(No Model.)

W. B. DEVEREUX.

APPARATUS FOR SEPARATING LEAD OR BULLION IN SMELTING FROM SLAGS, MATTES, OR SPEISS.

No. 407,335. Patented July 23, 1889.

Fig. 1.

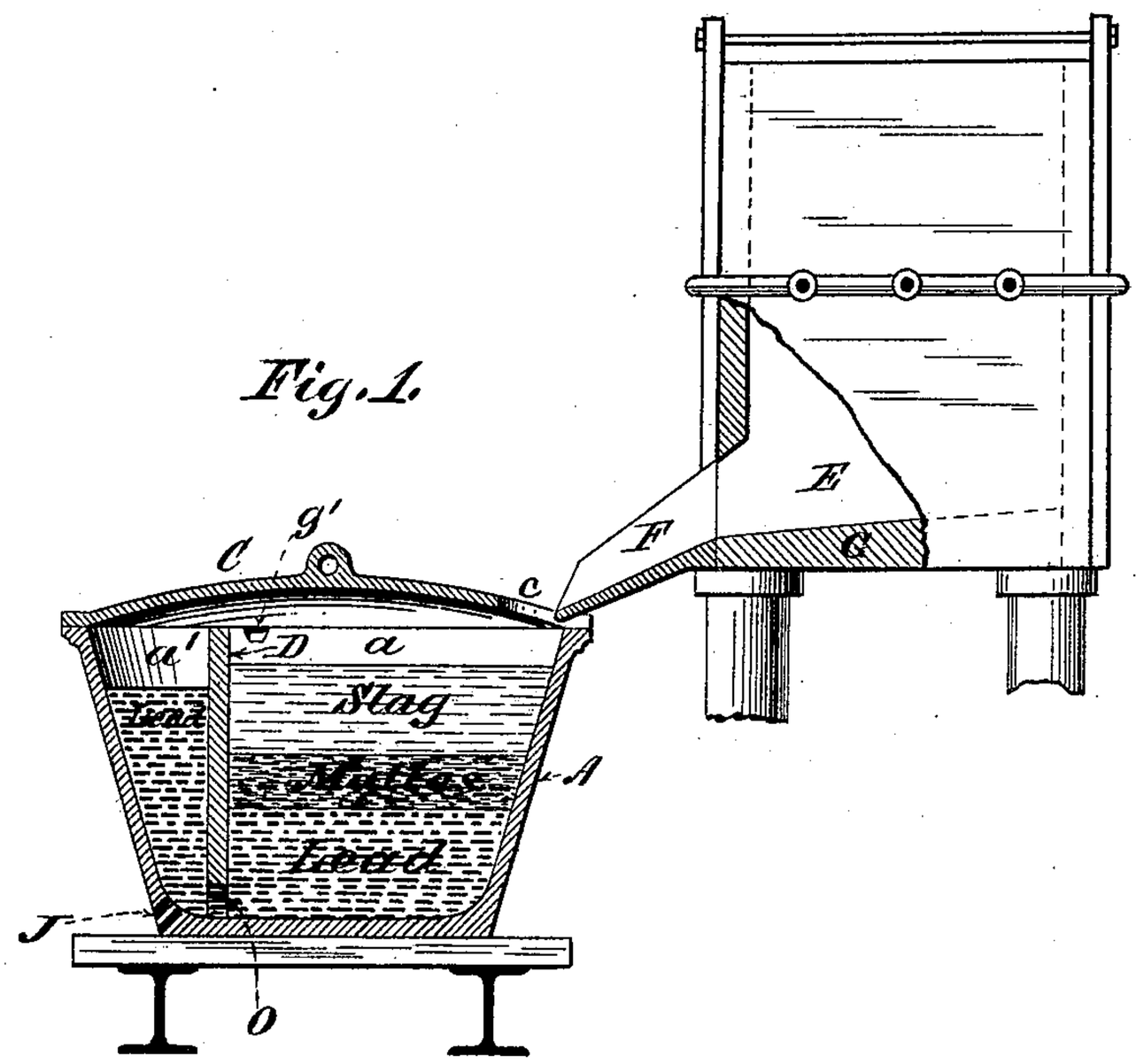


Fig. 2.

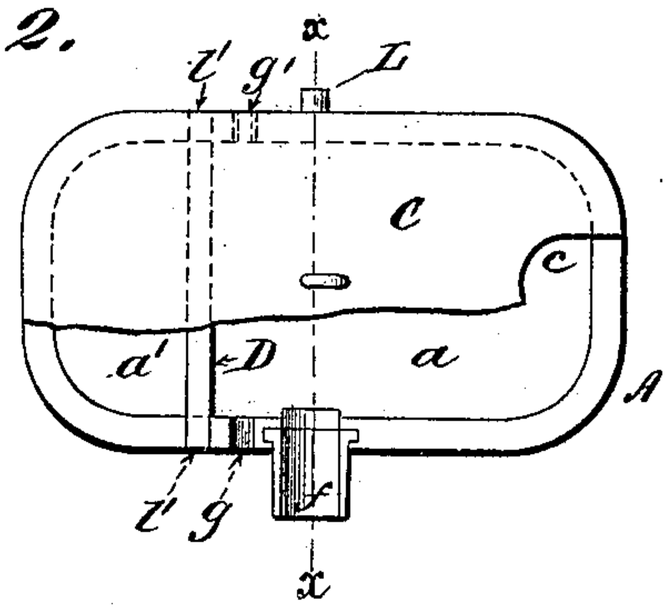
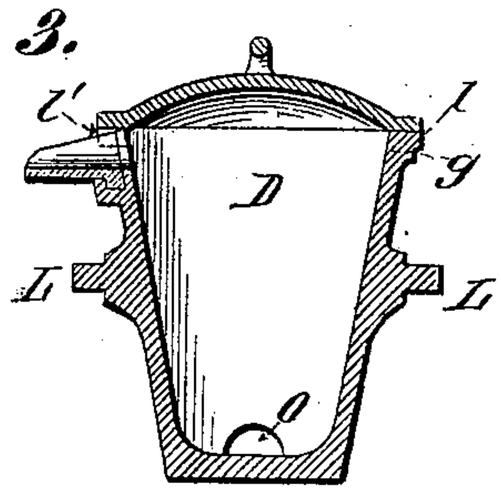


Fig. 3.



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WALTER B. DEVEREUX, OF ASPEN, COLORADO.

APPARATUS FOR SEPARATING LEAD OR BULLION IN SMELTING FROM SLAGS, MATTES, OR SPEISS.

SPECIFICATION forming part of Letters Patent No. 407,335, dated July 23, 1889.

Application filed February 24, 1886. Serial No. 193,065. (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 Aspen, in the county of Pitkin and State of Colorado, have invented certain new and useful Improvements in Apparatus for Separating Lead or Base Bullion in Smelting from Slags, Mattes, and Speiss, of which the following is a specification.

My invention relates to an apparatus for separating lead and the alloys of silver, gold, and other metal 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, and 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 and 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 by reason of the static pressure of the column of liquid material in the furnace-hearth, and from which the bullion is removed from time to time as it accumulates by means of a ladle. 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 of 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. 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, in which—

Figure 1 is a vertical longitudinal section of the apparatus; Fig. 2, a plan view of the same, and Fig. 3 a vertical cross-section on the line *x x* of Fig. 1.

Similar letters refer to similar parts throughout the several views.

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 after reduction.

The vessel, which in my invention is substituted for the furnace-crucible, is designated in the views by A. It may be of any convenient dimensions, shape, or material; but in practice it will be found most convenient to construct it of cast-iron, of rectangular form, with the sides slightly flaring from bottom to top and the corners rounded off. It may, if desired, 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 the diaphragm or partition D, with an opening O in its bottom, which divides the receiver into two compartments *a* and *a'*.

The diaphragm is made movable, so that its position in the receiver may be varied from time to time, as may be necessary, and so that it may be raised, lowered, or shifted therein, or readily removed when it is desired to clean out the receiver A, or to replace the diaphragm by a similar one having an opening in its bottom of a different shape or size. The diaphragm is made of cast-iron or other metal of any convenient thickness. In case the receiver is made with slightly-flaring sides, as shown in the views, the diaphragm will ordinarily be held in position by its own weight. Any device for holding the diaphragm may be employed; but in practice it will be found most convenient to provide it at the top with the projecting shoulders or lugs *l' l'*, fitting into corresponding nicks or grooves *g' g'* upon the upper edge of the receiver. By providing any number of pairs of grooves upon the upper edge of the receiver it is possible to hold the diaphragm at any desired point, and thereby vary the relative sizes of the compartments *a* and *a'*.

The diaphragm may be raised and lowered at pleasure when it is desired to increase the opening between the two compartments, or the diaphragm may be removed and replaced by one having a larger or smaller opening, as the case may be. The fact that the sides of the receiver are made flaring does not interfere with the raising or lowering of the diaphragm in the receiver, for the reason that the spaces left in such case at the sides, when a tapering diaphragm is used, are so small that the matte will chill in them and prevent any lead from flowing through them.

The opening O is placed at the base of the diaphragm, and is of any convenient size and shape. If desired, the diaphragm can be constructed of such dimensions that it will not reach to the bottom of the receiver, and so leave an opening between it and the bottom of the receiver, which will answer the same purpose as the opening O. A diaphragm with a semicircular opening at its center in the bottom will be found most convenient, for the reason that the opening can be closed from time to time with a piece of fire-clay, an iron plug, or other device, if it be desirable. The function of the diaphragm D, when placed in position shown in the views, is to divide the receiver into two separate compartments *a* and *a'* of varying size, according to the position of the diaphragm. These compartments will then be connected together at the bottom by means of the opening O in the lower end of the diaphragm, or the opening thereunder if a diaphragm shorter than the vertical depth of the receiver be used. Either end of the receiver, but preferably the receiving end, may be provided at its upper edge with a discharge-spout *f*, as shown in the views, in order that the contents of the receiver may be automatically discharged upon reaching a given height therein, in the manner hereinafter explained. In practice the spout *f* will be placed at a point upon the upper edge of the receiver as far as possible from the point where the material enters the same. The bottom of the receiver is provided with an opening J, which is filled up with fire-clay or with an iron plug while the vessel is running, and through which the lead may be drawn off by poking out the fire-clay or plug when the receiver for any reason becomes choked up with shell.

The receiver A, when constructed either of rectangular form or round, may be provided on either side with a pair of exterior lugs L L, cast in one piece with the same or bolted thereto, whereby the entire vessel with its contents may be lifted by a crane, carried to any desired point and dumped at pleasure. The receiving-well is provided with a cover C, provided with an opening *c* at one end to admit of the furnace-spout.

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 will flow off through the spout provided for its discharge.

The effect of the insertion of a diaphragm with an opening in its bottom into the receiver described is to divide the latter into two compartments *a* and *a'*, which are connected with each other through 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 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 the layer of lead or bullion in the compartment *a'* of sufficient depth to seal the entrance into 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.

Before the smelted mass is run into the receiver it will be found most convenient to close up the opening in the diaphragm by means of a piece of fire-clay or an iron plug. The opening is allowed to remain closed until the lead begins to settle in considerable quantities to the bottom of the compartment *a*. It is then opened by knocking out the fire-clay stopping or plug with a bar, and the lead will commence to flow in a practically-pure state into the compartment *a'*, and rise therein according as the pressure in the compartment *a* increases.

I am aware that attempts have been made to effect twofold separation of the ingredients of the mass tapped from smelting-furnaces by means of devices—such as the so-called "automatic" or "siphon" tap above referred to—attached to the furnace-crucible, and also by methods which employ a stationary lead-well placed outside of the furnace; also, that it is old to smelt ores in a furnace without a crucible, and to tap from a furnace into a movable receiving-well containing in its side walls openings for the purpose of effecting a separation of the materials contained therein; but I believe it is new to effect a threefold separation of the ingredients of the smelted mass by means of an apparatus which employs the agency of an exterior vessel containing in its interior movable devices by means of which the said separation is automatically effected through the specific gravity of the different portions of the smelted mass.

As I have heretofore, upon the 25th day of February, 1886, filed an application for Letters Patent for an apparatus for separating similar substances, numbered serially 193,200, and in which certain agencies are described, which may or may not be the same as those above described, I therefore disclaim the various combinations in the claims of said application contained, so far as the present application is concerned.

I claim as my invention—

1. The combination, with an exterior receiver or collecting-well, into which the molten products of the smelting-furnace are tapped, of a movable partition for the separation of the heavy from the light molten products.

2. The combination, with an exterior receiver or collecting-well into which the molten products of the smelting-furnace are tapped, of interior devices within said receiver, so constructed and arranged that they may be raised, lowered, removed, and replaced or moved to any point in the receiver for separating the lead and base bullion and the slags from the intermediate portions of the smelted mass.

3. The combination, with an exterior receiver or collecting-well into which the molten products of the smelting-furnace are tapped, of a diaphragm in the interior of said receiver so constructed and arranged that it can be raised, lowered, removed, and replaced or moved to any point therein, whereby the same is divided into two compartments, an opening in the bottom of or under said diaphragm connecting said compartments, whereby the heavier material discharged from the furnace into the one compartment flows into and rises in the other compartment in proportion as the static pressure in the first compartment increases, and a discharge-spout at the receiving side of the well, whereby the lighter material is discharged.

4. The combination, with an exterior receiver or collecting-well into which the molten products of the smelting-furnace is tapped, of a diaphragm in the interior of said receiver, so constructed and arranged that it can be raised, lowered, removed, and replaced or moved to any point therein, whereby the receiver is divided into two compartments, means, substantially as described, for holding said diaphragm in position, an opening in the bottom of or under said diaphragm connecting said compartments, whereby the heavier material discharged from the furnace into the one compartment flows into and rises in the other compartment in proportion as the static pressure in the first compartment increases, and a discharge-spout at the receiving side of the well, whereby the lighter material is discharged as it accumulates.

Signed at New York, in the county of New York and State of New York, this 15th day of February, A. D. 1886.

WALTER B. DEVEREUX.

Witnesses:

EDWIN T. RICE, Jr.,

WILLARD P. BUTLER.