No. 782,123. PATENTED FEB. 7, 1905.

O. S. GARRETSON.

METHOD OF MATTE OR PYRITIC SMELTING.

APPLICATION FILED JAN. 12, 1901.

2 SHEETS—SHEET 1.

Fig. 1.

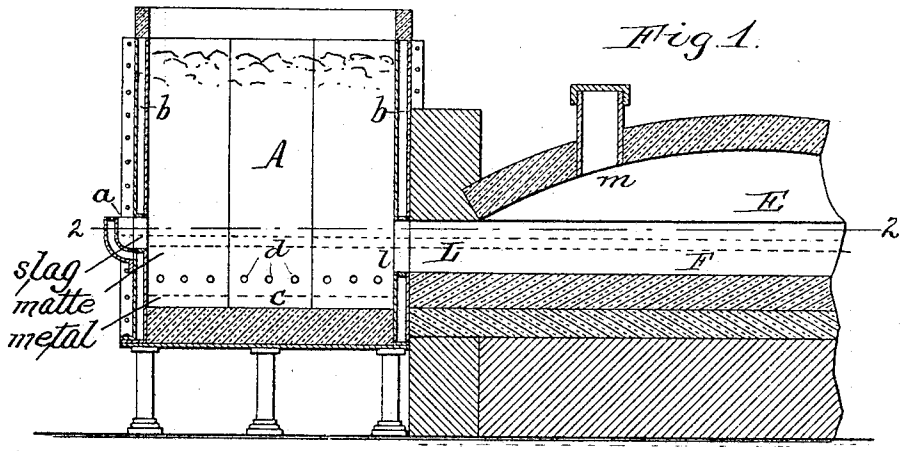
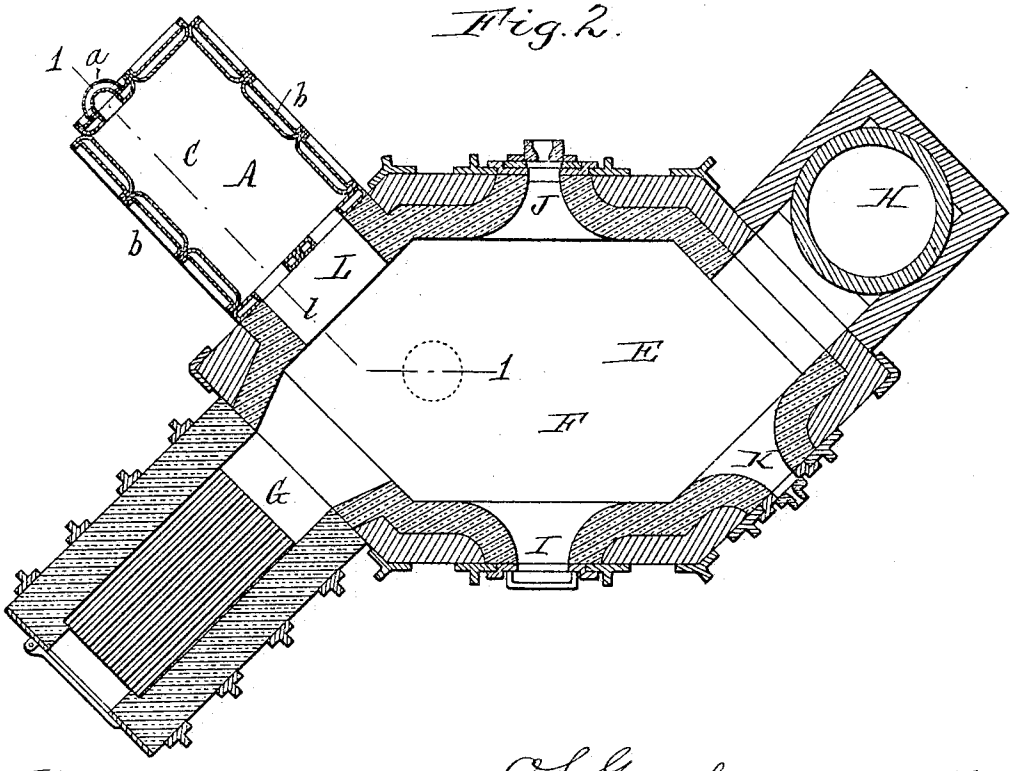


Fig. 2.



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2 SHEETS—SHEET 2.

Fig. 3.

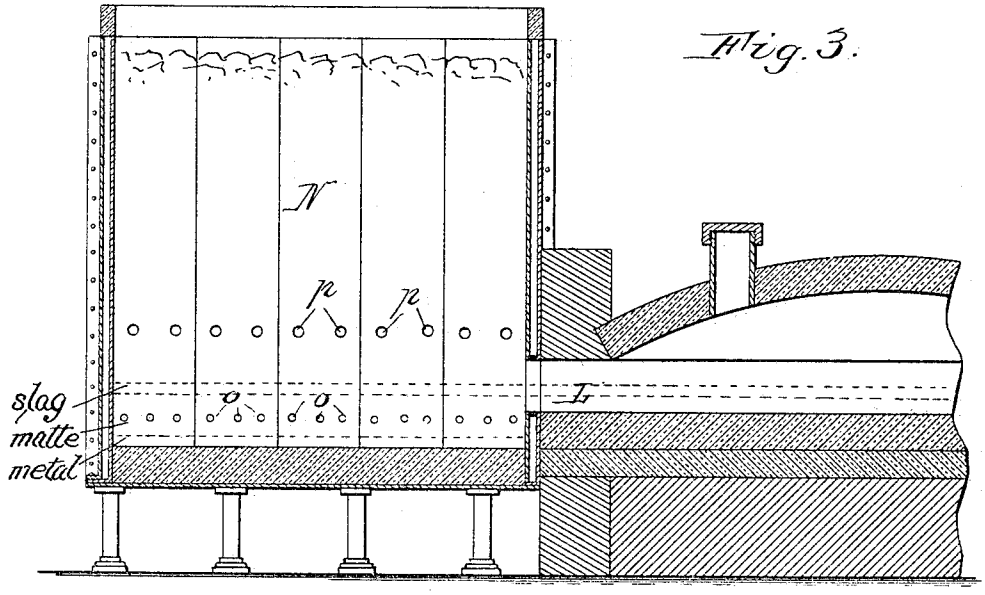


Fig. 4.

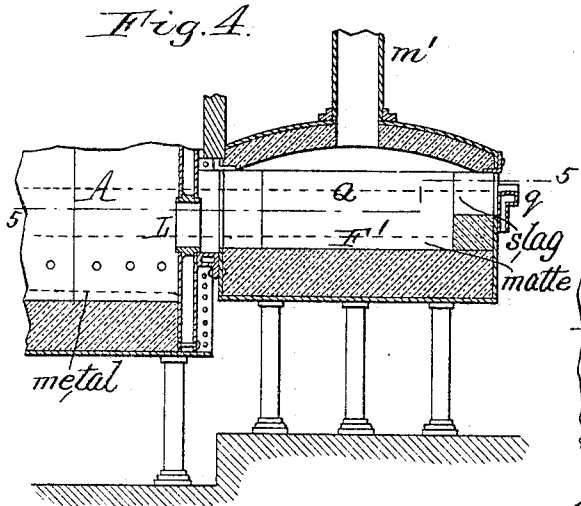
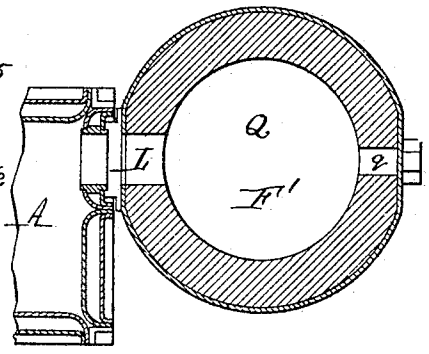


Fig. 5.



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No. 782,123. Patented February 7, 1905.

UNITED STATES PATENT OFFICE.

OLIVER S. GARRETSON, OF BUFFALO, NEW YORK, ASSIGNOR TO GARRETSON FURNACE COMPANY, OF PITTSBURG, PENNSYLVANIA, A CORPORATION OF WEST VIRGINIA.

METHOD OF MATTE OR PYRITIC SMELTING.

SPECIFICATION forming part of Letters Patent No. 782,123, dated February 7, 1905.

Application filed January 12, 1901. Serial No. 42,945.

To all whom it may concern:

Be it known that I, OLIVER S. GARRETSON, a citizen of the United States, and a resident of Buffalo, in the county of Erie and State of New York, have invented new and useful Improvements in Methods of Matte or Pyritic Smelting, of which the following is a specification.

This invention relates to a metallurgical operation which involves the treatment of matte by the converting or bessemerizing process by a blast underneath a column of ore and flux or silicious material. Operations of this character are described and claimed in Letters Patent of the United States Nos. 596,991 and 596,992, granted to me January 11, 1898. In the process of Patent No. 596,991 the matte is converted or bessemerized in the same furnace in which it is produced from the ore by smelting. In the process of Patent No. 596,992 the matte is converted or bessemerized in a furnace which is separate from the smelting-furnace. When rich mattes are produced in this manner, the slag is correspondingly rich and carries off values which should be recovered.

The object of my present invention is to clean this slag effectively and to save the values contained therein by a simple and economical method and also to combine the stack-furnace with a reverberatory furnace, so that the peculiar advantages of each method of smelting are realized.

In the accompanying drawings, consisting of two sheets, Figure 1 is a sectional elevation of an apparatus which can be used for practicing my improved method of matte or pyritic smelting, the section being taken in line 1 1, Fig. 2. Fig. 2 is a horizontal section of the same in line 2 2, Fig. 1. Fig. 3 is a sectional elevation similar to Fig. 1, showing a modified construction of the apparatus. Fig. 4 is a sectional elevation on a reduced scale, showing another modified construction of the apparatus. Fig. 5 is a horizontal section in line 5 5, Fig. 4.

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

A, Figs. 1 and 2, represents an upright converting-furnace or bessemerizing apparatus which is supplied with molten matte through a spout *a* from any suitable source. This furnace has its body composed preferably of a water-jacketed column, stack, or shell *b*, of cylindrical, prismatic, or other suitable form. C represents the bottom of this furnace.

d represents the twyers, through which a blast suitable for converting or bessemerizing the matte is injected into the molten matte. These twyers are arranged at such a height above the bottom C of the furnace that they deliver the blast into the zone occupied by the molten matte, which zone lies above the zone occupied by the molten metal on the furnace-bottom and below the zone occupied by the slag, as represented by dotted lines. The converting-blast is injected under a sufficiently high pressure to enable the blast to penetrate the molten matte, which pressure may range from four to five pounds or more per square inch.

The top of the furnace is constructed in any suitable or well-known manner for introducing the ore and flux or silicious material and for directing the escape of the gases.

E represents a reverberatory furnace or forehearth which receives the slag from the converting-furnace A and in which the slag is treated for recovering the matte and other values which are contained in the slag and returning the same to the converting-furnace.

F represents the hearth of the reverberatory forehearth, and G the fireplace of the same arranged at one end of the hearth near the converting-furnace A. H is the chimney, arranged at the opposite end of the hearth; I, a door arranged in the front of the furnace; J, a tap-hole arranged at the rear side of the furnace, and K a slag-notch arranged near the chimney.

L represents the passage which connects the converting-furnace A with the hearth of the reverberatory forehearth and through which the slag flows from the converting-furnace to this forehearth. The bottom or bridge *l* of this passage is arranged at such a height that

all of the metallic compounds which sink to the bottom on the hearth of the reverberatory forehearth flow back through this passage into the converting-furnace, while the bottom C of the converting-furnace is located so far below the bottom of this passage that the metal and matte which accumulate on the bottom of the converting-furnace cannot flow with the slag into the reverberatory forehearth. This passage L, which connects the converting-furnace with the forehearth, is preferably arranged near the fireplace of the latter.

m represents an opening formed in the roof of the reverberatory forehearth for introducing unroasted sulfid ore or ore rich in sulfur into the forehearth. This opening is preferably arranged near the passage L.

In practicing my invention by means of this apparatus the matte is produced in a smelting-furnace of any suitable construction and by any suitable method, and the matte and slag so produced in the smelting-furnace are withdrawn therefrom and introduced into the bessemerizing or converting furnace A through the spout *a*. When the slag is poor or practically clean, it need not be introduced into the converting-furnace, although in some cases it may be desirable to pass even a practically clean slag through the converter for the purpose of thinning the converter-slag and facilitating the flow of the latter to the forehearth. The converting-furnace is filled with a column of ore and flux or silicious material in lumps. Quartz, diorite, or other mineral containing a large percentage of silica may be used for this purpose. The weight of this column keeps the lower portion of the column pressed down into the layer of matte, so that the iron oxid which is formed in the matte by the oxidizing-blast can come in contact with the silica and combine with the same to a silicate which forms a liquid slag. The latter rises to the surface and flows through the passage L into the reverberatory forehearth. In the latter the slag is kept in a liquid condition by the heat generated in the fireplace, whereby the heavy particles of matte and metal are enabled to separate themselves from the surrounding particles of slag and sink to the sole of the forehearth. The latter is supplied with ore which is rich in sulfur and in such quantities from time to time as may be necessary to combine with the metallic values contained in the slag. The values contained in the slag are in this manner intercepted and incorporated in a poor matte, which flows back into the converting-furnace and combines therein with the molten contents and is subjected to the converting operation, as above described. The high heat which is maintained in the reverberatory forehearth keeps the slag in a freely-flowing condition and promotes the separation of the heavy particles of metal and matte from the lighter worthless slag. The clean slag is withdrawn from time to time from the forehearth through the slag-notch K or allowed to flow off continuously.

While I prefer to introduce the ore into the reverberatory forehearth through the opening in the roof of the same, it may be introduced in any other suitable manner.

Instead of producing the matte in a separate smelting-furnace and afterward converting it in a separate converting-furnace the operations of smelting and converting may be carried on in the same furnace substantially as described in my Letters Patent No. 596,991, above referred to. In that case a combined smelting and bessemerizing or converting furnace N is connected with the reverberatory forehearth by the passage L, as represented in Fig. 3. This furnace is provided with a set of bessemerizing or converting twyers O, which are arranged at such a height above the bottom of the furnace that they deliver the blast into the molten matte, as represented by dotted lines, and may also be provided at a higher level with a set of smelting-twyers *p*. This furnace is charged with ore and flux in such proportions that a matte is produced which collects on the furnace-bottom and which is converted by the bessemerizing blast. In starting the blast-furnace a suitable amount of fuel is used; but when the operation is fully established the fuel may be omitted, or nearly so, as the percentage of the combustible ingredients in the ore may warrant. The slag which is formed flows freely through the passage L into the reverberatory forehearth and is treated in the latter with sulfid ore, as above described, for recovering the values carried off by the slag, and the matte formed by this treatment in the forehearth flows back into the furnace.

My improved method of treating the slag in the forehearth effectually saves the values which are carried off by the slag, and thereby renders it practicable to produce comparatively rich matte in the converting-furnace or to concentrate the matte in the converting-furnace to a high degree without material loss by the escape of values with the slag. It also leaves the effective area of the converting-furnace available for converting matte or for the combined operations of smelting suitable lump ores and converting matte and leaves the reverberatory forehearth available for smelting concentrates, fines, flue-dust, or other material which is not suitable for smelting in the blast-furnace and also for effectually cleaning the rich slags made in the blast-furnace.

With some ores or mattes it is not necessary to maintain a fire in the fireplace of the reverberatory forehearth after starting, as the heat supplied to the forehearth by the converting-furnace and generated in the forehearth by the partial oxidization of the sulfid ore supplied to the same is sufficient to main-

tain the necessary degree of heat in the forehearth. In such cases the firing of the fireplace of the forehearth is entirely or partially omitted, as may be proper.

In some cases it is not necessary that the forehearth should be a reverberatory furnace. Such an apparatus is represented in Figs. 4 and 5, in which Q represents an ordinary forehearth which receives the slag from the furnace A through the slag-passage L, as indicated by dotted lines, and the ore through the inlet *m'* in the top of the forehearth. The matte which is formed in this forehearth flows from the bottom F' of the forehearth back into the furnace through the passage L, and the cleaned slag is withdrawn from the forehearth through the slag-spout *q*. This construction is particularly desirable in connection with small furnaces—for instance, a furnace having a smelting capacity of about thirty or forty tons of ore per day.

I claim as my invention—

1. The herein-described method of matte or pyritic smelting which consists in bessemerizing or converting matte by a blast underneath a column of material containing flux, maintaining a flow of the resulting slag to a forehearth, supplying sulfur-bearing material to the slag in the forehearth, while maintaining the slag in a freely-flowing condition, thereby producing a low-grade matte which combines with metal or matte contained in the slag, and maintaining a flow of such low-grade matte back to the bessemerizing or converting region, substantially as set forth.

2. The herein-described method of matte or pyritic smelting which consists in bessemerizing or converting matte by a blast underneath a column of material containing flux, maintaining a flow of the resulting slag to a reverberatory forehearth, supplying sulfur-bearing material to the slag in the forehearth, while subjecting the slag in a shallow layer to heat applied from above the level of the slag, thereby producing a low-grade matte which combines with metal or matte contained in the slag, and maintaining a flow of such low-grade matte back to the bessemerizing or converting region, substantially as set forth.

Witness my hand this 9th day of January, 1901.

OLIVER S. GARRETSON.

Witnesses:
JNO. J. BONNER,
C. B. HORNBECK.