(No Model.)

W. B. DEVEREUX.

METHOD OF SEPARATING LEAD AND BASE BULLION FROM SLAG, &c.

No. 407,337. Patented July 23, 1889.

Fig. 1.

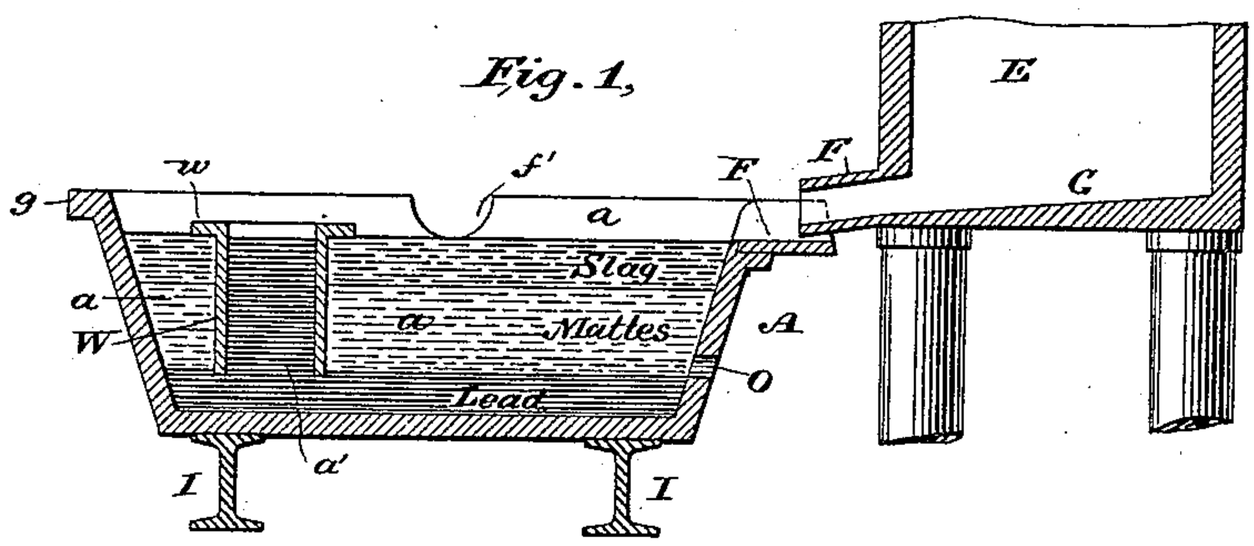


Fig. 2.

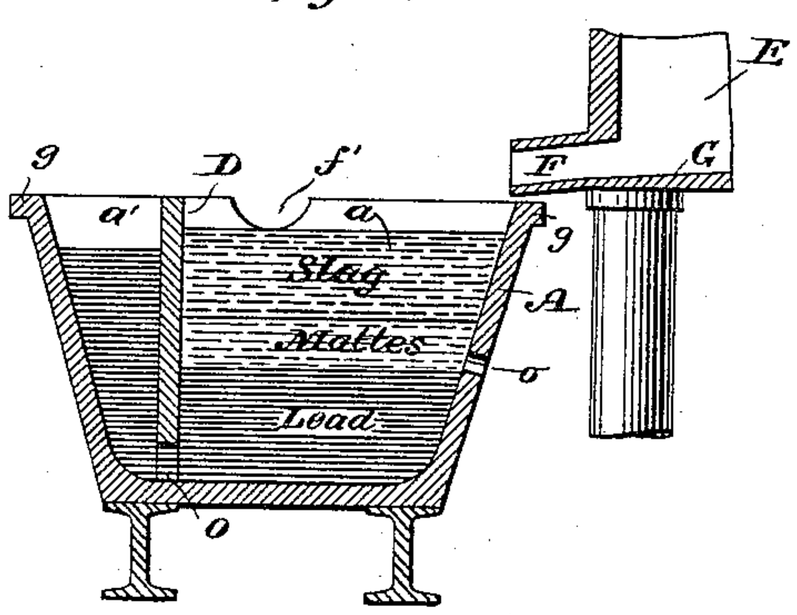


Fig. 3.

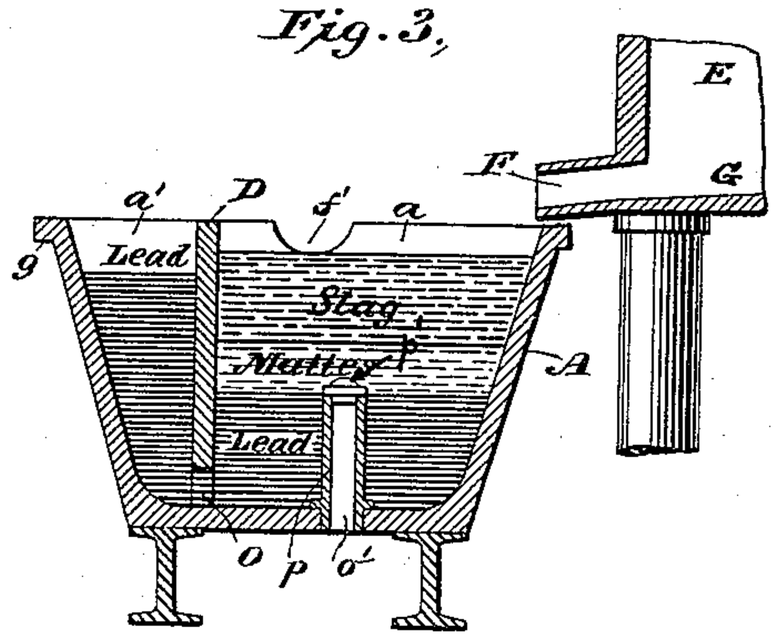
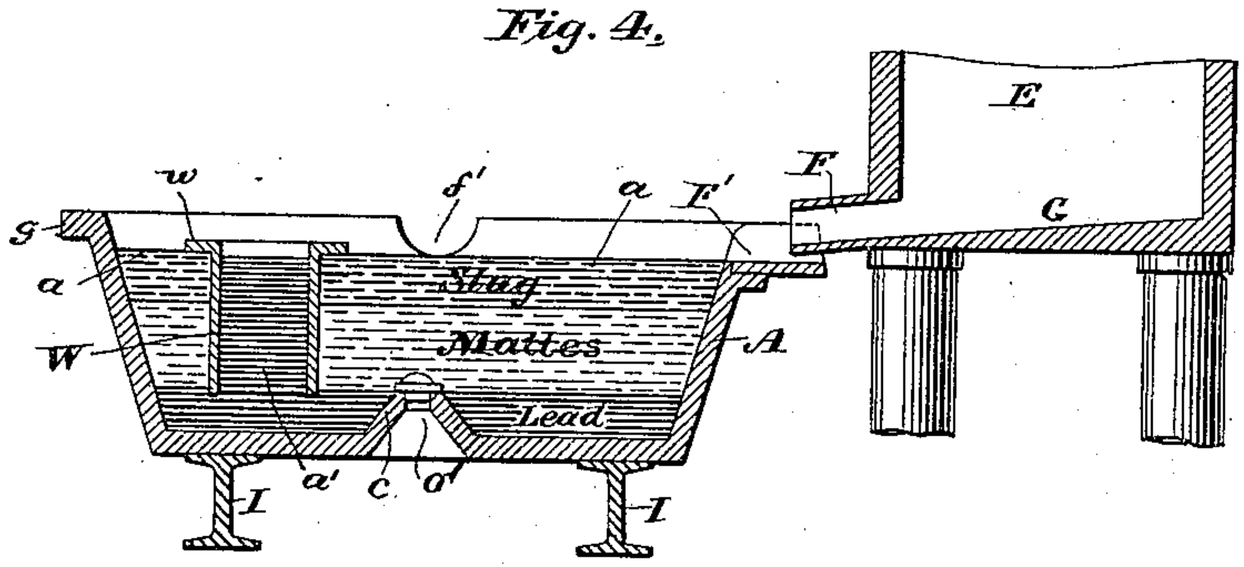


Fig. 4.



Witnesses
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UNITED STATES PATENT OFFICE.

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METHOD OF SEPARATING LEAD AND BASE BULLION FROM SLAG, &c.

SPECIFICATION forming part of Letters Patent No. 407,337, dated July 23, 1889.

Application filed April 4, 1889. Serial No. 305,958. (No model.)

To all whom it may concern:

Be it known that I, WALTER B. DEVEREUX, a citizen of the United States, and a resident of Glenwood Springs, Garfield county, Colorado, have invented certain new and useful Improvements in the Method of Separating Lead and Base Bullion from Slags, Mattes, and Speiss, of which the following is a specification.

My invention relates to a method of separating lead and the alloys of silver, gold, and other metals with lead, commonly known as "base bullion," from the slags and mattes which are formed in the smelting of the ores of such metals, and the object of the same is to effect the said separation outside of the furnace, while it is still running, in a more convenient manner than has heretofore been possible. It has heretofore been the practice in smelting silver ores and bullion to make use of a furnace provided with an interior hearth or crucible, into which the bullion, mattes, and slags settle after reduction, and to use in connection therewith some one of the many forms of devices which are in common use for separating out and removing the base bullion or lead while the same are still liquid and for tapping off the mattes and slags from the furnace, either together or separately. The most usual manner of tapping off bullion is to connect the furnace-crucible with an exterior basin, in which the molten base bullion or lead rises, owing to the static pressure of the column of liquid material in the furnace-hearth, and from which the bullion is removed by means of a ladle as it accumulates. The automatic or so-called "siphon" tap, which is largely in use throughout the western portion of the United States, is widely used for this purpose.

All of the various methods heretofore made use of for tapping off the bullion from furnaces are open in practice to very many and serious objections. The principal objection is that in cases where the ores to be smelted contain copper, zinc, baryta, or other impurities accretions are liable to be formed in the crucible, the formation of which is extremely difficult to prevent, and the growth of which causes an eventual stoppage of the furnace before it would otherwise be necessary, owing to the stoppage and chilling of the lead-well and the difficulty of keeping open the passage through the walls of the hearth. The accretions, which are hard tough masses, have to be removed by chiseling, to accomplish which it is necessary for the furnace to be put out of blast and cooled off. Now, I have discovered that by tapping the fluid contents of the furnace after smelting at intervals or continuously into an external receptacle provided with certain agencies in its interior for automatically separating the lead or so-called "base bullion" from the slags and mattes, and the former from the latter, by means of their specific gravity, I am able to effect a much more convenient and economical separation of the base bullion, as well as the mattes, from the slags than has been possible heretofore, to prevent also the formation of accretions, and at the same time to effect great economy in furnace construction. The reason of this is due to the fact that a furnace can be used in which nearly the entire crucible is eliminated. Moreover, the separation of the various portions of the smelted mass in a vessel outside of the furnace-hearth brings about greater regularity of working, thus producing campaigns of much greater length.

The invention will be best understood by reference to the accompanying drawings, containing four figures, which show the method of separation by means of combinations of different equivalent devices.

As above stated, the invention consists, to a certain degree, although not necessarily, in continuously tapping the smelted mass from the furnace into an exterior separating-vessel. To effect such continuous tapping, the furnace-hearth will naturally be eliminated and the furnace-bottom placed close up to the fusion-zone. In cases of furnaces already built it is possible to use the invention successfully by filling the bottom with refractory material up to the tap-hole.

In the ordinary shaft-furnace, which in the views is designated by E, the crucible is dispensed with and the bottom G made to incline slightly downward from the back toward the breast. The furnace is provided with the ordinary form of furnace tap hole and spout F, through which the entire smelted portion of the charge is drawn off.

The vessel A, which in my invention is substituted for the furnace-crucible, may be of any convenient dimensions, shape, or material; but in practice it will be found convenient to make it out of cast-iron, rectangular in shape, with the sides flaring from bottom to top and the corners rounded off. It may be provided at its upper rim with a flange *g*, to enable it to be dumped by seizing it with hooks attached to the arm of a crane. The separation of the lead and base bullion from the other materials tapped into the vessel is effected by means of a lead-well W, as shown in Figs. 1 and 4, or a diaphragm D, as shown in Figs. 2 and 3, with an opening O in the bottom, which may be supported in the receiver or well in any convenient manner, and may be movable or permanent, as may be found desirable.

In practice the lead-well is made in the form of a cylinder open at the top and bottom, and any method of supporting the lead-well in the receiver may be employed. The cross-section of the lead-well need not necessarily be cylindrical, but may be rectangular, elliptical, or even octagonal. In practice, however, the cylindrical form and a movable well will be found to be preferable for a variety of reasons. In this way the receiver is divided into two compartments *a* and *a'*, the latter within the former.

In place of the lead-well a vertical partition wall or diaphragm D may be used in the receiver, provided with an opening O at its bottom, as shown in Figs. 2 and 3, thus dividing the receiver, as before, into two compartments *a* and *a'*, connected at the bottom. Any other device or sets of devices may be used that will divide the receiver into two compartments of equal or unequal dimensions.

For the purpose of permitting the tapping off of the mattes as they accumulate, any suitable device or sets of devices may be employed that will permit of the desired separation. Thus, for example, an opening *o* may be provided in any one of the side walls of the receiver at a certain distance above the bottom of the same, as shown in Figs. 1 and 2. The essential part of my invention, so far as the use of this device is concerned, consists in placing this tap-hole at such a height above the bottom of the receiver that it will be above the line to which the lead settles therein. If the tap-hole were below the line of the lead, either lead or bullion would be drawn out when the tap was opened; or if the lead or bullion were allowed to get so low in the receiver as to be below the tap-hole the mattes, which float upon the lead or bullion, would then run into the lead-well or under the diaphragm and clog it up or cause great trouble or inconvenience. This opening may be closed in any convenient manner; but in practice a stopping of fire-clay may be used, or a cast-iron plug, or, in fact, any other substance that will not cause the generation of gases in the interior of the receiver by reason of its proximity to the smelted mass.

Instead of the opening *o*, the device shown in Fig. 3 may be employed. In this arrangement a pipe *p*, made of cast-iron or other material, of convenient diameter, open at both ends, is fitted into an opening in the bottom of the receiver and rises vertically in the interior to a point above that to which the lead will settle. The pipe may be closed in the same manner as the opening by means of an iron plug, or, preferably, by a stopping of fire-clay *p'*, as shown in the views, and may be opened by knocking out the plug by a bent rod or otherwise. Another and equivalent device for doing the same work is shown in Fig. 4. Here a hollow cone *c* or cylinder is cast in or attached to the bottom of the receiver, which cone is provided with an opening *o'* at its upper extremity, and the height of the same will be regulated by the height to which it is found that the lead will rise in the bottom of the receiver. The cone may be closed in the same manner as the pipe *p*.

In each form of apparatus a slag-spout *f'* is provided at the upper edge of the pot, through which the slag, being the lightest portion of the material tapped, flows off continuously into any desired receptacle.

The method of separation effected by such an apparatus is as follows: In the smelting of lead ores, as is well known, the various products and by-products of the furnace differ in specific gravity. The lead and base bullion, as they issue from the furnace, are slightly heavier than the mattes, speiss, and slags which flow out with them, and will consequently settle to the bottom of any vessel in which all of the furnace products are collected while molten, allowing the mattes, speiss, and slags to float on the top of the lead. Where the entire contents of the furnace-crucible is tapped into one compartment of a vessel divided into two compartments connected at the bottom, the lead as it settles to the bottom of the compartment into which the mass is tapped will flow through the opening under the dividing-wall into the other compartment, and will rise in that compartment in proportion as the static pressure of the liquid in the first compartment increases. The slag, mattes, and speiss, being lighter than the lead, and also liquid, will, by reason of their greater volume, keep the static pressure of the column of liquid in the two compartments practically constant, while the slag, being lighter than the mattes and speiss, will form the top of the mass, and the top layer of the same will cool rapidly and form a crust, which answers all the purposes of a cover to the receiver.

The effect of the insertion of a lead-well or a diaphragm with an opening in its bottom into the receiver described is to divide the latter into two compartments, which are connected with each other through the open bot-

tom of the lead-well or the opening in the diaphragm. When the melted material from the furnace, consisting of slag, mattes, speiss, and bullion, or either of them, is allowed to run, they immediately assume positions in the receiver in accordance with their relative specific gravity, the lead or bullion forming the lowest layer. As the lead or bullion accumulates in the receiver, it rises to a height in the lead-well or in the compartment back of the diaphragm equal to the static pressure of the material in the compartment *a* of the receiver. The lead may be dipped from compartment *a'* with a ladle from time to time as fast as it accumulates, it being necessary to leave only a layer of lead or bullion in the compartment *a'* of sufficient depth to seal the entrance into the lead-well or the compartment *a'*, as otherwise the mattes or speiss, which float directly on top of the lead or bullion in the compartment *a*, would enter the compartment *a'*, thereby causing great trouble and inconvenience. When a sufficient amount of mattes or speiss has accumulated in the receiver, the tap-hole, cone, or pipe, according to whatever device is used, is then opened and the mattes and speiss allowed to run out until slag commences to flow, when the orifice is immediately closed. By this means the matte is obtained in a comparatively pure condition and suitable for subsequent treatment. If for any reason lead or bullion is drawn out of this tap-hole or slag is allowed to run out with the matte, the former, after cooling, can easily be separated from the bottom of the matte, and the latter can be broken off from the top of the matte. The slag, which occupies the upper portion of the receiver, runs over through the spout provided for the purpose into the slag-buggy and is carried away.

I claim as my invention—

The hereinbefore-described method of separating lead and base bullion from slags, mattes, and speiss in the smelting of ores of precious metals, consisting in smelting the ores in a furnace having no crucible proper and in discharging the smelted mass into a receiver or collecting-well provided interiorly with devices, substantially as described, whereby the same is divided into two compartments, in one of which the lead and base bullion rise through the static pressure of the smelted mass in the other compartment, in tapping off the matte through an opening provided for that purpose in the side walls or bottom of the receiver, and allowing the slags to flow off automatically from the top of the receiver through a suitable aperture.

In testimony that I claim the foregoing as my invention I have signed my name, in presence of two witnesses, this 15th day of March, 1889.

WALTER B. DEVEREUX.

Witnesses:
JOHN CARDWELL,
H. LIDSTROM.