No. 708,438. Patented Sept. 2, 1902.

W. C. WETHERILL.

ZINC FURNACE.

(Application filed Oct. 12, 1900.)

(No Model.) 5 Sheets—Sheet 1.

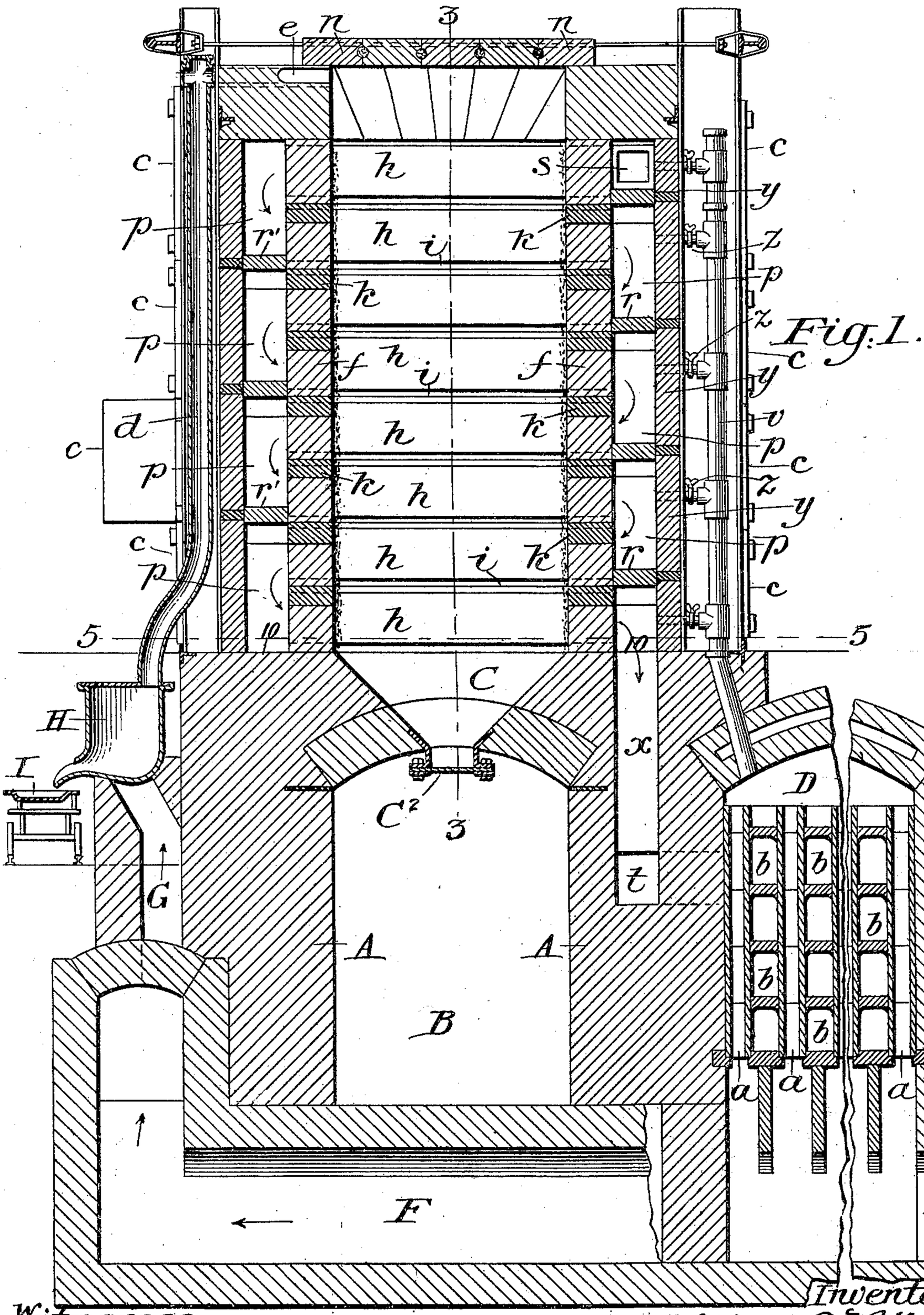

Fig. 1.

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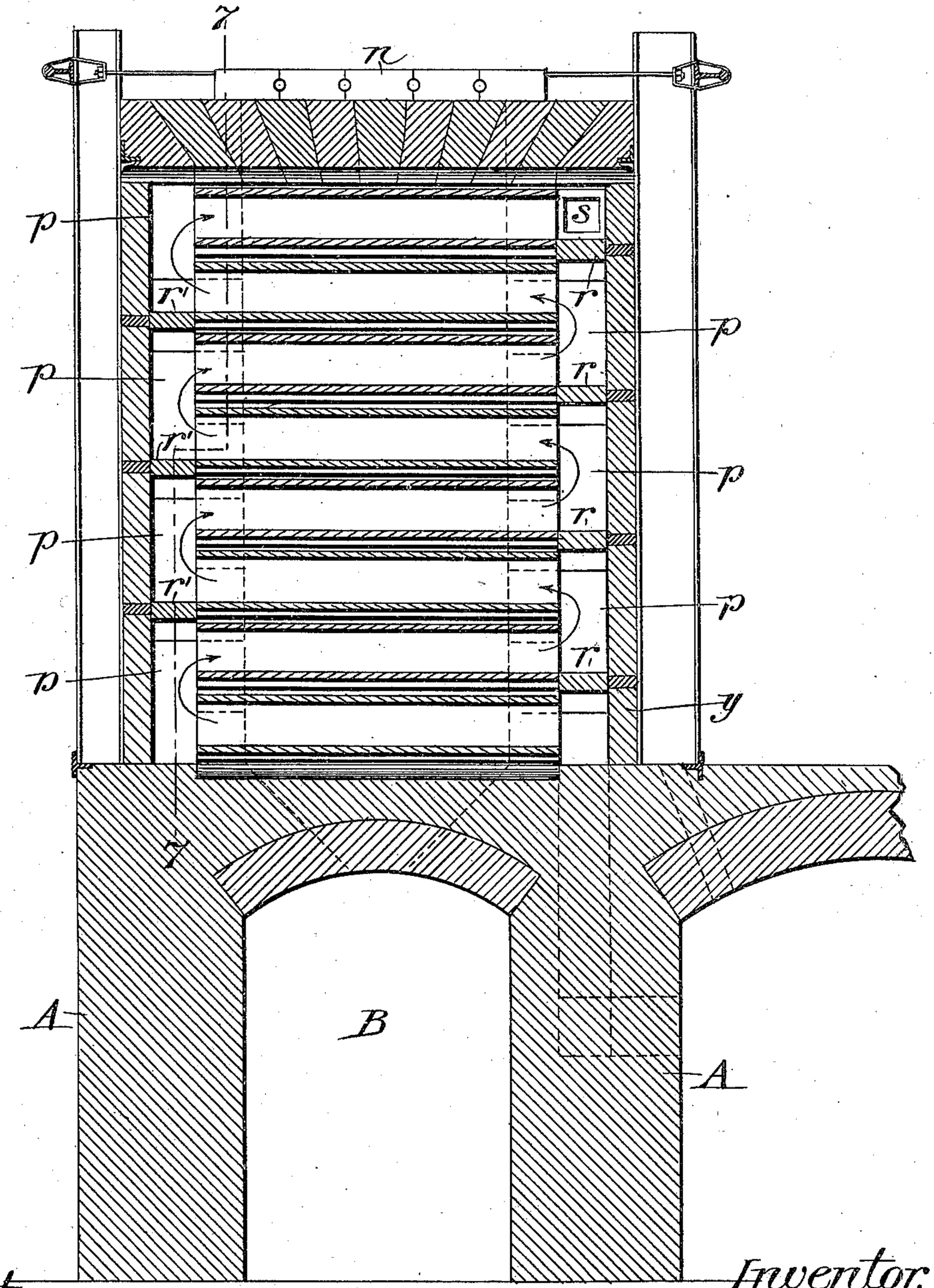
Fig. 2.



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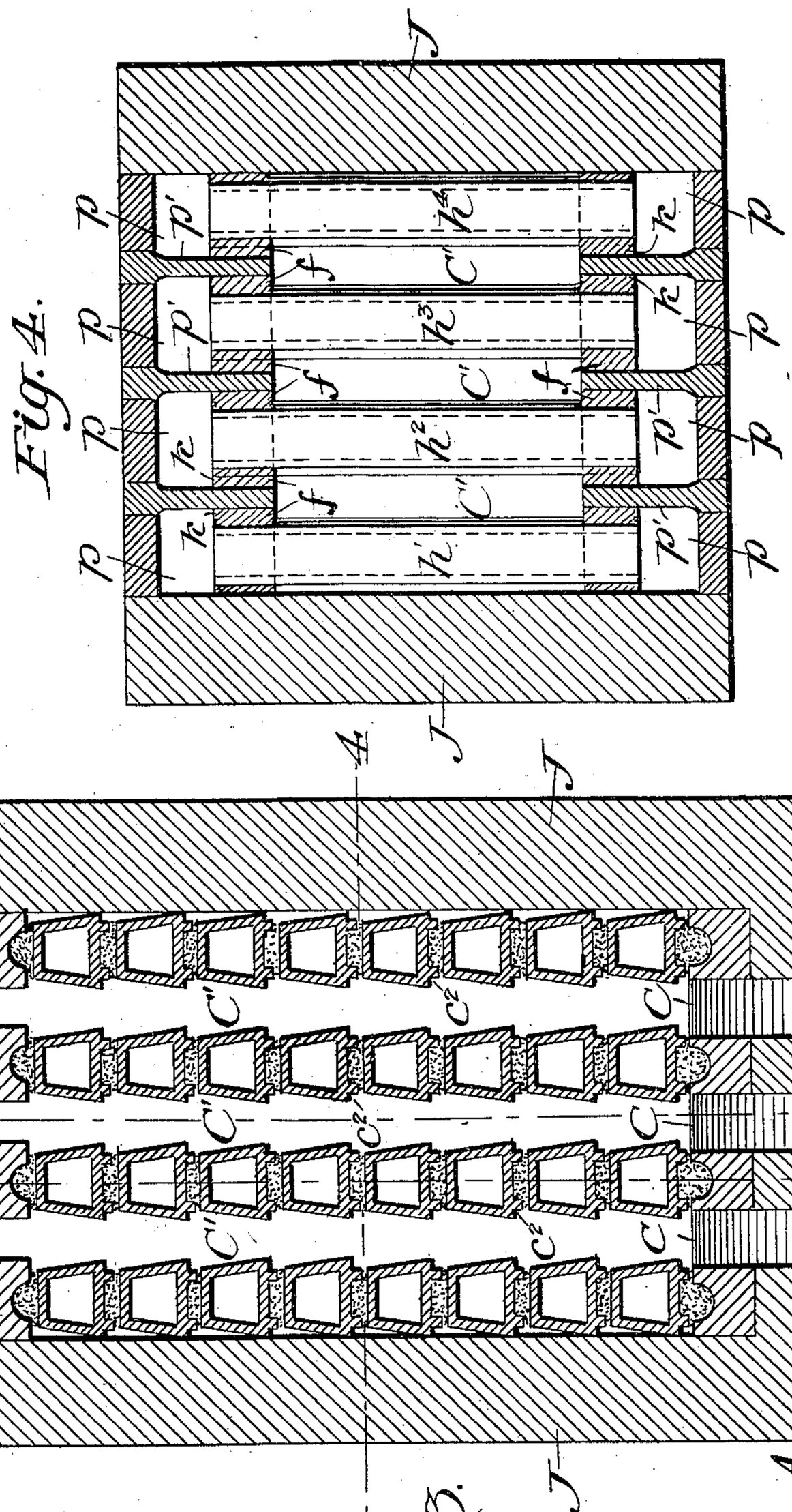
(No Model.) 5 Sheets—Sheet 3.



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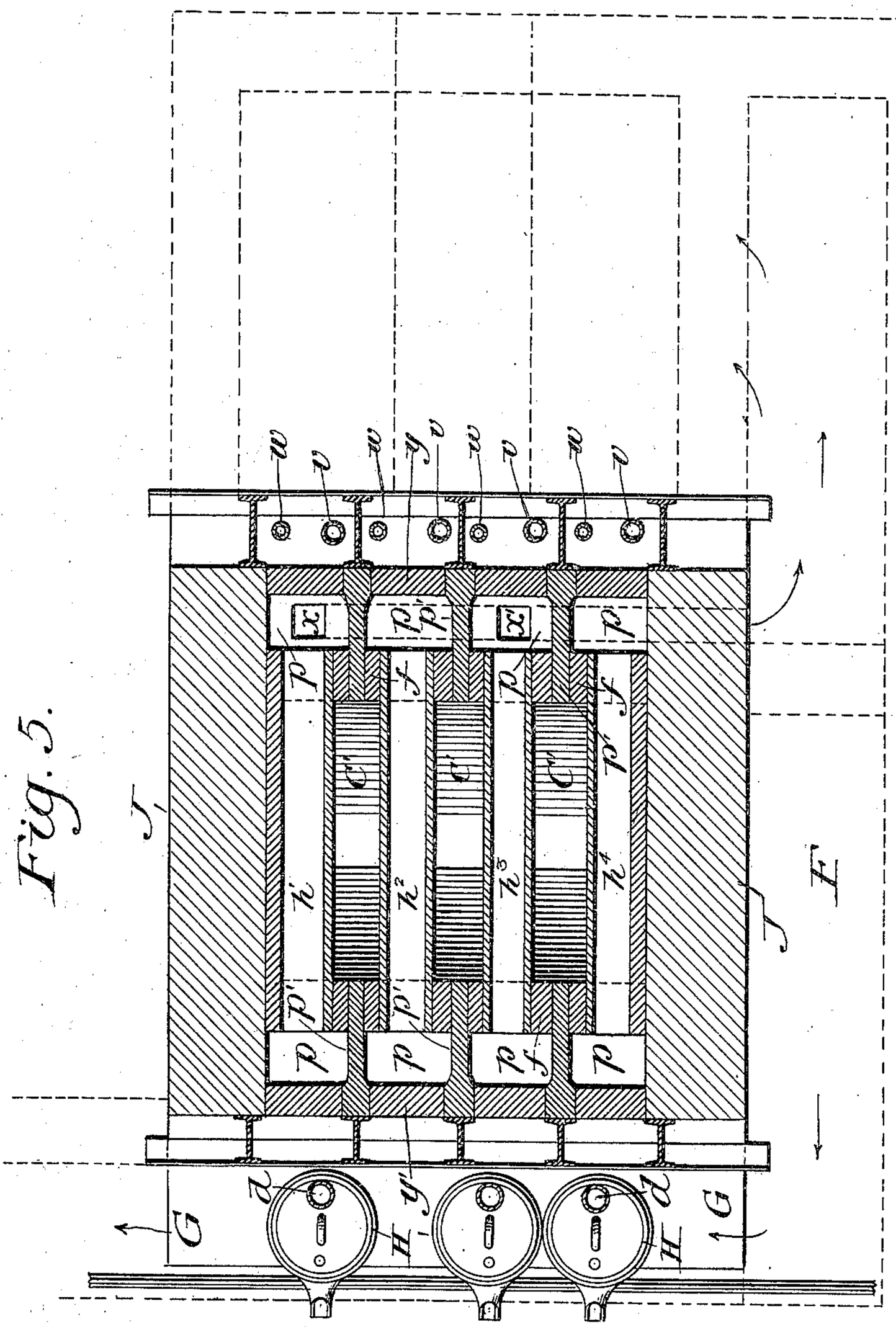
(No Model.) 5 Sheets—Sheet 4.

Fig. 5.



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(Application filed Oct. 12, 1900.)

(No Model.)

5 Sheets—Sheet 5.

Fig. 7.

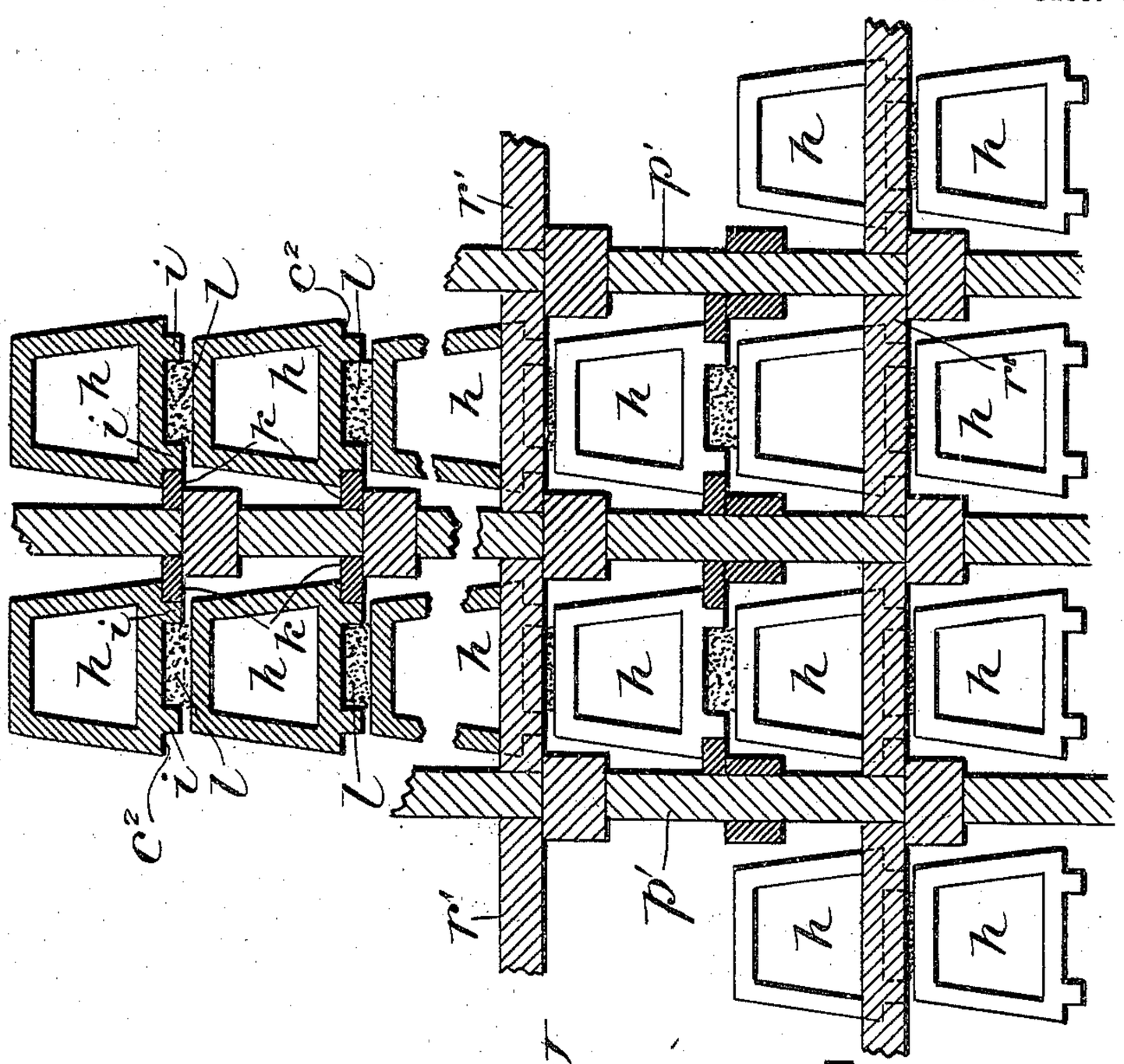

Fig. 6.

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UNITED STATES PATENT OFFICE.

WILLIAM C. WETHERILL, OF JOPLIN, MISSOURI.

ZINC-FURNACE.

SPECIFICATION forming part of Letters Patent No. 708,438, dated September 2, 1902.

Application filed October 12, 1900. Serial No. 32,885. (No model.)

To all whom it may concern:

Be it known that I, WILLIAM C. WETHERILL, a citizen of the United States, residing at Joplin, county of Jasper, State of Missouri, have invented certain new and useful Improvements in Zinc-Furnaces; and I 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.

My invention relates to certain new and useful improvements in zinc-furnaces, and is particularly designed to permit the charging, drawing, and recharging of the furnace to be accomplished at a minimum expenditure of labor, the charge itself being contained within relatively long and narrow chambers included between horizontal gas-tight removable heating-flues and having top charging-apertures and bottom discharge-outlets, these several features embodying the main elements of my improved construction.

In the accompanying drawings, Figure 1 represents a vertical sectional view of a furnace embodying my invention, taken on a plane indicated by the line 1 1 of Fig. 3. Fig. 2 represents a like view taken on a plane indicated by the line 2 2 of Fig. 3. Fig. 3 represents a view taken on the line 3 3 of Fig. 1. Fig. 4 represents a sectional view taken on the line 4 4 of Fig. 3. Fig. 5 represents a sectional plan view, the location of the flues of the preheater being indicated in dotted lines. Fig. 6 represents a front elevation. Fig. 7 represents in cross-section and on a larger scale the heating-flues and the means for supporting them from the walls of the furnace, said section being taken on the line 7 7 of Fig. 2.

Similar letters of reference indicate similar parts throughout the several views.

In the metallurgy of zinc ores it has been customary prior to my present invention to follow the familiar method of charging the ore into clay retorts or vessels externally heated by the furnace-gases. These retorts require to be cleaned and recharged by hand about once in every twenty-four hours, and the condensers must first be removed and then replaced, all of which involves great expenditure of labor and loss of time. Moreover, these clay retorts or vessels, as is well known, have a comparatively short life because of the destructive effects of the metals that are usually associated with the zinc in the retort charge—as, for instance, lead and the like—which form fusible silicates, which accumulate from day to day in the bottom of the retorts and in a short time bore through the thin clay walls. The retorts must then be replaced by others, and in addition to the destruction of the retorts themselves it is further to be noted that there is an actual loss of metal by absorption in the porous walls of the retorts, this loss amounting to from ten per cent. to twenty per cent. of the weight of the retorts themselves before the retorts begin to do effective work. To remedy these difficulties, my invention consists in substituting for the clay retorts a furnace wherein the charge is contained within long, narrow, and deep chambers C′, formed between the walls of the flues *h*, through which products of combustion are conveyed, the ends of said chambers being closed by the heavy front and rear walls of the furnace. Each of the deep vertical chambers so formed is provided at the top with a supply-opening for the admission of the charge and at the bottom with a discharge-hopper, both of said openings being adapted to be hermetically sealed or luted, so as to prevent the escape of the zinc-vapors during the furnace operation except to the condensers.

In the accompanying drawings I have for convenience shown as the preferred means for heating the wall-flues a preheating-furnace especially adapted for use in connection with natural or producer gas and wherein the air supplied to the combustion-flues is brought to a high temperature by heat imparted to it from the products of combustion on their way to the chimney-stack. It will be apparent, however, that the characteristic features of the invention as hereinbefore specified may be embodied in an apparatus heated by direct firing.

Referring to the drawings, A indicates the main walls of the lower portion of the furnace containing the tunnels B for the passage of the usual cars or trucks which receive the spent charges from the hopper-shaped bottoms C of the charge-containing chambers C′ through the discharge-openings closed by gates C^2.

D indicates an air-preheater of a familiar type, wherein the air entering from the external atmosphere at E passes up through the series of uptakes *a* and the products of combustion from the heating-flues pass downwardly from end to end of a series of flues *b* and finally pass into the bottom flue F, leading toward the stack, as indicated by the arrows in Figs. 1 and 5. The construction and operation of air-preheaters of this general type being familiar to those skilled in the art it is unnecessary for me to describe the same with greater minuteness. On their passage to the chimney-stack the products of combustion pass along a horizontal flue G and beneath the melting-pots H, thereby keeping the zinc therein in a sufficiently fluid condition to be readily tapped when desired into the receiving-molds I.

Upon the base A of the furnace is mounted the superstructure J, wherein are formed the deep narrow long externally-heated charge-containing chambers C′, with their removable heating-flues, constituting the main characteristic feature of my invention. The external walls of this superstructure at the sides and rear may conveniently be formed of brickwork strengthened and tied by vertical channel-beams and transverse T-irons, as shown. The front and rear walls are preferably provided with a series of hinged metallic plates *c*, as shown, thus retaining a proper temperature about the condensers and air and gas pipes and to make the interior of the superstructure readily accessible for the installation and removal for repairs of the flues within. Between the front external hinged plates and the interior flue structure are located the condensers *d* for the zinc-vapors, which issue through the transverse tubes *e*, leading from the top of the charge-containing chambers C′, and between the rear external hinged plates and that end of the flue structure are the air and gas pipes *v w*, leading from the preheater. By opening or closing one or more of these hinged doors the temperature of the walls of the condensers and the air and gas pipes may be appropriately regulated to increase or diminish the condensing effect as may be required by variations in the prevailing temperature of the furnace.

The removable combustion-flues *h*, constituting the side walls of the deep narrow charge-containing chambers C′, are introduced through the front wall of the furnace and are supported at their ends from the partitions *f* in the manner indicated more particularly in Fig. 7. In cross-section these flues are preferably of the general form of a truncated prism and are provided along their lower surfaces with longitudinal projections *i*, forming angular recesses to receive the supporting-tiles *k*, projecting laterally from the partitions, and also an intermediate recess for the reception of a body of luting material *l* between the bottom of one retort and the top of its next lower neighbor in the series. The supporting-tiles *k* are of course located only at the ends of the combustion-flues *h*, but the projections *i* are continued across the entire length of the combustion-flues, as clearly indicated in Figs. 1 and 3. Consequently the combination-flues along their outer lower edges are provided with longitudinal overhung recesses c^2, extending from end to end thereof. These overhung recesses afford a passage along which the vapors disengaged during the furnace operation can travel toward the ends of the charge-containing chambers. Their function is to avoid the possibility of the locking up of the zinc-vapors by pressure and the formation of slag within the charge-containing chambers, thus cutting off access to the flue-outlets *e*. To render them effective at the same time that the furnace charge is introduced into the deep narrow chambers C′, I also charge at both ends of said chambers a body of rough coke, extending from top to bottom of the chambers and of a width of about six to eight inches, as indicated at *s s*, Fig. 1, thereby affording a body of material through whose intercommunicating interstices the zinc-vapors may readily pass upward toward the exit-tubes *e*. The combustion-flues *h* are arranged in series, four of which, *h′*, h^2, h^3, and h^4, (see Figs. 4 and 5,) are shown in the drawings. Above each series of these flues is located an arch *m*, provided on its under surface with a luting-groove, as shown, and a like luting-groove is provided between the base of the lowermost combustion-flue and the subjacent brickwork of the main structure A, as indicated in Fig. 3. The supply-opening or top feed end of each of the deep narrow chambers is adapted to be closed by a series of bricks *n*, grooved along their proximate edges and luted thereat, as shown in Figs. 1 and 2. The free open ends of the flues of each series at front and rear of the furnace communicate with vertically-arranged series of chambers *p*, the individual chambers of each series being separated from one another horizontally by partitions *r r′*. There is one series of these chambers *p* for each series of flues *h*, and the series of chambers are separated from one another vertically by partitions *p′*. The products of combustion on their way to the exit-openings *x* therefore pass in a zigzag course through each series of flues *h* and chambers *p*. From the opening *x* these products pass into the flue *t* and thence through the flues *b* of the preheater. The heated air for supplying the necessary oxygen to the combustion-flues passes upwardly through the pipes *v* (see Figs. 1 and 5) and enters the chambers *p* by valved side branches *z* at different heights, so as to effect by secondary combustion the complete consumption of the gas admitted, which enters the same chambers through the corresponding series of pipes *w*. The gas and hot air from the pipes *w* and *v* enter the combustion-chambers *p* through the removable front tiles *y*.

They then enter the bottom removable flue-tile of the series h^2 and pass forward and backward, ascending through that series to the upper removable flue. Thence they pass across through the horizontal tile-flue s to the top flue of the next series h', and thence descend through the flues of that series to the bottom and through the outlet x and flue t to the preheater and furnace-stack.

The series of flues h is divided into sets of two rows each, flues $h' h^2$ forming one set and h^3 and h^4 constituting the other and each set being independent of the other both in its own structure and in its connection with the preheater and furnace-stack. The flues of the set h^3 h^4 are connected together and to the corresponding end chambers p in precisely the same way as the set h' and h^2, above described, and the exit for the products from the series h^3 into the flue F is through the opening x' at the bottom.

The operation of the apparatus is as follows: The charge of zinc ore to be reduced, together with the necessary carbonaceous material for that purpose, is introduced into the deep narrow chambers C', together with the supplemental vertical bodies of rough coke hereinbefore referred to, at the opposite ends of each charge. The top and bottom openings of the several chambers having been first carefully closed and luted, the apparatus is fired by the combustion of the ignited gas in the combustion-flues, and the products of combustion after traversing the combustion-flues, as above described, pass through the flues F and G to the chimney-stack. The metallic zinc-vapors disengaged from the charge find their exit through the tubes e and the condensing-pipes d into the metal pots or receptacles H, wherein the metal collects in a liquid condition ready to be tapped off through the outlet-apertures as desired into the molds I or the like, the waste heat of the outgoing products of combustion serving to maintain the liquid in the molten condition suitable for its ready outflow. When the charge is spent, it may be quickly removed through the hopper-bottoms C, (the hoppers C being always held full of spent hot charge,) whereupon a new charge may be at once admitted and the operation continued, the charging, drawing, and recharging the furnace being accomplished with a comparatively small expenditure of labor and an inconsiderable loss of time.

The method of replacing the tile flues h is as follows: Should any of these flues become cracked or broken, the charge in the chambers on either side would be drawn down to the floor-line. (See 10 11, Fig. 1.) The gas and air in that series of flues h and chambers p should then be turned off, and the doors c for that series at each end of the furnace should be opened. The tile plates y and y', corresponding to the broken flues, should then be removed from the front and rear of the furnace, also the horizontal plates $r r'$, condensers d, and pipes v and w. The air-tight lute fillings should then be removed, together with the carrier-tiles k, when by the insertion of bars at either end the broken flue can be taken out and replaced by a new one, whereupon the removed parts above described are replaced. Repairs are thus possible in any one of the series without interruption in the operation of the others.

Having thus described my invention, what I claim is—

1. A zinc-furnace, provided with a series of relatively deep, long and narrow charge-containing chambers, and removable tile combustion-flues separating said chambers from each other and forming the walls thereof, whereby the furnace may be charged and discharged without dismantling it, the destructive effects of the slags are largely obviated and the loss of zinc by absorption is materially reduced; substantially as described.

2. A zinc-furnace, provided with a series of relatively deep, long and narrow charge-containing chambers, and removable tile combustion-flues forming a zigzag passage and constituting the division-walls of said chambers, whereby the furnace may be charged and discharged without dismantling it, the destructive effects of the slags are largely obviated and the loss of zinc by absorption is materially reduced; substantially as described.

3. A zinc-furnace, provided with a series of relatively deep, long and narrow charge-containing chambers, removable tile combustion-flues separating said chambers from each other, said chambers being provided with top feed-openings and bottom discharge-openings, and exit-pipes for connecting the chambers with a condenser, whereby the furnace may be charged and discharged without dismantling it, the destructive effects of the slags are largely obviated and the loss of zinc by absorption is materially reduced; substantially as described.

4. A zinc-furnace, provided with a series of relatively deep, long and narrow charge-containing chambers, separated from each other by removable combustion-flues, said combustion-flues consisting of hollow tiles extending entirely across the said chambers and supported at their ends upon partition-walls, the ends of the tiles being joined by connecting-passages beyond said partition-walls, whereby the furnace may be charged and discharged without dismantling it, the destructive effects of the slags are largely obviated and the loss of zinc by absorption is materially reduced; substantially as described.

5. A zinc-furnace, provided with a series of relatively deep, long and narrow charge-containing chambers, separated by removable combustion-flues, said combustion-flues consisting of hollow tiles located one above the other and extending entirely across the said chambers and supported at their ends upon partition-walls, the ends of the tiles being joined by connecting-passages beyond said

partition-walls, and luting material located in recesses between the top of one tile and the base of another throughout the series, whereby the furnace may be charged and discharged without dismantling it, the destructive effects of the slags are largely obviated and the loss of zinc by absorption is materially reduced; substantially as described.

6. A zinc-furnace, provided with a series of relatively deep, long, and narrow charge-containing chambers, separated from each other by removable combustion-flues, said combustion-flues consisting of hollow tiles extending entirely across the said chambers and supported at their ends upon partition-walls, the ends of the tiles being joined by connecting-passages beyond said partition-walls, and flat arches above the several series of combustion-flues whereby the furnace may be charged and discharged without dismantling it, the destructive effects of the slags are largely obviated and the loss of zinc by absorption is materially reduced; substantially as described.

7. A zinc-furnace, provided with a series of relatively deep, long, and narrow charge-containing chambers, separated from each other by removable combustion-flues, said combustion-flues consisting of hollow tiles extending entirely across the said chambers and supported at their ends upon partition-walls, the ends of the tiles being joined by connecting-passages beyond said partition-walls, and flat arches above the several series of combustion-flues, and luting material located in recesses between the top of one tile and the base of another throughout the series, and between the uppermost tiles and the bases of the arches whereby the furnace may be charged and discharged without dismantling it, the destructive effects of the slags are largely obviated and the loss of zinc by absorption is materially reduced; substantially as described.

8. A zinc-furnace, provided with a series of relatively deep, long and narrow charge-containing chambers, separated from each other by removable combustion-flues, said combustion-flues consisting of hollow tiles extending transversely of the chambers, and provided at their lower edges with overhung recesses, substantially as described.

9. A zinc-furnace, provided with a series of relatively deep, long and narrow charge-containing chambers, separated from each other by removable combustion-flues, said combustion-flues consisting of hollow tiles having projections extending along their bases and within their lower edges, thereby forming luting-recesses and outlying overhung vapor-conveying recesses; substantially as described.

10. A zinc-furnace, provided with a series of relatively deep, long and narrow charge-containing chambers, separated from each other by removable combustion-flues, said combustion-flues consisting of tiles of the general configuration of truncated prisms, provided along their bases with lugs or shoulders extending longitudinally thereof; substantially as described.

11. A zinc-furnace, provided with charge-containing chambers and means for externally heating the same, condenser-pipes leading from said chambers and passing through a temperature-regulating compartment within the furnace-walls, and doors for said compartment adapted to be open or closed as desired whereby the temperature of said compartment is regulated; substantially as described.

12. A zinc-furnace, provided with charge-containing chambers and means for heating the same externally, condenser-pipes leading from the chambers, and metal-pots into which said condenser-pipes discharge, said metal-pots being located in the path of the waste products of combustion on their passage to the chimney-stack; substantially as described.

In testimony whereof I affix my signature in presence of two witnesses.

WILLIAM C. WETHERILL.

Witnesses:

WM. C. HOWARD,

I. M. SCATTERGOOD.