O. H. KING.

ORE CONCENTRATOR.

APPLICATION FILED APR. 1, 1911.

1,007,116.

Patented Oct. 31, 1911.

3 SHEETS—SHEET 1.

Fig. 1.

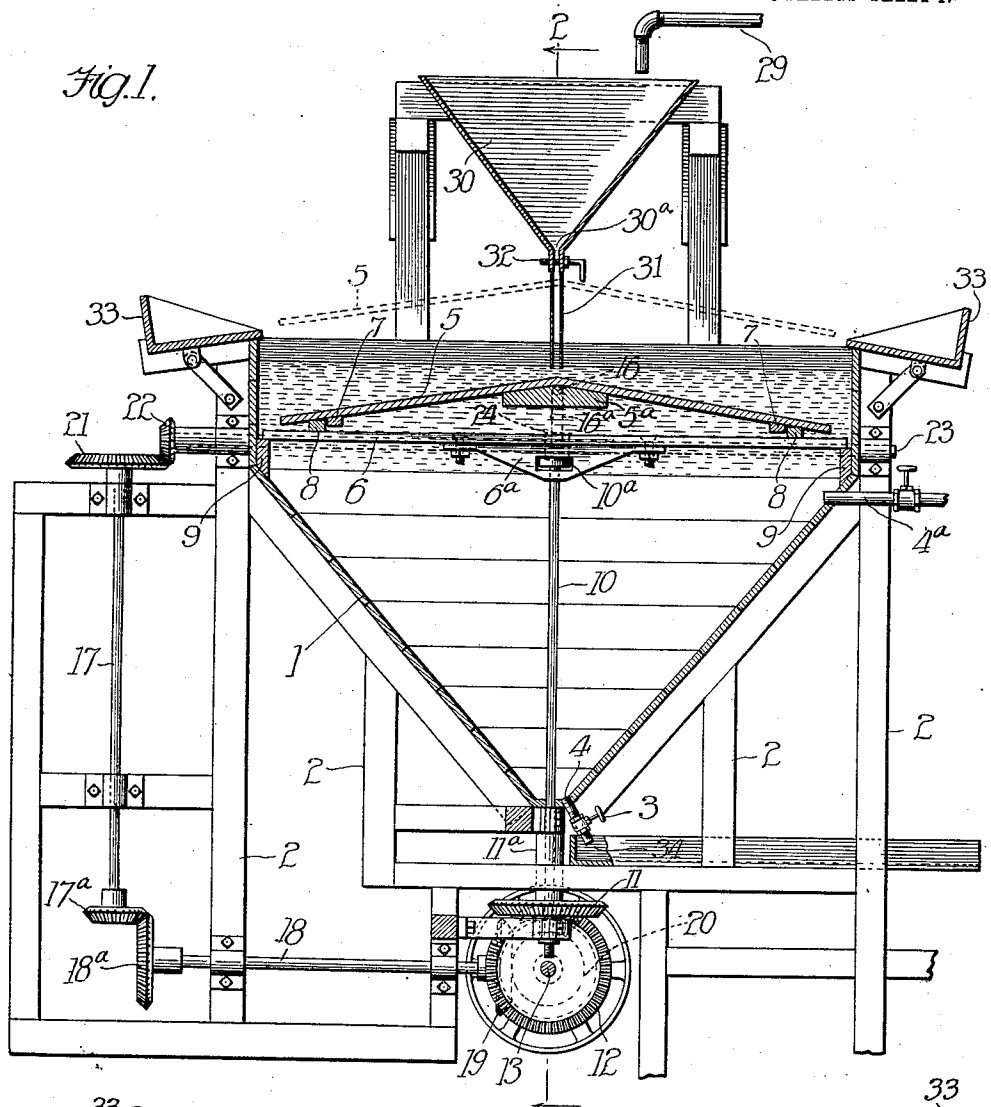
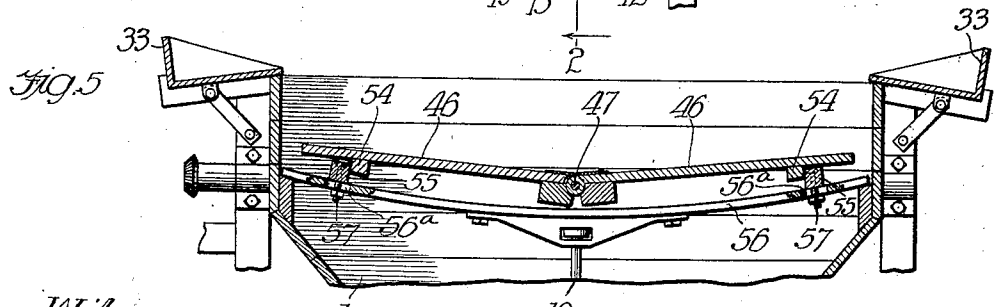


Fig. 5



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3 SHEETS—SHEET 2.

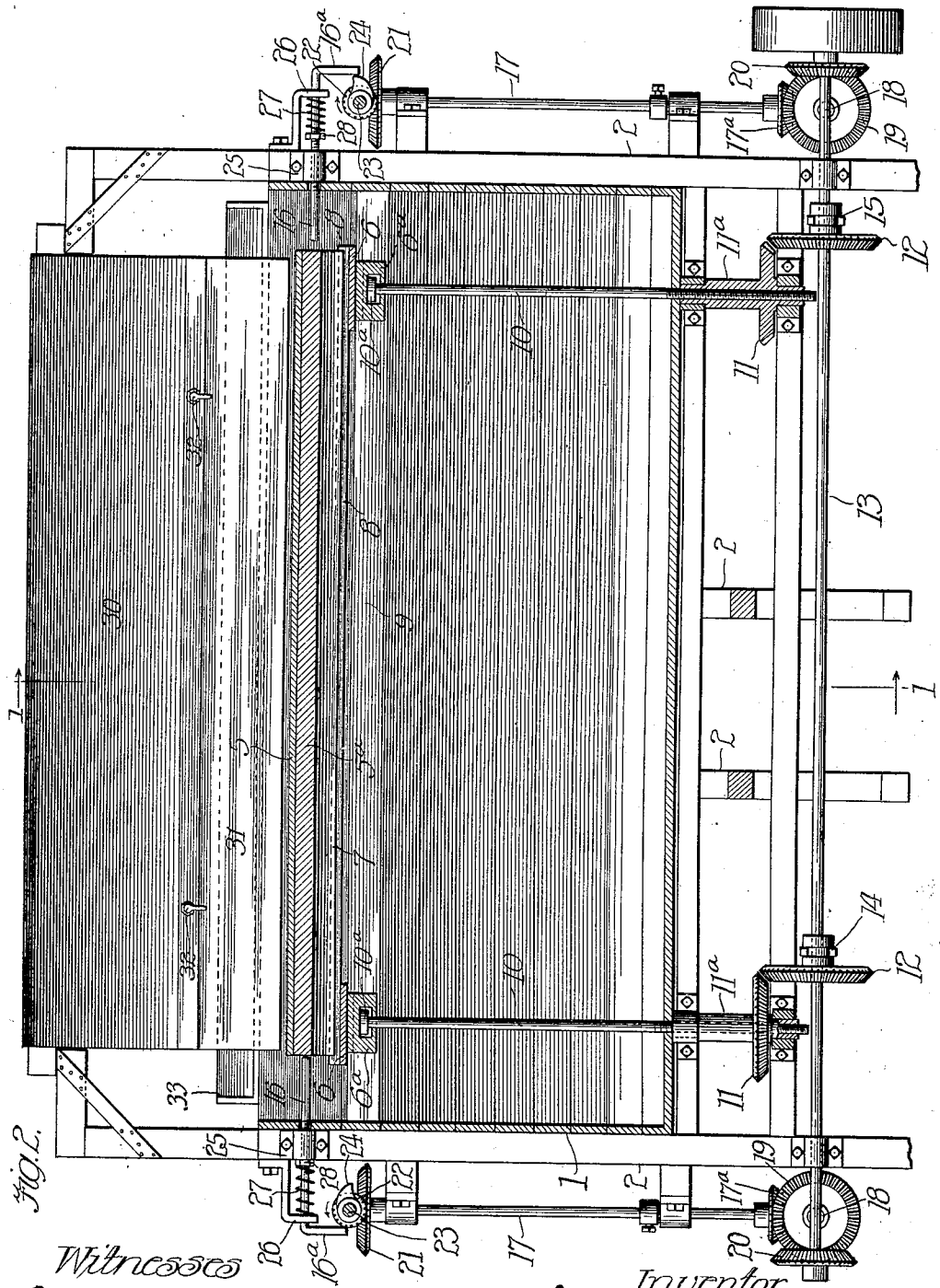

FIG. 2.

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3 SHEETS—SHEET 3.

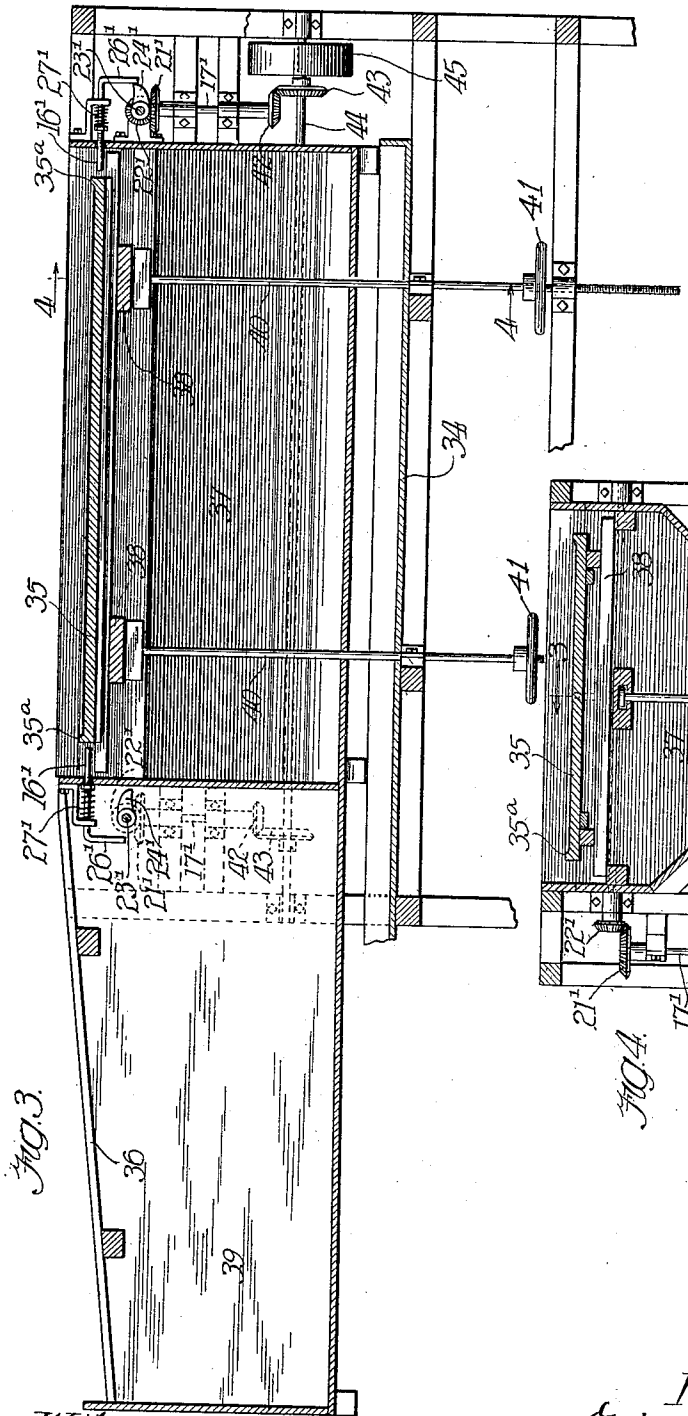

FIG. 3.

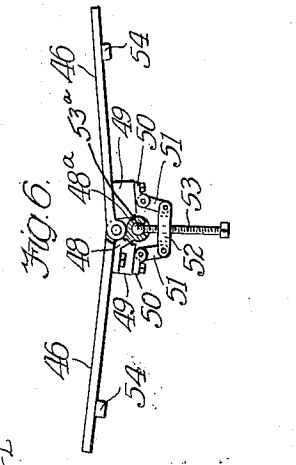

FIG. 6.

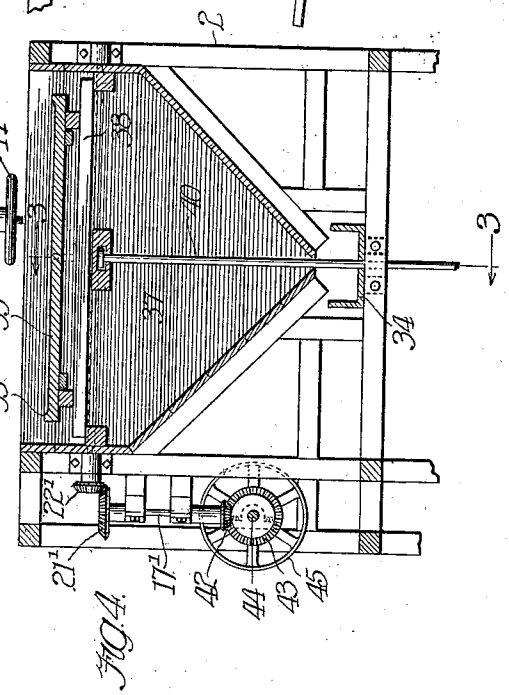

FIG. 4.

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UNITED STATES PATENT OFFICE.

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ORE-CONCENTRATOR.

1,007,116. Specification of Letters Patent. Patented Oct. 31, 1911.

Application filed April 1, 1911. Serial No. 618,407.

To all whom it may concern:

Be it known that I, ORRIN H. KING, a citizen of the United States, residing at Chicago, Cook county, Illinois, have invented certain new and useful Improvements in Ore-Concentrators, of which the following is a specification.

My invention relates to ore concentrators, and the object thereof is to produce a simple, efficient and reliable machine of this character working under the submerged process of ore concentration and adapted to remove or separate the values or concentrates from the slime or pulp form of mill tailings.

Speaking in general terms, my concentrator consists of a table of suitable form and submerged in a tank of water during the concentrating period, which table is adapted to be jarred by suitable mechanism during such operation and to be raised above the water line for the removal of the concentrates. The slime or pulp is arranged to be fed to the table while submerged until it has concentrated all that it is capable of concentrating at one time, whereupon the supply of slime is cut off, and the table raised and the concentrates washed off into suitable receivers or receptacles ready for the next operation. By the provision of a table of the proper concentrating surface and the application of jarring motion directly thereupon, I am enabled to obtain a very high percentage of recovery of concentrates. The preferred form of table is the convex form hereinafter described, although the concave form also hereinafter described may be used to advantage, particularly for a preliminary concentration, after which the convex form of table may be employed for a finishing operation, although either form is capable of performing the entire concentration. In practice any suitable number of these concentrators may be employed in a gang and operated by a common driving mechanism.

In the drawings Figure 1 is a sectional elevation of an apparatus illustrating my preferred form of concentrating table, such section being taken on the line 1—1 of Fig. 2. Fig. 2 a section on the line 2—2 of Fig. 1. Fig. 3 a vertical section on the line 3—3 of Fig. 4 showing a modified form of concentrating table; Fig. 4 a section on the line 4—4 of Fig. 3; Figs. 5 and 6 detail views showing another modified form of concentrating table.

Referring to the particular embodiment of my invention as disclosed in Figs. 1 and 2, in which the concentrating table is of the convex form, the same consists essentially of a tank adapted to contain water in which to perform the submerged process, a concentrating table on which the concentration takes place and which is arranged to be moved vertically in and out of the water of the tank and means for supplying the slime or pulp to the upper surface of the table, together with means for receiving the concentrates collected upon the table. As herein shown in Figs. 1 and 2, the tank 1 which is made of suitable shape and dimensions—being substantially V-shaped in cross section—is mounted in or upon a suitable frame consisting of various supports, all indicated by the reference character 2. This tank is provided at or near its bottom with a suitable outlet 4, governed by a valve 3, whereby the tailings or waste material separated from the concentrates may be removed from the tank. A fresh water valve governed outlet is provided at 4^a.

The concentrating table 5 here being described is of convex form in cross-section, the highest point being at the middle and sloping gradually with the desired degree of obliquity according to the character of the particular slime or pulp being operated upon. The entire table is preferably made of wood or the like, as distinguished from metal, inasmuch as it will not wear smooth and gives better concentrating action. Although the table is shown as being made entirely of wood or the like, it is obvious that it may be of composite formation, that is with a metallic frame and a surface of wood, or the like. As equivalents of the wood I will mention linoleum, fabric, etc., which will give satisfactory concentrating action. This concentrating table rests upon a vertically movable platform 6, the same being held in position against lateral displacement by means of the strips or cleats 7 which bear or rest against similar strips or projections 8 extending upwardly from the top surface of said platform. In its lowermost position this platform itself rests upon the supports 9 which are strips running longitudinally of the tank near the upper

end thereof. As hereinbefore stated, the concentrating table is adapted to be moved vertically and to this end its supporting platform is secured to the two similar and vertically movable rods 10 whose heads 10ª are contained and bear within the depending blocks 6ª of the supporting platform 6. These rods 10 are arranged to be moved vertically in unison or dis-simultaneously, so as to raise the concentrating table in a horizontal plane or to tilt it to any desired degree. For this purpose each of the rods 10 is screw-threaded at its lower end to engage the hub 11ª of a bevel gear 11 whose rotation in one direction or the other causes a vertical movement of its rod 10 accordingly. The bevel gears 11 are adapted to be operated by power and to this end the same mesh with similar driving bevel gears mounted on the drive shaft 13. These latter gears are connected to the drive shaft by means of the clutches 14 and 15 which may be of any well-known construction for this purpose. These two clutches are independently operable, with the result that when both of them are in operation the two rods 10 may be raised or lowered in unison and that when only one thereof is operated one or the other of the rods 10 may be raised or lowered, with a corresponding movement of the concentrating table.

In order to provide the proper jarring action, I arrange at the opposite ends of the table the jarring plungers 16 which work in a horizontal plane and are adapted to strike the ends of a central strip 5ª running centrally and longitudinally of the table 5. These plungers are adapted to be operated by power, preferably from the drive shaft 13, to which end the machine is provided at its opposite ends with the vertical shafts 17 operated from the drive shaft 13 by means of the bevel gears 17ª and 18ª, shafts 18 and gears 19 and 20. Each vertical shaft carries at its upper end a bevel gear 21 which in turn drives a small bevel gear 22 secured to a horizontal shaft 23. Upon each shaft 23 is secured a cam 24 which rotates in the path of the depending portion or arm 16ª of the plunger 16. Each plunger has a horizontal movement in a bearing 25 on the frame 1 and also a bearing formed by the bracket 26 secured to such frame. Each plunger is held inwardly toward the table with a yielding pressure as by means of the coiled spring 27 encircling its plunger and bearing respectively against the bracket 26 and an adjustable collar 28 on the plunger. As stated, the depending end 16ª of each plunger is arranged within the path of movement of the cam 24, with the result that in the rotation of such cam the plunger will be forced outwardly against the tension of its spring and then suddenly released when the cam has cleared the lower end of said arm. The plunger will thereupon deliver a blow against its end of the table, it being understood that the plungers act alternately in delivering their jarring blows.

The supply of slime or pulp is conducted from the source thereof through a supply pipe 29 and into a hopper 30 which is of the same general shape as the tank 1 and provided with a bottom outlet 30ª consisting of a long slot which is adapted to deliver the slime upon the table at its central or highest point and along the length thereof. This hopper is supported in any suitable manner and by preference is in a fixed position above the table, but in order to permit of the vertical movement of such table the supply conduit 31 which communicates with the outlet 30ª of the hopper is made of some suitable flexible material such as canvas or other fabric, so that it may not interfere with such upward movement of the table.

Describing the operation of my machine, Fig. 1 indicates the position of the parts ready for the concentrating operation, at which time the table is arranged below the water level of the tank 1. The slime or pulp is now delivered to the table at the highest point or apex thereof and the same falling upon the table, which during this time is being jarred, becomes concentrated, the concentrates being separated by clinging to the table while the worthless or lighter material or tailings mingle with the water of the tank and flow somewhat rapidly toward the side edges of the table and downwardly into the tank. It will be understood of course that my machine works under the submerged process inasmuch as the separation takes place below the surface of the water within the tank. By reason of the jarring the concentrates will have a tendency to keep collecting at or gravitating toward the sides of the table and when the operator observes that the table has received a sufficient supply of concentrates, that is when the table has reached its capacity of economical separation, he then shuts off the supply by operating the clamp 32 which operates as a valve to bring the lower portions of the hopper together to close the longitudinal outlet 30ª. The table is thereupon raised out of the tank to the position shown in dotted lines in Fig. 1 by operating the vertical rods 10 in the manner hereinbefore described. The two sluice boxes 33 which are pivotally supported in suitable manner upon the main frame are thereupon moved inwardly to a position somewhat under the side edges of the table and the concentrates are removed from the table and into the sluice boxes in any suitable manner, as by means of washing with a hose of fresh water. The concentrates are

conducted from the sluice boxes to any desired place for their reception. The tank may be kept to the proper water level by draining through the outlet 4, the same draining by preference into sluice box or way 34.

In Figs. 3 and 4 I have shown another embodiment of my invention in its broader aspect the same being similar to the machine illustrated in Figs. 1 and 2 with the exception of the shape of the concentrating table 35 which is here shown as somewhat dished by reason of having raised margins 35ª. If desired, the concentrating surface may be made concave. Moreover, this particular machine differs from the other machine in not being provided with the sluice boxes but having an inclined track 36 at one side of its tank 37, on to which track the table 35 is adapted to be bodily slid from off its support 38 after being elevated. This track 36 is arranged above a receiving tank 39 which is adapted to receive the concentrators removed or washed off from the table after being positioned upon the track 36. Furthermore, in this particular construction of Figs. 3 and 4 the vertical rods 40 corresponding to the rods 10 of the other construction are hand operated through the medium of the hand wheels 41, although the power drive may be adopted. In other respects the two machines are substantially the same and the same reference characters but primed are used to indicate corresponding parts. As in the first described construction the means for operating the jarring plungers are the same at opposite ends of the tank. In the present instance the transverse shafts 23′ which carry the cams 24′ are operated by the gears 22′ and 21′, vertical shafts 17′ and gears 42 and 43 driven by the main shaft 44 having the driving pulley 45. As in the case of the other construction, any suitable driving means or connections may be adopted for the end in view.

In the foregoing described constructions the concentrating table has a fixed surface, that is to say its surface is not adjustable to any different shape or degree of inclination. However, if desired such table may be made adjustable to any shape or inclination as shown in Figs. 5 and 6, wherein is illustrated a concentrating table made in two sections 46 hinged along their inner adjacent edges at 47. In order to adjust these sections to any desired inclination and to maintain them in such adjustment, any suitable means may be employed and in the present instance I have shown suitable means in Fig. 6, one of said means being provided at each end of the table. As shown, one of the sections is provided on its under side with the bracket or plate 48 terminating at its lower end with a socket 48ª at a point directly beneath the hinge or axis 47 of the two sections 46. To the under sides of the two strips or rails 49 fastened to the under side of said sections 46 I attach similar brackets 50, to whose inner ends are pivoted one end of links 51, whose other ends are pivotally secured to the opposite ends of a cross bar 52. Through this bar is screw-threaded a vertical adjusting screw 53 whose upper end terminates in a ball 53ª fitting in the socket 48ª and constituting a ball and socket joint with the bracket 48. It is evident that by rotating the screw 53 in one direction or the other the sections 46 are raised or lowered according to direction of rotation of the screw. In order to provide for the varying positions of the projections or strips 54 according to the adjustments of their sections, I make the strips 55 adjustable laterally upon the platform or support 56 through the medium of the slots 56ª in the platform and the bolts 57 secured to said strips 55. When the sections of the concentrating table have been adjusted to the proper position the strips 55 are adjusted laterally to a position to contact with the strips 54 and thereby support and brace the table. In other respects the construction is the same as that illustrated in Figs. 1 and 2.

I claim:

1. In an ore concentrator, the combination, with a tank adapted to contain water, of a table located within the tank, and a plurality of raising and lowering devices including vertical screws operatively connected at their upper ends with different parts of the table and of a length sufficient to elevate the table above the water level in the tank, a driving shaft and independently operable clutch mechanism between said shaft and screws.

2. In an ore concentrator, the combination of a table on which the material to be treated is concentrated and which has a fixed position in the concentrating operation, and alternately oppositely operating means acting on opposite ends of the table for jarring the same in the concentrating operation.

3. In an ore concentrator, the combination of a table on which the material to be treated is concentrated and which has a fixed position in the concentrating operation, and alternately oppositely operating means acting on opposite ends of the table and substantially in line with the concentrating surface of the table for jarring the same in the concentrating operation.

4. In an ore concentrator, the combination of a table on which the material to be treated is concentrated and which has a fixed position in the concentrating operation, and alternately acting jarring means adapted to operate in opposite directions and arranged to strike the opposite ends of the table sub-

stantially in line with its concentrating surface.

5. In an ore concentrator, the combination, with a tank adapted to contain water, of a table located within the tank, means for raising and lowering the table in the tank, a material-supplying hopper located above the table and above the water level at a height sufficient to permit the raising of the table out of the water, and a conduit extending from said hopper to the table, said conduit being flexible over an extent sufficient to permit such elevation of the table.

6. In an ore concentrator, the combination, with a tank, of a table located within the tank and while submerged therein adapted to concentrate the material to be treated, alternately oppositely operating means acting on opposite ends of the table for jarring the same in the contrating operation, said table being in a fixed position when in operation.

7. In an ore concentrator, the combination, with a tank, of a table located within the tank and while submerged therein adapted to concentrate the material to be treated, and alternately acting impacting means adapted to operate in opposite directions and arranged to strike the opposite ends of the table substantially in line with its concentrating surface for jarring it in the concentrating operation.

8. In an ore concentrator, the combination of a table, alternately acting impacting means adapted to operate in opposite directions and arranged to strike opposite ends of the table for jarring it in the concentrating operation, said plungers being normally pressed toward the table with a yielding pressure, and means for moving the impacting means against such pressure and then suddenly releasing them to cause their contact with the table.

9. In an ore concentrator, the combination, with a tank, of a table therein having its upper surface inclined downwardly from its central portion to its opposite sides and provided on its lower surface with longitudinal strips, a support having strips cooperating with the first mentioned strips, and means connecting with the support for raising and lowering it and the table.

10. In an ore concentrator, the combination with a tank, of a table located within the tank and having its upper surface inclined downwardly from its central position to its opposite sides from which the material discharges, means for raising and lowering the table, and receivers arranged adjacent said discharge sides of the table and adapted to be swung into position thereunder when the table is in raised position.

11. In an ore concentrator, the combination with a tank, of a table located within the tank and having its upper surface inclined downwardly from its central position to its opposite sides from which the material discharges, means for raising and lowering the table, and receivers supported upon the tank for movement into position under the discharge sides of the table when in raised position.

12. In an ore concentrator, the combination with a tank adapted to contain water, of a table located within the tank and having its upper surface inclined downwardly from its central portion to its opposite sides, means for raising the table above the water level and for lowering it below the same, and laterally movable sluice boxes located above the water level and adapted to be moved in position below the opposite edges of the table when raised to receive the concentrates therefrom.

13. In an ore concentrator, the combination of a concentrating table which is adjustable in obliquity, and a support for the table having upward laterally adjustable projections, the table being made in two sections whose obliquity is adjustable and which are provided on their under surface with means for engaging said projections.

14. In an ore concentrator, the combination, with a tank, of a table therein having its upper surface inclined downwardly from its central portion to its opposite sides and provided along its central under side with a strip, and alternately acting impacting means arranged to strike the opposite ends of said strip for jarring the table in the concentrating operation.

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