

(No Model.)

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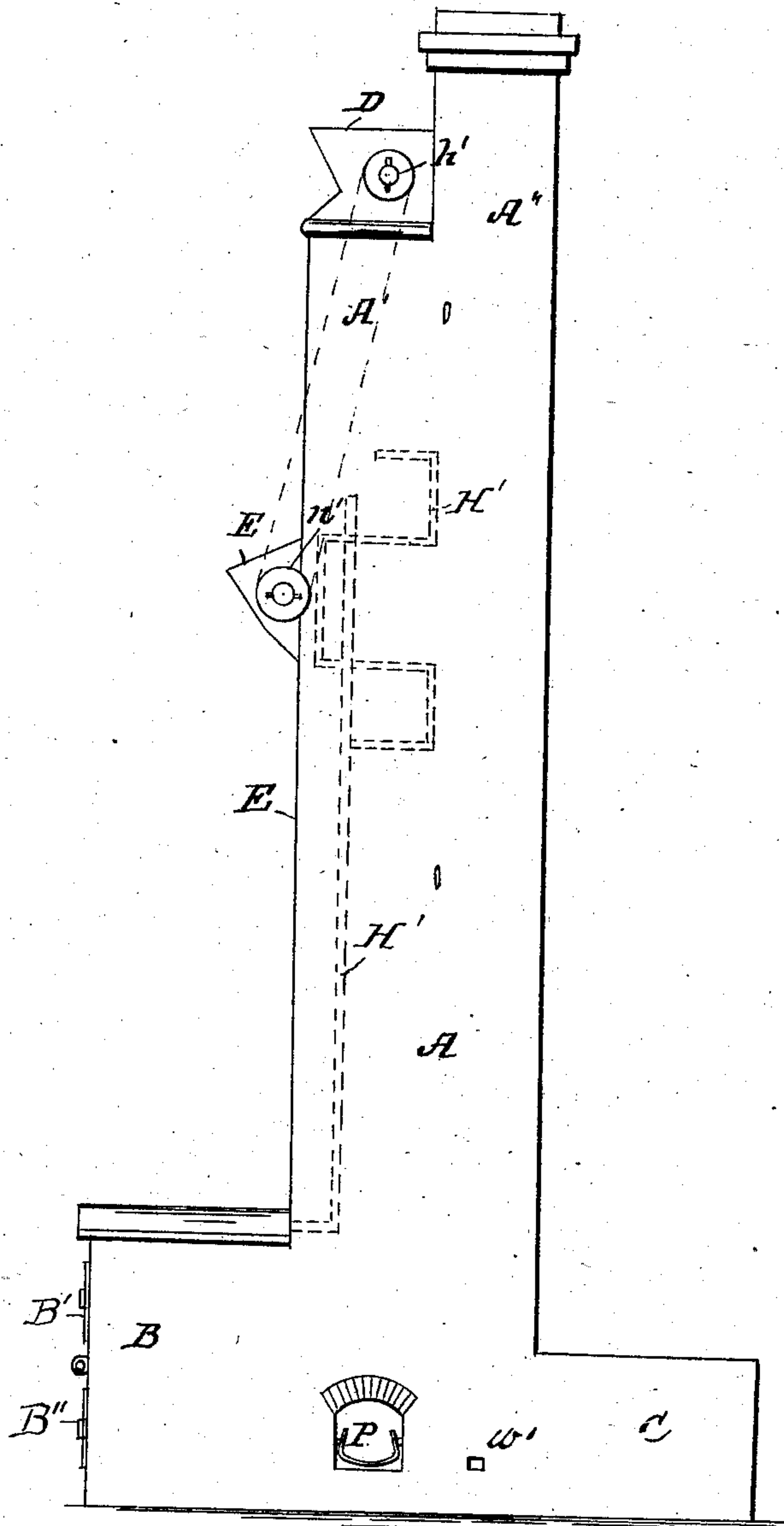
B. O. RUSSELL.

ROASTING AND SMELTING FURNACE.

No. 290,115.

Patented Dec. 11, 1883.

Fig. 1.



Witnesses.
Julius Solger
B. O. Russell

Benjamin O. Russell Inventor

Howard A. Snow Atty.

(No Model.)

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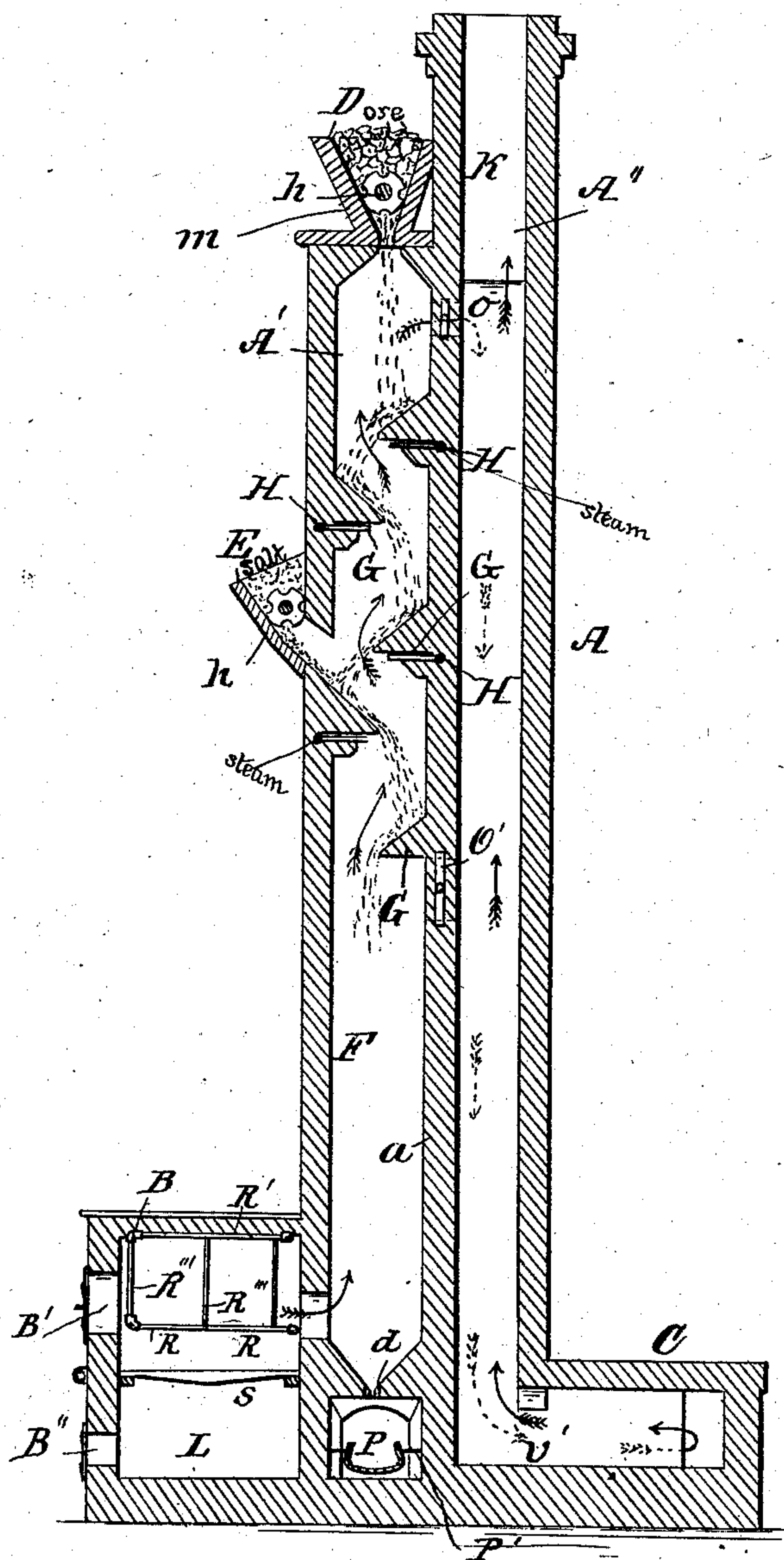
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Fig. 2.



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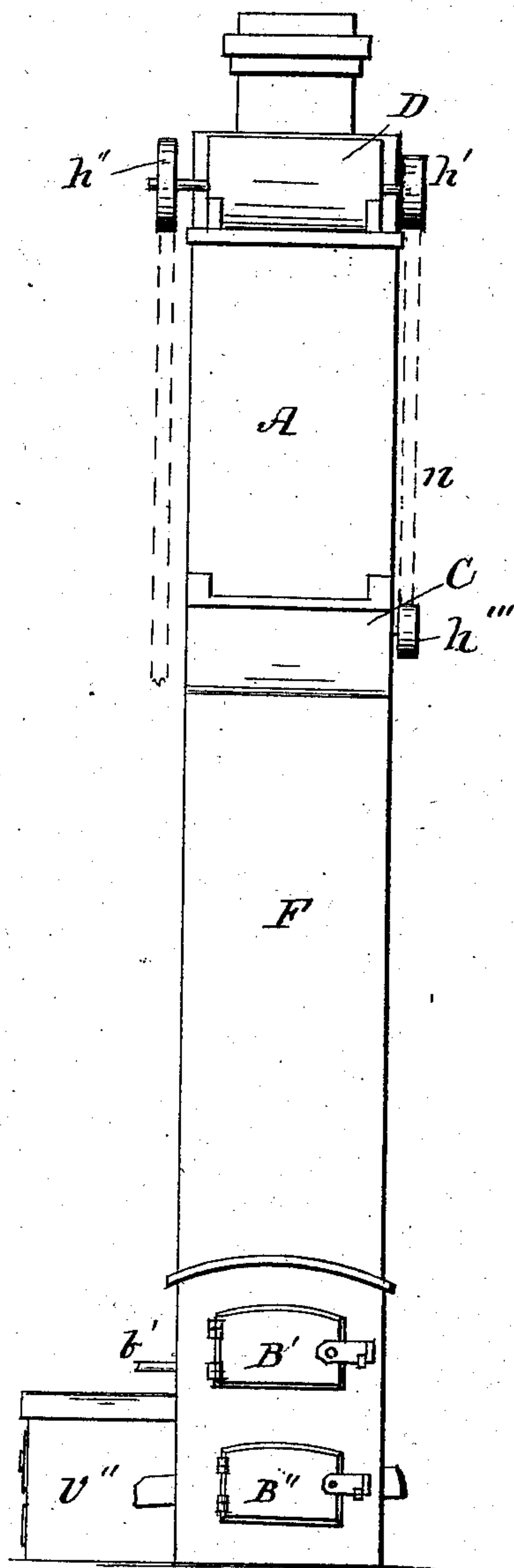
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Fig. 3.



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Fig. 4.

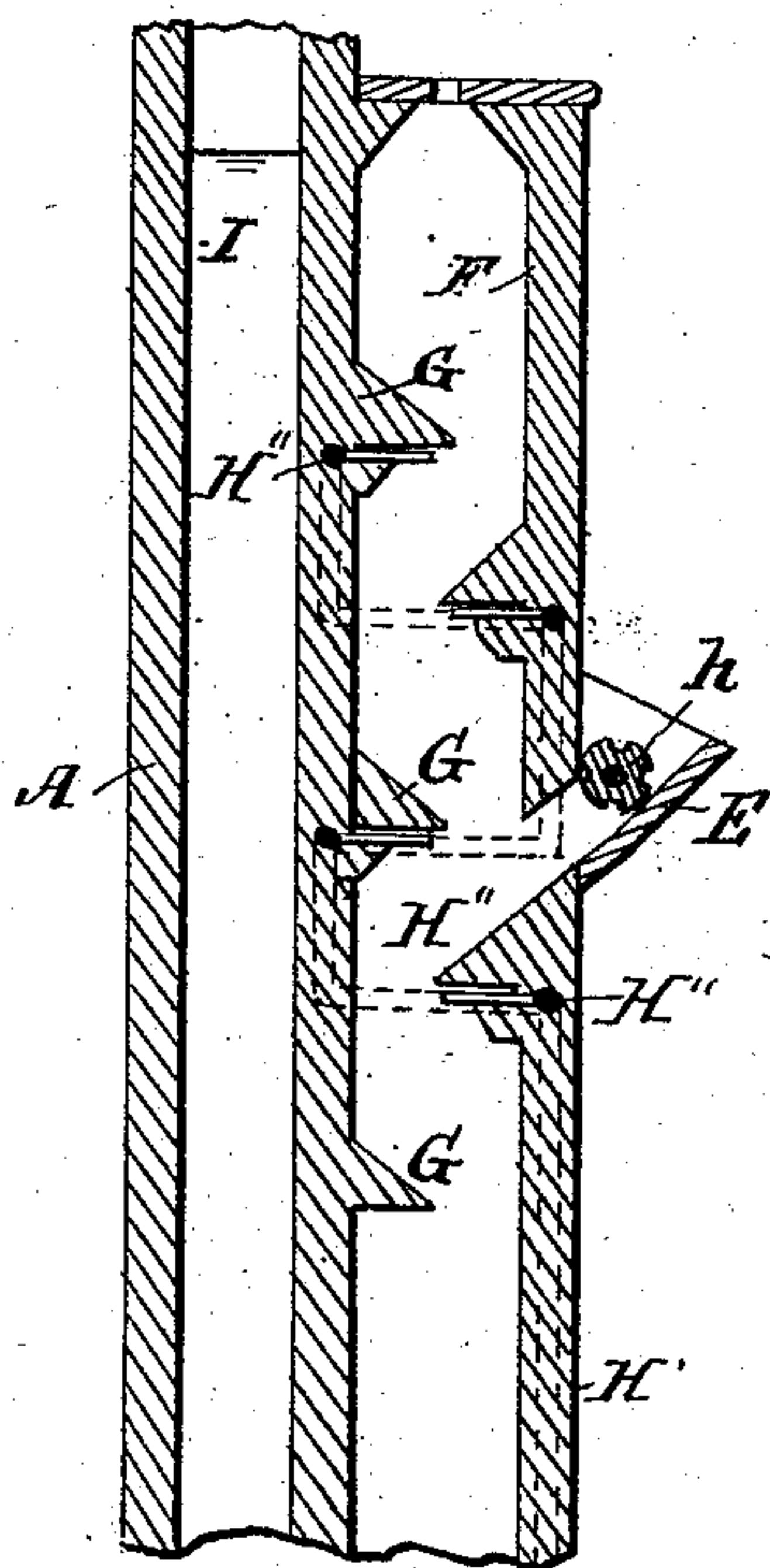


Fig. 5.

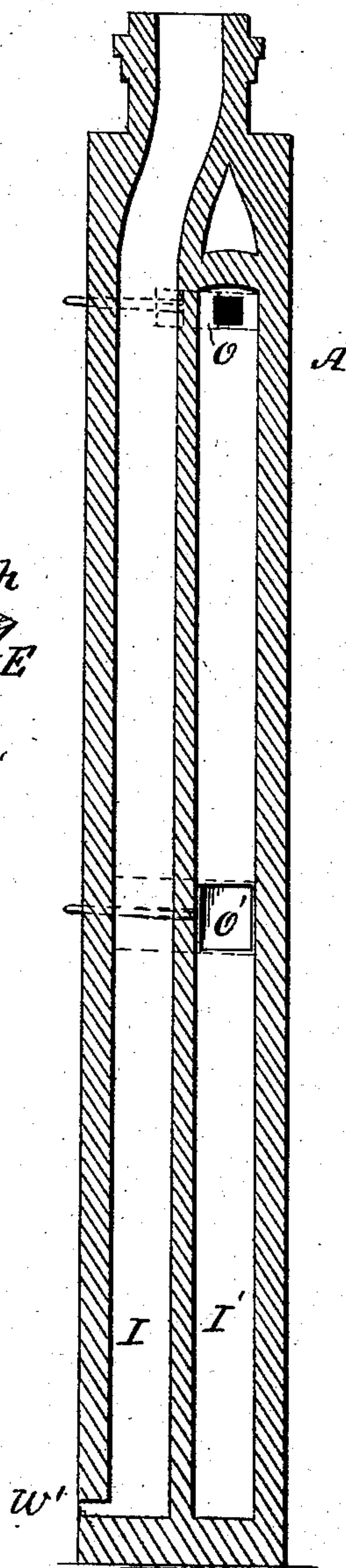
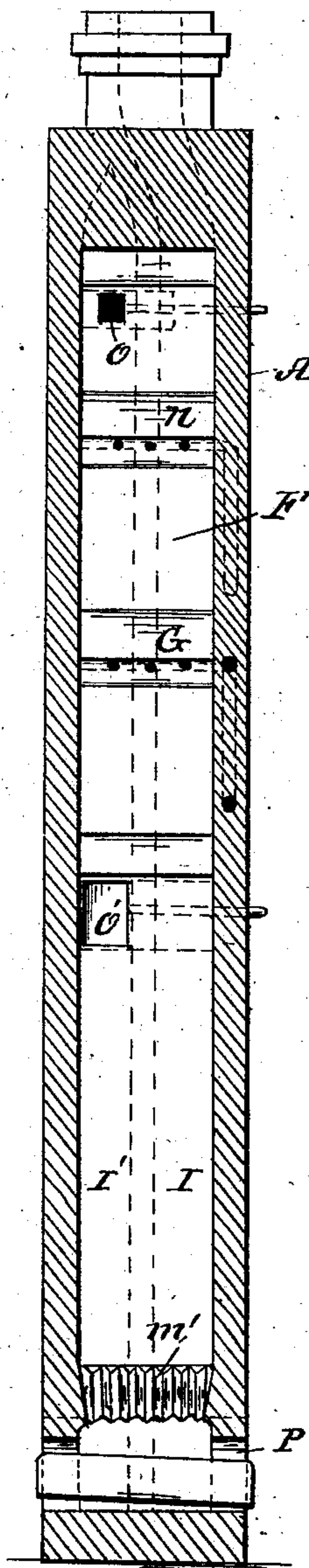


Fig. 6.



Witnesses.

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(No Model.)

5 Sheets—Sheet 5.

B. O. RUSSELL.

ROASTING AND SMELTING FURNACE.

No. 290,115.

Fig. 7. Patented Dec. 11, 1883.

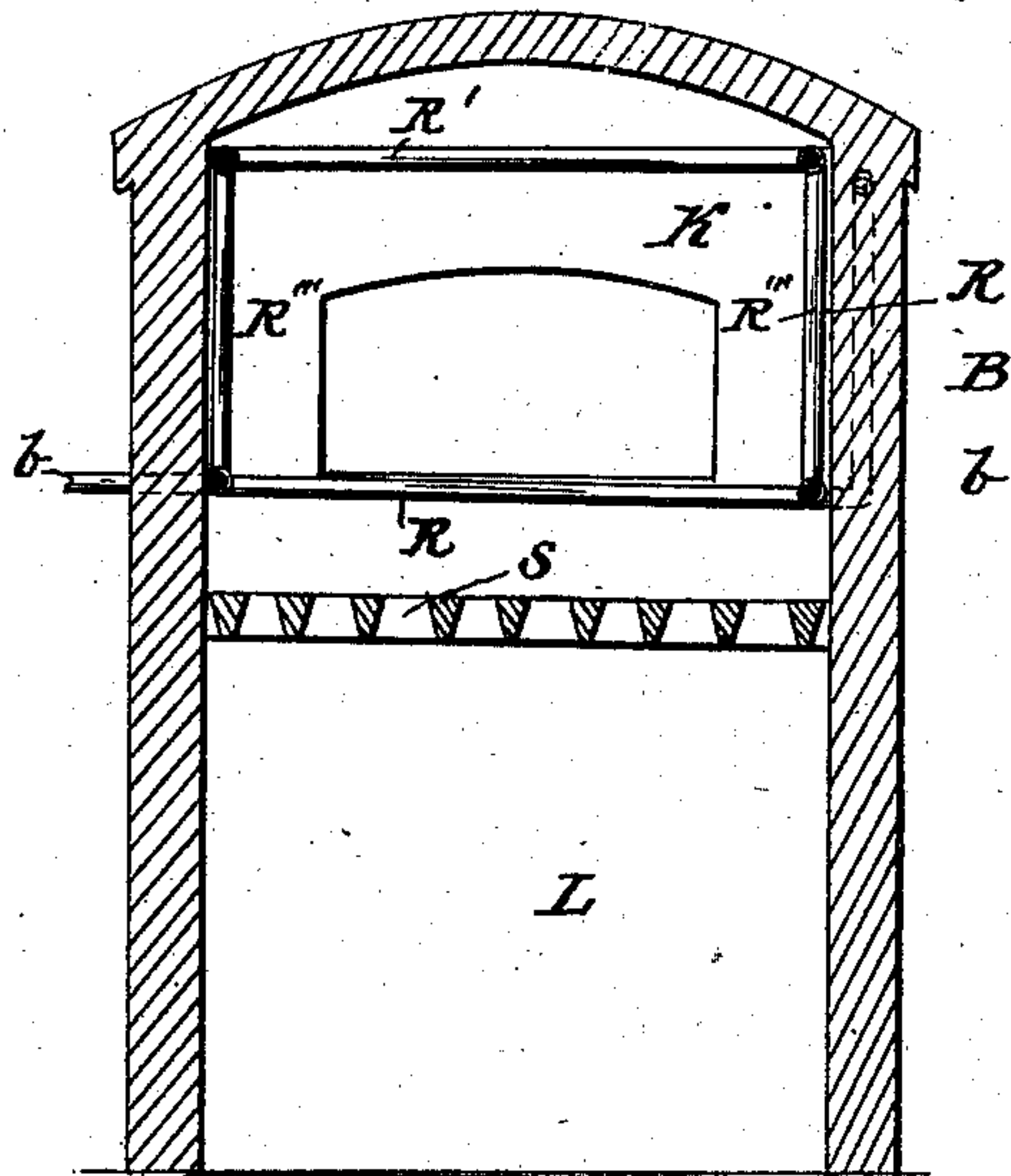
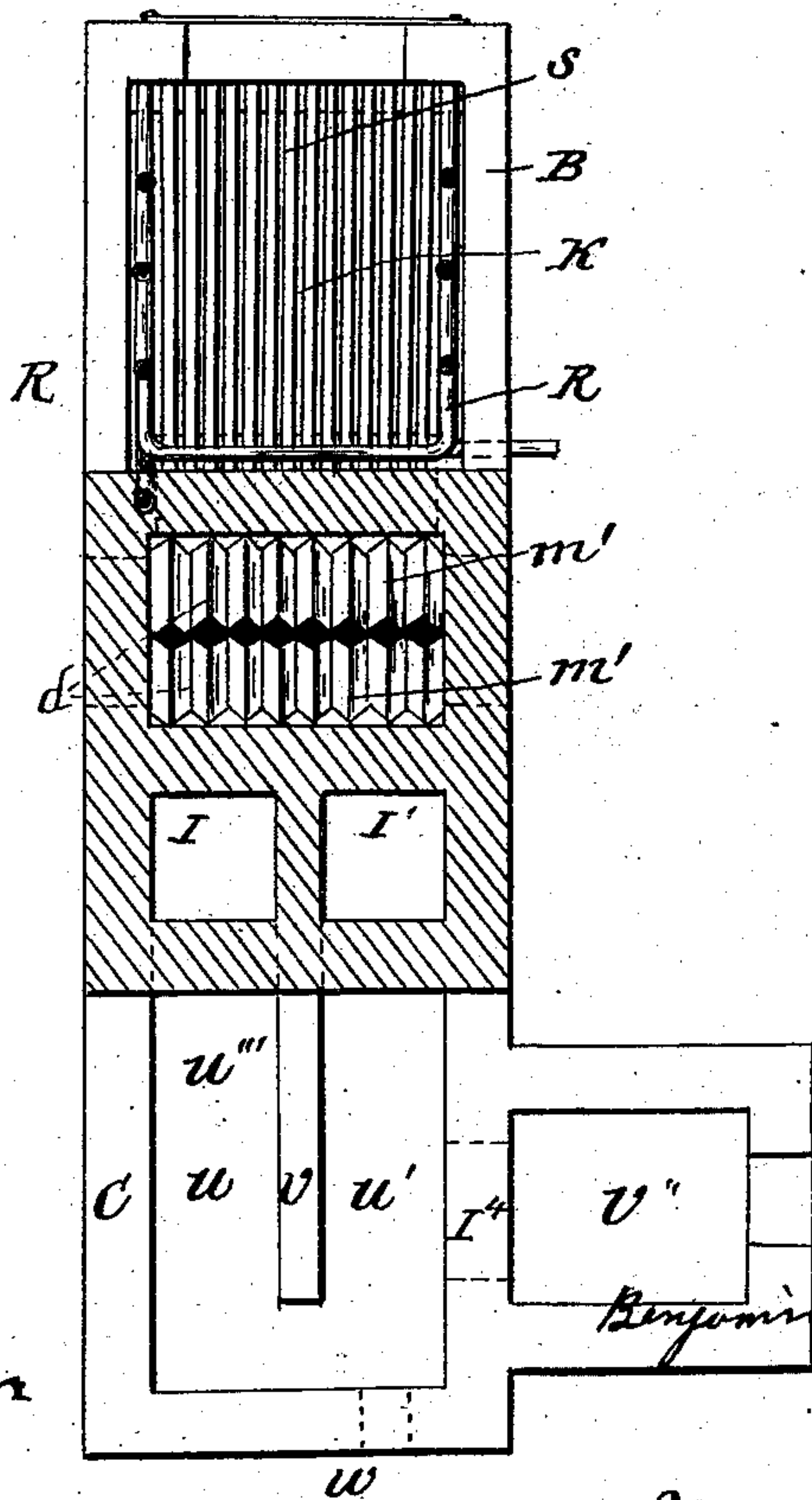


Fig. 8.



Witnesses.

Julius Solger
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Howard A. Snow Atty.

UNITED STATES PATENT OFFICE.

BENJAMIN O. RUSSELL, OF DENVER, COLORADO.

ROASTING AND SMELTING FURNACE.

SPECIFICATION forming part of Letters Patent No. 290,115, dated December 11, 1883.

Application filed August 20, 1883. (No model.)

To all whom it may concern:

Be it known that I, BENJAMIN O. RUSSELL, of Denver, county of Arapahoe, and State of Colorado, have invented a new and useful Improvement in Roasting and Smelting Furnaces; and I do hereby declare that the following is a full, clear, and exact description of the invention, which will enable others skilled in the art to which it appertains to make and use it, reference being had to the accompanying drawings, forming a part thereof.

My invention relates to improvements in means for treating ores, and it is especially designed to provide improved means for desulphurizing, oxidizing, dechloridizing, and smelting ores containing lead, silver, or gold, the objects being to treat profitably a low grade of lead ore and save the lead, and to treat telluric ores without loss.

With these objects in view my invention consists in a metallurgical furnace of peculiar and novel construction, as will be hereinafter fully described, and specifically pointed out in the claims.

I have illustrated these improved means in the annexed drawings, wherein Figure 1 is a side elevation of my improved furnace. Fig. 2 is a vertical cross-section of the same. Fig. 3 is a front elevation. Fig. 4 is a sectional view, showing the arrangement of the steam-pipe and steam-jet pipes. Fig. 5 is an elevated sectional rear view, showing the flues that lead to and from the drying-apartments. Fig. 6 is a front sectional view of the stack or shaft. Fig. 7 is a vertical sectional view of the furnace, and Fig. 8 is a plan view of the drying-furnace and dust and condensing compartment.

The letter B represents the fire-box or heating-furnace with its stack or chimney A. The structure is built of substantial masonry, and of such suitable material as may be adapted to resist the action of the heat to which it must be subjected.

I have erected a furnace intended to treat twenty tons of ore in a day, of which the stack is thirty-one feet high, and the walls of the roasting-flues seventeen inches thick, with a fire-box capable of giving flame and heat to successfully treat the amount of ore stated. In this furnace the flue in the roasting-stack is

eighteen inches by twenty-seven, and the flues leading to and from the drying and dust chamber each thirteen inches by nineteen inches. Other dimensions may be adapted and successfully effect the end intended. These are named for the purpose of showing that the furnace should be solidly and compactly built, in order that its stability and durability may be assured.

The primary and essential elements of my improvements are the fire-box B, the roasting-flue I, the downdraft-flue A'', leading into the dust and drying chamber C, and the updraft-flue I', with the drying and roasting furnace, the whole arranged and constructed as hereinafter combined.

The fire-box B is provided with ordinary doors, B' and B'', the former of which is for charging the furnace with fuel, and the latter opens into the ash-pit and affords access thereto, and for the purpose of cleaning the fire-grate S.

Arranged on both sides of the fire-box in contact with the fire are steam-pipes R and R', connected by vertical steam-pipes R'' and R''', the frame thus presenting large surface area to the action of the heat in the fire-box. The pipes may be suitably connected with a supply-reservoir on the outside of the furnace. The lower line of pipe R in each frame is projected outwardly through the masonry of the furnace, and affords an escape, these being suitably regulated by any well-known appliances. The upper horizontal pipes, R', of these frames on each side of the furnace, are connected with a cross-pipe, and then a single steam-pipe is carried into the masonry of the stack, and thence up the stack well embedded in the walls thereof, for, say, two-thirds of the height of the stack, or until it reaches a line with the under face of the uppermost deflector or inclined hearth. At intervals corresponding to the position of the base of each deflector or inclined hearth this vertical steam-pipe H' is formed or provided with branch pipes laid at right angles to its direction and across the face of the stack, and these branch pipes are supplied with a series of short pipes opening into the shaft directly under each deflector or inclined hearth, for the purpose of injecting steam into the shaft during the descent of the

pulverized ore. The direction of the main steam-pipe up the stack and the relative arrangement of the cross-pipe and jet-pipe are substantially shown in Figs. 1, 2, and 4 of the drawings, and are designated, respectively, by the letters H, H', and H''.

In the roasting-shaft A' are arranged at predetermined distances on opposite sides of the flue and alternating with each other, a plurality of projections, G, forming hearths, substantially as seen in Figs. 2 and 4, having their upper surface inclined, so that the pulverized ore in dropping on an upper projection or hearth is retarded in its descent and directed to the next lower hearth, and so on through the series, thus deflecting and retarding the progress of the ore through the shaft, in order that it may be subjected to all the chemical and heating processes required to effectuate the end intended. Any number of these hearths may be used, according to the height of the stack, the number being readily suggested by those skilled in the art, and the relative adjustment of their inclines being fixed according to the number and the width of the shaft. As stated heretofore, the steam-jet pipes should be set to as to open directly under the lips or edges of these projecting hearths, as this arrangement gives the best position for securing the intended effect of the steam on the descending ore, since it is rolled or tumbled from the lip of the incline in the direction of the one directly below, and the application is thus direct and complete.

Arranged on the top of and opening into the flue A' is an ore-feed hopper D, having journaled therein a feed-roller, *m*. In this hopper the pulverized ore is placed, and through it delivered to the shaft. To the end of the shaft of this feed-roller are fixed the pulleys *h'* and *h''*, the latter of which is designed as means to apply the power to operate the roller; but it is evident that other gearings may be used, since the object is to provide reliable mechanical means of sufficient power to drive the roller.

To the front side of the stack, at about two-thirds the height thereof, is fixed another hopper, E, which leads into the shaft, and is provided with a feed-roller, *h*, and has a pulley, *h'''*, fixed to a shaft, which may be connected by a belt, *n*, with the pulley *h'* on the shaft of the upper feed-roller, as shown, or it may be run by independent means connecting the power. This device is designed as a salt-feed, and for that purpose salt or chemicals are deposited in the hopper and delivered by the action of the roller in the shaft in a pulverized condition, to act on or commingle with the descending pulverized ore.

In the bottom of the shaft A' is set the smelting-hopper *d*, consisting of two corrugated plates, *m'*, placed on an incline, substantially as shown in the drawings, with their lower ends sufficiently apart to admit the matte to gradually drop through the interstice into a removable receptacle, P, set in the

opening P', formed in the base of the structure, or the matte may drop into a current of water, or be cooled by a current of air passed through this opening. The particles of ore precipitated from the top of the shaft are eventually deposited in this hopper *d*, and there subjected to the action of the flame and heat coming from the fire-chamber of the furnace, and in this way the ore is smelted, the metals united, and the dross consumed or carried out through the bottom of the hopper, all dropping into a proper receptacle or into a current of water. The heat from the furnace or fire-box not only acts as smelting purposes, as stated, but, ascending the shaft, serves the purpose of desulphurizing, oxidizing, and dechloridizing the shower of pulverized ore in a great measure, or completely, before it reaches the smelting-hopper.

Near the upper end of the roasting-shaft A' in the partition-wall *a* of the stack is formed an opening, O, to which is adjusted a sliding damper to control the draft at that point, and lower down in the partition-wall *a*, preferably under the lowest projection in the shaft, is formed another draft-hole provided with a sliding damper, O'. Both of these dampers or vents O and O' open into the flue I', leading into the dust and drying chamber.

In the rear of the main furnace is built an auxiliary furnace, serving as an ore-drying chamber and dust-receiving compartment. This auxiliary or drying furnace V'' may be of any suitable construction, having a direct draft through the space between the partition and the wall of the dust-chamber, substantially as shown. The drying-floors and dust-chambers C are divided into two compartments U and U' by the partition-wall V, which is extended part way of the length of the chambers, as shown in Fig. 8 of the drawings. The flue I' opens into the compartment U', and the compartment U opens into the flue or shaft I, which operates as the exit of the draft. A cold-air draft-hole, *w'*, is formed in the side of the furnace, and opens into the draft-flue I; and another cold-air draft-hole, *w*, is formed in the wall of the drying-chamber C opposite the shaft I', the purposes of which are well known. The stack may be strengthened by suitable metallic binders and rods in the manner usual in structures of the kind.

The purpose is to introduce the ores in such a manner and in such a condition as to be quickly acted on by the employed agents, and to deliver it to the smelting-hopper at the bottom of the shaft in such purified condition that the process of reduction is materially hastened. To this end the operation is substantially as follows: The furnace having been heated to a proper degree, the ore is placed in the hopper at the top of the stack or shaft, and by the feed-roller is delivered through the mouth of the hopper to the shaft of the furnace, where it meets in its descent the first incline, from whence it is deflected to the opposite incline, and so in order with succeeding inclines, thus

presenting the material in constant agitation to the direct action of the ascending current of heat, and igniting and eliminating the sulphur. To promote combustion and insure oxidation of the pulverulent ore, steam is injected in the shaft through the steam-jet pipes, which steam, having been already heated to a high degree, is further heated in its exit to the shaft by the heated current from the furnace, and coming in contact with the pulverulent ore hastens and perfects oxidation. Salts, having been placed in the salt-feeding apparatus and passed into the shaft through the hopper, meet the descending shower of ore, and act thereon with the well-known chemical results. Thus in its descent the pulverized ore is purified before it reaches the smelting-chamber at the bottom of the shaft, where the metals are melted and the silicates and gangue may remain unmelted, or, if melted, are separated from the metal in falling from the hopper, and the particles of metal unite, the union being effected usually during the progress over the corrugated hearth of the hopper. From the hopper the deposits are being continually discharged into a current of water or air or are run into a cooling-floor. It will be observed that as the draft in the roasting flue or shaft is upward, and its exit at one of the doors in the partition of the stack, through which door it descends in the flue I', thence through the compartment of the dust-chamber around the end of the partition-wall, thence through the exit to the chimney, and thence to the air, the heat will so effect a quantity of the pulverized ore in its descent, that it will be burned into dust and its course reversed, so that, instead of reaching the smelting-hopper, it will pass up and through the open damper, and from thence be deposited in the dust-chamber or drying-floor, to be subjected to the action of the heat in the drying-furnace, and removed from the receptacle, to be subjected to such further treatment or reduction as may be proper.

I do not wish to be understood as limiting myself to the precise constructions shown in the drawings, as the furnace with its adjuncts can be erected of any desired dimensions and capacity.

What I claim as my invention, and desire to secure by Letters Patent, is—

1. In combination, the steam-pipe frame arranged within the fire-box of the furnace, the steam-conducting pipe embedded within the masonry of the stack, and a series of steam-jet pipes connected with the steam-conducting pipe and communicating with the inside of the shaft or flue of the furnace at the base of inclined hearths arranged within the shaft of the stack, substantially as described.

2. The combination of the steam-pipe frame arranged within the fire-box of the furnace, and provided with a steam-conducting pipe having steam-jet pipes communicating with the inside of the flue or shaft of the furnace, the flue A', having the inclined deflecting-

hearths G, salt-feeding device, and ore-feeding device, substantially as described, and for the purpose set forth.

3. In combination with the shaft or stack of an ore-treating furnace, the ore-feeding device D, and the salt-feeding device E, arranged and combined to operate substantially as set forth.

4. The combination of the fire-box B, pipes R R' R'', connecting-pipe H', flue A', having the inclines G, pipes H, salt and ore feeds D E, provided with longitudinal grooved rollers *n* and *m*, having pulleys *h' h'' h'''*, inclined grate *d*, and receptacle P, all substantially as described and set forth.

5. The combination of the fire-box B, pipes R R' R'', connecting-pipes H', and steam-jet pipes H, flue A', with dampers O O', and having the inclines G, salt and ore feeds E D, provided with grinding-rollers and suitable actuating means, inclined grate *d*, and receptacle P, substantially as and for the purpose set forth.

6. The combination of the fire-box B, formed in the manner shown and described, the flue A', having the tortuous passage formed therein, and the ore-feed D, provided with a grooved grinding-roller, the shaft whereof is provided with the pulleys *h' h''*, the salt-feed E, having the grooved grinding-roller provided with the pulley *h'''*, connected to the ore-feed by the belt M, whereby they are operated simultaneously, and suitable motive power, substantially as set forth.

7. In an ore-treating furnace, the organized instrumentality herein described, consisting of the fire-box B, the steam-pipe frame arranged within the fire-box, provided with steam-conducting pipes embedded within the masonry of the furnace-stack, and provided with outlets or steam-jet pipes opening into the shaft, the smelting-hopper *d*, receptacle P, the stack or shaft A', formed with a series of inclined hearths, the salt grinding and feeding device E, fixed to and leading into the shaft, the ore grinding and feeding device arranged as set forth, the draft-holes O and O', provided with suitable dampers, the down-draft-stack I, the drying and dust chamber, the furnace V'', and the exit draft-flue I', the whole arranged and combined to operate substantially as and for the purpose set forth.

8. The stack consisting of the shaft A', provided on opposite sides with alternating inclined deflecting-hearths G, and steam-pipes having steam-jet pipes communicating with the shaft, the partition *a*, provided with draft-holes O O', the downdraft I', the dust-chamber C, and updraft I, arranged and combined substantially as described.

In testimony that I claim the foregoing I append my signature.

BENJAMIN O. RUSSELL.

Witnesses:

GEORGE S. RUSSELL,

BEN. F. RUSSELL.