No. 662,836. Patented Nov. 27, 1900.

S. TREDINNICK.

APPARATUS FOR REFINING AND DESILVERIZING LEAD.

(Application filed Apr. 2, 1900.)

(No Model.) 2 Sheets—Sheet 1.

Fig. 1.

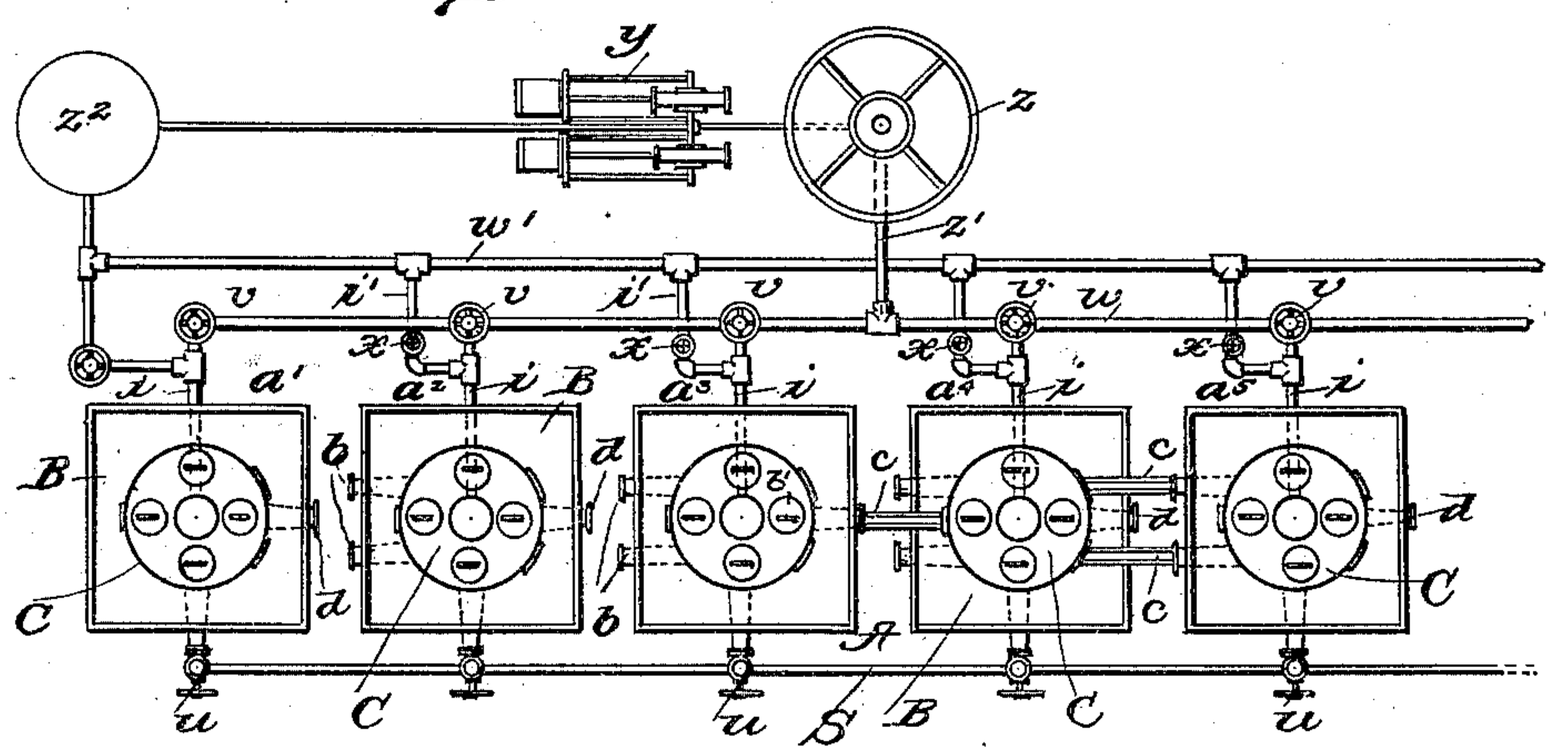

Fig. 2.

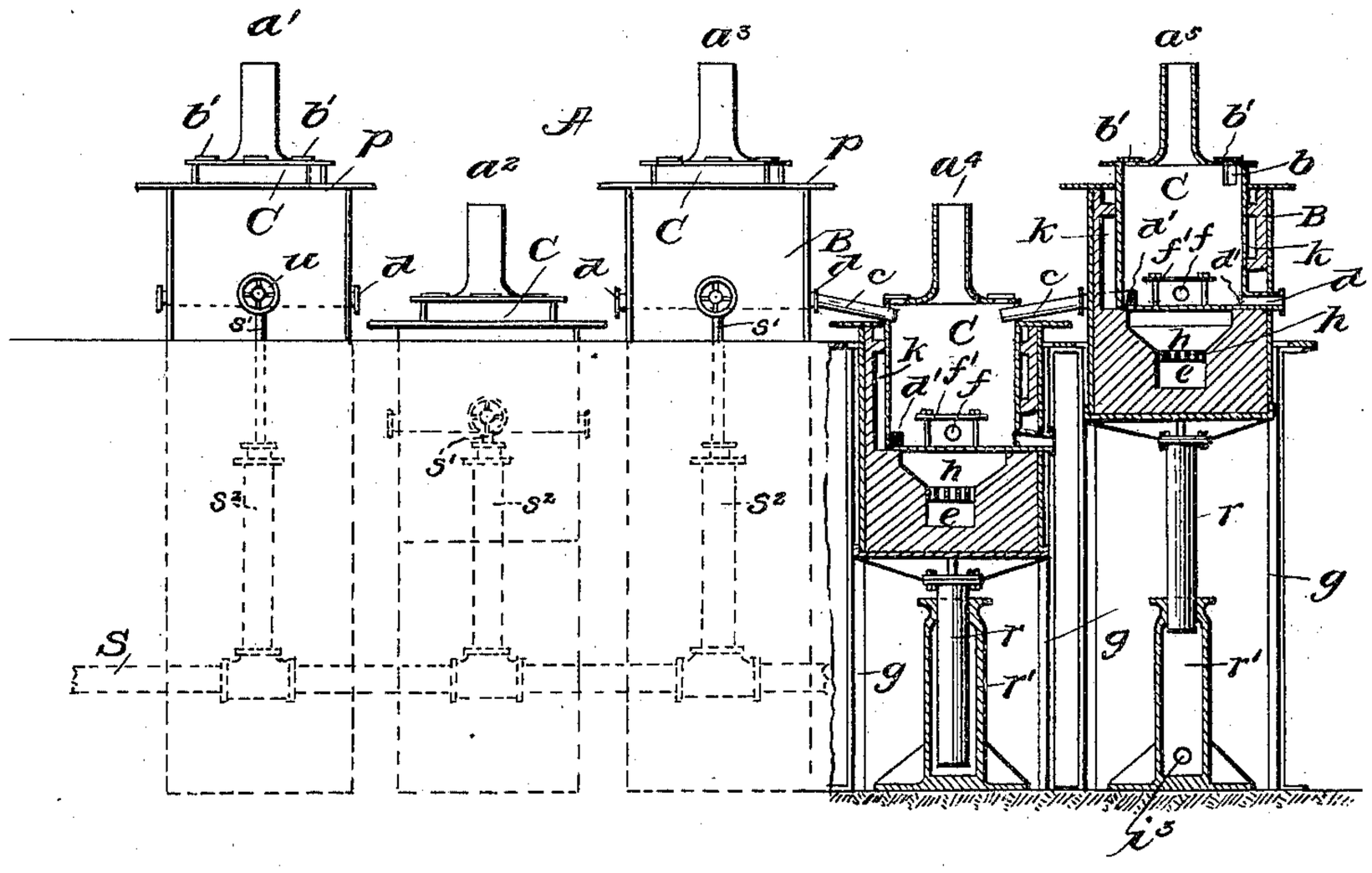

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Fig. 3.

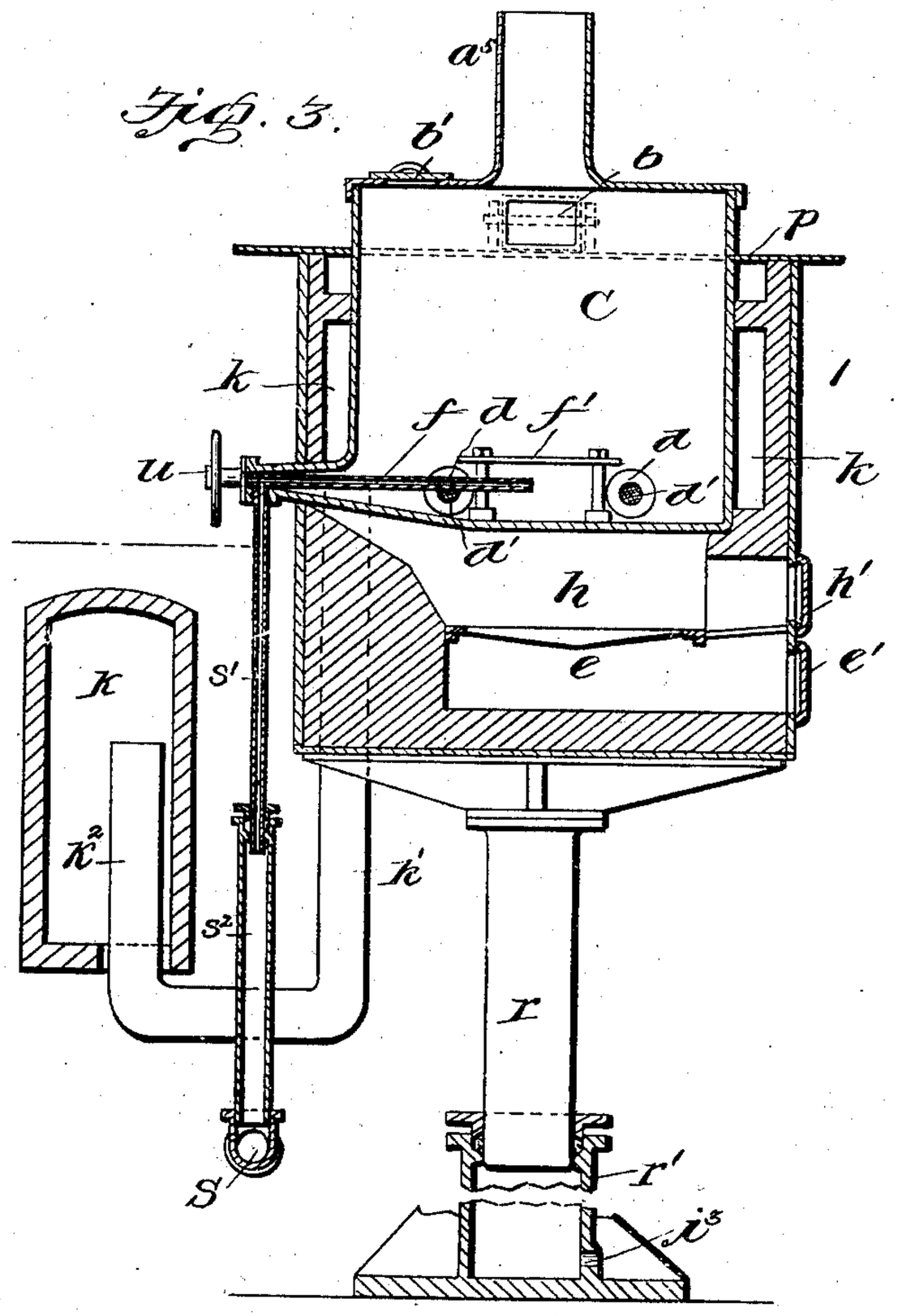
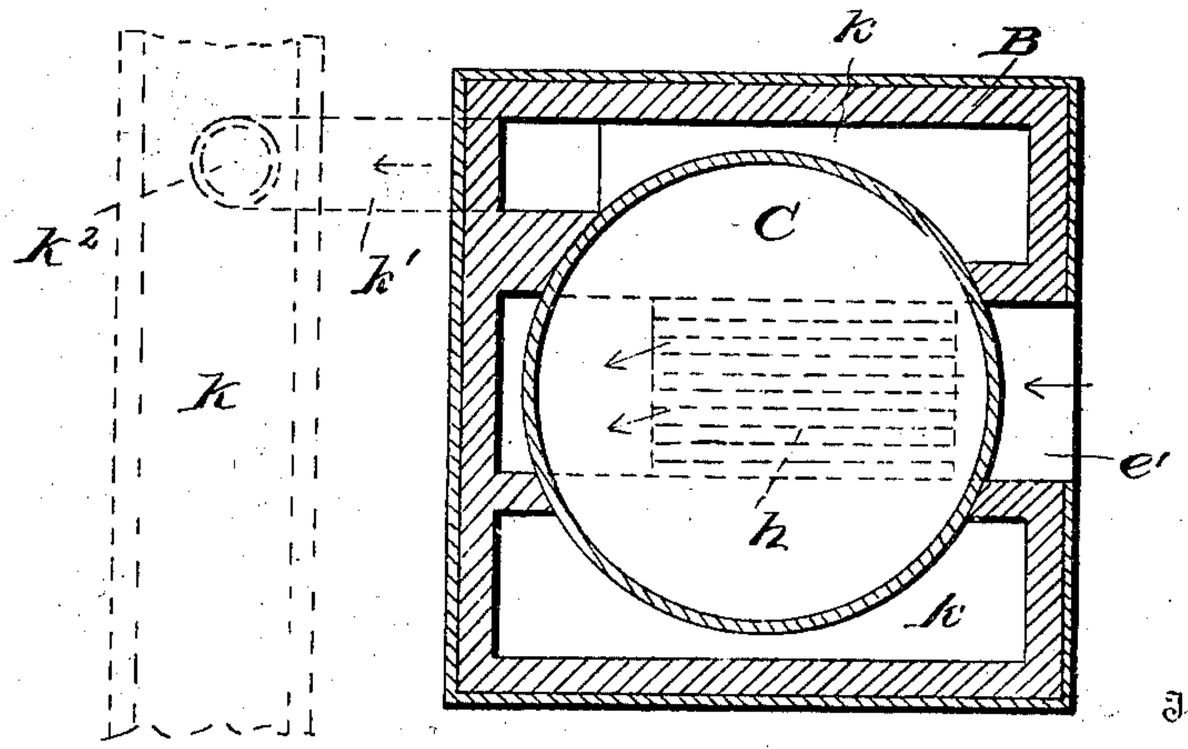


Fig. 4.



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UNITED STATES PATENT OFFICE.

STEPHEN TREDINNICK, OF BUTTE, MONTANA, ASSIGNOR OF ONE-FOURTH TO ADOLPH WETZSTEIN, OF SAME PLACE.

APPARATUS FOR REFINING AND DESILVERIZING LEAD.

SPECIFICATION forming part of Letters Patent No. 662,836, dated November 27, 1900.

Application filed April 2, 1900. Serial No. 11,275. (No model.)

To all whom it may concern:

Be it known that I, STEPHEN TREDINNICK, a citizen of the United States, residing at Butte, in the county of Silver Bow and State of Montana, have invented certain new and useful Improvements in Apparatus for Refining and Desilverizing Lead; and I do declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

My invention relates to improvements in apparatus for refining and desilverizing lead, and particularly to lead refining and desilverizing apparatus of the type shown in patents to Gustave Luce, No. 144,993, dated November 25, 1873, and No. 152,906, dated July 14, 1874. In this type of apparatus the crude argentiferous lead is melted down in a vessel heated by a fire and provided at its lower end with a spout closed with a slide, through which when the lead is melted it is caused to flow down into a lower crystallizing vessel or vat. When the lower vessel is full, steam is introduced through a central pipe leading down to near the bottom of the vessel, where it is provided with a valve and with a baffle-plate for dividing the steam as it enters. The steam in passing up through the molten lead effectually oxidizes all impurities, which then rise in the form of scum to the top of the metal, whence they are removed. The introduction of the steam at the same time produces a violent ebullition of the lead, causing it to crystallize, and when this crystallization has taken place to a sufficient extent the introduction of steam is stopped by closing the valve in the steam-pipe, and the remaining liquid portion of the lead, in which the greater proportion of the silver will be found concentrated, is run off through one or more spouts into troughs for conducting the lead into ingot-molds. During this time a fresh charge of lead containing a percentage of silver approximating to that of the crystals in the lower vessel has been melted down in the upper vessel and is run into the lower vessel as soon as all the liquid portion has been removed therefrom. Steam is then again introduced, effecting a further purification and separation of silver, and this process is continued until by the repeated crystallization one part of the lead is rendered comparatively free from silver to be used as merchant lead, while the lead run off is sufficiently rich in silver for the cupeling process.

The object of my invention is to provide an apparatus whereby the several operations incident to the process may be performed in a more thorough and expeditious manner than heretofore, economy in stock, labor, and fuel effected, and a proportionately larger quantity of material treated in a given period of time; and to this end it consists of certain novel features of construction, combination, and arrangement of parts, as will be hereinafter more fully described, and particularly pointed out in the appended claims.

In the accompanying drawings, Figure 1 is a top plan view of an apparatus constructed in accordance with my invention, showing five of a series of twelve kettles. Fig. 2 is a side elevation of the same, showing two of the kettles in vertical section. Fig. 3 is an enlarged detail sectional view of one of the kettles, the section being taken at right angles to that shown in Fig. 2, showing also the expansion-joint, downtake-flue, and common underground flue for the discharge of the smoke and products of combuston from all the kettles. Fig. 4 is a horizontal section of the same on the line of the ash-pit of the kettle.

Referring now more particularly to the drawings, in which like reference-letters designate corresponding parts throughout the several views, the letter A designates a series of kettles corresponding in number to the number of operations necessary to concentrate or desilverize the lead to the desired degree. In practice I prefer to employ a series of twelve kettles, of which five (designated a', a^2, a^3, a^4, and a^5) are shown in the present instance. It is desirable to concentrate a part of the argentiferous lead to five hundred ounces of silver per ton and to desilverize the remainder to from one-half to one-fourth of an ounce of silver to the ton, the result depending upon the number of crystallizing operations to which the silver is subjected, eleven such operations being necessary to secure the former, and twelve oper-

ations to secure the latter, result. The kettles are arranged in line in a pit and are similar in form and construction, so that a description of one will suffice for all. Each kettle, therefore, comprises an outer inclosing furnace B and a vat or crucible C contained therein, said furnace being provided with an ash-pit *e*, grate *h*, and ash-pit and fire doors *e'* and *h'*. Air for supporting combustion is admitted to the ash-pit through the door thereof in the usual way, and flues *k* are provided to allow the heated air, smoke, and products of combustion to pass upward and around the vat before discharging. The furnace is provided at top with a platform *p* for the crystallizer to work on, the term "crystallizer" as used in this connection meaning the person or individual operating the kettle.

b and *b'* are two series of doors in the sides and top of the vat above the platform *p*. Through the doors *b* the crystals, after having been melted into liquid form, are introduced into the kettles, while the bullion is worked through the doors *b'*.

d are outlets at opposite sides of the lower end of the vat C and to which are applied removable spouts *c*, through which the liquid contents of the vat are run out, each of said outlets having a screen *d'* to prevent the escape of the solid crystals. The spouts *c* are adapted to be placed in position when necessary to connect an intermediate kettle, as a^4, with two adjacent kettles, as a^3 a^5. It will be noted that the doors *b b* are two in number on one side of the kettle with but one outlet *d* between them, while at the opposite side of each kettle two outlets *d* and spouts *c* and but one door are employed, this arrangement continuing throughout the series of kettles. In my construction all the liquid is run out at one side of each kettle, and the purpose of the aforesaid arrangement of the discharge-spouts is to provide for the quick discharge of the liquid through the two spouts *c* at one side without disturbing the crystals, which when melted are to be discharged through the single spout at the opposite side.

f is a steam-nozzle through which steam is admitted to the vat from a steam-pipe *s*, and *f'* is a baffle-plate to distribute the steam through the mass of material in the kettle.

u is a valve which regulates the supply of steam from the pipe *s* to the nozzle *f*. The pipe *s* receives steam from a suitable source of supply and supplies each of the kettles, each kettle having its nozzle and controlling-valve.

The kettles are mounted to move in guides *g*, terminating at their upper ends in line with the floor or ground, and are adapted to be raised and lowered independently, each being mounted upon a plunger *r*, movable in a cylinder *r'*, the latter being provided at its lower end with a port i^3 for the ingress and egress of water or other fluid agent. The nozzles of the vats of the several kettles are connected to the steam-pipe *s* by expansion-joints to permit the kettles to be raised and lowered when necessary by the hydraulic cylinders, each of said expansion-joints consisting of telescoping pipes *s'* and s^2, the pipe *s'* being movably mounted in the pipe s^2 and having a steam-tight connection therewith. The smoke and products of combustion pass out of the kettle through a downflue *k'*, having an upwardly-bent upper end k^2, movably mounted to discharge in an underground flue or conductor K. This flue or conductor K receives the discharge of smoke and products of combustion from all the furnaces of the kettles and is in practice connected at some suitable point with a smoke-stack discharging to the atmosphere.

The mechanism for supplying fluid to and exhausting it from the cylinders for raising and lowering the kettles comprises a supply-tank z^2, connected with a pump *y*, which forces the water or other fluid into an accumulator *z*. This accumulator is connected by a pipe *z'* with a supply-pipe *w*, having a series of branches *i*, leading to the ports i^3 of the cylinders, each of said branches being provided with a valve *v* for cutting off and letting on the flow of water and whereby water may be admitted to either cylinder independently of the others. Connected to these supply-pipe branches *i* are branch pipes *i'*, leading from a return-pipe *w'*, connected with the tank z^2. These branches *i'* are each provided with a valve *x* for cutting off the return flow of water. In supplying water to either one or all of the cylinders or any desired number of them one, all, or the required number of the valves *v* are opened, and the water enters the cylinders through the branches *i* and ports i^3. To exhaust the water to lower the cylinders, the valves *v* are closed and the valves *x* opened, and the water flows from the cylinders, through ports i^3, branches *i*, and branches *i'*, to the common return-pipe *w'*, and thence back into the tank z^2 to be again used.

In the practical operation of the apparatus, assuming that the kettles *a'*, a^3, and a^5 are elevated, charged, and ready to be operated upon to crystallize the contents and the intermediate kettles a^2 a^4 empty and lowered to receive the enriched liquid therefrom, the lead contained within the kettles *a'*, a^3, and a^5 is reduced to a molten state and the fire then drawn to allow the lead to cool. At this time a jet of water is run through the cover of each of these kettles to agitate the molten lead, so as to produce crystallization in proportion as the temperature decreases, and steam is admitted through the nozzle *f* to prevent the crystals so formed from settling on the bottom of the vat. In passing through the molten metal the steam is decomposed and produces oxids of lead, antimony, and copper, according to the degree of impurity of the lead. The oxids rise to the surface of the bath, whence they are removed. When the proportion of lead crystals appears to be sufficient—that is, when the charge is of a

consistency of two-thirds crystals and one-third liquid—the jet of water and current of steam are shut off and the liquid run off through the outlets d and spouts c from the elevated kettles to the empty lowered kettles—for instance, from one of the kettles a^3 or a^5 into the intermediate kettle a^4. In practice three only of the entire series of twelve kettles are operated at one time to discharge the crystallized contents of one kettle and enriched liquid from the other kettle, and so on continuously throughout the series, the enriched liquid running in one direction and the desilverized lead in the other direction as the operation progresses. Assuming that the liquid is being carried toward the end kettle a' and the lead toward the opposite end kettle a^{12} (not shown) of the series, the elevated kettles are alternately operated, the crystallizing process being effected in one—say, kettle a^5—while the charge of lead or the lead crystals are being melted in the next adjoining elevated kettle—say, the kettle a^3—and the intermediate kettle a^4 receives the enriched liquid from the former and the desilverized melted lead from the latter. The one-third liquid of kettle a' runs out through the pair of spouts c on one side is enriched lead and cupeled, while the two-thirds crystals remaining therein after being melted are run out through the one spout d on the other side into kettle a^2. The one-third liquid of a^3 will be of the same grade of bullion as the two-thirds crystals of a' and is run into kettle a^2, completing the charge of same. The two-thirds crystals of kettle a^3 after melting is run into kettle a^4 with the one-third liquid of kettle a^5, which is the same grade of bullion and will complete the charge of kettle a^4. Kettles a^2 and a^4 are now charged and raised and ready to be operated, while kettles a', a^3, and a^5 are empty and lowered to be again charged in like manner, and so on throughout the series. As stated, of the whole series of twelve kettles only three will be operated on at one time, while the crystals of the three kettles previously operated on are being melted. With low-grade bullion the separation is half or double—viz., the one-third liquid is double as rich as the original charge and the two-thirds crystals are reduced to half the richness of the original charge. With high-grade bullion the one-third bullion gains one-third instead of one-half in richness.

It will thus be seen that the operation is continuous, resulting in the production by gradual decrease in the percentage of silver of merchant lead on the one hand and of lead ready for the cupeling process on the other hand. By thus making the operation continuous I obviate the necessity of running the lead into molds and remelting it at each operation, and consequently effect a saving in fuel, time, and labor.

Having thus fully described my invention, what I claim as new and useful, and desire to secure by Letters Patent of the United States, is—

1. An apparatus for refining and desilverizing lead, comprising a series of kettles, means for connecting the kettles for effecting the discharge of the contents of one into another, hydraulic cylinders on which the kettles are mounted, a fluid-tank, a pump, connections between the tank and pump and pump and cylinders to supply fluid to raise the cylinders, and connections for exhausting the fluid from the cylinders back to the tank, substantially as set forth.

2. An apparatus for refining and desilverizing lead, comprising a series of kettles adapted to communicate one with the other, means for raising and lowering the kettles, nozzles for injecting a current of steam or the like into the kettles, a steam-pipe, and expansion-joints between the nozzles and steam-pipe, substantially as set forth.

3. An apparatus for refining and desilverizing lead, comprising a series of independently-movable kettles, and hydraulic mechanism comprising cylinders, a source of fluid-supply, and supply and return connections for raising and lowering the kettles, said connections being valved for controlling the supply or exhaust to and from one, all or any desired number of the cylinders, substantially as set forth.

4. In an apparatus for desilverizing and refining lead, a series of kettles having inlet and outlet passages, removable spouts for connecting the outlet-passage of one kettle with the inlet-passage of another kettle, and means for raising and lowering the kettles, substantially as set forth.

In testimony whereof I have hereunto set my hand in presence of two subscribing witnesses.

STEPHEN TREDINNICK.

Witnesses:
F. E. CURTIS,
D. S. SHAFFER.