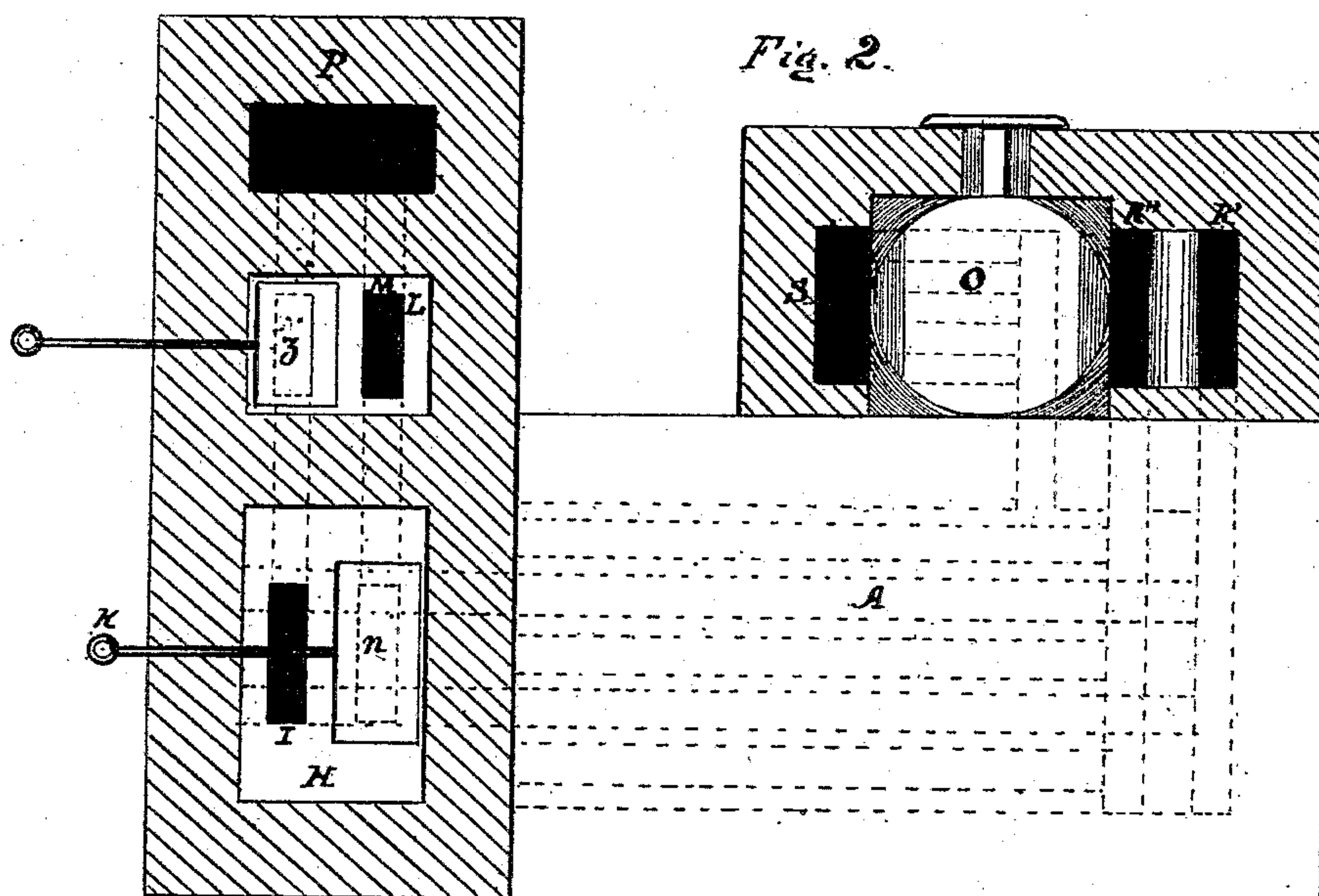
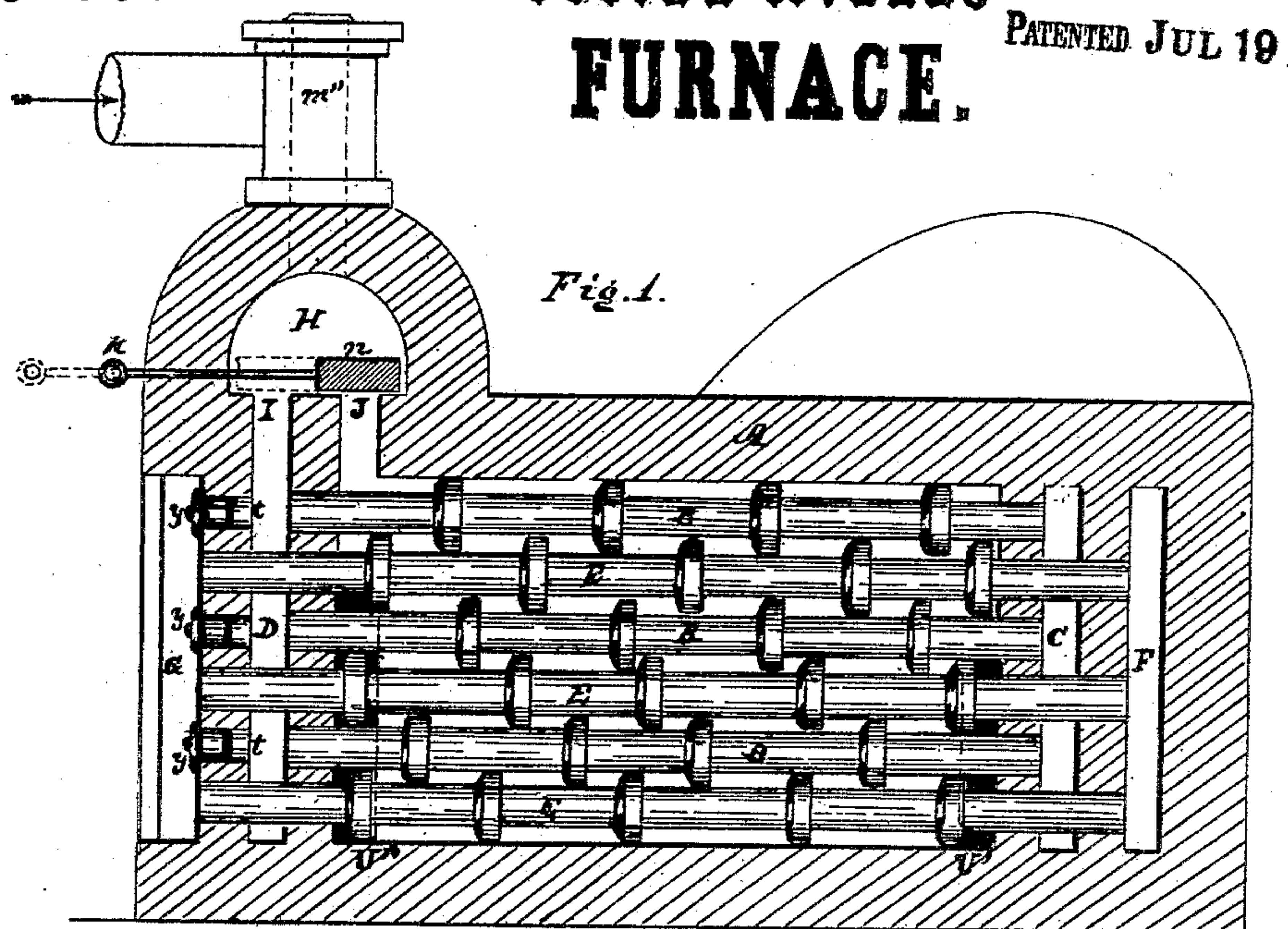


JOSIAH W. ELLS FURNACE.

PATENTED JUL 19 1870



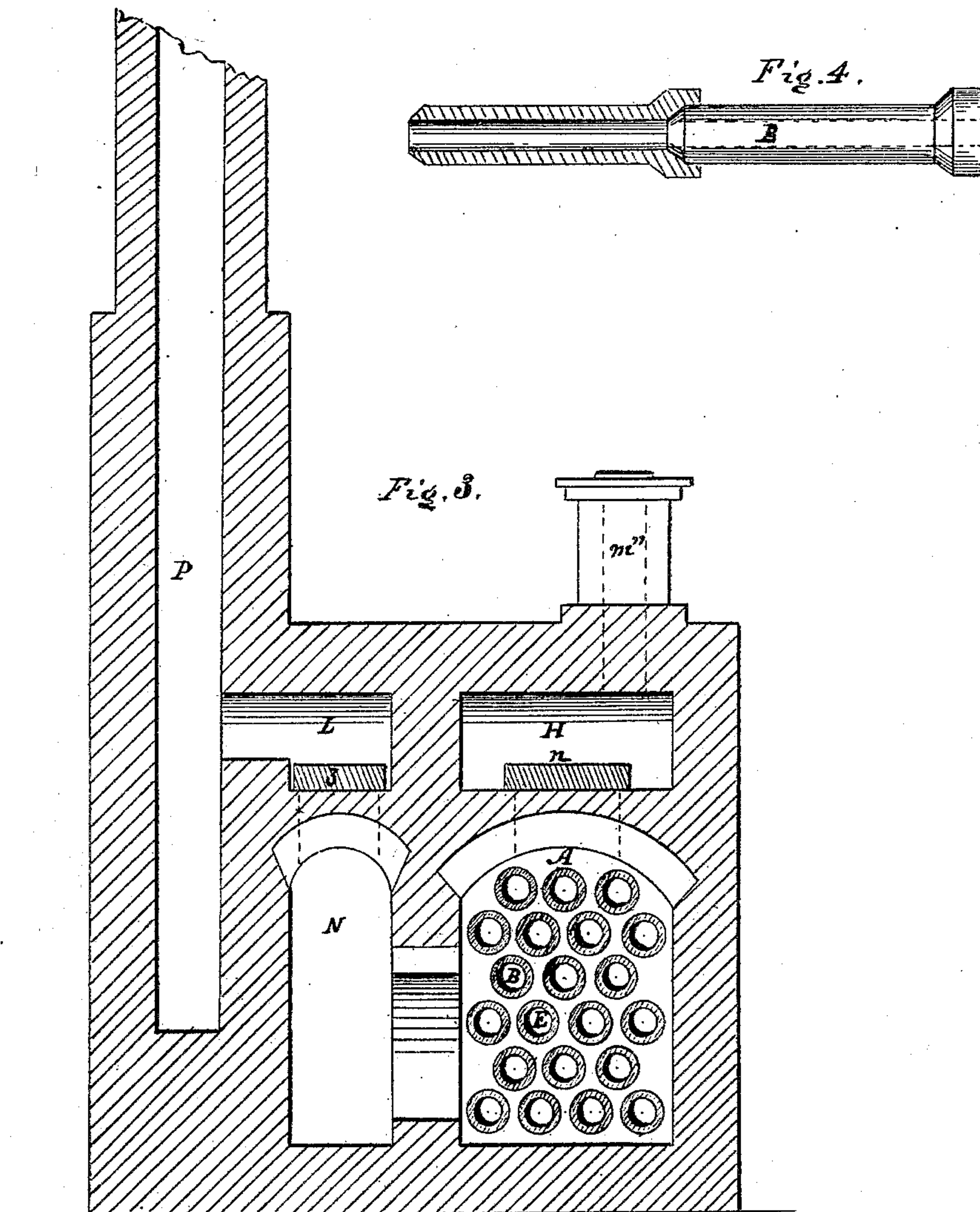
Witnesses.

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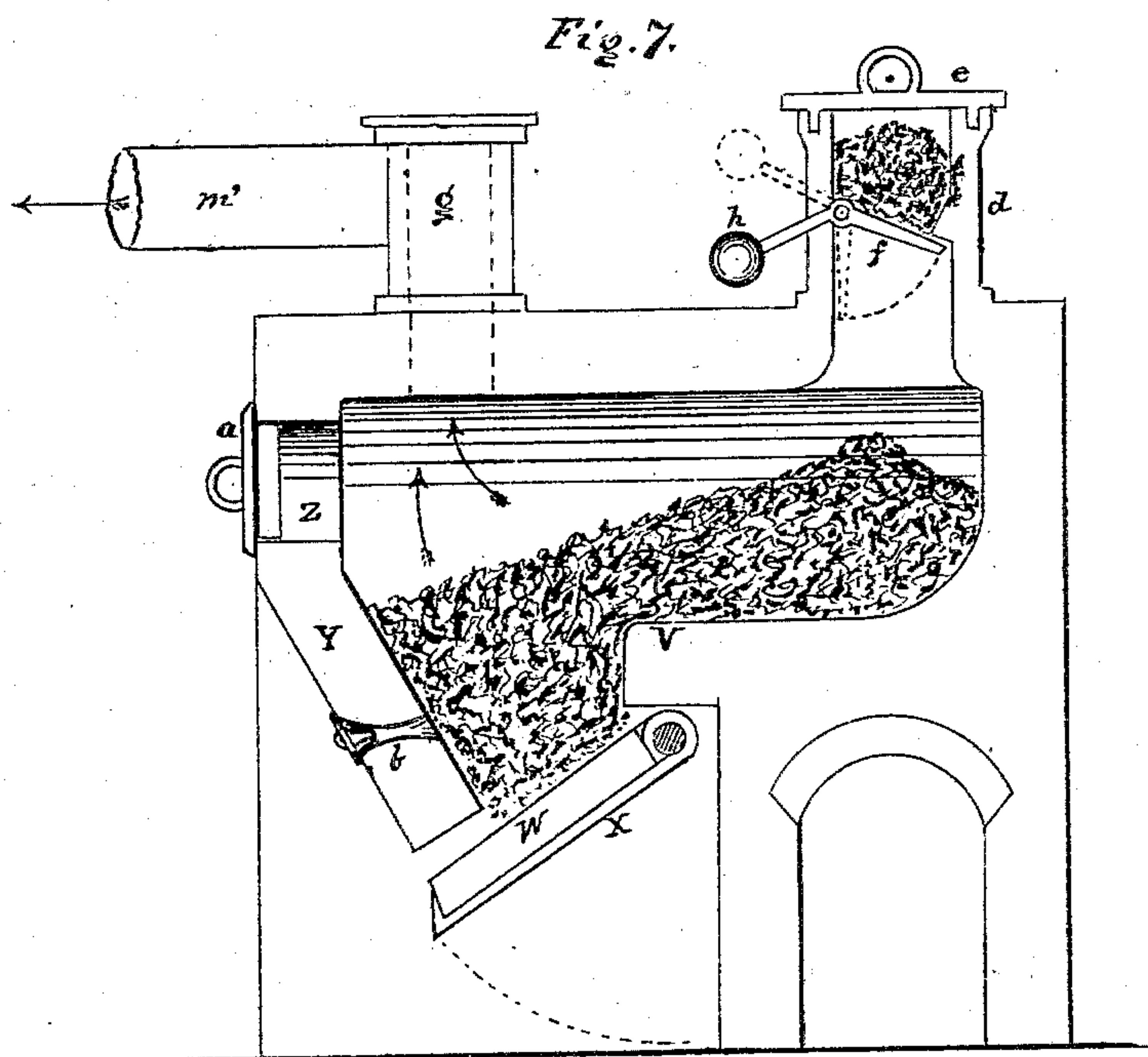
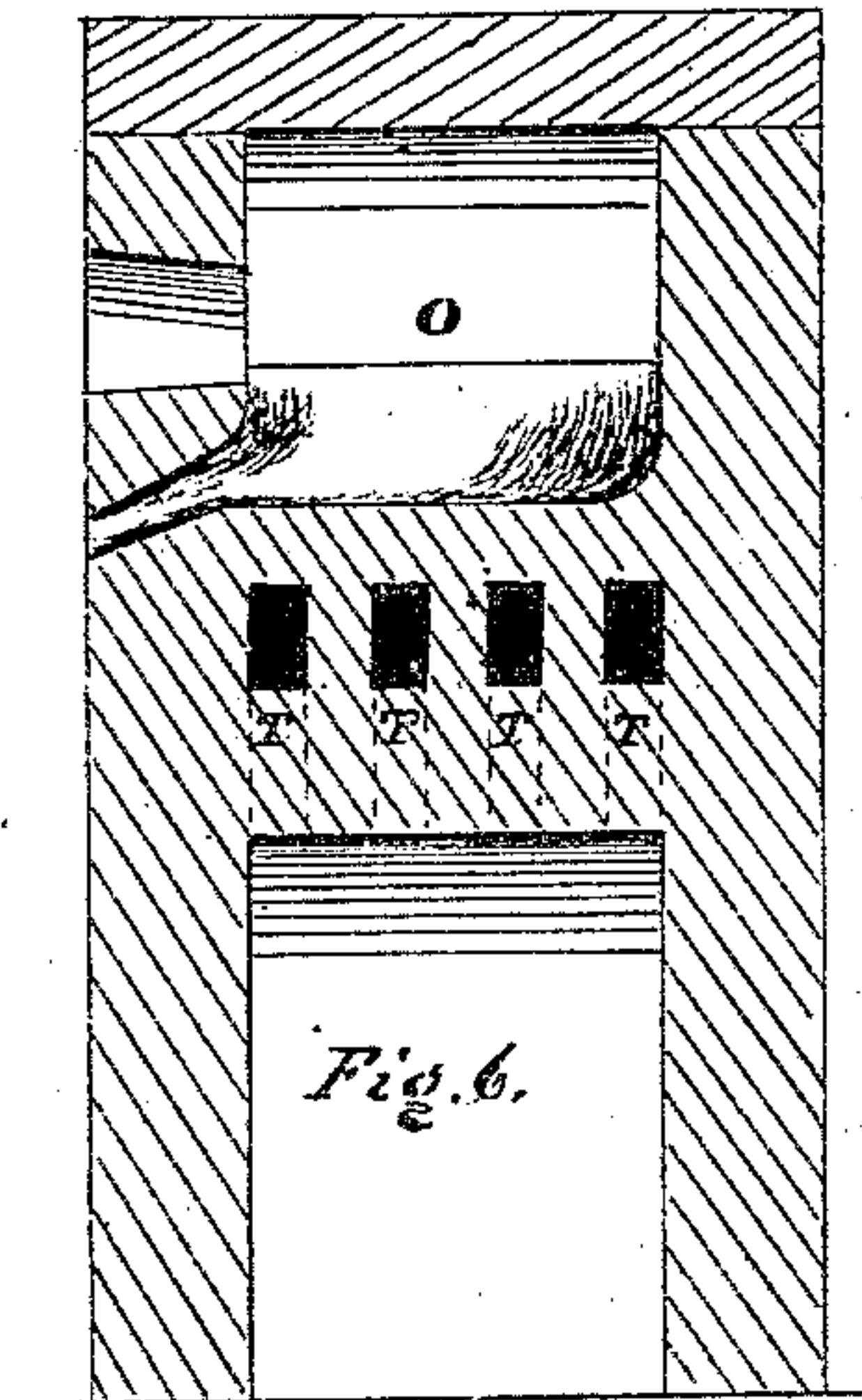
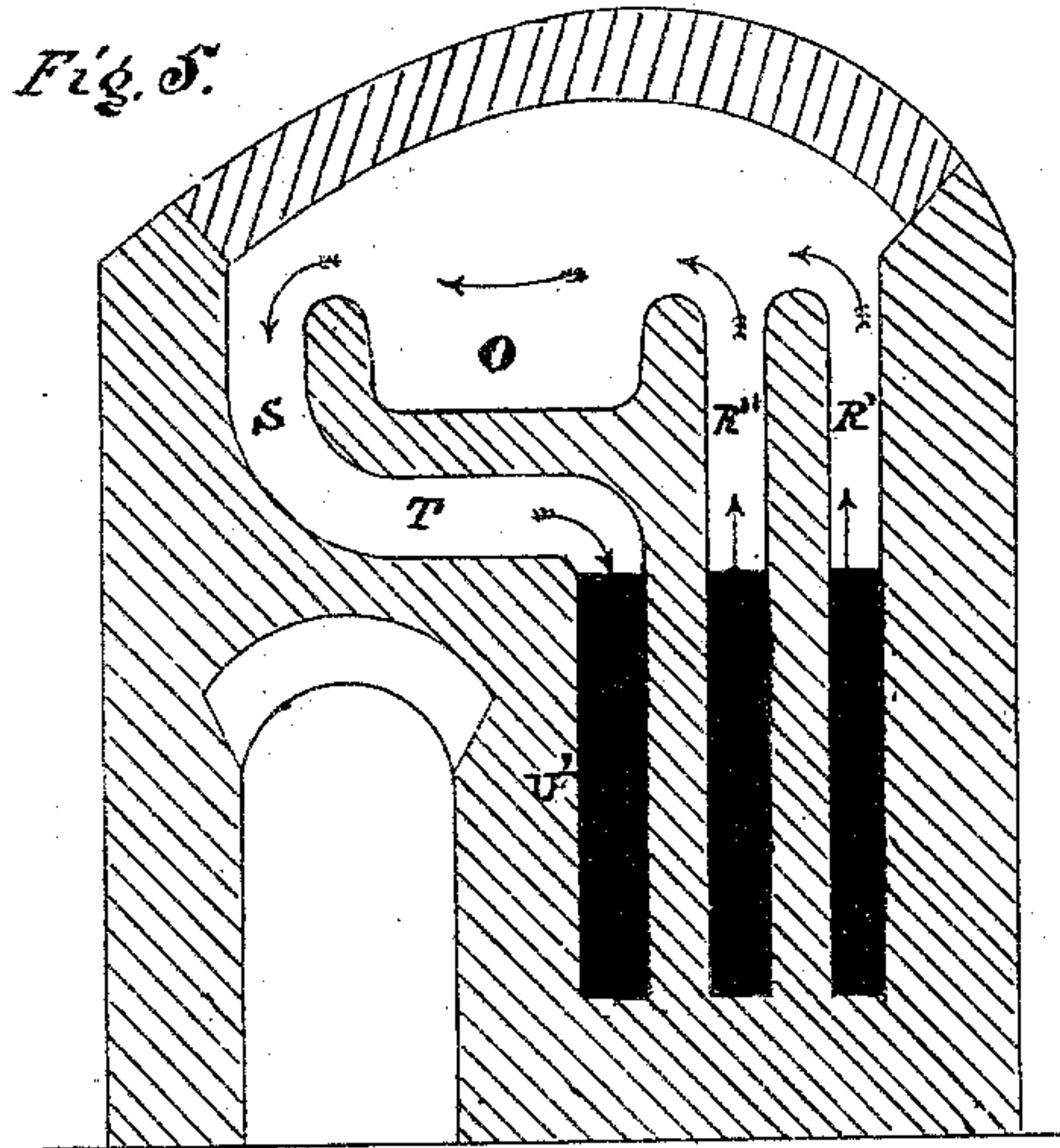
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Letters Patent No. 105,557, dated July 19, 1870; antedated July 6, 1870.

IMPROVEMENT IN APPARATUS FOR GENERATING AND BURNING GASES IN METALLURGIC FURNACES.

The Schedule referred to in these Letters Patent and making part of the same.

To all whom it may concern:

Be it known that I, JOSIAH W. ELLS, of Pittsburg, in the county of Allegheny and State of Pennsylvania, have made a new and useful invention, having reference to Furnaces of various kinds, and especially to that class of furnaces wherein inflammable gases are generated by the slow combustion of carbonaceous fuel in one compartment, which are transmitted to a place designed for their combustion, through tubes arranged within chambers, and heated by the escaping products of said combustion on their way to the chimney, by which these gases are heated, and brought in contact with currents of atmospheric air, also heated in a similar manner.

Hitherto, in all furnaces of this character, the tubes used as gas-passages are placed in a chamber separate and distinct from that occupied by the air-supplying tubes, by which arrangement the body of the outgoing heat or waste products of production is divided, and, consequently, much diminished in heating power, the greater portion traveling through that part or chamber taken up by the gas-tubes. For, as the gases come from the generator quite hot, the temperature of these tubes increase, and the flame eventually tends to that direction, leaving the air-tubes and their chamber comparatively cool. As these gases are wholly transmitted through one set of passages without any arrangement for changing them to another, or cleansing them in case of obstruction, they, in a short time, become choked by a filamentous deposit of soot, or other forms of carbon, so much so as to greatly impede the flow of gas, and seriously interfere with the proper working of the furnace.

The nature of my invention consists in arranging the gas and air-tubes all within the space of one chamber, so that the whole or undivided body of the outgoing caloric and products of combustion will be distributed equally around and among them on its way to the chimney, by which arrangement all the tubes, those used for supplying air as well as those employed for the transmission of gases, will be heated uniformly and alike.

Another part of my invention consists in arranging the gas and air-tubes within the heating-chamber in such a manner as that the interior of the tubes may be examined at all times from the outside of the apparatus, and, if necessary, a certain amount of atmospheric air allowed to mingle with the gases on their way through the tubes, and as these tubes are made in sections.

Another part of my invention consists in constructing each section with an enlarged end or bowl, into which is fitted the small end of the section next it, and so arranging them within the heating-chamber as that the joints of one length of tubes will be op-

posite and rest against the solid portion between the joints of that arranged beside it, by which they tend to support one another, leaving intercepted spaces between the tubes, forming a tortuous or labyrinthian passage through which the flame and heated products of combustion play while passing through the chamber on their way to the chimney.

Another part of my invention consists in constructing the furnace with its several tubes, passages, and dampers so arranged with relation to each other that, by changing the position of the dampers, the in going gases may be directed through the heating-chamber around the outside of the tubes, while the heated products of combustion will pass through them on their way to the chimney, or *vice versa*. By this means I am enabled to burn out all deposits of soot, or other carbonaceous matter found in the tubes and chamber, as often as may be requisite to secure a perfect operation of the furnace.

Another part of my invention consists in the peculiar construction of the gas-generator, which will be hereinafter fully described.

To enable others to understand, make, and use my improved furnace, I will proceed to describe its construction and operation by reference to the accompanying drawing, in which—

Figure 1 represents a longitudinal vertical section through the center of the tube-heating chamber, passages for gas, air, and damper-chest.

Figure 2 is a section on a horizontal plane through the valve-chambers and melting-furnace.

Figure 3 is a transverse vertical section on a line through the center of the chimney, showing the gas and flame-passages at that end of the heating-chamber, with their respective dampers, and view of the heating-tubes in cluster.

Figure 4 represents a portion of one of the gas or air-tubes, one part being in perspective and the other in longitudinal section.

Figure 5 is a longitudinal vertical section of the melting-chamber or puddling-furnace.

Figure 6, transverse vertical section of the same.

Figure 7, longitudinal vertical section of the gas-generator.

Having in view the application of my invention to a furnace for melting and refining of metals, or for other purposes where an intense heat is required, I construct my apparatus by making a long curved chamber, A, with transverse passages extending across each end. In this chamber a series of highly refractory, or heat-sustaining tubes, constructed as hereinbefore stated, is placed, and so arranged with relation to each other and their respective flues as that one end of the gas-tubes B will enter and communicate with the inside passage C at the rear end of

the chamber, while the other ends of said tubes will have intercourse with the inside passage D at the opposite end of the chamber.

The other tube E being longer, one of their ends will project through the inner wall across the inside passage C, and through the division wall into the outside passage F; while the other ends of this set of tubes E will pass in like manner through the front passage D and its walls to a space or small chamber, G, closed by a door on the outside.

Above the front passage D, and on top of the leading chamber, is a closed archway, forming a valve-chest, H, through the bottom of which are a couple of drop-flues, I J, one, J, extending down directly into that part of the heating-chamber occupied by the body of tubes, the other into the front transverse passage-way D.

A damper, n, made of fire-clay, or other refractory material, closes one of these flues, and may, by means of the handle K, operated from the outside, be moved or shifted so as to open that and close the other.

Under this arch, nearer the chimney, (figs. 2 and 3,) and communicating therewith, but divided from the valve-chest H by a heavy wall, is another valve-chest, L, similar in construction to the one just described, having within it two flues and a damper operated the same way; one of these flues, M, leads into a covered chamber, N, connected with the passage way D in front of the short tube B, the other entering in like manner the large heating-chamber A in the direction indicated by the dotted lines in fig. 2.

The furnace O, or place designed for the combustion of the gases, is built at the side and near the end of the heating-chamber A furthest from the chimney P.

At the extreme end of this furnace are two inlet-flues; one, R', of them entering the outside passage-way F, and the other, R'', entering the inside passage-way C through channels in the wall of that part of the heating-chamber, while at the other end of the furnace is an exit-flue, S, which leads, by several smaller flues T T T T, under the bed of the melting-chamber, and thence downward into a channel, U, continuing into the body of the heating-chamber among the tubes.

For the production of combustible gases, I construct a generator, (fig. 7,) which consists of a large fuel-chamber lined with fire-brick, the bottom of which constitutes a bench, V, extending from the back of the generator to about two-thirds of the distance toward the front.

Just below the edge of this bench V is suspended, at an angle of forty-five degrees, an apron, W, composed of fire-brick, resting upon an iron plate, X, so pivoted to the under side of the bench as to admit of its being dropped to hang in a vertical line.

The front wall Y of this generator is sloped downward and inward, so that its lower edge will nearly meet the apron W when raised to its proper height.

Above this slope, and near the top of the generator, is an opening, Z, furnished with a tightly fitting door, a.

Between this door and the bottom of the front wall are several stoke-holes b, through which a poker may be introduced to stir the fire from time to time.

At the top, and near the back end of the generator, is placed a cast-iron hopper, d, provided with a nicely-fitting cover, e, and tilting bottom, f, while at the other end of the generator is placed an exit-pipe, g, for conveying the gases to the heating-chamber.

The operation of the entire apparatus is as follows:

After a fire has been kindled in the generator, such fuel as is necessary for the production of combustible gases, preferably small lumps of bituminous coal or

bottom, f, which, when full, is closed by the lid or cover e, and the bottom tilted by means of the weighted lever h being brought to the position indicated by the dotted lines.

This drops the fuel onto the horizontal bench V a sufficient depth below to allow a deep layer of coal to intervene between it and the top. As the fuel accumulates on this bench, a portion of it slides down forward onto the inclined apron W, the air necessary to support combustion entering the space between the apron and front wall Y.

As the fuel on this becomes impoverished, a fresh supply is added to that on the bench by means of the hopper, which soon becomes ignited. The apron W may then be lowered, and the decomposed fuel, ashes, clinkers, &c., allowed to fall out.

The apron is then raised, and the live coals on the bench drawn forward onto it, as before, by opening the door a in the front wall, and introducing a long iron rake for this purpose, when additional fuel may be supplied, from time to time, through the hopper, as the circumstances of the case require.

After the generator has been heated to a considerable degree by the fire within, the walls will radiate heat on the fresh fuel as it lies on the bench, and thus cause a distillatory change, by which the whole of the available hydrogen, together with a large percentage of the carbon, is expelled as volatile inflammable hydrocarbon gases.

As fast as the gaseous matter is eliminated from the fuel, it ascends through an opening, g, at one end of the generator, and escapes through the horizontal pipe m' to the heating apparatus, entering through the pipe m'', directly above the gas-valve n, which, being set as shown at figs. 1 and 2, allows them to pass down the flue I into the passage-way D, in front of the short tubes B, and through them to the transverse passage-way C at the other end of the heating-chamber, and from thence, by a continuation of said passage-way, to the furnace or place designated for their combustion.

At the same time atmospheric air may be allowed to enter the front space G, and pass direct, in the same manner, through the long tubes E, to the furnace, where the said aerial and gaseous currents mingle and are to be fired.

The heated volatile products, or spent gases resulting from the combustion of the said currents of gas and air, will flow out of the furnace and into and down the opening or drop-flue S, through the small horizontal flues T, beneath the basin of the furnace, into a channel, U', leading into the main heating-chamber A, and, after circulating around the intricate winding passage-way among the tubes, the said spent products will be directed through a flue, U'', at the opposite end of the chamber A, and up past the flame-valve z, into, and will escape by the chimney P.

As these heated products of combustion play around the tubes, they are soon brought to a white heat, and, as the air and gases pass through them, much of that heat will be imparted to the two currents, so that, when brought together in the furnace and fired, a brilliant pure flame and heat of very great intensity will be produced, which may be applied to the melting of steel, refining and puddling of iron, and various other purposes useful in the arts.

I have described the gases and air as passing through the tubes on their way to the place designed for their combustion, and the hot spent products of such combustion passing through the chamber around the outside of said tubes.

Still, as these passages and tubes are liable to become choked by an accumulation of soot and other forms of carbonaceous matter, it is of no slight importance that some provision should be made for in-

specting the interior of the tubes, and its removal at any time without a stoppage of the furnace, or in any way affecting the heat.

This I accomplish by having a series of holes, *t t t*, through the wall in front of the gas-tubes B, one hole for each tube, of a size and on a line corresponding therewith. Each hole *t* is fitted with a plug, *y*, which may be readily removed for that purpose.

To burn out all deposits of soot and other matter that may accumulate in the gas-tubes and passages, I have so arranged the dampers or valves that, by shifting the valve *n* from the position it appears to occupy in drawing, figs. 1 and 2, to that indicated by the dotted lines in fig. 1, and at the same time making a similar change in the flame-valve *z*, but in a reverse direction, the gases will be directed into the body of the heating-chamber around the outside of the tubes, while the flame and waste products arising from the combustion of those gases will flow through them, and thus burn out particles of matter that may tend to obstruct them.

Should the operations of the furnace, or any other cause, require that the inflammable gases, as they come from the generator, be kept out of the heating-chamber or tubes, this may be done by setting the gas-valve *n* so as to correspond with that of the flame-valve *z*, or *vice versa*, by which the gases will be directed downward through an opening leading into the smoke-chamber N, and thence upward through one of the outlet-flues into the chimney.

Having stated the nature of my invention,

I claim—

1. Arranging the gas and air-tubes all within the space of one chamber, so that the whole or undivided body of the outgoing heat and products of combustion will be distributed equally around and among them on

its way to the chimney, by which all the tubes, those used for supplying air as well as those employed for the transmission of gases, will be heated uniformly and alike, as herein described.

2. Arranging the gas and air-tubes within the heating-chamber, in such a manner as that one end of said tubes may be exposed, and their interior examined at all times from the outside of the apparatus, in the manner described.

3. Arranging each section forming the gas and air-tubes with an enlarged end or bowl, into which is fitted the small end of the section next it, and so arranging them within the heating-chamber as that the joints of one length of tubes will be opposite, and rest against the solid part of that arranged beside it, by which they tend to support one another, leaving intercepted spaces between the tubes, in the manner and for the purpose hereinbefore described.

4. The arrangement of the gas and air-heating chamber, with its several tubes, passages, and dampers, so arranged, with relation to each other, that, by changing the position of the dampers, the ingoing gases may be directed through the heating-chamber around the outside of the tubes, while the heated products of combustion will pass through them, or *vice versa*, in the manner and for the purpose hereinbefore set forth.

5. The use, in the gas-generator, fig. 7, of the falling apron W, in combination with the bench V, constructed and operating substantially as herein set forth.

JOSIAH W. ELLS.

Witnesses:

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T. C. KIER.