(No Model.)

W. A. KONEMAN & H. H. SCOVILLE.

AMALGAMATING APPARATUS.

No. 310,062. Patented Dec. 30, 1884.

Fig 1.

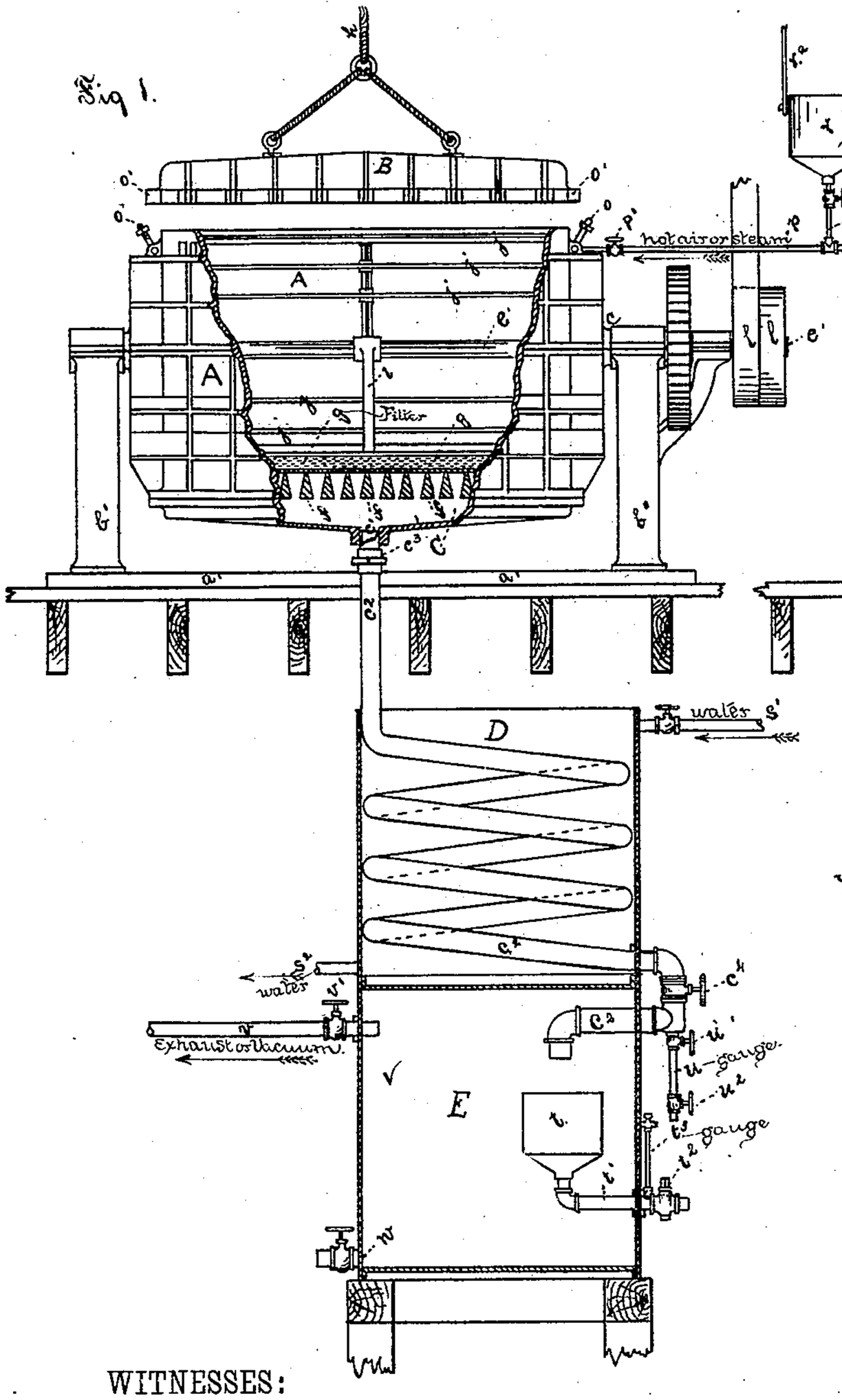


Fig 2.

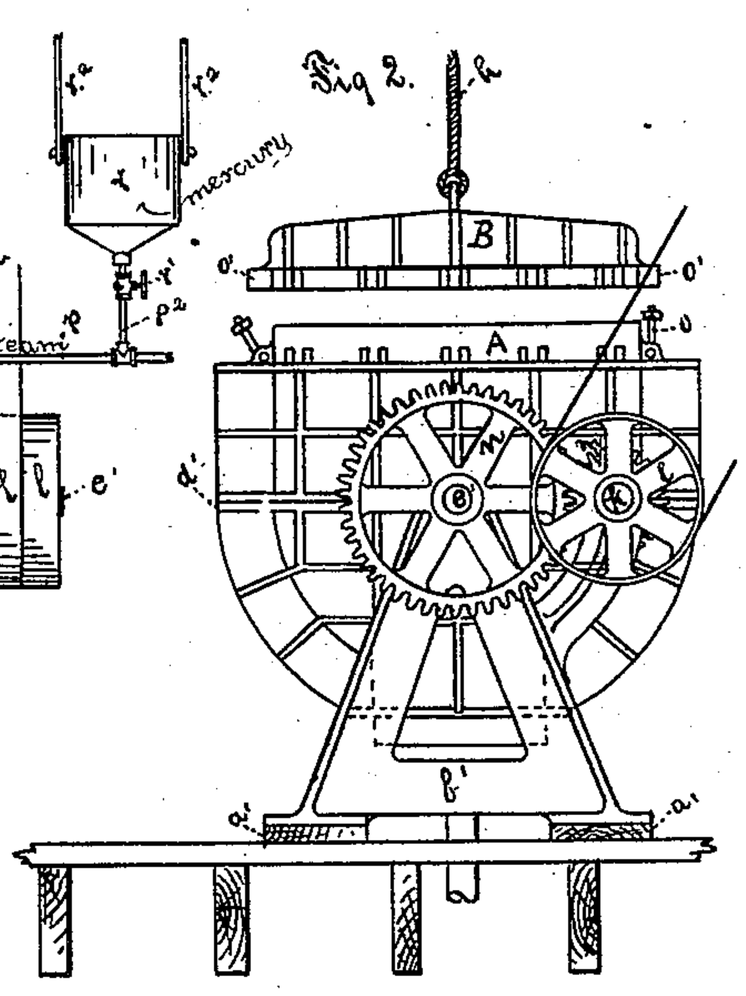
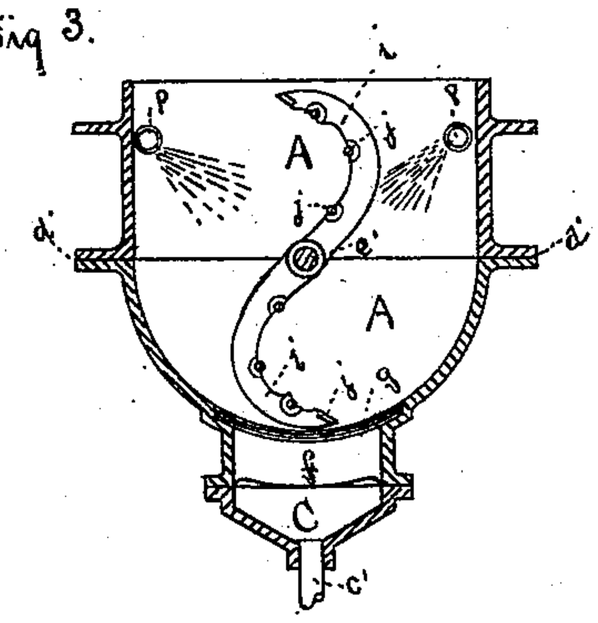


Fig 3.



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AMALGAMATING APPARATUS.

SPECIFICATION forming part of Letters Patent No. 310,062, dated December 30, 1884.

Application filed April 8, 1884. (No model.)

To all whom it may concern:

Be it known that we, WILLIAM A. KONEMAN and HIRAM H. SCOVILLE, of the city of Chicago, county of Cook, and State of Illinois, and citizens of the United States of America, have invented certain new and useful Improvements in Amalgamating Apparatus; and we do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in mechanical art to make and use it, reference being had to the accompanying drawings, which form a part of this specification, in which—

Figure 1 represents a front elevation of the receiving-box with a part of outer shell broken away, so as to give a sectional view of the internal arrangement of stirrers and straining-bottom, in combination with a sectional view of condenser and vacuum-chamber. Fig. 2 represents an end view of receiving-box, receiving-box supports, and driving-gear for stirrer-axle. Fig. 3 represents a cross-section through the center of receiving-box, showing the relative position of steam or air pipes, stirrer, straining-bottom, and suction-chamber.

The object of our invention is to provide an apparatus in which its contents of gold or silver bearing ores are devolatilized, and so constructed that superheated steam or air may be introduced and its percolation through the ore particles facilitated by a straining-bottom of large area and aided by suction created by means of a vacuum.

A further object of our invention is to provide an apparatus in which its contents of gold or silver bearing ores may be subjected to an infusion of vaporized or atomized mercury by means of steam or air, and in which the percolation of said mercury is facilitated by a straining-bottom of large area and aided by suction created by means of a vacuum.

A further object of our invention is to provide an apparatus in which its contents of gold or silver bearing ores are purified, and in which amalgamation of the gold or silver with mercury is forced after purification, and in which purification and amalgamation may be accomplished during one continuous operation.

Referring to the drawings, *a' a'* represent foundation-timbers for the receiving-box supports; *b' b'*, supports or stands for receiving-box trunnions, firmly bolted to foundation-timbers *a' a'*. The trunnions of receiving-box, which rest in the bearings of supports *b' b'*, are a part of the receiving-box, and are made hollow, thus forming in turn bearings for axle *c*.

A is a receiving-box, which may be made of any material or shape warranting sufficient strength. We prefer cast-iron. It is constructed with a perforated straining-bottom, which we do by omitting a portion of the bottom in the casting. We then fit a strong set of grate-bars into the open portion thus created in the bottom. We then build the straining-bottom proper on the grate-bars *f f* by covering the bars first with a sheet of perforated metal, cover this perforated metal with a layer of felt, cover the felt lightly with asbestus, cover the felt and asbestus with another sheet of perforated metal, and fasten both perforated plates, which hold the felt and asbestus between them, firmly to grate-bars *f f*, thus forming a substantial straining-bottom, *g*. We prefer, also, to cast this receiving-box A in two halves or sections, and joint them by means of flanges *d' d'*.

B is a cover for receiving-box A, and it is made with steam-tight joints. It is so constructed that it may be raised, lowered, or held suspended by means of rope or cable *h*, and it can be fastened down on box A by means of bolts *o* and lugs *o'*. The receiving-box A has a suction-chamber, C, below the straining-bottom, and it is fitted to box A in a perfectly air-tight manner. The bottom of suction-chamber C converges from the four sides to a central discharge-opening, *c'*, and discharge *c'* may be connected with suction and condensing pipe c^2 by means of a suitable coupling, c^3.

i i are stirrers, made of any suitable shape, and they are firmly fastened to axle *e'*.

j j are stirrer-bars, which are firmly fastened to and connect stirrers *i i* in such a manner that *i i* and *j j* form practically a grate fastened to and rotated by axle *e'*.

k is a counter-shaft supported by stand *b'*,

and rotates in one of the bearings of stand *b*.

l is a driving-pulley, and it is fastened to counter-shaft *k*.

m is a pinion-gear, also fastened to counter-shaft *k*.

n is a spur-wheel, and is fastened to axle *e'*, and it is rotated by pinion *m*, while it rotates the axle *e'* and stirrers *i i* and *j j*.

p is a pipe for admitting steam or hot air to receiving-box A. It receives its steam or air from a suitable boiler or furnace, with which it connects, and it delivers the steam or air received from a boiler or furnace to a suitable superheater, in order to raise the temperature of the steam or air to the desired degree of heat. It receives the steam or air again in a superheated state from the superheater, and delivers it in its superheated state to receiving-box A in such a manner that it strikes the contents of ore with its full force. This pipe *p* is provided with a suitable coupling at the point where it enters the box, so that it may be readily attached to or detached from the receiving-box.

p' is a valve in pipe *p*.

r is a mercury receiver or tank, and is connected with pipe *p* by means of pipe p^2.

r' is a valve, by means of which the flow of mercury from tank *r* into pipe *p* is regulated.

r^2 r^2 are hangers by means of which mercury-tank *r* may be suspended.

D is a receptacle for water and for condensing-pipe c^2; we prefer to make it cylindrical in shape and open at the top. It should be kept full of cold water, which cools condensing-pipe c^2, and we prefer to keep a constant current of water through it, charging or filling by means of water-pipe *s'*, and discharging by means of discharging-pipe s^2.

c^2 is a coil of metal pipe, connected at its upper end with suction-chamber C by means of coupling c^3, whence it extends downward into tank D, and it is coiled round repeatedly inside of tank D until it reaches a point near the bottom of the tank. It is then led outside of the tank D, and is exposed, so that it may be opened or closed by means of valve c^4. This valve causes the communication to or the shutting off of suction from suction-chamber C. Below valve c^4 pipe c^2 enters vacuum-chamber E, and it also connects with a test or sight gage, *u*, which gage is fitted with valves *u'* and u^2, by means of which liquids or gases may be abstracted from condensing-pipe c^2 for examination without interference with the vacuum in vacuum-chamber E. This vacuum-chamber E may be made of any suitable material; but it must be perfectly air-tight in all its joints and connections.

t is a receptacle for condensed mercury inside of vacuum-chamber E. It may be emptied by means of discharge-pipe *t'* and valve t^2. The discharge-pipe *t'* is provided with a suitable gage, t^3, and the object of gage t^3 is to determine the amount of mercury which has been condensed and collected in mercury-receptacle *t*.

v is an air-pipe, connected with vacuum-chamber E at one end and with a suitable air-pump or exhaust-fan at the other end.

w is a discharge-pipe, by means of which accumulations of condensed water or minerals are withdrawn from the vacuum-chamber.

The operation of the apparatus when both purification and amalgamation are desired is as follows: The receiving-box cover D is first raised and held suspended by rope or cable *h*. Power is then applied to pulley *l*, which rotates counter-shaft *k* and pinion *m*. Pinion *m* rotates spur-wheel *n*, axle *e'*, stirrers *i i*, and stirrer-bars *j j*. The speed of these stirrers varies according to the consistency of the ore. The steam-pipe *p* is attached or coupled to the receiving-box A, and discharge *c'* and suction-pipe c^2 are also securely coupled, and suction-pipe valve c^4 and vacuum-pipe valve *v'* are opened. The ore, which has previously been pulverized, is now introduced, together with the water, if it has been pulverized by a wet process, into box A, and the air-pump or exhaust-fan is set in motion, which causes air to be drawn through the ore, and this air, together with water from the ore, is drawn into vacuum-chamber E. In this manner the bulk of the water which is being introduced with the ore is withdrawn while the box is filling. When the box is nearly full, cover B is let down and firmly fastened to the box by means of bolts *o* and lugs *o'*. Steam-valve *p'* is now opened to admit superheated steam and inject it into the ore in box A. This steam is constantly drawn through the ore and enters suction-chamber C through straining-bottom *g*. Thence it enters suction-pipe c^2, and is condensed in the immersed and coiled portion of suction-pipe c^2, and is collected as water in vacuum-chamber E. The steam should be superheated to as high a degree as practicable, in order to decompose and destroy such chemical combinations as sulphide of iron or of copper, (pyrites,) thus setting free the precious metals they may carry, while the sulphur will be drawn off as sulphureted hydrogen and as sulphuric acid, other volatile minerals—such as arsenic, tellurium, or antimony—forming either corresponding combinations with the hydrogen and oxygen, and are so withdrawn from the ore, or the vapors of these volatile substances are withdrawn as soon as set free without having formed such chemical combinations, and are condensed in the suction-pipe.

In treating what are termed "rusty" ores—that is to say, ores which carry the precious metals in a free metallic state and not in chemical combinations, and where the precious metals are only coated with what might be termed a "film" of volatile minerals (generally sulphur)—the purifying process is finished in a space of time equal to about forty-

five minutes to a charge of two thousand pounds, regulating the time according to the weight of the charge; but when the ore contains volatile minerals in defined chemical combinations the time varies from one to three hours to a ton of ore.

The purifying process is finished when a sample of the water or gases abstracted from suction-pipe c^2 gives no chemical reaction for the volatile minerals known to be present in the ore; but no such tests must be made until at least thirty minutes have elapsed from the time that the superheated steam or air has been turned on. The ore when sufficiently treated presents a spongy or woolly appearance. The mercury-tank r is now examined to see that it contains from two to four times as much mercury as it is desired to charge the ore with, and valve r' is now opened enough to allow a fine spray of mercury to enter steam-pipe p. The steam volatilizes or atomizes this mercury, (according to the heat,) and it enters the box in this state and is drawn through the ore in finely-subdivided particles or atoms. The suction is continued until the surplus of mercury has been drawn through the straining-bottom and collected in mercury-well t, and the amount of mercury condensed is shown and indicated by mercury-gage t^3. When this is accomplished, steam-valve p' and suction-pipe valve c^3 are closed; but the ore is stirred for about twenty minutes longer in order to cool it and to gather the particles of mercury and amalgamated metals together. The lid B is then raised, steam-pipe P and suction-pipe c^2 are uncoupled from the box, and the box is turned over on its trunnion-bearings, and the contents are dumped into a suitable receptacle, which conveys the ore to a settler or other separating machine or apparatus. The box may be turned over by means of any suitable contrivance, such as pulley blocks or gear.

The object of the overcharge of mercury is, first, to insure a perfect shower of this metal through the ore, so that no particle of the precious metals may escape contact with it; second, that whatever mercury-sickening qualities the ore may contain after the preliminary treatment may exert themselves on and be absorbed by such mercury as is drawn off and collected in the mercury-well.

The principal points of advantage in our invention over the present method of copper plate and pan amalgamation are, first, the ore and water are run into a receptacle, which, from the nature of its construction, prevents the escape of float gold or silver particles or of coated gold or silver particles; second, all gold or silver particles which, on account of a foul or rusty exterior, refuse to unite with and sicken the mercury, and which are therefore lost and wasted under the present plate-and-pan process, receive such treatment in our apparatus as will put them in proper condition for amalgamation with mercury; third, no particle of gold or silver can escape repeated contact with mercury in our apparatus—thus we force its amalgamation; fourth, as the mercury does not come in contact with the ore until its sickening qualities have been removed, there is no loss of mercury on account of flouring, sickening, or conversion into calomel or corrosive sublimate, &c.; fifth, our invention furnishes a method by means of which the ore is both purified and amalgamated in the same apparatus and during one continuous operation.

It is evident that the air or steam introduced into receiving-box A would readily escape through the straining-bottom under a low compression, especially when the ore in the box is being stirred or agitated. The escaped steam can also be condensed without the use of a vacuum-chamber. We therefore do not confine ourselves to the use or construction of an apparatus having such vacuum-chamber; but we introduce and add a vacuum-chamber to our apparatus as an auxiliary aid—that is to say, we use it in order to aid the passage of the steam or hot air (which is being injected into the receiving-box) through the ore and straining-bottom, as soon as it has given up its greatest heat to the ore; also to avoid too great a compression of steam or air in the receiving-box, so that the jets of steam or air may strike the ore particles with as much force as possible, thereby centralizing its heat on a small area of ore and thus facilitating decomposition.

We do not claim any method or apparatus for chloridizing the silver in silver ores and dissolving out and straining off the chloride of silver formed by means of hot water, as per G. A. Koenig's patent of December 21, 1880. We further disclaim the method or mechanical construction of apparatus for the treatment of gold and silver bearing ores, as per Wyckoff and Fell's patent of November 27, 1860. We further disclaim the method or construction of apparatus employed by Forster and Firmin, patent October 16, 1877, or the numerous methods identical with theirs—that is to say, any method or apparatus where the raw or previously roasted and pulverized ore is fed continuously into a receptacle having an unobstructed discharge into a suitable settler, and where such ore is subjected to an injection of a spray of mercury during its passage or fall through the amalgamating-chamber. We further disclaim the method and apparatus used and employed by C. E. Ball, patent August 2, 1881, or any of the numerous methods or apparatus employed operating upon the same principle—that is to say, we disclaim any and all methods where pulverized ore is subjected to the passage through a column (or mass or quantity) of mercury. We further disclaim all those methods or apparatus which have for their object the

purification of ores uncombined with amalgamation, or amalgamation uncombined with devolatilizing. We desire further to disclaim any intention of laying claim to the principle of desulphurizing ores or devolatilizing ores by means of superheated steam, or by means of fire and steam combined, as various apparatus employing these agents have been constructed. We therefore only lay claim to our method of application. We further disclaim any intention to lay claim to the principle of amalgamation by means of mercury and steam, except our special method of application.

We desire to call particular attention to the principal points wherein we differ from all known methods employing steam and mercury for the purpose of purification and amalgamation of ores bearing the precious metals. We use a receiver or decomposition-receptacle having a straining-bottom of large area so constructed as to prevent the outflow of mineral particles, but to allow the passage of water and a free escape of steam or air and such gases and solutions as are formed by the decomposition of volatile minerals. This strainer enables us to treat wet ore as well as dry ores, which is not accomplished by any of the apparatus constructed for the combined purpose of devolatilizing and amalgamating. These apparatus have also failed to accomplish anything like perfect purification of ores, on account of a greater or less pressure in the receiver, which pressure prevents the free escape of the gases when set free, and they consequently form other chemical combinations, which leaves the ore in a changed but partially purified condition only. We avoid this trouble by communicating suction to the receiver, which draws all gases therefrom as soon as set free, and enables us, further, to draw mercury through the ore and force its perfect percolation. In the treatment of dry ores this suction may be employed or communicated to the receiver on top, and the steam or mercury, or both, may be injected at the bottom, and as there is no water to be drawn off the straining-bottom may be dispensed with.

What we therefore claim, and desire to secure by Letters Patent, is—

1. The combination, in an ore devolatilizing and amalgamating apparatus, of a receiving-chamber, A, having a steam-tight removable cover, B, a straining-bottom, *g*, air or steam and mercury inlet *p*, stirrers *i i* and *j j*, rotating in chamber A, and chamber C below straining-bottom *g*, constructed substantially as and for the purpose set forth.

2. The combination, in an ore purifying and amalgamating apparatus, of a receiving-chamber, A, having a straining-bottom, *g*, a removable cover, B, air or steam inlet *p*, and a chamber, C, below the straining-bottom *g*, connecting with condensing-pipe c^2, all constructed substantially as and for the purpose set forth.

3. The combination, in an ore purifying and amalgamating apparatus, of a receiving-chamber, A, having a straining-bottom, *g*, a removable cover, B, and air or steam inlet *p*, in connection with suction-chamber C, fitted air-tight below the straining-bottom *g* and to receiving-chamber A, condensing-pipe c^2, fitted to the discharging-point c' of suction-chamber C at its upper end and a vacuum-chamber, E, at its lower end, the intermediate space being immersed to facilitate condensation, and vacuum-chamber E, so constructed that a vacuum created in it by means of an air-pump or other air-exhausting apparatus will be connected with or communicated to receiving-chamber A (when closed) by means of suction and condensing pipe c^2.

4. The combination, in an ore devolatilizing and amalgamating apparatus, of air or steam and mercury inlet-pipe *p* in direct connection with a suitable superheater at one end and with receiving-chamber A at the other end, and being connected at a point between said superheater and box A with a suitable mercury-receptacle discharging into pipe *p* in such a manner that mercury injected into pipe *p* is vaporized and injected into the ore contained in receiver A, and said receiver A, constructed with a straining-bottom in such a manner that the mercury may be withdrawn from the ore to the extent desired by suction created by means of a vacuum, all constructed substantially as and for the purpose set forth.

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Witnesses:
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