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APPARATUS FOR WET SCREENING
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FIG. 1

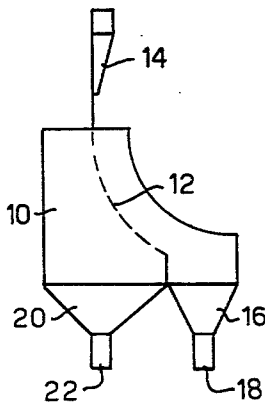
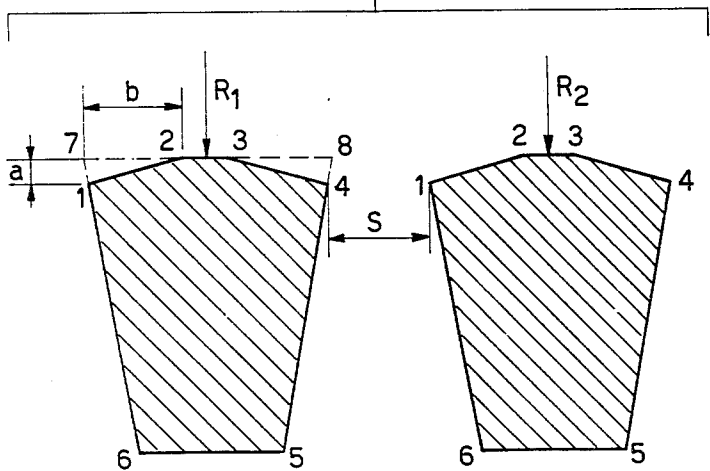


FIG. 2



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APPARATUS FOR WET SCREENING

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This invention relates to particle separation and more particularly to improvements in wet screening apparatus and procedure of the sieve bend type, such as disclosed in U.S. patent application Serial No. 475,251, filed December 14, 1954, of which this application is a continuation-in-part.

Such apparatus, hereinafter referred to as a sieve bend, is disclosed in said U.S. patent application as including a screening deck, preferably curved, which may be made up either of parallel bars separated from each other by slots, or of a plate with slot-type openings formed therein and extending perpendicular to the direction of material flow. In the procedure involved, the material to be separated is fed together with a suspending liquid in layer formation tangentially to the concave surface of the screening deck at a pre-determined initial velocity so that the structure of the screening deck defining the openings or slots engage incremental layers of the moving material to cause entrained particles of the material, which are of the order of one-half the size of the openings, to pass therethrough.

The bars of the screening decks or the dams between the slots in the screening plates commercially available have a flat top surface with rounded-off transitions to the lateral surfaces of the bars or dams. Heretofore, sieve bends of such construction have been employed in screening fairly hard materials, such as coal, ore, gangue, magnetite, sand, etc., with complete satisfaction. However, when dealing with fine-grained soft materials which must be screened with slot openings not exceeding 0.3 mm. as, for example, starch suspensions, different problems were presented, particularly when the soft materials contained fibrous constituents.

Accordingly, it is an object of the present invention to provide an improved apparatus and procedure of the type described particularly adapted to separate fine-grained soft materials, especially fibrous materials, with a high degree of efficiency.

Another object of the present invention is the provision of an improved screening deck construction operable to effectively separate mixtures of fine-grained soft materials, particularly fibrous materials.

These and other objects of the present invention will become more apparent during the course of the following detailed description and appended claims.

The invention can best be understood in conjunction with the accompanying drawings in which an illustrative embodiment is shown.

In the drawings:

Figure 1 is a side elevational view of a screening apparatus embodying the principles of the present invention; and

Figure 2 is an enlarged cross-sectional view of two adjacent bars of the screening deck of the apparatus.

Referring now more particularly to Figure 1 of the drawings, there is shown a screening apparatus of the sieve bend type, such as disclosed in the U.S. patent ap-

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plication Serial No. 475,251. In brief, the apparatus includes a housing 10 having a cylindrically curved screening deck 12, preferably reversibly mounted therein. A feeding device 14 is provided adjacent the upper end of the screening deck for directing the material to be screened, together with a suspending liquid in layer formation, to the concave side of the screening deck at a predetermined minimum initial velocity. The oversize or coarse fraction issuing from the lower end of the deck is collected in a hopper 16 and is discharged at 18. The undersize or fine fraction issuing through the screening deck openings is collected in a hopper 20 and is discharged at 22.

Referring now to Figure 2 wherein two adjacent bars 15 of the screening deck 12 are shown, the numerals 1 through 6 designate successive points of intersection between the plane of the drawing and the corresponding lines of intersection bounding the surfaces of the bars. The numerals 7 and 8 designate the theoretical lines of intersection between the top surface 2—3 and the lateral surfaces 1—6 and 4—5.

The direction of flow of the material to be screened is from left to right as viewed in Figure 2. Therefore, the leading edge is defined by a transition plane 1—2 extending between top surface 2—3 and the leading lateral surface 1—6. As shown, the transition plane 1—2 is flat. However, it will be understood that it may be curved, if desired.

The distance a from line 1 to plane 2—3, i.e., in the drawing, the length of the perpendicular from point 1 to the line 2—3, may, according to the invention, not be smaller than $\frac{1}{20} S$ and not larger than $\frac{1}{2} S$, where S is the desired predetermined slot width. By preference said maximum distance should not exceed $\frac{1}{4} S$. The requirements for the transition plane 3—4 may be less exacting. The only requirement to be met by this plane is that the perpendicular distance from line 4 to plane 2—3 is not greater than $\frac{1}{2} S$. By preference said maximum distance should not exceed $\frac{1}{4} S$. There is, however, no objection against this distance being smaller than $\frac{1}{20} S$, or even equal to zero, in which case the planes 2—3 and 5—4 intersect along the line 8 so that there is no rear transition plane provided. If the perpendicular distance a between the line 1 and the top surfaces 2—3 becomes smaller than $\frac{1}{20} S$, there is the risk of fibrous particles getting stuck against the edge, between the planes 6—1 and 2—1 formed by the line 1, thereby "blinding" the screen deck. The distance b , i.e., the length of line 2—7 in the drawing, should preferably not exceed $5 S$.

R_1 and R_2 represent the radii of the circles touching the top surfaces 2—3 of two adjacent bars, said circles having their centers coincident with the center of the curved screen deck. According to the invention, the difference between R_1 and R_2 must not exceed $\frac{1}{10}$ part of the slot width. The screen decks need not have a specified radius of curvature. Such radius may be fixed at will, depending on the object in view, and may even be given a very high to infinite value, in which latter case the screen deck is flat. Even when using a flat screen deck with bars or dams according to the invention, fine-grained fibrous materials may be screened without any appreciable clogging, provided the material has a sufficiently high flow velocity in the direction parallel to the screen deck.

Example

A suspension of a fibrous material was fed at a gauge pressure of 1 atmosphere to a commercial type of sieve bend having a curvature of 330° , with a slot width of 0.1 mm. and a dimension a greater than $\frac{1}{4} S$. The undersize, which at the start amounted to 95 percent of the total feed, dropped to 60 percent after 15 minutes, to

48 percent after 30 minutes and to 38 percent after 60 minutes.

When the same material was fed to a sieve bend according to the invention, all the other conditions being the same, the undersize amounted to 84 percent after 15 minutes, 79 percent after 30 minutes and 70 percent after 60 minutes, after which the percentage of the undersize remained constant.

From the above, it can be seen that even with soft materials, good results may be obtained by the present invention. In accordance with the principles of the present invention, the surface forming the transition from the flat top surface of each bar or dam to its lateral surface facing towards the feed end of the screen must intersect the lateral surface along a line spaced from the top surface a distance which is not less than $\frac{1}{20}$ and not greater than half of the distance of the desired predetermined slot width, by preference not greater than $\frac{1}{4}$ of said slot width. The transition surface from the top surface to the lateral surface facing away from the feed end of the screen must intersect the lateral surface along a line spaced from the top surface a distance not greater than half of the distance of said slot width. The radii of the circles touching the top surfaces of two adjacent bars or dams and having their centers co-incident with the center of the curved screen deck must not differ by more than $\frac{1}{10}$ part of the desired predetermined slot width.

In addition, it is preferable that not more than 10 percent of the number of slots provided have a slot width of 1.1 to 1.2 times the desired predetermined slot width. Furthermore, not more than 10 percent of the number of slots provided should have a slot width of 0.9 to 0.8 times the desired predetermined slot width. Finally, not more than 5 percent of the number of slots provided should have a slot width greater than 1.2 times the desired predetermined slot width.

If a screen deck constructed in accordance with the principles of the invention is not reversible with respect to the direction of flow of the material to be screened, it is not necessary for the side of the bars or dams facing away from the feed end of the screen to meet the same exacting requirements as the side of the bars or dams facing towards the feed end of the screen. However, it is essential for the line of intersection between the transition surface and the lateral surface to remain below a given distance to the top surface, but a minimum distance is not required, so that it is contemplated that no transition surface at all will be provided on the side facing away from the feed end and the top surface and the lateral surface will simply intersect along a straight line.

If the screen deck can be reversed with respect to the direction of flow of the material, as shown, both sides of the bars or dams must, of course, meet the requirements specified for the side facing towards the feed end.

It thus will be seen that the objects of this invention have been fully and effectively accomplished. It will be realized, however, that the foregoing specific embodiment has been shown and described only for the purpose of illustrating the principles of this invention and is subject to extensive change without departure from such principles. Therefore, this invention includes all modifications encompassed within the spirit and scope of the following claims.

I claim:

1. In an apparatus for separating fine grained soft materials suspended in a liquid according to size, a cylindrically curved screening deck having a feed end, a discharge end, and longitudinally spaced transverse portions defining a plurality of screening openings of predetermined width extending perpendicular to the direction of flow of the material between said feed end and said discharge end, said portions having flat surfaces defining the material receiving side of said deck, opposed lateral surfaces defining the openings, and transition surfaces between said flat surfaces and said lateral surfaces,

the transition surfaces between the flat surfaces and the lateral surfaces facing the feed end of the screening deck intersecting the lateral surfaces along lines spaced from the flat surfaces a distance not less than one-twentieth and not greater than one-half of the distance of said predetermined opening width, the transition surfaces between said flat surfaces and the lateral surfaces facing away from the feed end of the screening deck intersecting the lateral surfaces along lines spaced from the flat surfaces a distance not greater than one-half of the distance of said predetermined opening width, and the radii of the circles touching the flat surfaces of two adjacent portions and having their centers coincident with the center of curvature of said screening deck having distances which do not differ by more than one-tenth of the distance of said predetermined opening width.

2. A screening deck as defined in claim 1, wherein the maximum distance to the top surfaces of said portions of the lines formed by the intersection of the lateral surfaces and the transition surfaces does not exceed one fourth of the distance of the predetermined opening width between the bars.

3. A screening deck as defined in claim 1 wherein the distance from the lines of intersection between the transition surfaces and the flat surfaces to the theoretical lines of intersection between the associated lateral surfaces and the flat surfaces is not greater than five times the predetermined opening width.

4. A screening deck as defined in claim 1 wherein said portions are bars each having lateral surfaces symmetrical in relation to a plane of symmetry and a flat surface substantially perpendicular to said plane of symmetry, said lateral surfaces converging in a direction away from said flat surface.

5. An apparatus for separating fine grained soft materials according to size comprising a fixed cylindrically curved screening deck having a feed end and a discharge end and a plurality of longitudinally spaced transversely extending bars defining a plurality of screening openings of predetermined width between said feed end and said discharge end, and means for supplying a mixture of fine-grained soft particles and a suspending liquid in layer formation tangentially at the feed end to the concave side of the screening deck at a predetermined minimum initial velocity in a direction perpendicular to said bars and openings, said bars having flat surfaces defining the concave side of the screening deck, opposed lateral surfaces defining the openings, and transition surfaces between said flat surfaces and said lateral surfaces, the transition surfaces between the flat surfaces and the lateral surfaces facing the feed end of the screening deck intersecting the lateral surfaces along lines spaced from the flat surfaces a distance not less than one-twentieth and not greater than one-half of the distance of said predetermined opening width, the transition surfaces between said flat surfaces and the lateral surfaces facing away from the feed end of the screening deck intersecting the lateral surfaces along lines spaced from the flat surfaces a distance not greater than one-half of the distance of said predetermined opening width, and the radii of the circles touching the flat surfaces of two adjacent bars and having their centers coincident with the center of curvature of said screening deck having distances which do not differ by more than one-tenth of the distance of said predetermined opening width.

6. A screening deck as defined in claim 5 wherein the maximum distance to the flat surfaces of the bars of the lines formed by the intersection of the lateral surfaces and the transition surfaces does not exceed one fourth of the distance of the predetermined opening width between the bars.

7. A screening deck as defined in claim 5, wherein the distance from the lines of intersection between the transition surfaces and the flat surfaces to the theoretical lines of intersection between the associated lateral surfaces

and the flat surfaces is not greater than five times the predetermined opening width.

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