

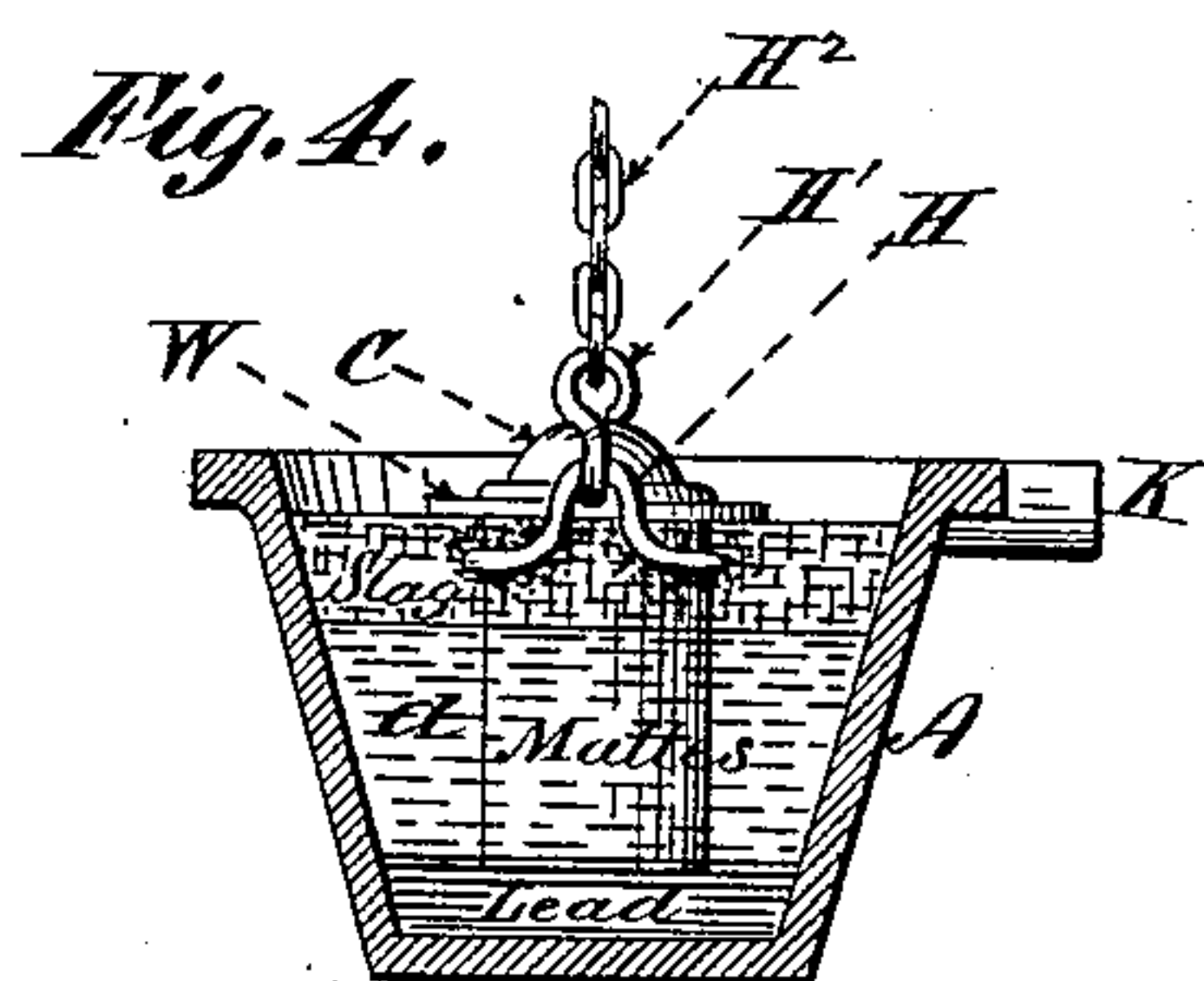
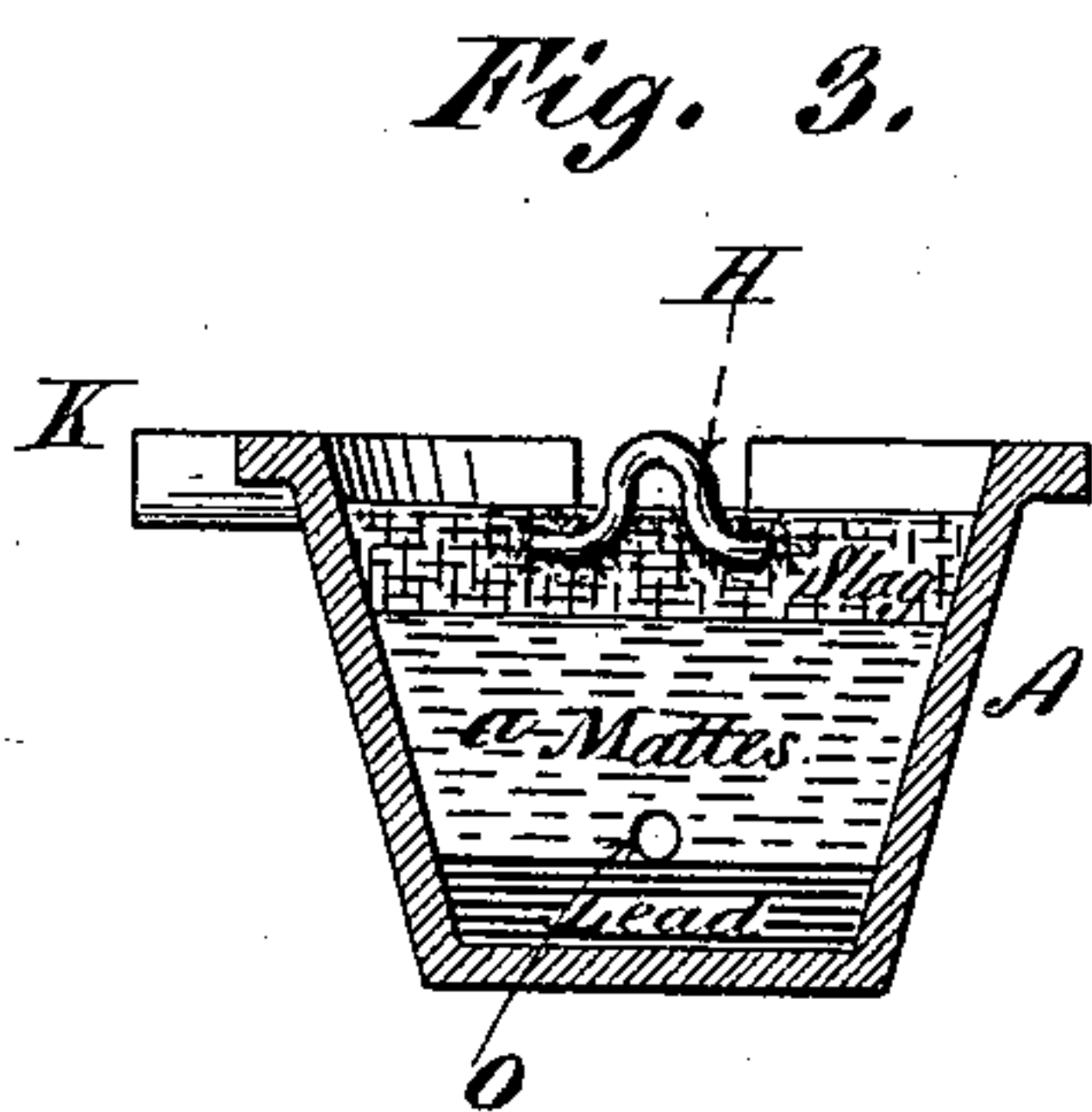
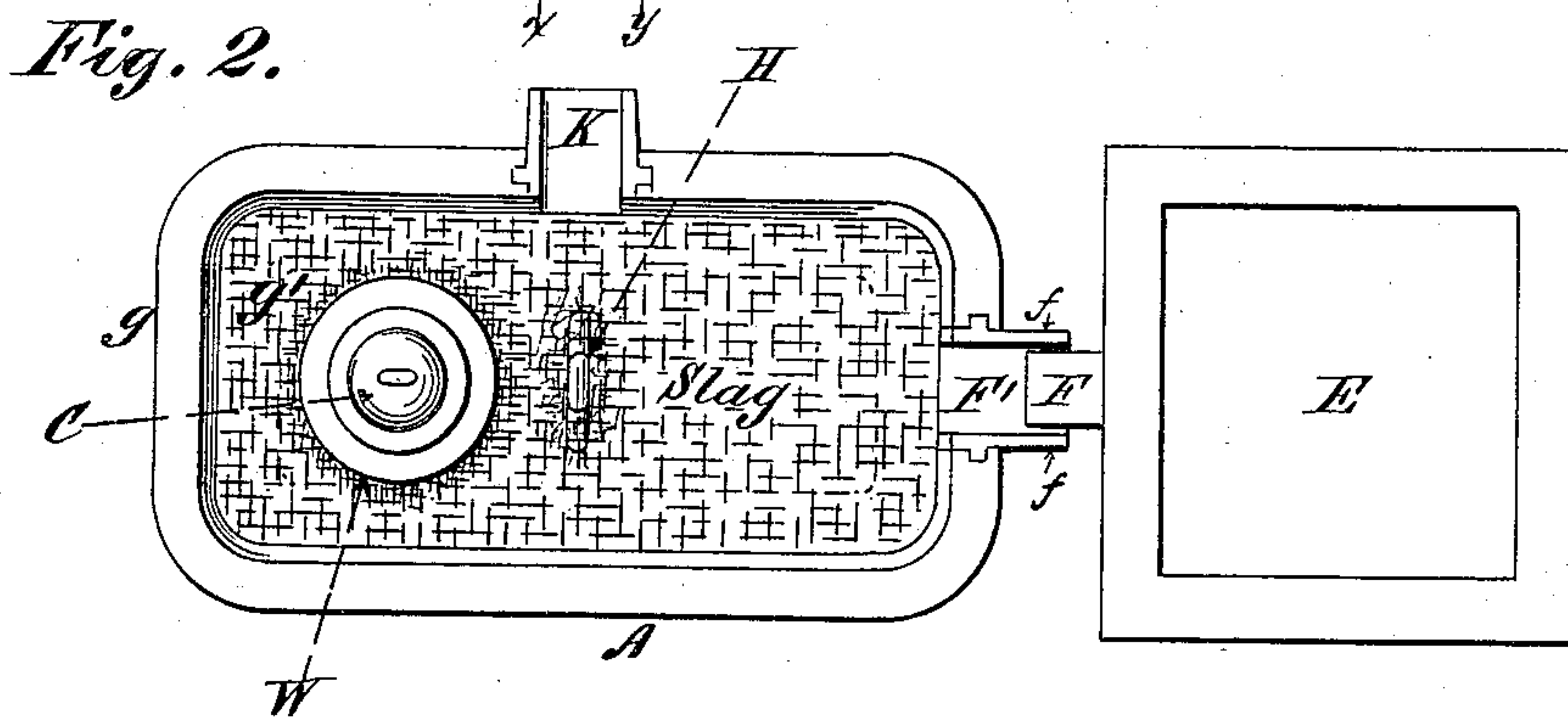
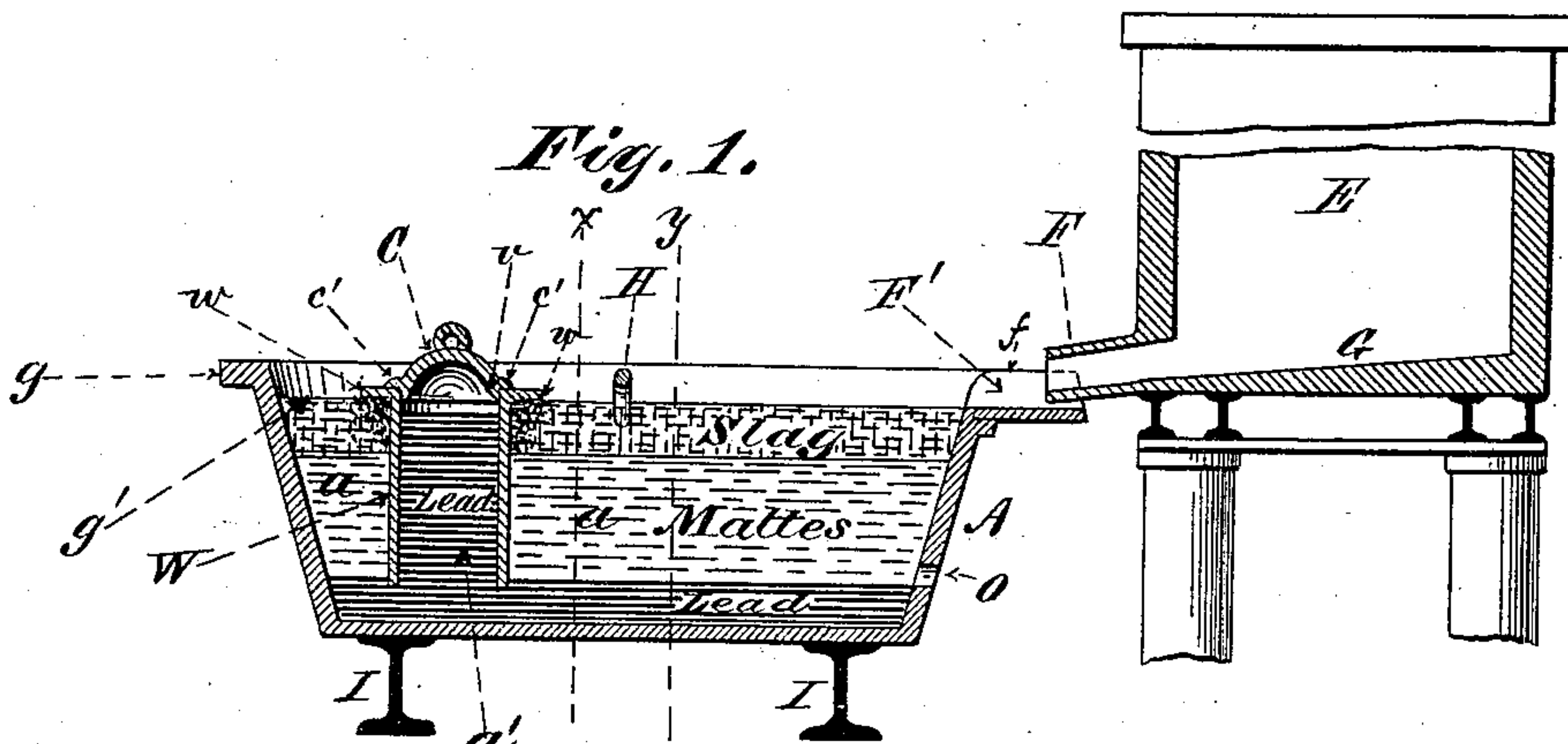
(No Model.)

W. B. DEVEREUX.

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

No. 407,336.

Patented July 23, 1889.



Witnesses:  
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# UNITED STATES PATENT OFFICE.

WALTER B. DEVEREUX, OF ASPEN, COLORADO.

APPARATUS FOR SEPARATING SLAGS, MATTES, AND SPEISS, AND LEAD OR BASE BULLION IN LEAD-SMELTING.

SPECIFICATION forming part of Letters Patent No. 407,336, dated July 23, 1889.

Application filed January 12, 1888. Serial No. 260,508. (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 a certain new and useful Improvement in Apparatus for Separating Slags, Mattes, and Speiss, and Lead or Base Bullion in Lead-Smelting, of which the following is a specification.

My invention relates to the separation of 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 hitherto 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 is 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 for this purpose, is too widely known and used to require description in this connection.

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 the passage open through the walls of the hearth. The accretions, which are hard, tough masses, have to be removed by chiseling, necessitating the furnace being put out of blast and cooled off. Now, I have discovered that by tapping at intervals or continuously the fluid contents of the furnace after smelting into an external or movable receptacle provided with means of the character hereinafter described for separating the lead or so-called "base bullion" from the slags and mattes, and the former from the latter, 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, and to prevent also the formation of accretions, and at the same time to effect great economy in furnace construction, for the reason that a furnace can be used in which nearly the entire crucible is eliminated, and by reason of the separation of the various portions of the smelted mass in a vessel outside of the furnace-hearth greater regularity of working is brought about, thus producing campaigns of much greater length.

My invention, which consists in an apparatus for separating the base bullion and slag from each other and from the mattes or speiss, 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; Fig. 3, a vertical cross-section on the line X X of Fig. 1, looking toward the right; and Fig. 4, a vertical cross-section on the line y y of Fig. 1, looking toward the left.

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 fill-



ing the bottom with refractory material up to the tap-hole. In the drawings, E is an ordinary shaft-furnace, in which the crucible is dispensed with and the bottom G made to incline slightly downward from the back toward the breast in the manner shown in the views.

F represents the ordinary form of furnace tap-hole and spout, through which the entire smelted portion of the charge is drawn off. The vessel which in my invention is substituted for the furnace-crucible is represented in the views by A. It 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, as shown in the views, with the sides flaring from bottom to top and the corners rounded off. It is 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 A is effected by means of a movable lead-well W, which may be supported in the receiver or well A in any convenient manner. In the views the lead-well W is made in the form of a cylinder open at the top and bottom. The lead-well terminates at its upper extremity in a flaring circular flange *w*. The lead-well is covered by means of a separate cover C, which rests upon the flange *w* of the lead-well and serves to support the cover, and is provided with an interior flange *v*, which fits against the inner edge of the lead-well and serves to keep the cover C in place. Any method of supporting the lead-well W in the receiver A may be employed that will permit of the removal of the lead-well W from the receiver on such occasions as may be necessary, the essential part of the construction described consisting in the removability of the lead-well.

I have found in practice that the simplest method of supporting the lead-well is to hold it in the proper position when the melted slag is first run into the receiver. As soon as the upper crust of the slag cools around the lead-well it forms a solid support for the well. At the same time a piece of bent iron with the loop or hook at the top may be inserted in the upper part of the melted slag, and when it is desired to remove the accumulated slag-crust and lead-well from the receiver it can easily be done by attaching any suitable lifting device to this hook. The cross-section of the lead-well need not necessarily be cylindrical. It may be rectangular, elliptical, or even octagonal; but in practice the form shown in the drawings will be found to be preferable.

For the purpose of permitting the tapping off of the mattes as they accumulate, an opening O is provided in any one of the side walls of the receiver A a certain distance above the bottom of the same. The essential part of my invention consists in placing this tap-

hole at such a height that it will be above the bottom of the movable lead-well when the latter is in place. The purpose of this tap-hole is to draw off the mattes which accumulate in the receiver from time to time as it becomes necessary. If the tap-hole were below the bottom of the lead-well, 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 and clog it up or cause great trouble or inconvenience. This hole O 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.

For the purpose of facilitating the discharge of the furnace into the receiver A, an inflow-spout F' is provided, with the parallel side walls *f f* at the upper edge of the receiver, as shown in Figs. 1, 2, and 3. When the receiver is placed under the furnace-spout F, it is impossible to hoist the shell or slag from the receiver without moving the same. By providing such a spout F', which passes under the furnace-spout F, it is only necessary to break off the small portion of the shell which has cooled in the spout F' to enable the entire contents of the receiver to be removed. The inflow-spout F' may be cast in one piece with the receiver or may be made separate and fastened to it in any convenient manner. For the purpose of removing the material collecting and hardening in the upper part of the receiver, a piece of bent iron H is cooled in the slag as it runs in. When the mass becomes cold, it may be removed by means of this piece of iron and a hook H' attached to a chain H<sup>2</sup> in the manner heretofore described. To permit of the automatic discharge of the slag when the vessel is full, a discharge-spout K is provided, attached to the upper rim of the receiver A in any convenient manner.

The method of separation effected by the apparatus and the mode of operation of the same are 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 which are 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



between the compartments into the other compartment, and will rise in that compartment in proportion as the static pressure of liquid in the first compartment increases. The slag, mattes, and speiss, although lighter than the lead, being liquid, will keep the hydrostatic 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 the movable lead-well W into the receiver A is to divide the latter into two compartments *a* and *a'*, which are connected with each other through the open bottom of the movable lead-well. 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 equal to the static pressure of the material in the receiver outside of the lead-well. The lead may be dipped from this lead-well 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 outside receiver of sufficient depth to seal the entrance into the lead-well, as otherwise the mattes or speiss, which float directly on top of the lead or bullion, would enter the lead-well, thereby causing great trouble and inconvenience. When a sufficient amount of mattes or speiss has accumulated in the receiver, the tap-hole is then opened and the mattes and speiss allowed to run out until slag commences to run out of the tap-hole, when the orifice is closed. By this means the matte is obtained in a comparatively pure condition and suitable for subsequent treatment. If by any means, or if owing to any neglect, lead or bullion are 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 a spout into the slag-buggy, and is carried away. The object of this invention is to carry out a threefold separation in the exterior receiver, by means of which lead and bullion, matte and speiss, and slag are obtained in a comparatively pure state.

If from any cause the mattes and material in the slag-pot become solidified, so that there is not sufficient room for the melted materials to separate according to their specific gravity, thereby causing matte and bullion, or either of them, to flow over the slag-spout into the slag-buggy, the receiver can easily be cleaned by attaching a lifting device to the

hook solidified in the upper slag-crust. By this means the whole solid mass, including the lead-well, can be lifted out in a very short time, leaving the liquid lead and bullion in the bottom, as, owing to its low melting temperature, it will very seldom become solid. Another lead-well is then inserted into the receiver and the melted contents of the furnace are allowed to run once more into the receiver, and the operation goes on as hereinbefore described. Should all the contents of the receiver become solid, it may be moved away from the furnace and another receiver substituted. As soon as the slag mass becomes cool it is broken up, and the lead-well W and bent piece of iron H are removed and made ready for use again. The lead and base bullion, after removal from the compartment *a'*, will in practice be cast into bars or ingots, as may be desired.

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 stationary devices—such as the so-called “automatic” or “siphon” tap above referred to—attached to the furnace-crucible, and also by means of a stationary lead-well placed outside of the furnace, and I am also aware that it is old to smelt ores in a furnace without a crucible, and that it is old 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 so to combine the various agencies above described that a threefold separation of the ingredients of the smelted mass is effected in a movable vessel outside of the furnace containing a lead-well so constructed and arranged that it may be removed therefrom at pleasure.

Having heretofore on the 4th day of December, 1888, filed a separate application for Letters Patent for apparatus for separating lead and base bullion from slags and mattes by means of some of the agencies herein described, in which application said agencies are claimed in other combinations, I therefore disclaim the various combinations in the claims of said application contained so far as the present Letters Patent are concerned.

I claim as my invention—

1. The combination, substantially as hereinbefore set forth, with a portable receiving or collecting well into which the contents of the smelting-furnace are tapped, of a lead-well placed in said receiving-well, having an opening in its base, and so constructed and arranged as to be readily removed therefrom, and an opening in the side walls of said receiving-well at a higher level than the opening in said lead-well and at a level lower than the slag-spout of said receiver, for the purposes specified.

2. The combination, substantially as hereinbefore set forth, with a portable receiving or collecting well into which the contents of



the smelting-furnace are tapped, of a lead-well placed in said receiving-well, having an opening in its base so constructed and arranged that it may be removed therefrom at  
5 pleasure, an opening for tapping in the side walls of said receiving-well at a higher level than the opening in said lead-well and at a level lower than the slag-spout of said receiver, and means for closing and opening,  
10 substantially as described.

Signed at Glenwood Springs, in the county of Garfield and State of Colorado, this 29th day of December, A D. 1887.

WALTER B. DEVEREUX.

Witnesses:

F. H. A. LYLE,  
H. M. SPICKLES.