(No Model.) 2 Sheets—Sheet 1.

G. M. HOLSTEIN & J. D. JAMES.

PROCESS OF AND APPARATUS FOR REFINING ZINC.

No. 554,184. Patented Feb. 4, 1896.

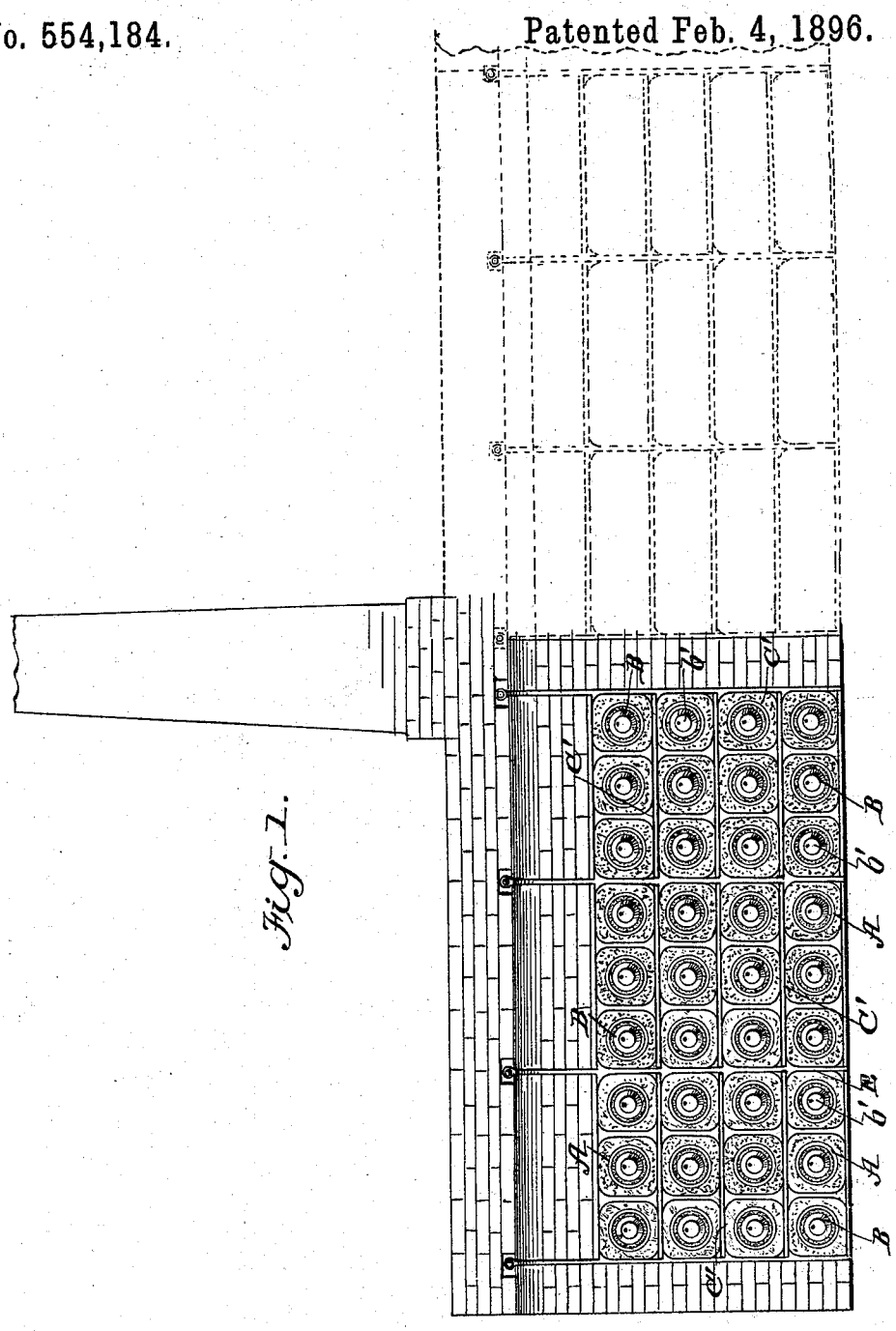


Fig. 1.

WITNESSES:
Jos. A. Ryan
Edw. W. Byrn.

INVENTORS
George M. Holstein
John D. James.
BY Munn & Co.
ATTORNEYS.

(No Model.) 2 Sheets—Sheet 2.

G. M. HOLSTEIN & J. D. JAMES.

PROCESS OF AND APPARATUS FOR REFINING ZINC.

No. 554,184. Patented Feb. 4, 1896.

Fig. 2.

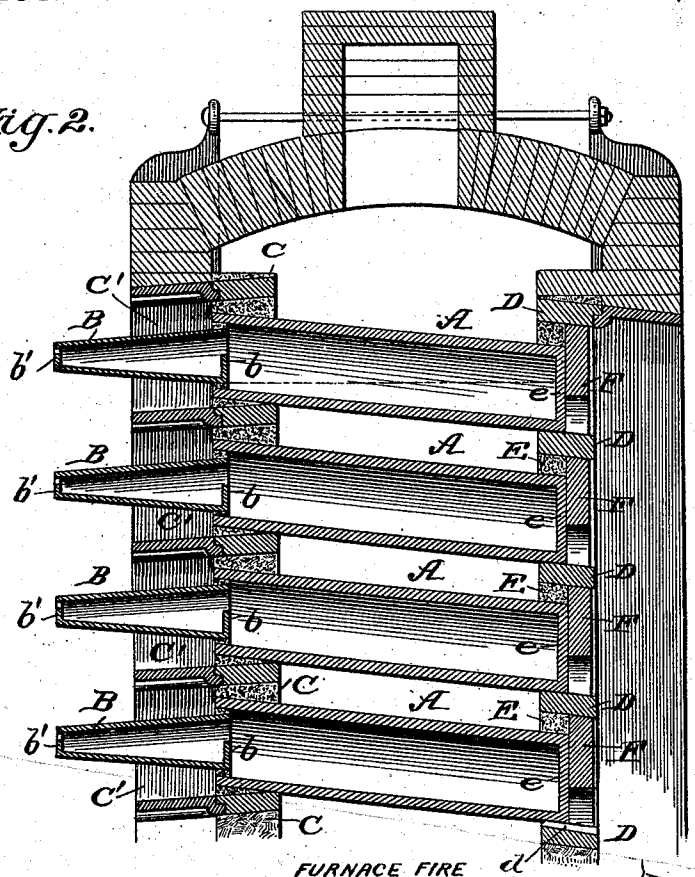


Fig. 4.

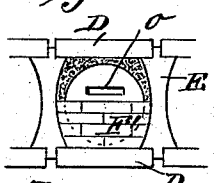


Fig. 5.

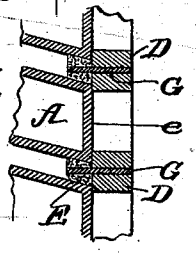


Fig. 3.

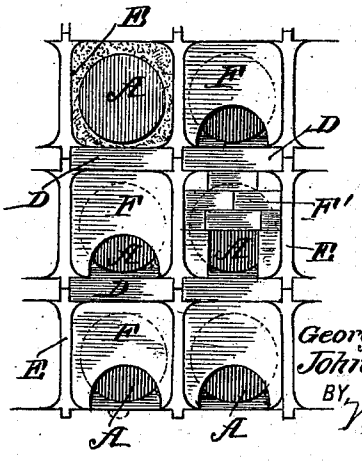


Fig. 6.

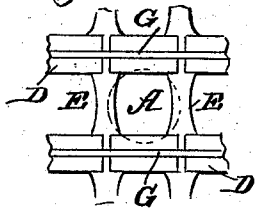
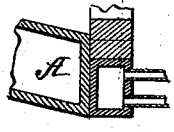


Fig. 7.



WITNESSES:

Jos. A. Ryan

Edw. W. Byrn.

INVENTORS

George M. Holstein

John D. James

BY Munn & Co.

ATTORNEYS.

UNITED STATES PATENT OFFICE.

GEORGE M. HOLSTEIN AND JOHN D. JAMES, OF PULASKI CITY, VIRGINIA, ASSIGNORS, BY DIRECT AND MESNE ASSIGNMENTS, TO THE BERTHA MINERAL COMPANY, OF JERSEY CITY, NEW JERSEY.

PROCESS OF AND APPARATUS FOR REFINING ZINC.

SPECIFICATION forming part of Letters Patent No. 554,184, dated February 4, 1896.

Application filed May 27, 1895. Serial No. 550,811. (No model.).

To all whom it may concern:

Be it known that we, GEORGE M. HOLSTEIN and JOHN D. JAMES, of Pulaski City, in the county of Pulaski and State of Virginia, have invented a new and useful Improvement in Processes of and Apparatus for Refining Zinc, of which the following is a specification.

The object of our invention is to provide a process and apparatus for refining zinc spelter, and more especially for separating therefrom the lead with which it may be contaminated; and it consists in certain steps for carrying out the same based upon the relative specific gravity, the melting-points, and volatilizing-points of these two metals, and a special construction and arrangement of furnace and retorts for making the same practically available, as will be hereinafter more fully described with reference to the drawings, in which—

Figure 1 is a front elevation of a portion of the furnace; Fig. 2, a vertical section through a portion of the retorts, condensers, and their front and back supports; Fig. 3, a rear view of a part of the back end wall or supporting-shelves for the back ends of the retorts, partly broken away; and Figs. 4, 5, 6, and 7 are details of modifications.

In the drawings, Fig. 2, A A represent the retorts made of clay and baked in the usual manner, and having their back ends *e* closed, and their front ends provided with the tapering conical condensers B, into which the volatilized zinc is condensed and collected when distilled from the retorts. These condensers are luted or cemented temporarily in the open ends of the retorts with a paste of clay, and are of the usual construction, being made at the lower edges of their larger open end with a semicircular bridge wall or dam *b* which prevents the boiling metal in the retorts from slopping over into the condenser, and also prevents the pure distilled and molten zinc in the condenser from running back into the retort. The outer and smaller end of this condenser is partly closed with a stopple *b'* of clay, which is removed when the contents of the condenser are to be drawn off.

The outer ends of the retorts are held in a front wall composed of an inner lining C, of fire brick and clay, and a facing of cast-iron boxes C' through which the condensers protrude, the whole being arranged to form a bank or nest of retorts, condensers and box-frames, as shown in Fig. 1, which are secured in place in the usual manner by iron buck-stays and tie-rods, and thus integrally organized.

At the back end the retorts are surrounded by a luting E^2 of clay and are entered into and supported upon a checker-work or skeleton frame of fire-brick composed of horizontal tile-blocks D of fire-brick and vertical standards E of the same material having concave side and tenons at top and bottom, as shown in Fig. 3. These fire-clay nests protrude beyond the back ends of the retorts far enough to receive an outer cap or covering of fire-clay tile or brick. This cap may be made in one piece, as shown at F, or be built up from bricks or sectional tile, as shown at F'. In either case this closure or cap at the back end of the retort only covers the upper portion of it, leaving the lower portion exposed for the purpose hereinafter described. In building this wall at the back end of the retorts in large furnaces we propose, for the purpose of greater stability, to incorporate an iron frame G therein, as shown in Figs. 5 and 6, which frame has the fire-brick packed in its cells.

Having thus described the construction of the furnace, we will now show how the process is carried out therein, and first let it be understood that we cant or incline all of the retorts, so that their back ends are about four inches lower than their front ends, as shown in Fig. 2.

The zinc spelter in the form of bars having been first charged into the retorts, the heat from the subjacent fire circulating up through the retort causes it to melt and assume a level, (shown by the dotted line in Fig. 2,) and then as the proper temperature is reached the zinc volatilizes, and, passing over into the condensers, is collected in the form of pure melted zinc.

The furnace fires are so regulated as to keep the retorts as nearly as possible at the

temperature at which zinc volatilizes, (1,040° centigrade,) lead, the chief impurity which this process is designed to remove, requiring a slightly higher temperature to volatilize. As soon as the spelter begins to melt, the lead, owing to its lower melting-point (330° centigrade as compared with zinc 412° centigrade) and owing also to its greater specific gravity, (lead, 11.37, zinc, 7.3,) collects in the lowest part of the retort at the back end. This part of the retort, it will be seen, is partly exposed to the air, which chills or lowers the temperature of the metal within. This, it will be seen, by diminishing ebullition at this point, gives the necessary condition of quiescence in the molten metal, and the greater specific gravity of the lead has a chance to assert itself and carry the lead to the bottom, and the cooling of the exposed end of the retort also so lowers the temperature as to get below the volatilizing-point of lead, so that the latter is not carried over into the condenser with the zinc, which is thus distilled in a condition of almost perfect purity, running from 99.80 to 99.98 per cent. of pure zinc. A proper regulation of the temperature of the furnace is all that is required from this stage of the treatment on to maintain and continue the separation of the lead from the zinc.

The zinc volatilizing passes over the bridge into the condenser, where it condenses into the molten condition, and so remains until drawn off or ladled out.

The lead kept in the coolest part of the retort is not volatilized, but in part is absorbed by the silica of the retort forming lead silicate, and in part remains at the lowest end of the retort, as metallic lead, and at intervals is removed with rabbles through the front end of the retort.

In our process it will be seen that there are two co-operating and necessary features to our invention. One is the making of the back end of the retort lower than the front end, so as to cause the molten metal to flow to that end, and the other is the exposure and chilling of that end of the retort, so as to take advantage of the distinguishing physical qualities of lead—*i.e.*, its greater specific gravity, its lower melting-point, and its higher volatilizing-point—that is to say, lead having a lower melting-point first melts and runs to the back end of retort, and, having a higher volatilizing-point, the chilled end of the retort keeps it from volatilizing and also promotes such quiescence in the molten metal at this point as to facilitate the separation of lead into a lower layer by virtue of its greater specific gravity.

Ordinarily the back ends of the retorts are the hottest, because they are arranged centrally in the furnace. In our invention the back ends of the retorts are in an outside wall and exposed to the air at certain points. We prefer to expose the lower edge of the retort, as shown in Figs. 2 and 3, for the reason that the molten metal is in this lower plane, while the volatilized pure zinc occupies the upper zone or layer and should not be chilled since its continuous volatilization is necessary to its separation. We also in some cases form a small channel *d* in the supporting-tile D beneath the retort, which lets air in and further chills this end. We find good results, however, following the chilling of any portion of the back end of the retort, and in some case we expose the upper edge of the back end of the retort, as shown in Fig. 4. This is not because it is most desirable in itself, but it affords us another means of charging the metal plates of spelter into the retorts, for in such cases we make an opening *o* in the upper part of the back end of the retort large enough to receive the full size pig or plate of spelter, which is at once charged into the retort without being remelted into smaller bars, as is necessary when the spelter is charged into the retort through the relatively small opening of the condenser at the other end. This opening *o* is during the process closed up with a mixture of an equal bulk of clay and coal-dust, which is made firm by ironing with a hot iron after being applied to the opening.

As a further modification for chilling the back end of the retort we may employ a water-jacket, as shown in Fig. 7, in which the water-chamber A^2 is supplied with a flowing body of water through suitable inlet and outlet pipes.

We do not confine our invention to separating lead from zinc, as it is obvious that any other metals having similar relative characteristics may be separated by the same process and apparatus.

Having thus described our invention, what we claim as new, and desire to secure by Letters Patent, is—

1. The process herein described of refining zinc and separating it from lead, which consists in melting the spelter and causing the lead by its lower melting-point greater specific gravity and higher volatilizing-point to flow to a point of lower level, chilling the metal at this point, to hold the lead below its volatilizing-point, and volatilizing and separating the zinc at a temperature below the volatilizing-point of lead substantially as shown and described.

2. A refining-furnace for zinc having retorts with one end lower than the other, and having at their lower ends a supporting-wall with openings through it which are opposite to the lower part of that end of the retort, the said wall covering and inclosing the upper part of said end of the retort substantially as and for the purposes described.

3. A refining-furnace for zinc having retorts with one end lower than the other, and having at their lower ends a supporting-wall provided with an opening *d* passing entirely

through the said wall below the bottom of the lower end of the retort substantially as and for the purposes described.

4. A refining-furnace for zinc having retorts with their back ends lower than their front ends, a back wall composed of horizontal tile D, and vertical tile E with tenoned ends fitted to the horizontal tile so as to form an open wall or support, and a detachable cap or filling of tile or brick covering a portion of the end of the retort substantially as and for the purposes described.

GEO. M. HOLSTEIN.
JOHN D. JAMES.

Witnesses:
T. L. MASSIE,
D. W. BARNARD.