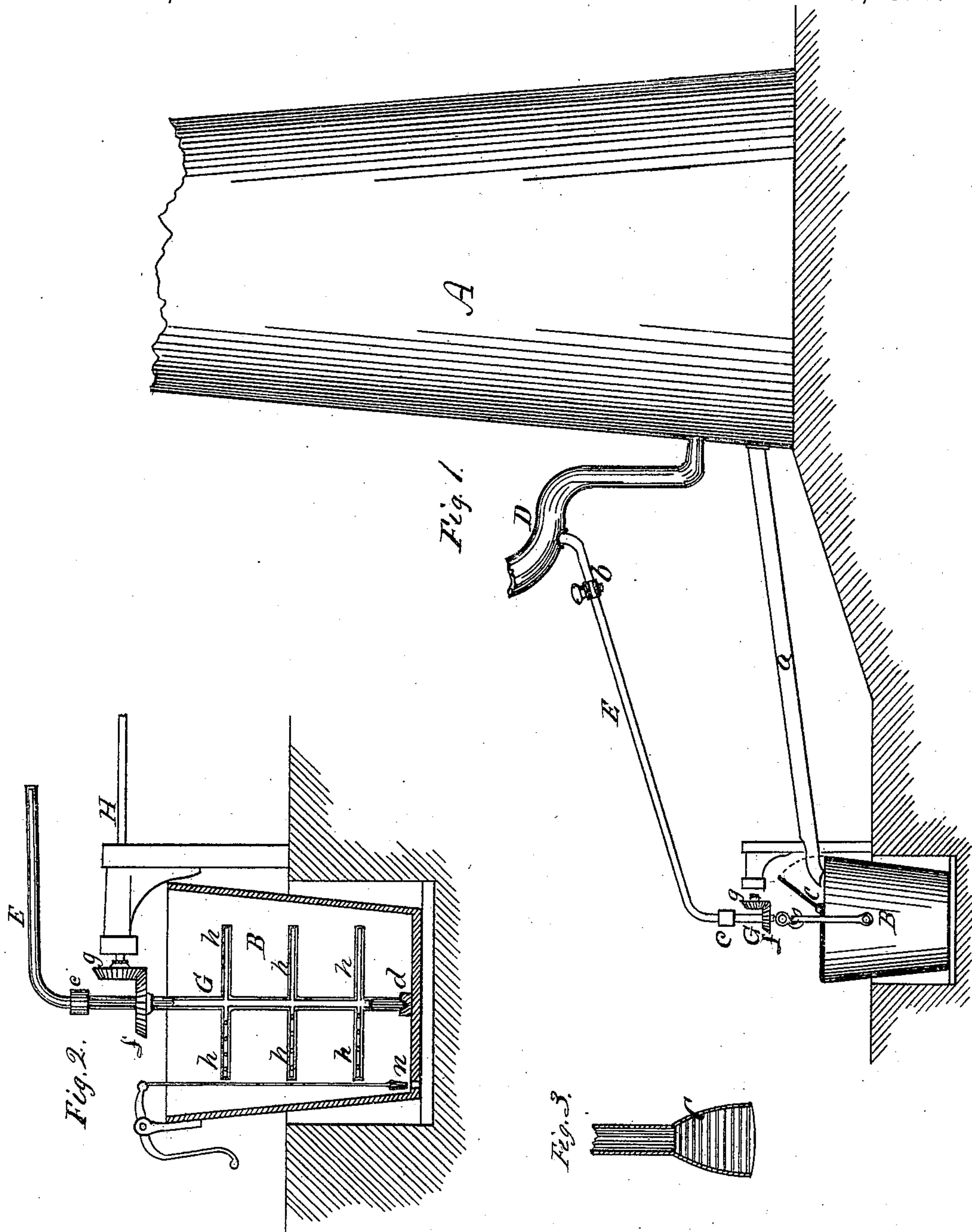


F. A. LUCKENBACH.

Method and Apparatus for Treating Furnace-Slag.

No. 133,466.

Patented Nov. 26, 1872.



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Fig. 4.

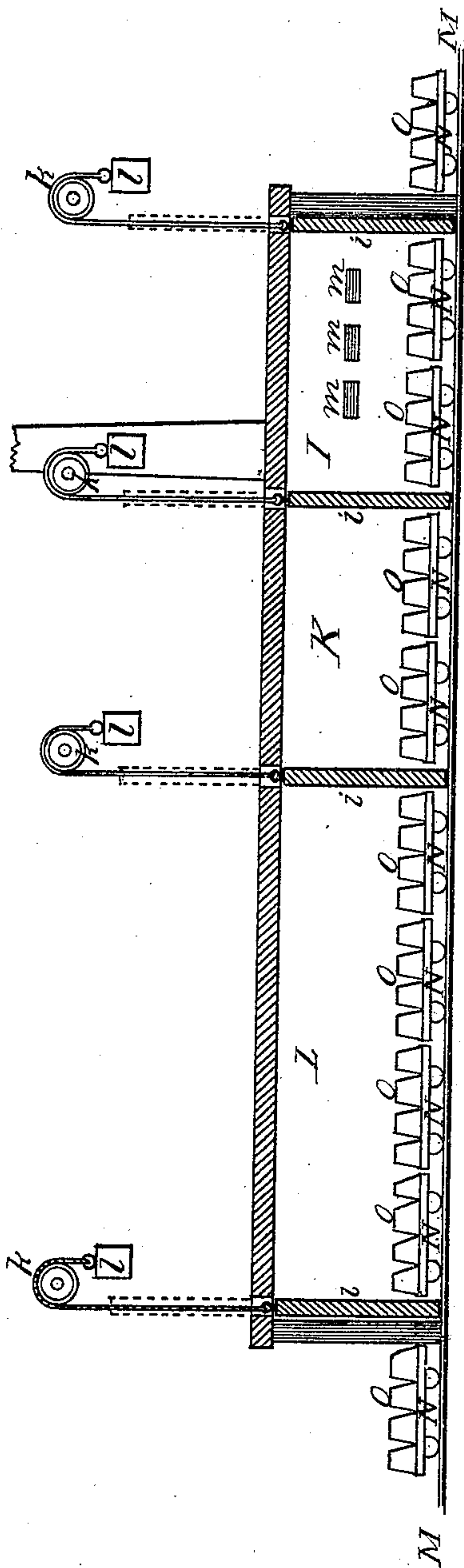


Fig. 5.

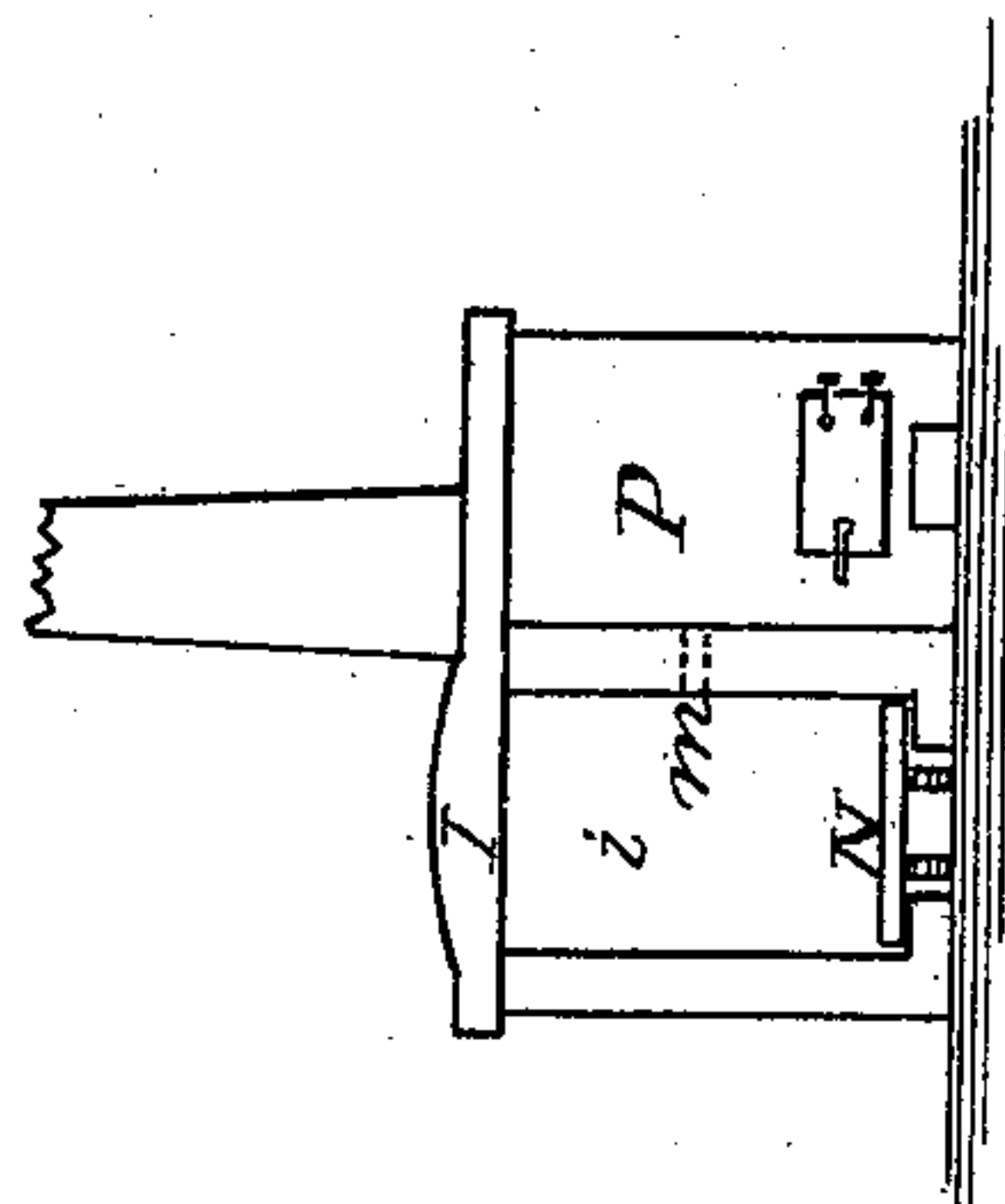
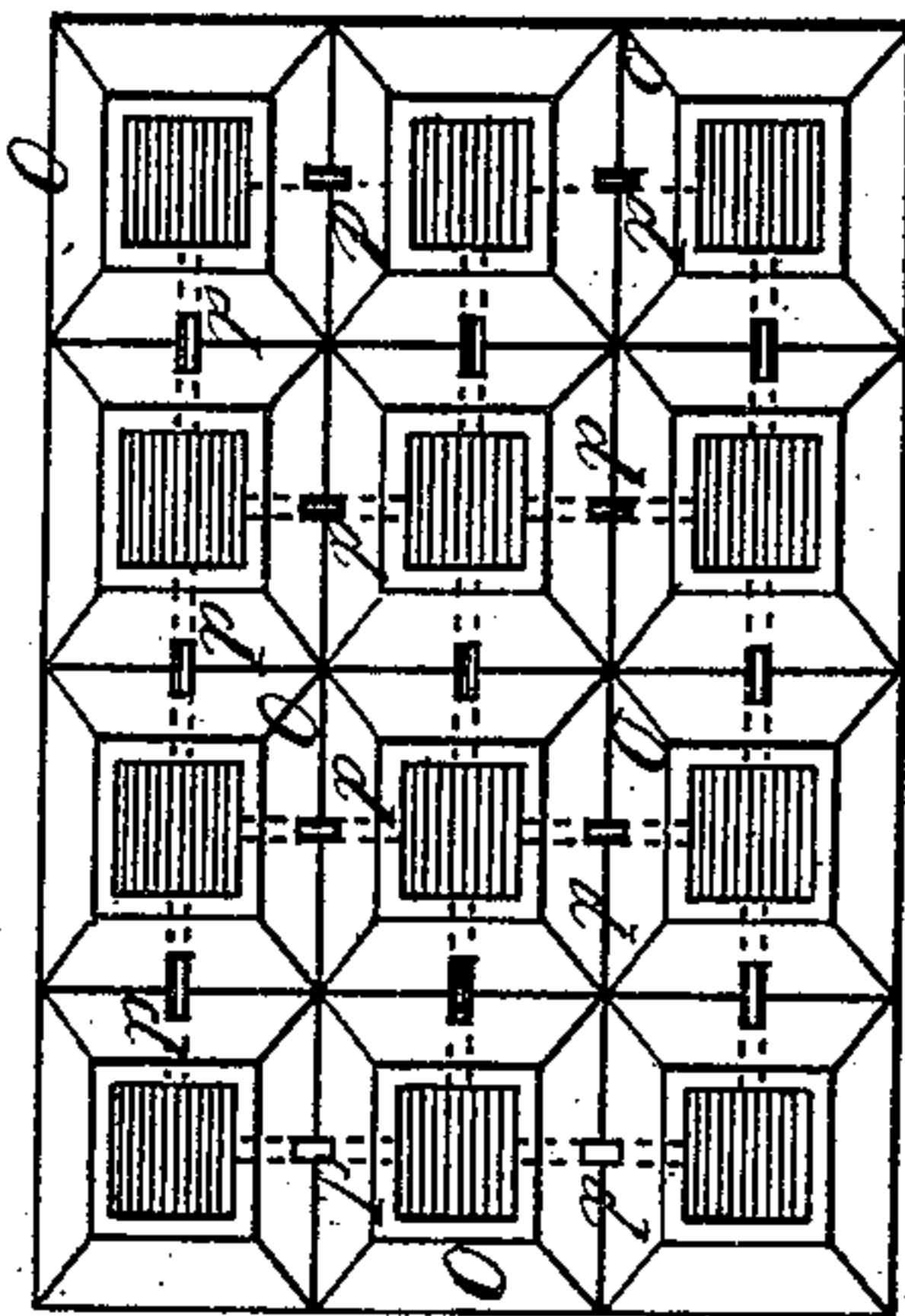


Fig. 6.



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UNITED STATES PATENT OFFICE.

FREDERIC A. LUCKENBACH, OF NEW YORK, N. Y.

IMPROVEMENT IN THE METHODS AND APPARATUS FOR TREATING FURNACE-SLAG.

Specification forming part of Letters Patent No. 133,466, dated November 26, 1872.

To all whom it may concern:

Be it known that I, FREDERIC A. LUCKENBACH, of the city, county, and State of New York, have invented improvements in the method and apparatus for treating furnace-slag, and converting it into blocks for pavements, buildings, constructing docks and piers, and other analogous uses; and I do hereby declare that the following is a full and exact description thereof, reference being had to the accompanying drawing making part of this specification—

Figure 1 being a side elevation of a furnace from which the melted slag is drawn, together with a ladle in position for drawing off, and an agitator for treating the slag preparatory to pouring it into the molds; Fig. 2, a central vertical section of the ladle and agitator on a larger scale; Fig. 3, section of a spreader upon which the slag impinges as it flows into the ladle; Fig. 4, a longitudinal, vertical section of an improved oven in which the slag is molded into blocks and prevented from cooling too rapidly, showing also the railway track upon which the mold-trucks are moved through the oven; Fig. 5, a front-end view of the oven; Fig. 6, a top view of a set of molds as arranged for receiving the slag.

Like letters designate corresponding parts in all of the figures.

In the processes heretofore adopted or attempted for converting iron furnace-slag into blocks or molded forms for paving, building, and other similar uses, serious difficulties have been encountered, which have prevented the realization of successful or profitable results. These difficulties have arisen from three principal causes: first, the presence of sulphur and other impurities which—in various proportions, according to the character of the ores, limestone, and fuel employed in the smelting-furnace—accompany and are absorbed by the silica, alumina, and lime that constitute the principal ingredients of the slag; second, molds made of cast-iron, which, being a quick conductor of, too rapidly absorb, the heat from the liquid slag coming in contact therewith, and consequently seriously affects the blocks of slag by forming a glassy, brittle surface thereon, and rendering them unfit for practical use; third, the intense heat of the slag when first drawn from the

furnace, 3000°, more or less, and its pressure upon the iron, softening the molds, so that they lose their proper shape, by expansion, and become useless.

My present improvements are for the purpose of overcoming these difficulties, so as to successfully produce blocks of very superior quality for the purposes herein designated.

In order to expel the sulphurous impurities from and purify the slag, I cause it to be thoroughly agitated while in its most liquid condition directly after drawing it from the furnace. For this purpose, while the slag is flowing from the furnace, or directly after it has run into the ladle, I introduce into and force through it a strong current of air, most conveniently and economically from the hot-blast of the furnace, so as to afford sufficient oxygen to combine with the sulphur and expel it from the slag in the form of a sulphurous gas. The blast also may be charged, if necessary or desired, with fluoric or other purifying acid.

In Figs. 1 and 2 is represented an apparatus by which hot air is forced through the slag for this purpose. Let A represent the furnace from which the melted slag is drawn through a pipe or spout, *a*, into a ladle, B, prepared and arranged to receive it. First, as the slag flows from the pipe or spout into the ladle, it is or may be caused to strike upon and flow over the surface of what I have termed a "spreader," C, shown in section on a larger scale in Fig. 3, and in position Fig. 1. It has a corrugated or roughened surface, as shown in Fig. 3, so as to commingle air with the flowing slag; and it is placed at the end of the spout over the ladle, so that the flowing slag will fall upon it. Then, from the hot-blast pipe D of the furnace, extends a pipe, E, provided with a stop-cock or valve, *b*, to let on the air and regulate its flow through the pipe. It is curved or bent at its outer end, so as to overhang the ladle B vertically and centrally; and it terminates in a bearing, *c*, to receive the upper end of a vertical, straight, revolving tube or hollow shaft, G, which has a step or bearing, *d*, in the bottom of the ladle. This shaft is provided with a bevel-pinion, *f*, into which gears another bevel-pinion or cog-wheel, *g*, on a revolving shaft, H, for rapidly turning the hollow shaft, which has hollow arms or

branch tubes *h h*, suitably perforated, so as to agitate the liquid slag in the ladle, and at the same time distribute the hot air forcibly through it. This revolution of the hot-air distributor continues for a few moments only after the slag is poured into the ladle, which is then conveyed to the oven to pour the slag into the molds. In order to cool the slags slowly in the molds and properly anneal it, so as to render it tenacious and free from the brittle and vitreous quality which ordinarily characterizes blocks molded from slag, I employ a cooling-oven of peculiar construction, as represented in Figs. 4 and 5. It is oblong or tunnel-shaped, and has successive compartments I K L in the direction of its length, through which a railway track, M, extends for the mold-trucks N N to travel on. The compartments are closed at the outer ends, and separated from one another by movable partitions or doors *i i*, which are conveniently closed or opened by being suspended from pulleys *k k* with counter-weights *ll*, so that they may be easily raised and lowered; or any other suitable arrangement may be employed, or even the movable partitions may be dispensed with, and openings between the compartments just large enough to allow the trucks and molds thereon to pass through may be employed; although by such a construction the heat cannot so well be regulated in the several compartments as with the movable partitions or doors. The first or receiving compartment I is required to be heated to about 1800° of heat; and, for the purpose of raising and keeping up the heat to that degree, a heating-furnace, P, is located by the side of it, with openings or flues *m m* leading into it therefrom. The succeeding compartments K L have successively a lower temperature, derived partly from the blocks themselves in the molds, and partly by conveyance from the first compartment I.

The empty molds are first brought into the compartment I upon the trucks, and are heated to the regular temperature of the compartment before filling them with the melted slag. The ladle B, as soon as filled with the slag, and the agitator G has ceased to operate upon the slag therein, is conveyed, by means of a crane or otherwise, directly over the truck containing the molds to be filled. It is constructed with a tap or aperture, *n*, at the bottom, through which a small stream of slag flows directly downward into one of the molds on the truck. The ladle should hold enough slag to fill all of the molds on one truck at one time. In order to accomplish a successful and practical result, I have found that the molds O O must be made of a material or combination of materials that not only can withstand without injury the intense heat of the melted slag, but which also possesses heat non-conducting properties in a very high degree, in order to prevent unequal cooling and irregular molecular arrangement of the slag material while in the molds. For this purpose I make the molds either of fire-clay or of the iron furnace-slag

itself, or of a mixture of the two materials, which possess the requisite qualities to a similar degree, and are analogous in those respects. The molds may have any desired form or pattern, to produce blocks as required. Each truck also has a floor of the same material or materials that forms the bottoms of the molds placed thereon. They are arranged side by side on the truck, contiguous to one another, as indicated in Fig. 6. There are openings *p p* through the adjacent sides of the molds, near the bottom, corresponding to one another in position, as shown in the same figure, so that communications are opened from one mold to all of the others in the set, and the slag, when poured into one of the molds, flows therefrom into all of the other molds, which, being thus filled at the bottom, allow the gases to escape freely upward at the open tops of the molds. The mold-filling compartment I of the oven having received as many trucks of molds as it will hold at once, and the molds therein being filled, the innermost truck is moved forward into the next compartment K, giving place for another truck to be introduced from the outside; and, when the compartment K is filled with trucks transferred from the compartment I, the most advanced truck therein is transferred to the next compartment L, until that is filled, wherein, if that compartment is the last in the oven, the trucks remain until sufficiently cooled to withdraw from the oven. As each truck is advanced to the next compartment another is brought forward from the preceding compartment; or, in case of the compartment I, another empty truck is introduced therein to replace the truck withdrawn therefrom. The cooling-compartments K L together should hold all the trucks of molds filled in twenty-four hours, or longer, if convenient, before the final discharge of the molds from the oven. Thus the entire length of the several compartments of the oven is kept continually filled with trucks loaded with full molds, the operation of introducing trucks of empty molds and withdrawing trucks of molds containing cooled blocks going on one at a time continuously. Any other arrangement may be employed for agitating, and consequently desulphurizing, the slag by the use of air brought in contact with it in its liquid state, so as to accomplish the same result, instead of the agitator G above described.

What I claim as my invention, and desire to secure by Letters Patent, is—

1. In molding blocks from furnace-slag, desulphurizing and purifying by subjecting the liquid slag to the action of a current of air, substantially as and for the purpose herein specified.

2. The agitator G, constructed and operating substantially as described, so as to force a current of air through the liquid slag while agitating it, as herein specified.

3. A cooling-oven divided into separate compartments I K L, respectively, heated to different degrees of temperature inside, to which

the molded blocks are successively subjected, substantially as and for the purpose herein specified.

4. In combination with an oven constructed as described, a railway track, M, extending through the same, and mold-trucks N N, to be moved along the said railway successively into and out of the compartments thereof, substantially as herein specified.

5. Slag-molds O O, made of fire-clay, furnace-slag, or a mixture of the two materials, for the purpose herein specified.

6. The trucks N N having a floor or platform

of fire-clay, furnace-slag, or a mixture of the two materials, and forming the bottoms of the molds placed thereon, substantially as herein specified.

7. The molds O O having openings *p p* so arranged as to communicate one with another, when they are arranged together on the trucks, substantially as herein specified.

FREDERIC A. LUCKENBACH.

Witnesses:

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WILLIAM A. HARDING, Jr.