No. 750,224. PATENTED JAN. 19, 1904.

J. B. ROSSMAN.

AMALGAMATOR AND CONCENTRATOR.

APPLICATION FILED MAR. 16, 1901.

NO MODEL. 2 SHEETS—SHEET 1.

Fig. 1.

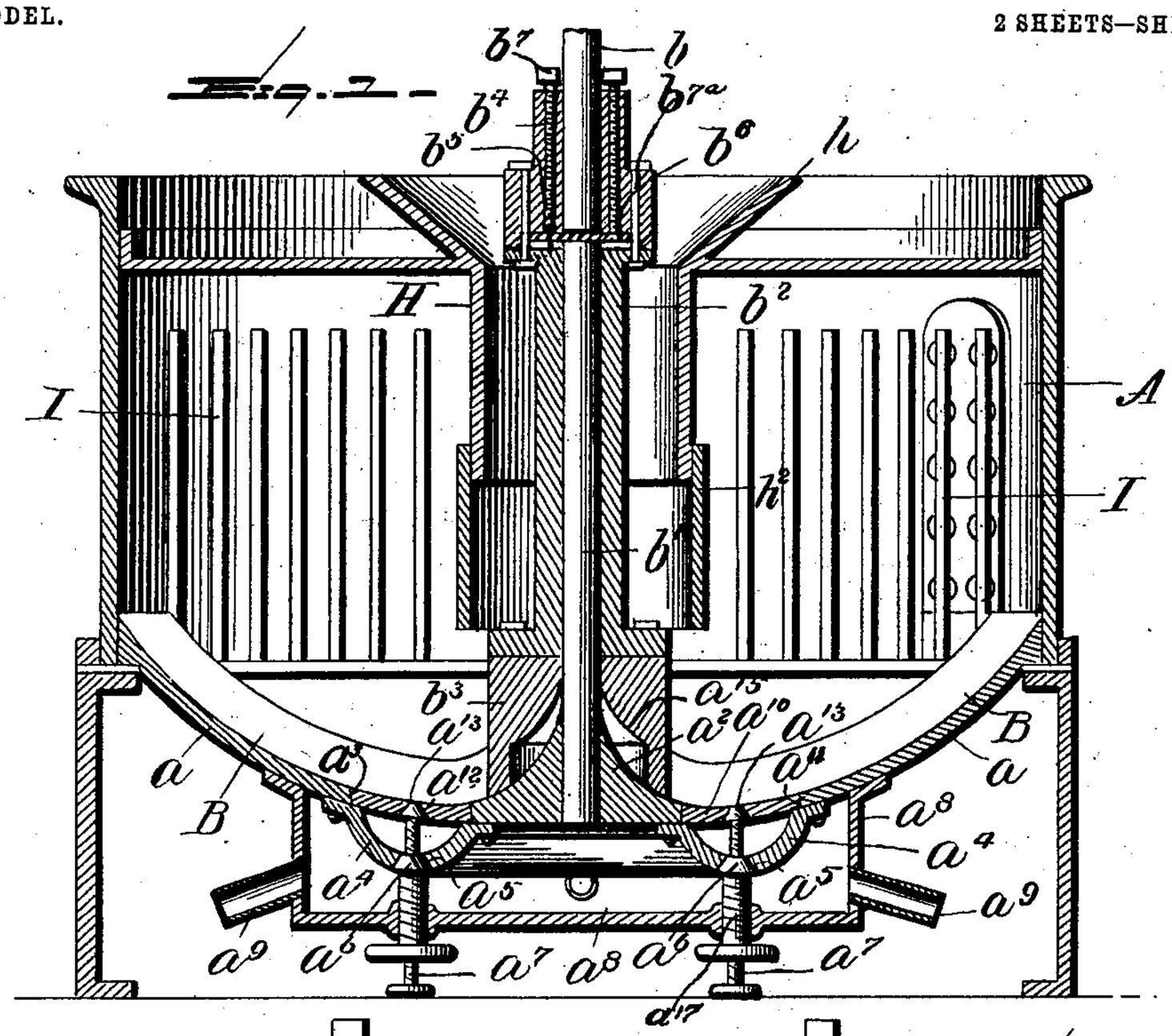



Fig. 8.

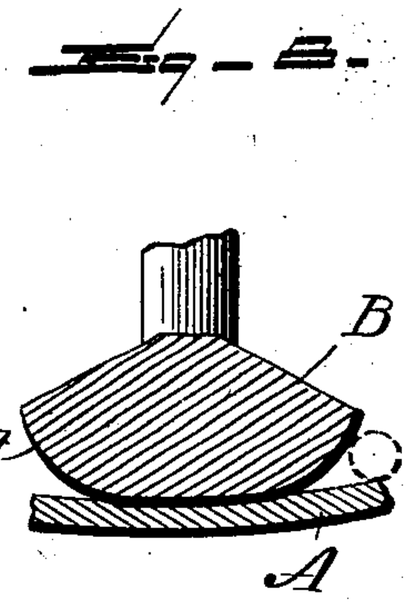



Fig. 9.

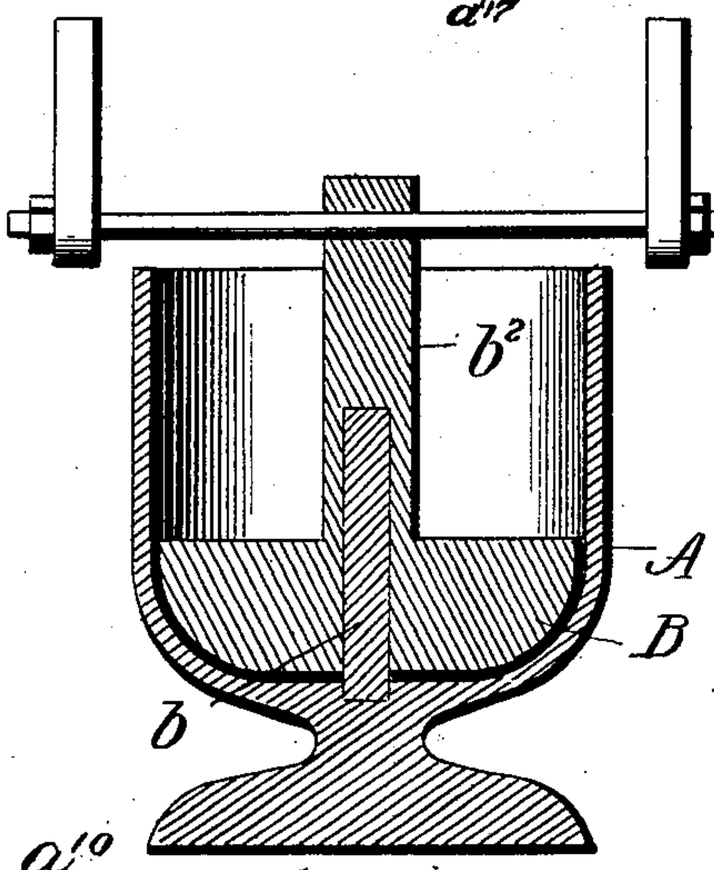
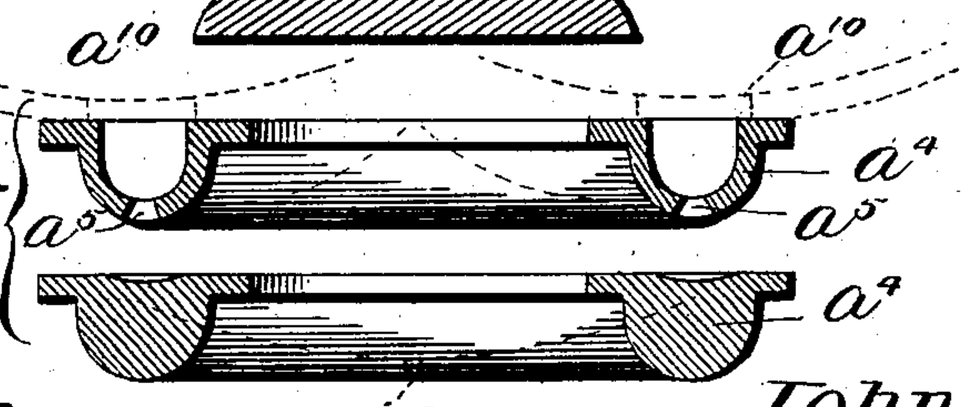



Fig. 10.




WITNESSES:

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R. M. Elliott.

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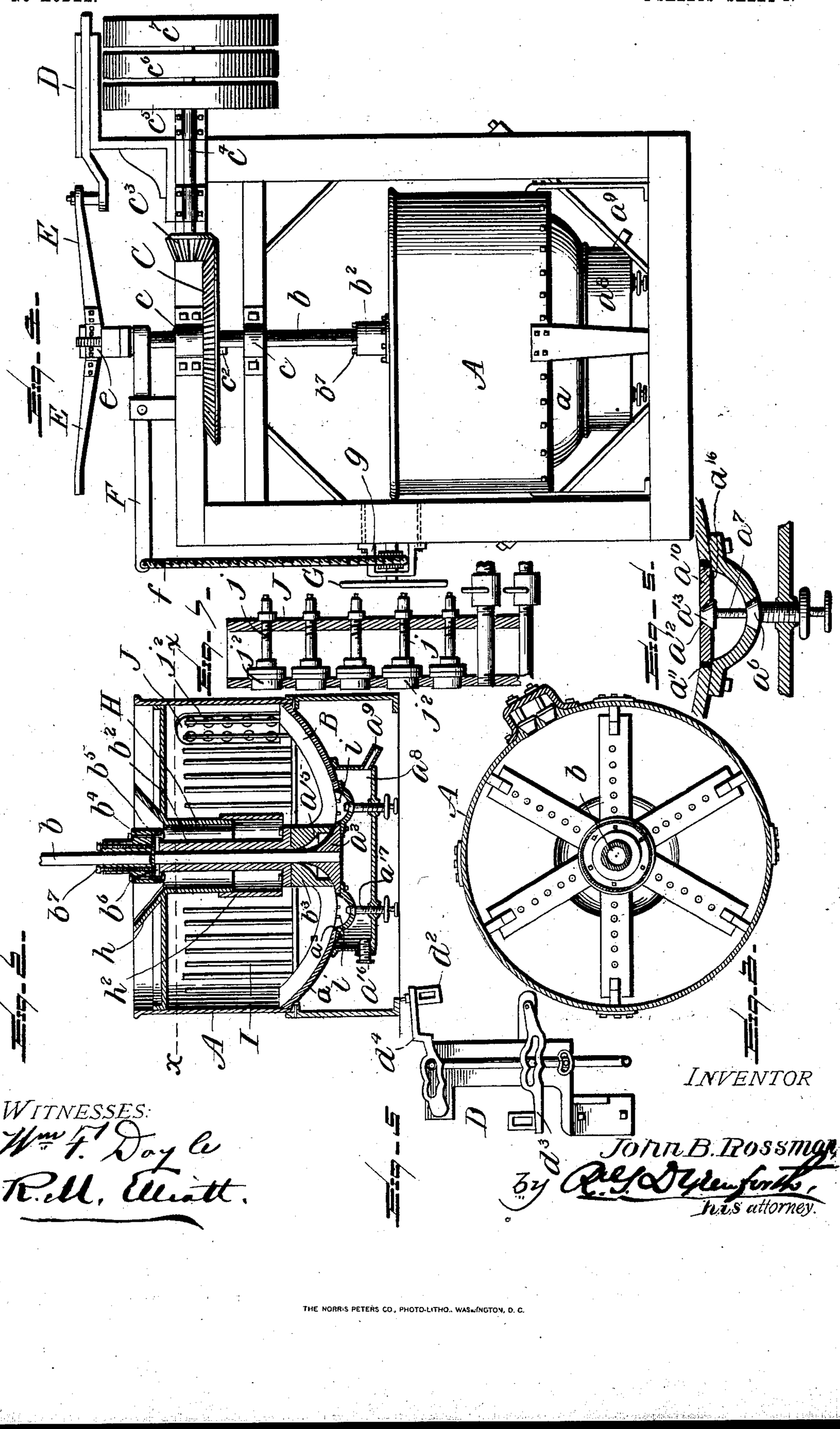
# AMALGAMATOR AND CONCENTRATOR.

APPLICATION FILED MAR. 16, 1901.

NO MODEL. 2 SHEETS—SHEET 2.

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No. 750,224. Patented January 19, 1904.

# UNITED STATES PATENT OFFICE.

JOHN B. ROSSMAN, OF ST. PAUL, MINNESOTA.

## AMALGAMATOR AND CONCENTRATOR.

SPECIFICATION forming part of Letters Patent No. 750,224, dated January 19, 1904.

Application filed March 16, 1901. Serial No. 51,540. (No model.)

*To all whom it may concern:*

Be it known that I, JOHN B. ROSSMAN, a citizen of the United States, residing at St. Paul, in the county of Ramsey and State of Minnesota, have invented certain new and useful Improvements in Amalgamators and Concentrators; and I do hereby 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.

The object is in a ready, simple, and efficient manner to effect separation from refractory ores of all precious metals associated therewith.

With this object in view the invention consists in the novel construction and combination of parts of a combined amalgamator and concentrator, as will be hereinafter fully described and claimed.

The important results accomplished by the mechanism hereinafter to be described are—

First. The prevention of flouring of the mercury, when the device is used as an amalgamator, by which more effective amalgamation and saving of mercury is effected. This result is attained by the peculiar contour of the rubbers or grinders, which in operation cause the mercury to be moved back and forth in large balls or globules.

Second. The prevention of any centrifugal motion within the amalgamator, thereby permitting the precious metals readily to settle to the bottom of the amalgamating-pan.

Third. The grinding or rubbing action to which the refractory metals are subjected in comparatively still water, thereby thoroughly cleansing the gold from the refractory substances which prevent amalgamation and by which the precious metals as separated in the form of flour-gold are permitted to settle to the bottom of the amalgamating-pan, and thus prevented from being carried away with the tailings.

Fourth. The effective separation of the precious metals from the pulp.

In the accompanying drawings, forming a part of this specification, and in which like letters of reference indicate corresponding parts, Figure 1 is a view in sectional elevation displaying the device when employed as an amalgamator. Fig. 2 is a similar view showing the same when employed as a concentrator. Fig. 3 is a plan sectional view taken on the line $x\,x$ of Fig. 2. Fig. 4 is a view in side elevation displaying more particularly the means by which vibratory motion is given to the rubbers or grinders and also the shifting mechanism by which the operating mechanism driving the apparatus may be reversed to produce a vibratory motion. Fig. 5 is a view in detail of the reversing mechanism detached. Fig. 6 is a detail view of the sluice-box and gate-rods by which the parts of the sluice-box may be operated. Fig. 7 is an enlarged view in section of the central annular sluice box or trough of Fig. 1. Fig. 8 is a detail sectional view showing the shape of one of the rubbers. Fig. 9 is a sectional view of a modified form of amalgamator, and Fig. 10 is a detail view showing the peculiar construction and arrangement of the parts of the bottom portion of the amalgamator bowl or pan.

Referring to the drawings, A designates the bowl or amalgamating-pan, which is constructed with a curved bottom $a$, rising at the center, as shown at $a^2$. The bottom of the bowl is cut through by a circular opening $a^3$, beneath which is bolted a circular sluice box or trough $a^4$, forming a part of the bowl-bottom, into which box the precious metals as separated from the pulp or gangue will settle. The bottom of the sluice-box is formed with two depressions, as shown in Fig. 10, on opposite sides of the bowl, which viewed in elevation are semicircles, at the lowest portion of each of which is an orifice $a^5$ to be closed by a plug $a^6$, which, as shown, may be operated through the medium of a screw $a^{17}$ or in any other suitable manner. The object of having the bottom of the sluice-box thus formed is to cause the precious metals as separated from the gangue or pulp to settle toward the orifices, so that by lowering the plug these may escape to a runway or casing $a^8$, secured beneath the bowl-bottom, with which connects a discharge-pipe $a^9$, leading to a suitable receptacle for receiving the metals.

When the device is to be used as a concentrator, as will appear farther on, the sluice-

box $a^4$ is open or free to permit the settling of the precious metals, as described; but when used as an amalgamator, as shown in Figs. 1 and 6, the sluice-box is sealed by a closure $a^{10}$, consisting of two semicircular pieces of iron, which are preferably fitted into the opening $a^3$ and are turned on their upper surface to conform exactly to the contour of the bottom of the bowl, so that no obstruction will be presented to the rubbers in passing thereover. It is to be understood that, if preferred, the closure may be a single piece of metal turned to the proper shape and constituting, in effect, a ring.

To prevent any escape of mercury into the sluice-box when the device is used as an amalgamator, it is preferred to interpose rubber or other resilient materials between the closures and the walls of the sluice-box, as shown at $a^{16}$, Fig. 6, thus to present a hermetic seal at these points. To cause the closures $a^{10}$ to be retained in position, the walls of the opening $a^3$ are incut on each side, as at $a^{11}$, and in the recesses thus formed the closures will fit, as clearly shown in Figs. 1 and 6. Each closure is also provided with an orifice $a^{12}$ to be closed normally by a plug $a^{13}$, carried by the upper portion of the screw-rod $a^7$, so that when material is to be removed from the device when used as an amalgamator by turning the screw $a^{17}$ both the plugs $a^6$ and $a^{13}$ will be drawn down, thereby permitting the material to escape to the runway $a^8$. In some instances it may be necessary only to have a single plug in the sluice-box, and in this case the sluice-box will slope easily from a point opposite to the plug down to the same.

Arranged in the bowl and fitting the bottom thereof closely are a plurality of shoes or rubbers B, the same being adapted for vibratory motion by mechanism to be described later, whereby the material in the bowl in the operation of the rubbers is kept in a state of suspension without creating a current, which would tend to carry off the fine gold. The rubbers B are in this instance carried by six arms; but it is to be understood that I do not desire to be limited to this number, as a greater or less number may be used, if preferred or necessary. These rubbers are made to fit the bottom of the bowl exactly, so that the mercury will always be caused to be pushed back and forward in front of the rubbers without passing under them, by which means instead of having the mercury flour or be broken up into very small globules large globules will be utilized for the purpose, thereby not only effecting more ready amalgamation, but preventing loss of the gold by flouring. To effect the formation of these globules and at the same time to cause the material to be brought into proper relation with the rubbers, the faces of the rubbers are rounded or beveled, as shown at $a^{14}$ in Fig. 8, in which a globule of mercury is indicated by dotted lines. The arms or rubbers are securely bolted to a center hub $b^3$, the under side or face of which is formed to fit the central raised portion $a^2$ of the bowl-bottom and is also tapped to take the central stub-shaft $b'$, which is secured to the central portion of the bowl-bottom and extends upward into the body portion of the bowl. Secured in any suitable manner to this central hub is the sleeve $b^2$, bored to fit the stub-shaft $b'$, and having secured at its upper portion in any suitable manner, as by bolts $b^{7a}$, a collar $b^4$. In the central portion of the face of this collar adjacent to the sleeve $b^2$ is formed a square recess $b^5$, in which is placed a piece of steel $b^6$, adapted to rest on the upper end of the stub-shaft $b'$ and to constitute a thrust-bearing, which shares the weight of the shaft and rubbers with the hub $b^3$. This collar is secured to the main shaft $b$ in any suitable or preferred manner. Passing downward through the collar $b^4$ are arranged a number of bolts $b^7$, screw-threaded within said collar and having their lower ends in contact with the steel piece $b^6$. The function of these bolts is to permit a ready adjustment of the rubbers with relation to the bowl-bottom, the loosening or tightening of these bolts exerting pressure upon the steel piece, thus causing the collar $b^4$ to rise upon the shaft $b$ and carry with it the sleeve $b^2$ and the rubbers B. In order to compensate for any wear of the rubbers, so as to cause them always to fit closely the bottom of the bowl, the lower portion of the hub $b^3$ may be chambered about the upper part of the raised portion $a^2$ of the bowl-bottom, as shown at $a^{15}$, this arrangement serving to permit the rubbers to contact with the bowl and, as stated, to take up wear.

On the top of the frame of the apparatus is a large gear C, which is rendered stationary against vertical movement by journal-boxes $c$, the center shaft working in the boxes being provided with a key $c^2$, Fig. 4, to engage a keyway in the shaft-opening of the gear, by which arrangement the shaft may be raised or lowered to effect adjustment of the rubbers. Motion is imparted to the gear C, and thus to the rubbers, by a pinion $c^3$, carried by a shaft $c^4$ and pulleys $c^5$, $c^6$, and $c^7$. The center pulley $c^6$ is fixed to the shaft $c^4$, and the other pulleys, on each side, are loose, and these latter pulleys are connected with the driving-shaft by two belts (not shown) running in opposite directions. Above the pulleys is a two-part belt-shifter D, provided with the usual belt-guides $d$ $d^2$, carried by levers $d^3$ $d^4$, respectively, these levers being adapted to be engaged alternately by arms E, carried by collars $e$, secured to the upper end of the center shaft. The arms E are moved by the motion of the shaft until one of them contacts with the operating-lever of the belt-shifter, when the belts are shifted and the motion of the shaft $b$ is reversed. The motion in this direc-

tion continues until another arm E contacts with the belt-shifter lever again to reverse the motion. When it is desired to have the machine make a complete revolution before reversing, only one of the arms will be used. If a half-revolution be desired, two of the arms will be employed, arranged at right angles to each other, covering a quarter of a circle.

To effect raising or lowering of the center shaft when desired, a lever F is provided, which is connected by a wire rope *f* or other flexible connection with a hand-wheel G, the latter being held in position against the frame by a bracket *g*. By operating the hand-wheel G the lever F is manipulated to effect the raising or lowering of the shaft *b*, as well as the rubbers.

Supported in any desirable manner in the bowl is a tube H, provided at its top with a funnel *h*, the tube extending down to the upper portion of the rubbers and being provided with a telescopic lower section $h^2$, which may be raised, as will be obvious, thereby to allow the rubbers to be lifted, as desired. This tube constitutes the feed or delivery tube for the machine, and all material is delivered by it to the machine at or around the center of the shaft and at the top of the rubbers.

Each of the four sides of the runway or casing $a^8$ is provided with a threaded opening, which may be engaged by the pipe $a^9$ for carrying off the precious metals to a suitable place of deposit. As a rule it will only be necessary to use one of these pipes, so that when but one is used the other three openings will be closed entirely, as by a threaded plug $a^{16}$. Should a change of flow of direction of the discharge be desired at any time, it will only be necessary to remove the pipe and one of the plugs and change their relative positions. When the bowl is to be emptied of its contents, the screw $a^{17}$ is turned to lower the plugs $a^6$ and $a^{13}$, and the material contained in the bowl will pass out through one of the pipes $a^9$. In lieu of the screw and hand-wheel a lever may be used to force the said plugs into the orifices.

When the device is to be used as a concentrator, a plurality of rods I, extending upward any desired distance above the top of the rubbers, are attached to the rubbers, as shown in Fig. 3, these operating to break up and disintegrate the clay, talc, &c. As before stated, when the apparatus is to be used as a concentrator the closure or ring $a^{19}$ is removed from the bowl, thereby leaving the sluice-box to catch the concentrates that settle to the bottom thereof, to effect removal of which the plugs $a^6$ and $a^{13}$ are lowered in the manner described in connection with the amalgamator. In addition to the rods I the rubbers may have a plurality of stirrers *i* arranged on the under side and extending down into the sluice-box, thus serving to keep the concentrates and whatever substance settles in the sluice-box in a state of constant agitation.

Secured to the side of the bowl is a casing J, passing through the outer wall of which are screw-threaded stems *j*, carrying on the inner end plugs $j^2$ to fit openings in the side of the bowl, these plugs being adapted to be opened to permit the tailings to pass from the apparatus when used as a concentrator. By means of the screw-shanks these plugs will be made tightly to fit the openings in the bowl, so that escape of liquid therefrom will be obviated.

The operation of the machine as an amalgamator is the same as those in ordinary use, except as to increased efficiency in the manner of cleaning the gold from refractory substances, of effecting amalgamation, and of saving mercury, as has been pointed out. When used as a concentrator, the pulp from the stamp-mill or pulverizer is carried by sluice-boxes (not shown) to the funnel surrounding the center shaft and by it delivered to the top of the rubbers. There being no current of water at the center of the machine, the precious metals quickly settle to the bottom of the machine, and by their specific gravity are caused to remain there. The vibratory motion given to the rubbers and the beaters keeps the material in a state of suspension, and as there is no current to keep the fine gold away from the bottom it quickly settles there, as well as the heavier particles of material, such as iron and the like. These crowd up the lighter silicates, and the latter pass away through the gates and sluice-boxes to the dump. (Not shown.) In ores where the precious metals are coarse nothing will be lost by allowing the tailings to pass away through the lowest gate, but where the ore contains microscopic and flour gold it may be necessary to close the lower gates and allow the tailings to pass away from the top gate. Where the ore contains talc and clay, which holds the gold from settling, the rods in the concentrator-bowl will be used, these by passing backward and forward through the pulp effecting a thorough disintegration of the talc and clay, and will allow the precious metals to settle to the bottom of the machine. When the machine has been run a suitable time, so there is danger of losing valuable material, the flow of pulp will be switched off into the next machine, it being understood that there will be a series of these connected up, and the concentrates will be drawn off through the bottom into the amalgamator. When used as a settler or saver of amalgam, the process will be similar to concentrating, only that the machine will be below the amalgamator and receive the discharge from it direct. The plugs in the bottom of the rubbers will keep the material agitated in the sluice-box at the bottom and the amalgam will settle around the discharge-plugs. This

amalgam will be drawn out by opening the plugs for a moment. The machine will then continue to act as a concentrator, and if by any means any of the valuable material has not been amalgamated it will remain in the bottom of the sluice-box and will be drawn off and amalgamated again.

In Fig. 9 I have exhibited a form of device, though on a small scale, embodying the essential features of the larger device, this device being particularly well suited for use in making tests on small quantities of ore. The only difference in construction of this device over the large one is that the mechanism for imparting rotary oscillatory motion to the rubbers is dispensed with and these are operated by hand, the rubbers, as in the large machine, to conform closely to the bottom of the bowl. Further, the rising center portion of the bowl is omitted, although it may be employed.

It is to be understood that in connection with the amalgamator and the concentrator certain chemicals are to be used to effect cleansing of the gold from grease or the like and also to separate the gold from the refractory materials. Any suitable chemical or combination of chemicals well known in the art may be employed, and a detailed description of their mode of operation is deemed unnecessary. It is also to be understood that I do not limit my invention to having the circular sluice-box $a^4$ formed as a separate element and secured to the bowl-bottom, as it is obvious that the bottom may be cast or otherwise constructed with the sluice-box as an integral part of the bowl-bottom.

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

1. An apparatus of the character specified, comprising a bowl having a curved bottom slightly rising in the center, in combination with rubbers centrally pivoted, extending radially and having close contact with the bottom, means for imparting a circular, oscillatory motion to the rubbers, and rods projecting above the rubbers and operating to disintegrate the material within the bowl and to break up any currents formed therein, substantially as described.

2. An apparatus of the character specified, comprising a bowl having a curved bottom slightly rising in the center, in combination with rubbers centrally pivoted, extending radially and having close contact with the bottom, a feed-funnel arranged at the center of the bowl, means for imparting a circular, oscillatory motion to the rubbers, and rods projecting above the rubbers and operating to disintegrate the material within the bowl and to break up any currents formed therein, substantially as described.

3. An apparatus of the character specified, comprising a bowl having a curved bottom slightly rising in the center, in combination with rubbers centrally pivoted, extending radially and having close contact with the bottom, means for imparting a circular, oscillatory motion to the rubbers, rods projecting above the rubbers and operating to disintegrate the material within the bowl and to break up any currents formed therein, and valve-controlled openings in the bottom near the center, substantially as described.

4. An apparatus of the character specified, comprising a bowl having an outwardly-convexed bottom, rubbers centrally pivoted, extending radially and fitting the bottom, means for imparting a circular oscillatory motion to the rubbers, rods mounted upon and projecting above the rubbers, a sluice-box concentrically located in the bowl-bottom and valved discharge-openings in the sluice-box, substantially as described.

5. An apparatus of the character specified, comprising a bowl having a sloping bottom, rubbers located within the bowl and closely fitting the bottom, means for imparting motion to the rubbers, a curved sluice-box located in the bowl-bottom, said sluice-box being of different depths in different portions, and valve-controlled discharge-openings in the lower portions of said sluice-box, substantially as described.

6. An apparatus of the character specified, comprising a bowl having a sloping bottom, rubbers located within the bowl and closely fitting the bottom, means for imparting vibratory motion to the rubbers, a curved sluice-box located in the bowl-bottom, said sluice-box being of different depths in different portions, and discharge-openings in the lower portions of said sluice-box, substantially as described.

7. An apparatus of the character specified, comprising a bowl having a sloping bottom, rubbers located within the bowl and closely fitting the bottom, a curved sluice-box located in the bowl-bottom, discharge-openings in said sluice-box, a runway or casing secured below said sluice-box and provided with suitable discharge-openings, and means for imparting motion to the rubbers, substantially as described.

8. An apparatus of the character specified, comprising a bowl having a curved bottom slightly rising in the center, in combination with rubbers centrally pivoted, extending radially and having close contact with the bottom, means for imparting a circular oscillatory motion to the rubbers, rods projecting above the rubbers and operating to disintegrate the material within the bowl and to break up any currents formed therein, and a series of vertically-arranged valved openings in the side of the bowl, substantially as described.

9. An apparatus of the character specified, comprising a bowl having a curved bottom, a central shaft, rubbers pivoted upon said cen-

tral shaft and fitting the bowl-bottom, means for imparting motion to said shaft, an arm carried by the shaft and operating at predetermined intervals to actuate the shaft-operating means and effect a reversal of motion in said shaft and rubbers, substantially as described.

10. An apparatus of the character specified, comprising a bowl having a sloping bottom, rubbers located within the bowl and closely fitting the bottom, a curved sluice-box located in the bowl-bottom, a removable covering adapted to fit the sluice-box and serve as a contact bearing-surface for the rubbers, and means for imparting motion to the rubbers, substantially as described.

11. An apparatus of the character specified, comprising a bowl having a sloping bottom, rubbers located within the bowl and closely fitting the bottom, an annular curved sluice-box concentrically located in the bowl-bottom, a removable covering adapted to fit the sluice-box and serve as a contact bearing-surface for the rubbers, and means for imparting motion to the rubbers, substantially as described.

12. An apparatus of the character specified, comprising a bowl having a sloping bottom, rubbers located within the bowl and closely fitting the bottom, a curved sluice-box located in the bowl-bottom and provided with valved discharge-openings, and with a removable cover flush with the bowl-bottom and adapted to serve as a bearing-surface for the rubbers, and means for imparting motion to the rubbers, substantially as described.

13. An apparatus of the character specified, when used as a concentrator, comprising a bowl having a curved bottom, rubbers closely fitting the bottom, means for imparting an oscillatory motion to the rubbers, a feed-funnel arranged at the center of the bowl, a curved sluice-box arranged at the bottom of the bowl, and mechanism carried by the rubbers for causing disintegration of the material in the bowl and agitation of the substance within the sluice-box, substantially as described.

14. An apparatus of the character specified, when used as a concentrator, comprising a bowl having a curved bottom, rubbers closely fitting the bottom, means for imparting an oscillatory motion to the rubbers, a feed-funnel arranged at the center of the bowl, a curved sluice-box arranged at the bottom of the bowl, mechanism carried by the rubbers for causing disintegration of the material in the bowl and agitation of the substance within the sluice-box, and valve-controlled openings arranged at the side of the bowl, substantially as described.

15. An apparatus of the character specified, when used as a concentrator, comprising a bowl having a curved bottom, rubbers closely fitting the bottom, means for imparting an oscillatory motion to the rubbers, a feed-funnel arranged at the center of the bowl, a curved sluice-box arranged at the bottom of the bowl, mechanism carried by the rubbers for causing disintegration of the material in the bowl and agitation of the substance within the sluice-box, orifices in the bottom of the sluice-box, plugs for closing the orifices, a runway or casing below the sluice-box, and valve-controlled openings arranged at the side of the bowl, substantially as described.

16. An apparatus of the character specified, when used as a concentrator, comprising a bowl having a curved bottom, rubbers closely fitting the bottom, means for imparting an oscillatory motion to the rubbers, a feed-funnel arranged at the center of the bowl, a curved sluice-box arranged at the bottom of the bowl, mechanism carried by the rubbers for causing disintegration of the material in the bowl and agitation of the substance within the sluice-box, orifices in the bottom of the sluice-box, plugs for closing the orifices, a runway or casing below the sluice-box, valve-controlled openings arranged at the side of the bowl, and a ring or closure fitting a circular opening in the bottom of the bowl and conforming to the shape of the bowl, substantially as described.

In testimony whereof I affix my signature in the presence of two subscribing witnesses.

JOHN B. ROSSMAN.

Witnesses:

EDWARD J. EDWARDS,

L. W. HEATH.