(No Model.) 3 Sheets—Sheet 1.

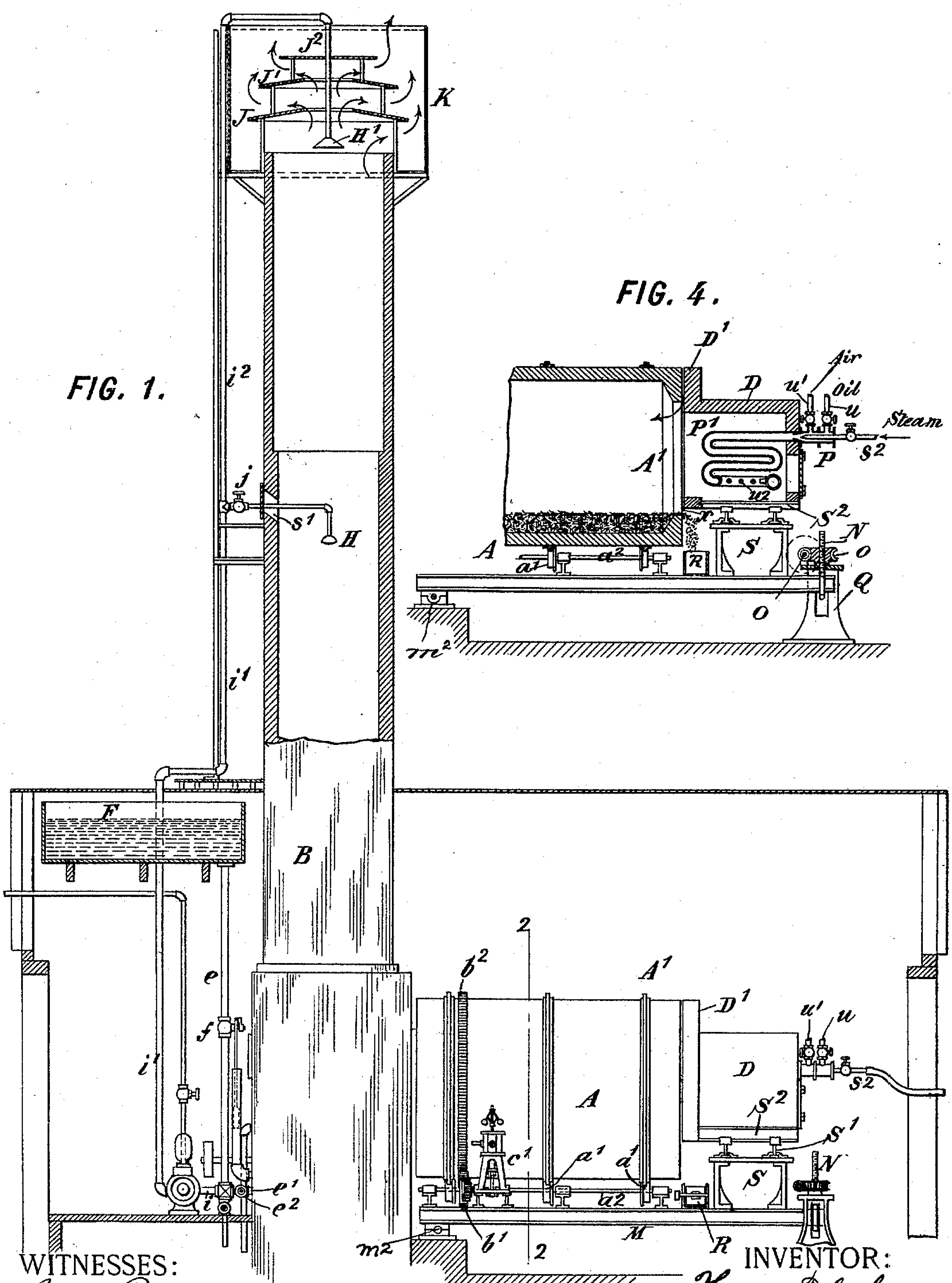
H. BLACKMAN.

APPARATUS FOR RECOVERING ALKALI.

No. 497,088. Patented May 9, 1893.

FIG. 1.

FIG. 4.



WITNESSES:

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(No Model.) 3 Sheets—Sheet 2.

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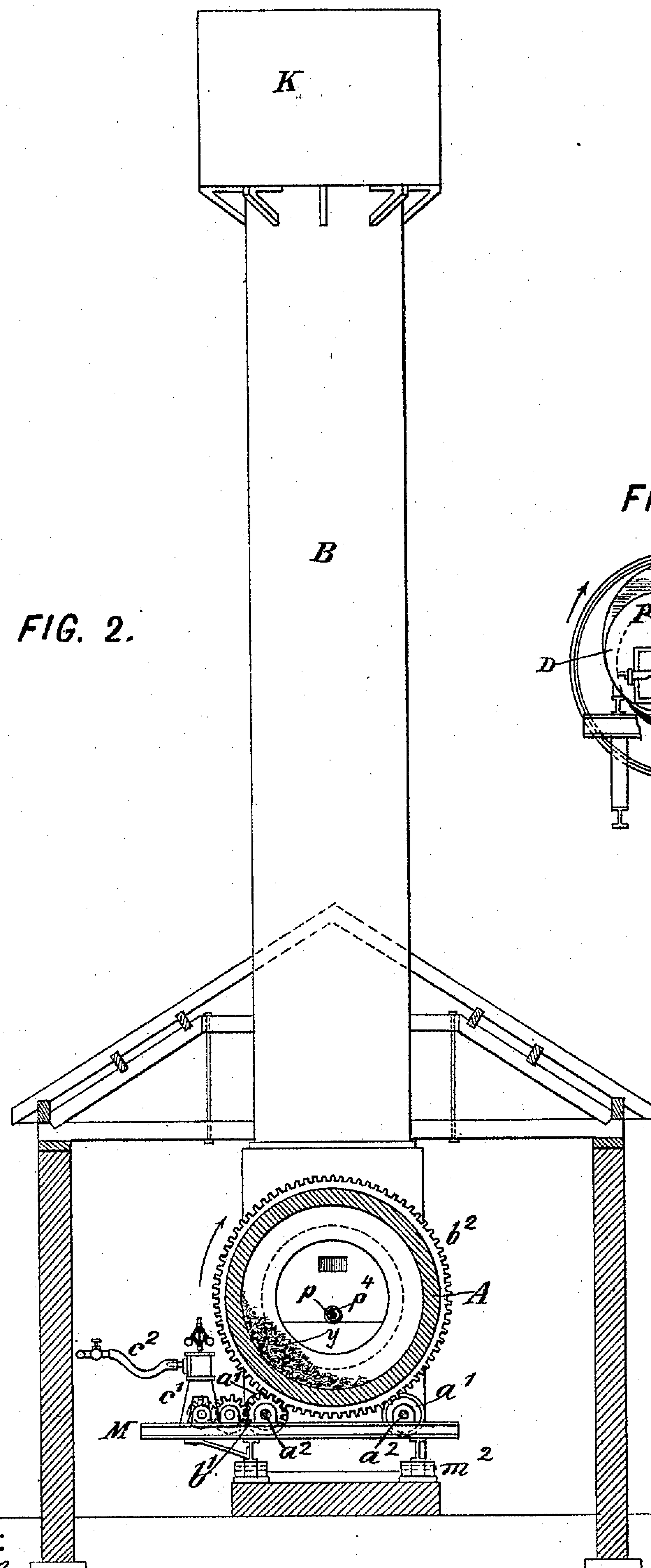
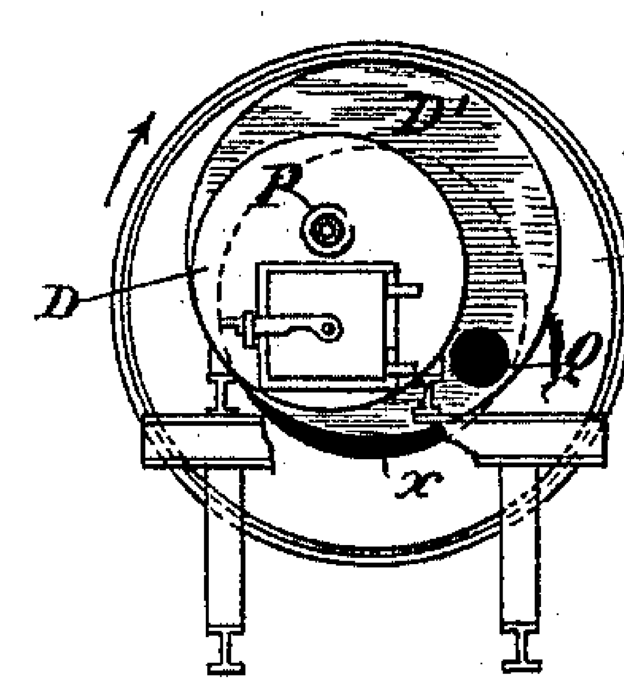


FIG. 2.

FIG. 5.



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(No Model.)

3 Sheets—Sheet 3.

H. BLACKMAN.

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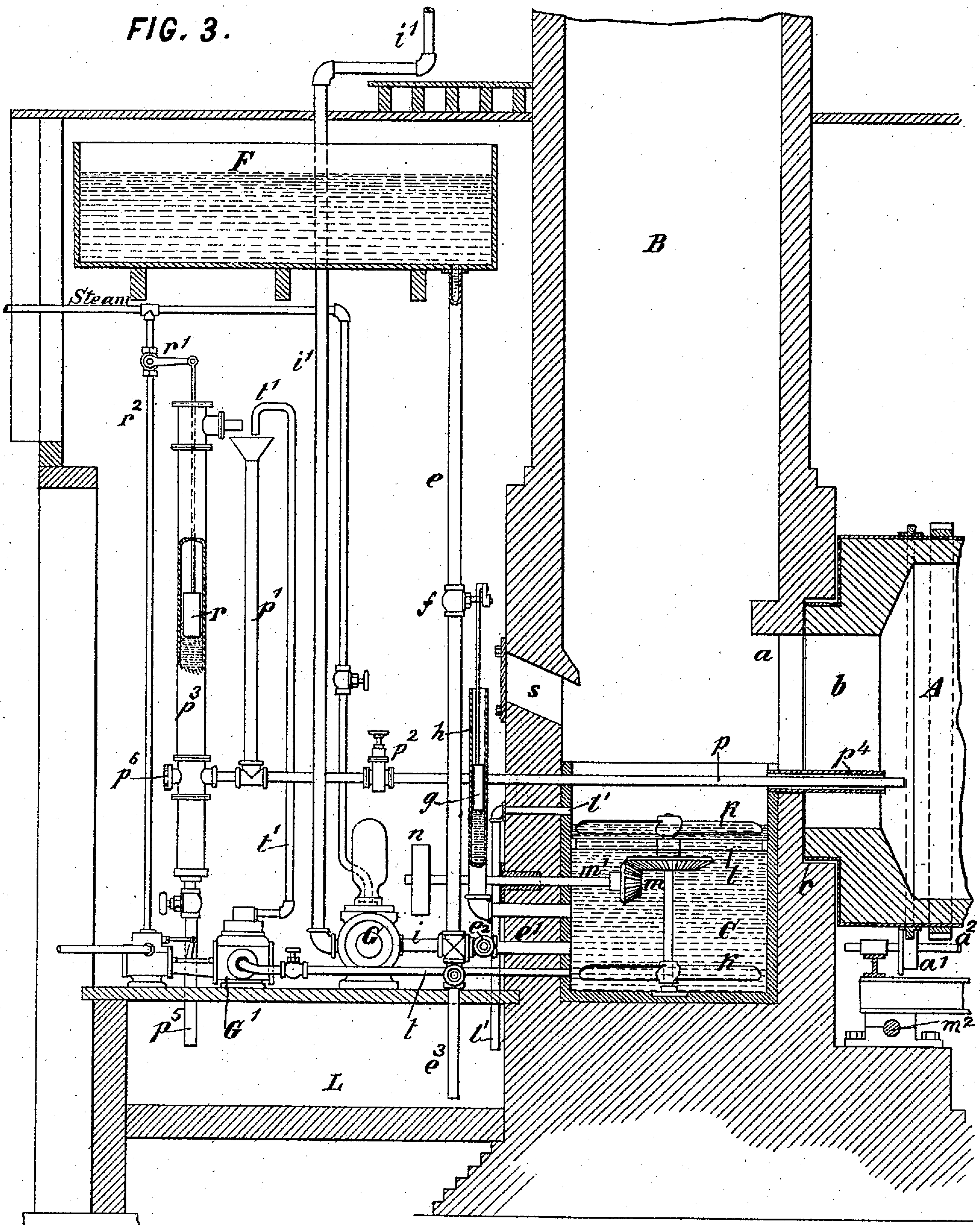
FIG. 3.



WITNESSES:
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UNITED STATES PATENT OFFICE.

HENRY BLACKMAN, OF NEW YORK, N. Y.

APPARATUS FOR RECOVERING ALKALI.

SPECIFICATION forming part of Letters Patent No. 497,088, dated May 9, 1893.

Application filed March 19, 1892. Serial No. 425,543. (No model.)

To all whom it may concern:

Be it known that I, HENRY BLACKMAN, a citizen of the United States, residing in the city, county, and State of New York, have invented certain new and useful Improvements in Furnaces for Evaporating and Calcining Alkaline and other Solutions, of which the following is a specification.

My invention provides certain improvements in furnaces, and more particularly in rotary furnaces designed for the recovery of soda or other alkalies from the refuse liquors of pulp mills, but applicable also for the recovery of other incombustible chemicals from solutions.

In recovering the refuse liquors from pulp mills, it is customary to first concentrate the liquor and then to subject it to calcination in a furnace, whereby the ligneous, mucilaginous, and other combustible impurities contained in the liquor are burned out, leaving the alkali in a tolerably pure condition.

My present invention is most directly an improvement upon the furnace disclosed in my application, Serial No. 387,139, filed March 31, 1891, for Letters Patent of the United States. Renewed July 26, 1892, Serial No. 441,324.

My present invention relates in part to the means for concentrating the alkaline liquor, for handling it during concentration, and for feeding it to the calcining chamber of the furnace, and in part to accessories of the rotary calcining chamber or hearth of the furnace.

Figure 1 of the accompanying drawings is a side elevation of my improved furnace partly in vertical mid-section. Fig. 2 is an end elevation thereof partly in vertical section on the line 2—2 in Fig. 1. Fig. 3 is a vertical longitudinal section of a portion of the apparatus on a larger scale than the preceding figures. Fig. 4 is a vertical section of the discharge end of the rotary calcining chamber, and of the supplying furnace or fire-box. Fig. 5 is an elevation of the discharge end of the furnace.

Referring to the drawings, let A′ designate the furnace or combustion chamber and B the chimney or stack. The furnace A′ consists of a rotary calcining chamber A and means for supplying combustible gas or fuel thereto and for effecting the ignition of such fuel. The stack B is built preferably of solid masonry in any manner common in the building of chimneys, and extends to a suitable height to afford the requisite draft. At its lower end, and below the opening *a* through which it communicates with the calcining chamber A, it is provided with a pit C constituting a receiving tank for the alkaline solution. This tank is preferably constructed with a metal shell and a brick lining. The rotary chamber A is constructed with its outlet end *b* which communicates with the opening *a* in the stack, to project into a recess *c* formed around this opening so as to make a suitably close connection or joint between the revolving chamber and the stationary stack. The opposite end of the chamber is nearly closed by the fire-box or furnace D, which is arranged close against it, and which is formed with a flange or shield D′ on its side toward the chamber. This fire-box is mounted in any suitable manner by means of which it may be drawn back from the outer end of the chamber A, as is customary in rotary furnaces.

The alkaline liquor to be concentrated and calcined is placed in a supply tank F, from which it is introduced by any suitable means into the stack B at any suitable height in order to be showered or streamed down the stack and thereby concentrated. In the base of the stack, or in any other suitable or convenient location, is constructed a receiving tank or pit C for receiving the liquid thus concentrated. The preferred means for introducing the liquid from the tank F into the stack is by pumping it up and spraying it into the stack. The liquid flows through a pipe *e* to a pump G, from which it is pumped up through a pipe *i′* to discharge into the stack through a spraying nozzle H arranged at any suitable height within the stack B (see Fig. 1). The flow to this nozzle is regulated by a valve *j*. Another nozzle H′ is arranged at or near the top of the stack, and by more or less closing the valve *j*, the liquid may be forced to this nozzle through a pipe i^2 forming a continuation of the pipe *i′*. The nozzles H H′ may be of any suitable construction adapted to either spray or subdivide the liquid and thereby cause it to shower down through the stack, or to deflect it against the walls of the stack so that it shall be caused to stream down against the heated walls. The liquid thus descending through the stack is concentrated by the hot walls thereof, or by the hot gases of combustion ascending therethrough, and ultimately falls into the tank C, which thus forms a receptacle for the concentrated solution.

From the tank C the concentrated liquid is fed into the calcining chamber as will be hereinafter described. A uniform level in this tank is preserved in the following manner. The flow of liquid from the tank F through the pipe *e* is determined by the level of the liquid in the tank C, which rises in a stand-pipe *h*, in which is mounted a float *g* that is connected to a valve *f* in the pipe *e*, so that as the level in the tank C rises the float rises and partly closes the valve, thereby reducing the flow. A branch pipe *e′* leads from the tank C to the pump G, so that the latter may draw liquid either from the tank F through the pipe *e*, or from the tank C through the pipe *e′*. The latter pipe is ordinarily closed by a valve e^2, but whenever the liquid in the tank C is not sufficiently concentrated, this valve will be more or less opened, so that a greater or less proportion of concentrated liquid from the tank C will be drawn to the pump and mixed with the unconcentrated liquid from the tank F, and the two together be introduced into the stack. The more the valve e^2 is opened, the greater proportion of already concentrated liquid will be pumped up and showered down through the stack, and hence the more concentrated will become the liquid in the tank C.

The liquid in the tank is kept agitated by an agitator or stirring arms *k k* mounted on an upright shaft having a bearing at its upper end in a cross-frame *l*, and driven through bevel gears *m* from a horizontal shaft *m′* which enters the side of the tank through a suitable stuffing box, and is revolved by a belt on a pulley *n*, or by other means. From the bottom of the tank C, an outlet pipe *t* leads to the suction of a pump G′, from the discharge of which a pipe *t′* extends upward and terminates in a downturned nozzle discharging into a vertical pipe *p′*, from the lower end of which a horizontal pipe *p* extends into the furnace, and through the throat *b* of the rotary calcining chamber thereof, and terminates just within this chamber in order to discharge the concentrated solution thereinto. It is desirable that the solution be discharged at a certain predetermined rate of flow into the calcining chamber in order that the latter may be supplied with material for calcination at a rate just as rapid as, and no more rapid than, it is capable of effecting the concentration. This flow is regulated chiefly by means of a valve p^2 in the pipe *p*, but it is obvious that some special means is requisite to cause the pump G′ to operate at a rate exactly in proportion to the flow determined by this valve. To this end I provide a stand-pipe p^3 in communication with the pipes *p* and *p′*, in which stand-pipe a head of liquid will stand at a level determined by the adjustment of the valve p^2, and by the rate of flow from the pump. When the pump pumps the liquid up and discharges it into the pipe *p′* faster than it can flow out through the valve p^2, its level in this stand-pipe will rise. Floating on the liquid in this stand-pipe is a float *r*, which is connected by a rod to a valve *r′* in a steam-pipe r^2, which supplies steam for operating the pump G′. Consequently when the pump pumps the liquid up too rapidly and the level in the stand pipe rises, the ascent of the float will partly close the valve *r′* and throttle back the steam supplied to the steam cylinder of the pump, so that the pump will then work more slowly until the level in the stand-pipe falls, whereupon the descent of the float will open the valve and admit more steam to the engine, so that the operation of the pump will be automatically controlled so as to pump the liquid into the pipe *p′* at the same rate of flow as that determined by the adjustment of the valve p^2 for the admission of the liquid to the calcining chamber of the furnace. The pipe *p* passes through the upper part of the tank C above the level of the liquid therein, and is inclosed and protected by passing through a pipe p^4 in the throat of the calcining chamber. The pipe *p* is made perfectly straight and enters at one side of the stand-pipe p^3, and in the opposite side thereof, and in line with the pipe *p* is an opening closed by a cap p^6, so that by draining out the liquid from the pipes and removing this cap, access may be gained to the interior of the pipe *p* to clean it in case it should become clogged.

It will be seen from the foregoing description that the apparatus is wholly automatic, it being only necessary to determine the rate of flow into the calcining furnace by the adjustment of the valve p^2, and to determine the extent of the concentration of the liquid by the adjustment of the valve e^2. If the pump G′ draws the denser liquid from the bottom of the tank more rapidly than it is being admitted by showering down the stack, the level of the liquid in the tank, and consequently that in the stand-pipe *h*, will fall, so that the float *g* will open the valve *f* and admit a greater flow to the pump G, so that a greater volume of liquid will be showered down the stack and thus supplied to the tank C. Obviously the pump G′ might pump directly through the pipe *p* into the calcining chamber, but this would involve the disadvantage that the exact degree of concentration of the liquid could not be readily determined. But by showering the liquor from the pipe *t′* into the funnel mouth of the pipe *p′*, the operator can tell at a glance the degree of concentration, or if need be he can readily take a sample for testing.

In my former application hereinbefore referred to, the liquid from the tank F was discharged into the tank or pit C, and was pumped up from this pit and discharged down the stack, falling back into the pit, and there mixing with the unconcentrated liquor entering from the tank F. It resulted from this that the liquor introduced into the calcining chamber was not uniformly concentrated, since the proportions of freshly introduced liquor, and of liquor concentrated by showering down the stack, could not be kept uniform. In my former apparatus also, the liquor was fed to the stack by flowing off from the top of the mass of liquor in the tank C, it being designed that the concentrated liquor falling from the stack would be swept over by the upper stirring arms and forced to flow into the calcining chamber, but this result was attended with uncertainty by reason of this concentrated liquor being more dense than the unconcentrated liquor freshly introduced from the tank F, so that the latter would tend to rise and immediately enter the calcining chamber. My present invention overcomes these difficulties, and insures that the liquor from the tank F shall be concentrated before being admitted to the tank C, and it further enables the degree of concentration of the liquor in the tank C to be determined by pumping out a greater or less proportion thereof and showering it again through the shaft in order to more thoroughly concentrate it.

Under the pump platform is constructed a save-all tank L, which serves to catch any liquid which may leak from the pump or from any pipes or joints. In case the level in the tank C should rise above the normal, the liquid may overflow through a pipe l', which discharges into the save-all tank L. A pipe e^3 is also provided as a continuation of the pipe e, in order that the pipes $e\ i\ i'\ i^2$, and the pump G, may be drained of liquor in case of necessity. A pipe p^5 is also provided for draining off the liquor from the pipes $p\ p'\ p^3$. The pipes e^3 and p^5 are provided with suitable valves for keeping them normally closed. The liquor which accumulates in the save-all L may be pumped up by the pump G through the pipes e^3 and i by keeping closed the valves e^2 and f.

At the top of the stack is placed a vapor separator consisting of an open-topped chamber K surrounding the top of the stack, and of plates or disks J J′ J^2 (more or less in number) placed one above another over the top of the stack and within the chamber K. The ascending gases are deflected by these plates, being forced to pass outwardly around them. The lower disks are made annular in order that the ascending gases may partly pass through them and be deflected by the upper disks. By the deflection of the disks, any spray, dust or solid matter carried up by the gases is disengaged and caught in the chamber K, from which it may be washed out from time to time and caused to flow down the stack. The stack is provided with an opening s to permit access to the tank C, and with an opening s' to permit access to the nozzle H.

The rotary calcining chamber A is constructed in any suitable manner, an outer shell of iron lined with fire-brick being preferable. The outer shell carries annular rails which roll on supporting flanged wheels $a'\ a'$ fixed on two shafts a^2 at each side. These shafts are mounted in bearings on a supporting frame or platform M, which is pivoted on trunnions at m^2 at one end, and at its opposite or free end is provided with means for raising or lowering it, so that the platform, and consequently the chamber A, may be tilted to any suitable inclination the construction in this respect being the same as in my aforesaid application and consisting of a screw N from which the platform is hung, engaged by a nut O which is supported on a frame Q, and is a worm-wheel turned by a worm O′ on a transverse shaft which may be turned by hand. This is important, as it enables the speed of travel through the chamber of the material undergoing calcination to be governed at will. The frame M is preferably constructed of longitudinal girders resting on the trunnions at one end, and connected with a lifting apparatus at the other, and with transverse girders over them on which rest the bearings of the shafts. The trunnions are preferably arranged as near the end b of the chamber as practicable. For tilting the frame or platform M, any suitable mechanism may be employed, such as adjusting screws, chain pulleys, hydraulic cylinders, &c. I have shown a screw N engaged by a rotary nut. On one of the shafts a^2 is fixed a gear wheel b' which meshes with gear-teeth b^2 on the exterior of the cylinder, so that the latter is driven positively from this shaft. The shaft carrying this gear is driven by a train of gears from a steam engine c' mounted on the same platform M as the chamber A, and supplied with steam through a flexible hose c^2, Fig. 2. Thus the transmission of power to rotate the chamber A is not interrupted by the tilting of the platform M to different angles.

The fire-box D is supported on the same platform M as chamber A, so that it is tilted with the latter. For supporting it, I provide a frame S mounted on the platform M, over which are mounted transversely sliding frames S′ which have a sliding engagement with longitudinally sliding beams S^2 to which the fire-box D is fixed. By means of these frames the fire-box may be slid backwardly or to either side in order to get access to the interior of the chamber A. In my former construction, I employed a mere shield in the position of the shield D′, and having a gas and air injector entering through it. I now construct the shield with a combustion chamber forming the fire-box D, having an opening nearly as large as that of the outlet end of the chamber A, as shown in Fig. 4. The particular construction will be governed by the fuel that is to be used, but for burning liquid petroleum, I employ the construction shown, an injector nozzle P being provided connecting with a steam-pipe s^2, an oil supply pipe *u*, and an air supply pipe *u'*, all governed by suitable valves. The entering stream or jet of steam draws in inductively air and oil, and the oil is sprayed or atomized and discharged into a superheating pipe or coil P' within the fire-box. At or near the end of this coil are nozzles or jet openings u^2 through which the gas resulting from the heating of the mixture of atomized oil, air and steam in the coil is discharged into the combustion chamber, where it burns, and from which the flame sweeps through the calcining chamber A. Air enters through the space between the end of the revolving chamber A and the screen D', in greater or less volume according to the adjustment of the thickness of this space. The bottom portion of the shield D' is cut away eccentrically as shown in Fig. 5, leaving a space *x* intended chiefly for the discharge from the calcining chamber of the calcined ash, which sifts out of this space as the chamber revolves and falls beneath into a conveyer trough R, by which it is carried away. This space is so shaped by reason of the eccentricity of the outline of the shield D' to that of the opening in the chamber A, as shown in Fig. 5, being of greatest thickness at the bottom, and tapering thence gradually toward each end, that the outflowing ash nearly fills this space, so that the proportion of air entering through this space is not excessive as compared with that which enters around the remainder of the circumference of the opening. No adjustment of the shield to vary the amount of air admitted, even though the shield be moved into contact with the end of the chamber A, to close the intervening air space, can close the ash opening *x*, or contract it beyond the minimum area provided, which is that circumscribed by the eccentric arcs bounding this opening.

As seen in Fig. 5, the fire-box D is set eccentrically to the chamber A so that the heat therefrom is concentrated at the side of the chamber on which the greatest mass of the material undergoing calcination will rest by reason of the rotary motion of the chamber. This mass is shown at *y* in Fig. 2. This arrangement of the fire-box D also affords room for the placing of a poke hole Q in the shield close against the opposite side of the opening in the chamber A, through which hole Q the operator may thrust a poker or scraper for dislodging ash and clinker from the inner side of the rotary chamber. This hole Q is placed opposite the portion of the chamber which should have the cleanest surface, since the mucilaginous matter undergoing calcination clings to the inner wall of the chamber as the latter revolves and is carried around with it, and thereby exposed in a thin layer to the calcining action of the flames playing through the chamber, and this layer is most effectively calcined by the time the revolution of the chamber has been completed and the material has consequently reached a position on the descending side thereof near the bottom, at which point the hole Q is located. Through this hole also the calcining operation may be observed in order to determine the proper regulation of the admission of material to be calcined.

My invention is not limited in all respects to the exact details of construction herein shown, as the same may be modified in many respects. Those features of my invention which I consider essential are hereinafter defined in the claims. Those features of my invention which pertain to the concentrating of the solution before its calcination are not limited in their application to rotary calcining furnaces, but are equally applicable to those furnaces wherein the calcining chamber is stationary.

It will be understood that the employment of the pump G for introducing liquid from the tank F into the stack is necessitated solely because the level of the tank F is below that at which it is desired to introduce the liquid into the stack. The pump G might be omitted by elevating the tank F sufficiently to afford a proper head for running the liquid directly from this tank into the stack. In such case the pump G, if used at all, will be used solely for pumping the concentrated liquid up into the stack to be showered down a second time to re-concentrate it and increase the concentration of the liquid in the tank C. It will also be understood that the pump G' need not necessarily or essentially be a steam pump, but it might be operated by any suitable source of power, and that all that is essential to the automatic regulation controlled by the float *r* is, that this float shall be so connected to the source of power as to cut off or reduce the power supplied to the pump when the float rises, and readmit the power for operating the pump when the float falls.

I claim as my invention the following defined novel features or improvements substantially as hereinbefore specified, namely—

1. In a calcining furnace comprising a calcining chamber and a stack, the combination of means for introducing a liquid to be treated into said stack so that it shall descend therein and be thereby concentrated, a tank for receiving the liquid thus concentrated, and a pump for drawing the concentrated liquid from this tank and introducing it into the calcining chamber.

2. In a calcining furnace comprising a calcining chamber and a stack, the combination of means for introducing a liquid to be treated into said stack so that it shall descend therein and be concentrated thereby, a tank for receiving the liquid thus concentrated, a pump for drawing the concentrated liquid from this tank and introducing it into the calcining chamber, and means for controlling

the introduction of liquid into the stack so as to preserve a uniform level in said tank consisting of a valve operated by a float and responding to variations of level of the liquid in said tank.

3. In a calcining furnace comprising a calcining chamber and a stack, the combination of means for introducing a liquid to be treated into said stack so that it shall descend therein and be thereby concentrated, a tank for receiving the liquid thus concentrated, a pump for drawing the concentrated liquid from said tank, a pipe receiving the liquid from said pump and discharging it into the calcining chamber, and a valve in said pipe for regulating the rate of admission to the calcining chamber.

4. In a calcining furnace comprising a calcining chamber and a stack, the combination of means for introducing a liquid to be treated into said stack so that it shall descend therein and be thereby concentrated, a tank for receiving the liquid thus concentrated, a pump for drawing the concentrated liquid from said tank, a pipe receiving the liquid from said pump and discharging it into the calcining chamber, and a valve in said pipe for regulating the rate of admission to the calcining chamber, and means for controlling the opertion of said pump consisting of a stand-pipe in communication with said valved discharge pipe, a float responding to variations of level in said stand-pipe, and means operated by the rise and fall of said float for controlling the application of power to said pump.

5. In a calcining furnace comprising a calcining chamber and a stack, the combination of means for introducing a liquid to be treated into said stack so that it shall descend therein and be thereby concentrated, a tank for receiving the liquid thus concentrated, a steam pump for drawing the concentrated liquid from said tank, a pipe receiving the liquid from said steam pump and discharging it into the calcining chamber, and a valve in said pipe for regulating the rate of admission to the calcining chamber, a stand-pipe in communication with said valved discharge pipe, a float responding to variations of level in said stand-pipe, and a valve in the steam-pipe supplying steam to said pump connected to and operated by said float, whereby the speed of the pump is automatically governed proportionally to the adjustment of said valve.

6. In a calcining furnace comprising a calcining chamber and a stack, the combination of means for introducing a liquid to be treated into said stack so that it shall descend therein and be thereby concentrated, a tank for receiving the liquid thus concentrated, a pump G′ with its suction pipe t connected to said tank for drawing the concentrated liquid therefrom, a discharge pipe t' ascending from said pump, a vertical pipe p' receiving the liquid from said pipe t', a pipe p extending thence into the calcining chamber, a valve p^2 for controlling the discharge of liquid through said pipe, a stand-pipe p^3 in connection with pipes p p', a float r in said stand-pipe, and means controlled by said float for governing the speed of the pump.

7. In a calcining furnace comprising a calcining chamber and a stack, the combination of a supply tank for liquid to be treated, means for introducing liquid from said tank into the stack so that it shall descend therethrough and be thereby concentrated, a tank for receiving the liquid thus concentrated, means for introducing the concentrated liquid from this tank into the calcining chamber, and means for controlling the admission of liquid to the stack consisting of a valve operated by a float responding to variations in the level of the concentrated liquid in said receiving tank.

8. In a calcining furnace, the combination with a calcining chamber and an upright stack, of a supply tank for the liquid to be treated, a pump drawing from said supply tank, a pipe leading from the outlet of said pump extending upward and discharging the liquid into said stack, whereby the liquid is showered down the stack, and a receiving tank at the base of said stack for receiving the liquid thus concentrated.

9. In a calcining furnace, the combination of a calcining chamber and an upright stack, a supply tank for the liquid to be treated, a pipe extending therefrom to a pump, a pipe leading from the outlet of said pump extending upward and discharging into the stack to shower the liquid down therethrough, a receiving tank at the base of the stack to receive the liquid thus concentrated, and means for controlling the flow of liquid from said supply tank consisting of a valve, and a float operating said valve and responding to variations of level in said receiving tank.

10. In a calcining furnace comprising a calcining chamber and a stack, the combination of a supply tank for the liquid to be treated, means for introducing liquid from said tank directly into the stack so that it is concentrated by descending therethrough, a receiving tank at the base of the stack for receiving the liquid thus concentrated, a suction pipe passing from said receiving tank, and a pump for drawing the concentrated liquid therefrom through said pipe and elevating it and discharging it into said stack to be again concentrated.

11. In a calcining furnace comprising a calcining chamber and a stack, the combination of a receiving tank at the base of said stack, a supply tank for the liquid to be treated, a pump, pipes leading from said supply tank and said receiving tank to said pump, and the discharge pipe of said pump extending upward and discharging the liquid therefrom into said stack, whereby the liquid thus discharged into the stack may be drawn either from said supply tank or said receiving tank, or partly from each.

12. In a calcining furnace comprising a calcining chamber and a stack, the combination

of a receiving tank at the base of said stack, a supply tank for the liquid to be treated, a pump, pipes leading from said supply tank and said receiving tank to said pump, valves in said pipes for controlling the flow therethrough, and a pipe leading from the discharge of said pump and discharging into said stack, whereby the concentration of liquid in said receiving tank may be determined by pumping from it a greater or less proportion of the concentrated liquid mixed with unconcentrated liquid drawn from said supply tank.

13. In a calcining furnace, the combination with calcining chamber A, stack B and tank C, of supply tank F, pump G, pipe *e* leading from tank F to pump G controlled by float-valve *f g*, pipe *e′* leading from tank C to pump G, valve e^2 controlling said pipe, and discharge pipe *i′* extending from said pump upwardly and discharging into the stack, whereby the degree of concentration of the liquid in tank C may be determined by the adjustment of valve e^2, the flow from tank F being governed automatically and proportionally to such adjustment by the float-valve.

14. In a calcining furnace, the combination with calcining chamber A and stack B, of tank C, pump G′ drawing therefrom, pipes *p* and p^3 receiving the liquid from said pump and discharging it into the calcining chamber, and removable cap p^6 in line with pipe *p*, whereby by removing this cap access may be gained to the interior of pipe *p* for cleaning it.

15. In a calcining furnace comprising a calcining chamber and stack, the combination of a save-all L, supply tank F, pipe *e* leading to pump G, and valved-pipe e^3 communicating with pipe *e*, whereby the tank F may be drained into the save-all through pipe e^3, and its contents afterward pumped out through said pipe to the pump.

16. In a rotary calcining furnace, the combination with the revolving calcining chamber of a shield exterior thereto and arranged against the opening at the discharge end thereof to cover and close said opening, formed with its bottom portion eccentric to said opening and above the bottom thereof so as to leave a space *x* uncovered at the bottom thereof through which to discharge the calcined ash, and said shield mounted to be bodily adjustable toward and from the chamber to afford a narrower or wider space for entrance of air, whereby such adjustment of the shield cannot close the opening *x* through which the ash is discharged, nor reduce its area beyond the minimum predetermined area circumscribed by the eccentric arcs bounding said opening.

17. In a rotary calcining furnace, the combination with the revolving calcining chamber thereof, of a fire-box or furnace applied to its discharge end eccentrically and nearest the ascending side of the calcining chamber, whereby the flames from said fire-box are directed over the greater mass of material within the calcining chamber at the ascending side thereof.

18. In a rotary calcining furnace, the combination with the revolving calcining chamber thereof, of a shield for closing the discharge end of said chamber, constructed with a fire box or furnace arranged eccentrically and nearest the ascending side of the calcining chamber, and the shield formed with a hole close to the opposite and descending side of the chamber, whereby during the ascent of the material it is exposed to the flames from said fire box, and during its descent the calcined material may be observed through said hole, or manipulated by a poker inserted through said hole.

In witness whereof I have hereunto signed my name in the presence of two subscribing witnesses.

HENRY BLACKMAN.

Witnesses:
GEORGE H. FRASER,
ARTHUR C. FRASER.