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E. A. WALL.

ORE WASHER OR CONCENTRATOR.

APPLICATION FILED NOV. 2, 1906.

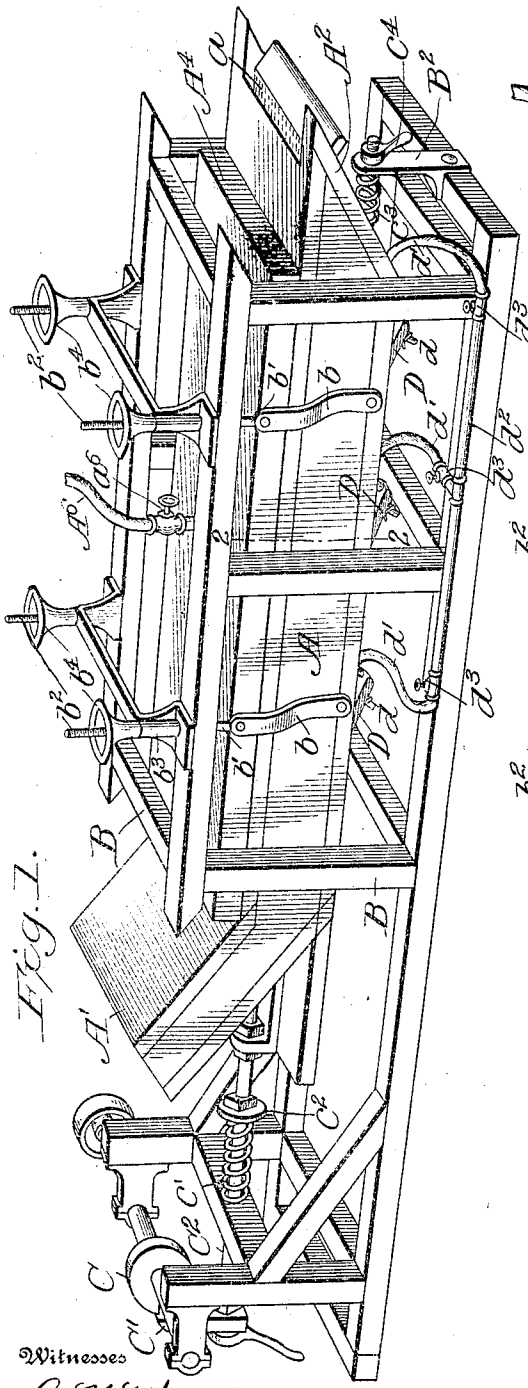

Fig. 1.

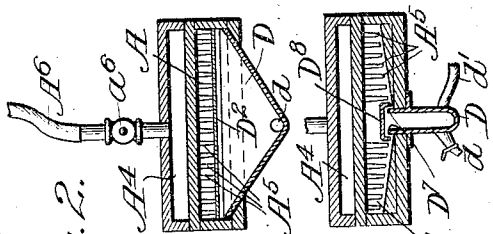

Fig. 2.

Fig. 3.

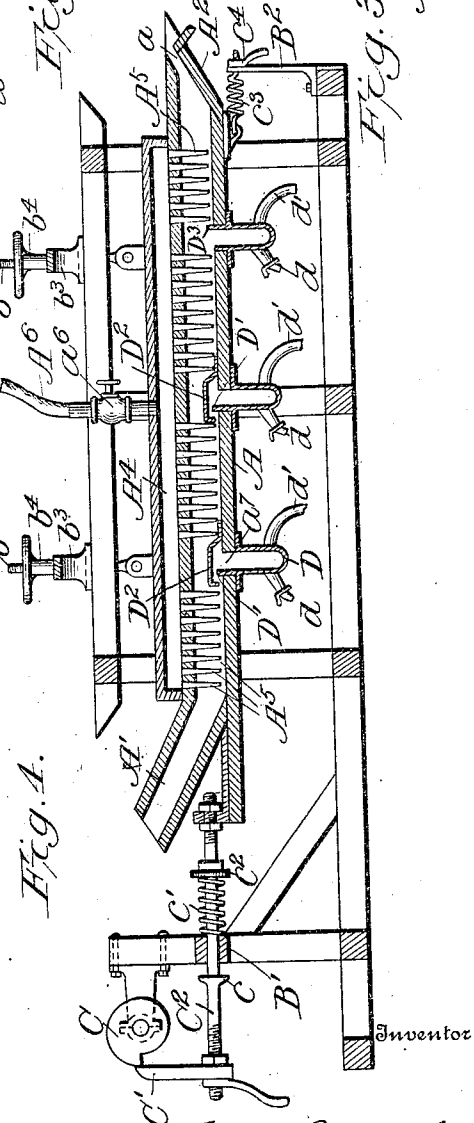

Fig. 4.

Witnesses

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ORE WASHER OR CONCENTRATOR.

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To all whom it may concern:

Be it known that I, ENOS A. WALL, a citizen of the United States, residing at Salt Lake City, in the county of Salt Lake and State of Utah, have invented certain new and useful Improvements in Ore Washers or Concentrators, of which the following is a specification.

My invention relates to that class of machines which are designed to receive finely crushed or comminuted metalliferous ores or sands and water, and are so manipulated as to agitate the mass and produce a separation of the heavier and valuable particles of ore from the lighter and worthless sands composing the so-called gangue of the same. The machine and methods in common use, adapted to this purpose, are numerous and of great variety in form of construction and method of operation, though operated upon the same general theory or line of thought; all being dependent, however, upon careful preliminary "sorting" or separation of the various particles of crushed or comminuted material into different grades or classes in which each separate class shall be composed of particles as nearly as practicable of the same relative size. The coarser portions are then subjected to a process familiarly known as "jigging," while the finer portions are treated with indifferent success upon some one of the various types of "jerking" or "bumping" tables in common use; or, if the material be very finely pulverized or "slimed" then upon some form of revolving "buddle" or traveling belt. In all of the latter named machines, the finely pulverized ores are spread upon the surface of the machine in a thin sheet or film, and the separation of the valuable portions thereof is then effected by means of a thin sheet of water passed over the mass, the operation being assisted by a reciprocal vibratory or jerking motion applied to the machine. Many of the machines in use for this purpose are efficient and successful in their operation to a profitable degree, but all are deficient in important respects, and are especially limited in capacity and withal involve excessive cost in operation.

My machine differs radically from all those in use in all essential respects, except that its operation is attended with similar reciprocating vibratory motion; its effective principle, however, bears close relation to that of the "miner's sluice" used in extracting gold from auriferous sands or gravel, which is simply a long wooden box or trough having a bottom and two side walls, but is open at both ends for the free introduction and passage of water, gravel and sands. In operation various kinds of obstructing riffles, such as blocks, slats or perforated boards are placed in the bottom of the sluice in such manner as to provide numerous small recesses and crevasses in which the gold, by reason of its superior specific gravity, finds lodgment, while the worthless sands and gravel are carried by the flowing water through the sluice to the waste dump. In operation the sluice is placed so as to slope or incline from the "head" or intake, toward the "tail" or discharge portion at such degree as will cause the auriferous sands and gravel (when mingled with a proper volume of water) to drift forward over the riffles to and over the discharge part, while the contained gold settles to the bottom and finds lodgment in the numerous recesses provided by the riffles and is there held secure from the action of the overflowing current of water and drifting sand and gravel. This is the most simple and effective of all concentrating devices and possesses ideal conditions for the treatment of the baser metalliferous ores, but the extreme limit of its capacity to retain large quantities of the concentrated product, renders its use in its present form absolutely impracticable, for the reason that it would be impossible to provide capacity in the riffles of an ordinary sluice to impound but a few pounds of the concentrated material at one time; for, as in the case of gold, but few ounces are seldom recovered in a day's run of perhaps a thousand tons of gravel; whereas, in the treatment of a like volume of metalliferous ores, from twenty-five to a hundred and fifty tons of concentrated product would result. In the operation of the miner's sluice the coarse gravel and finest sands are treated together without any preliminary assorting or classification, the mass being passed through the sluice in such volume as to produce a continuous flow of a stratum of sand and gravel upon the floor of the sluice several inches in thickness, but the agitation of the particles caused by the movement of the mass is such as to cause the gold to settle to the bottom at once, and become securely lodged in the meshes of the riffles, the finer particles being less liable to loss than those of the largest size, and similar results would follow the treatment of metalliferous ores in the miner's sluice until the riffles became filled, after which, of course the entire mass would be carried forward with the flow of water into the waste dump.

The object of my invention is to secure the concentrating effect of a flowing stream of water mingled with crushed or comminuted mineral ores, or metalliferous sands as in the operation of the miner's sluice, and to secure its continuous operation by withdrawing continuously and automatically the valuable portions of the moving mass as rapidly as it settles upon the floor of the sluice, and without disturbing the concentrating effect of the moving volume of pulp and water. This object I accomplish by the construction shown in the accompanying drawings in which—

Figure 1 is a perspective of my improved ore washer; Fig. 2 is a transverse section on line 2—2 of Fig. 1; and Fig. 3 is a view similar to Fig. 2 showing the washer provided with a concave bottom and a slightly modified form of riffle. Fig. 4 is a vertical longitudinal section through the machine.

A designates a tubular washer in the form of an elongated flattened box closed on all sides. The head

A′ of the washer is inclined upwardly at an angle of about thirty degrees and is open at its upper end to receive the material to be treated. The tail board A^2 which closes the opposite end of the washer is also inclined up to the top of the washer to an outlet *a* therein; this outlet being, of course, considerably lower than the inlet at the head A′, so that the washer will always remain full of water during action.

The top of the washer A forms the bottom of a water chest A^4, and through this top extend into the washer a series of tubes A^5. These tubes are placed over the entire top of the washer at intervals of about two inches and extend down to within a small fraction of an inch from the floor of the washer. Water is supplied to this chest or reservoir A^4 by means of a flexible pipe A^6 having a valved connection at a^6 with the chest.

The washer A is suspended near its four corners within a framework B, by means of links *b* pivoted at their lower ends to the washer and at their upper ends pivoted to plates *b′* secured to the lower ends of screws b^2 mounted in bearings b^3 and provided thereabove with adjusting nuts b^4 so that the washer may be raised or lowered.

The washer may be reciprocated by any suitable means but I prefer the mechanism shown which consists of a rotary cam C, working against a tappet or arm C′ projecting up from a rod C^2 extending from the head of the washer through an opening in a post B′ and provided at the outer side of the post with a buffer or collar *c*, and at the inside of the post with a spiral spring *c′*, bearing at one end against the post and at the opposite end bearing against an adjustable collar c^2 on the rod so that when the cam forces the rod to the left it will compress the spring until its shoulder passes the tappet whereupon the spring will be suddenly released and throw the washer towards the tail end until it is suddenly stopped by the buffer striking the post. The opposite or tail end of the machine is provided with a spiral spring c^3, the outer end of which is secured adjustably to a post B^2 by means of a nut c^4 on a threaded extension of the spring.

In order to secure the concentrating effect of a flowing stream of water mingled with crushed or comminuted ores or metalliferous sands as in the miner's sluice and to secure a continuous operation by withdrawing continuously valuable portions of the moving mass as rapidly as it settles upon the floor of the washer without disturbing the concentrating effect of the moving volume of pulp and water I provide narrow transverse slots a^7, at short intervals, in the bottom of the washer beneath which openings I place V shaped receptacles D, secured to the bottom of the washer. These are placed at intervals of two to four feet apart according to the mineral to be treated. The slots a^7 nearest the head of the washer are each provided at their edges next to the head with an obstructing riffle D′ formed of a thin sheet metal plate which extends entirely across the bottom of the washer. These riffles D′ are covered by hoods D^2 formed of sheet metal plates attached to the floor of the washer at the tail side of the openings and extending over the openings and riffles and then bent down at an angle so that the lower edge of the hood will lie about a quarter to a half inch above the floor.

Thus it will be seen that in order that the bottom stratum of mineral which forms on the bottom of the washer when in operation may pass through openings a^7 and into the receptacles D, it must pass under the depending edges of the hoods D^2 and then rise over the riffles. It is evident therefore that before heavier mineral can so pass over the riffles the stratum of such mineral must attain a thickness equal to the height of the riffle. Whereupon if the mass including the heavier concentrated mineral forming the bottom stratum be made to flow forward equally, any additions to the stratum of concentrated mineral must force an equal amount forward beneath the hood D^2 over the riffle D′ and into the receptacle D, while the lighter portions constituting the waste sand and gangue being borne up by the heavier material, will be carried forward over the hoods to the tail for further treatment. Three or four riffles constructed as described will be sufficient to extract all recoverable values in ores or sands of ordinary occurrence, but to provide against possible loss of portions of the lighter mineral and subject the same to further treatment, I provide a riffle D^3 which is placed at the lower or tail side of the opening a^7 next to the tail of the washer and its purpose is to dam or obstruct the flow of the bottom stratum of the mineral and sands that have passed the first named riffles and cause the same to flow into the receptacle D. These receptacles D are provided in their bottoms with discharge valves or gates *d* and also with flexible water supply pipes d^2, leading from a main or pipe d^2 and provided with suitable valves d^3. The operator may withdraw from this last receptacle D, through its gate *d*, the remaining unconcentrated portions of mineral together with a limited quantity of the heavier non-mineral sands for retreatment upon machines adapted to the recovery of the valuable mineral of that class.

The operating mechanism will impart a bumping or jerking motion to the washer and cause the concentrates lying next to the floor to slide forward at each throw, jerk or bump of the washer under the hood and over the riffle as above described.

In operation, the water and the upper and lighter stratum of gangue will travel much faster than the lower stratum and in an open top washer the finely divided or slimed mineral will float near or upon the surface of the water and is thus carried out with the waste so that it is necessary in such washers to place the same nearly or quite level in order that the flow may be sufficiently slow to give sufficient time for the finer particles to settle, but this causes the coarser sands, which are kept partially suspended by the oscillation of the washer, to move forward too slowly and so reduce the capacity of the machine. To overcome such objections and secure important additional advantages when treating ores containing an excessive proportion of finely divided or slimed ores, I close the top of my washer and arrange its tubular intake or head at an angle so that it projects above the body of the washer about two feet and also close and incline the tail end as before described. By this construction, when the washer is in operation with the body portion at about a level, the body portion will at all times be filled with flowing water confined by the cover whereby the hydrostatic pressure of the water in the inclined

head portion will force the sands through the level body portion and out over the elevated tail or discharge end. Instead of floating on the surface therefore, the finely divided or slimed minerals will settle to the bottom and combine with the coarser mineral of its kind while the waste material will be forced rapidly forward to the discharge by the pressure of water. This finely divided or slimed mineral, however, has a tendency to adhere more tenaciously to the floor of the washer than the coarser mineral, but this deficiency is overcome by means of the shallow water chest or tank A^4 and the tubes depending therefrom as water under pressure may be introduced close to the bottom of the washer throughout its entire area to gently agitate the adhering slimes upon the floor and render them susceptible to the bumping or jerking action of the washer and the flow of water therethrough.

The washer may be constructed of wood or other suitable material and its dimensions may be considerably varied according to the material to be operated upon. The bottom may be flat as in Figs. 1 and 2, but it may be concaved as in Fig. 3 in which event the riffle D^7 and hood D^8 will not extend across the entire width of the floor, but will be narrow and located in the lowest portion of the floor.

In order to discharge the concentrate as rapidly as it accumulates in the receptacles D, but so that none of the feed or wash water will be allowed to escape into the receptacle with the concentrate, the gate *d* is opened sufficiently to permit the discharge of the concentrate as rapidly as it forms and a sufficient quantity of water from pipe *d'* is admitted into the receptacle in sufficient volume to keep the receptacle filled and in addition fill the gate.

Should more water be allowed to flow into the receptacle D than can pass out through the gate, the excess would rise and flow up into the body of the washer without interfering with the concentration or discharge of the mineral into the receptacle D. This is also true in regard to the last receptacle next to the tail.

It will be understood that by "tubular body adapted to be filled with water" as used in the claims, I mean that the said body or sluice is closed at its top and that the ends are likewise closed or raised from the bottom in contradistinction to an open top trough open at its ends.

What I claim is—

1. An ore washer or concentrator comprising a horizontally disposed tubular body, having its head end extended upwardly above the top of the body to give the proper head to the water and ore fed therein and having its opposite or tail end closed and provided with an outlet for the waste material and water at its upper portion above the level of the upper internal surface of the body; whereby the tubular body is maintained completely filled with water, and air contact with the contents avoided, and means for imparting a longitudinal reciprocating movement to the tubular body adapted to cause the concentrate to move toward the tail end of the body.

2. An ore washer or concentrator comprising a horizontally disposed tubular body, having its head end extended upwardly above the top of the body to give the proper head to the water and ore fed therein and having its opposite or tail end closed and provided with an outlet for the waste material and water at its upper portion above the level of the upper internal surface of the body; whereby the tubular body is maintained completely filled with water, and air contact with the contents avoided, means for automatically effecting a continuous discharge of the concentrate through the bottom of the body, and means for imparting a longitudinal reciprocating movement to the tubular body adapted to cause the concentrate to move toward the tail end of the body.

3. An ore washer or concentrator comprising a horizontally disposed tubular body having its head end extended upwardly above the top of the body to give the proper head to the water and ore fed therein, and having its opposite closed end provided with an outlet for the waste material and water at its upper portion above the level of the upper internal surface of the body; whereby said tubular body is maintained completely filled with water, and air contact with the contents avoided; the bottom of the body having a discharge opening for the concentrates, a riffle at the head side of the discharge opening, a hood over the said opening and riffle, a receptacle below said opening, a discharge valve or gate for said receptacle, a water supply for said receptacle to admit water thereto under pressure, and means for imparting longitudinal reciprocation to said body adapted to feed the concentrate toward said receptacle.

4. An ore washer or concentrator comprising a horizontally disposed tubular body having its head end extended upwardly above the top of the body to give the proper head to the water and ore fed therein, and having its opposite closed end provided with an outlet for the waste material and water at its upper portion above the level of the upper internal surface of the body; whereby said tubular body is maintained completely filled with water, and air contact with the contents avoided; the bottom of the body having a discharge opening for the concentrates, a riffle at the head side of the discharge opening, a hood over the said opening and riffle, a receptacle below said opening, a discharge valve or gate for said receptacle, a water supply for said receptacle to admit water thereto under pressure, an integral water chest on the upper side of the body, tubes leading from the chest to near the floor of the body, and means for imparting a longitudinal reciprocation to said body adapted to feed the concentrate toward said receptacle.

5. An ore washer or concentrator comprising a horizontally disposed tubular body having its head end extended upwardly above the top of the body to give the proper head to the water and ore fed therein and having its opposite or tail end closed and provided with an outlet for the waste material and water at its upper portion above the level of the upper internal surface of the body; whereby the tubular body is maintained completely filled with water, and air contact with the contents avoided, means for collecting and discharging the concentrates, springs at the ends of the tubular body, means for moving the tubular body in the direction of its head against the action of said springs and suddenly releasing it, and a bumping mechanism at the head end of the tubular body.

6. An ore washer or concentrator comprising a horizontally disposed tubular body having its head end extended upwardly above the top of the body to give the proper head to the water and ore fed therein and having at its opposite or tail end an outlet for the water and waste material above the level of the upper internal surface of the body; whereby said tubular body is maintained completely filled with water and air contact with the contents avoided, means in the bottom of the tubular body for discharging the concentrates, a water chest forming the top of the body and having discharge tubes extending down close to the floor of said body and means for imparting a longitudinal reciprocation to the body adapted to feed the concentrates toward the tail end.

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

ENOS A. WALL.

Witnesses:
GEO. H. EVANS,
H. P. HOWARD, Jr.