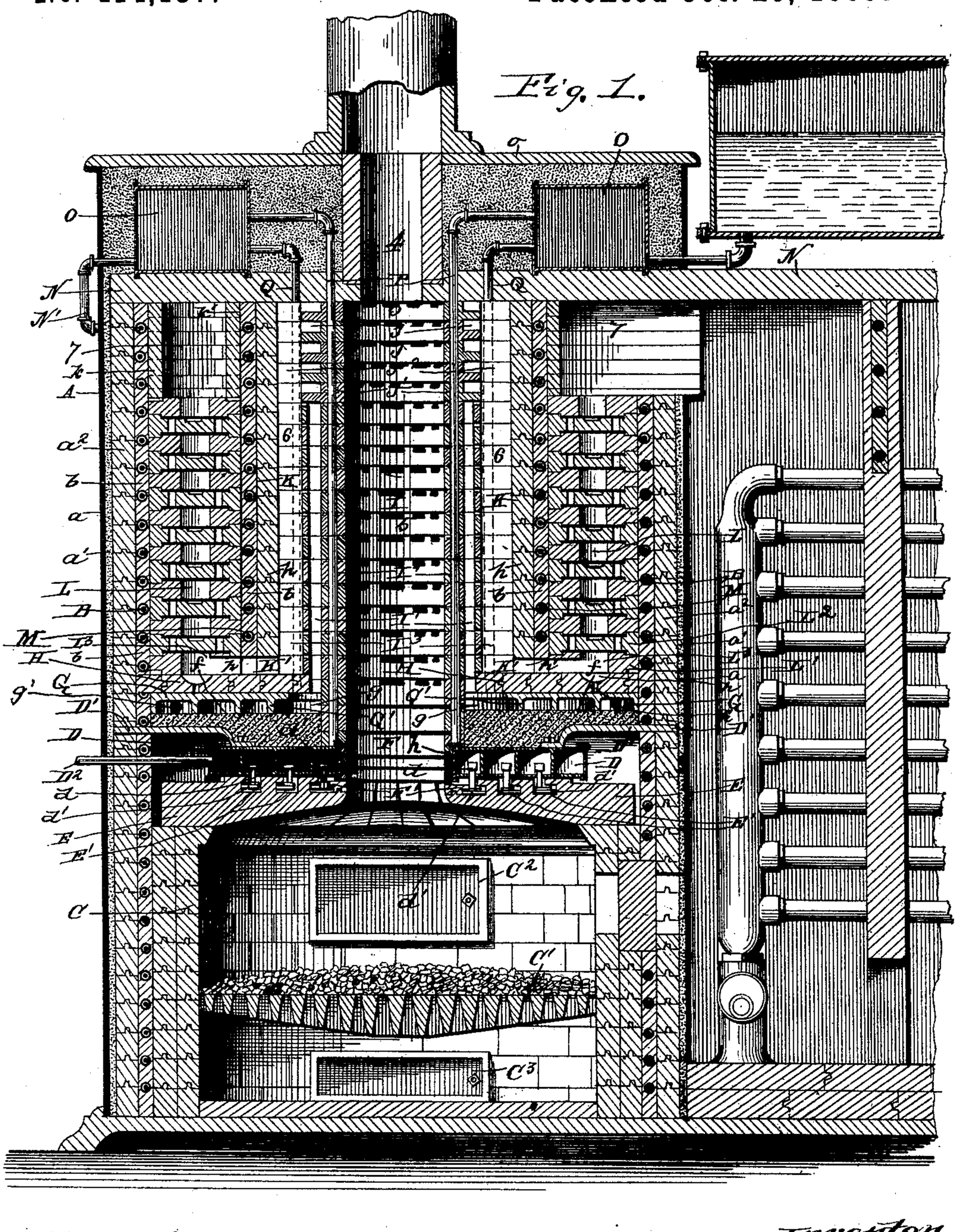
(No Model.) 3 Sheets—Sheet 1.

V. W. BLANCHARD.

FURNACE.

No. 414,137. Patented Oct. 29, 1889.

Fig. 1.



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(No Model.) 3 Sheets—Sheet 2.

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Fig. 2.

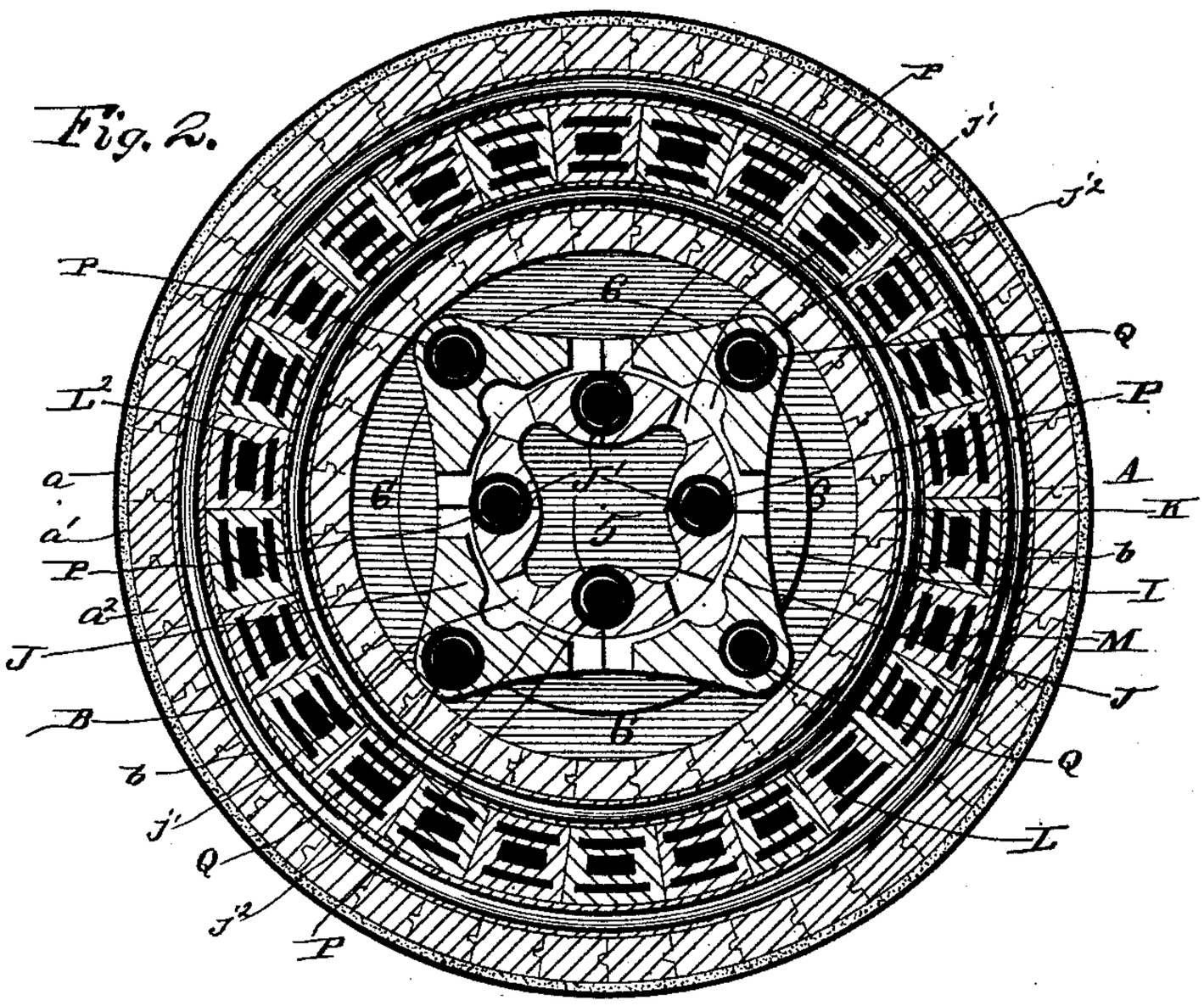
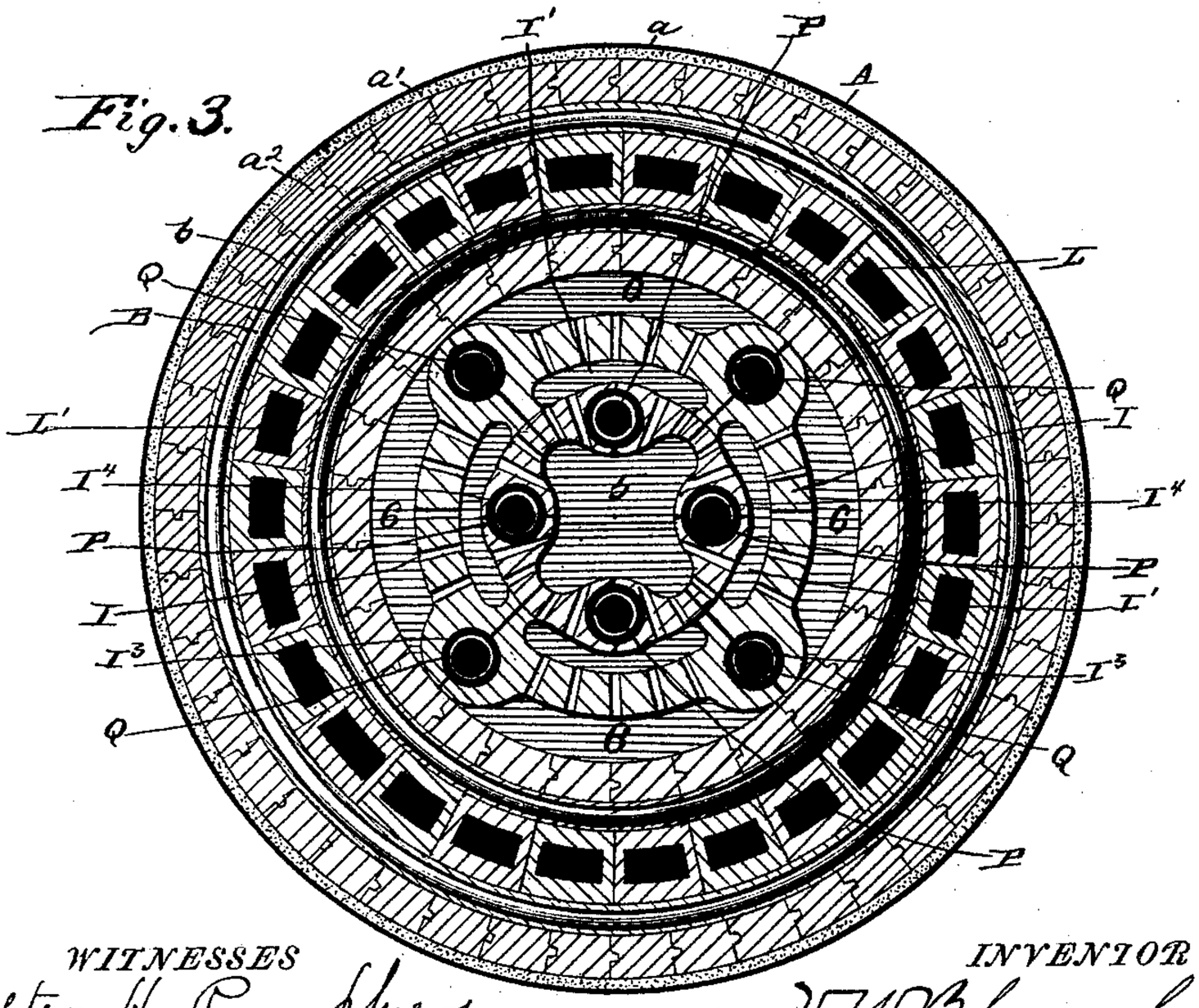


Fig. 3.



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(No Model.) 3 Sheets—Sheet 3.

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Fig. 4.

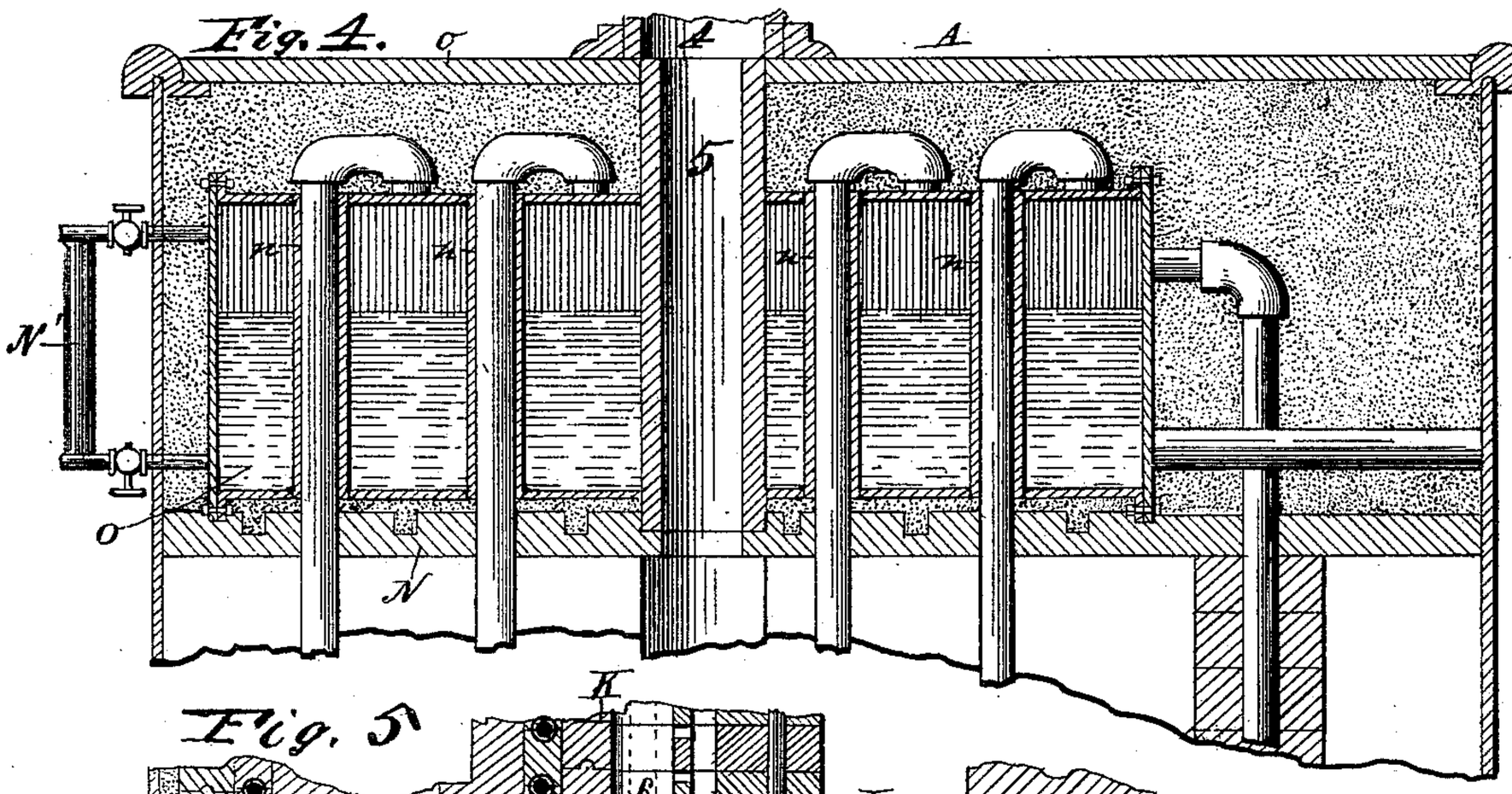
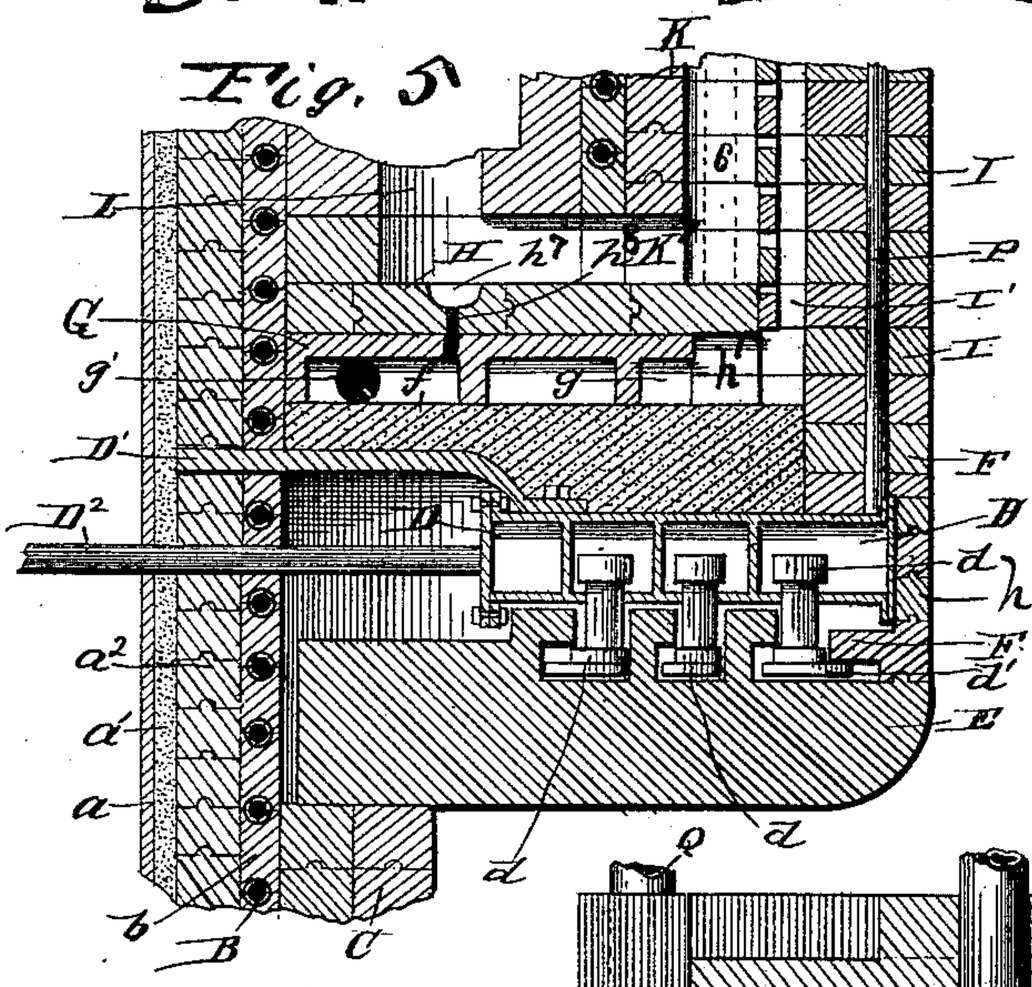


Fig. 5



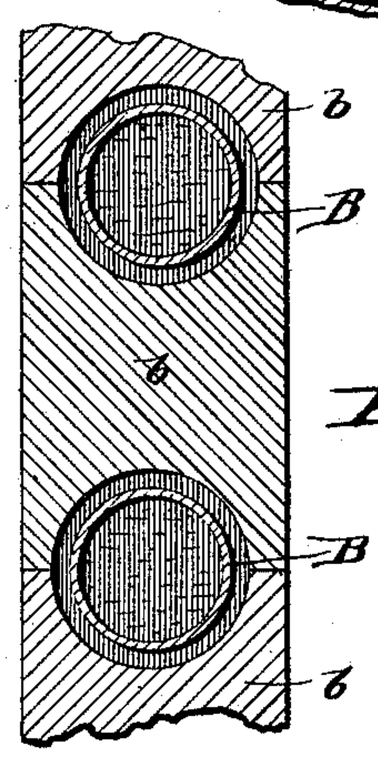


Fig. 6.

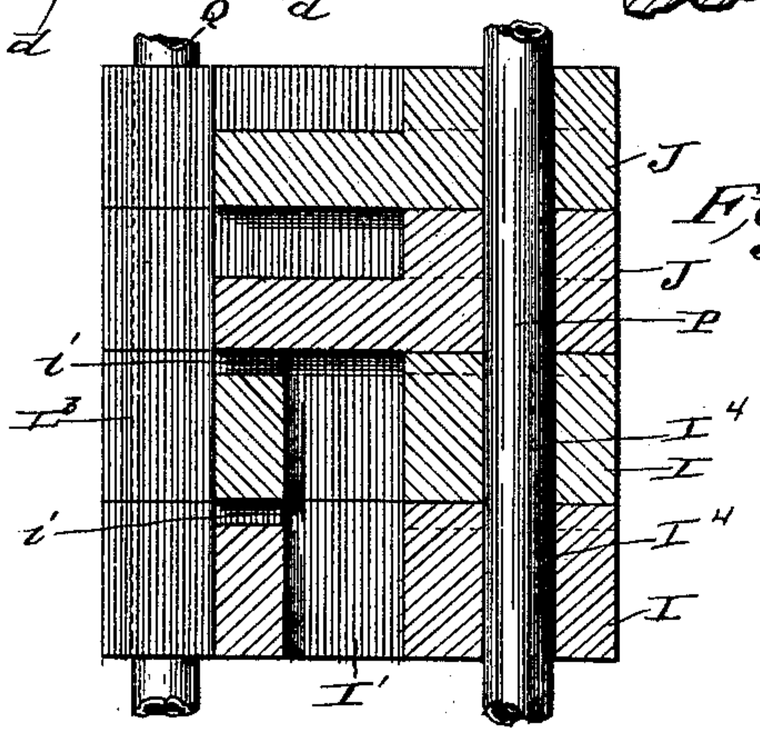


Fig. 7.

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UNITED STATES PATENT OFFICE.

VIRGIL W. BLANCHARD, OF NEW YORK, N. Y.

FURNACE.

SPECIFICATION forming part of Letters Patent No. 414,137, dated October 29, 1889.

Application filed June 21, 1889. Serial No. 315,073. (No model.)

To all whom it may concern:

Be it known that I, VIRGIL W. BLANCHARD, of New York, in the county of New York and State of New York, have invented certain new and useful Improvements in Furnaces; and I do hereby declare that the following is a full, clear, and exact description thereof, reference being had to the accompanying drawings, and to the letters of reference marked thereon, which form part of this specification, in which—

Figure 1 is a central vertical section through my improved furnace. Fig. 2 is a transverse horizontal section through the furnace in the plane of bricks J. Fig. 3 is a similar section in the plane of bricks I. Fig. 4 is a detail sectional view showing a modification of the water-drum and pipe attachments thereto. Fig. 5 is a detail sectional view, enlarged, showing the water-dome and air-passages above the fuel-chamber. Fig. 6 is a detail sectional view illustrating the water-pipe and bricks. Fig. 7 is a detail vertical sectional view through bricks I and J, enlarged.

This invention is an improvement in furnaces wherein it is desired to produce an intense heat; and its objects are to so construct the same that the walls and the compartments therein will be kept from injury by the heat through the medium of a water-circulation through pipes so arranged that while they reduce the temperature of the interior portion of the bricks do not affect the surface heat thereof; or, in other words, while not visibly affecting the interior temperature of the furnace, the interior portions of the bricks are kept at a comparatively low temperature, making them self-sustaining and preventing collapse thereof when the heat generated in the furnace becomes excessive. Another object is to permit removal and replacing of worn-out fire-brick without tearing down the furnace-wall.

The invention consists in the novel construction and arrangement of the furnace-wall, the mixing-chambers thereof, the supports for said mixing-chambers, and the arrangement of water-chambers and circulating-pipes, as will be clearly understood from the following description.

Referring by letters to the drawings, A designates the outer casing of the furnace, composed of a metal shell a and a wall a^2, of porous fire-brick closely jointed, between which and the shell is a layer a' of asbestus paper or other suitable non-heat-conducting material. At the inner side of the wall a^2 is a vertical coil of pipes B, which lie close to wall a^2 and are inclosed between layers of annularly-chambered fire-bricks b b, the channels in said bricks being greater in diameter than pipe B, to permit expansion and contraction thereof.

The furnace may be, and is preferably, cylindrical in cross-section, as indicated in the drawings.

At the lower part of the furnace, in the ash-pit and fire-chamber thereof, is an interior lining C of fire-brick, which protects the lower portion of coil B from the heat.

C′ designates the grate, and C^2 C^3 the openings into the ash-pit and fuel-chamber, closed by suitable tightly-closing doors. Above the grate is suspended an annular metallic vessel D, which is supported upon wall a^2 by means of stout metallic arms or peripheral flange D′, as shown. This vessel is made, preferably, of boiler-plate, and is provided with stay-bolt and braces to enable it to withstand interior pressure and support exterior superimposed weight. The opening in the center of the annulus is in the vertical axial line of the furnace. Vessel D communicates by a pipe D^2 with a water-supply and a water-forcing engine, preferably. (Not shown.)

d d are a series of short vertical tubes entering the vessel through the bottom plate thereof, with which they make steam-tight joints. The ends of these tubes in vessel D are closed, but perforated, to permit entrance of water therein in any suitable manner, the tubes being thus made to prevent sediment entering therein. The tubes depend two or three inches below the bottom of the vessel D, and, as shown, are arranged on radial lines, three on each line and at regular intervals apart. The lower ends of the two outermost tubes are closed by elongated caps, or bent outwardly at right angles into an L shape, as shown, the curved portions projecting outwardly. The innermost tubes have their lower

ends provided with T heads or caps d', projecting both outwardly and inwardly.

E designates a series of fire-bricks below vessel D. These fire-bricks are formed on the segment of a circle, as indicated in Fig. 1, and are provided at the top with transverse L-shaped grooves E′ E′, as shown. The bricks are longer than the width of vessel D, and are preferably formed with tongue-and-groove joints on their sides, so that closed joints can be made between them if properly laid. The bricks E are arranged in the form of an arch or dome above the fire-chamber and below vessel D, and are partly suspended from the latter, as shown in Fig. 1, by means of the angular ends of tubes d, which are engaged by the angular grooves E′ of the brick E, as shown. The outer ends of the brick E are supported on the top of the wall C, and their inner ends project beyond the inner periphery of the annulus, as shown. In some instances tubes d may be omitted, as the bricks are beveled on their lower faces, and will be supported partly on wall C and partly by their abutment against each other, as is evident, their upper faces lying close against the lower plate of vessel D. It will be observed by reference to Fig. 1 that a space is left between the outer end of bricks E and the coil B, which permits the bricks to be moved outwardly until the grooves E′ and tubes d are disengaged, and the brick can be removed. In putting up a furnace this space between all the bricks, excepting the last one, can be filled with packing, such as mineral wool or pulverized fire-brick, the packing being omitted from the one brick to permit that to be slid back and removed if it becomes necessary to repair the dome or replace any of the bricks E, as after one of said bricks is removed the entire arch can be readily taken apart without disturbing the other portions of the furnace, and the key-brick can be readily replaced also, as is evident, by reversing the operation necessary for its removal.

Upon the outer end of the bricks E are partly supported the inner annular wall of fire-brick F, which protect the inner wall of vessel D. The lowermost bricks F have an inwardly-projecting rib F′, which engages the head D′ of the inner row of tubes D, and thereby supports bricks F independently of bricks E. The wall F rises above the top of the vessel, as shown, and its bricks preferably have tongue-and-groove joints with each other and with brick E, as shown. The space above vessel D and between the tops of bricks F and the coil B is filled with pulverized fire-brick, as shown, forming a bed f, upon which is supported a metal or fire-brick annular casting G, having a depending rib G′, that is made convolute to form a convolute air-channel g, communicating with an air-supply pipe through an opening g' in the furnace-wall. Above casting G is a bed of fire-brick H. Upon wall F and the bed f is supported an annular wall of fire-bricks H, I, and J, through the lower portions of which are openings h', communicating with the innermost volute of passage g. Wall h rises flush with the top of bed H, and upon it is built up a cylindrical annular series of fire-bricks I, as shown clearly in Fig. 1. These fire-bricks are made of segments of circles, and, as shown, occupy one-quarter circle each, or any portion of a segment of a circle; but a greater or less number to a tier may be employed, as desired, or according to the size of the furnace. The bricks have a central vertical passage I′, which communicates with the inner volute of the air-channel g, top lateral channels $i\,i'$, a vertical opening I^3 to the inside of passage I′, and exterior outwardly-projecting end lugs at their meeting edges, when two bricks are laid together, as shown, for semi-cylindrical projections I^2, through which is a central opening I^4, half being in each brick. The several tiers of bricks I are laid similarly above each other, so that passages I and openings I^3 and I^4 correspond. Air only is designed to be passed through the passages and channels in bricks I.

J designates an annular series of fire-bricks superimposed on bricks I, and likewise formed on the segment of a circle. Each tier of bricks J correspond in general contour to the tiers of bricks I, and are laid to correspond therewith. Bricks J have openings J′ corresponding with openings I^4, and also openings J^2 corresponding with openings I^3. In the tops of bricks J are formed central depressions or traps j, that communicate with the central flue 5 of the furnace by lateral passages j' and by bent passages j^2 with vertical diving-flues 6 6, which are formed between a cylindrical fire-brick wall K and bricks I and J, as shown. This wall K is supported upon floor H, and is composed of imperforate jointed fire-bricks, as indicated, rising to the top of bricks J, and touching the projections of bricks I and J, as shown. The bottom row of bricks K have lateral radial passages K′, by which the heated products can escape from flue 6. These passages K′ communicate with the bottom of a series of mixing-chambers L, composed of alternate fire-bricks L′ and L^2, that are provided, respectively, with central and side flues and with top and bottom passages, by which the currents of gases passing therethrough are alternately expanded and compressed and directed outwardly and inwardly, being caused to take a tortuous course in their passage therethrough, such bricks being clearly described in my application for furnace filed April 17, 1889, Serial No. 307,614.

Between wall K and bricks L′ L^2 is a vertical coil of pipes M, laid between fire-bricks b, similar to coil B. The lowermost bricks L′ have a lateral passage L^3, communicating with passage K′, and in the floor H, below the mixing-chamber, is an annular trap or a series of traps h^7, communicating with the air-passage by perforations h^8, as shown. The mixing-chambers do not rise entirely to

the top of the wall K, but leave an annular chamber 7 between said wall and the casing of the furnace, the coils B and M being protected in said chamber 7 by fire-brick walls *k* *k'*, as indicated in the drawings.

N designates a heavy fire-brick top supported on a^2 and K, and closing the tops of the spaces between the other walls and the flues, as shown, leaving a contracted opening 4 over flue 5, as shown.

Above the furnace, and supported on the top N, is an annular water tank or jacket O, with which coil B communicates through a connection B^3, and coil M through a connection M', as shown. The outer shell *a* of the casing is extended above the sides of the tank O, and the space surrounding said tank is filled with porous fire-brick, mineral wool, or other non-heat-conducting packing, as shown.

P P designate vertical pipes passing through openings J' in bricks J and I^4 of bricks I, communicating at their lower ends with vessel D and at top with tank O, and Q Q are pipes passing vertically through openings J^2 and I^3 of bricks J and I, and communicating with tank O and vessel D. By said pipes a water-circulation is maintained from the tank to the vessel through the bricks, as is evident. The connections between pipes P and Q, vessels D, and tank O must be steam-tight, and as regards the tank may be arranged as shown in Fig. 1 or Fig. 4. In the latter the pipes Q pass through vertical sleeves *n n* in the tank and then bend over and enter the top thereof. The sleeves *n* are tightly expanded in the heads of the tank-brace, the latter taking the place of tie-bolts, and the connection of the pipes, being at top, can be more readily and conveniently reached. The tank may be connected with a gage N' for ascertaining the depth of water therein.

o designates a plate closing the top of the furnace above tank O.

3 designates a fire-brick or metal flue leading from opening 4 to the top of the furnace, and through which fuel may be fed into the top of the furnace. This flue must connect with a suitable tightly-closed feeding device, by which fuel can be fed into the furnace without escape of gases therefrom.

In the drawings I have shown my improved steam-boiler connected to the furnace, which boiler is clearly described in my application for patent filed April 9, 1889, Serial No. 306,535, and it communicates with the outlet-flue of the furnace, as shown, the shell of the furnace proper being extended over the water-leg of the boiler and the casing, forming close joint therewith. The upper part of coil B is extended into the projecting portion of the casing, as shown. This boiler has a steam-drum R, and a mechanical circulation of water may be maintained through its pipes and drum, as described in said application. The tank O is connected by a pipe *r* with the steam-drum, as indicated in the drawings. The lower portion of coils B and M are preferably connected to a pump (not shown) to establish mechanical circulation therethrough. The furnace is provided with suitable air-inlet and feed pipes, and its operation is substantially similar to that of my furnace above referred to, with the exception that by the employment of the water-circulating system described I am able to raise the temperature to a greater heat without injury to the brick. When at an extreme heat fire-brick becomes plastic and is unable to support great weight, owing to its poor conducting qualities, it takes considerable time before an intense heat on the surface of the brick affects the interior thereof, and my pipes are so located that the water circulating therethrough keeps down the temperature of the interior parts of the brick several inches from its heated surface, and thus preserves a rigid non-yielding stratum of brick in the furnace, notwithstanding the extreme temperature therein. The heat that is absorbed through the brick is taken up by the water in the pipes, and I thus am enabled to utilize this heat for heating feed-water or for generating steam. Owing to the thickness of the brick, however, and the slow conductivity thereof, even were cold water ejected into the pipes after the bricks were at high heat externally, there would be small or no effect produced on them externally, and I am able to keep up the heat without any noticeable expenditure of fuel on account of water-coils. The peculiar construction of the casing and the arrangement of non-heat-conducting substances and water-coils in the wall thereof keep down the temperature of the exterior shell and prevent loss of heat by radiation.

In operation the gases generated in the fuel-chamber rise into flue 5, where they are mixed with air jetted therein from the passages in bricks I, and at the top of the flue 5 they escape through the bricks J into the flues 6, wherein they descend until they escape into the mixing-chambers L, being again mixed in their descent through flues 6 with air jetted from passages I' in bricks I. In these mixing-chambers the gases and air are thoroughly commingled and all the combustible products of combustion consumed, and solid products being caught in the traps in the chambers and bricks J are retained until volatilized and consumed. The heated gases passing from the furnace into the steam-boiler casing deliver their heat to the water-pipes therein, and thus generate the steam.

Having thus described my invention, what I claim is—

1. The combination, in a furnace, of the ash-pit, a dome above the same, a water-containing vessel in said dome, incased with fire-brick and non-conducting material, and the water-circulating pipes connected to said vessel, substantially as described.

2. The combination, in a furnace, of a water-holding vessel suspended above the fire-cham-

ber thereof, a fire-brick dome below said vessel, and the fire-brick walls and mixing-chambers supported thereon, substantially as specified.

3. The combination, in a furnace, of the channeled and perforated fire-bricks I J, arranged above the fire-chamber thereof, and the water-circulating pipes passing through said fire-bricks, but not exposed to the fire, substantially as specified.

4. The combination of the fire-chamber, its fire-brick dome, a water-holding vessel above said dome, and the channeled and chambered fire-bricks above said vessel, with the pipes connected to said vessel and rising through said fire-bricks, as and for the purpose specified.

5. The combination, in a furnace, of a water-holding vessel suspended above the fire-chamber and the fire-brick suspended from said vessel, substantially as described.

6. The combination, in a furnace having a fire-chamber, a dome above said chamber, a central flue, perforated and channeled fire-bricks surrounding said flue, and descending flues exterior thereto, with a water-holding vessel in said dome protected by the fire-bricks thereof, and the water-pipes rising therefrom through said bricks, as and for the purpose set forth.

7. The combination, in a furnace having a central flue above the fire-chamber, and a wall of perforated and channeled fire-brick surrounding the same, the descending flues exterior thereto, and the fire-brick wall inclosing said descending flues, with a water-circulating coil exterior to said wall and its inclosing fire-brick, all substantially as set forth.

8. The combination, in a furnace having a central flue, perforated and channeled fire-brick walls surrounding the same, exterior descending flues, and a series of ascending mixing-chambers, with a water-circulating coil inclosed in fire-brick walls between the descending flues and mixing-chambers, and a water-circulating coil exterior to said chambers, substantially as set forth.

9. The combination of the furnace having a fire-brick dome, water-holding vessel above the same protected by fire-brick, and a series of channeled and chambered fire-bricks above said vessel, with a water-holding tank above said fire-brick, and the pipes extending through said bricks and communicating with the tanks and vessel, all substantially as described.

10. The combination, in a furnace, of a fire-brick dome, a water-holding vessel therein, an air-chamber above said vessel, and the ascending and descending flues, and the mixing-chambers, constructed and arranged substantially as and for the purpose set forth.

11. In a furnace, the combination of a series of bricks J, constructed substantially as described, with vertical openings and lateral channels and passages, with a series of vertical water-pipes passing through said bricks, as and for the purpose specified.

12. In a furnace, the combination of a series of bricks I, having vertical openings and lateral passages and channels, substantially as described, and the series of water-pipes passing through the vertical openings in said bricks, as and for the purpose set forth.

13. The combination, in a furnace, of the casing having an outer metal shell, an inner and outer fire-brick wall, and a water-circulating coil B between said walls, substantially as set forth.

14. The combination, in a furnace, of a water-holding vessel suspended above the fire-chamber thereof with a series of fire-bricks suspended from and protecting said vessel, as and for the purpose set forth.

In testimony that I claim the foregoing as my own I affix my signature in presence of two witnesses.

VIRGIL W. BLANCHARD.

Witnesses:

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P. L. BROOKS.