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PATENT SPECIFICATION

DRAWINGS ATTACHED

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COMPLETE SPECIFICATION

Improvements in apparatus for Gravity Separation of Materials

We, JOHN ALEXANDER FOYSTER, OLGA MAY FOYSTER, CLIVE JOHN FOYSTER, LLOYD FOYSTER and MARK FOYSTER, all Australian Citizens, of Kingscliff, in the State of New South Wales, Commonwealth of Australia, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to improvements in apparatus for gravity separation of materials.

Gravity separation of materials is usuable in many applications, including the separation of fine particles of grains of minerals from silicon sand, the separation of foreign matter from coal in coal washing procedures, the separation of silt from water, and so on. To consider, as an example, the separation of mineral sands, it is usual for a head feed of pulp, which is a mixture of water with sand from which a fairly small included proportion of mineral sand is to be extracted, to be fed to an upgrader, the purpose of which is to separate from the main body of silicon sand, a concentrate very rich in mineral sands, and which is subsequently conveyed to a plant for further concentration and separation of its various components. In certain circumstances, it may be found desirable, in the absence of copious supplies of water, for dry separation to be used to produce a concentrate; and dry separation is also used in subsequent treatment of concentrates.

Various types of upgraders and gravity separators have been proposed, and it is common for the bulk material to be caused to flow through a sluice which has an opening, or a series of openings, each such opening being substantially transverse to the direction of flow, and undercut in such a way that its far edge is of knife-like form serving, in effect, to slice the mineral-rich bottom layer from the material, which in flowing through the sluice tends to stratify, with the denser mineral sands, at the bottom, the less dense silica sands at the top.

Now, the material being separated usually includes a quantity of foreign matter, such as particles of grass, roots leaves and other vegetable matter, despite cleaning processes which are normally carried out before the upgrading.

It is found that the sluice openings referred to are likely to become partly clogged in time by the foreign matter, in particular, in the material being processed, the particles of vegetable matter or the like bridging the openings, and causing a build-up around them of sand and other material, so that the separator fails to function properly unless given a good deal of maintenance. This maintenance may interfere with the continuous operation of the upgrader and result in considerable economic losses.

It is desirable to provide gravity separation apparatus which will not be liable to blockages as described, but which will be particularly efficient and trouble-free in operation.

It is also desirable to provide gravity separation apparatus in which the width of the slot-like opening may be readily adjusted as may be required from time to time.

The invention consists in gravity separation apparatus including a forwardly and downwardly inclined sluice unit having an unobstructed bottom over which material to be separated may flow from rear to front, an outlet opening in the form of a slot flush with said bottom and transverse to the flow, said slot having a face extending down from its front edge and inclining downwardly towards the rear, one edge of said slot being formed separately from said bottom and being movable in the plane of said bottom at an angle oblique to the long axis of said slot, thereby to vary the width of said slot.

The invention will now be described in more detail, by way of example, with reference to

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the accompanying drawings, in which:—

FIG. 1 is a perspective view of part of a sluice unit of an upgrade for mineral sand separation, made according to the invention,

FIG. 2 is a plan view of the apparatus shown in Fig. 1,

FIG. 3 is a sectional view along line 3—3 in Fig. 2,

FIG. 4 is an inverse plan view of the apparatus shown in the preceding figures, but with the mineral collecting box removed.

The apparatus is a secondary sluice of an upgrader for mineral sand separation, the upgrader consisting of a number of similar parallel primary upgrader trays (not shown) arranged one above the other, the assembly being tilted so the bottom of each tray inclines downwardly towards the front and each tray bottom is common to a series of sluices each with side walls which are forwardly convergent to a restricted front passage, the front passage of one leading into the rear of the next, a transverse outlet opening being provided in the bottom at each restricted front passage. Pulp fed to the rear of each of the upgrader trays flows through the series of sluices of that unit, in each sluice undergoing a primary upgrading, the mineral-rich lower stratum of the pulp passing through the outlet opening of the primary sluice and entering the rear part of a secondary sluice. Consequently, with each primary upgrader tray there are associated a number of secondary upgrader sluices as shown in the figures of the drawings, each receiving pulp from one outlet of the primary upgrader tray.

The secondary sluice illustrated has forwardly and downwardly inclined bottom 10 on which are mounted a pair of forwardly convergent side walls 11, of which the front parts of the inner faces are bevelled to reduce somewhat their angle of convergence to a restricted front passage 12.

The sluice bottom 10 is not continuous, a part being omitted to leave, near the front of the sluice, an opening of which the rear edge 13 is transverse to the sluice, the front edge 14 being at an angle to the rear edge. In this opening there are fitted a rear outlet unit 15 and a front outlet unit 16, both with their upper faces co-planar with the upper surface of the sluice bottom 10. The rear outlet unit is secured by screws 17 to close the rear part of the opening in the sluice bottom, the front outlet unit is laterally slidable, its front face 18 being at an angle to its rear and abutting against the oblique front edge 14 of the opening in the sluice bottom. The front face 19 of the rear outlet unit 15 is parallel to the rear face 20 of the front outlet unit 16, both inclining downwardly towards the rear, and as the front outlet unit 16 is moved laterally in one direction or the other, its rear face 20 is moved in parallelism nearer to or further from the fixed front face 19 of the rear outlet unit 15, to narrow or widen the downwardly and rearwardly inclined outlet opening 21 between them. To guide the front outlet unit 16 in its transverse movement and retain it in place, a guide bracket 22 is secured by screws 23 under the front part of the sluice bottom 10 and has a flange 24 engaging in a groove 25 formed in the underside of the movable front outlet unit 16 and parallel to the oblique front face thereof.

To close the sides of the outlet opening 21, two pieces 26 of a resilient compressible material, such as sponge plastic, are cemented to the sides of the rear outlet unit 15 and bear against the inclined rear face 20 of the front outlet unit 16.

The outlet opening 21 leads into a mineral collecting box 27, which may be of moulded plastic, and which is secured under the front part of the sluice. The bottom of the box slopes downwardly to the front from which leads a conduit 28.

As the pulp flows over the sluice bottom 10, it tends to stratify, this being assisted preferably by a layer of sand adhesively secured to the sluice bottom. The flow of the pulp is constricted by the convergence of the sluice side walls 11, so that the bottom stratum, rich in mineral sand, is deepened towards the front of the sluice. This relatively dense and slow moving stratum passes through the outlet opening 21, the less dense and more rapidly moving strata of silicon sand, together with foreign vegetable matter, flow over the outlet opening 21 and, as tailings, are discharged through the front sluice passage 12.

The concentrate passing through the outlet opening 21 is caused to flow rearwardly and downwardly into the mineral collecting box 27 and thence, through the conduit 28 to any means for collecting the concentrate from the upgrader.

The outlet 21 may be widened or narrowed as may from time to time be required to achieve the desired concentration of minerals simply by moving the front opening unit 16 to one side or the other manually; though mechanical means may be provided for this purpose if desired.

It will be found that the rearwardly and downwardly inclined outlet opening 21 will efficiently separate denser strata from the pulp flowing through the sluice and at the same time the inclination of the front face 19 of the outlet will tend to cause less dense strata and vegetable and other foreign matter to flow past the slot, which consequently will not be likely to become clogged and rendered ineffective even when the outlet is reduced to a very small width.

Satisfactory results have been obtained where the front and rear faces of the outlet opening incline rearwardly and downwardly at about the same angle to horizontal as the sluice bottom inclines forwardly and downwardly;

and for wet separation of mineral sands, good results have been achieved when the angle between the front face of the outlet opening and the bottom of the sluice is between 20° and 60° to horizontal, the front face of the outlet opening being inclined at a similar angle to horizontal, but in reverse direction, so that the angle between the sluice bottom and the front face of the outlet opening may be of the order of 100° to 120°. It is to be understood, of course, that the invention is in no way restricted to angles within these limits, which are given by way of illustrative example only. In other applications of the invention, angles outside these ranges may be found to give optimum results.

WHAT WE CLAIM IS:—

1. Gravity separation apparatus including a forwardly and downwardly inclined sluice unit having an unobstructed bottom over which material to be separated may flow from rear to front, an outlet opening in the form of a slot flush with said bottom and transverse to said flow, said slot having a face extending down from its front edge and inclining downwardly towards the rear, one edge of said slot being formed separately from said bottom and being movable in the plane of said bottom at an angle inclined to the long axis of said slot, thereby to vary the width of said slot.

2. Apparatus as claimed in claim 1, in which a second face extends down from said rear edge, also inclining downwardly towards the rear.

3. Apparatus as claimed in claim 1, in which said front and rear faces are parallel and their angle to the horizontal is substantially equal to the angle to horizontal of said bottom of said unit.

4. Apparatus as claimed in claim 1, 2 or 3, in which the ends of said slot are closed by compressible resilient members.

5. Gravity separation apparatus substantially as described with reference to the accompanying drawings.

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