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METHOD OF EXTRACTING GOLD

Filed Dec. 19, 1923

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This invention relates to a method of extracting free gold particles from adobe (clay-sand) placer deposits, the crushed clay-sand tailings of quartz mills and from any soft material of mines or deposits, such as oxidized surface ores, clay porphyries and talcose gangue. The adobe material consists of clay, sand, stones and rocks cemented together more or less and containing free gold particles distributed through the mass and associated with a heavy mineral which is usually magnetite or black sand.

It is an object of the present invention to provide a method whereby the free gold can be recovered economically by subjecting the bulk material to successive treatments whereby disintegration of the clay-sand material is effected, the clay is carried off in the form of a slime, and the free gold, by separate steps, is separated from the sand and the slime respectively without requiring the use of expensive machinery.

With the foregoing and other objects in view the invention resides in certain steps of the method hereinabove described and claimed, it being understood that within the scope of what is claimed, changes in the precise embodiment of the invention disclosed can be made without departing from the spirit of the invention.

In the accompanying drawings the preferred form of the apparatus used in carrying out the invention has been shown.

In said drawings—

Figure 1 is a plan view of the apparatus.

Figure 2 is a side elevation thereof.

Figure 3 is an elongated vertical transverse section through the disintegrating mill on line 3—3, Figure 2.

Figure 4 is a section on line 4—4, Figure 3.

Figure 5 is a section on line 5—5, Figure 4.

Figure 6 is an enlarged vertical transverse section through the screening mechanism, said section being taken on the line 6—6, Figure 1.

Figure 7 is an enlarged section through the slime table and cooperating parts, said section being taken on the line 7—7, Figure 1.

Figure 8 is an enlarged section on line 8—8, Figure 7.

Figure 9 is an enlarged section through the sluice boxes, taken on line 9—9, Figure 1.

Figure 10 is an enlarged section on line 10—10, Figure 9.

Figure 11 is an enlarged transverse section through the rifle grating, said section being on the line 11—11, Figure 1.

Figure 12 is a view showing, in diagram, the complete apparatus.

The crude material to be subjected to the process of separation is first divided into undersized and oversized screenings. This separation is effected by employing a separator on which the material is deposited.

This separator includes a fine screen 1 overhanging an inclined chute 2 provided with a suitable gate 3 whereby the discharge of material from the chute can be controlled.

This screen is adapted to separate the undersized fines from the other material. The tailings will be deposited on the inclined grizzly 4 made up of the parallel rods shown in Figure 2 and discharging its tailings against a flange 5 which merges into a discharge or delivery spout 6. A water supply nozzle 7 is preferably employed for directing a stream of water against the upper portion of the flange 5 so as to wash thoroughly the rocks and stones delivered as tailings from the grizzly. This coarse washed material will be delivered from the spout 6 while the material delivered through the grizzly will be collected in a sluice box 8.

The dividing of the material by means of the apparatus thus far described is not merely to facilitate treatment but is extremely vital to insure proper recovery of the gold. This is due to the fact that should the material not be divided as mentioned, the undersized and oversized material when treated with water would establish a close cohesion and become a pasty agglomerated mass. This is a species of hydraulic settling that will clog any rotary screen or the like and will precipitate and form a cement-like thickness on the bottom of a sluice box in a very short time. This property, which is inherent in this class of material, has been the chief difficulty heretofore encountered in processes of gold separation by sluicing methods, making the cost prohibitive because of great losses of gold. It has only been possible to save the heaviest coarse gold particles and the fine and medium weight values have been lost.

The fine screenings delivered to the chute 2 are directed into a disintegrating vat shown in detail in Figures 3 and 4. This vat includes a suitably supported bottom plate 9 having an upstanding circular outer
wall 10 extending around and concentric with an inner wall 11. A gasket, preferably of rubber, is fastened between the bottom plate 9 and the walls 10 and 11 and formed in the bottom plate between the ends of the inner wall 11 is an outlet 12 above and discharging downwardly into a distributing box 13.

Mounted on the structure 14 on which the bottom plate 9 is secured, is a superstructure 15 in which is journaled the upper portion of a shaft 16. The lower end of this shaft can be journaled in a bearing 17 supported by the center of the bottom plate 9. This shaft can be rotated by hand power or by any suitable motor.

Secured to the shaft 16 so as to rotate therewith is a hub 21 having radial wings 22 to each of which is fastened the inner end of a stirring blade 23. These stirring blades are provided at their lower edges with teeth 24 supported about one inch from the bottom plate 9 and the teeth on two of the blades are preferably pitched forwardly in the direction of rotation of the shaft at angles of approximately 45°.

The blades are connected by braces 25 and are formed with longitudinal slots 26.

Arranged back of each blade 23 is a conical roller 27 mounted to rotate freely on an axle 28 and the outer end of each axle is connected by a chain 29 or other flexible element to the outer end of the adjacent blade while the inner end of each axle is similarly connected, as at 29, to an intermediate portion of the adjacent blade, the two connections 28 and 29 preferably extending within vertical planes converging in the direction of rotation as shown in Figure 4. As shown in Figure 3, however, it will be noted that these connections occupy different transverse planes. Thus it will be seen that the rollers will rest on the bottom plate 9 and when the shaft is rotated they will be pulled around back of the blades but will be capable of moving freely upwardly and downwardly and also laterally. A water discharge nozzle 30 is supported above the bottom plate 9 so as to direct a stream of water downwardly into the vat and in the path of the rotating blades.

As before stated this disintegrating vat receives the undersized crude material which is delivered by the chute 3. The material when delivered to the vat is mixed thoroughly with the water discharged from the nozzle 30 and as the shaft 16 rotates at a slow speed the mixed material will not be thrown radially by centrifugal force but will remain where it can be properly acted on by the movable parts within the vat. The outlet 12 is so proportioned that it will retard the discharge of the mixed material so that all parts of the material will be acted on thoroughly before being delivered. The discharge will be continuous however and as water is being constantly admitted to the vat the mixture will be maintained constantly at a predetermined level. In other words the ratio of the area of the discharge to the capacity of the vat becomes a governing factor in effecting uniform and rapid mixing of the material. The retarding of the discharge is thus an essential feature of the invention. The water-mixed mass is agitated by the toothed arms and by the rollers to obtain the dissolution and release of the sand and clay contained in the vat. The harder clay portions are disintegrated by the rotary stirring of the toothed blades together with the crushing and sliding action of the rollers. This results in the distortion, in all directions, of the clay particles so as to render them more quickly pervious to water and thus prevent them from forming into plastic balls. This operation differs entirely from that of any known crushing machinery or grinding mill, it being understood that it is not the object of this apparatus to secure abrasion of the material but merely to obtain water disintegration of the compact plastic mass. It has been found in practice that the operation of this disintegrating mechanism with its stirring, rolling and sliding portions for aiding water dissolution, actually changes the physical condition of the crude clay-sand material so that colloidal, greasy and free particles of alkali soil (which, if still in combination with the fine material in their natural state, would offer strong resisting cohesion) are released. As herebefore stated the water disintegrating material is delivered from the vat through the outlet 12 and into a distributing box 13. This box has downwardly converging front and back walls 31 and 32 forming the bottom thereof. A slime overflow trough 33 is extended laterally from the upper portion of one end of this box while extending downwardly from the bottom of the box and forwardly therefrom is a sluice 34 preferably divided longitudinally by a partition 35 to form two or more sluice-ways. An outlet 36 is provided in the wall 31 for discharging into each sluice-way, each outlet being provided with a gate 37 for controlling the discharge of material to the sluice. Extending longitudinally under the distributing box 13 is a pipe 38 having a series of nozzles 39 opening upwardly through the lowest portion of the bottom of the box. This pipe is connected with a supply tank 40 located at a suitable elevation so that a sufficient pressure can be applied to its outlet and into the bottom of the pipe. This water mixed with the discharge from the vat is directed upwardly, through the nozzles 39, by the structural arrangement so that the mixture will be distributed in a uniform manner throughout the entire area of the sluice 34.
obtained to cause water to discharge upwardly within the box and keep the upper portion of the fluid in the box 13 agitated.

It will be apparent, from the foregoing, that when the muddy mixture of water, clay and sand is discharged from the vat, 9—10—11, the heavier sand will gravitate at points between the nozzles, the concentration of this sand due to its following the downwardly converging walls of the box, serving to express any lighter clay particles commingled therewith. Furthermore the upward water currents from the nozzles 39 carry the finer clay particles to the surface in suspension so that they will overflow into the slime box as a clay-slime. Thus the material which will be discharged through the outlets 36 will consist of clean washed sand which, being separated from the clay, can be treated by ordinary sluice box methods without the usual losses experienced in the treatment of sand-clay material. It might be stated that when the clay particles are separated from the sand in the manner described the colloidal, greasy and free alkali particles also become separated by suspension and are discharged with the clay into the slime box. It will be noted that this distributing box not only receives the material delivered from the vat but also receives the clay-sand washed from the oversized screenings and which was discharged into the sluice 8, this sluice opening directly into the box as shown.

The sluice 34 is provided at its upper end with an amalgam plate 41 over which the material delivered from the box 13 is discharged to the sluice. This sluice as before pointed out can be divided longitudinally into separate sluice-ways and extending transversely of the sluice are riffles 42 each consisting of a length of wood, iron or other suitable material having slots 43 extending into the ends thereof for the reception of the ears 44 fastened to the side walls of the sluice-ways. These slots do not extend throughout the width of the riffles but project thereinto from their lower or front faces so that the pressure of material against the riffles will tend to hold them pressed tightly onto the ears as will be obvious by referring to Figure 10.

Secured to the front face of each riffle is one edge portion of a strip of sheet rubber, indicated at 45, this strip being extended under the riffle and having a free longitudinal edge portion projecting back of the riffle and forming a retarding apron or flap 46.

Any desired number of riffles can be used and located in the lower portions of the sluice-ways are transverse gratings 47 preferably of cast iron and having diamond shaped openings the long diameters of which are parallel with the sides of the sluice. These gratings rest on mats 48 of asbestos which rest on the bottom of the sluice. It is to be understood that the gratings and the mats of asbestos are removable readily. Furthermore the riffles 41 are also readily removable by sliding them backwardly off of the ears 44. Ordinarily, however, they are held firmly in place by set screws 49 which bind upon the bottom of the sluice.

An outlet 50 is provided at the front or lower end of the sluice and discharges onto a table 51 which, in turn, is designed to deliver waste sand tailings into a trough 52.

It is well known to those skilled in the art, that the saving of gold on riffles or amalgam plates depends on the difference in the specific gravity of the gold and sand particles and the recovery is dependent largely on whether or not the gold particles are in rounded grains. If the particles are flat and very fine, any water current of sufficient velocity to move grains of sand to keep them from settling between the riffles will carry off these fine flat particles. The form of riffle herein described has been designed to overcome this objection. As the sand and gold flows downwardly within the sluice box the flaps 46, which are concaved toward the bottom as shown in Figure 10, will cause deflections of the obstructive water current flowing along the sluice box with the result that gold and heavy minerals will be deflected downwardly before the particles can rise over the riffle. Thus the gold is saved by being deposited under the flap, some of the heavier mineral iron concentrates being also collected with the gold. These rubber- shed riffles insure tight contacts with the sluice box so that there is no danger of leakage. As before pointed out the riffles can be readily removed to give access to the deposits or accumulations.

By providing the gratings with the asbestos pads thereunder the gold and heavy concentrates passing the riffles will fall through the gratings and become enmeshed in the fibers of the asbestos. The use of asbestos is superior to the use of carpet, burlap or other fabrics because the asbestos pads can be removed and heated to a high temperature so as to quickly dry, the temperature being far greater than that which could be withstood by ordinary fabrics.

After the asbestos has thus been quickly dried the accumulated values can be brushed therefrom after which the asbestos can be restored to the sluice box and under the gratings in a perfectly clean condition free from colloidal or slimy organic substances. It is to be understood that sufficient water may be supplied to the sluice box when desired, to keep the riffles free from bedding sand. The number of sluice-ways used can be varied to meet the requirements.

The slime overflow from the distributing...
5 of outlet openings 53 each of which has a gate 54 for controlling the outflow of material. These outlets are adapted to deliver the slime onto a table 55 which is pivotally mounted at its upper end as shown at 56 and has a covering 57 of canvas or other suitable fabric. This covering is preferably of three different meshes, the coarsest mesh being at the top and the finest at the bottom or forward end of the table. The forward or movable end of the table can be supported by a transverse rod 58 mounted adjustably in notched standards 59 and a counterbalancing weight 60 can be provided for facilitating angular adjustment of the table. This weight is secured to one end of a cable 61 mounted on a wheel 62, the other end of the cable being fastened at any suitable point to the forward end of the table. One or more counterbalances can be used. A spraying pipe 63 is extended transversely above the upper portion of the table 55 and has a series of downwardly discharging spraying nozzles 64 controlled by valves 65. Spaced ribs 66 are extended longitudinally of the table to provide separate passages along the canvas covered top of the table.

3.5 fabric.

The foregoing it will be noted that by opening the gates 54 successively beginning with the one nearest the sluice 34, the slime can be distributed along the separate passages upon the slime table, it being designed to close each gate as soon as the slime reaches the lower end of the passageway into which it has been discharged. The heaviest particles in suspension will settle on the canvas while the water and the lighter particles will drain from the table and into the trough 68 to which said material will be directed by the apron or chute 66 which is normally positioned as shown by dotted lines in Figure 7. The jets of clear water distributed from the nozzles 64 are turned on after the slime has thus been distributed and the water thus delivered cleanses the concentrated fine material, such as sand, associated with the gold and enmeshed in the canvas. Furthermore this fresh water also washes any remaining light particles into the waste trough or sluice 68. Thereafter the jets of water are turned off, the table is allowed to drain and the canvas covering is brushed off thoroughly, the apron 66 being first adjusted to the position shown in full lines in Figure 7 so that these sweeplings will be directed into the trough 69. The gold and concentrate product thus secured is treated in any of the well known ways so as to separate all of the gold from the other material recovered.

During this slime treatment process the magnetic sands will show black against the white canvas as the water current spreads the slimes down the slope of the table. This denotes the right time to wash and sweep the runways or passages so that the table will not be overloaded. The action of the table is not that known as "blanket sluicing" wherein the gold and heavy concentrates are caught and enmeshed in the fibers of blankets or the like. Instead the values are permitted to settle in the spaces between the threads of the fabric because of the fact that the flow of the slimes is stopped as soon as the table is covered and the slimes permitted to drain. There is no washing action such as results from the use of a continuous current.

The sweeping of the deposits from the table can be effected by the use of an ordinary broom or by suitable power operated brushes.

What is claimed is:

1. The herein described method of separating gold from clay-sand material which consists in effecting a dry separation of the undersized material from the oversized material, crushing and stirring the undersized material in water to release the sand from the clay, washing the oversized material and combining the washings with the treated undersized material and precipitating the sand from the clay particles.

2. The herein described method of separating gold from clay-sand material which consists in first effecting a dry separation of the undersized material from the oversized material, washing the oversized material and retaining the washings but discarding the washed material, crushing and stirring the undersized material in water to effect the disintegration and release of sand from clay, combining the treated material with the washings, and then allowing the sand to settle in an elongated mass, said mass being subjected to transverse compression for condensing the precipitated sand thereby to express clay particles from between the sand particles to form a slime.

3. The herein described steps in the method of separating the gold from granular clay-sand material which consists in distorting the granules in water to effect the sus
pension and release of clay and sand and subsequently separating the clay from the sand particles by lateral compression and flotation thereby to form a slime, delivering the slime in a film upon a porous surface, then permitting the surface to drain, and subsequently washing the surface and drying and cleansing it thereby to recover deposited values in the pores thereof.

4. The herein described method of separating fine gold from granular clay-sand material which consists in first effecting a dry separation of the undersized portion from the oversized portion, then distorting the granules in moving water to effect the disintegration and release of the clay and sand of the undersized portion, combining the separated clay and sand with washings from the oversized portion, thereafter separating the sand from the clay and other light particles by suspension to form a slime, then spreading the slime, draining it, and finally recovering values precipitated from the drained slime.

In testimony that I claim the foregoing as my own, I have hereto affixed my signature.

JOSEPH LOWREY WARNER.