No. 654,177. Patented July 24, 1900.

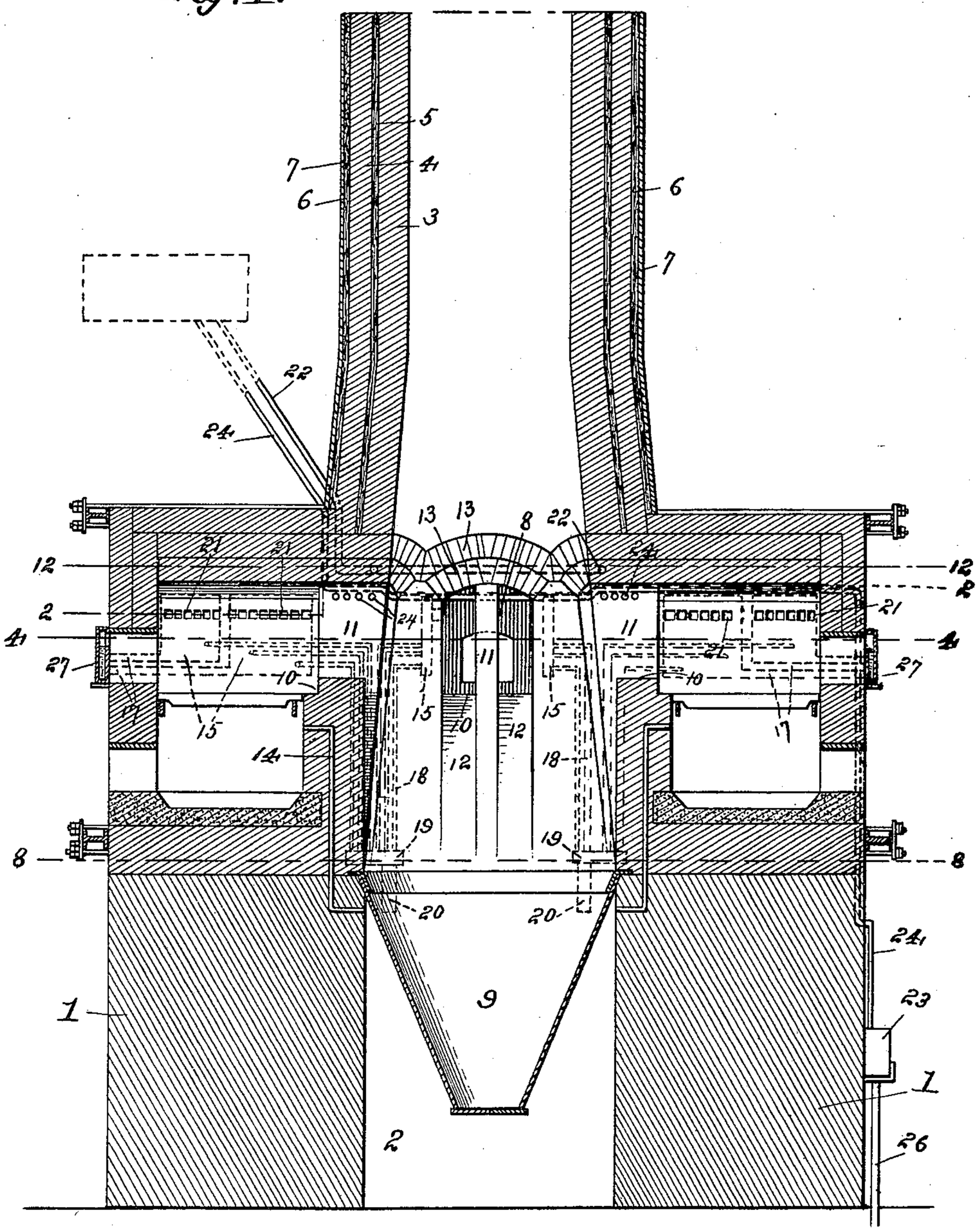
J. E. PATTERSON.

STRUCTURE FOR CALCINING STONE.

(Application filed Feb. 26, 1898.)

(No Model.) 4 Sheets—Sheet 1.

Fig. 1.



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(No Model.) 4 Sheets—Sheet 2.

Fig. 2.

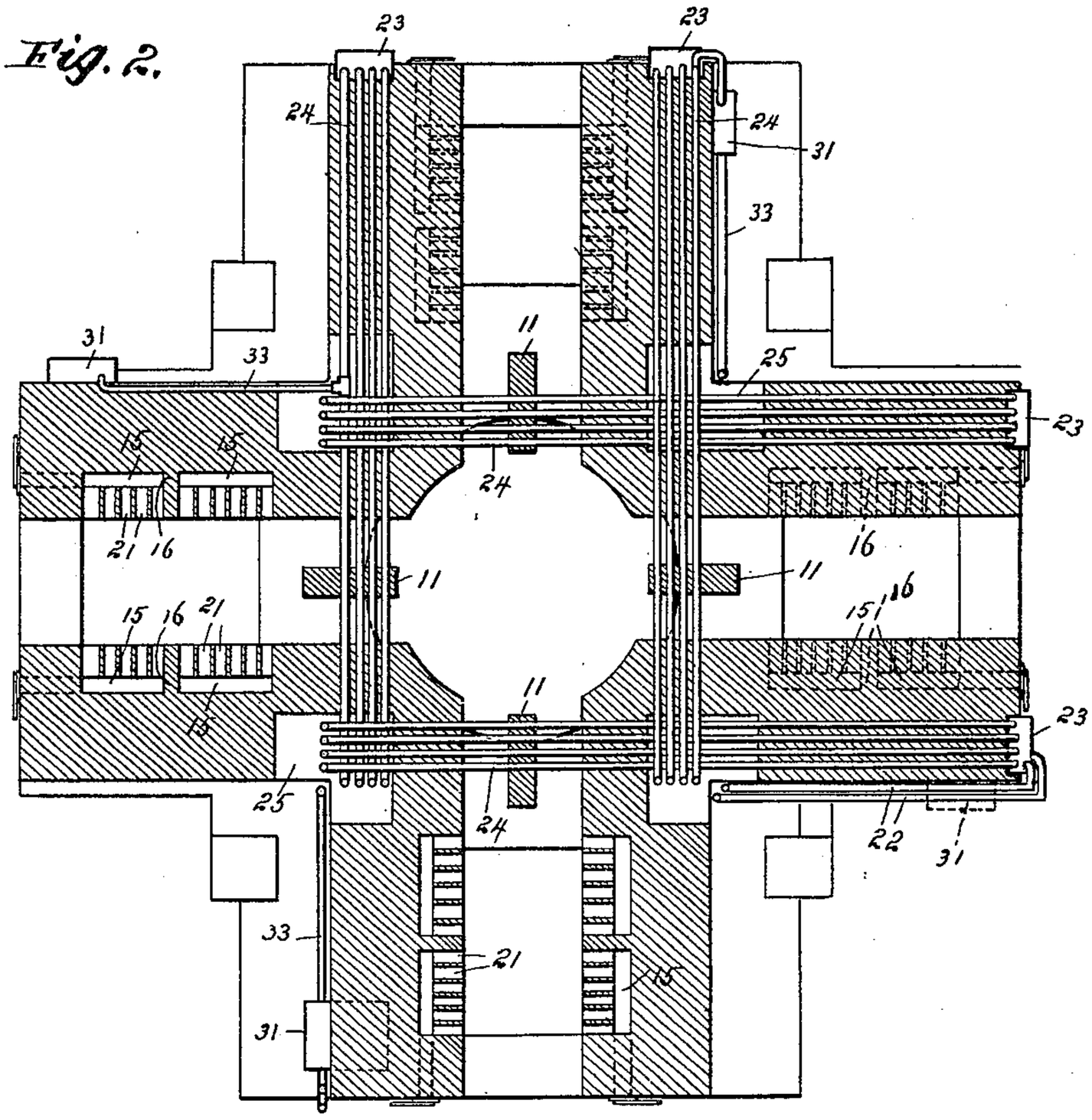
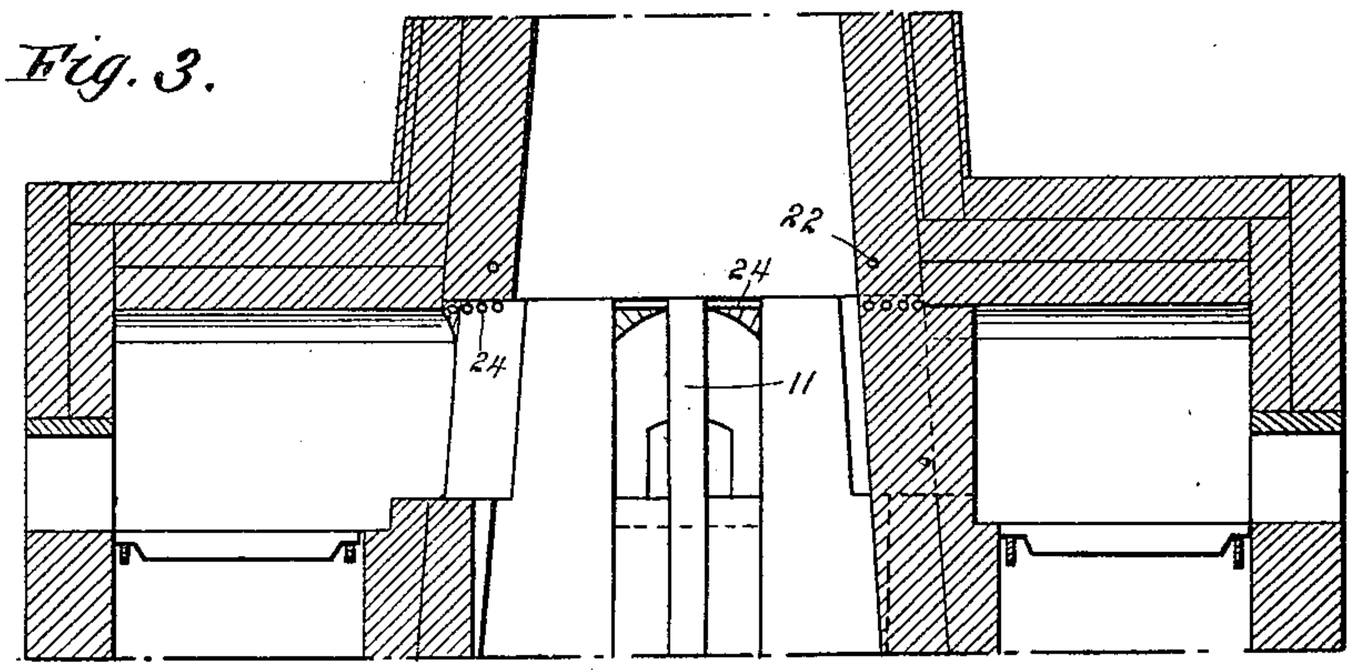


Fig. 3.



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(No Model.) 4 Sheets—Sheet 3.

Fig. 4.

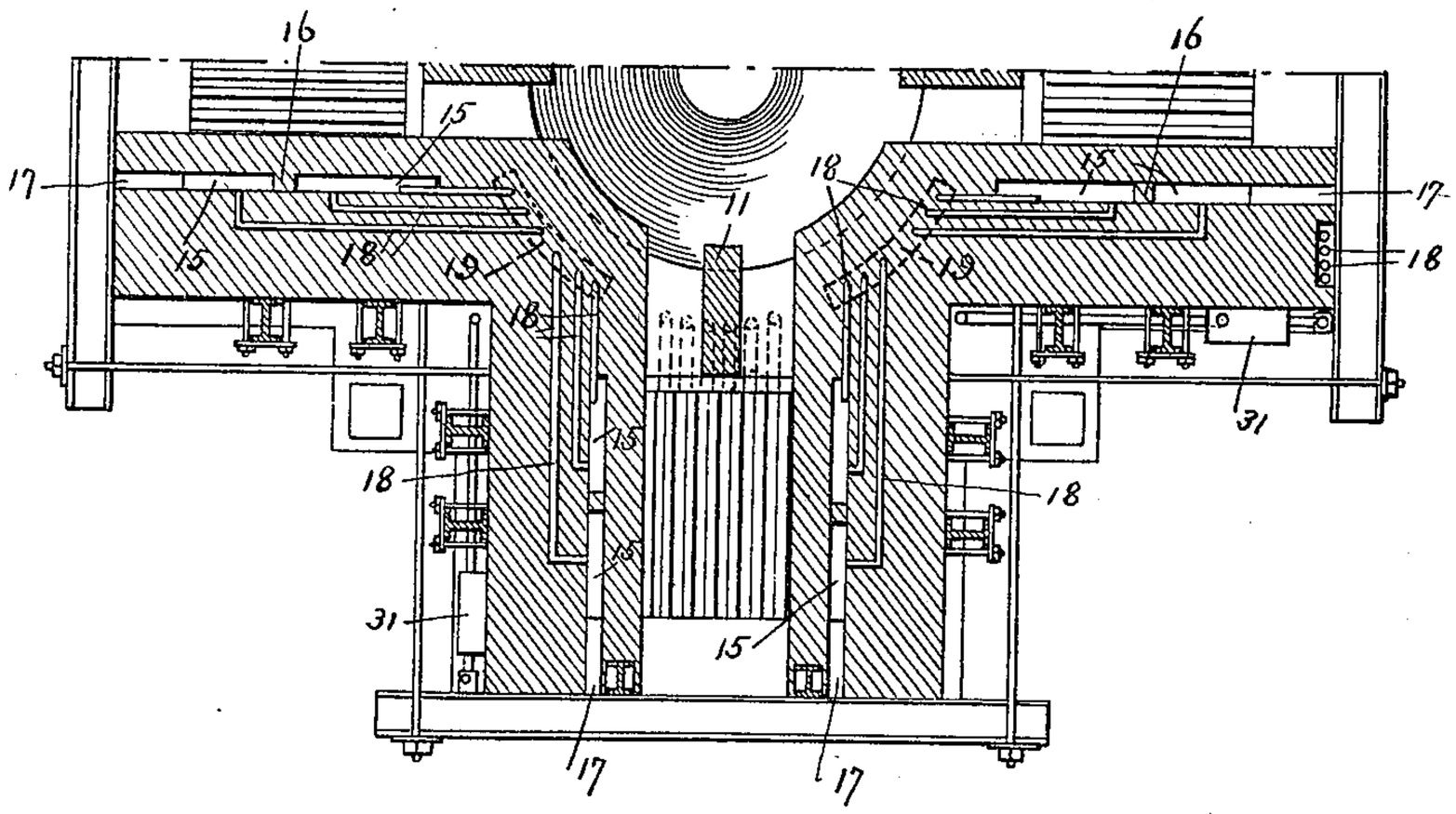


Fig. 5.

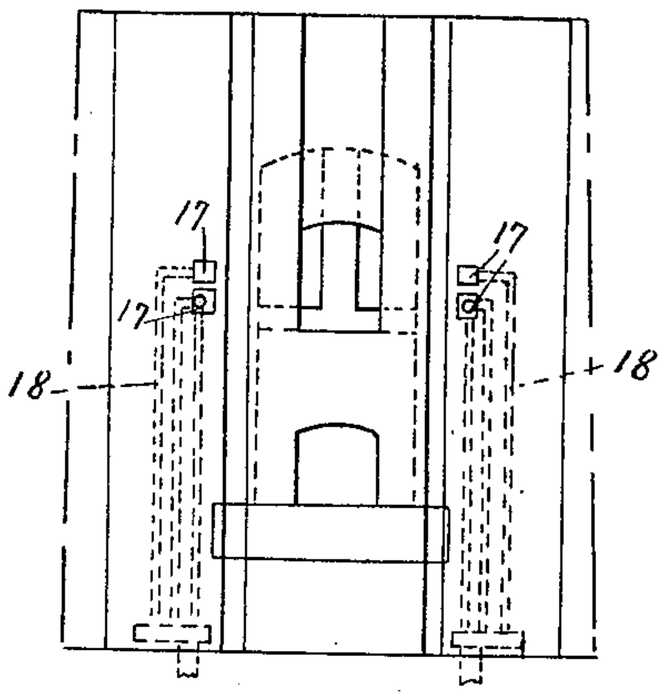


Fig. 6.

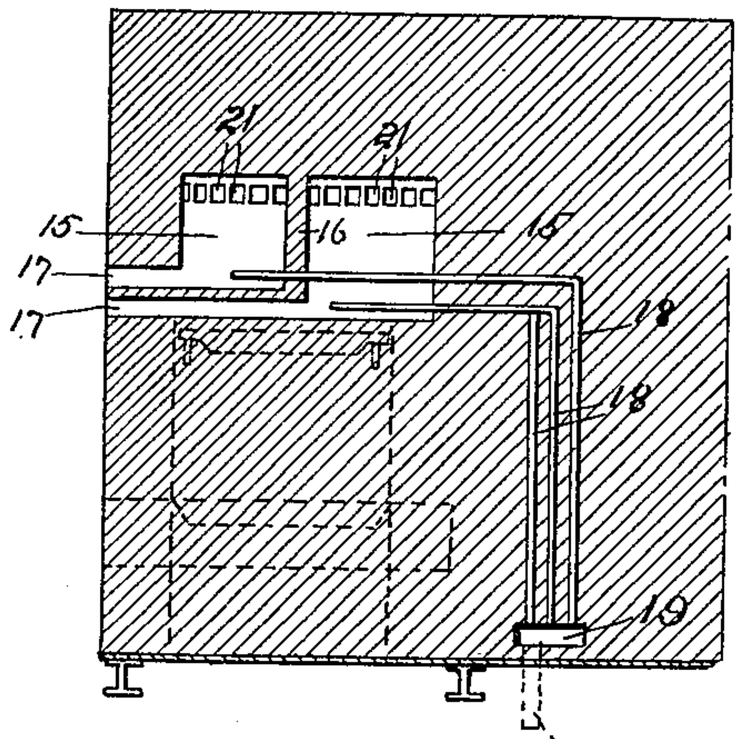
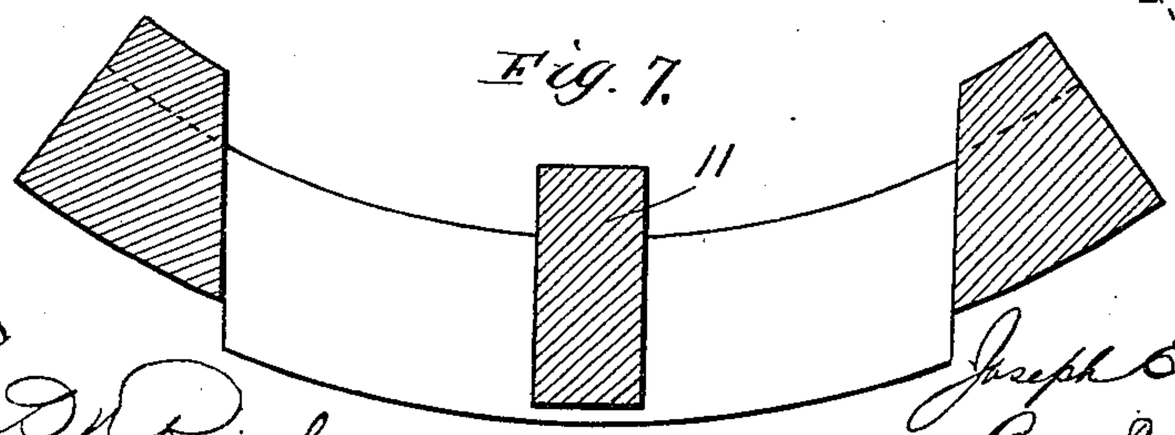


Fig. 7.



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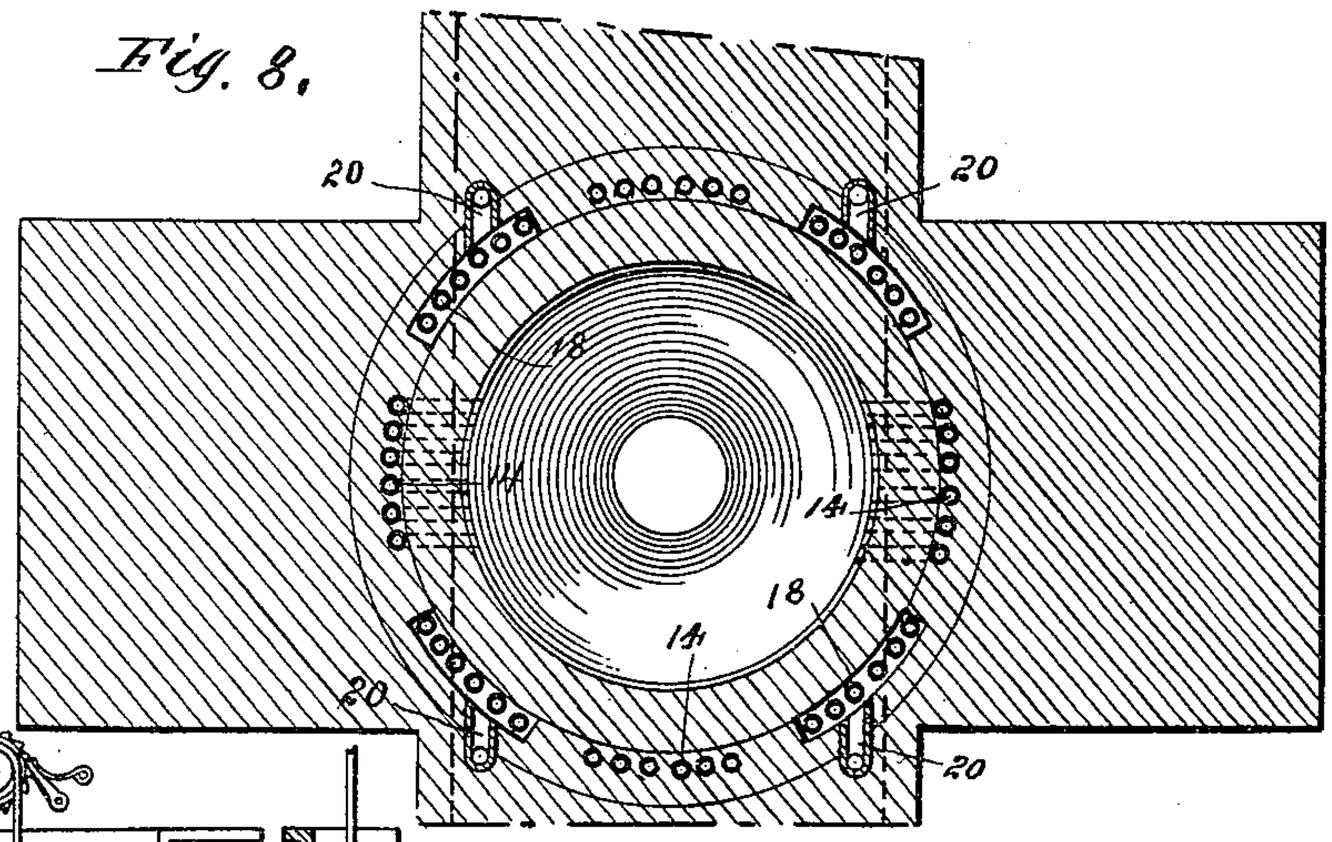
(No Model.) 4 Sheets—Sheet 4.

Fig. 8.



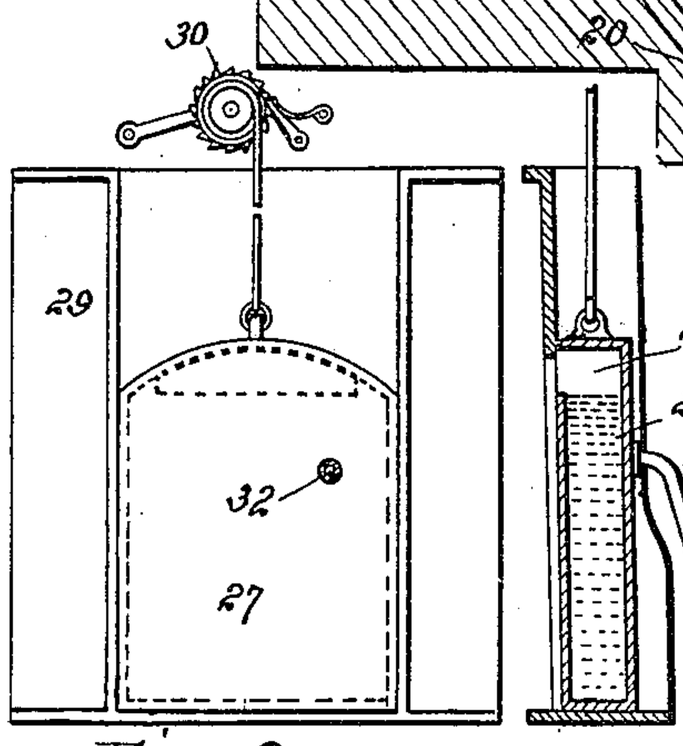


Fig. 9

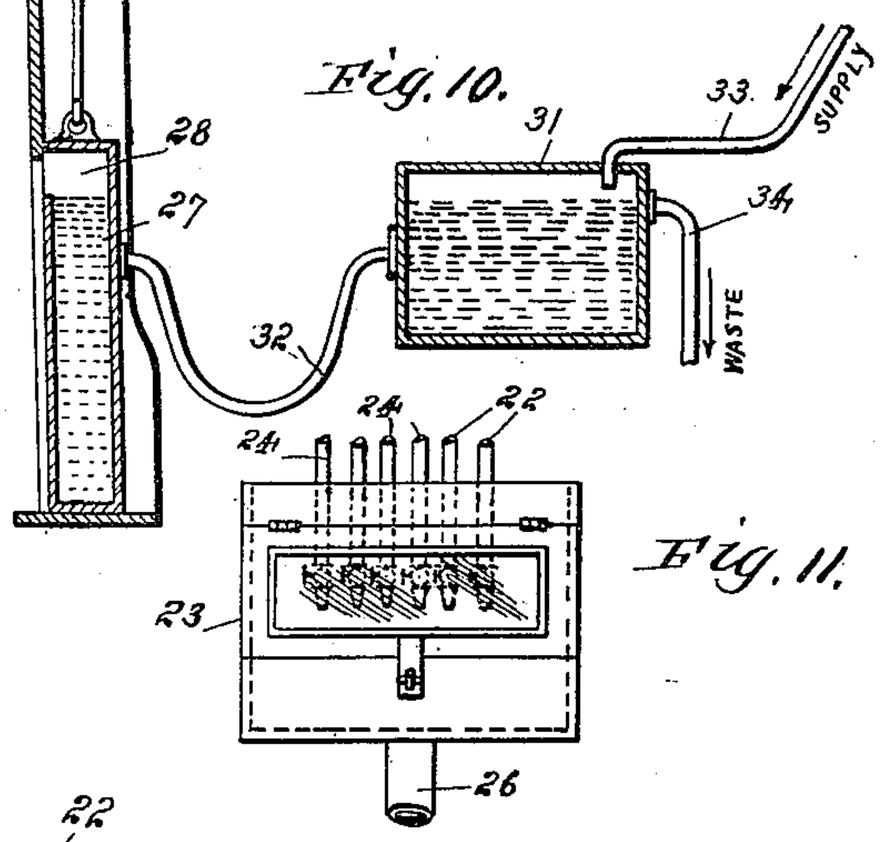


Fig. 10.

Fig. 11.

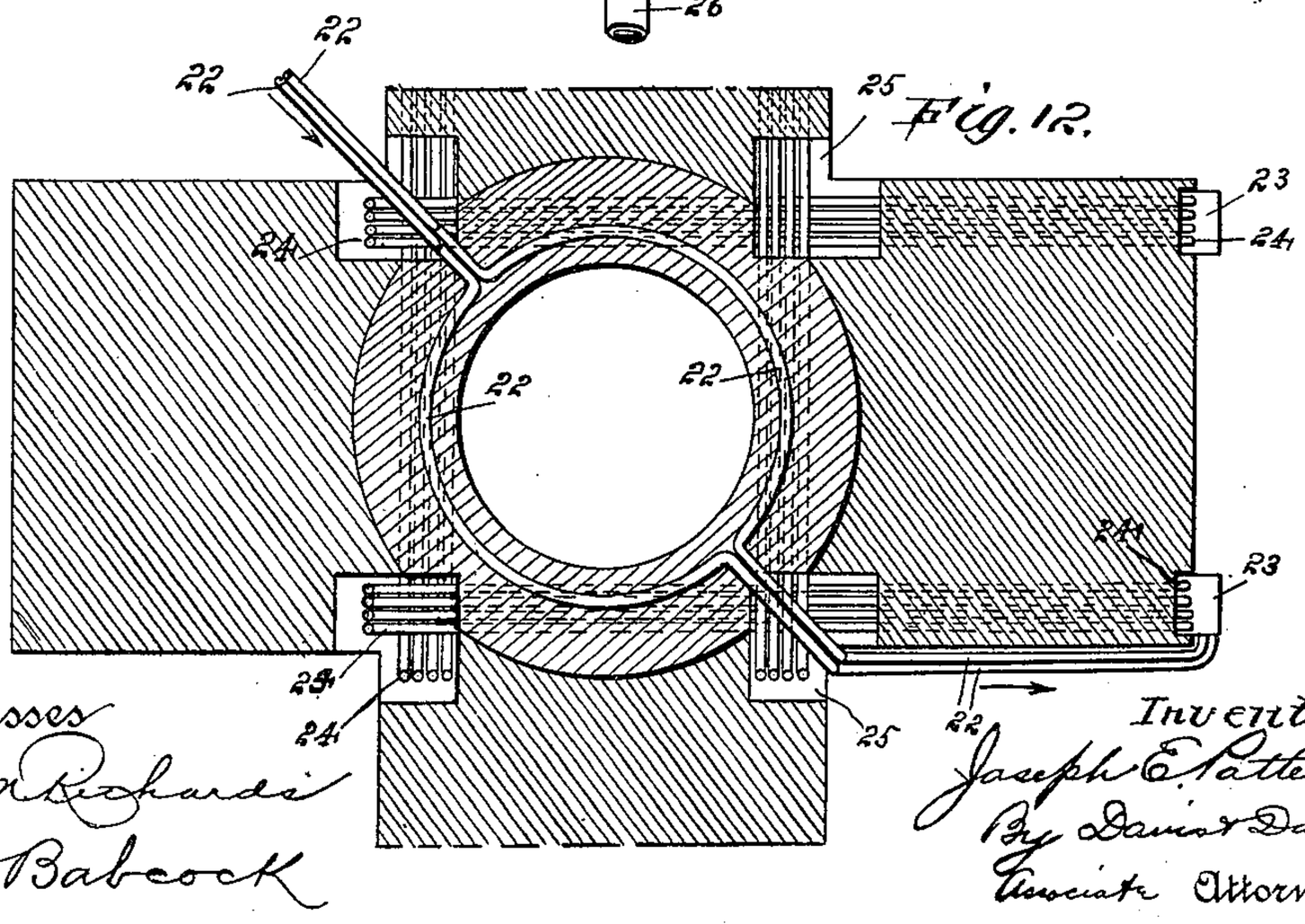


Fig. 12.

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UNITED STATES PATENT OFFICE.

JOSEPH E. PATTERSON, OF WILKES-BARRÉ, PENNSYLVANIA.

STRUCTURE FOR CALCINING STONE.

SPECIFICATION forming part of Letters Patent No. 654,177, dated July 24, 1900.

Application filed February 26, 1898. Serial No. 671,830. (No model.)

To all whom it may concern:

Be it known that I, JOSEPH E. PATTERSON, a citizen of the United States, residing at Wilkes-Barré, in the county of Luzerne and State of Pennsylvania, have invented certain new and useful Improvements in Structures for Calcining Stone; and I do 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, reference being had to the accompanying drawings, and to the figures of reference marked thereon, which form a part of this specification.

My invention relates to structures for calcining stone, and especially to that form of structure known as "lime" or "cement" kilns, and more especially to that form in which the material is calcined by the intense heat of the flame and hot gases from the fires within the structure, the fuel of which is in separate chambers and not mixed with the raw product.

The objects of my invention are as follows: first, to provide a kiln that shall be more economical in operation than those heretofore existing; second, to provide a kiln that shall be more durable; third, to provide a kiln that shall be more easy and convenient to operate; fourth, to provide a kiln more economical in fuel, and, fifth, to provide a kiln requiring fewer repairs. These objects I attain in the structure and appliances illustrated in the accompanying drawings, in which like figures of reference refer to similar parts throughout the respective views.

Figure 1 represents a vertical sectional view of my improved kiln; Fig. 2, a horizontal section on the line 2 2 of Fig. 1; Fig. 3, a vertical sectional view showing a modification of the construction of the flue leading from the furnace into the stack; Fig. 4, a horizontal section on the line 4 4 of Fig. 1; Fig. 5, a front view of a portion of one of the furnaces; Fig. 6, a vertical sectional view of the wall of one of the furnaces; Fig. 7, a detail horizontal section showing clearly the construction of the flue leading from the furnace into the stack; Fig. 8, a horizontal section on the line 8 8 of Fig. 1; Fig. 9, a front elevation of the door of one of the furnaces; Fig. 10, a vertical sectional view thereof connected to a supply-tank; Fig. 11, a front elevation of one of the drip-boxes, and Fig. 12 a horizontal section on the line 12 12 of Fig. 1.

The apparatus shown consists of a central stack and a series of four radiating furnaces, these latter forming a cross-like structure in horizontal section and being supported on two foundations 1, these foundations forming an alley or passage-way 2, into which the burned lime is discharged. The stack consists of an inner wall 3 and an outer wall 4, separated by a lining 5, of asbestos, to retain the heat and protect the outer wall. The outer wall is covered with a layer 6, of asbestos or other heat-resisting or non-conducting lining, and an outer metal jacket 7. From a suitable point above the flues 8, which lead from the furnace into the stack, the interior wall of the kiln diverges downward to a point at or near the base of the furnace, this tapering enlargement downward facilitating materially in the drawing of the calcined products of the kiln. Fixed in the masonry of the structure is the metal part 9 of the cooler, which tapers downward to a suitable contracted opening provided with the usual door, this metal chamber beginning at the point where the enlargement of the kiln stops. This inverted shell depends into the passage-way 2 and forms the lower part of the cooler, the upper part extending from the bridge-walls 10 of the flues 8 to the top of the metal shell. As is obvious, the cooling of the lime begins just as soon as it falls below the bridge-walls 10.

Each flue 8 is divided centrally by a pier 11, having its inner wall flush with the inner surface of the stack, and formed in the inner wall of the stack, directly below each flue, are two vertical recesses or grooves 12, opening into the flues at their upper ends and tapering at their lower ends into the inner wall of the stack. The pier extends downward and forms the division-wall between these recesses. As shown in Fig. 1, the inner wall of these recesses is practically vertical and the taper is given to the recesses by the angle of the inner surface of the kiln-wall. It will be observed that the piers and recesses serve to prevent the falling or crowding of the material into the furnaces through the flues, whatever material crowding into the

grooves or recesses being carried down with the great mass of the burned products and delivered out of the recesses at their lower ends, where they taper into the surface of the kiln-wall. It will be observed that the piers 11 extend back on the bridge-walls to or near to the grate-bars and serve to assist in supporting the arches 13 over the flues.

Extending from a point under the grate-bars of each furnace downward to the passage or alley way 2 are a series of pipes 14, which serve to supply fresh air to the furnace and at the same time to keep down the temperature of the upper or masonry part of the cooler.

Formed in each side wall of each furnace are two vertical air-chambers 15, separated from each other by a wall 16 and having flues 17 extending to the front of the furnace, where they may be provided with suitable valves or doors. A series of pipes 18 supply these chambers 15 with fresh air, these pipes 18 extending inward and downward and opening into chambers 19 near the base of the furnace and connected to the passage or alley way 2 by pipes 20. There are four chambers 19 formed at points between the furnaces, and extending upward from each chamber is a series of six pipes, which are divided into two groups of three each where they turn outward, these groups extending to the respective chambers 15 of the adjacent furnaces, two pipes of each group entering the nearest chamber 15 and the other pipe extending to the farthest chamber. A series of openings 21 lead from each chamber 15 into the top of the combustion-chamber of the furnace. By this arrangement of flues or pipes it will be observed that a constant supply of fresh heated air is maintained for the furnaces, the distribution being even and regular and the cold air being utilized to reduce the temperature of the masonry part of the cooler. The chambers 15 are made separate in each furnace-wall in order that there may be a more even distribution of the fresh air, it being evident that with but one chamber in each wall the greater portion of the fresh air would be drawn into the furnace at its inner end, where the draft is greatest. By the ducts 17 the attendant may let in an additional supply of fresh air if enough is not supplied through the pipes 18.

It will be observed that the pipes 18 are arranged around the cooling-chamber at points between pipes 14, so that the cooling-chamber is practically embraced and surrounded by these pipes, whereby the temperature of the masonry will be materially reduced and the heated air thus obtained will be utilized to render the combustion in the furnace more perfect. A feature which contributes to the utility of the apparatus lies in the fact that by the arrangement of air-flues shown distribution of fresh air to the various furnaces will be uniform, so that there will be a substantial uniformity in the supply of heat from the several furnaces to the stack, thereby producing a uniformly and thoroughly burned product.

To cool the wall of the kiln at the point of greatest intensity of heat, I embed in the masonry above the flues 8 an annular pipe 22, through which by any suitable means a cooling liquid is caused to circulate, this pipe consisting of two sections entering the masonry of the stack at one side at a point between two adjacent furnaces, passing around the stack in opposite directions and then emerging at diametrically-opposite points from where they enter, from whence they are extended outward along the side of one of the furnaces and then downward into a box 23, secured to the front of one of the furnaces. The inlet ends of these pipes are connected to any suitable source of supply, so that a constant circulation of liquid will be maintained. To further cool the wall of the stack at the point of greatest intensity of heat and the arches of the flues 8, which, as is well known, are subjected to a very great temperature, I build in the masonry four groups of pipes 24, which run horizontally across under the arches of the flues. The several pipes of each group lie beside each other, but are separated slightly, and where one of the groups crosses another one of the groups is slightly bent, so that they may pass each other without interference. The groups or series extend outward through the masonry roofs of the furnaces and then downward in grooves in front of the furnaces on either side of the furnace-door and enter boxes 23, supported at suitable points below the furnace-floor. These pipes and the terminals of the above-described pipes 22 are provided with suitable stop-cocks, whereby the flow of liquid through the pipes may be regulated, and the fronts of the boxes 23 are made transparent, so that the attendant may observe that the liquid is flowing freely through the pipes. These boxes 23 are each provided with a door, which may be locked to prevent mischievous persons interfering with the flow of liquid through the pipes, it being obvious that the flow of liquid must be continuous in order that steam shall not be generated in the pipes. The inlet ends of the pipes are extended upward and connected to a suitable source of supply. Where the groups of pipes cross each other, the stack and adjacent furnaces are recessed, as at 25, whereby the burned-out or clogged pipes may be removed without taking down the masonry, it being simply necessary to uncouple the pipes and slide them out endwise, slightly bending them if necessary. It is of course obvious that instead of passing the pipes 24 under the arches of the flues, which exposes them directly to the flames, I may arrange them so as to pass through the arches, where they would be protected from the direct flames by the bricks of the arches, while at the same

time keeping down the temperature at the point where the greatest destruction from the intense heat usually occurs. From the boxes 23 a waste-pipe 26 carries off the water discharged from the pipes 22 and 24.

The furnace-door 27 is formed hollow—that is, is provided with a water-back—an opening 28 at its upper end leading from the water-back directly into the furnace, whereby the heat of the furnace will generate steam in the furnace-door, which steam will pass out into the furnaces and aid combustion. The door is adapted to slide vertically in a suitable iron frame 29, fastened to the furnace-front, a suitable windlass or ratchet device 30 being preferably employed to raise the door. The water is maintained at the proper level in the door by any suitable means, preferably by means of the tank 31, fastened to an adjacent wall of the furnace and connected to the door by means of a flexible or flexibly-jointed pipe 32, this tank being supplied through a pipe 33, and its waste or overflow being carried off by a suitable pipe 34. This tank is located so that its overflow-outlet will be substantially on a level with or a little below the steam-opening 28 of the door when the door is at the lowest extremity of its movement, which will insure the level of the water in the door being kept at or near the lower edge of opening 28 when the door is down. When the door is raised, it is obvious that that portion of the water between the point of connection of pipe 32 in the opening 28 will flow back into the tank, from whence it will flow out through the waste-pipe; but when the door is again lowered sufficiently the water will quickly flow into the door from the tank to replenish that which escaped when the door was raised. A continuous supply of water is preferably maintained; but of course in lieu thereof the attendant may renew the water in the tank at intervals.

A very essential feature of the invention lies in the peculiar form of the kiln-chamber and upper part of the cooling-chamber. Heretofore considerable trouble has been experienced by the lime catching on the bridge-walls 10, which have been brought out flush with the interior of the kiln-wall, and from there working its way into the furnaces. This trouble I obviate by tapering or enlarging the kiln-chamber downward from a point above the flues and the bottom of the masonry part of the cooler and stopping the bridge-walls short of the interior face of the kiln-walls and extending downward therefrom grooves or recesses, which taper into the face of the wall at or near the upper edge of the metal part of the cooler. Thus enlarging the kiln-chamber and cooling-chamber downward facilitates the drawing off of the burned lime, and setting back the bridge-walls and forming the grooves below the same prevents the engagement of the lime with the edges of the bridge-walls and insures the same falling directly downward without obstruction into the discharge or funnel part of the cooler. The piers 11 of course assist in keeping the lime out of the flues without obstructing its passage downward, the inner faces of the piers being coincident with the inner face of the kiln-wall.

It is obvious that any cooling liquid or fluid may be circulated in the pipes, and it is also obvious that in lieu of pipes 14 and 18, set in the masonry, suitable flues may be built therein. It is also obvious that the number of air flues or pipes and liquid-carrying pipes may be varied without departing from the invention.

In the modification shown in Fig. 3 the only change lies in the fact that the double arches over the flues are done away with and a flat arch is employed, which is a much cheaper form of construction. In this view the pipes 24 are shown passing directly under the arches; but it is obvious that they may be passed through or between the bricks composing the arches if it be desired to protect them.

Having thus described my invention, I wish to be distinctly understood that in describing my improved kiln as being constructed with four furnaces and their flues and other parts I do not limit myself to such construction, as it is evident that a kiln with one or a greater number of such duplicate parts would be equally within the field of my improvement, nor do I wish to be understood as confining myself to a single furnace, with its accompanying features, as my claims relate to a structure embodying one or more such elements.

What I claim, and desire to protect by Letters Patent, is—

1. In a kiln, the combination of a barrel enlarging downward toward its lower end with a furnace having its discharge-flue entering said barrel at a point above its lower end, thereby converting the part of the barrel below the flue into the upper part of the cooling-chamber, said upper part of the cooling-chamber enlarging downward and being provided with a recess running downward from said flue and having its back wall approximately vertical so that the recess will taper into the inner face of the upper part of the cooling-chamber at or near the lower end of the barrel, and a part below adapted to serve as the lower part of the cooling-chamber.

2. In a lime-kiln, a stack or barrel having a cooling-chamber at its lower end, a furnace having a grate and connected to the stack, air-ducts communicating with the space below the cooling-chamber and carried up in the wall of the cooling-chamber, one of these air-ducts being extended outward into each of the opposite side walls of the furnace, an air-chamber formed in each side wall of the furnace and connected to the adjacent one of said air-ducts, said air-chambers having openings leading into the combustion-chamber of

the furnace above the grate therein and also into the atmosphere, these latter openings being valved, substantially as described.

3. In a lime-kiln, the combination of a stack, a series of furnaces radiating therefrom, and connected thereto by flues, liquid-carrying pipes 24, arranged in four groups, embedded in the masonry of the furnaces and stack, one group extending across above the flue of each furnace and the groups crossing each other at points between the furnaces, means for supplying liquid to these pipes and maintaining a continuous flow of liquid therethrough, regulating-cocks on the terminals of said pipes, and a lock-box inclosing the terminals of each group of pipes and provided with a sight-opening and a drain-pipe, as and for the purposes set forth.

4. In a lime or other kiln, the combination of a central stack, a series of furnaces having grates and arranged around the same and connected thereto by flues, an air-chamber in the side wall of each furnace and connected with the interior of the furnace above the grate-bars, several groups of air pipes or flues in the walls of the stack below the entrance of the furnace-flues thereto, these pipes or flues being arranged at substantially-equidistant points around the stack and opening at their lower ends into the outside atmosphere and at their upper ends into the aforesaid chambers in the furnace-walls, a substantially-equal number of pipes connecting with the respective chambers, whereby the supply of air to the furnaces will be substantially uniform, as and for the purposes set forth.

5. In a lime or other kiln, the combination of a stack and a series of furnaces arranged around the same and connected thereto above its lower end by flues, air-chambers in the side walls of each furnace, these air-chambers opening into the combustion-chambers of the furnaces, groups of air-pipes in the wall of the stack below the furnace-flues, these groups being equal in number to the furnaces and arranged around the same at equidistant points, the pipes of each group separating at their upper ends, some leading to one of the air-chambers in the side walls of one furnace and the remainder leading to the air-chamber in the adjacent side wall of the adjacent furnace, and the lower ends of said pipes being connected to the atmosphere, and a second series of groups of air-flues in the stack-wall below the flues, these groups being arranged alternately with the first-mentioned groups and extending from points under the grate-bars of the respective furnaces to the atmosphere, as and for the purposes set forth.

6. In a lime or other kiln, the combination of a stack, a series of furnaces radiating therefrom and connected thereto by flues, recesses 25 being formed in the tops of the furnaces where they connect to each other and the stack, a series of groups of cooling-pipes embedded in the wall of the stack these groups crossing each other within said recesses and crossing the flues leading from the furnaces into the stack, substantially as set forth.

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

JOSEPH E. PATTERSON.

Witnesses:

LOUISE RAEDER,

M. R. KEELER.