No. 728,795. PATENTED MAY 19, 1903.

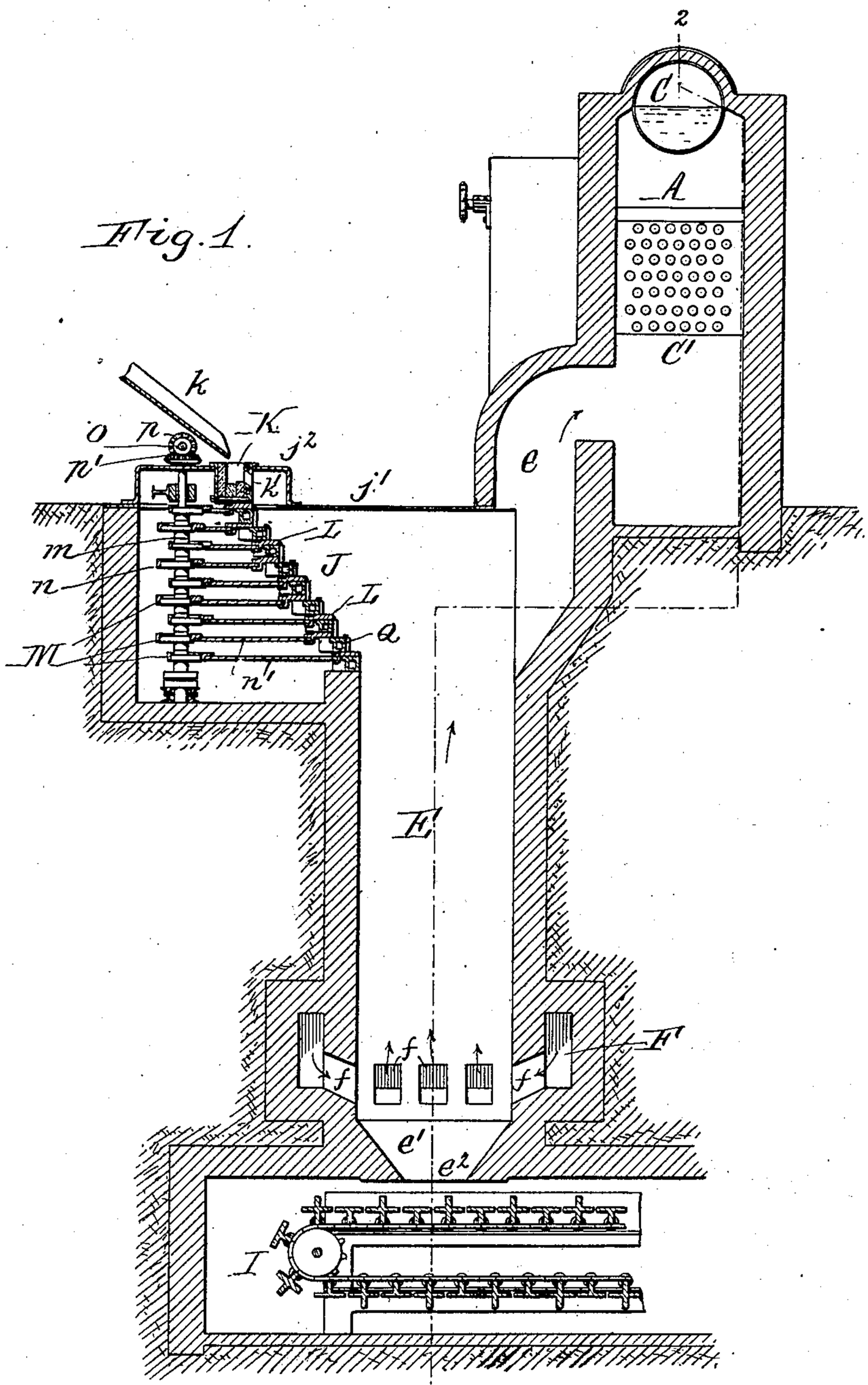
O. S. GARRETSON.

SLAG FURNACE.

APPLICATION FILED MAR. 19, 1902.

NO MODEL. 3 SHEETS—SHEET 1.

Fig. 1.



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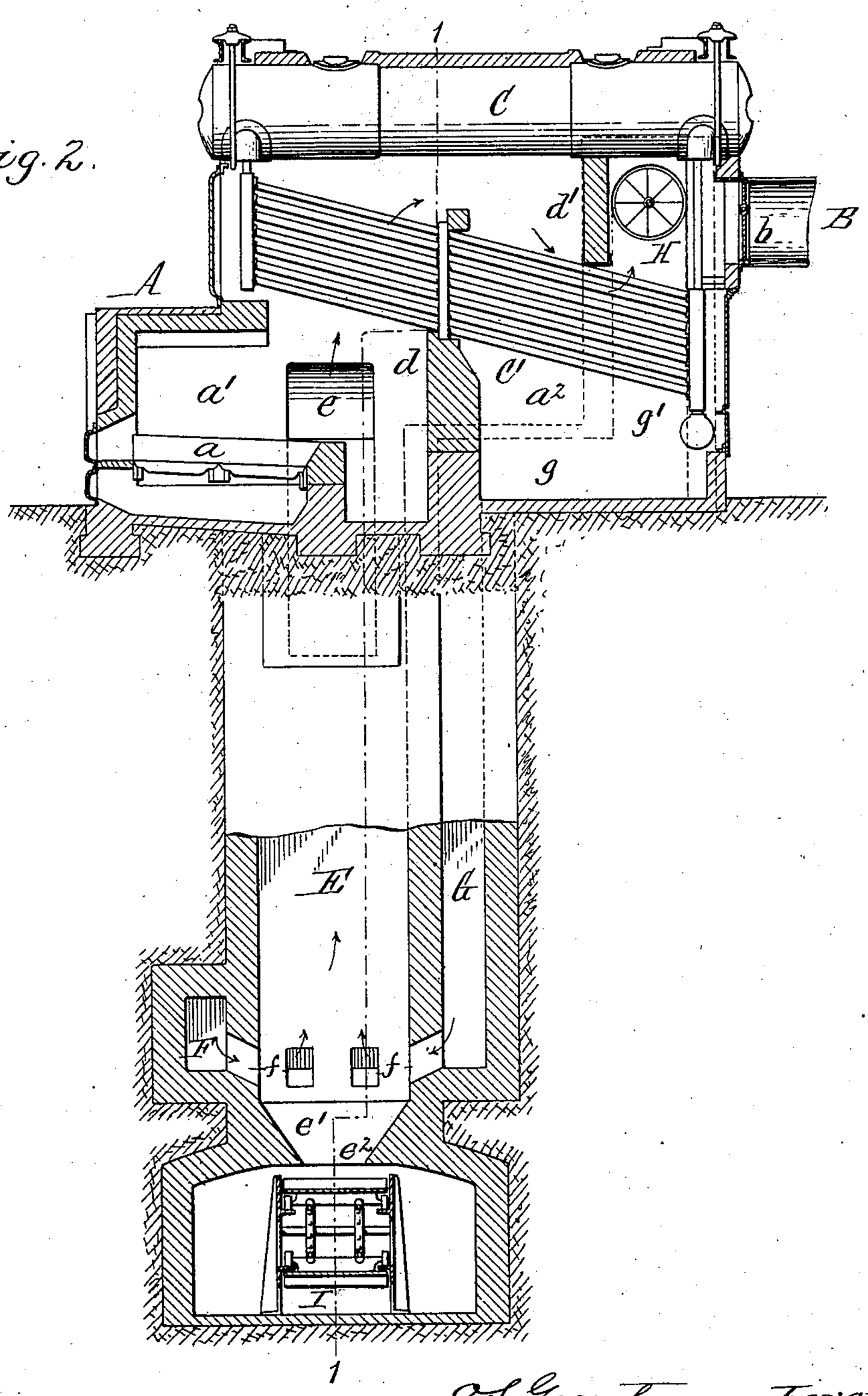
NO MODEL. 3 SHEETS—SHEET 2.

Fig. 2.



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NO MODEL. 3 SHEETS—SHEET 3.

Fig. 4.

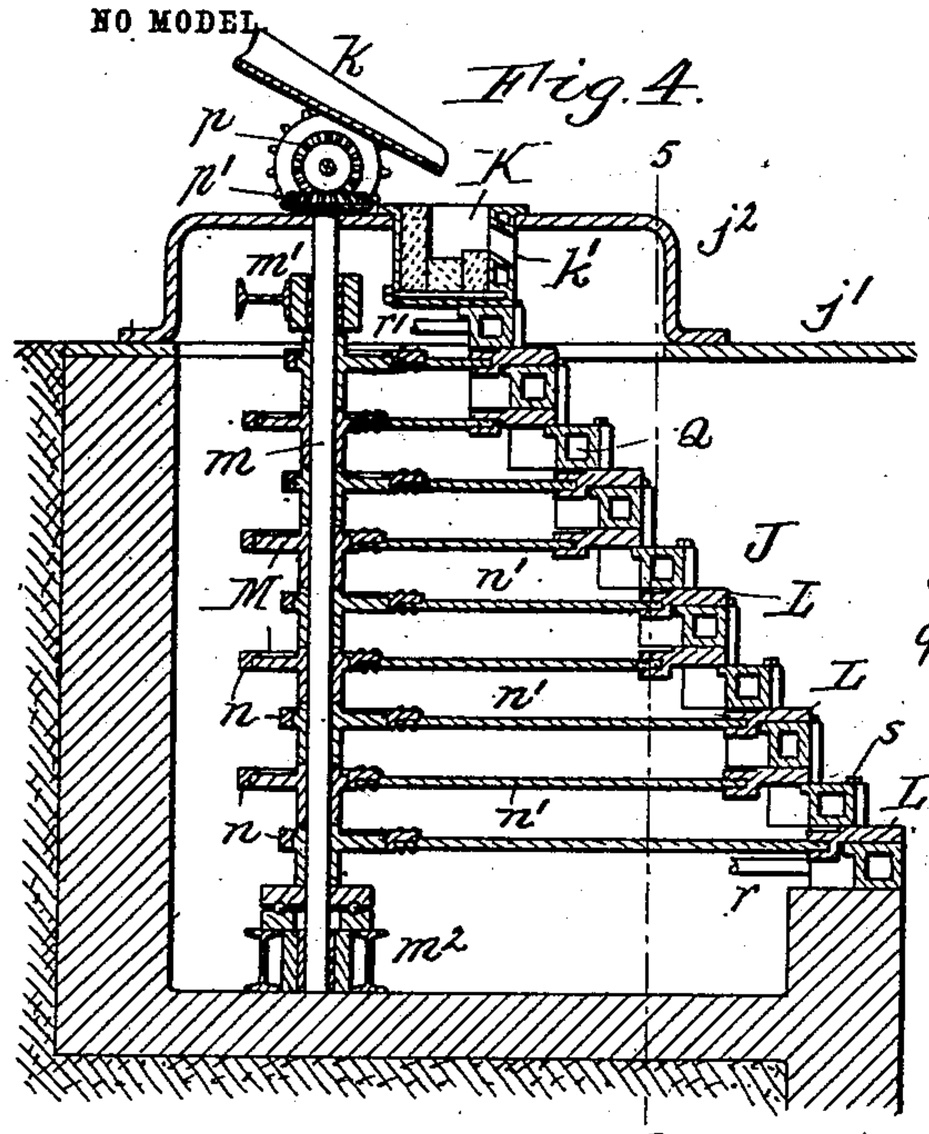

Fig. 5.

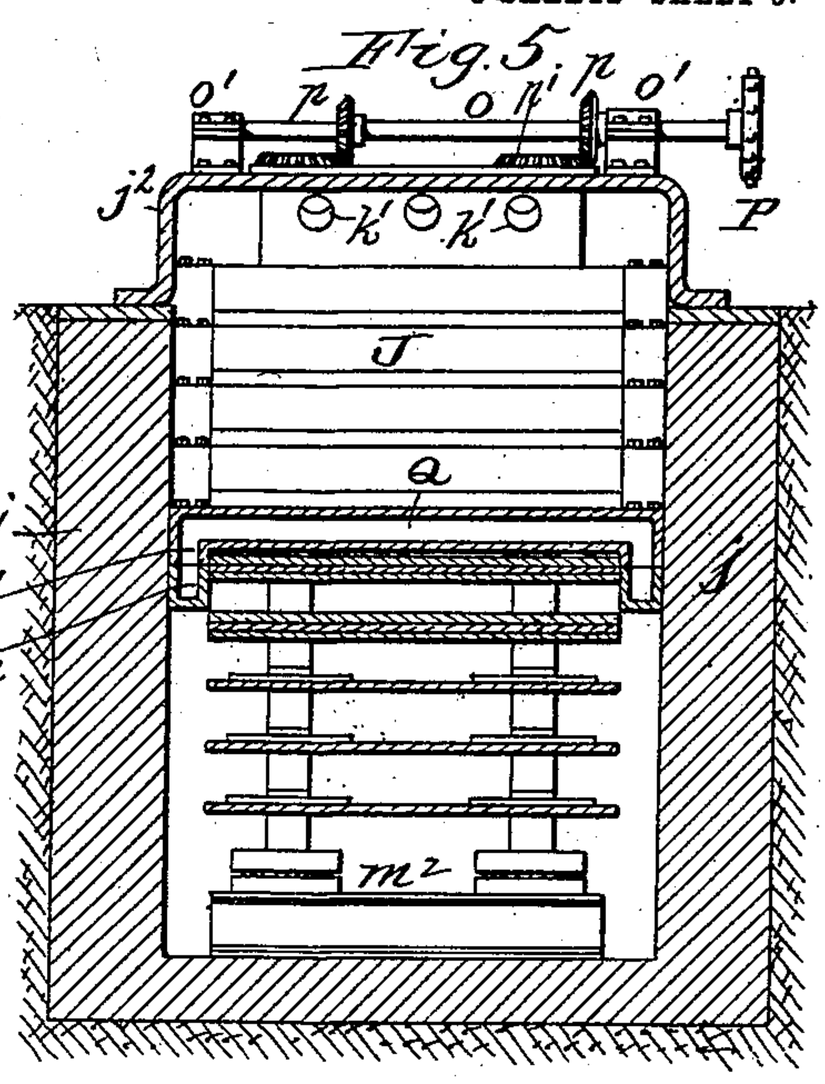

Fig. 6.

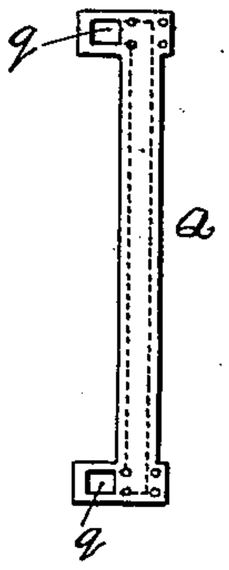

Fig. 7.

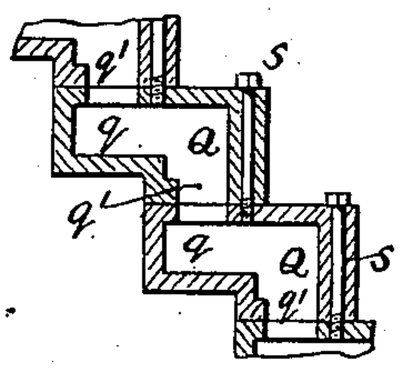

Fig. 3.

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No. 728,795. Patented May 19, 1903.

UNITED STATES PATENT OFFICE.

OLIVER S. GARRETSON, OF BUFFALO, NEW YORK.

SLAG-FURNACE.

SPECIFICATION forming part of Letters Patent No. 728,795, dated May 19, 1903.

Application filed March 19, 1902. Serial No. 98,915. (No model.)

To all whom it may concern:

Be it known that I, OLIVER S. GARRETSON, a citizen of the United States, residing at Buffalo, in the county of Erie and State of New York, have invented new and useful Improvements in Slag-Furnaces, of which the following is a specification.

This invention relates to an apparatus of the same general nature as that disclosed in my application for United States patent, Serial No. 98,159, filed March 14, 1902, and which is intended for utilizing the heat contained in molten slag to heat air by partially cooling the slag to the point at which it is congealed and non-adhesive while still containing the bulk of its heat and piling this hot slag in the form of small pieces or fragments in a chamber or pit through which the air is caused to flow which is to be heated.

The present invention is directed to a particular mechanism for partially cooling and congealing the slag; and its object is to provide such a mechanism which has a step-shaped or broken inclined surface over which the liquid slag flows in a sheet or thin stream and on which it is cooled to the congealing-point and formed into small pieces or fragments which can be piled or heaped in the slag-chamber in a loose mass having numerous interstices through which the air can be readily circulated and whereby a large heating-surface of congealed slag is presented to the air.

In the accompanying drawings, consisting of three sheets, Figure 1 is a longitudinal sectional elevation through an apparatus embodying the invention in line 1 1, Fig. 2. Fig. 2 is a transverse sectional elevation through the apparatus in line 2 2, Fig. 1. Fig. 3 is a plan view of the apparatus. Fig. 4 is a longitudinal vertical section, on an enlarged scale, through the slag-congealing mechanism. Fig. 5 is a transverse sectional elevation in line 5 5, Fig. 4. Fig. 6 is a top plan view of one of the steps. Fig. 7 is a vertical longitudinal section, on an enlarged scale, through the heads of several steps.

Like letters of reference refer to like parts in the several figures.

The apparatus shown in the drawings illustrates the application of the invention to a steam-boiler.

A represents the boiler furnace, which is provided with a grate *a* or other suitable means for burning fuel, a combustion-chamber *a'*, and a draft-passage a^2, which communicates at its rear end with the smoke-flue B, provided with a damper *b*. The boiler shown in the drawings is of the Babcock & Wilcox type, having an upper drum C and lower inclined water-tubes C'. The products of combustion pass from the combustion-chamber over the bridge-wall *d*, downwardly in rear of the latter and in front of the baffle-wall *d'*, and upwardly in rear of the latter to the smoke-flue B. A furnace and boiler of any other form, construction, and arrangement may, however, be employed, or instead of heating a boiler the invention may be employed for heating some other apparatus.

E represents a slag chamber or pit, which is preferably arranged below the level of the steam-boiler furnace and to one side thereof, as indicated in Fig. 1. This slag-chamber communicates at its upper end with the combustion-chamber of the boiler-furnace by a passage *e*. The lower end of the slag chamber or pit is preferably contracted, as indicated at *e'*, and is provided with a discharge-opening e^2 for the cooled slag. The slag-chamber is provided in its walls near its lower end, preferably above the contracted portion, with ports *f*, which communicate with a horizontal flue F, surrounding the lower portion of the slag-chamber. This flue F communicates with a vertical return flue or passage G, which connects by a horizontal passage *g* with the lower end of a passage *g'*, opening into the rear portion of the draft-passage of the boiler-furnace.

H represents a fan or blower, which may be of any suitable type and arranged at any suitable point to cause the air to circulate through the slag-chamber, the boiler, and the return flues or passages. In the construction shown the fan is located at the mouth of the passage *g'* and operates to move the air up through the slag chamber or pit, through the boiler flues or passages *e*, and down through the return flues or passages *g'*, *g*, G, and F and ports *f* to the lower portion of the slag-chamber.

I represents a conveyer of any suitable construction arranged below the discharge-open-

ing e^2 of the slag-chamber to receive the cooled slag discharged through the same and carry it off to a desired point.

Before introducing the slag into the slag pit or chamber it is cooled to the congealing-point, at which it is non-adhesive, but still very hot, and divided into small fragments, slabs, or pieces, which when dropped into the slag pit or chamber will pile or heap indiscriminately and form a loose mass having numerous spaces or interstices through which the air can be freely circulated. The mechanism shown in the drawings for this purpose and forming the subject-matter of this application is constructed as follows: J represents a flight of steps forming a broken inclined flowing-surface, over which the molten slag flows in a sheet, thin stream, or cascade. These steps are arranged horizontally between the side walls j of a compartment which opens into the upper portion of the slag-chamber. This compartment is closed by a cover j' and a raised housing j^2, which extends over the congealing mechanism.

K represents the feed trough or box, which is arranged above the top step and opens through the housing j^2. The molten slag is delivered into this trough from the metallurgical furnace by a spout k or in any other suitable manner. The front wall of this trough or box is provided with one or more openings k', through which the molten slag flows to the top step. The slag spreads out in one or more sheets or thin streams and flows down from step to step in a sort of cascade and gradually cools and congeals. As the slag hardens its movement is retarded, and it becomes necessary to provide means for assisting the movement of the slag from step to step down the flight. The means shown in the drawings for this purpose comprises transverse push-plates, bars, or agitators L, which slide back and forth on the tops of the steps, so as to push the slag from the lower portion of the upright front face of each step and over the top face of the next lower step. Each push-plate is arranged in a slot or space formed between the top of each step and the bottom of the next step above. These push-plates may be operated by any suitable mechanism, that shown in the drawings consisting of vertical shafts m, journaled in bearings m' m^2 in rear of the flight of steps and each provided with a series of eccentrics M, arranged in rear of the push-plates and connected therewith by straps n and rods n'. The eccentrics on each shaft are preferably arranged alternately on opposite sides of the shaft, so that adjacent push-plates are moved back and forth in opposite directions. The push-plates push the slag over each step and accelerate the movement of the slag, particularly on the lower portion of the stepped cooling-surface, where the slag is nearly congealed, and the push-plates further break up the continuity of the sheet or stream and reduce the congealed slag to small pieces or fragments. The shafts m are driven by any suitable mechanism—for instance, as shown, by a horizontal shaft O, journaled in bearings O' on the housing j^2, and provided with a driving sprocket-wheel or the like P and with bevel gear-wheels p, meshing with bevel gear-wheels p' on the vertical shafts.

In order to prevent the slag from burning the steps and to hasten the cooling and congealing, the steps are made hollow, and water or some other cooling medium is circulated through the same. A convenient connection between the water-spaces of the steps is shown in the drawings and is constructed as follows: Each step is provided at each end with a hollow horizontal head Q, Figs. 4, 6, and 7, which is arranged on the outer side of the push-bar and which projects rearwardly from the step. The heads are so much higher than the steps that slots or spaces for the push-plates are formed between the steps, as shown in Fig. 5. Each head is provided in the rear portion of its upper face with a port q, which registers with a port q' in the front portion of the lower face of the next higher step, Fig. 7, so that the water flows through these ports from one step to the other. The water is admitted to the bottom step by a pipe r and discharged from the top step by a pipe r'. The steps are secured together by screw-bolts s, passed through the heads, or other suitable means.

The operation of the apparatus is as follows: The molten slag spouted into the trough or box K flows from the latter over the top step and spreads out in one or more sheets or thin streams and flows down from step to step and becomes gradually cooled to the congealing-point during this flow. The slag is worked from step to step down the flight by the push-plates, and the congealed but still very hot slag falls from the bottom of the flight in the form of small pieces, plates, or fragments into the slag pit or chamber, in which these pieces pile up in a mass or heap which has numerous spaces or interstices and which presents a large heating-surface to the air, which flows upwardly through the same.

When starting the apparatus and until the slag reaches a sufficient height in the pit or chamber, the furnace can be operated by a fire built on the grate a. While the fire is burning, the damper b in the smoke-flue B is open and the products of combustion pass from the combustion-chamber through the boiler-passages to the smoke-flue. When sufficient slag has accumulated in the slag pit or chamber to heat the boiler, the damper is closed and the fire permitted to die. The fan is then started, and the air, as indicated by the arrows, is drawn up through the slag pit or chamber and the slag therein and through the boiler-passages and returned to the lower portion of the slag-chamber. The air circulation is continuous and takes place

in such manner that the hot air from the slag pit or chamber passes to the boiler, heats the latter, and after it has given up more or less of its heat to the boiler is returned to the slag-chamber to be reheated. The cold slag is removed gradually from the bottom of the heap by the conveyer, and hot slag is supplied to the top as may be necessary to maintain the desired temperature.

I claim as my invention—

1. In a slag-cooling apparatus, the combination of a broken, descending cooling-surface and an agitator for breaking the continuity of the sheet or stream of slag flowing over the same, substantially as set forth.

2. In a slag-cooling apparatus, the combination of a descending cooling-surface and a reciprocating bar which breaks the continuity of the sheet or stream of slag flowing over the same, substantially as set forth.

3. The combination of a step-like cooling-surface and a movable agitator-bar arranged upon the same, substantially as set forth.

4. The combination of a step-like cooling-surface, means for feeding the material upon the same, and agitators which accelerate the downward movement of the material over the cooling-surface, substantially as set forth.

5. The combination of a step-like cooling-surface, means for feeding the material upon the same, and reciprocating bars arranged upon the steps of the cooling-surface, substantially as set forth.

6. The combination of a series of horizontal cooling-steps, means for feeding the material upon the upper step, and horizontal agitator-bars arranged to slide over the top faces of the steps, substantially as set forth.

7. The combination of a series of horizontal cooling-steps, means for feeding the material upon the steps, horizontal agitator-bars arranged to slide over the top faces of the steps, an upright shaft, and eccentrics mounted on said shaft and connected with said bars, substantially as set forth.

8. The combination of a series of horizontal cooling-steps, means for feeding the material upon the upper step, agitator-bars arranged to slide over the top faces of said steps, and actuating means whereby adjacent bars are moved in opposite directions, substantially as set forth.

9. The combination of a series of hollow steps, means for supplying a cooling agent to the cavities of the steps, means for breaking the continuity of the sheet or stream of slag flowing over said steps and means for feeding the material to be cooled upon the upper step, substantially as set forth.

10. The combination of a series of hollow steps, means for supplying a cooling agent to the cavities of the steps, means for feeding the material to be cooled upon the upper step, and agitators for accelerating the downward flow of the material over the steps, substantially as set forth.

11. The combination of a series of hollow horizontal steps provided at their ends with heads having communicating ports, means for supplying a cooling agent to the cavities of said steps, reciprocating bars arranged upon the steps, and means for supplying the material to be cooled to the upper step, substantially as set forth.

12. The combination of a slag-chamber, a step-like slag-cooling surface, means for supplying slag to said surface, and means for breaking the continuity of the sheet or stream of slag flowing over said surface and discharging the hot congealed slag into said chamber, substantially as set forth.

13. The combination of a slag-chamber, a step-like slag-cooling surface, means for supplying molten slag to said surface, means for breaking the continuity of the sheet or stream of slag flowing over said surface and discharging the hot congealed slag into said chamber, and means for causing an air-current to flow through said slag-chamber, substantially as set forth.

14. The combination of a slag-chamber, a step-like slag-cooling surface, means for supplying molten slag to said surface, means for breaking the continuity of the sheet or stream of slag flowing over said surface and discharging the hot congealed slag into said chamber, means for causing an air-current to flow through said slag-chamber, and a steam-boiler which is heated by the air passing through said chamber, substantially as set forth.

15. The combination of a slag-chamber, a step-like slag-cooling surface, means for supplying molten slag to said surface, means for breaking the continuity of the sheet or stream of slag flowing over said surface and discharging the hot congealed slag into said chamber, means for causing an air-current to flow through said slag-chamber, a steam-boiler which is heated by the air passing through said chamber, and a return-passage by which the air passes from the boiler to the slag-chamber, substantially as set forth.

16. The combination of a slag-chamber, a step-like cooling apparatus arranged near the upper part of said chamber, means for supplying molten slag to said apparatus, agitators which assist in moving the slag from step to step and into said chamber, and means for causing an air-current to flow through said chamber, substantially as set forth.

Witness my hand this 10th day of March, 1902.

OLIVER S. GARRETSON.

Witnesses:
JNO. J. BONNER,
CLAUDIA M. BENTLEY.