(No Model.) 2 Sheets—Sheet 1.

P. KROTTNAURER.

APPARATUS FOR THE CALCINATION OF CEMENT.

No. 447,155. Patented Feb. 24, 1891.

Fig 2.

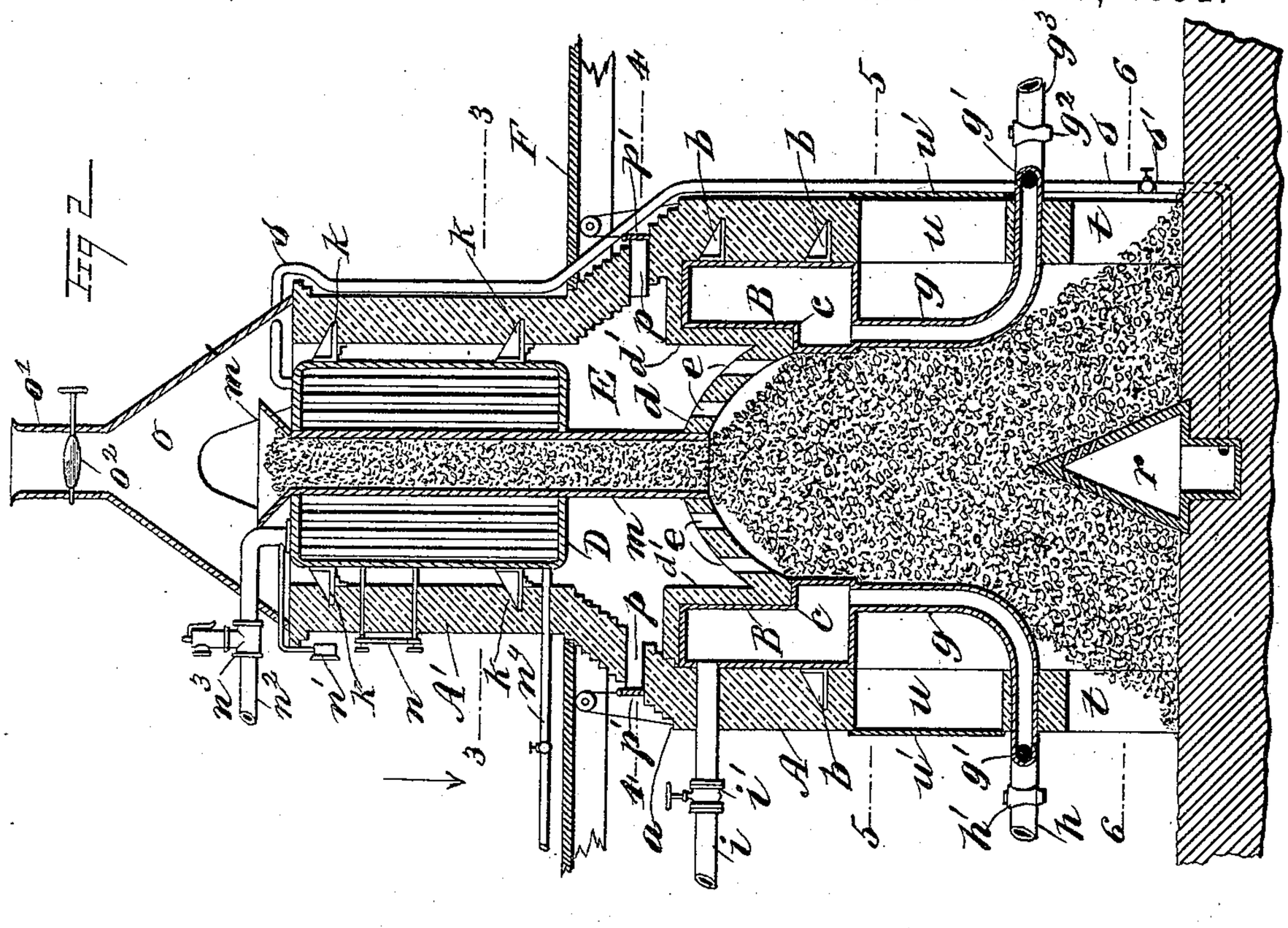
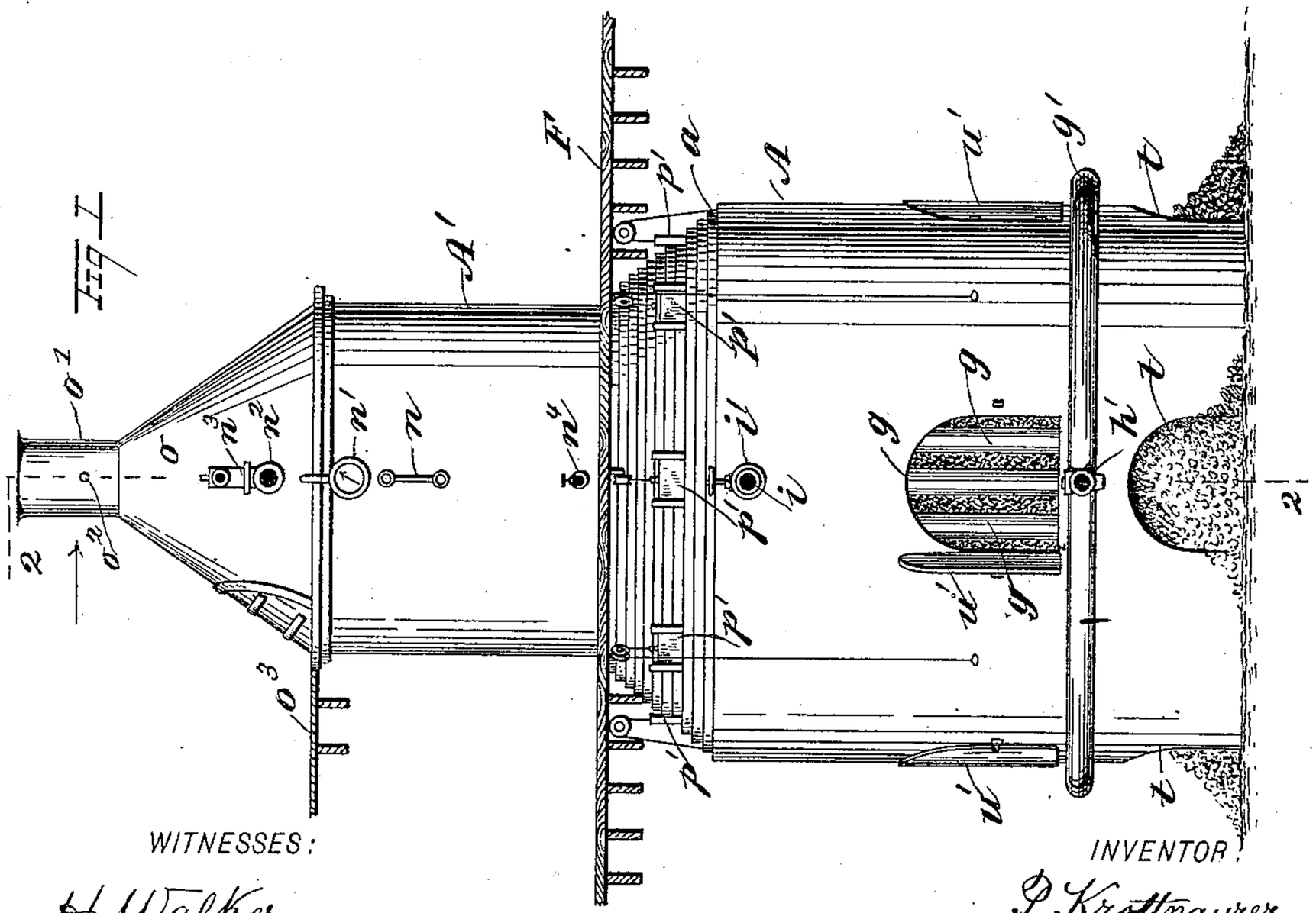


Fig 1.



WITNESSES:

H. Walker

C. Sedgwick

INVENTOR:

P. Krottnaurer

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(No Model.) 2 Sheets—Sheet 2.

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Fig 4.

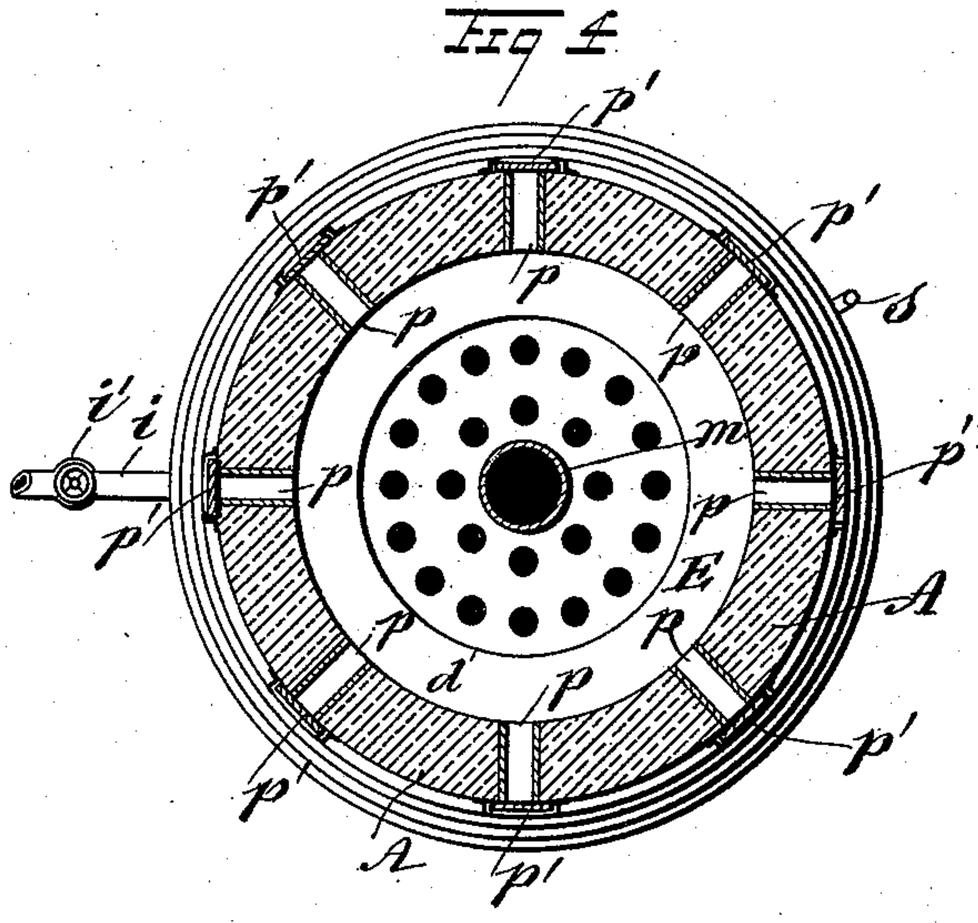


Fig 3.

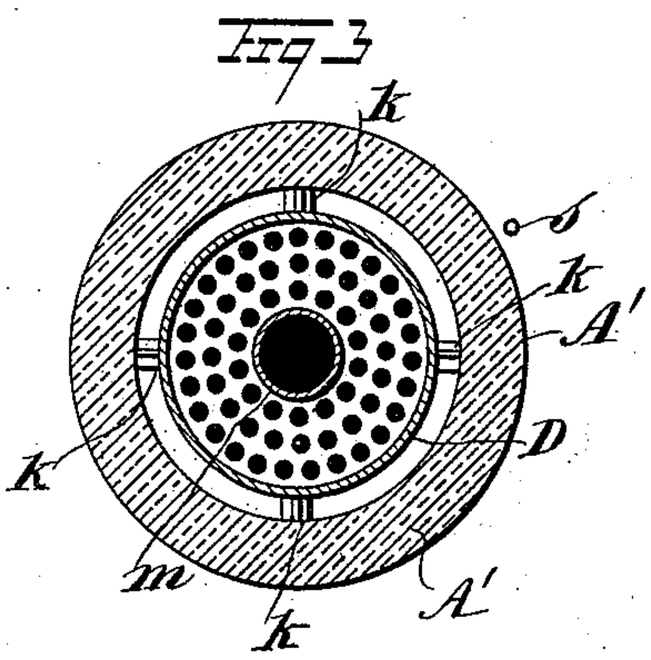


Fig 5.

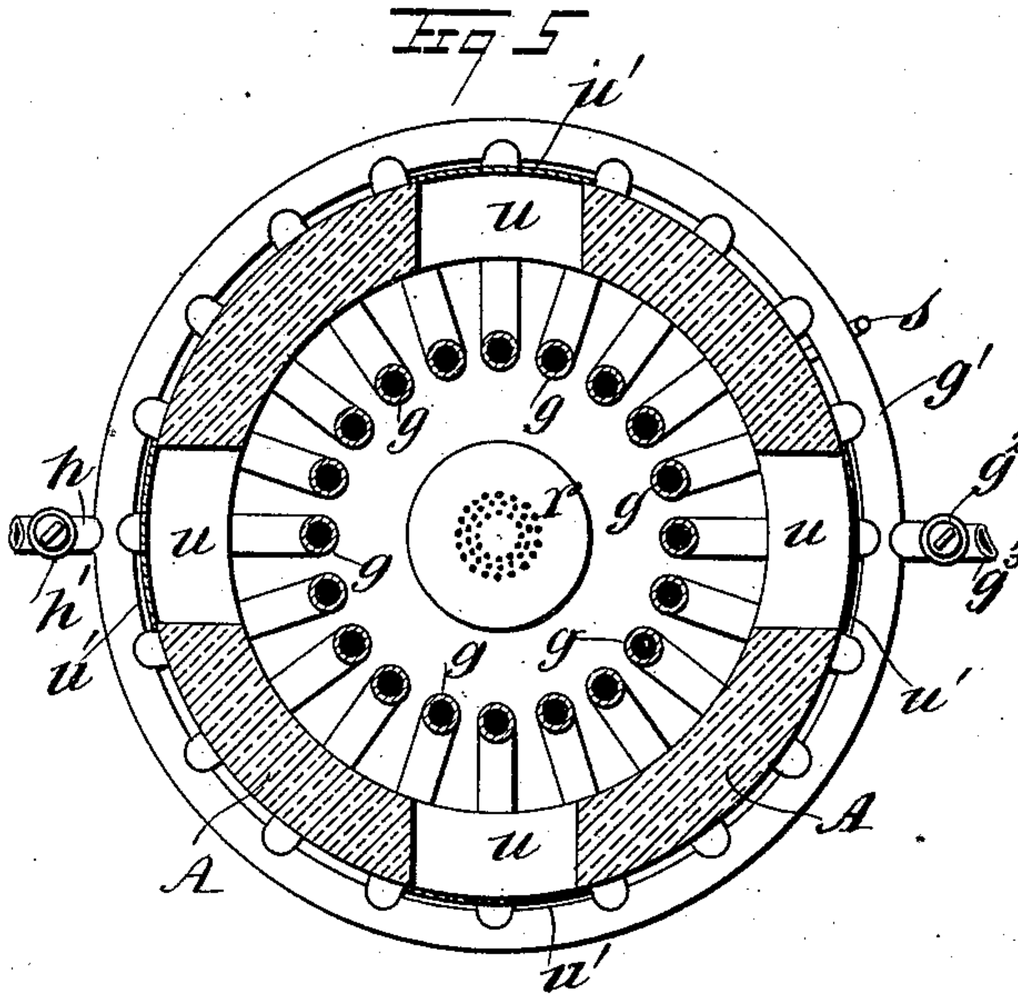
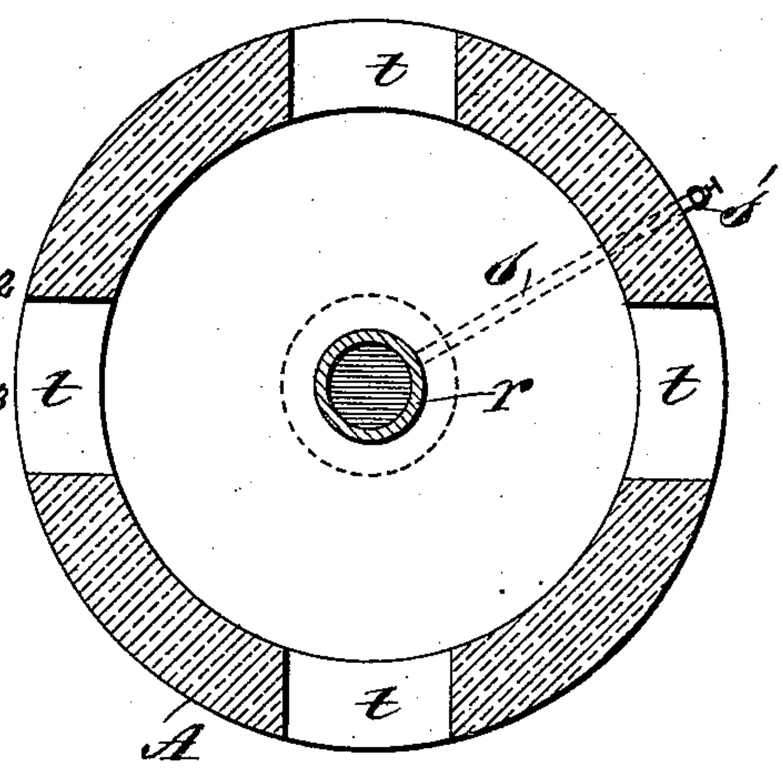


Fig 6.



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UNITED STATES PATENT OFFICE.

PAUL KROTTNAURER, OF WHITE HALL, PENNSYLVANIA, ASSIGNOR OF ONE-FIFTH TO AMABLE B. BONNEVILLE, OF SAME PLACE.

APPARATUS FOR THE CALCINATION OF CEMENT.

SPECIFICATION forming part of Letters Patent No. 447,155, dated February 24, 1891.

Application filed April 16, 1890. Serial No. 348,199. (No model.)

To all whom it may concern:

Be it known that I, PAUL KROTTNAURER, of White Hall, in the county of Lehigh and State of Pennsylvania, have invented a new and useful Apparatus for the Calcination of Cement or Lime, of which the following is a full, clear, and exact description.

This invention relates to an improved kiln for burning cement or lime continuously in an economical manner, the objects being to provide an apparatus which will economize fuel, prevent slagging adhesion of material on the wall of the combustion-chamber of the kiln, and utilize escaping heat from the combustion-chamber to generate steam employed in the burning process and also for general uses.

To these ends my invention consists in the construction and combination of parts, as is hereinafter described, and indicated in the claims.

Reference is to be made to the accompanying drawings, forming a portion of this specification, in which similar letters of reference indicate corresponding parts in all of the figures.

Figure 1 is a side elevation of the device. Fig. 2 is a side elevation in section, taken on the line 2 2 in Fig. 1. Fig. 3 is a transverse section of the upper portion of the apparatus, taken on the line 3 3 in Fig. 2. Fig. 4 is a sectional plan view of the device, taken on the line 4 4 in Fig. 2. Fig. 5 is a plan in section, taken on the line 5 5 in Fig. 2; and Fig. 6 is a plan in section on the line 6 6 in Fig. 2.

A vertical cylindrical wall A is provided which rests on a durable foundation, said wall being provided to encompass the combustion-chamber of the apparatus, and at *a* this circular wall of fire-brick or other suitable material is "racked" in to reduce the diameter and afford an upper encircled inclosure A′, the use of which will appear.

Within the upper portion of the inclosure A, preferably termed "jacket-wall," an annular metallic chamber B is supported in close contact with the wall A, the upper edge of which chamber is aligned with the point where this wall is gathered in, and to sustain the chamber suspended from the wall projecting bracket-arms *b* are affixed to the side wall of the same and enter the wall A, as shown in Fig. 1. There is an inward step projection of the chamber B at *c*, thus providing a base on which the dome-wall *d* is erected, said wall arching over the space below it as a cover, and is perforated at spaced intervals, which apertures *e* are provided as draft-holes, the object of which will be explained.

At the base of the dome-wall *d* a brick lining wall *d′* is placed in close contact with the inner shell of the chamber B, extending over its upper surface to connect with the racked portion of the jacket-wall A, the dome-wall and lining being constructed of refractory material.

From the lower wall of the metallic chamber B a series of spaced tubes *g* are downwardly extended to a proper point above the hearth or masonry foundation of the kiln, forming a circular wall, and are thence outwardly projected through the wall A a short distance, where they have connection with a continuous tubular ring *g′*.

The circular wall just described constitutes the combustion-chamber of the kiln, and to prevent the series of tubes from burning out, and the exposed surface of the chamber B also, a current of cold water is circulated through the same. To this end there is a water-supply pipe *h* attached to the junction-pipe *g′*, this supply-conduit being extended to connect with a water-main or other source of supply that will afford water under pressure.

Near the upper wall of the chamber B an outlet-pipe *i* is introduced and outwardly extended to a sewer or other place of discharge, which may be a feed-water tank for a boiler, there being stop-cocks *h′ i′* placed in the inlet and outlet pipes named to control the flow of water through them.

Oppositely of the inlet-pipe *h*, or at any other preferred point in the pipe *g*, is a waste-cock g^2, attached to a branch pipe g^3, the latter being extended to any proper point for discharge, the cock or plug valve just named being designed to blow sediment from the chamber B and series of tubes attached to it.

Concentrically within the upper jacket-wall

A′ a vertical tubular boiler D for generation of high-pressure steam is suspended. Bracket-feet *k*, which are affixed upon the shell of the boiler, project into the wall A′ and retain the boiler in position, allowing an annular space to intervene between the boiler-shell and the inner surface of the jacket-wall.

There are central circular apertures formed in the opposite head-sheets of the boiler D, having a suitable diameter to receive a vertical cylindrical conduit for material which is to be introduced within the combustion-chamber, which conduit *m* is extended from a funnel-shaped hopper *m′* to tap the center of the dome-wall *d*.

The boiler D is furnished with the usual necessary fittings, such as a water-column gage *n*, a steam-gage *n′*, and on the outlet-pipe n^2 for steam a safety-valve n^3 is placed. A feed-water pipe n^4, that enters the lower portion of the boiler, is laterally extended to a source of water-supply provided by a pump or injector. (Not shown.) Upon the jacket-wall A′ a hood *o* is placed, which is shaped conically, and from its apex there is a vertical stack *o′* erected, in which a damper-valve o^2 is suspended and adapted to be adjusted as occasion requires. Transversely through the hood *o* an arched passage is formed for the introduction of material into the combustion-chamber B through the hopper *m′*, a platform o^3 affording access thereto, which platform may be extended to provide space for deposit of a considerable supply of fuel and material that is to undergo calcination.

Between the dome-wall *d* and the lower flue-sheet of the boiler D an annular compartment E is produced, through which the hot products of combustion pass from the orifices in the dome-wall to enter the boiler-flues and surround the boiler on their passage to the stack *o′*.

As it may be found that the heat developed in the combustion-chamber is of too high a temperature for contact with the boiler D, provision is made to obviate an excess of heat in the compartment E by forming spaced apertures through the jacket-wall A, as at *p*, thus permitting the introduction of cold air into the caloric chamber or compartment E, sliding gates *p′*, that are counterbalanced and suspended from pulleys by wire ropes, being adapted to graduate the flow of air into the same or seal the apertures *p*.

Central with the jacket-wall A a conical jet-head *r* is placed and partly embedded in the hearth of the kiln. The conical portion which is above the level of the hearth is perforated at intervals near its apex. The orifices in one or more rows extend outwardly and downwardly, so that if the hollow head is filled with steam under pressure the jets issuing from the head *r* will project outward and slightly downward, whereby they will be caused to permeate a mass of incandescent material around the jet-head.

A steam-supply pipe *s* is made to extend from the top of the boiler D outward and downward along the side of the jacket-wall and terminate in the buried portion of the jet-head *r*, to which it is attached, a valve *s′* being conveniently located in the pipe to permit steam to be transmitted from the boiler to the jet-head at the will of the operator.

A proper number of discharge-openings *t* are made through the jacket-wall A at spaced intervals, and above these holes other apertures *u* are formed in the wall A opposite the tubular wall of the combustion-chamber B, thus exposing these tubes to view when the doors *u′* or any one of them is opened. Above the doors *u′* a platform F is erected to afford access to the boiler-mountings and permit inspection of the steam-gage and water-gage as well as the valve whereby adjustment of water-feed into the boiler is effected.

In operation the annular chamber B and attached tubular wall-pipes *g*, with their connecting-ring *g′*, are filled with cold water, provision being made to insure adequate supply that free circulation through the chambers and pipes is assured, so as to avoid such a heat as will generate steam in the same. The boiler D being also supplied with water, fuel may be ignited at the base of the combustion-chamber around the jet-head *r*, which fire may be increased as combustion progresses. A mixture in proper proportion of coal and material which is to be calcined is now introduced until the combustion-chamber and vertical conduit *m* connected therewith are filled, as shown, and as the combustion-chamber is comparatively low and of considerable diameter incandescence will result in a comparatively short period of time, owing to direct draft vertically afforded. When the material in the combustion-chamber is sufficiently heated to calcine such as is below, steam may be introduced into the head *r*, which will issue from the jet-orifices therein in an expanded condition, as the head will be highly heated. The action of the steam upon the white-hot calcined cement or lime will lower its temperature at the base of the mass, which is desirable, as it should be partly cooled to permit of its being handled by drawing it out through the discharge-holes *t*. After the steam strikes the incandescent material around the jet-head *r* it is partly dissociated thereby, and passing upward becomes assimilated with the carbonaceous material, intensifying combustion by evolution of carbonic-oxide and crude hydrocarbon gas that results from the combination of the steam and coal, as stated, a more complete calcination of the cement or limestone being effected thereby. As the passage of water through the tubes *g* and chamber B keeps these from injury, it also serves to prevent a slagging action on the same, so that the tubular wall of the combustion-chamber is never clogged and the calcining operation can be continuously conducted.

If the boiler D is proportioned to have req-

uisite capacity, a surplus of steam may be evolved therein to drive an engine which will run a water-pump for boiler-supply and also actuate crushing-mills to reduce the calcined cement to a powder, as is required before it is fit to use.

While a steam-boiler is a useful adjunct to the calcining device, it is not imperative that it be employed in combination therewith, as the peculiar construction of a water-protected wall of tubes and connected annular water-chamber above them with a feed-conduit and perforated arch wall to support the lower end of the feed-conduit, with other essential co-acting parts which produce the novel lime or cement calcining kiln, may be used independently of the steam-boiler, if preferred. Hence I do not limit the construction to the exact forms shown, as slight variations therefrom may be made within the scope of my invention.

Having thus described my improved apparatus for calcining lime or cement, what I claim as new, and desire to secure by Letters Patent, is—

1. A lime or cement calcining apparatus having an enveloping cylindrical jacket-wall, a combustion-chamber within comprised of an annular water-chamber and tubes depending therefrom in a circular row which are adapted to circulate water through them, a tubular steam-generator above the combustion-chamber, and a jet-head below said chamber which is connected to the steam-generator, substantially as set forth.

2. A lime or cement calcining apparatus having an outer masonry jacket, an inner concentric annular water-chamber at the top of the combustion-chamber, a series of spaced depending tubes arranged in cylindrical form that are bent outwardly below to be connected together and to a source of water-supply, and a water-discharge for the annular water-chamber, substantially as set forth.

3. The combination, with a jacket-wall, of an annular water-chamber within, a series of tubes which form a combustion-chamber depending from the water-chamber, a water-supply and discharge therefor, and a steam-boiler above the combustion-chamber and within the jacket, substantially as set forth.

4. The combination, with a jacket-wall, of an annular water-chamber, a series of spaced tubes attached to the water-chamber in a circular row and connected at their lower ends, a water supply and discharge therefor, and a perforated dome-wall on the water-chamber, substantially as set forth.

5. The combination, with a jacket-wall, of an annular water-chamber, a series of spaced tubes attached to and extending down from the water-chamber in a circular row and connected at their outer ends, a water supply and discharge therefor, a perforated dome-wall on the water-chamber, and a feed-conduit penetrating the dome-wall, substantially as set forth.

6. The combination, with a jacket-wall, of an annular water-chamber, a series of spaced tubes attached to and extending down from the water-chamber in a circular row and connected at their outer ends, a water supply and discharge therefor, a perforated dome-wall on the water-chamber, a feed-conduit penetrating the dome-wall, and a boiler above the dome-wall, through which extends the said feed-conduit, substantially as set forth.

7. The combination, with a cylindrical jacket-wall that is reduced in diameter above a combustion-chamber within, a combustion-chamber comprised of an annular water-chamber, and tubes which depend in a circular spaced row therefrom and outwardly bent to join a connecting tubular ring, a tubular ring, and a water inlet and discharge for the combustion-chamber, of a perforated dome-wall on the water-chamber's inner wall, a feeding-conduit above the dome-wall, a steam-boiler having vertical flues located above the dome-wall, and a draft-stack on the jacket-wall, substantially as set forth.

8. The combination, with a jacket-wall, an annular water-chamber within, depending tubes therefrom that are adapted to have water circulation, a water supply and a water-discharge for the tubes and water-chamber, a perforated dome-wall, and a feed-conduit, of a steam-boiler, a jet-nozzle head below, and a steam-connection for the jet-head with the steam-boiler, substantially as set forth.

9. The combination, with a jacket-wall having apertures with doors on its sides, discharging-apertures below, a contracted upper portion, and air-inlets that are in the jacket-wall having adjustable gates for supplying air to a hot-air compartment within the jacket-wall above a combustion-chamber, of a combustion-chamber comprised of an annular water-chamber having a series of depending tubes therefrom that are provided with means for continuous water-circulation, a dome-wall which is perforated at intervals, a feeding-conduit thereon, a tubular boiler above the dome-wall, through which the feed-conduit passes, a stack above the boiler seated on a hood, and a hood which is adapted to permit access to the feed-conduit, substantially as set forth.

PAUL KROTTNAURER.

Witnesses:
T. J. DEILY,
R. A. HURLY.