(No Model.) 2 Sheets—Sheet 1.

O. S. GARRETSON.

METHOD OF AND APPARATUS FOR MATTE OR PYRITIC SMELTING.

No. 596,991. Patented Jan. 11, 1898.

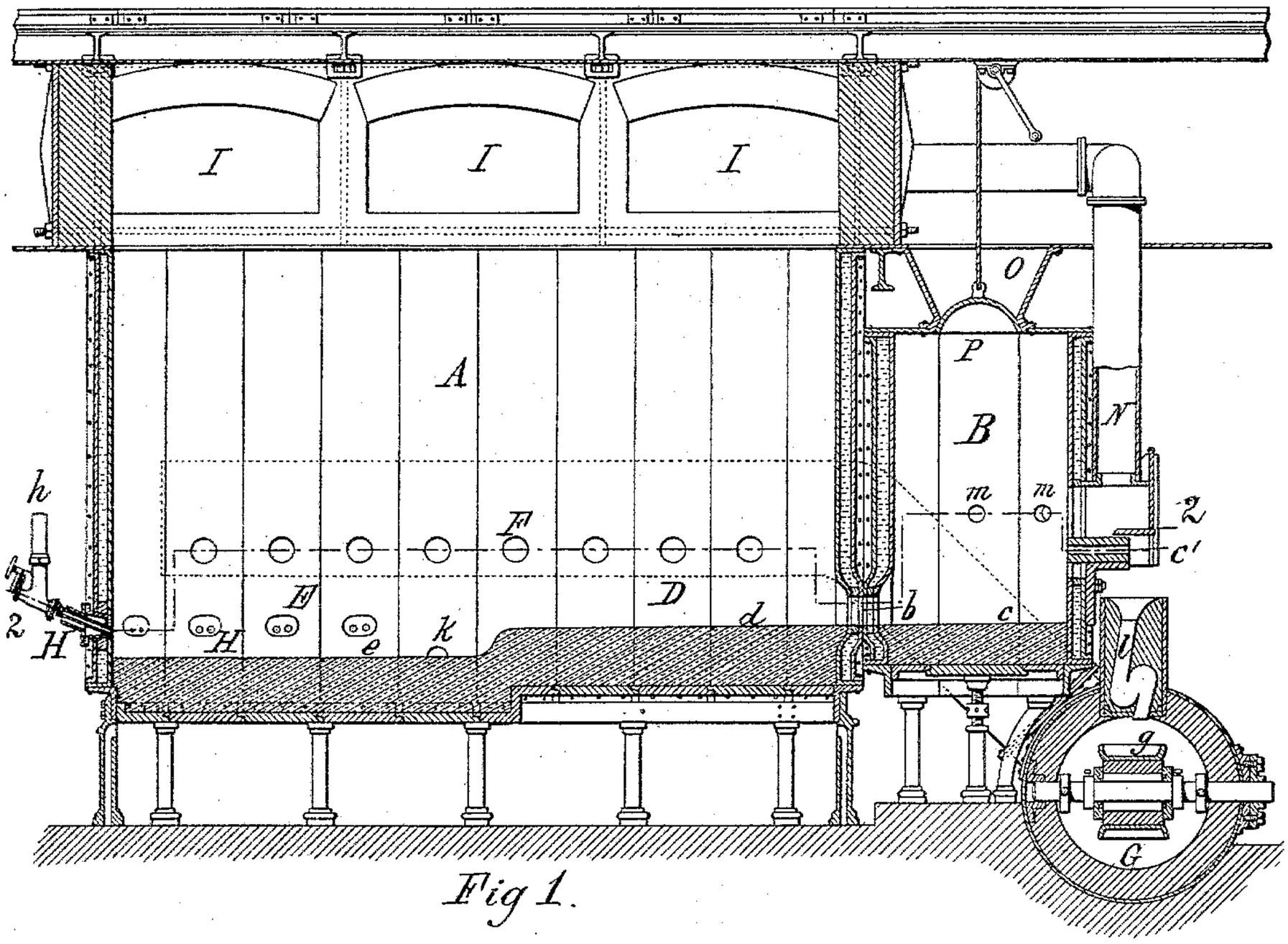

Fig 1.

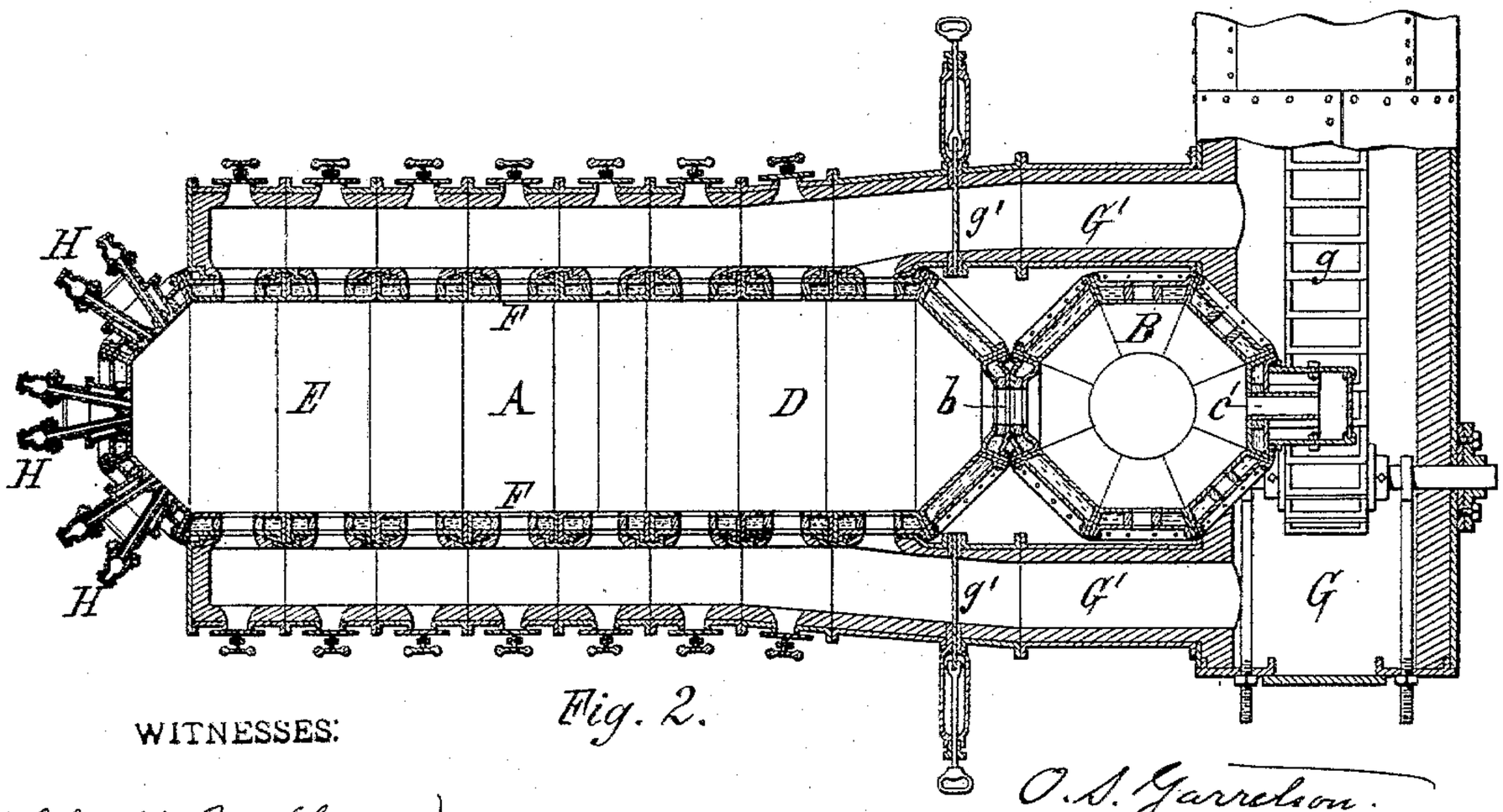

Fig. 2.

WITNESSES:

Chas. F. Burkhardt.
Henry L. Deck.

O. S. Garretson.
INVENTOR.

By Wilhelm Bonner.
ATTORNEYS.

(No Model.) 2 Sheets—Sheet 2.

O. S. GARRETSON.

METHOD OF AND APPARATUS FOR MATTE OR PYRITIC SMELTING.

No. 596,991. Patented Jan. 11, 1898.

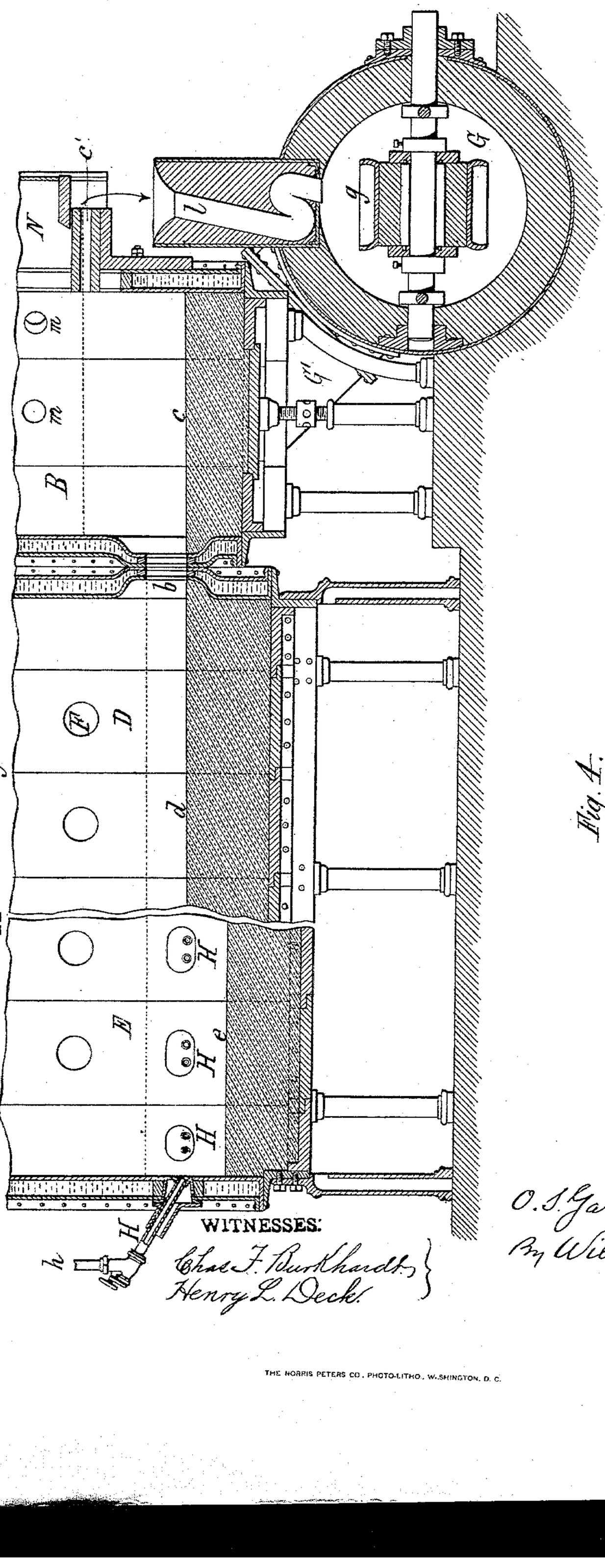

Fig. 3.

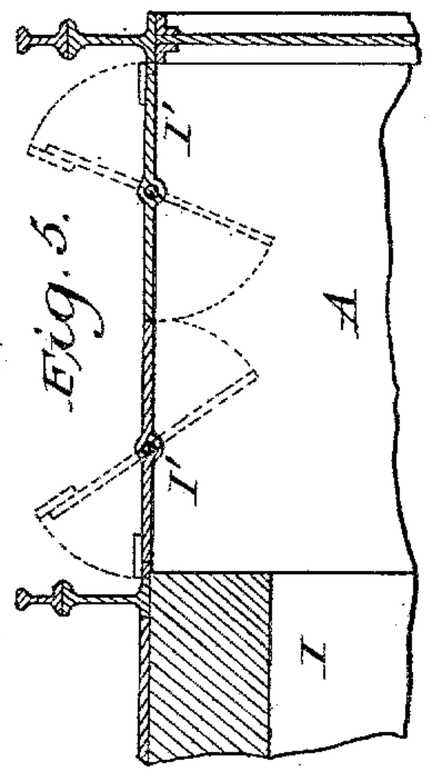

Fig. 5.

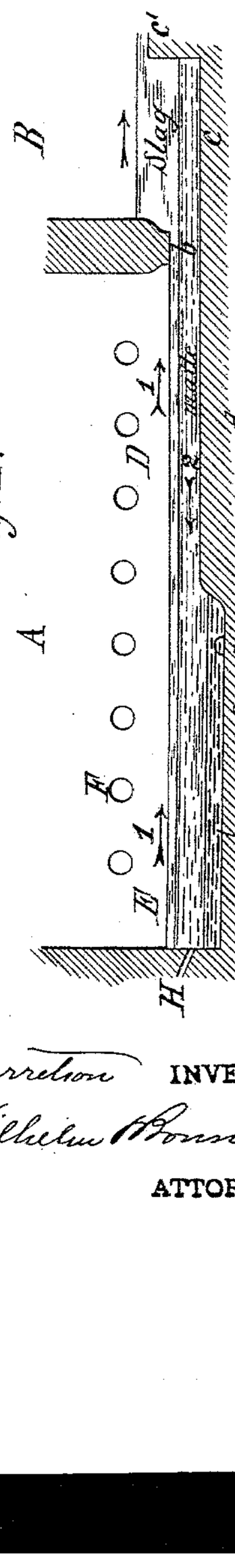

Fig. 4.

WITNESSES:

Chas. F. Burkhardt,
Henry L. Deckel.

O. S. Garretson INVENTOR.

By Wilhelm Bonnet

ATTORNEYS.

UNITED STATES PATENT OFFICE.

OLIVER S. GARRETSON, OF BUFFALO, NEW YORK.

METHOD OF AND APPARATUS FOR MATTE OR PYRITIC SMELTING.

SPECIFICATION forming part of Letters Patent No. 596,991, dated January 11, 1898.

Application filed November 7, 1896. Serial No. 611,338. (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 a new and useful Improvement in Methods of and Apparatus for Matte or Pyritic Smelting, of which the following is a specification.

This invention relates to that class of metallurgical operations and furnaces which are employed in matte and pyritic smelting, and has for its object to treat the ore in a furnace in such manner that the ore is smelted to a matte in one part of the furnace and the matte is converted or bessemerized in another part of the furnace, whereby metal or enriched matte, as the case may be, and practically clean slag are produced by a simple and continuous operation, as will be hereinafter fully set forth.

In the accompanying drawings, consisting of two sheets, Figure 1 is a longitudinal vertical section of a furnace embodying my improvements and by which my improved method can be practiced. Fig. 2 is a horizontal cross-section in line 2 2, Fig. 1. Fig. 3 is a fragmentary longitudinal vertical section of the lower portion of the furnace on an enlarged scale. Fig. 4 is a diagram illustrating the flow of the molten material in the furnace. Fig. 5 is a fragmentary cross-section of the top of the furnace at right angles to Fig. 1 on an enlarged scale.

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

A represents the furnace, and B the forehearth or settling-well arranged at one end of the furnace and communicating therewith by a passage *b*. The furnace is preferably made long and narrow in horizontal cross-section, the forehearth being arranged at one of the narrow ends. The bottom *c* of the forehearth is practically on a level with the bottom of the passage *b* or slopes slightly toward said passage, so that any matte or other molten metallic compounds which settle to the bottom of the forehearth flow back into the furnace.

c' is the slag-outlet of the forehearth, which outlet is arranged somewhat higher than the passage *b*.

The portion D of the furnace, which is nearest the forehearth, is the matte-forming region or portion of the furnace and has its bottom *d* arranged to slope toward the opposite end of the furnace, where the bottom is depressed below the bottom *d* of the matte-forming region, as shown at *e*, the portion or region E above this depressed bottom being the converting or bessemerizing portion or region of the furnace.

F represents a row of twyers which are constructed and arranged in any suitable manner, so as to deliver a blast suitable for smelting into the smelting-zone of the furnace, which lies above the slag-level. This blast is preferably heated by any suitable heating apparatus; but I prefer for that purpose the hot-blast apparatus which forms the subject-matter of my application for Letters Patent filed October 29, 1896, Serial No. 610,403. In this hot-blast apparatus the blast is heated by the discharged molten slag in a conduit G, through which the slag is conducted by an endless carrier *g*. From this heating-conduit G the blast passes to the twyers through two conduits G', arranged on opposite sides of the furnace and provided with valves *g'* for regulating or shutting off the blast.

H represents a row of twyers which are arranged in the converting or bessemerizing portion of the furnace at such a height that they deliver a blast suitable for converting or bessemerizing the matte in the zone which is occupied by the matte above the depressed portion *e* of the bottom of the furnace. This zone lies above the zone which is occupied by the metal upon the depressed bottom and below the slag zone. The pressure of this converting or bessemerizing blast is higher than that of the smelting-blast in order to enable the converting-blast to penetrate the molten matte and may range from four to five or more pounds per square inch, while the smelting-blast may range from one-half to one and one-half pounds. The converting-blast need not be heated and may be supplied to the twyers H by flexible pipes *h* from any suitable conduit. These converting-twyers H are preferably double, while the smelting-twyers may be single, as shown.

The top portion of the furnace is constructed in any suitable or well-known manner for feeding the ore to the furnace and for permit-

ting the escape of the gases through the uptakes I—for instance, by pivoted doors I′, as shown in Fig. 5.

In practicing my invention the iron or copper sulfid ore, mixed with a suitable flux, consisting mainly of silica—for instance, quartz, diorite, or the like—is charged into the furnace at suitable intervals in such a way that the furnace is kept fairly filled with ore and flux. In starting the furnace a suitable amount of fuel is used, but when the operation is fully established the fuel may be entirely omitted, or nearly so, as the percentage of combustible ingredients in the ore may warrant. As the ore is being smelted down a matte is formed. That part of the matte which collects on the depressed portion of the furnace-bottom is converted or bessemerized, so that the metal is precipitated and collects on the depressed bottom. The iron oxid which is formed or liberated in forming the matte and in converting or bessemerizing the same combines with the silica to form a silicate, which flows freely as a liquid slag in the direction of the arrows 1, Fig. 4, from the bessemerizing portion E of the furnace toward the passage *b*, which leads from the furnace to the forehearth. In flowing to the forehearth this liquid slag is compelled to flow through the matte-forming portion D of the furnace, where the raw ore and poor matte predominate. The sulfur, which is there in excess, combines with any free metals or oxids which may be carried by the slag and converts the same into matte, whereby the copper and other values carried by the slag are returned to the matte. The latter flows toward the depressed portion *e* of the bottom of the furnace, as indicated by the arrow 2, Fig. 4, and is there again subjected to the bessemerizing-blast. In this manner a circulation is maintained in the molten material in the furnace. A molten sulfur compound or matte is constantly formed in the portion of the furnace nearest the forehearth and over the elevated portion of the bottom. This comparatively poor matte flows constantly along the bottom of the furnace toward the opposite end thereof and becomes gradually richer by the burning out of the sulfur, iron, and other combustible ingredients. The rich matte is constantly converted or bessemerized in that portion of the furnace which lies over the depressed portion of the bottom. A correspondingly rich slag is constantly formed in the converting portion of the furnace, which slag flows in the opposite direction or from the bessemerizing end to the matte-forming end and passes through the matte-forming portion before escaping to the forehearth, and the values contained in the slag are exposed to the action of the predominating sulfur and poor matte in the matte-forming portion and are thereby intercepted and returned, whereby the escape of values with the slag is to a large extent prevented. In order to promote this action of the molten materials, the matte-forming portion of the stack-furnace is preferably charged with proportionately more ore and the bessemerizing portion of the stack with proportionately more flux, so that the raw ore and poor matte preponderate in the matte-forming portion and the flux in the bessemerizing portion. If the ores which are being treated differ in the percentage of sulfur or other combustible ingredients, the ore containing most sulfur is used in the matte-forming portion.

The precipitated metal which collects on the depressed portion of the furnace-bottom is drawn off from time to time through a suitable tap-hole *k*.

Such metallic compounds as escape into the forehearth and settle there flow back into the furnace through the passage *b*.

The slag-outlet *c′* of the forehearth is arranged higher than the passage *b*. The blast-pressure in the furnace is sufficient to drive the slag to this outlet, through which it passes to the slag-inlet *l* of the hot-blast apparatus, if the latter is used. This pressure is maintained in the furnace, as is well known, because the stack of the furnace is filled with a column of ore and fuel through which the blast must force its way in order to escape. If necessary, the stack of the forehearth may be kept filled with charcoal, so that the slag is filtered through the charcoal before escaping from the forehearth, whereby a further portion of the values contained in the slag is filtered out or reduced. The forehearth may be provided with twyers *m* for supplying air to burn a part of the charcoal sufficient to maintain the heat which is necessary to keep the slag sufficiently fluid. When such a heating of the forehearth is necessary, the stack of the forehearth is preferably provided with an escape-pipe N for the products of combustion, which pipe connects with the forehearth immediately above its slag-outlet, while the feed-hopper O at the top of the stack of the forehearth is provided with a movable cover or bell P. This permits the charcoal to be burned in the forehearth at the bottom of the fuel-column in the manner of a base-burner.

The herein-described method and apparatus are applicable to the various ores for which matte or pyritic smelting is suitable—for instance, copper and iron pyrites, sulfids, arsenical ores, and others. The process produces in a simple, direct, and continuous manner a metallic alloy or a rich matte and substantially clean slag.

I claim as my invention—

1. The herein-described method of matte or pyritic smelting which consists in conducting the operations of producing molten matte and converting or bessemerizing the same side by side, maintaining a flow of matte from the matte-forming region to the connecting or bessemerizing region, forming a fluid slag by the addition of flux in the converting or bessemerizing region, and compelling such slag to flow through the matte-forming region on

its way to the slag-outlet, thereby subjecting the slag to the action of the sulfur and sulfids in the matte-forming region, whereby the values contained in the slag are intercepted and returned to the matte, substantially as set forth.

2. The herein-described method of matte or pyritic smelting which consists in conducting the operations of producing molten matte and converting or bessemerizing the same side by side in the same furnace and charging the matte-forming region with a preponderance of ore and the converting or bessemerizing region with a preponderance of flux, substantially as set forth.

3. A smelting and converting furnace having its bottom provided with a depressed portion near one end of the furnace, a device for supplying a converting or bessemerizing blast arranged over the depressed portion of the bottom, and a slag-outlet arranged at or near the opposite end of the furnace, above the elevated portion of the bottom, substantially as set forth.

4. A smelting and converting furnace having its bottom provided with a depressed portion near one end of the furnace, a stack arranged over the elevated and the depressed portions of the bottom, a device for supplying a converting or bessemerizing blast arranged over the depressed portion of the bottom, a device for supplying a smelting-blast arranged over the elevated portion of the bottom, and a slag-outlet arranged at or near the opposite end of the furnace above the elevated portion of the bottom, substantially as set forth.

5. The combination of a smelting and converting furnace having its bottom provided with a depressed portion near one end of the furnace, a device for supplying a converting or bessemerizing blast arranged over the depressed portion of the bottom, a device for supplying a smelting-blast arranged over the elevated portion of the bottom, and a slag-outlet arranged at or near the opposite end of the furnace above the elevated portion of the bottom, of a forehearth communicating with said slag-outlet and having its bottom arranged practically on a level with the elevated portion of the bottom of the furnace, substantially as set forth.

6. The combination with a smelting-furnace, of a forehearth communicating with the slag-outlet of said furnace and having a slag-outlet, a stack which is independent of said furnace and extends upwardly from said slag-outlet and is adapted to hold a column of fuel, and a conduit for the escape of the products of combustion which is separate from the smelting-furnace and from said stack and connected with the lower portion of said stack, substantially as set forth.

Witness my hand this 6th day of November, 1896.

OLIVER S. GARRETSON.

Witnesses:
JNO. J. BONNER,
KATHRYN ELMORE.