Aug. 30, 1938. D. M. WRIGHT 2,128,447

REAGENT MIXER

Filed Nov. 23, 1936 2 Sheets-Sheet 1

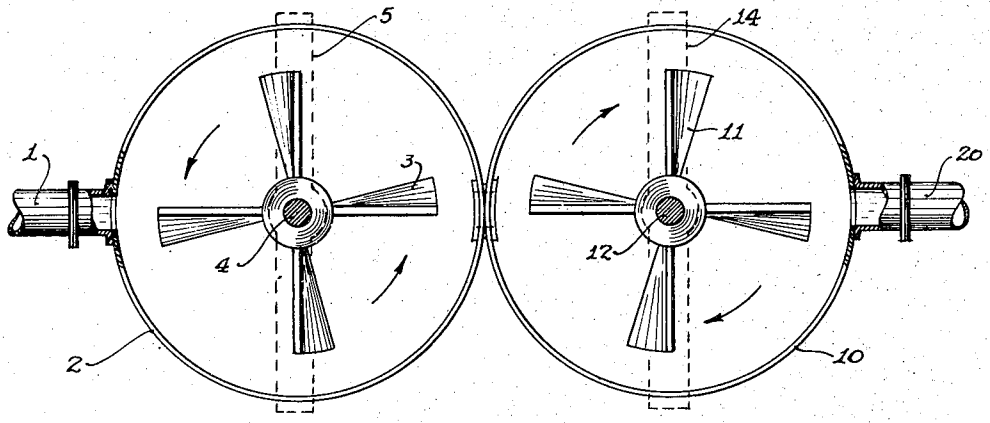


Fig. 1

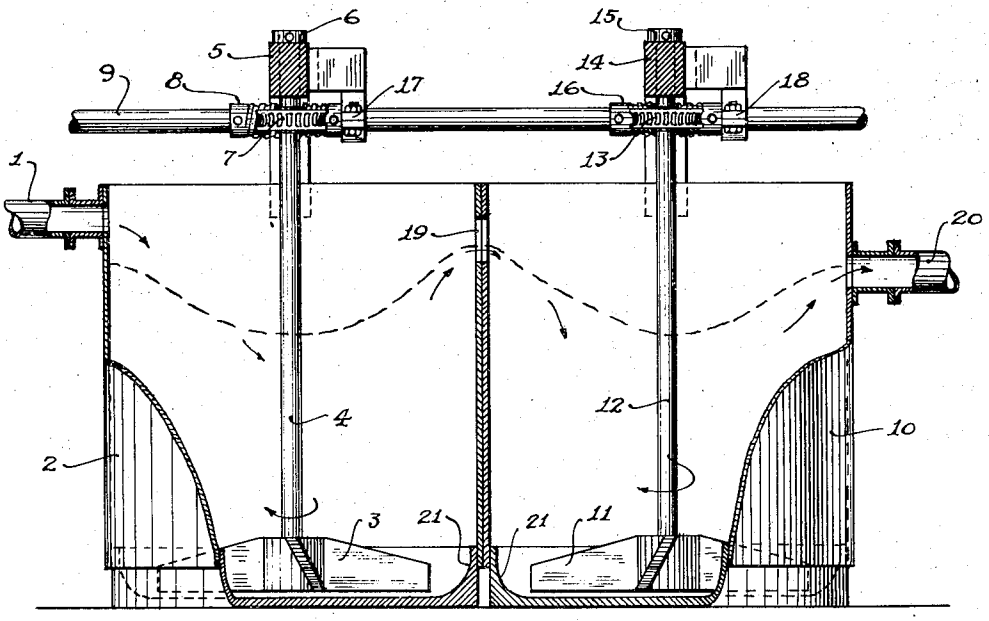


Fig. 2

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ATTEST -
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REAGENT MIXER

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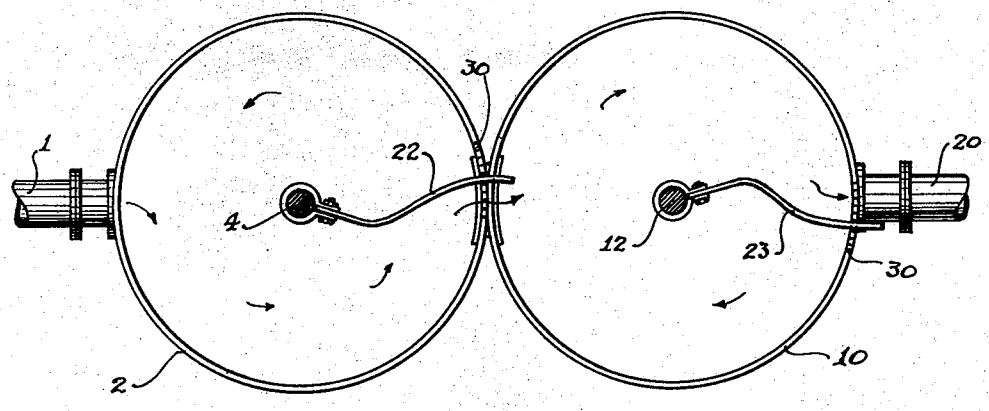


Fig. 3

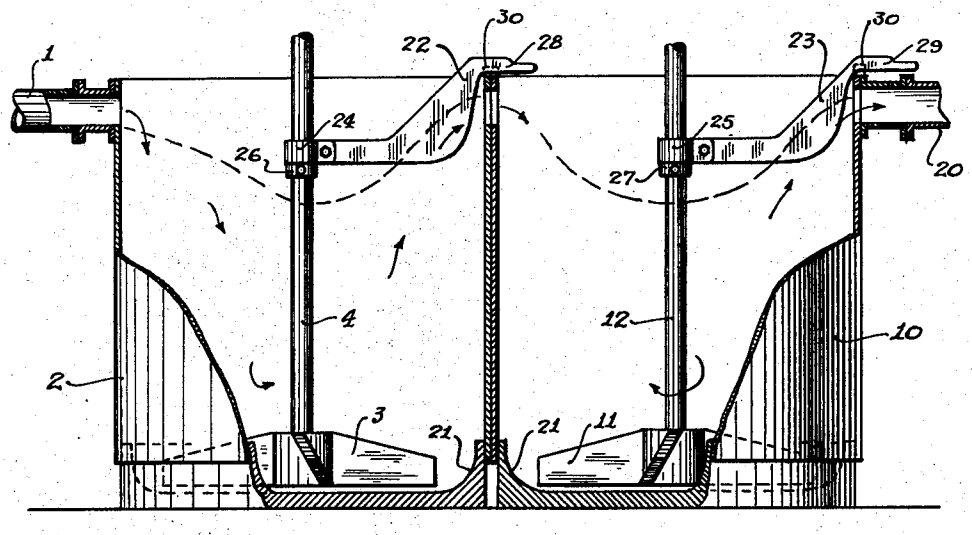


Fig. 4

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UNITED STATES PATENT OFFICE

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REAGENT MIXER

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Application November 23, 1936, Serial No. 112,406

2 Claims. (Cl. 259—64)

This invention relates to a reagent mixer.

One of the objects of the invention is to provide mixing apparatus for mixing reagents with phosphate rock feed.

Another object of the invention is to provide a mixer so constructed as to prevent by-passing of eddy currents.

Other objects of the invention will be apparent from the description and claims which follow.

In the mining of phosphate rock, for example in the Florida fields, the matrix is removed from an open pit mine by hydraulic mining methods. Material in the form of a wet slush is pumped over a washer, which consists of lugs and screening and settling apparatus, by means of which screening and settling apparatus the pebble phosphate is removed. The tailings from the washer have traditionally been delivered to the debris dumps.

In recent years, various recovery methods have been applied to recover the phosphate values from the washer tailings, since large percentages of phosphate values in the matrix exist in particle size such as to prevent effective screening. An example of recovery methods is the familiar flotation method, with which recovery is effected by mixing reagents such as oil, fish acid and caustic with the tailing to form floccules of phosphate values, which may be floated by beating in air. Due to the relatively low value of the mineral values recovered, it is important in such recovery methods that reagent quantities be kept at a minimum. This necessitates high efficiency in mixing the reagents with the feed.

The present invention provides an efficient mixing apparatus which greatly reduces reagent costs and increases effective recovery.

A preferred embodiment of the mixing apparatus of the present invention is shown in the drawings in which similar characters of reference in the several figures indicate similar parts.

Figure 1 is a plan view of a mixing battery.

Figure 2 is a view, partly in section, of the mixer shown in Figure 1.

Figure 3 is a plan view showing a modified form of mixer in which adjustable baffles are employed to control material flow.

Figure 4 is a view, partly in section, of the mixing battery shown in Figure 3.

To secure thorough mixing, it is desirable to employ more than a single mixing chamber. Effective mixing may be secured by employing two mixing chambers. The feed coming through pipe 1 passes into vessel 2 and is stirred by agitator blades 3 mounted upon shaft 4 journalled in bushing 5 fixed by collar 6. Shaft 4 is provided with gear 7 driven by worm 8 mounted upon drive shaft 9. The vessel 10 is provided with agitator blades 11 mounted upon shaft 12, journalled in bushing 14 fixed by collar 15. Shaft 12 is provided with gear 13 driven by worm 16 mounted upon drive shaft 9. Similarly, power may be transmitted to other machinery in the line from shaft 9. Worms 8 and 16 on drive shaft 9 are held in contact with gears 7 and 13 on shafts 4 and 12 by bushings 17 and 18 attached to main bushings 5 and 14. Material entering vessel 2 is thoroughly mixed therein, is passed through opening 19 into vessel 10 and thence out pipe 20 whence it may be led to flotation cells or other apparatus.

It will be seen that the vessels are cylindrical and are provided at the bottom with rounded, concave corners. The rounded corners 21 present curved circumferential surfaces relative to the zone of operation of the agitator blades and thus cooperate with the agitator blades to prevent the setting up of eddy currents in the vessels and to assure thorough, rapid mixing. A reagent may be added to the feed at any desired point along line 1 although it is preferable to add the reagent by continuous dropping directly into vessel 2.

If desired, the flow of material from vessel 2 to vessel 10 and from vessel 10 through pipe 20 may be controlled by adjustable baffles 22 and 23, respectively, as shown in Figures 3 and 4. Sleeves 24 and 25 of baffles 22 and 23 ride upon collars 26 and 27. Handles 28 and 29 are placed in any desired groove 30 to fix the baffles in position.

Prior to the present invention, it has been customary in the mining industry to employ square mixers, which were thought to have a special virtue in effective mixing. I have found that a cylindrical, stationary mixer with a closed bottom and in a vertical position with a vertical shaft is superior to the conventional square mixer. I have also discovered that the cylindrical mixer may be operated on phosphate rock feed with a much smaller quantity of water in the feed than may be effectively employed with a square mixer of similar dimensions and agitated by motors of the same rating.

If the amount of moisture in feed with which the cylindrical mixer operates satisfactorily were employed in the conventional square mixer, the motor would be unable to pull the load and be stopped. As a direct result of the great reduction in the amount of moisture required in the cylindrical mixer, the cylindrical mixer of the present invention has resulted in greatly in-

creased recovery percentages in the treatment of phosphate rock feeds.

Attention is directed to the shape of the bottom of the mixing vessels whereby with rounded corners stagnant eddy currents are eliminated.

In the use of the mixing apparatus of the present invention, a substantially dewatered feed in the form of a slush is subjected to successive, continuous, circular agitation accompanied by the continuous addition of reagents, after which the treated feed is subjected to conventional recovery processes such as flotation, tabling, underwater screening, skin flotation, or the like.

I claim:

1. In a mixing device, a battery of cylindrical vessels mounted in the same horizontal plane and interconnected with one another through communication openings located near the top edges of the respective vessels, each of said vessels being provided with a vertical side wall, a flat bottom and a continuous rounded corner between the side wall and bottom, and an agitator comprising a plurality of radially extended, angularly inclined blades, rotatably, coaxially mounted within each of said vessels, the blades of each agitator being positioned closely adjacent the bottom and extended within the zone of the rounded corner of the respective vessel, the blades of the agitator of each vessel being adapted to swirl a slush mixture upwardly against the side wall of the respective vessel, the swirled material being passed to the next succeeding vessel through the respective communication opening.

2. In a mixing device, a battery of cylindrical vessels mounted in the same horizontal plane and interconnected with one another through communication openings located near the top edges of the respective vessels, each of said vessels being provided with a vertical side wall, a flat bottom and a continuous rounded corner between the side wall and bottom, an agitator comprising a plurality of radially extended, angularly inclined blades, rotatably, coaxially mounted within each of said vessels, the blades of each agitator being positioned closely adjacent the bottom and extended within the zone of the rounded corner of the respective vessel, the blades of the agitator of each vessel being adapted to swirl a slush mixture upwardly against the side wall of the respective vessel, and baffle means positioned relative to the communication opening of each of said vessels to force the swirled material through the opening and into the next succeeding vessel.

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