

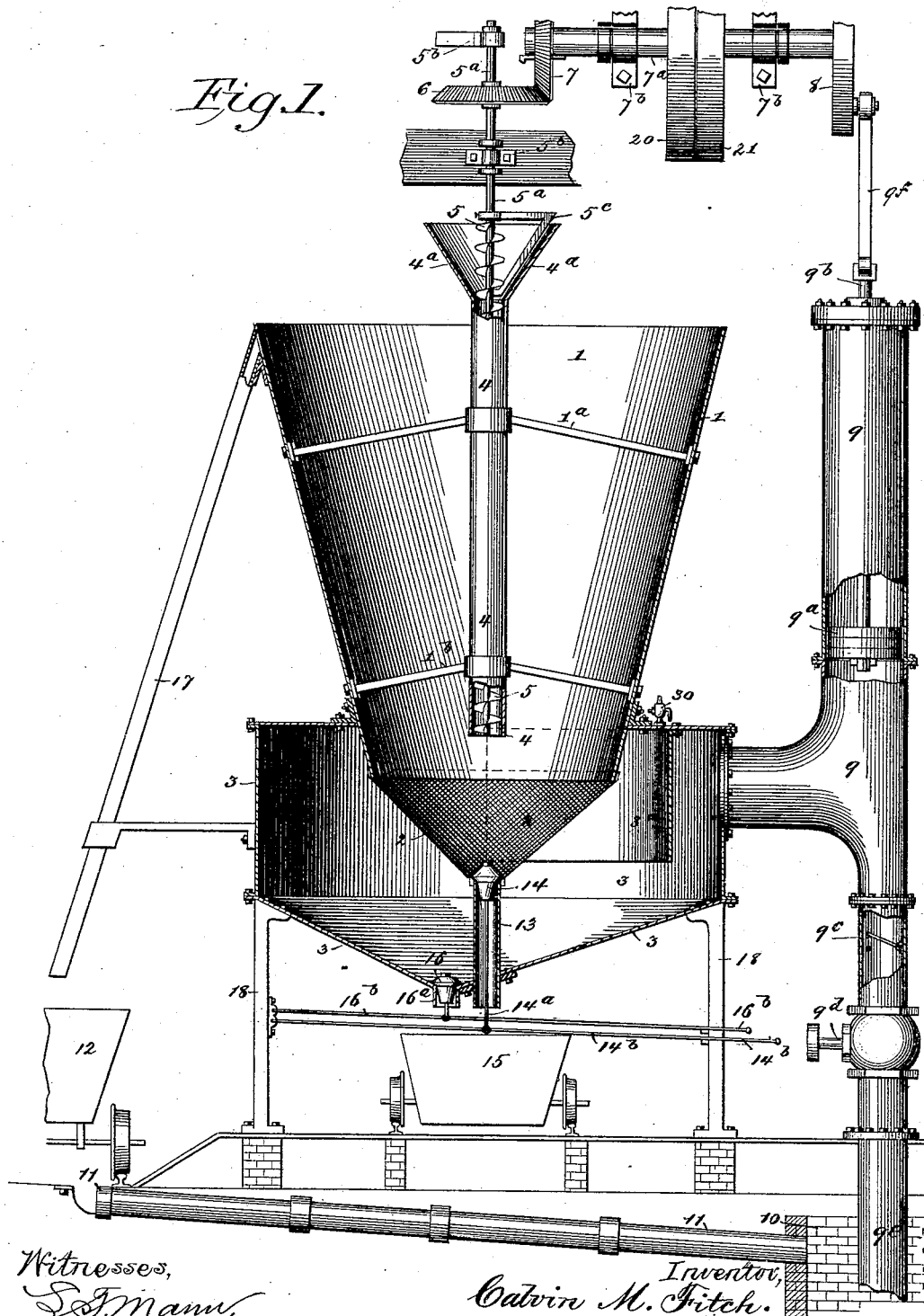
C. M. FITCH.

ORE CONCENTRATING AND SEPARATING APPARATUS.

No. 453,928.

Patented June 9, 1891.

Fig. 1.



(No Model.)

2 Sheets—Sheet 2.

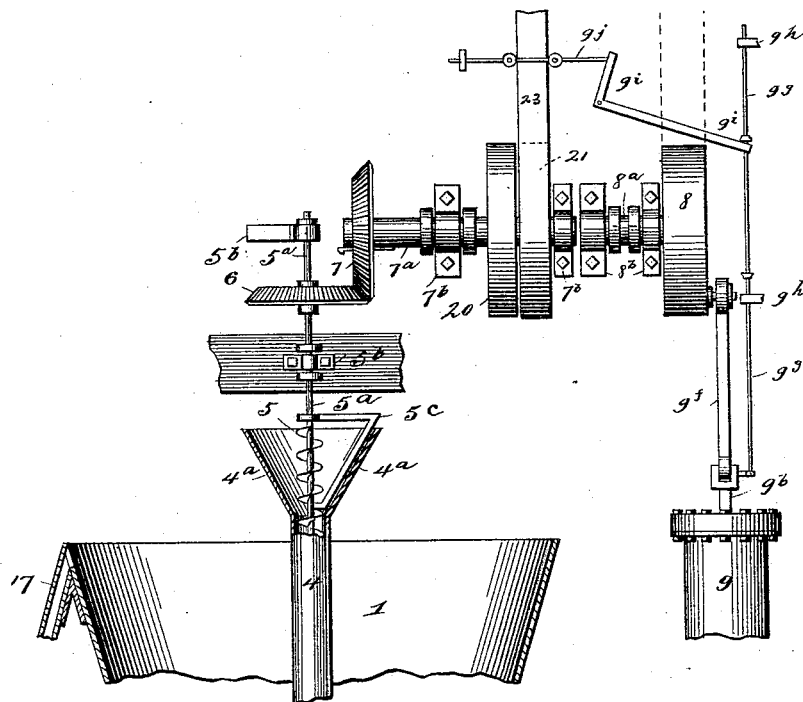
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Fig. 2.



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UNITED STATES PATENT OFFICE.

CALVIN M. FITCH, OF CHICAGO, ILLINOIS.

ORE CONCENTRATING AND SEPARATING APPARATUS.

SPECIFICATION forming part of Letters Patent No. 453,928, dated June 9, 1891.

Application filed April 3, 1889. Serial No. 305,850. (No model.)

To all whom it may concern:

Be it known that I, CALVIN M. FITCH, a citizen of the United States, residing at Chicago, in the county of Cook and State of Illinois, have invented certain new and useful Improvements in the Method of and Apparatus for Concentrating and Separating Ores, of which the following is a description, reference being had to the accompanying drawings, and to the numbers of reference marked thereon, which form part of this specification.

My invention relates to the concentration and separation by the washing process of comminuted ore; and it consists, as will hereinafter appear, in certain improvements in apparatus and method whereby the values or mineral contained within the ore may be closely, rapidly, and economically separated from the worthless material, being especially adapted to the treatment of ores of a low grade.

The main features of the invention consist, first, in the novel construction and operative arrangement of the ore feeding and washing apparatus, whereby the comminuted ore or pulp is fed or discharged into the washing-receptacle in its lower portion at or near the point at which the values are intended to accumulate and acted upon by the water, which is alternately withdrawn downwardly from and through the pulp through the lower portion of the washing-receptacle and returned through such point to pass with force upwardly through the mass to be treated, thereby causing the worthless matter to be washed upward, while the mineral remains below to be withdrawn from time to time from the apparatus; second, the construction and operative arrangement of the ore-washing receptacle, whereby the water introduced under pressure to the ore through the lower portion of the receptacle, while preliminarily capable of lifting or keeping in agitation the entire material to be treated, is caused at a point suitably distant from its point of admission to lose its lifting-power to such extent as will insure its failure to further raise the mineral contained within the receptacle, though still capable of raising the lighter worthless material, which, being separated from the values, is washed away or otherwise removed; third,

the organization and operative arrangement relatively of the ore-feeding devices and the water feeding and withdrawing apparatus, whereby the pulp is fed into the washing-receptacle in suitable quantities only coincident with the influx of the water into the washing-receptacle and its consequent upward motion therethrough.

Other features of novelty and utility are embraced in the invention, notably the arrangement of the pumping apparatus, whereby at each operation of the pump employed for alternately forcing the water into and withdrawing it from the washing apparatus additional water may be drawn in suitable quantity from a source of supply and forced into and through the washing apparatus and pulp, all of which will be hereinafter fully described.

To fully make known my invention I have illustrated in Figure 1 of the accompanying drawings a simple form of apparatus substantially embodying its several features, together with certain adjuncts which may be employed to advantage in connection therewith. Fig. 2 is an enlarged detail illustrating the means, in part shown in Fig. 1, for imparting motion to the ore-feeding mechanism coincident with the water-feeding action of the pump.

Referring by number to the details of construction shown in said drawings, 1 indicates a hopper, desirably of sheet metal, in the form substantially of an inverted cone, the lower terminal portion 2 of which consists of a screen or sieve composed of wire-cloth or perforated metal duly supported and of such fineness as the size of the metal to be treated shall require.

3 indicates a closed tank or reservoir, preferably cylindrical in form, with an irregularly conical bottom, into which the hopper 1, which is fixedly sustained thereby, enters by its lower or screen-consisting portion.

13 is a discharge-pipe extending downwardly from the apex of the portion 2 of the hopper to the bottom of the reservoir 3, being provided with a closing-valve 14, which is connected by its stem 14^a with an operating-lever 14^b.

16^a is a discharge pipe or opening provided

in the bottom of the reservoir 3, provided with a closing-valve 16, which is connected by its stem with an operating-lever 16^b.

9 indicates a pump suitably connected with the reservoir 3, preferably through its side at or near the top thereof, forming desirable means for alternately withdrawing from and forcing water into the reservoir, and so raising or lowering the water within the hopper for the purpose of washing the pulp contained therein.

9^c is an induction-pipe extending from the bottom of the pump-cylinder to a source of water-supply 10, affording means whereby a quantity of water in excess of the quantity ordinarily contained within the hopper and reservoir may at any time be forced by the pump into the reservoir, and therefore into the hopper, thereby facilitating the overflow from the upper portion of the hopper, as well as preventing the material from becoming too stiff or compact for satisfactory working. The quantity of water thus drawn by the pump from the source of supply is regulated by means of a cock 9^d, located within said pipe 9^c intermediate the pump and the source of water-supply.

9^e is a trap-valve located within the pipe 9^c, between the cock 9^d and the pump, its office being to prevent the escape of the water drawn from the source of supply through said pipe 9^c upon the downward or ejecting stroke of the pump, thus securing its passage to the reservoir.

30 is an air cock or valve located in the upper wall of the reservoir 3, its office being to afford means of escape for such air as may accumulate in the reservoir, either from the water, with the introduction of the pulp, or in consequence of leakage of the apparatus.

3^a is an apron located within the reservoir 3, projected downwardly from the upper wall thereof to a point sufficiently near to the bottom for the purposes required, and extending for a suitable distance around the screen or lower portion 2 of the hopper.

4 is a feed-pipe located concentrically of the hopper 1, sustained by radial arms 1^a, fixed to the sides of the hopper, within which works a worm 5, carried by a shaft 5^a, suitably sustained by its upper portion in bearings 5^b, the worm affording means by which the material to be treated is introduced into the hopper 1 at or near its bottom. Intermittent axial motion is given to the worm-shaft 5^a, and therefore to the worm 5, by means of a bevel-gear 6, carried by said shaft, to which motion is imparted by a corresponding gear 7, carried by the shaft 7^a, sustained in bearings 7^b, which carries, as a matter of preference, tight and loose pulleys 20 21, adapted to be alternately put in action by any well-known shifting devices—as, for example, that shown in Fig. 2—which forms no part of this invention, but is introduced merely for the sake of illustration, and which consists of a horizontally-movable shipping-bar 9^d, which

is connected by means of a bell-crank 9ⁱ with a perpendicularly-movable rod 9^g, (working in bearings 9^h,) pivoted to the stem 9^b of the pump-piston and adapted to be reciprocated thereby. On the upstroke of the pump-piston the belt 23 is shifted to the loose pulley 20, which renders the feeding devices inactive. On the downstroke of the piston the belt is shifted to the tight pulley 21, which causes motion of the worm, and therefore the feeding or discharge of the pulp into the hopper at the instant the material within the hopper is lightened by the influx of the water thereto.

8 is a disk or belt-pulley (see particularly Fig. 2) carried by the shaft 8^a, which works in bearings 8^b, and 9^f is a rod connected therewith and to the stem 9^b of the pump-piston 9^a.

5^c is a stirring-arm fixedly carried by the worm-shaft 5^a within a pulp-feed hopper 4^a, formed integrally of or attached to the upper termination of the feed-pipe 4, the office of said arm being to prevent by its rotative movement the accumulation or packing of the pulp on the sides of said hopper 4^a.

17 is a chute connected by its upper end with the upper portion of the hopper 1, being the means employed for carrying away, desirably into a car 12, the tailings or worthless matter separated and washed upwardly from the values by the action of the apparatus.

15 indicates a car provided for receiving the concentrates separated from the pulp, as it is desired from time to time to draw the same from the hopper and reservoir by the opening of the valves 14 and 16, respectively.

11 is a conduit through which the water overflowing from the hopper with the tailings may be carried back to the source of supply 10, to be again used, if desired.

The action of the apparatus, as will be seen, is like that of an ordinary jig, with this important and essential difference that while in an ordinary jig the material to be treated is fed in at or near the top of the hopper or pulp-holder and the values separated by subsidence in my invention the material to be treated is introduced toward or about the bottom of the hopper at or near the point where the values are to remain, while the lighter and worthless material is washed upward and passes away. In an ordinary jig whatever values fail to subside or settle are lost, and the length of time the material is subjected to the action of the water is so brief that a large percentage of the values is carried over with the tailings, and it is only by the use of a succession of jigs that close saving can be effected. In an ordinary jig coarse material only can be treated to advantage. Particles of a diameter less than one-fiftieth of an inch fall so slowly through water that the loss is excessive. In my apparatus subsidence is not essential. The material duly sized is introduced at or near the bottom of the apparatus, the point where the values are to remain, into a current of water forced by the

pump by way of the reservoir through the screen portion of the hopper, sufficiently strong at first to lift everything, mineral as well as gangue. As the current of the water in the hopper is reversed by the reverse or withdrawing action of the pump-piston, the material to be concentrated is suddenly packed, to be again lightened up by the upward movement of the water forced into the hopper by the pump, and this alternate packing and lightening of the material prevents the channeling and formation of upward currents through the mass, which might carry with them some of the lighter or finer mineral, and so cause loss.

In a set of my concentrators each apparatus will treat material sized within certain limits, and the force and volume of water injected can be accurately graduated and proportioned according to the fineness of the material and the quantity to be acted upon. The ore-feeding devices being operated intermittently discharge the pulp into the hopper only as the water is forced therein and its contained mass lightened, thus avoiding undue strain upon the screen forming the apex of the hopper.

The employment of a cock or valve for permitting the escape of air from the reservoir is highly important to the perfect working of the apparatus, for the main reason that if a greater resistance is offered to the upward passage of the water through the screen and pulp which becomes packed in the lower portion of the hopper by the withdrawal of the water therefrom than the resistance of the air to compression, a portion of the water forced into the reservoir intended to be driven into the hopper would displace by compression the air occupying the space created by such displacement, and therefore fail to enter the hopper at the proper moment, the air-cushion tending to cause the water to flow upwardly into the hopper after the pump has completed its downstroke, and possibly even after the piston begins to ascend, at any rate preventing on the part of the material within the hopper that prompt response to the movement of the pump-piston that is deemed necessary to the most effective working of the apparatus.

The reservoir is made large enough to hold water in sufficient quantity to prevent its undue agitation by the operation of the pump, so that such mineral as may pass or be drawn through the screen will readily settle or accumulate in the bottom of the reservoir, whence it is from time to time drawn off.

The apron located within the reservoir prevents the undue impact or swash of the entering water upon the screen, and thus secures its more uniform action upon and passage through the bottom of the hopper.

The details of construction shown and described herein may obviously be varied in practically carrying out my invention with-

out deviating from its intent and scope. Thus, for example, devices other than a worm, not deemed necessary to be shown herein, may be employed for feeding or discharging the pulp in or about the bottom of the washing-receptacle, and devices or apparatus for alternately forcing the water and withdrawing it from the reservoir, hopper, and material may be substituted for the pumping mechanism shown. I therefore do not limit myself in the premises, except in so far as is specified in the appended claims.

I claim as my invention and desire to secure by Letters Patent—

1. The combination of the water-reservoir, the hopper or washing-receptacle provided at its lower end with a screen located, as described, within the reservoir, the pump having connection with the reservoir, whereby water may be therethrough alternately forced upwardly into and withdrawn from the washing-receptacle through the screen, ore-feeding devices located within the washing-receptacle, arranged and adapted to convey the ore to or about the bottom thereof and to discharge the same adjacently above the screen and point of influx of the water to the washing-receptacle, and means for intermittently actuating the ore-feeding devices so that the ore will be discharged thereby into the washing-receptacle coincident with the stroke of the pump which forces the water therein, substantially as herein set forth.

2. In ore concentrating and separating apparatus, the combination, with a closed water-reservoir having an inclined bottom, the washing-receptacle provided at its lower end, located interior of the reservoir, with a conical screen, as 2, and means connected with the reservoir for alternately forcing water therein and withdrawing it therefrom and therethrough into and from the washing-receptacle by way of said screen, substantially in the manner set forth, of a screw ore-conveyor located within the washing-receptacle, having its discharging end located in the lower portion of the washing-receptacle operatively contiguous to said screen and the point of influx of water to the washing-receptacle, substantially as shown and described.

3. The combination, with the water-reservoir, the washing-receptacle having at its lower end the screen 2, located within the reservoir, and the pump 9, connected with the reservoir, adapted to alternately force water through the reservoir into the washing-receptacle through the screen 2 and to withdraw the water therefrom, of an air cock or valve 30, having operative connection with the interior of the reservoir, adapted to permit the escape of air therefrom, substantially as and for the purposes set forth.

4. The combination of the washing-receptacle, the closed water-reservoir, a pump 9, connected with the water-reservoir, substantially as set forth, an induction-pipe or conveyor connecting the pump with a source of

water-supply, as 10, an induction regulating-cock 9^d, located, substantially as shown, intermediate the pump-piston and the source of water-supply, and a trap-valve 9^c, located, substantially as shown, intermediate the said regulating-cock and the pump-piston, adapted to prevent the return of the water to the source of supply on the stroke of the pump-piston, which is intended to force the water into the said reservoir, substantially as described.

5. The combination, with a closed water-reservoir having an inclined bottom, a washing-receptacle provided at its lower end with a conical screen located within said washing-receptacle, and a pump having connection with the reservoir, whereby water may be therethrough alternately forced upwardly into and withdrawn from the washing-receptacle through the screen, of ore-feeding devices located within the washing-receptacle, arranged and adapted to discharge the ore at or about the bottom thereof adjacent to and above the screen and point of influx of the water to the washing-receptacle, substantially as herein set forth.

6. The combination, with a water-reservoir having an inclined bottom provided with a discharge-opening, a valve for said discharge-opening, a washing-receptacle provided at its lower end with a screen, and a discharge-pipe extending from said washing-receptacle through said reservoir and provided with a closing-valve, of means for feeding the ore to said washing-receptacle and discharging the same contiguous to said screen, and means for alternately forcing water into and with-

drawing it from said washing-receptacle through said screen.

7. The combination, with a water-reservoir having an inclined bottom provided with a discharge-opening, a valve in said opening, a washing-receptacle provided at its lower end with a screen, and a discharge-pipe extending from said washing-receptacle through said reservoir and provided with a closing-valve, of a pump connected with the reservoir for alternately forcing water therethrough upward and withdrawing it from the washing-receptacle through the screen, and a screw conveyer located within the washing-receptacle and discharging the ore contiguous to said screen and point of influx of water to the washing-receptacle.

8. The combination, with a water-reservoir having an irregular conical bottom provided with a discharge-opening, a valve in said opening, a washing-receptacle provided at its lower end with a conical screen located within said reservoir, and a discharge-pipe extending from the apex of said screen through said reservoir and provided with a closing-valve, of a pump connected with the reservoir, whereby water may be therethrough alternately forced upwardly into and withdrawn from the washing-receptacle through said screen, and a screw conveyer located within the washing-receptacle and discharging operatively contiguous to said screen and the point of influx of water to the washing-receptacle.

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