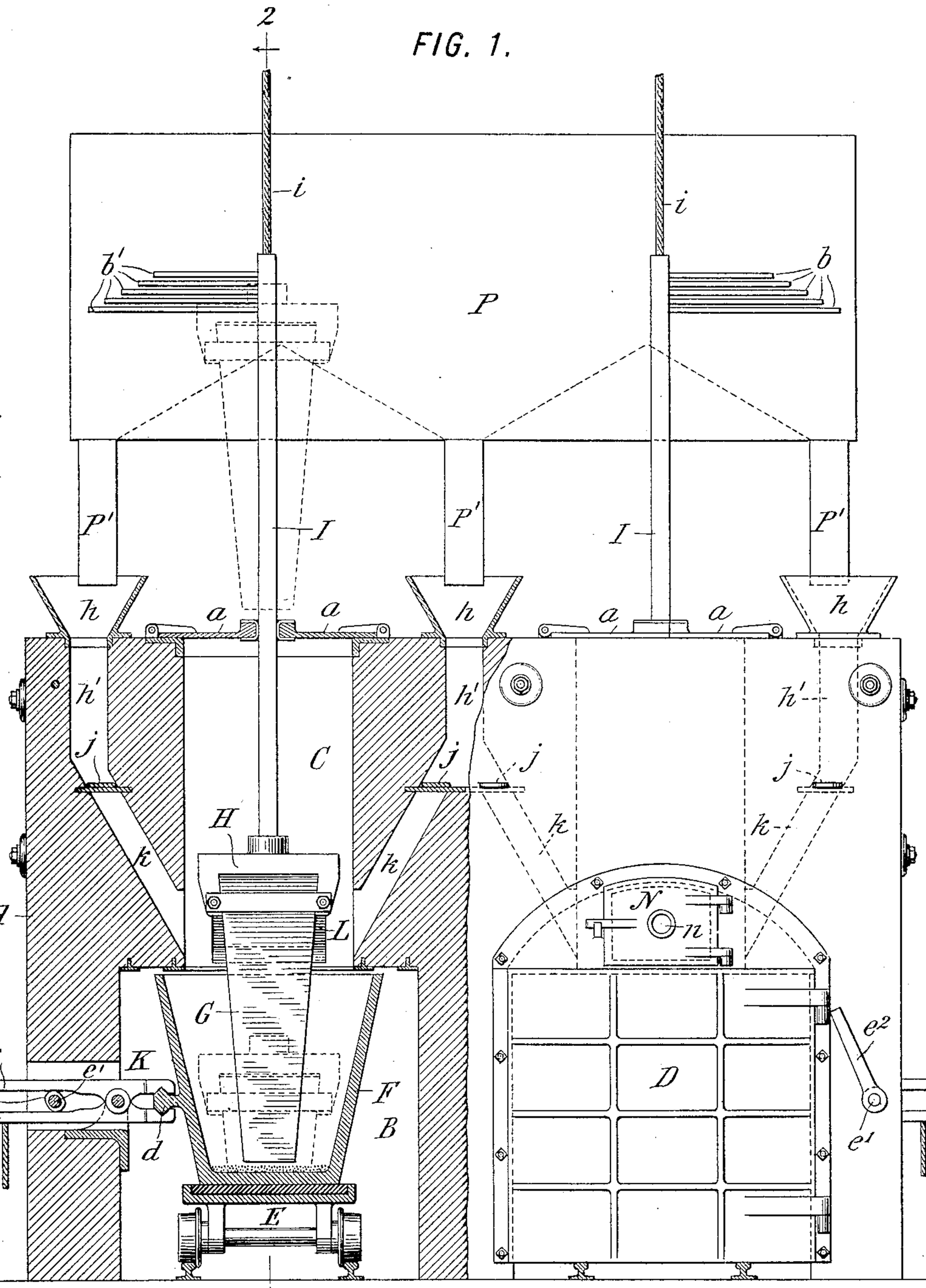
(No Model.) 5 Sheets—Sheet 1.

T. L. WILLSON.

ELECTRIC FURNACE.

No. 597,476. Patented Jan. 18, 1898.

FIG. 1.



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2

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(No Model.) 5 Sheets—Sheet 2.

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FIG. 2.

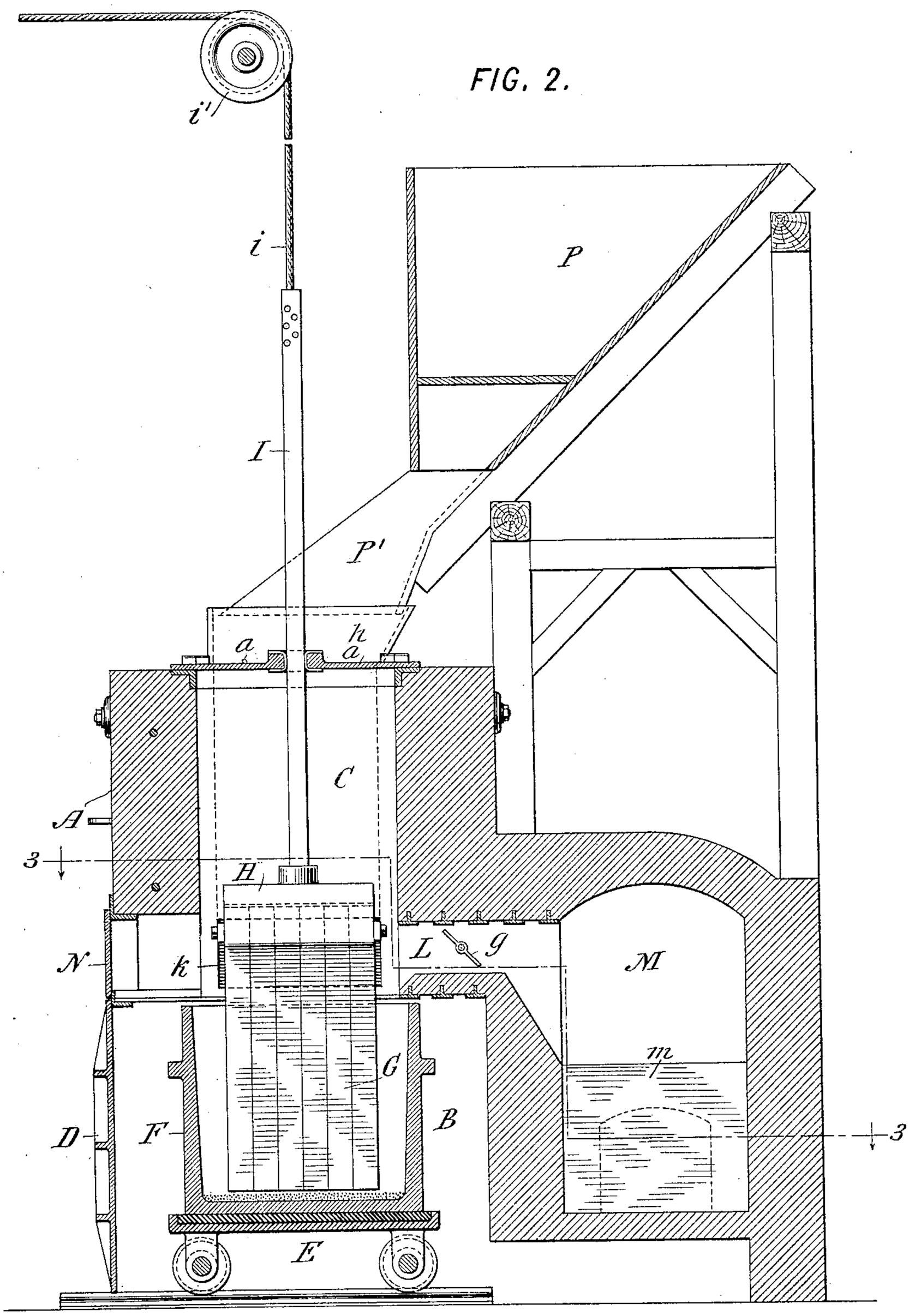

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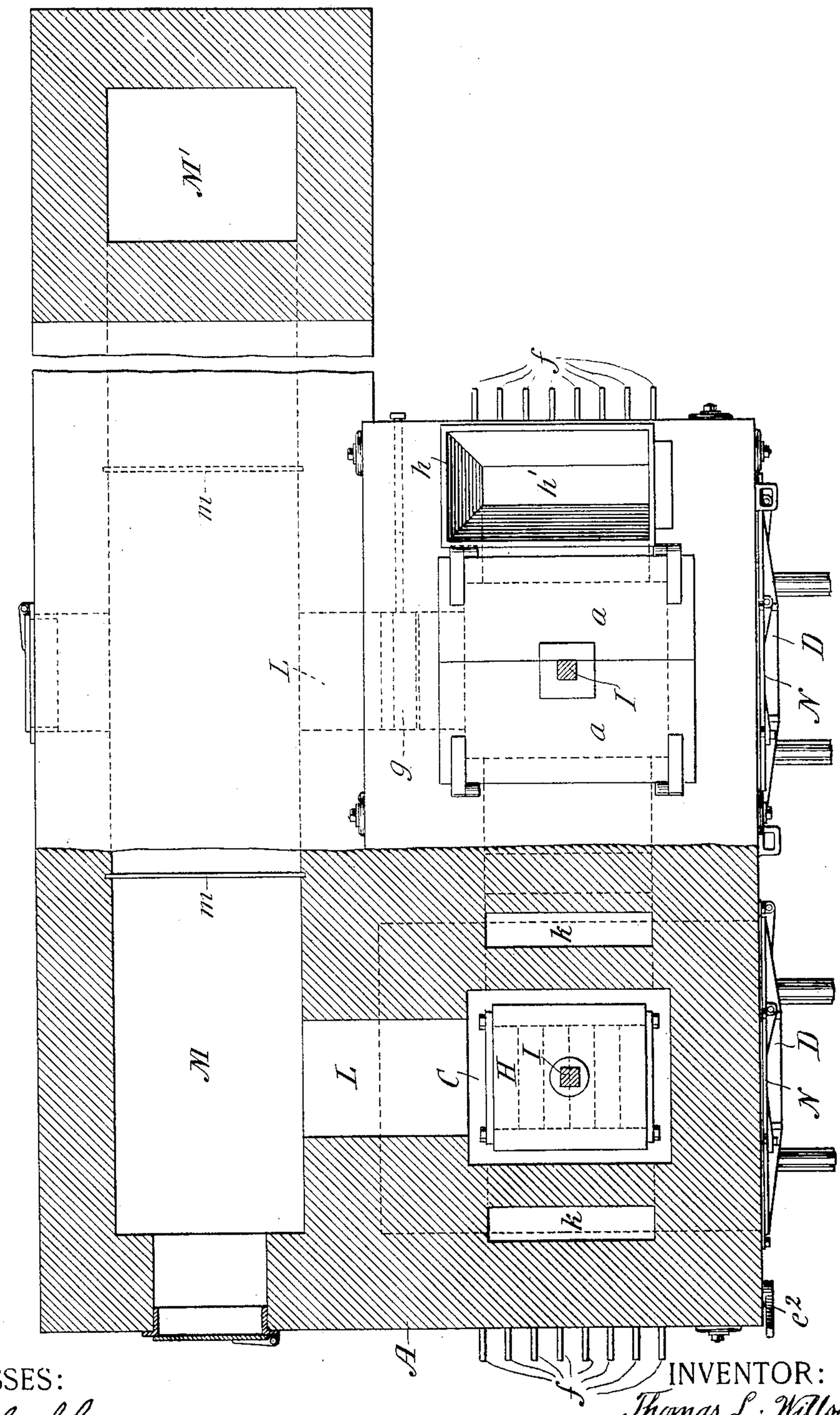
FIG. 3.



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ELECTRIC FURNACE.

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FIG. 4.

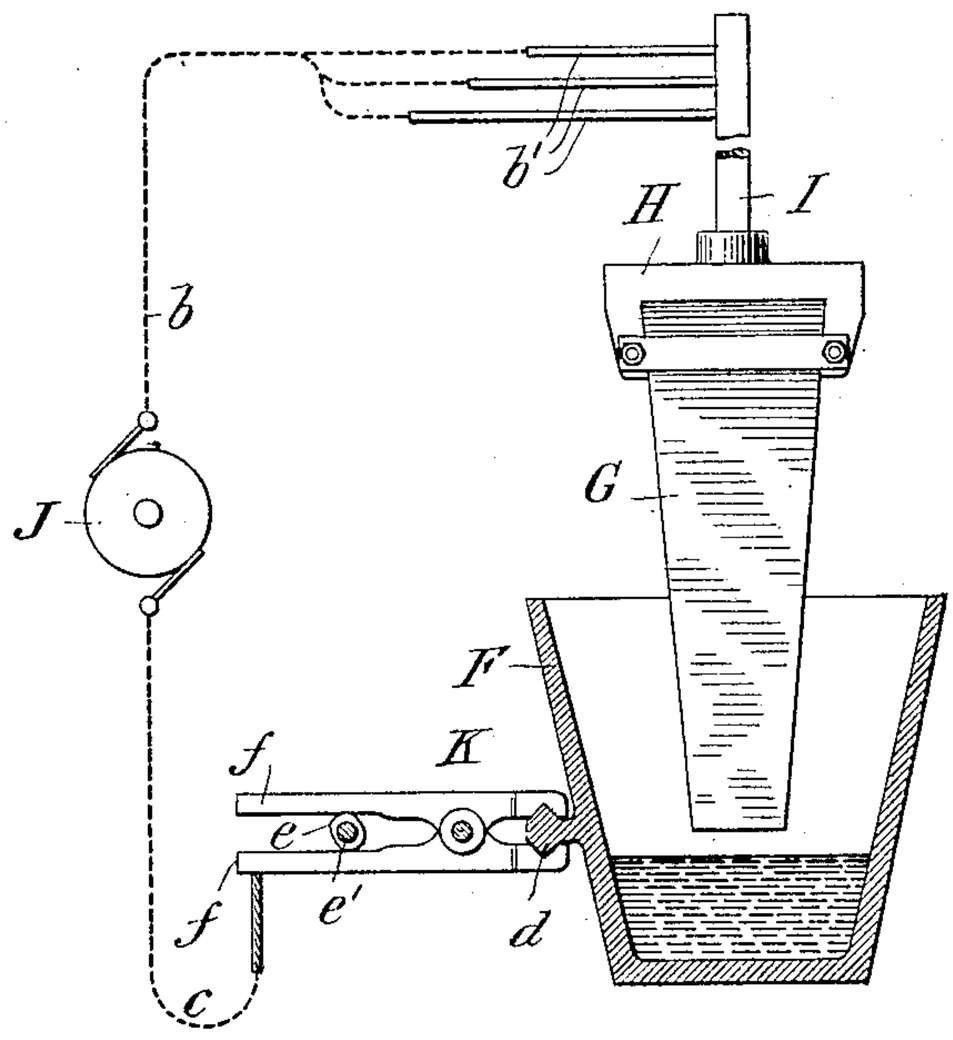
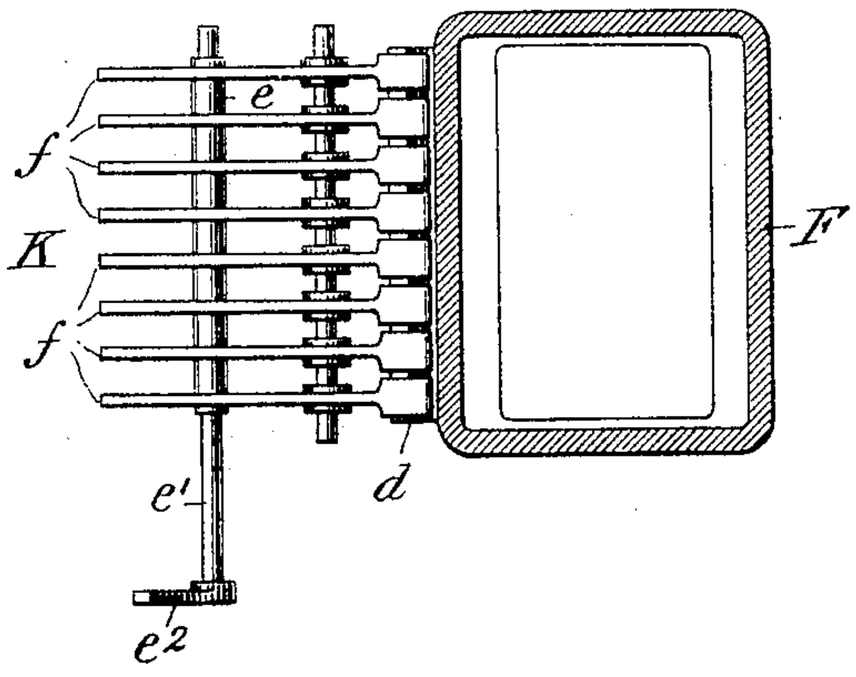


FIG. 5.



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(No Model.) 5 Sheets—Sheet 5.

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ELECTRIC FURNACE.

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FIG. 7.

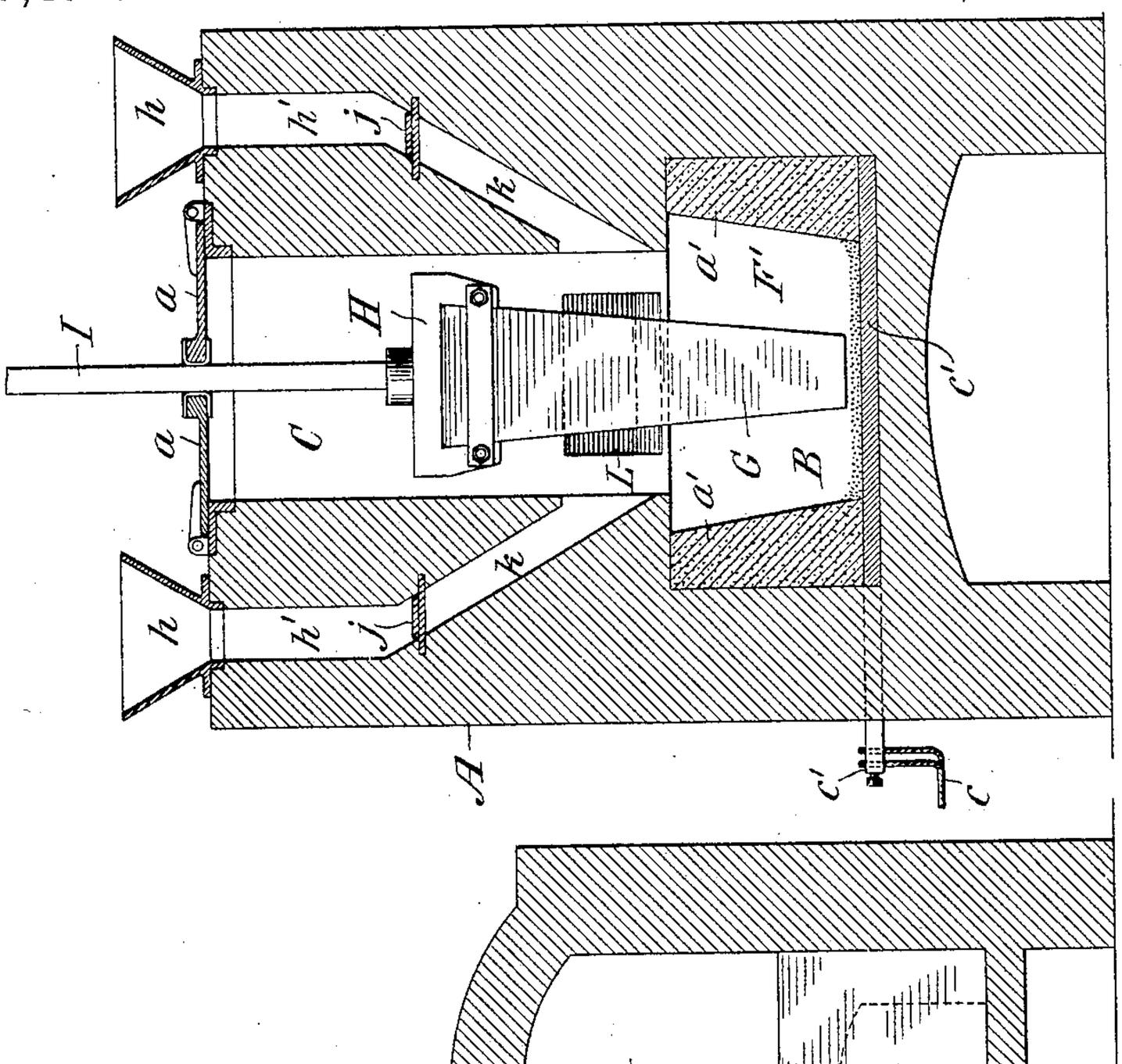
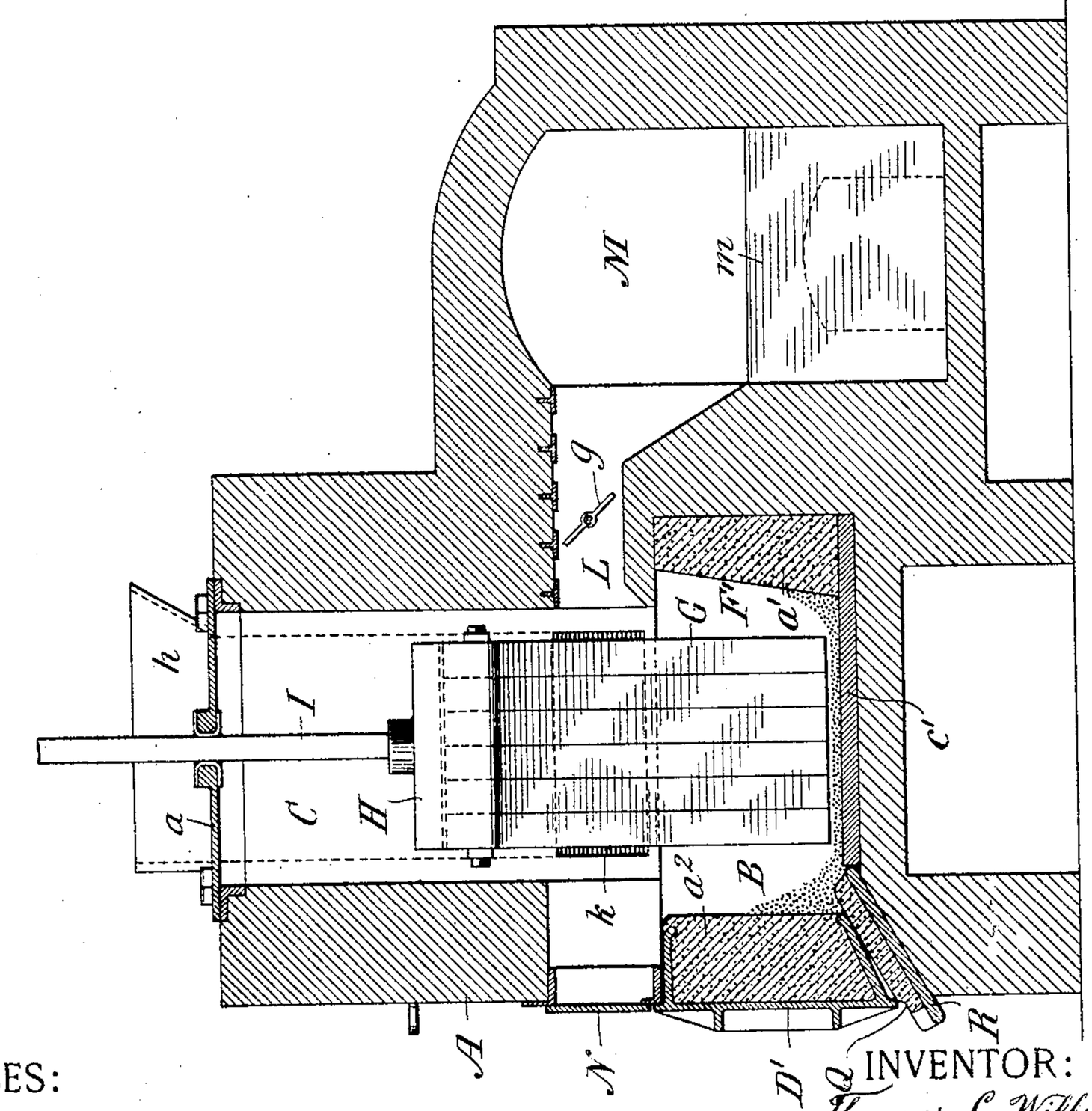


FIG. 6.



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Arthur G. Fraser & Co.

UNITED STATES PATENT OFFICE.

THOMAS L. WILLSON, OF NEW YORK, N. Y., ASSIGNOR TO THE ELECTRO GAS COMPANY, OF SAME PLACE.

ELECTRIC FURNACE.

SPECIFICATION forming part of Letters Patent No. 597,476, dated January 18, 1898.

Application filed November 15, 1895. Serial No. 569,071. (No model.)

To all whom it may concern:

Be it known that I, THOMAS L. WILLSON, a citizen of the United States, residing in the city, county, and State of New York, have invented certain new and useful Improvements in Electric Furnaces, of which the following is a specification.

This invention relates to electric furnaces and their accessories, the same being especially designed and adapted for electrometallurgical reductions—such, for example, as the production of calcium carbid by the electric smelting of lime and carbon.

The accompanying drawings show the preferred embodiment of my invention as applied to a pair of furnaces, the number of furnaces which can be assembled in a series or bench being variable at will.

Figure 1 is a front elevation of one furnace of the pair and a vertical mid-section of the other furnace. Fig. 2 is a vertical transverse mid-section on the line 2 2 in Fig. 1. Fig. 3 is a plan, partly in horizontal section, in the plane of the line 3 3 in Fig. 2. Figs. 4 and 5 are detail views. Figs. 6 and 7 are vertical sections of a modification.

Let A designate the brickwork or bench of the furnace or furnaces. This for each furnace is built to form a furnace-chamber B beneath, with a somewhat smaller chamber C, which I may call a "pencil-chamber," above it, this chamber being closed, if desired, by trap-doors or lids *a a* on top, and the chamber B being closed, if desired, by a large door D, of iron or other material, in front. Experience, however, has demonstrated that it is preferable to leave the front and top open. Either a portable crucible may be used to contain the material being smelted, as shown at F in Figs. 1 to 7, or a stationary lining may be provided for the furnace-chamber, constituting it a hollow hearth, reaction-chamber, or cupola, as shown at F′ in Figs. 6 and 7. In the former case a track is preferably laid extending into the chamber B, on which track may roll a car E, carrying the crucible F. This crucible may be simply a cast-iron pot, as shown, or, if preferred, it may be lined with suitable material, as carbon or graphite. The proportions are such that the top of the crucible comes close beneath the top of the chamber B, only just enough clearance being provided to enable the crucible-car to be rolled in and out.

The carbon pencil G of the furnace is constructed, preferably, of a series of slabs of carbon placed together face to face and held in a conducting holder or clamp H, which is carried on the lower end of a vertically-movable adjusting rod or stem I, which is hung in any suitable manner admitting of its being raised and lowered in order to regulate the length of the arc. It is shown as being hung by a wire rope or chain *i*, carried over a pulley *i′* to any suitable windlass or other adjustable connection by means of which the chain may be taken up or paid out at will. The rod I and the hole through which it passes are preferably square to keep the pencil from turning.

The furnace-hearth or crucible and the carbon pencil are connected to opposite poles of a dynamo, which may be either a continuous current or alternating dynamo, or if an alternating current is employed they may instead be connected to a transformer. These connections may be made in the manner shown in Fig. 4, where J designates the dynamo and *b c* the conductors leading from the poles thereof and connecting the former to conducting-rods *b′*, projecting from the carbon-carrying rod I, and the latter to a contact-clamp K, which connects with a flange *d*, formed on the side of the crucible. This clamp affords a very effective means for making a good connection with the crucible, the clamp being made up of several opposite levers or tongs *f f*, (see Fig. 5,) pivoted together, as shown in Fig. 4, and having tails, between which acts an eccentric or spreader *e*, by which to force the tails apart and thereby bring the clamping-jaws together to grip the flange *d* between them. The spreader *e* is mounted on a shaft *e′*, to which, on the exterior of the furnace, is connected a handle e^2, by which to turn it. The several transverse arms *b′* on the rod I admit of the subdivision of the conductor *b* into several flexible strands, which may be connected to the respective arms with slack enough to permit of the required extent of vertical movement of the rod I.

The carbon pencil G as it is raised or low-

ered moves freely in the chamber C, which is made high enough to admit of the pencil being lifted entirely out of the crucible in order to permit of the latter being run out of the furnace-chamber and replaced by an empty one which may be run in, or the carbon pencil may be lifted entirely out of the chamber C and elevated to the height shown in dotted lines in Fig. 1. The carbon-holder is moved to this position when it becomes necessary to fit it with a fresh carbon pencil. The chamber C is provided chiefly for the purpose of inclosing the carbon pencil and permitting it the requisite movement. From the lower part of this chamber there extends a flue L, which opens into a large settling-chamber M, which chamber extends back of the row or bench of furnaces, as shown in Fig. 3, and communicates with a chimney or stack M′ at any convenient location. This chimney affords sufficent draft to carry off from the furnace through the flue L and chamber M any gases, smoke, or fumes that may be generated during the smelting operation. Where two or more furnaces communicate with the same chamber M, each flue L is provided with a valve or damper *g*, by which to close it when the furnace is out of operation.

The settling-chamber M is for the purpose of depositing any dust or powder that may be carried over from the furnace by the draft, and for this purpose the lower part of the chamber is subdivided by partitions *m m* at intervals in order to afford pockets or dead-spaces into which the powder may fall. The flues L open into the upper part of the chamber M, which extends thence a considerable distance downwardly in order that the draft or current of gases may be confined almost wholly to its upper part, while the lower part is free from currents to permit the powder or dust to settle undisturbed. For giving access to the lower part of the chamber C an arch or opening is formed in the front of the brickwork, this opening being closed by an iron door N at the front, which door may have a hole *n*, through which to inspect the operation or through which a poker may be thrust.

For feeding the material to be smelted to the furnace I provide a large bin or hopper P above, into which a suitable mass of the material may be deposited, and from the bottom of this bin extend inclined discharge-chutes P′ P′, terminating over the furnace-bench, one on each side of each furnace. They open over hoppers *h h*, from which flues *h′* extend downwardly in the brickwork. Each of these flues is closed by a transverse slide *j*, working through a slot in the brickwork and extending to the front, where it has a handle by which it may be operated. Beneath the slide each flue is carried down obliquely, as indicated at *k*, there being then over each furnace two of these sloping flues *k k*, which enter the bottom part of the chamber C on opposite sides thereof, as shown in Fig. 1. The material to be smelted, which in the case of making calcium carbid is powdered lime and carbon intermixed in suitable proportions, descends from the bin P and fills the chutes P′ and flues *h′*, and when the slides *j* are opened a quantity of the material falls through the inclined flues *k* directly into the crucible F or hearth F′ at each side of the carbon pencil G. The introduced material by thus entering the sides of the crucible avoids obstructing the flue L or impeding the flow of gases to this flue.

In the operation of the furnace the carbon-holder H is first fitted with sufficient carbon slabs to build up a pencil of the required size, and the pencil is lowered into the chamber C, whereupon these doors are closed. The main door D being open, a car E, carrying the crucible F, is rolled into the chamber B, and the door may then be closed. The tongs or jaws of the clamp K are then closed upon the flange of the crucible, and thereby connect the crucible in the circuit. The dynamo being in operation, the pencil G is then lowered until its lower end touches the bottom of the crucible F and completes the circuit. To protect the crucible from burning by the arc that is thus formed, it is preferable to cover its bottom with a layer of an inch or so of carbon. By opening the slides *j j* a suitable quantity of the material to be reduced is caused to fall into the crucible on each side of the carbon pencil. The furnace is fed in this manner at intervals, and whenever necessary the carbon pencil should be raised a little in order to properly maintain the arc. The smoke and gases that are formed, principally CO_2 and CO, pass out through the flue L and chamber M to the chimney, any of the powdered material with which the crucible is charged which may be carried over or blown out from the furnace being caused to settle and collect on the bottom of the chamber M, whence the accumulated material may be removed at suitable intervals. The material which is reduced accumulates on the bottom of the crucible and gradually builds up as a pool or bath, which in the case of calcium carbid is a sufficiently good conductor to carry the current, the arc passing between its surface and the pencil G and the unreduced material floating on the surface of the molten mass. The operation is continued, the carbon pencil being gradually raised as the level of reduced material rises, until the crucible is sufficiently full, whereupon the introduction of fresh material is stopped, the carbon pencil is lifted out of the crucible into the chamber C, the clamp K is released, and the crucible-car is rolled out.

When practicable, the molten material may be dumped out from the crucible or tapped out; but in the case of calcium carbid and similar materials having an exceptionally high melting-point the better practice is to permit the material to partly cool in the crucible, when it may be readily dumped out. Immediately on removing one crucible from the

furnace a new one is wheeled in and the operation recommenced. As the carbon pencil wears away it is lowered sufficiently to compensate therefor until finally toward the end of its service its holder may be lowered quite into the crucible, as indicated by dotted lines in Fig. 1. When worn down as short as practicable, the carbon-holder should be recharged with new carbon slabs.

The furnace thus far described is designed for use with a portable crucible or hollow hearth in which the smelting operation is conducted. In Figs. 6 and 7 is shown a construction wherein the hollow hearth is stationary, being built fixedly into the furnace. The hollow hearth or cupola F′ is here constructed with an iron bottom plate c', to which the conductor c connects, and with side walls or linings a', of carbon, molded around the interior of the furnace-chamber B formed in the masonry. The door D′ has a slab a^2 of carbon, lime, or other suitable material to protect it from the heat and close the front of the chamber. These linings, however, are not essential, as a brick chamber B with an iron plate to conduct the current will serve the purpose if sufficient of the pulverized material being reduced is supplied to protect the walls. Broadly, any furnace-chamber having means for conducting the current to the arc will serve the essential purposes of a crucible. In the construction here shown the reduced material, if of sufficiently low melting-point to make it feasible to tap it out, may be run off through a tap-spout R by first removing the slab or plug Q which closes this spout; but in smelting a material having a melting-point so high that it would be liable to solidify in the spout and choke it the better practice is to permit the reduced product to cool and solidify in the furnace, then open the door D′, loosen the mass by poking away the granulated carbon around it, and then seize it with hooks and pull it out from the furnace onto a car or truck, which takes it to a place where it is dumped to cool.

I claim as my invention the following-defined novel features, substantially as hereinbefore specified, namely:

1. The combination in an electric furnace of a furnace-chamber having a hearth, an upright movable carbon pencil, an upright chamber adapted to wholly inclose said pencil in its movements, and a feeding-flue discharging into the lower part of said upright chamber at one side thereof, whereby material dumped through said flue falls into the furnace-chamber against the side of the carbon pencil, and an outlet-flue leading from the furnace.

2. In an electric furnace, the combination with the stationary bench thereof of the movable crucible having an exterior projecting flange, and an electric contact device consisting of a clamp K mounted on said bench and having arms or tongs pivoted together, with gripping-heads at one end to engage said flange, and means for acting on said arms to cause the clamp to grip the flange.

3. In an electric furnace, the combination with the crucible having flange d, of a contact device consisting of a clamp K comprising a series of upper and lower levers f f pivoted together, a cam e for simultaneously actuating said levers to cause them to grip said flange, and a shaft and handle for oscillating said cam.

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

THOMAS L. WILLSON.

Witnesses:
CHARLES K. FRASER,
GEORGE H. FRASER.