PORTABLE ORE CLASSIFIERS AND CONDITIONERS

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ABSTRACT

This invention is designed as an improvement over the ore classifier disclosed in prior U.S. Pat. No. 2,992,740 and employs a portable supporting structure upon which a power device and a horizontal, rotatable, top plate, from the axis of which a hollow tubular stack vertically extends, is supported. The power device constantly jogs the top plate vertically and circumferentially. A plurality of substantially similar ore concentrating pans are mounted upon and concentrically surround the stack one above the other so the jogging movements of the top plate will be simultaneously imparted to all of the pans so as to discharge light weight materials into the stack and retain the relatively heavier materials for salvage.

8 Claims, 8 Drawing Figures
PORTABLE ORE CLASSIFIERS AND CONDITIONERS

This invention relates to a classifier and conditioner for removing washing, grading and classifying the mineral values from deposits of bulk ore and mineral-bearing gravel and sand, so as to facilitate the recovery of the metallic values therefrom. This application relates more particularly to an ore classifier of the type illustrated and described in applicant's prior U.S. Pat. No. 2,992,740 which issued July 18, 1961.

The principal object of the present invention is to simplify the construction and improve the efficiency of the apparatus disclosed in the said patent and to provide an ore classifier and conditioner which can be readily and economically modularly assembled to accommodate various kinds and capacities of inputs and to provide desired degrees of concentration in the output so that various assemblies can be produced to suit the requirements of the various field conditions encountered.

Another object is to provide means for simultaneously and mechanically moving an adjustable plurality of similar ore panning pans in directions similar to the movements employed in skilled hand gold panning so that a multiplied, power operated, panning action may be continuously attained.

Still another object is to provide an ore classifier and conditioner which will be economical to manufacture and assemble; which will efficiently, rapidly and continuously remove clays, slime-producing particles and underize and oversize non-concentratable particles and other valueless materials from the incoming feed, and which will uniformly and continuously deliver clean, exposed metallic particles of the proper mesh for efficient final recovery by conventional ore milling or smelting operations.

A further object is to provide a highly efficient, portable, self-contained ore concentrating, classifying and conditioning unit which can readily be moved from job to job and which can be effectively adjusted on the job to suit the particular conditions encountered.

A further object of the invention is to provide a device of this character which will combine a powerful mixing action and fluid flow in correct balance to clean all particles for accurate specific gravity, wet or dry processing, classification and concentration, and which will combine an intensive mechanical agitation with a hydraulic action for high recovery and closer quality control of several specific gravity materials.

Other objects and advantages reside in the detail construction of the invention, which is designed for simplicity, economy, and efficiency. These will become more apparent from the following description.

In the following detailed description of the invention, reference is made to the accompanying drawings which form a part hereof. Like numerals refer to like parts in all views of the drawings and throughout the description.

In the drawings:

FIG. 1 is a top plan view of the improved ore concentrating, classifying and conditioning unit of this invention;

FIG. 2 is a side elevational view thereof;

FIG. 3 is an enlarged cross section therethrough taken on the line 3-3 of FIG. 1;

FIG. 4 is a horizontal, partially broken away, sectional view, on the scale of FIG. 1, looking downwardly on the line 4-4 of FIG. 3;

FIG. 5 is a similar horizontal sectional view looking downwardly on the line 5-5 of FIG. 3;

FIG. 6 is a fragmentary, detail, plan view, on the scale of FIG. 1, of a base plate and supporting rollers to be later described;

FIG. 7 is a similar fragmentary, detail view looking in the direction of the arrow "7" in FIG. 6; and

FIG. 8 is a detail perspective view of an axis stack and top plate assembly removed from the conditioner and which will also be later described.

The improved ore classifier and conditioner is preferably supported upon two parallel, spaced apart, I-beam stringers 11. A horizontal, circular base plate 10 is affixed upon the forward extremities of the stringers 11 and an engine housing 12 is fixedly mounted upon the rear extremities thereof to enclose a suitable power source, such as a conventional gas engine or an electric motor, from which a power take-off shaft 13 extends to rotate a crank shaft 14 which is rotatably and transversely mounted in suitable bearings 15 on the stringers 11. A crank disc 16, provided with an eccentric crank pin 17, is fixedly mounted on each extremity of the crank shaft 14, the two crank pins being positioned in 180° radial relation with each other.

Four arcuate indented lower raceways 18 are fixedly mounted in spaced circular relation on the base plate 10, as shown in FIG. 6. The raceways 18 are arcuate in plan so as to form four uniformly spaced portions of a circumferential path concentrically positioned about the center of the base plate 10. The upper surface of each raceway 18 is arcuately concave, as shown in FIG. 7, and is radially inclined downwardly and outwardly to receive a conical supporting roller 19 which freely rolls upon the concave, inclined upper surface of each of the raceways 18. The rollers 19 are provided with terminal flanges 20 which retain and guide them back and forth along their individual raceways.

A circular top plate 21, having four upper, inclined, arcuate raceways 22, similar to the lower raceways 18, mounted on its bottom over each of the supporting rollers 19, as shown in FIG. 8. The inclined surfaces of the rollers and the flanges 20 thereon automatically center the top plate 21 over the base plate 10.

A connecting rod 23 extends from the crank pin 17 on each of the crank disks 16 to a suitable universal joint connection 24 eccentrically mounted on the lower side of the top plate 21 to reciprocally rotate the top plate 21 back and forth. The reciprocal rotation of the top plate causes the rollers 19 to roll up and down the concavities in the raceways 18 and 22 to impart a simultaneous reciprocal rotative and vertical movement or jogging action to the top plate 21. A hollow, cylindrical axis stack 25 is axially mounted on and arises vertically from the top plate 10 to support the concentrating, classifying and conditioning units of this invention thereon so that they will move in unison with the said "jogging" movements of the top plate 21.

The axis stack 25 will be of sufficient vertical length to receive any desired number of substantially similar concentrating pans. As illustrated, a first, or lower, concentrating pan 26, having a flat bottom 27 of reduced diameter, concentrically surrounds the stack 25 and is bolted to the top plate 21, as shown at 28. A first concentric annular inner pan 29 is bolted, as shown at 30, to the stack 25 above the bottom 27 and within the confines of the concentrating pan 26.

The first or lower inner pan 29 is of less diameter than the first concentrating pan 26 and the upper edge of the inner pan 29 is positioned below the upper edge of the concentrating pan 26 so as to leave an annular overflow space 36.

The inner pan 29 is V-shaped in radial cross section so as to provide an inclined, medial bottom portion 31 slanting upwardly and inwardly to slume-discharge ports 32 in the wall of the stack 25.

A lower circular, conical, axial disc 33 having a central overflow opening 35 and an outer diameter corresponding to the inner diameter of the axis stack 25 is positioned within the latter and supported as indicated at 34 to provide a continuation of the inclined bottom portion 31 within the axis stack.

An annular relatively close fitting discharge port 36 be positioned in the overflow space 36 and a relatively fine circular screen 38 closes the top of the inner pan 29 about the axis stack 25 below the top of the latter and above the slume ports 32. One or more fine concentration spouts 39 discharges from the bottom of the inner pan 29 through the wall of the first outer raceway 26 at one side of the latter and a tailings spout 40 similarly discharges from the bottom of the outer pan 26 at the opposite side thereof. Discharge passages 41 are formed in the wall of the axis stack 25 immediately above the flat bottom 27.

The above described elements form a complete washing and concentrating unit. Additional similar units may be mounted.
on the axis stack 25, one above the other, to provide additional washing and concentrating units if desired.

As illustrated, a second or upper concentrating pan 42, substantially similar to the first pan 26, is concentrically mounted on the axis stack above the pan 26, as indicated at 55, and contains an upper inner pan 43, corresponding to the first or lower inner pan 29, which is also mounted upon the axis stack, as indicated at 64. The inner pan 43 has a V-shaped cross section and an inclined medial bottom portion 63, similar to the bottom 31, which axially terminates in upper slime discharge ports 62 which discharge onto an upper conical disc 46 mounted in the axis stack, as shown at 59, which is provided with a central overflow opening 60 corresponding to the lower disc 33 and its opening 35.

The upper pans 42 and 43 are substantial duplicates of the lower pans 26 and 29 and are provided with screens 44 and 45 corresponding, respectively, to the lower screens 37 and 38.

One or more fine-concentrate spouts 47, corresponding to the first concentrate spouts 39, drain the heavy concentrates from the bottom of the upper inner pan 43 and one or more overflow spouts 48 drain the overflow light effluent from the upper outer pan 42 to the circular screen 38 of the lower inner pan 29. The overflow spouts 48 maintain the desired fluid level in the outer pan 42.

A circular or-receiving and washing pan 49, surrounded by an outwardly inclined flange or rim 50, is horizontally and concentrically mounted on the upper extremity of the axis stack 25 in any desired manner, such as by means of attachment screws 51. An annular second washing pan 52, corresponding in diameter to the second concentrating pan 42, is suspended from and below the ore-receiving pan 49 in any suitable manner, such as upon suitable hanger bolts and spacers 53 so as to be vertically spaced above the second concentrating pan 42. The second washing pan 52 has an open center 54 which discharges the washed incoming material onto the screen 45.

OPERATION

For the purpose of description, let us assume the portable classifier has been positioned adjacent an abandoned mine or mill dump for value testing purposes and that a water supply hose or pipe 56 and an ore supply chute 57 have been provided to deliver water and ore and entrained dross material from the dump to the medial portion of the jogging receiving pan 49. The ore and water will be continuously jogging both vertically and differentially back and forth in the pan 49 to exert a violent scrubbing action upon the mineral particles, if any, in the ore to free them from the clay and other gangue materials and to deslime, abrade and polish their exposed metallic surfaces. The movement of the pan and the weight of the incoming material will cause a rolling, heaving mass of water, dross material and ore particles to travel outwardly to, and cascade over the outwardly inclined pan rim 50, onto the second washing pan 52, as indicated by the arrows "A" in FIG. 3.

The particles in the cascading material are still further washed from the gangue and dross material by travelling inwardly over the similarly jogging second pan 52. The cleanly separated and cleanly washed immersed particles fall with the water through the open center 54 of the second pan 52 onto the similarly jogging fine screen 45 of the second inner annular pan 43 so as to screen the fine clays and other fine dross materials together with mineral bearing fines into the inner pan 43. The jogging movement of the inner pan 43 will wash the clays and other valueless flotsam radially upward on the inclined bottom 63 of the pan and through the upper slime ports 62 and up the upper inclined conical disc 46 through the overflow opening 60 and into the axis stack 25. The heavier valuable fines passing through the screen 45 will settle to the V-shaped bottom of the pan 43 and be discharged from the fine-concentrate spouts 47.

The coarser particles which cannot pass through the fine screen 45 are surged and vibrated over the upper edge of the pan 43 onto the top of the annular coarse screen 44 where the rocks and other large chunks, if any, may be retained and removed at intervals. If preferred, the wall of the pan 42 may be notched and provided with discharge chutes, as indicated in broken lines at 65, to discharge the large materials. The coarser value-containing particles pass through the screen 44 or the bottom of the second outer pan 42.

A bed of solution is maintained in the bottom of the pan 42 by one or more raised slime overflow spouts 48, and the concentration of settled mineral values therein can be discharged at intervals by any suitable manner such as by the operation of a conventional gate valve 58 provided with an operating handle 61. Any remaining fines and slimes in the solution overflow the spouts 48 and fall onto the lower fine screen 38 of the lower inner pan 29 where the same procedure takes place as above described with reference to the upper pans 42 and 43 so as to provide a second concentration in the pans 26 and 29.

The heavy valuable particles are discharged from the lower inner pan 29 through a lower concentrate spout 39 and the remaining slimes and gross particles are washed radially upward on the inclined bottom portion 31 through the lower disc 33 and into the axis stack 25. The tailings from the lower concentrating pan 26 and the tailings and water from the axis stack 25, in fact the tailings from the entire assembly, are discharged through any suitable tailings spout 40.

It is desired to call particular attention to the fact that while only two concentrating pan units (26 and 42) have been shown, additional units, such as the one containing the pan 42, can be positioned on the axis stack 25, one above the other intermediate the washing pans 49 and 52 and the bottom concentrating pan 26, the height of the axis stack being, of course, correspondingly increased. The pans can be added or subtracted by simply disconnecting them from the stack and lifting them on or off the stack.

The concentrate spouts 39 and 47 are preferably square in cross section and are positioned so that their side walls incline at 45° as shown in FIG. 2. This provides an elongated V-shaped bottom trough throughout the length of each spout in which the exceedingly heavy and most valuable particles will concentrate while the water will flow thereover and facilitates "cleaning up" operations.

While the principal use is the concentration of valuable particles from ore or ore sands, it also has value in sand and gravel plants in supplying various meshes of clean sands and gravels for concrete work.

The screen meshes will be suitable to the job being done. In actual present practice, the screen 44 is 1 inch mesh; the screen 45 is % inch mesh; the screen 38 is 1/16 inch mesh; and the screen 37 is % inch mesh. The rocks and large chunks will usually be eliminated before the bottom pan is reached so in most cases the screen 37 may be eliminated.

While a selected form of the invention has been above described, it is understood that mechanical variations and detail substitutions can be made by one skilled in the art without departing from the spirit of the invention.

I claim in the following detailed description of the invention, reference is made to the accompanying drawings which form a part hereof. Like numerals refer to like parts in all views of the drawings and throughout the description.

1. A classifier and conditioner for granular materials comprising:
   a. a horizontal, rotatably mounted top plate;
   b. power means intermittently rotating said top plate alternately in opposite directions;
   c. a tubular axis stack axially secured to and arising vertically from said top plate and bottomed thereon;
   d. an annular, lower concentrating pan affixed to said top plate and concentrically surrounding said axis stack;
   e. a lower inner pan positioned within said lower concentrating pan about said axis stack having a conical bottom extending radially inward and upward and in communication-

2. The classifier and conditioner of claim 1 wherein:
   a. said classifier and conditioner comprises a single pan;
   b. said classifier and conditioner comprises two pans;
   c. said classifier and conditioner comprises three pans;
   d. said classifier and conditioner comprises four pans;
   e. said classifier and conditioner comprises five pans;
   f. said classifier and conditioner comprises six pans;
   g. said classifier and conditioner comprises seven pans;
   h. said classifier and conditioner comprises eight pans;
   i. said classifier and conditioner comprises nine pans;
   j. said classifier and conditioner comprises ten pans;
   k. said classifier and conditioner comprises eleven pans;
   l. said classifier and conditioner comprises twelve pans;
   m. said classifier and conditioner comprises thirteen pans;
   n. said classifier and conditioner comprises fourteen pans;
   o. said classifier and conditioner comprises fifteen pans;
   p. said classifier and conditioner comprises sixteen pans;
   q. said classifier and conditioner comprises seventeen pans;
   r. said classifier and conditioner comprises eighteen pans;
   s. said classifier and conditioner comprises nineteen pans;
   t. said classifier and conditioner comprises twenty pans;
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A classifier and conditioner for granular materials as described in claim 1 in which the means for introducing materials includes:

a. a second similar upper concentrating pan secured to said axis stack above said lower concentrating pan;
b. a second similar inner pan positioned within said second concentrating pan about said axis stack with a conical bottom discharging slime into said stack similarly to said lower inner pan;
c. means for continuously discharging lighter concentrates from said second concentrating pan into the inner pan of the lower concentrating pan; and

d. means for withdrawing the heavier concentrates from said second inner pan at intervals.

3. A classifier and conditioner for granular materials as described in claim 2 in which the means for introducing materials includes:

a. a material-receiving pan mounted on and projecting radially about said axis stack above said second concentrating pan;

b. means for conducting the overflow of said material-receiving pan to said second inner pan.

4. A classifier and conditioner for granular materials as described in claim 3 in which the means for conducting the overflow comprises:

a. a feed-return pan of larger diameter than said material-receiving pan and supported below the latter and provided with an open center about said stack and over said second inner pan said feed-return pan acting to catch the overflow of said material receiving pan and conduct same radially inward so as to deposit said materials in said second inner pan adjacent said axis stack.

5. A classifier and conditioner for granular materials as described in claim 2 having:

a. a set of slime ports formed in the wall of said axis stack above said lower inner pan and a bore said second inner pan to facilitate the passage of material into said axis stack; and

b. an upwardly directed conical disc having an axial overflow opening positioned in said axis stack below each set of slime ports to form continuations of the conical bottoms of said lower inner pan and said second inner pan within said axis stack.

6. A classifier and conditioner for granular materials as described in claim 2 in which:

a. the second inner pan is of less diameter than the second concentrating pan so as to leave an annular overflow space between the latter two pans;

b. a first annular screen covering said second inner pan; and

c. a second annular screen covering said annular overflow space, said second screen being of finer mesh than said first screen.

7. A classifier and conditioner for granular materials as described in claim 6 in which the means for continuously discharging lighter concentrates from said second concentrating pan into the inner pan of the lower concentrating pan comprises:

a. an overflow spout through the bottom of said second concentrating pan, said latter spout intaking at a fluid level in spaced relation above said latter bottom so as to retain heavy concentrations in said second inner pan.

8. A granular material classifier and conditioner of the type having a horizontal rotatable plate combined with means for intermittently and alternately rotating said plate in opposite directions, means for supporting a plurality of superimposed material-concentrating pans concentrically on said plate so that they will move in unison therewith comprising:

a. a hollow cylindrical axis stack secured to and axially arising from said plate and extending through said plurality of concentrating pans in fluid receiving relation thereto;

b. means on said stack securing each of said pans in vertical spaced relation to its vertically adjacent pans;

c. means for transferring slimes from certain of said concentrating pans into the interior of said axis stack; and

d. means for transferring heavy concentrates from certain of said concentrating pans to the next below concentrating pan.

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