March 2, 1943. H. M. LEWERS 2,312,563

HYDRAULIC CLASSIFIER

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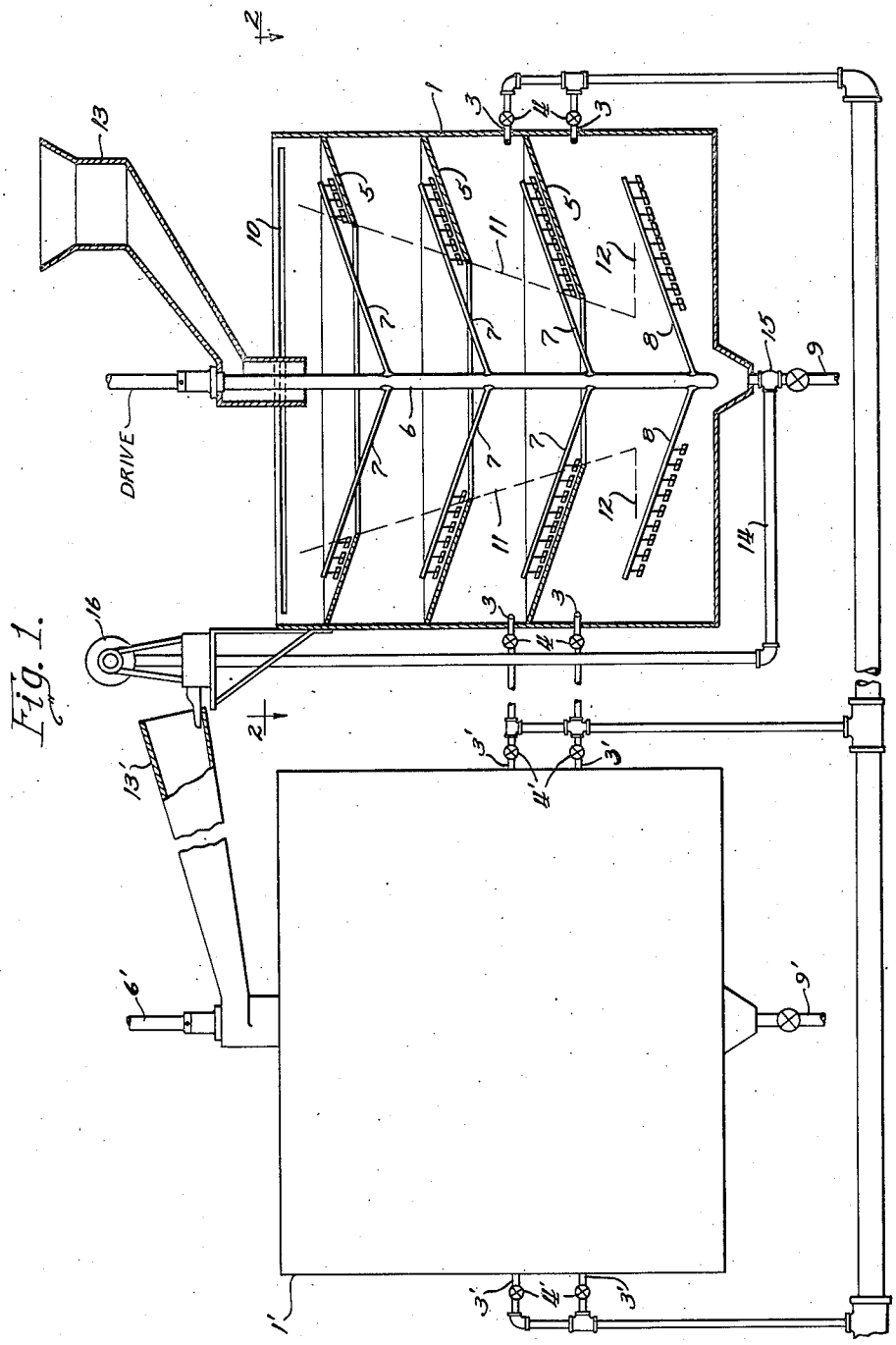

Fig. 1.

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Fig. 2.

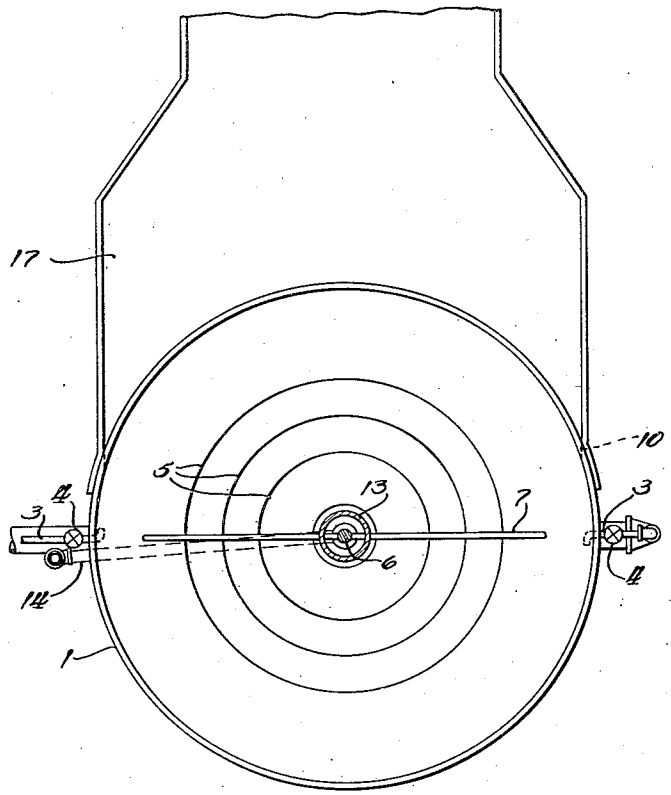
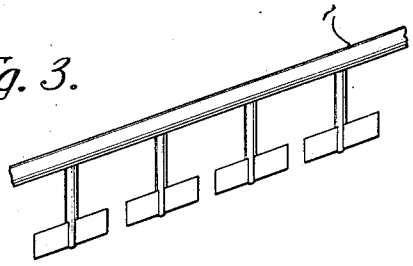


Fig. 3.



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2,312,563

UNITED STATES PATENT OFFICE

2,312,563

HYDRAULIC CLASSIFIER

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Application November 4, 1941, Serial No. 417,794

4 Claims. (Cl. 209—208)

This invention relates to an apparatus for sorting or dividing, by hydraulic classification, mixtures of coarse and finely divided particles into the constituent sizes.

It has been found that in grinding metallic and non-metallic ores there is a continuous reduction in particle size from substantially 65 mesh (208 microns) down to 10 to 18 microns. At the latter point there is a definite interruption of continuity inasmuch as practically all material smaller than that is found to be in the colloidal state, most of the particles being smaller than 3 to 5 microns. It is only these fractions which are to be discarded with the aid of the classifier according to the invention. However, the term "colloidal" is used throughout the specification and claims to include not only colloidal, but also near-colloidal particles and, in general, material showing colloidal behavior.

It is the main object of the invention to provide a low cost hydraulic classifier economical of operation and of relatively small volume, which is adapted to eliminate effectively colloidal material from granular or coarsely dispersed matter such as is found, for example, in a mineral grind. A particular object of the invention is to provide an economical means for de-sliming suspensions of pulverized ores in water, intended to be concentrated by means of froth flotation.

Other objects and advantages of the present invention will become apparent from the following description taken in connection with the appended drawings in which:

Figure 1 shows a preferred embodiment of the invention in a vertical sectional view, and also illustrates a multiple-effect arrangement in which a plurality of the hydraulic classifiers of the present invention are arranged in series;

Figure 2 is a plan view of the apparatus taken along the line 2—2 of Figure 1 looking in the direction of the arrows; and

Figure 3 is a detail of the rake-elements hereinafter described.

By reference to the drawings, it will be seen that the apparatus of the present invention comprises a container 1 with two or more, preferably four, water inlet pipes 3 with valves 4, which pipes are provided in the lower half of the container 1 at opposite points on its periphery. Disposed within the container 1 is a series of open-bottom, imperforate walled, hollow members 5 in the shape of truncated cones, the larger bases of which are of equal diameter, whereas the diameters of the smaller bases are progressively decreasing downwardly, so that the height of the successive members accordingly increases. These members are coaxially superimposed at intervals with their truncated ends toward the bottom of the container 1, the flattest thereof being placed as the uppermost near the top, the deepest as the lowermost near the bottom of said container. A vertical shaft 6 in the center of the container rotates rake-like shaped blades 7 so placed as to sweep over the inner surface of the hollow members 5. Stirrers 8 are provided near the bottom of the container 1 to concentrate at the center thereof the material to be discharged. 9 is a withdrawal pipe for "sands" and water in the center of the container bottom, whereas the "fines" pass through an overflow slit 10. A spillway 17 is placed adjacent overflow slit 10 to convey away the overflow "fines." The assembly can be regarded as a sequence of hollowed members of the bowl classifier type disposed one above the other, each of which opens into the next member thereunder, in combination with means serving to produce an upward current of water streaming successively through said elements with gradually decreasing velocity.

The dotted lines 11 connecting the corners of the smaller parallel sides of the trapezoidal sections through the hollow members 5 or, more exactly, the angle between this line and the horizontal line 12 indicates the classifying capacity of the apparatus. This slope is consequently to be adjusted according to the character of the material to be treated. In the embodiment shown, the angle in question is approximately 60 degrees. This is suitable for a material containing approximately equal amounts of coarsely dispersed and colloidal particles. With an increasing proportion of colloidal material, the slope should become accordingly steeper.

In the use of this apparatus for separating the discrete particles of a pulp from the "fines," the feed is supplied at the top through the central hopper 13 countercurrent to the water entering tangentially near the bottom and rising to the top, and in so rising, is forced to pass, in three (or more) stages, through openings of gradually decreasing diameter. As a consequence thereof the rate of flow of the solution decreases from stage to stage. The whirling motion imparted to the solution by the rake-like blades 7 rotating in the conical rake-boxes 5 assists the water stream in raising the particles of relatively finer size to the surface, whereas the "sands" are deposited on the inclined walls of said boxes from which they are removed by the rake elements 7, to be again

and again exposed to the washing action of the water stream. In the flattest uppermost element 5 the fresh feed falls in with the counterflow of the solution moving relatively slowly, so that only the finest particles are caused to pass to the overflow 10. On the other hand, in the deepest, lowermost element 5 the coarsest particles, which have undergone the classifying action of the upper elements 5 on a considerably prolonged path, encounter the fresh water moving upward with relatively high speed and are therefore discharged through the withdrawal pipe 9 practically freed from colloidal concomitants. All these means in cumulative cooperation produce results far superior to those achievable with an equal number of separate rake classifiers connected in series. Moreover, the apparatus of the present invention is capable of effecting considerable savings in floor space as well as in equipment cost, when compared with a series of individual classifiers of equal capacity.

When plant capacity is high, or when a particularly difficult ore is being classified, the classifying units may be placed in series as is illustrated in Figure 1. In such a case, the "sands" which are to be reclassified are diverted from withdrawal pipe 9 to pipe 14 by closing valve 15, whence they are transported to container 1' by means of pump 16 and chute 13'. In Figure 1, all of the primed reference numerals refer to the corresponding parts in the sectioned elevation view.

Having described my invention, what I claim and desire to protect by Letters Patent is:

1. An apparatus of the character described comprising a container having a feeder at the top, a discharge at the bottom and means adapted to cause wash water to rise in counter-current to the feed to overflow near the top; and a plurality of superimposed settling compartments within the container, each of which communicates through a central opening in the bottom wall with the next thereunder, the said compartments being disposed so as to follow each other from above to below in an order of increasing depths, whereas the diameters of the bottom holes gradually decrease downwardly.

2. An apparatus of the character described comprising a container adapted to be continuously fed at the top and likewise discharged at the bottom and having means for causing wash water to rise in counter-current to the feed and to overflow near the top, and adapted to hold a series of stationary decks inclining downwardly and inwardly toward the center and provided with central openings and rotary surface rakes, said decks being coaxially disposed at intervals one above the other within the container so as to divide the same into a plurality of superimposed closed settling compartments, each of which communicates with the next thereunder through the central openings of the decks, and the compartments being arranged from above to below in an order of increasing depths, whereas the diameters of the central openings of the successive decks decrease downwardly.

3. An apparatus of the character described comprising a cylindrical container having a feed charging appliance at the top and a discharging device for settled solids in the central part of the bottom, peripheral wash water inlets in its lower half and an overflow near the top, and being adapted to hold a series of dish-shaped upwardly facing, substantially horizontal partitions provided with central openings and with sweeps for moving the settled solids towards the bottom holes, said partitions being disposed at intervals within the container so as to form the bottoms of superimposed settling compartments, each of which communicates with the next thereunder through the central openings, except the undermost which opens into a common lower chamber for the accumulated settled solids, and the said compartments being arranged from above to below in an order of increasing depths, whereas the diameters of the successive inter-compartment outlets decrease downwardly.

4. An apparatus for the hydraulic classification by sizes of solids suspended in water, a container having a feeder at the top, a discharge at the bottom and means for causing wash water to rise in counter-current to the feed and to overflow near the top, the said container being adapted to hold a sequence of coaxially superimposed stationary partitions in the shape of open-bottom, imperforate walled truncated cones equipped with rotary surface rakes, and to hold also means for rotating said rakes, the larger bases of the said partitions being of equal diameters, whereas the diameters of the smaller bases are progressively decreasing, and the said partitions being arranged at intervals, with their truncated ends toward the bottom of the container, so as to divide the same in a plurality of adjacent settling compartments following one another from above to below in an order of increasing depth and of decreasing inter-compartment outlet sections.

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