharge-mouth, the front wall of the said mouth being curved toward the flue-sheet, substantially as described.

6. In a smoke and gas consumer for furnaces, a hollow arch-flue having its front end provided with a series of draft-openings arranged next to the flue-sheet, and its rear end with a discharge-mouth located in the upper face of the flue and extending transversely across the same, substantially as described.

7. In a smoke and gas consumer for furnaces, an arch flue having a series of conduits, a series of draft openings at its front end between the conduits and next to the flue-sheet, and a discharge-mouth on the upper face of its rear portion, substantially as described.

8. In a smoke and gas consumer for furnaces, the combination with the flue-sheet of a boiler, of an arch flue having a series of conduits, a series of draft openings at its front end between the conduits next to the flue-sheet, and through which draft from the fire-box is free to pass, and a discharge-mouth on the upper face of its rear portion, substantially as described.

In testimony whereof we affix our signatures in presence of two witnesses.

JAMES C. KEYS.
CHARLES L. PAGENHART.

Witnesses:

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WALKER REED.