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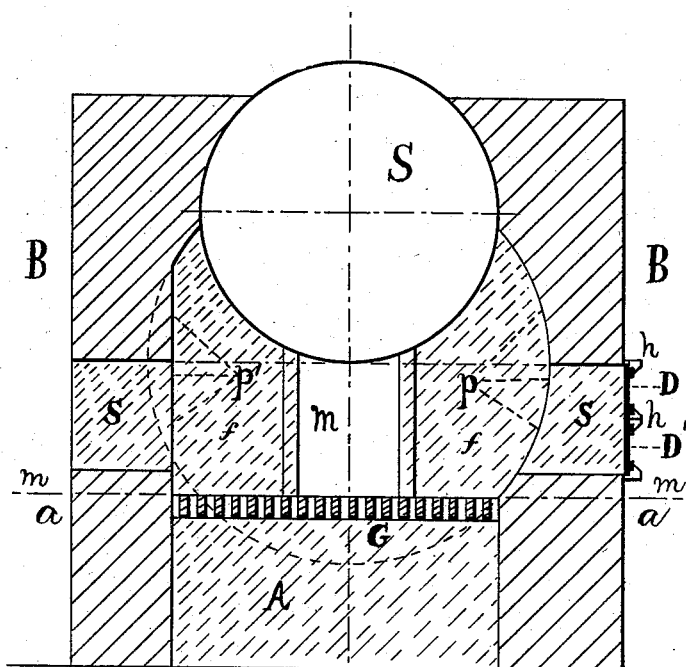
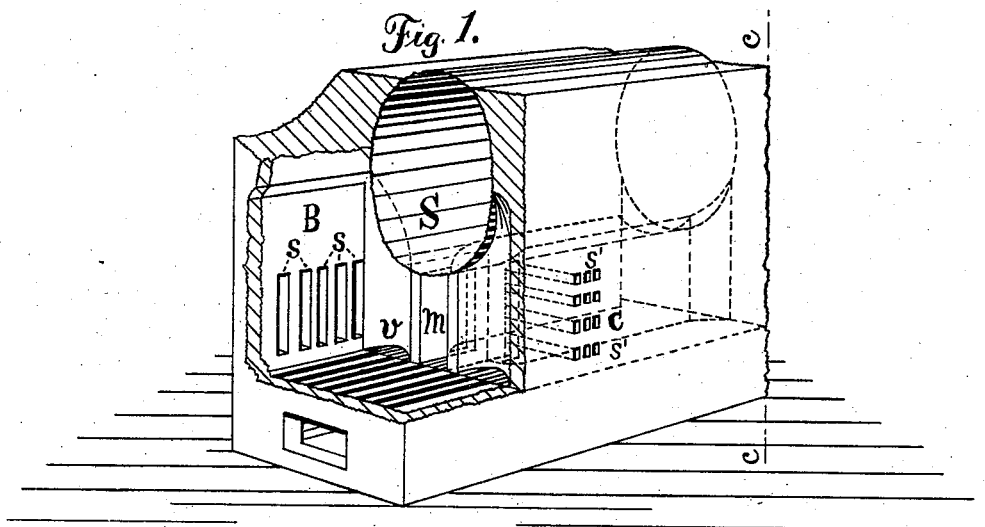
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J. C. CULBERTSON & W. A. EUDALY.

SMOKE CONSUMING FURNACE.

No. 260,170.

Patented June 27, 1882.



Witnesses:  
Charles Lathrop  
E. P. Robbins.

*Fig. 2.* Inventors:  
James C. Culbertson,  
W. A. Eudaly.

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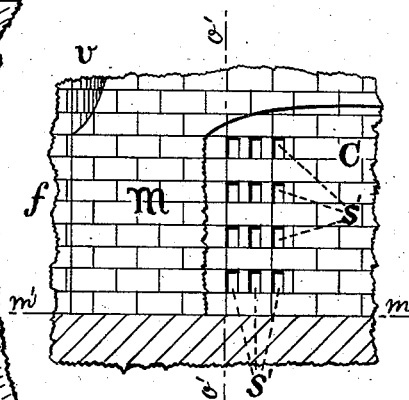
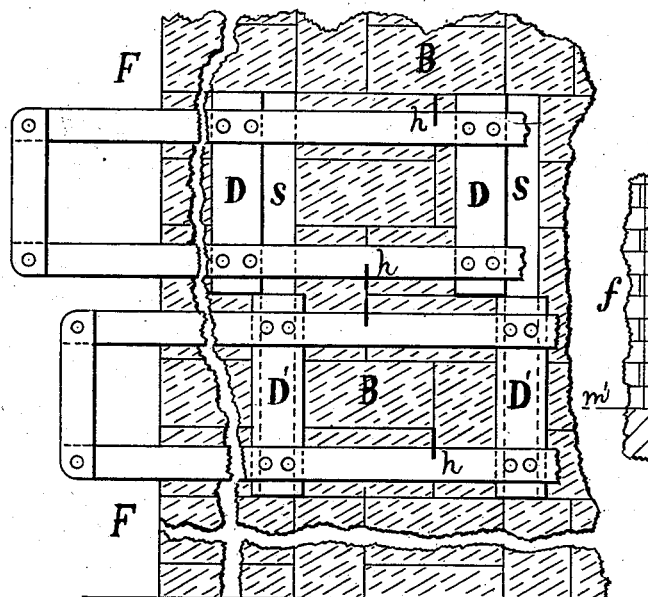
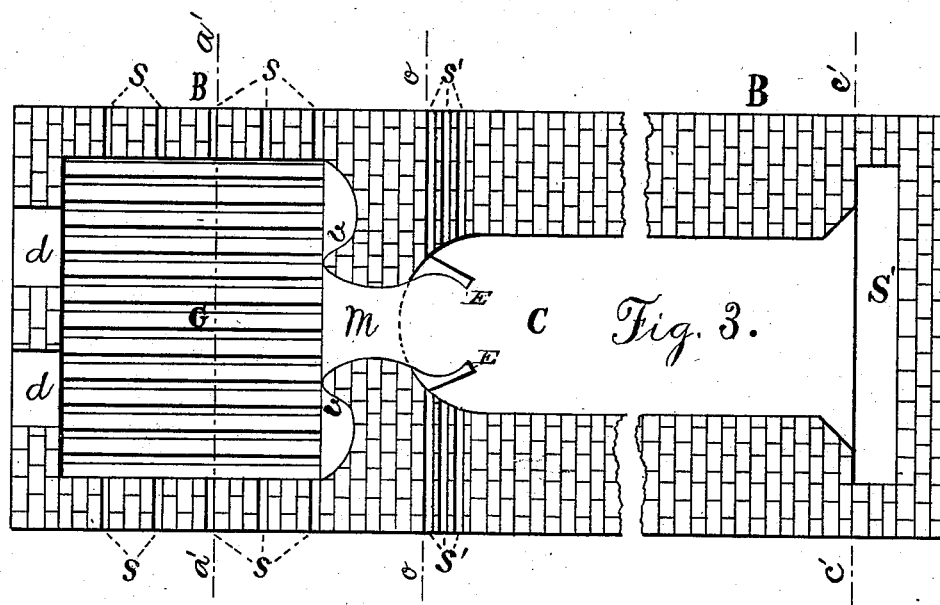


Fig. 4.

Fig. 5.

Witnesses:

Charles Sathrop  
E. P. Robbins.

Inventors:

James C. Culbertson,  
W. A. Eudaly.

# UNITED STATES PATENT OFFICE.

JAMES C. CULBERTSON AND WILLIAM A. EUDALY, OF CINCINNATI, OHIO.

## SMOKE-CONSUMING FURNACE.

SPECIFICATION forming part of Letters Patent No. 260,170, dated June 27, 1882.

Application filed May 24, 1882. (No model.)

*To all whom it may concern:*

Be it known that we, JAMES C. CULBERTSON and WILLIAM A. EUDALY, both of Cincinnati, county of Hamilton, and State of Ohio, have invented a smoke and gas consuming furnace of novel design and construction, and which pertains to furnaces used for heating steam-boilers and to the economical use of fuel in such furnaces, as set forth in the following specification and accompanying drawings.

Our invention relates to the class known as furnaces for consuming smoke and for the economy of fuel, and has for its objects the economy of fuel and the prevention of smoke.

To these ends our invention consists—

First. In providing the sides of the furnace with vertical narrow elongated apertures for the introduction of external air, said apertures being adapted to be controlled in such manner that any required quantity of air directly from the outside can be introduced at any stage of combustion.

Second. In the combination and arrangement of the furnace in such manner that the escaping products of combustion from the fire-box into a rear or adjoining combustion-chamber are made to pass through a vertical elongated flue or throat, said flue having flaring ends enlarging from its center toward each end, and in cross-sections resembling the segment of a circle. By this means it forms a centrally-contracted throat, by which the gases and other combustibles are made to focalize and compress while passing through said centrally-contracted flue, thus compelling them to become more intimately mixed, and will, when released, flash violently into the rear expansion-chamber in diagonal or cross directions.

Third. It further consists in the means of supplying atmospheric air at such points relative to the centrally-contracted flaring-ended flue or throat by which the gases are met in their path and made to commingle and unite with thin sheets or jets of air in such a manner that complete combustion ensues.

Fourth. It further consists in the construction and arrangement of the furnace in such manner as to cause the flame and gases to reverberate from side to side of the furnace by means of the concave side walls, and before their escape into the narrow vertical flue are

again partially arrested in their course by the end-wall cavities, in which they are made to eddy, and by which process the air entering from the sides is thoroughly mixed with the gases within, which prepares them for complete combustion in the expansion-chamber.

Fifth. This invention further consists in providing the rear end walls of the fire-box with an elongated vertical flue centrally contracted and flaring at its ends, and opening into an expanded flue or chamber, the said contracted flue having curved winged wall deflectors, whereby the products of combustion are deflected in opposite directions from said winged walls for the more thorough commingling of the air and gases in the expansion chamber or flue, as described.

Sixth. It consists, further, in combination with a furnace such as described, of the centrally-contracted flue and the curved winged walls projecting rearwardly from said flue in such manner as to form behind said winged walls an air-space communicating with the outer air, whereby said winged walls serve the double purpose of deflecting the heated gases from one side or sides and the air from the other side or sides of said winged walls in such a direction as to come in contact with each other.

Seventh. This invention further consists in the combination and arrangement of a series of dampers secured to the outsides of the furnace-walls, and with the narrow elongated vertical air-ducts located in said walls, and with the rear air-ducts located in the rear of the contracted flue, whereby the required quantity of air is controlled to suit the conditions of the fuel while in a state of combustion, as will more fully hereinafter appear.

Figure 1 represents a perspective view of the interior of our furnace, constructed in accordance with our invention, the front and one side of the furnace being removed, also that part of the boiler immediately over the fire-box. Fig. 2 represents a transverse section of the fire-box, drawn through at the line *a' a'* of Fig. 3, showing the fire-box both with and without concave side walls. Fig. 3 represents a horizontal longitudinal section drawn in the same plane with the upper edge of the grate-bars, showing the bottoms of the centrally con-

tracted and expanded flues and the curved winged walls, together with the positions of the influent air-ducts. Fig. 4 represents an exterior broken section of one side of the fire-box, showing the manner of applying the series of dampers. Fig. 5 represents an interior vertical section of the expanded flue at the base, through which the influent air-ducts  $s' s'$  pass.

In said drawings, S represents the boiler. B represents the brick-work. F F represent the front of the furnace.  $d d$  represent the front doors. A represents the ash-pit.  $f$  represents the fire-box. G represents the grate-bars. D D' represent the series of dampers.  $v v$  represent the concave rear end walls.  $p$  represents a fire-box with concave side walls.  $p'$  represents a fire-box with partially-concave side walls. M represents centrally-contracted flue. E E represent the winged walls. C represents the expanded flue.  $s s$  represent the vertical influent air-ducts in the sides of the fire-box.  $s' s'$  represent the influent air-ducts in the base of the expanded flue.

It is found that the point of combustion varies from the grate-bars upward in proportion to the amount of fuel and heated gases in the fire-box. Consequently these narrow vertical air-ducts are provided with a series of dampers, D D', so that by adding a number of these rows of dampers air can be admitted at any point desired. It is also found that the amount of atmospheric air admitted should always be in proportion to the amount of combustible materials in the fire-box, which is also controlled by the same series of dampers.

We claim that by long narrow vertical air-ducts  $s s'$ , in combination with the series of dampers D D', we are enabled to admit currents of air in thin sheets or waves, which, on account of their vertical position, must necessarily come in contact with the inflamed carbon and gases, and being admitted in thin sheets or waves, they become instantly heated without materially reducing the temperature in the fire-box. The concave side walls of the fire-box are segments of a circle the center of which is situated in a line drawn directly under and against the bottom of the boiler, the radius of which should be at least equal to two-thirds the length of the diameter of the boiler.

The concave rear end walls,  $v v$ , of the fire-box should be constructed with like proportions as the concave side walls. By the aid of the concave rear end walls,  $v v$ , and concave side walls,  $p p'$ , the currents of commingled air and gases are deflected toward the center of the fire-box, where, by means of the laterally and centrally contracted flue M, the sides of the flame are brought in close contact with each other, which greatly increases the temperature without lessening the draft.

We are aware that hot air and steam have been heretofore introduced through openings situated in various parts of the furnace by means of hollow walls, pipes, and other devices;

but we are not aware that atmospheric air has ever been admitted directly through long narrow vertical influent air-ducts situated in the sides of the furnace and communicating directly with the external surface.

The operation is as follows: The entire front of the furnace and openings to the ash-pit being closed, the vertical influent air-ducts should afford the only means for the introduction of air, the volume of which is governed by a series of dampers, D D'. The ducts  $s s$  being situated in the opposite sides of the fire-box, and being the only influent air-channels, currents of air passing through them from the opposite sides, and aided by the concave rear end walls,  $v v$ , and concave side walls,  $p p$ , and centrally-contracted flue M, are caused to meet and commingle in the center of the fire-chamber, thus affording the necessary supply of oxygen, which, in combination with the inflamed carbon and other gases, is caused to pass along between the opposing side currents toward and through the centrally-contracted flue M into the expanded flue C, where said currents receive an additional supply of oxygen admitted through the direct influent air-ducts  $s' s'$ , situated in the sides of the base of the expanded flue C and in the rear of the winged walls E E, along which course complete combustion takes place.

Having thus described our invention, and the best means at present known to us for carrying the same into effect, we do not desire to be confined to the exact construction and arrangement shown, as many modifications may be made of the same, within wide limits, without departing from the spirit of our invention.

What we claim as our invention, and desire to secure by Letters Patent, is—

1. In a smoke-furnace, long narrow vertical influent air-ducts  $s s$ , situated in the side walls of the fire-box, the air passing through said ducts, regulated by a series of dampers, D D', substantially as and for the purposes specified.

2. In a smoke-consuming furnace, long narrow vertical influent air-ducts  $s s$ , situated in the sides of the fire-box, in combination with a series of dampers, D D', by means of which the inflow of air is regulated at different heights with relation to the fire-bed, substantially as and for the purposes specified.

3. In a smoke-consuming furnace, long narrow vertical influent air-ducts  $s s$ , situated in the sides of the fire-box, and the series of dampers D D', in combination with the rear end walls of the fire-box, substantially as and of the purposes specified.

4. In a smoke-consuming furnace, long narrow vertical influent air-ducts  $s s$ , situated in the sides of the fire-box, and the series of dampers D D', in combination with the concave side walls,  $p p'$ , of the fire-box, substantially as and for the purposes specified.

5. In a smoke-consuming furnace, long narrow vertical influent air-ducts  $s s$ , situated in

the sides of the fire-box, the series of dampers D D', and the concave rear end walls, *v v*, of the fire-box, in combination with the laterally-contracted flue, substantially as and for the purposes specified.

6. In a smoke-consuming furnace, long narrow vertical inflowing air-ducts *s s*, situated in the sides of the fire-box, the series of dampers D D', and the concave side walls of the fire-box, in combination with the laterally-contracted flue, substantially as and for the purposes specified.

7. The combination, in a smoke-consuming furnace, of the long narrow vertical influent air-ducts *s s*, situated in the side walls of the fire-box, the series of dampers D D', and the concave rear end and side walls of the fire-box, with the laterally-contracted flue extending to and within the expanded flue C, substantially as and for the purposes specified.

8. The combination, in a smoke-consuming furnace, of the long narrow vertical influent air-ducts *s s*, situated in the side walls of the fire-box, the series of dampers D D', and the concave side walls of the fire-box, with the laterally-contracted flue and the winged walls, substantially as and for the purposes specified.

9. In a smoke-consuming furnace, the long narrow vertical influent air-ducts *s s*, the series

of dampers D D', the concaved rear end walls, *v v*, and the concave side walls, *p p*, of the fire-box, and the laterally-contracted flue M, in combination with the expanded flue or chamber C, together with vertical influent air-ducts *s' s'*, substantially as and for the purposes set forth.

10. In a smoke-consuming furnace having a primary combustion-chamber, a rear combustion chamber or flue, and a dividing-wall provided with a vertical elongated flue centrally contracted, in combination with winged walls arranged substantially as and for the purposes set forth.

11. In a smoke-consuming furnace having a front and rear combustion chamber or flue, a dividing-wall provided with a vertical elongated flue centrally contracted and flaring at both ends, the winged curved walls, and the rear air-ducts communicating with said rear flue, operating together substantially as and for the purposes mentioned.

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

JAMES C. CULBERTSON.  
WILLIAM A. EUDALY.

Witnesses:

LOUIS F. ROETTER,  
HENRY HEYL, Jr.