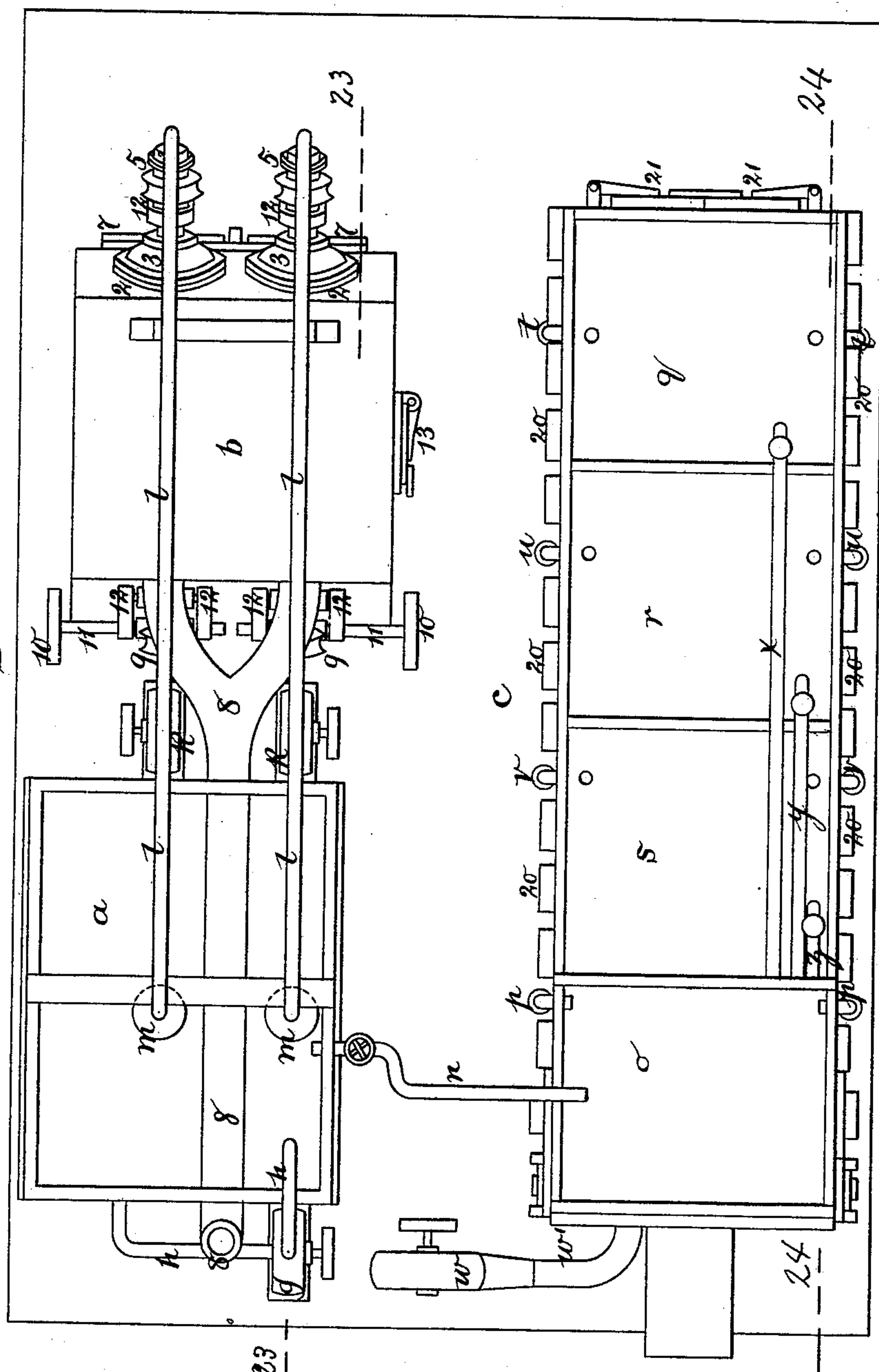


M. NIXON.
Apparatus for Evaporating and Calcining Alkaline
Solutions.

No. 218,056.

Patented July 29, 1879.

Fig. 1.



Witnesses.
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John Staut

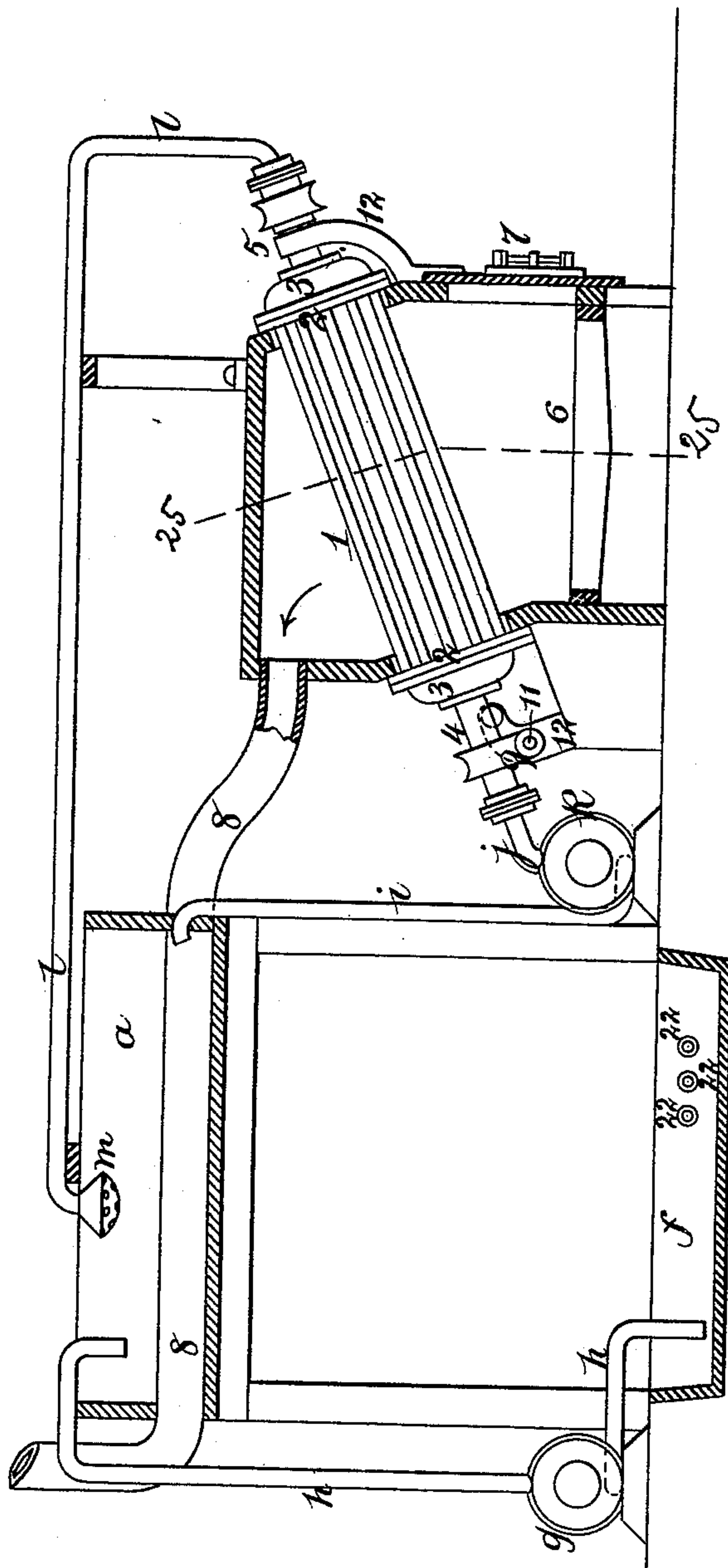
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Martin Nixon
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Fig. 2.



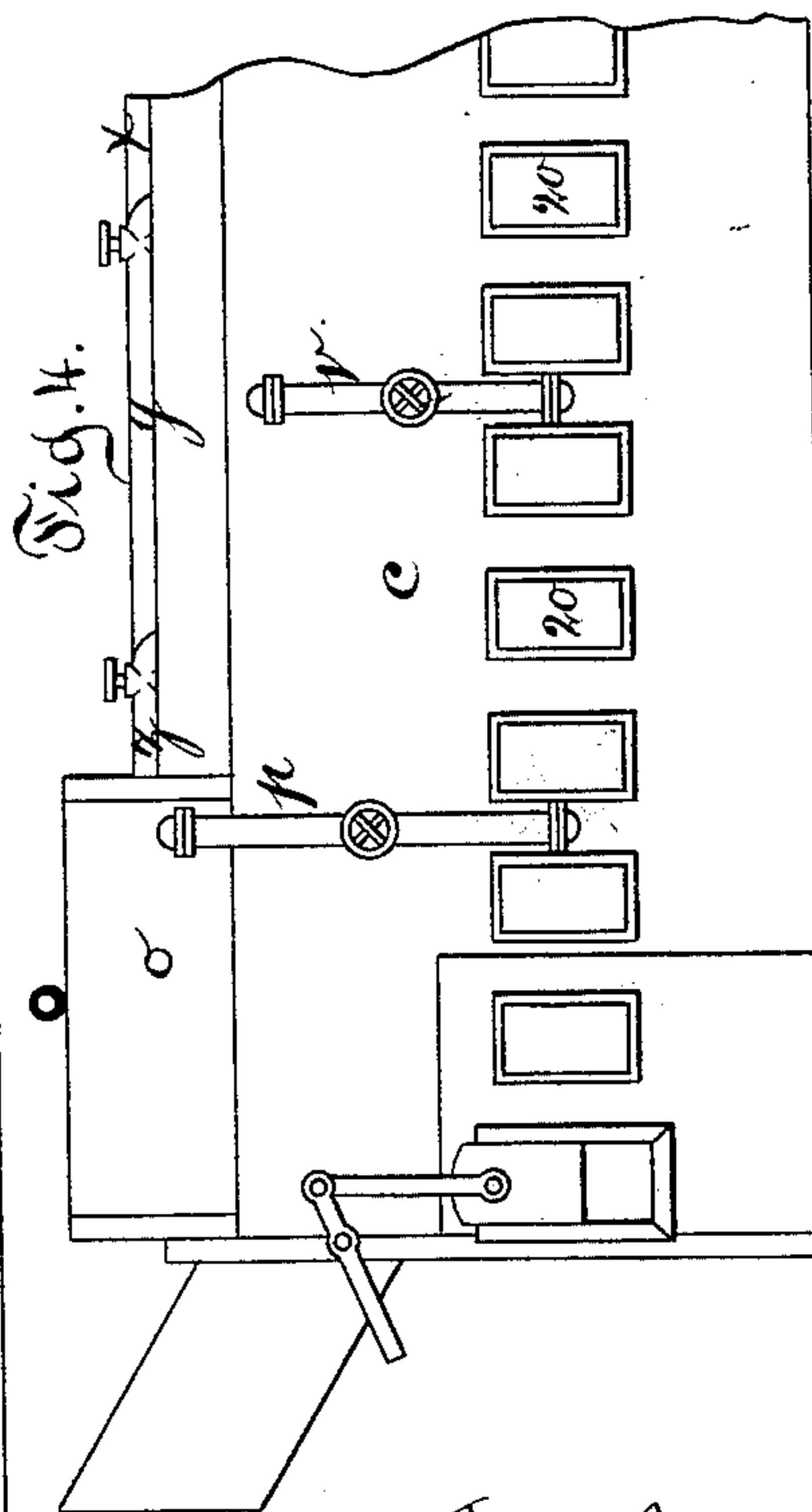
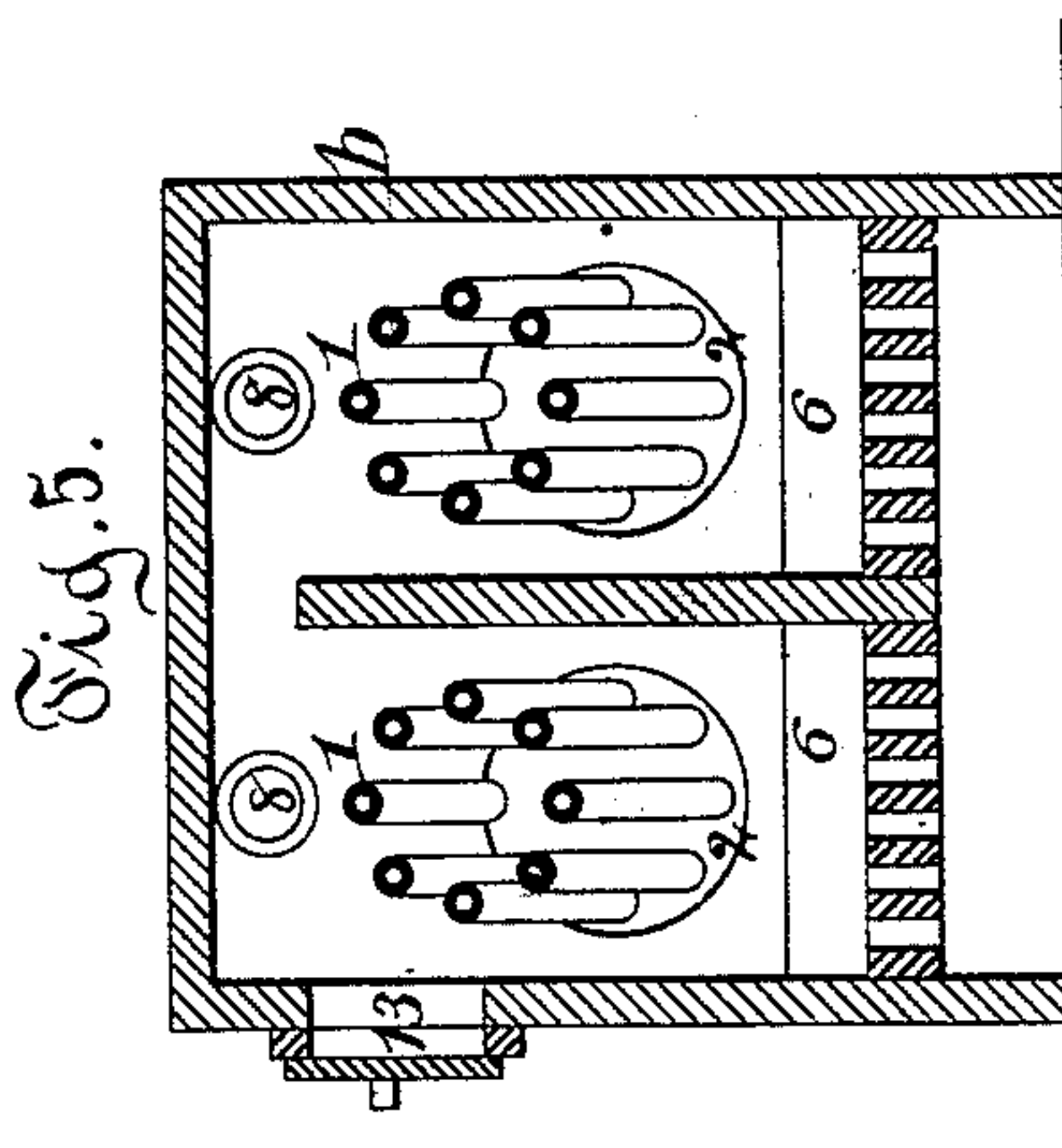
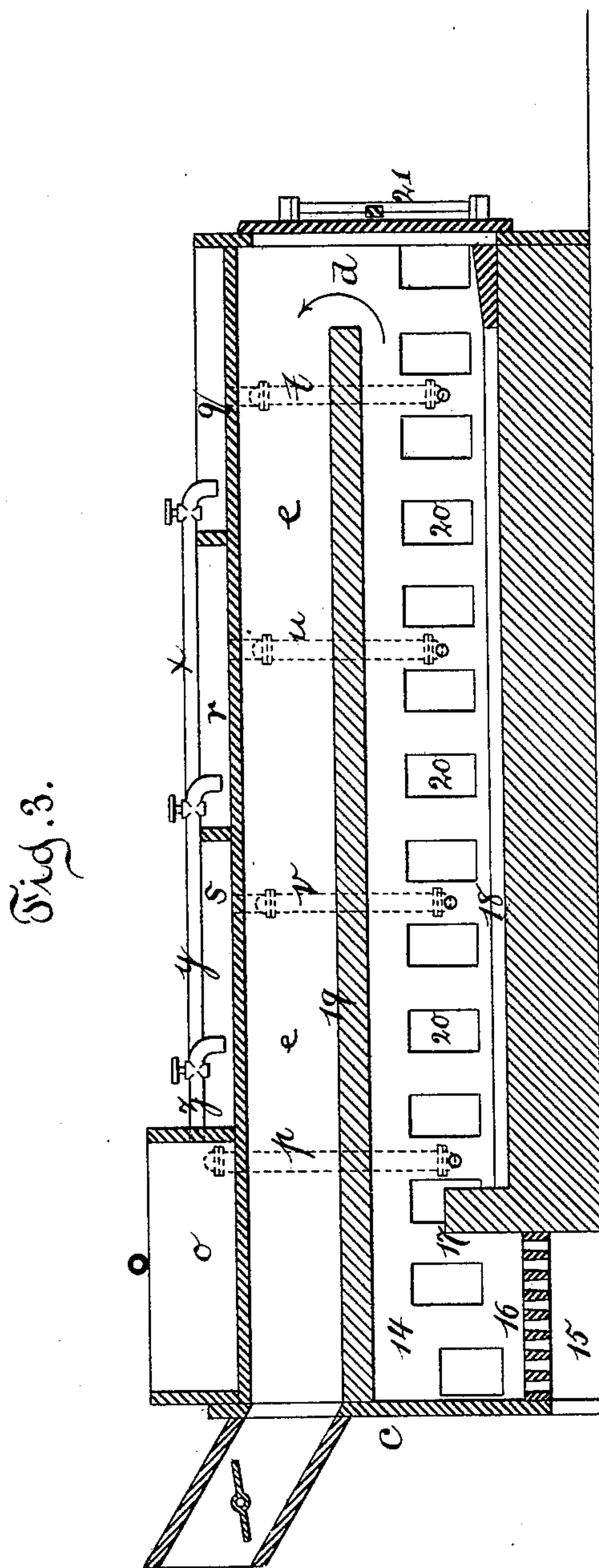
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UNITED STATES PATENT OFFICE

MARTIN NIXON, OF PHILADELPHIA, PENNSYLVANIA.

IMPROVEMENT IN APPARATUS FOR EVAPORATING AND CALCINING ALKALINE SOLUTIONS.

Specification forming part of Letters Patent No. **218,056**, dated July 29, 1879; application filed April 26, 1879.

To all whom it may concern:

Be it known that I, MARTIN NIXON, of Philadelphia, in the State of Pennsylvania, have invented certain new and useful Improvements in Evaporating and Calcining Alkaline Solutions; and that the following is a specification thereof, reference being had to the accompanying drawings, having letters and figures marked thereon, in which—

Figure 1, Sheet 1, is a plan of my combined heating apparatus, concentrator, and calcining-furnace. Fig. 2, Sheet 2, is a longitudinal section of the heating apparatus and concentrator, taken through the dotted line 23 23 of Fig. 1. Fig. 3, Sheet 3, is a longitudinal section of the calcining-furnace, taken through the line 24 24 of Fig. 1. Fig. 4, Sheet 3, is a side elevation of a portion of the calcining-furnace; and Fig. 5, Sheet 3, is a cross-section of the heating apparatus, taken through the line 25 25 of Fig. 2.

This invention is particularly intended for alkaline solutions resulting from the manufacture of paper-pulp from wood and other substances requiring like treatment.

Its principle is the rapid and economical evaporation of such solutions and recovery of the alkali contained in them by causing the solution to circulate between a concentrator and heating apparatus, whereby it is evaporated to a viscid state before transferring it from the concentrator to a reverberatory furnace, in which it is readily calcined and the recovery of the alkali is completed.

I will proceed to describe the best mode in which I have contemplated practicing my invention.

The solution, after the treatment of the wood or other substance, is admitted by the pipes 22 into the reservoir *f*, from which it is forced through the pipes *h h*, connected with the pump *g*, into the open concentrator or evaporating-vat *a*, in quantity sufficient after evaporation to complete one charge of the calcining-furnace.

The solution in the concentrator *a* is forced to circulate between the concentrator *a* and the heating apparatus *b* by means of the pumps *k k*, connected with the pipes *i i*, leading from the lower part of the concentrator, and with the pipes *j j*, leading into the lower hollow trun-

nions, 4 4, of the heating apparatus, and the pipes *l l*, leading from the upper hollow trunnions, 5 5, of the heating apparatus into the open concentrator *a*, and terminating in perforated nozzles *m m* above the surface of the solution in the concentrator.

The heating apparatus *b* consists of two series of tubes, 1 1, secured in perforated end plates 2 2 2 2, to which are bolted hollow convex heads 3 3 3 3, having hollow protruding trunnions 4 4 5 5. These tubes are set in an inclined position above fire-places 6 6, and inclosed in brick-work.

The doors 7 7 of each fire-place are below the upper trunnions, 5 5, and the hot gases from the fire, after passing up between the tubes of each series, are led by the forked pipe 8 through the concentrator before entering the smoke-stack, in order to conduct their heat to the solution in the concentrator.

Each system of tubes is rotated by worm-gear 9 9, actuated by pulleys 10 10, secured to shaft 11, supported between the lower heads of the tubes and the pumps *k k*, and the two trunnions of each system revolve on anti-friction rollers turning on journals 12 12, secured to the brick-work.

A side door, 13, opens into the interior of the brick-work. The pipes *j j* are packed steam-tight in the trunnions 4 4 5 5, and other details of construction will be readily understood from the drawings.

By employing this system of heating apparatus the solution is forced to pass from within the lower heads in many divided streams through the tubes, and is also continually changing its location therein with relation to the upward current of hot gases from the fire beneath the rotating tubes, and thereby the solution is rapidly raised to a high temperature.

This system is also attended with the advantages that it is readily cleaned by forcing water instead of the solution through the tubes, and that the interior of the tubes may be readily laid open to view by unbolting the heads 3 3, should any incrusting of the solution in the tubes be apprehended; and it is evident that one or more rotary heaters may be employed according to my invention.

The highly-heated solution, upon its ejection through the perforated nozzles *m m*, flashes

into steam or falls in fine jets, and a violent ebullition is kept up in the solution, causing its rapid evaporation in the concentrator during the circulation of the solution from the concentrator to the heating apparatus, and thence around to the concentrator again.

This circulation is continued for about six hours, or until the solution is evaporated to a thick or viscid state, but sufficiently liquid to allow it to flow, as the most convenient mode of removing it from the concentrator *a* to the calcining-hearth 18.

The concentrator and its heating apparatus may be worked continuously, and by their use the solution is evaporated simultaneously with the calcination of the charge in the recovery-furnace.

The concentrated solution is conducted from the concentrator *a* to the calcining-furnace *c* through the pipe *n*, leading from the concentrator to the tank *o*, and thence through the pipe *p*, leading from the tank *o* to the calcining-hearth 18, and admitting the solution to the hearth 18 just beyond the bridge-wall 17 of the calcining-furnace. This furnace has the ordinary fire-chamber 14, with ash-pit 15 and grate 16, appended to which are the fan-blower *w* and pipe *x* for introducing a blast of air, the bridge-wall 17, the hearth 18, of concave form, made of specially hardened brick and set in an iron pan to prevent any possible leakage from the hearth, the brick arch 19, and numerous side doors, 20, through which the mass on the hearth is stirred or worked over and under during the calcination, and removed when the calcination is finished. It is also constructed with vertical and longitudinal flues *d e*, formed by the extension of the furnace beyond the hearth 18 at the end opposite to the fire-place, and by the top of the arch 19 and fire-chamber 14, and by the bottom of tank *o* and pans *q, r*, and *s*, set side by side in line with tank *o*, and secured, together with tank *o*, to the brick-work carried up above the arch 19 and fire-chamber 14. The smoke-stack extends from the longitudinal flue *e* between the fire-chamber 14 and the tank *o*, while doors are provided at the opposite end of the furnace, by means of which the whole hearth 18 and flues *d e* may be exposed to view.

By the introduction of the flues *d e*, tank *o*, and pans *q, r*, and *s*, connected severally with tank *o* by the pipes *x, y*, and *z*, and with the hearth 18 by pipes *t, u*, and *v*, the heat of the gases passing from the fire and hearth 18 is availed of to evaporate still further the concentrated solution contained in the pans and tank before subjecting it to calcination. The hearth being empty, the fire of the calcining-furnace is cleaned, which requires about an hour and a half. The valves are open in pipes *n* and *p*, and the concentrated solution in a highly-heated state flows from the concentrator *a* and tank *o* into the hearth 18 of the

calcining-furnace during the cleaning of the fire and for about four hours longer, until the hearth is full. The valves in pipes *n* and *p* are then closed, and shortly afterward—about three-quarters of an hour—the valve in pipe *t* is opened, and in about a quarter of an hour the contents of pan *q* are emptied into the hearth 18. After another period of three-quarters of an hour the valve in pipe *u* or *v* is opened, and in another quarter of an hour pan *r* or *s* is emptied into the hearth 18.

The addition of the contents of two pans, *q* and *r* or *s*, to the mass in the hearth completes one charge of the calcining-furnace, and as more heat is derived by pan *q* from the hot gases passing through flue *e* than by pan *r* or *s*, pan *q* is emptied at every charge of the hearth 18, and pans *r* and *s* are emptied at alternate charges thereof. The pans *q, r*, and *s* and tank *o* are charged as soon as emptied from the concentrator *a*. When the second pan, *r* or *s*, is emptied the side doors, 20, which have hitherto remained closed, are opened, and the mass on the hearth 18 is stirred until the calcination is finished and the black ash removed, which occupies about four hours and a half. Accordingly one charge of the calcining-furnace is recovered every twelve hours.

In a paper-mill producing, for example, eleven thousand pounds of wood-pulp, dry weight, every twenty-four hours, and requiring for the treatment of the wood fourteen thousand pounds of ash, of which eighty-five per cent. is recovered ash, it is necessary to recover about twelve thousand pounds of ash during every twenty-four hours. This may be done economically by my method.

Having thus described my invention, what I claim, and desire to secure by Letters Patent, is—

1. An evaporating-vat adapted to contain the solution, an outlet-pipe connected with a force-pump, and an inlet-pipe, in combination with one or more rotary heaters, consisting of tubes, hollow heads, and trunnions communicating with said outlet and inlet pipes, whereby the solution is caused to circulate, and is heated during circulation in divided streams, substantially as described.

2. The combination, substantially as set forth, of two separate furnaces, an intermediate evaporating-vat connected with both furnaces, one of which contains a calcining-hearth, and the other a rotary heater, constructed as described, and a force-pump, whereby the solution is forced to circulate between the vat and the heater before passing from the vat to the other furnace, the whole being adapted to evaporate the solution and recover its alkali, substantially as described.

MARTIN NIXON.

Witnesses:

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JOHN STANDFAST.