2 Sheets—Sheet 1.

J. M. THOMPSON.

ORE-CONCENTRATOR.

No. 171,747. Patented Jan. 4, 1876.

Fig. 1.

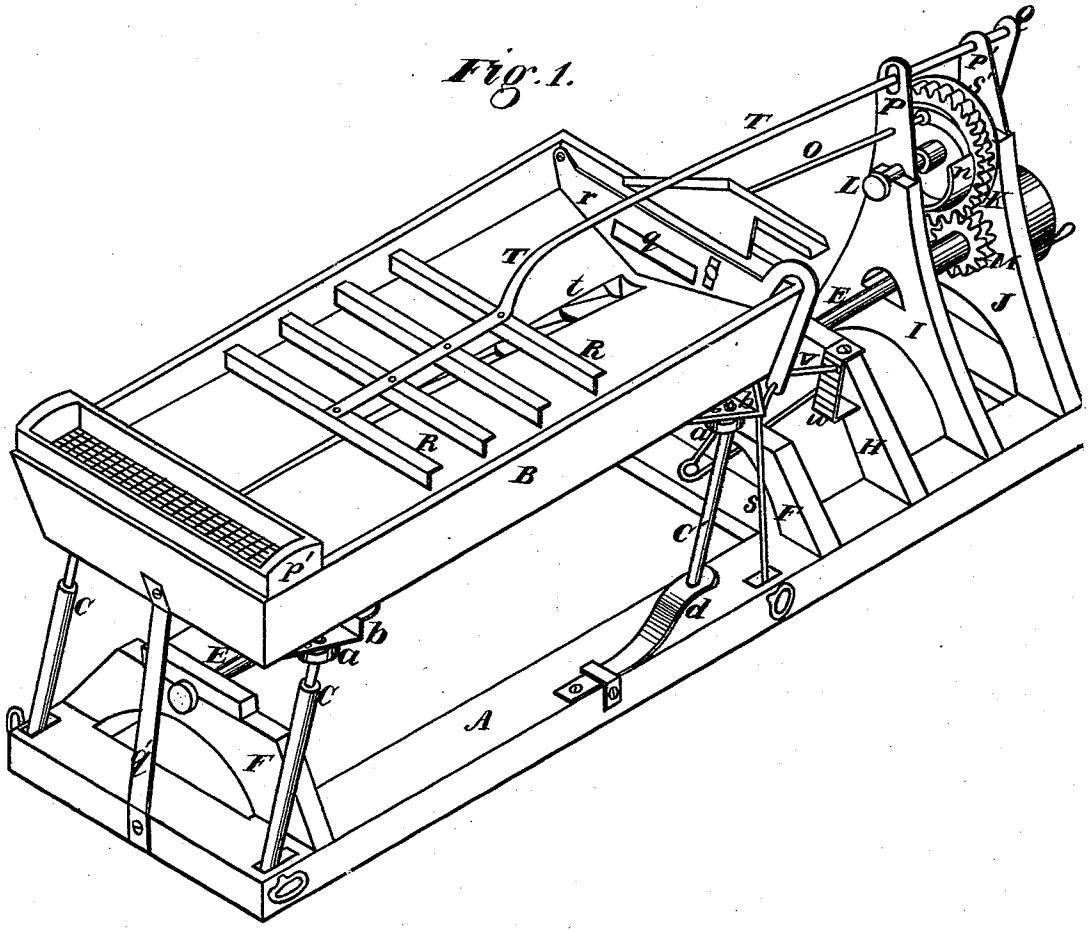
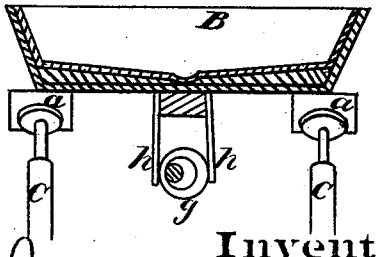


Fig. 2.



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2 Sheets—Sheet 2.

J. M. THOMPSON.

ORE-CONCENTRATOR.

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Fig. 3

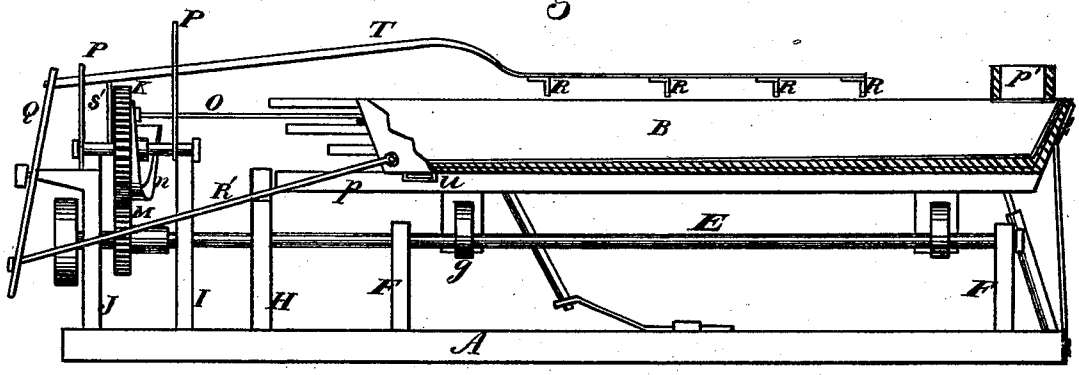


Fig. 4.

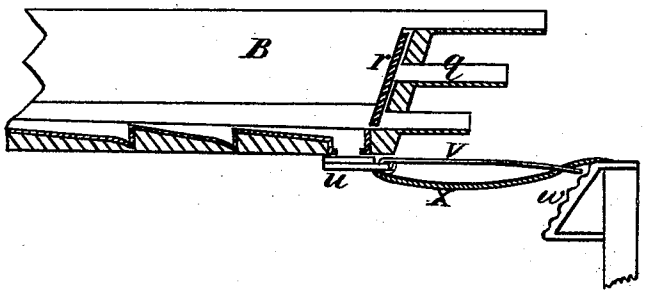
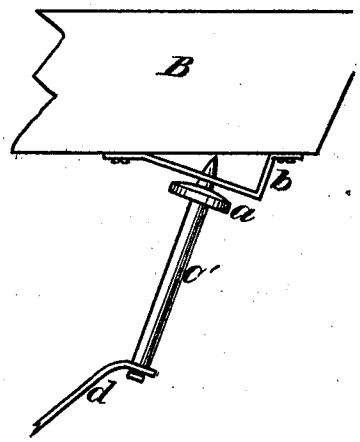


Fig. 5.



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UNITED STATES PATENT OFFICE.

JAMES M. THOMPSON, OF SAN FRANCISCO, CALIFORNIA.

IMPROVEMENT IN ORE-CONCENTRATORS.

Specification forming part of Letters Patent No. **171,747**, dated January 4, 1876; application filed January 30, 1875.

To all whom it may concern:

Be it known that I, JAMES M. THOMPSON, of San Francisco city and county, State of California, have invented an Improved Concentrator; and I do hereby declare the following description and accompanying drawings are sufficient to enable any person skilled in the art or science to which it most nearly appertains to make and use my said invention or improvement without further invention or experiment.

My invention relates to an improved machine for concentrating and separating the heavy particles of pulverized ore and other finely-divided substances from the lighter portions.

My machine can be used for concentrating either wet or dry material.

In order to illustrate my invention so that others will understand its construction and operation, reference is had to the accompanying drawing forming a part of this specification, in which—

Figure 1, Sheet 1, is a perspective view of my concentrator. Fig. 2, Sheet 1, is a transverse section. Fig. 3, Sheet 2, is a side elevation with a longitudinal section of the pan. Figs. 4 and 5 are enlarged details of part of the machine.

A represents a base upon which I mount an open-topped box or sluice-section pan B by means of the supporting-legs C C′. This pan or sluice section may be constructed of either wood or metal; but I prefer to first construct a wooden pan with flaring sides and ends and then line it inside with sheet-copper or other suitable thin sheet metal, thus combining lightness, strength, and durability in its construction. The bottom of this tray or pan I construct sloping from each side to its middle, so as to provide a longitudinal chamber trough which inclines toward the front end of the pan, and into which the heavy particles will settle. The legs C which support the rear end of the pan are hinged or otherwise loosely attached to the bottom of the pan at their upper ends, and to the base A at their lower ends, while the legs C′, which support the forward end of the tray or pan, are attached in a similar manner at their upper ends, while their lower ends are attached to the free end of a spring, *d*, as shown, so that the weight of the forward end of the pan is supported by this spring. It will be necessary in some kinds and forms of concentrators to support them entirely on springs. A shaft, E, extends along underneath the middle of the pan B from end to end, bearing at suitable points in boxes supported by standards F, and extends far enough in advance of its forward end to accommodate the necessary gearing and driving mechanism. An adjustable or double eccentric, *g*, is secured upon this shaft near each end of the pan, and a pendant or plate, *h*, depends from the bottom of the pan upon each side of both of the eccentrics, so that when the shaft is rotated the eccentrics will throw against the pendants upon each side alternately and give the pan an oscillation from side to side. The oscillation can be made more or less variable or irregular by altering the shape of these eccentrics. Standards H I J are secured upon the base A in front of the pan at a short distance apart, the standard H, which is nearest the pan, being somewhat lower than the other two. A spur-wheel, K, is mounted upon a shaft, L, which bears in boxes upon the upper ends of the standards I J, and engages with a pinion, M, on the shaft E beneath.

The spur-wheel K is thus supported at a point opposite the middle of the front end of the pan, and its face, which is toward the end of the pan, is provided with an inclined rim, *n*, which gradually rises from a fixed point and extends around the wheel, ending by an abrupt offset, (or more than one offset can be made,) thus providing a circular track or inclined plane, as shown. A rod, O, has one end so secured to the middle of the front end of the pan as to permit the pan to oscillate, and this rod extends far enough toward the wheel K to permit its opposite extremity to bear against this inclined rim or track on the face of the wheel. Thus, when the wheel K is rotated the cam or inclined track will push the rod and pan in a direction away from the wheel, until the end of the rod drops from the highest point of the incline and strikes or ap-

proaches near to the lowest point. A buffer-beam, *p*, extends forward from the front end of the pan far enough to strike against the upper end of the first or lowest standard H, when the pan moves forward again, after the end of the push-rod drops from the highest point of the inclined track, and thus produces a concussion which carries all the particles toward the front or discharge end of the pan. A spring, *q'*, has it lower end secured to the base A, while its upper end bears against the rear end of the pan, so that it will move the pan forward, after each drop of the rod O, with considerable force, or retard it as much as may be necessary to decrease the effect of the concussion.

The length of the push-rod O should be regulated so that the hinged legs C' C', which support the forward end of the pan, will stand at an angle leaning toward the front end of the machine at all times when the end of the rod bears against the inclined track. When this is the case it is evident that the discharge or forward end of the pan will have a rising and falling, as well as a back and forth, motion, owing to the difference in the angle of the legs as the pan moves back and forth, which will cause the concussion to have also the effect of throwing down or precipitating the heavier particles of the pulp, while it is at the same time carrying all the particles toward the front or discharge end of the pan, thus acting with the current, instead of against it, as in all other concentrators of this description of which I have any knowledge.

As the wheel K is several times larger than the pinion M on the shaft E, it is evident that the shaft E will make several rotations to one rotation of the wheel K, so that the pan will receive as many oscillations from side to side during each backward movement or concussion as the rotations of the shaft E exceed the rotations of the wheel K, and this difference can be easily regulated at will by varying the dimensions of these wheels; or if it should be desired to produce a very rapid oscillation, and but few concussions, a worm or screw can be substituted in the place of the pinion M, on the shaft E, to rotate the wheel K, by which the difference in the number of rotations of the shafts E and L can be very greatly increased.

Heretofore it has been usual to mount this class of concentrators, and actuate it so that one end of the pan only can have the transverse oscillatory motion, while the other end remained stationary, thus leaving a portion of the pan-surface inactive, or, at least, incapable of concentrating the particles; but, by my arrangements, the entire pan is oscillated bodily, thus giving motion to all the particles which it contains.

Across the rear end of the pan is the trough *p'*, into which the pulp or ore is deposited, and through the screen or perforated bottom of which it passes into the pan. At the front end of the pan is a waste or overflow trough, which conveys away the water and worthless or lighter portions of the ore.

To discharge the sulphurets from the pan I have devised an automatic arrangement, by which the weight of the sulphurets, as they accumulate, will open a gate, so as to allow the overweight to pass out, and thus retain a uniform quantity in the fan all of the time. To do this I make an opening, *q*, at the middle of the forward end, near the bottom, or at the lowest part, and across this opening I mount a gate, *r*, by hinging one end to the side of the pan. The opposite end of the gate is formed into a goose-neck, which passes over the side of the pan, as shown. A rod, *s*, connects the end of this goose-neck with the base A, so that when a sufficient weight of sulphurets or heavy particles of ore accumulate in the forward end of the pan to cause the spring *d*, upon which the forward legs C' rest, to be depressed, the rod *s* will hold the gate firmly in place, so that the lowering or sinking down of the pan will uncover the opening *q*, and allow the excess of sulphurets to pass out until the springs *d* again lift the pan so as to cause the gate to cover the opening.

Two or more openings can be made in the front end of the pan at different heights, and a single gate be employed to thus automatically open and close them by making suitable openings in the gate, as shown. I can thus remove the sulphurets or heavy particles in grades according to their specific gravity, as the heaviest particles will settle to the bottom, and pass out at the lower opening, while the lighter particles will arrange themselves above and pass out at the upper openings. I also supply a bottom-discharge by making an opening, *t*, in the bottom of the pan near the end of the middle channel, and to the under side of the pan I hinge one end of a gate, *u*, so that it will cover the opening. To operate this gate I extend a rod, V, from its free end forward, so as to strike a plate, *w*, which is fixed to the standard H. This plate is secured to the standard at an angle, and steps or benches are formed on its outer face, as shown, so that when the pan moves forward the rod will strike the plate *w* and open the gate. As the height of this end of the pan is variable on account of the changing weight of sulphurets, which it supports or contains, the rod V will strike the plate at different points of its length, according to the amount of depression, and each stroke forces the free end of the gate *u* backward away from the opening *t*, so as to allow the sulphurets to pass out. A cord or chain, *x*, again draws the gate over the opening when the pan moves backward, thus closing the opening and providing an intermittent discharge through the bottom of the pan.

Other devices could be employed by which the elevation or depression of the pan, caused

by the superior gravity of the sulphurets, can be made to regulate the discharge—as, for instance a pipe or covered sluice could lead from and be connected with the pan at the discharge-opening, and a gate could be so placed as to be caused to move across it by the elevation or depression of the pan, or the pan could be placed in a frame and made to rest on springs at its discharge end, and be so adjusted in the frame that its discharge-openings would be exactly opposite similar openings in the end of the frame when the accumulation of the sulphurets reaches its maximum, and the motion imparted to the pan by giving it to the frame in which it rests. In the bottom of the pan I also make one or more cavities at a level below the lowest discharge-opening, to receive and retain any quicksilver which the pulp may contain. Each of the discharge-openings *q q* has a spout leading outside of the pan, through which the sulphurets are conveyed to a receptacle. The longitudinal channel before described, which is formed by depressing the bottom from its sides toward its center, serves the triple purpose of collecting and directing the heavier particles toward their discharge-opening, and forms a cavity or depression, which will be constantly filled by a compact body of these heavier particles, and by which a flow of water out of their discharge-opening will be prevented. R R R are scrapers or stirrers, which are operated automatically by the back and forth movements of the pan. These scrapers are secured at intervals apart to a rod, T. The end of this rod to which the scrapers or hoes are attached extends over the pan, while its opposite end passes through a slot in the vertical plate P, which extends upward from the standard I, and through a hole in the plate P′ on the standard J, while its extremity is secured to one arm of a centrally-pivoted lever, Q′. The extremity of the opposite arm of this lever is connected with the pan by a rod, R′, so that as the pan moves back and forth the scrapers will be given an opposite or raking movement. A plate, S′, is secured to the spur-wheel K, so as to form an eccentric, which serves to lift these stirrers as the pan moves forward, and drop them as it moves backward, thus allowing them to rake the surface of the ore or pulp, and keep it moving toward the outlet. This raking attachment will be especially useful when concentrating dry substances, as it will continually rake off the top or lighter portion, which is not affected as much by the concussion as the heavy particles, and which would in a wet concentrator be carried off by the water.

By supporting the pan upon legs I dispense with the frame-work over the pan, which has been heretofore used in the construction of this class of concentrator, and by giving the legs an inclination forward I impart a down-hill or descending movement to the pan when it moves forward, which aids in moving all the particles, and more especially the heavier portions of them to their discharge-openings.

By changing the angle or position of the legs, the descending or down-hill movement can be regulated as desired, and by lengthening or shortening, and giving the legs C C, which support the rear end of the pan, either more or less inclination than the legs *c′ c′*, which support the front or discharge end, any desired variation in the relative height of the ends of the pan can be produced, the most rapid variation or undulation taking place during the forward movement of the pan, and just previous to the concussion, and by giving the legs *c c*, which support the rear end of the pan, more or less inclination opposite to that of the legs *c′ c′*, any desired elevation of the rear end of the pan can be produced during its forward movement, and a corresponding depression during its backward movement, which would be just the opposite elevation or depression to that of the front or discharge end of the pan.

By the usual method of hinging or securing the legs to a fixed point on the bottom of the pan, it is made to describe a curve as it oscillates, and vibrates corresponding to the curve which the upper end of the legs describes, and which is more or less abrupt in proportion to the length of the legs. The shorter these legs the more abrupt the curve.

The same effect is produced when the pan is suspended by rods, except that the curve described is just the opposite to that in which it moves when it is supported on legs. This produces a very rapid rising and falling of the pan when it is actuated, which has a disturbing effect on the particles of the pulp and interferes with the process of separation.

To avoid this disadvantage, I have discovered that the movements of the pan as it oscillates and vibrates must be in straight lines, and that its only elevation and depression must be during its back-and-forth motions, which I call its "longitudinal vibration," the elevation taking place, as before described, during the backward movement, and the depression during the forward movement and just previous to the concussion.

Various devices can be employed to so support or suspend the pan as to cause it to move in this manner; but the one I have found to be the best is that shown in the drawings.

a a are round plates or flanges, which are secured to the upper ends of the legs *c c*, and the upper faces of which are rounded, so that these faces constitute segments or portions of a sphere, whose radius or semi-diameter is equal to the length of the legs measured from these faces to their lower ends. The upper ends of the legs project through the plates, and also fit loosely in holes in the inclines or plates *b b*, which are secured to the bottom of the pan. These plates are so adjusted to the

pan that their faces can always be kept at right angles to the legs.

Now, it is evident that as the distances from the lower end of the legs to any point on the upper curved or spherical faces of the plates are exactly equal, that the pan as it is actuated and moves or rolls on the faces of these plates, will describe a straight line in any direction which it may be moved, which will be a tangent to the curve described by the curved faces of the plates, and which will be at right angles to a straight line drawn from the point at which the lower end of the legs rest to the point of contact between the curved faces of the plates or flanges *a a* and the faces of the plates or inclines *b b*.

It is evident that a pan being mounted in this or any other equivalent manner, and being placed in a level position, and the legs *c c* which support it being placed perpendicularly, would be kept during all its movements in a perfectly level plane, as its oscillation and vibrations would be in lines which would always be at right angles to the perpendicular position of the legs, and consequently always horizontal, and the pan would be kept in a perfectly level position, and also at the same height all the time, and it is then easily understood that if the supporting-legs *c c* are inclined from a perpendicular, and the faces of the inclines or plates *b b* adjusted at right angles to the legs, that the pan would then in all its movements be kept in a plane which would be at right angles to the inclination of the legs *c c*.

The convexity of the faces of the plates *a a* can be decreased or varied, so as to give the pan any desired movement corresponding to that which it would have if suspended by rods.

The arm or rod *o* is hinged to the end of the pan, and passes loosely through a hole in the upright plate *p*, by which it is guided, so that it creates but little friction.

It will be noticed that the concussion and flow of water in the pan will be in the same direction, instead of in opposite directions, as heretofore, thus greatly facilitating the operation of settling the heavy particles, and carrying them, as well as all the particles, toward their discharge-openings.

By this arrangement, the two forces which are employed to effect the separation and discharge of the particles contained in the pulp are caused to act together and aid each other, and the nice adjustment is not required as is necessary in concentrators where the force of the concussion is alone depended upon to carry the heavier particles in a direction opposite to the flow of the water, and where the force of the water or current is alone depended upon to carry the lighter particles in a direction opposite to the effect of the concussion.

Instead of placing the driving-shaft E below the middle of the pan, the shaft could be placed near its side, and where two or more pans are to be used side by side, one shaft could be placed between them so as to serve for both pans, and impart the oscillatory movement to the pan by pitmen, and the concussion by means of rag-wheels and chains, instead of pinions, or by means of a single cam-wheel and centrally-pivoted arms or elbows with one of each of their ends bearing against the face of the incline or cam, and the other being loosely attached or hinged to the end of the push-rod *o*.

The outer wooden pan is for supporting the inner pan, which is made of sheet-copper, or other metal or alloy capable of being plated with silver, copper, or quicksilver. This inside pan, having the support of the outside wooden pan, can be made of very light and thin material.

If desired, the wooden sides can be dispensed with, as hereinbefore stated, and a simple wooden bottom alone be employed.

The bottom can be made of thick plank, and the end next to the bumper or cam can be narrowed and extended beyond the end of the pan, so as to receive the blow of the concussion.

By having an outer wooden pan the additional advantage is gained of being able to secure the pan more firmly to the bottom or timber which receives the blow of the concussion, and thus prevent the trouble which, by the ordinary arrangement, is encountered by the wear of the bolts in their holes in a pan constructed entirely of metal occasioned by the continual jarring which the pan is subjected to, and which causes the holes to wear larger and the bolts and pan to become loose.

Having thus described my invention, what I claim, and desire to secure by Letters Patent, is—

1. The vibrating and undulating concentrating pan B supported upon hinged legs C C′, the angle and length of which can be adjusted, substantially as and for the purpose above described.

2. The concentrator B mounted or suspended on the springs *d d*, which cause its elevation to vary in proportion to the accumulation of the heavier particles in it, in combination with the gate *r*, by which the elevation or depression of the pan regulates the size of the discharge-opening.

3. In combination with a vibrating concentrator, an automatic intermittent discharge, consisting of a pivoted gate, *u*, operated through a rod, V, and cord *x*, and caused by the back and forth movements of the pan to alternately open and close the discharge-opening, and in combination with the springs *d d* and plate *w* to regulate the discharge, substantially as described.

4. In combination with a vibrating concentrator, B, an automatic rake or scrapers, R R R, operated by the movements of the concentrator by means of the pivoted lever

Q, connecting-rod R′, and eccentric S on the wheel K, substantially as and for the purpose described.

5. A concentrating pan or sluice section, in which the flow of the water and the motion or concussion act together, to move all the contents of the pan in the same direction, and provided with discharge-openings at different heights for discharging all the contents at the same end of the pan.

6. A concentrating pan or sluice section mounted or suspended on flexible bearings, which are provided with the plates *a a*, having spherical faces, in combination with the adjustable plates *b b* secured to the bottom of the pan, by which the pan is caused to move in planes either horizontal or inclined, substantially as and for the purpose described.

In witness whereof I hereunto set my hand and seal.

JAMES MONROE THOMPSON. [L. S.]

Witnesses:

GEO. H. STRONG,

C. M. RICHARDSON.