Jan. 9, 1951 H. L. BOSSERT 2,537,570

GRINDING DISK

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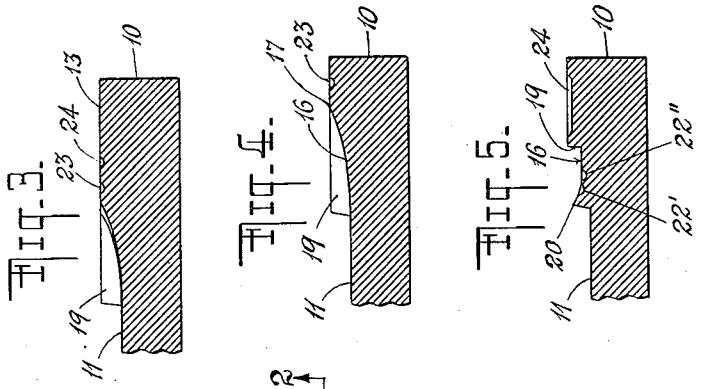

FIG. 3.

FIG. 4.

FIG. 5.

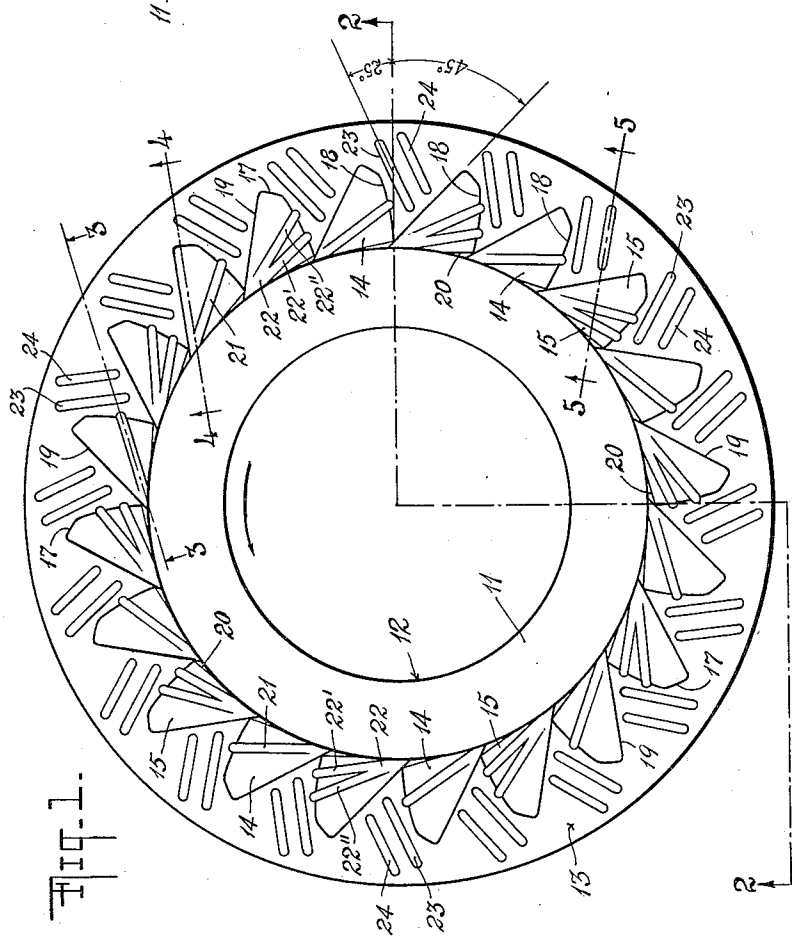

FIG. 1.

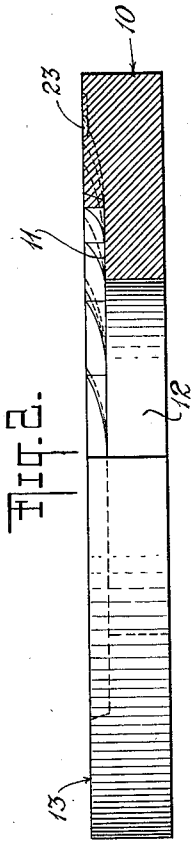

FIG. 2.

WITNESS

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GRINDING DISK

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8 Claims. (Cl. 241—296)

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This invention relates generally to colloidal mills of the type in which a mixture of the solid material and liquid is fed radially outward from near the center of a pair of annular grinding discs set face to face, passes between the opposed grinding surfaces of such discs where the solid material is ground to colloidal dimensions and is then discharged at the peripheries of such grinding discs.

The invention pertains more particularly to an improved construction of the grinding faces or surfaces on each disc, whereby the solid particles can be reduced from sizes of 100 to 200 mesh, to less than ½ micron in size without excessive wear of such surfaces. These objects are attained by constructing the grinding surfaces of the discs so that the flow of the solid particles across such surfaces is restricted and the larger particles become trapped or concentrated in closed chambers wherein they are materially reduced in size before proceeding toward the outer peripheries of such surfaces to be discharged.

A better understanding of the invention, as well as the features of novelty thereof, will be obtained from a perusal of the following description, when read in connection with the accompanying drawings, in which Fig. 1 is a face view of a grinding disc embodying the invention; Fig. 2 is an end view, parly in section, of the disc shown in Fig. 1; the view being taken along the line 2—2 of Fig. 1; Fig. 3 is a sectional detail view taken along the line 3—3 of Fig. 1; Fig. 4 is a sectional detail view taken along the line 4—4 of Fig. 1 and Fig. 5 is a sectional detail view taken along the line 5—5 of Fig. 1.

In the drawings, the reference numeral 10, designates generally, the body portion of the grinding disc which may be either a stator or rotor and is paired with another disc of the rotor or stator type, respectively, having a similar grinding surface construction. The body portion 10 of the grinding disc, by which the disc is mounted on a suitable support, is provided with a relatively large central opening 12 for accommodating the shaft of the mill and for receiving the supply of the mixture of solid and fluid. The manner in which the grinding disc may be mounted in a mill and supplied with the mixture to be ground, is disclosed in Letters Patent No. 2,437,147 issued March 2, 1948, to Ellsworth B. A. Zwoyer. The smooth, annularly-shaped grinding surface 13 of the disc extends from the outer periphery of the body portion 10 to a point short of the inner periphery of such body portion, such grinding surface having a width approximately two-thirds the width of the body portion 10. The grinding surface 13 is raised from the inner peripheral part 11 of the body portion, as is shown more clearly in Fig. 2 of the drawings.

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The grinding surface 13 is provided with a plurality of recesses 14 and 15, which are located adjacent to one another in alternate relation and which have open ends on the inner periphery of such surface. The recesses 14 and 15 are similar to each other in the respects that each are provided with a bottom wall 16 which, at the open end of the recess, is substantially flush with the top surface of the body part 11 and then extends outwardly and upwardly in a curved fashion to the grinding surface 13 as is shown more clearly in Fig. 4 of the drawings. The bottom wall 16 meets the grinding surface 13 along a line having a portion 17 disposed at approximately 55° to a radius of the disc, and a portion 18 disposed generally at about 10° to a radius of the disc; portion 18 having a slightly curved contour and meeting portion 17 in a curve so that portions 17 and 18, as a whole, have a substantially concave shape. The length of the bottom wall 16 is approximately two-thirds the width of the grinding surface 13, so that it terminates in the outer portion of the latter. The recesses 14 and 15 are each provided on the counter-clockwise side of the bottom wall 16, as viewed in Fig. 1 of the drawings, with a straight side wall 19 which extends at an angle of 45° to a radius of the disc (note Fig. 1) from the inner periphery of surface 13 to the outer end of bottom wall 16 (compare Figs. 1 and 4). From side wall 19, bottom wall 16 in a transverse direction, extends substantially horizontally towards the inner periphery of surface 13 and then curves upwardly and inwardly to the grinding surface 13 (note Fig. 5), and meets such surface along a line 20 extending at an angle of approximately 90° to a radius of the disc. In other words, the recesses 14 and 15 have a V-shaped or fan-like configuration in plan view, with one leg 19 at an angle of 45° to a radius of the disc, and another leg 20 substantially tangent to the inner peripheral edge of the grinding surface 13, the entrance openings to such recesses being provided on leg 20 adjacent to the apex formed by legs 19 and 20 and the discharge openings being on a concave line joining the ends of such legs and disposed transversely of the grinding surface 13. From this construction, it will be seen that as the disc rotates in the direction of the arrow, the

mixture to be ground, which is composed of solid and fluid and preferably fed under pressure, enters into the recesses 14 and 15 through the mouths thereof formed by side walls 19 and the lines of juncture 20 between the grinding surface 13 and the bottom walls 16 thereof. The material to be ground entering the recesses 14 and 15, is caused by the walls 19 thereof, to flow in a direction at approximately 45° to the radius of the disc and toward the juncture line portions 17 and 18 thereof between the grinding surface 13 and the bottom walls 16 thereof. In order to better control the flow of the material toward the lines of juncture 17 and 18, and to create a turbulence in the material during its flow through the recesses, the bottom walls 16 of the recesses 14 are provided with channels 21 whose inner ends open in the region of the inner ends of side walls 19 of such recesses and whose outer ends project beyond the central portions of the lines of juncture 18 and meet the grinding surface 13. In a similar fashion, recesses 15 are provided with channels 22 which divide to form two branches 22', 22'' as they extend toward the lines of juncture 18 of such recesses.

Located between the recesses 14 and 15 are elongated recesses or pockets 23 and 24 arranged in parallel relation. Pockets 23 and 24 are disposed at an angle of approximately 25° to the radii of the disc and extend across the discharge ends of recesses 14 and 15. Pockets 23 extend approximately from the discharge ends of the channels 21 and 22 of such recesses to an extension of the outer ends of the side walls 19 of such recesses. Pockets 24 are slightly less in length than pockets 23 but also lie across the discharge ends of the channels 21 and 22 of the recesses and the portions of the discharge ends of the recesses between such channels and the side walls 19 thereof.

It will be understood from the foregoing description, that when two grinding discs having the dressing described, are arranged in grinding relation in a mill, the pockets 23 and 24 of each disc will be in effect, sealed by the grinding surface 13 of the other plate except for the slight spacings between the two grinding surfaces. In its passage between the discs, the solid particles of the material in the recesses 14, 15 and pockets 23 and 24 of each disc will be ground by the solid particles in the recesses and pockets of the other disc and will be sheared by the knife-like edges of such recesses and pockets. As the solid particles are discharged from the recesses 14 and 15, the larger particles will become trapped in the pockets 23 and 24. Due to the centrifugal force created by the rotor of the two discs, there will be a tendency to provide an excess of material to pockets 23 and 24. As the larger and therefore heavier particles tend to be forced to the bottoms of pockets 23, 24, each pocket in time, becomes a reservoir of large particles, some of which remain at the top of the pocket because of the feed of material. As the whirling knife-like edges of the slots come into engagement with such particles, the latter are sheared into finer fragments. As the particles on the surfaces of the pockets are thus reduced, they are skimmed off by the combined action of the whirling edges of the pockets and centrifugal force and ground to their final colloidal dimensions between the grinding surfaces 13. The material as it is discharged from the peripheries of the grinding discs will contain solid particles less than one-half micron in size. It has been found that grinding discs provided with the above described dressing, will not only provide a more thorough breaking down of the solid particles, but will also provide a better homogenized product which is of major importance in products like liquid fuels. These dressings have also been found to increase the life of the grinding discs substantially. For example, seven hundred tons of a coal-oil mixture have been passed through a mill provided with the grinding discs of this invention without damage, a performance that could not be accomplished with prior known discs of similar construction, but with different types of dressings.

I claim:

1. A grinding disc having a smooth annular-shaped grinding surface, said grinding surface being provided with a plurality of separate recesses extending outwardly from its inner peripheral edge, the recesses having entrance openings along said inner peripheral edge and diminishing in depth outwardly of such edge, the outer discharge ends of said recesses being substantially wider than the entrance openings thereof and disposed transversely of said grinding surface, and closed elongated pockets in said grinding surface arranged across the discharge ends of said recesses and adapted to catch the larger particles of solid material discharged by said recesses, said pockets being disposed transversely of said grinding surface and located between the discharge ends of said recesses and one of the sides thereof.

2. A grinding disc having a smooth annular-shaped grinding surface, said grinding surface being provided with a plurality of recesses extending outwardly from its inner peripheral edge, the recesses having entrance openings along said inner peripheral edge, diminishing in depth outwardly of said edge and increasing in width outwardly of said edge, the outer discharge ends of said recesses being disposed transversely of said grinding surface and closed elongated pockets in said grinding surface arranged in spaced, substantially parallel relation across the discharge ends of each of said recesses and adapted to catch the larger particles of solid material discharged by said recesses, said pockets being disposed transversely of said grinding surface and located between the discharge ends of said recesses and one of the sides thereof.

3. A grinding disc having a smooth annular-shaped grinding surface, said grinding surface being provided with a plurality of recesses extending from its inner peripheral edge, the recesses being substantially V-shaped with one side of each recess disposed at an angle of approximately 45° to a radius of the disc and one side disposed substantially tangential to the inner peripheral edge of said grinding surface, said recesses being provided with an entrance opening along said tangential side adjacent to the apex formed by said sides and being provided with a discharge end along a line connecting the outer ends of said sides and disposed transversely of said grinding surface, the discharge ends of said recesses having a greater width than the entrance ends thereof, and a pair of parallelly spaced, closed, elongated pockets in said grinding surface disposed across the discharge end of each of said recesses.

4. A grinding disc having a smooth, annular-shaped grinding surface, said grinding surface being provided with a plurality of recesses extending from its inner peripheral edge, the recesses being substantially V-shaped, with one

side of each recess disposed at an angle of approximately 45° to a radius of the disc and one side disposed substantially tangential to the inner peripheral edge of said grinding surface, said recesses being provided with an entrance opening along said tangential side adjacent to the apex formed by said sides and being provided with a discharge end along a line connecting the outer ends of said sides and disposed transversely of said grinding surface, each of said recesses having an elongated channel provided in the bottom wall thereof and extending from the region of the apex formed by said sides to the central portion of the discharge end thereof, and a pair of parallelly spaced, closed, elongated pockets in said grinding surface disposed across the discharge end of each of said recesses.

5. A grinding disc having a smooth, annular-shaped grinding surface, said grinding surface being provided with a series of recesses extending from its inner peripheral edge, the recesses being substantially V-shaped with one side of each recess disposed at an angle of approximately 45° to a radius of the disc and one side disposed substantially tangential to the inner peripheral edge of said grinding surface, said recesses being provided with an entrance opening along said tangential side adjacent to the apex formed by said sides and being provided with a discharge end along a line connecting the outer ends of said sides and disposed transversely of said grinding surface, alternate recesses in such series being provided in the bottom walls thereof with an elongated channel extending from the region of the apex formed by said sides to the central portion of the discharge end thereof, and alternate recesses in such series being provided in the bottom walls thereof with an elongated channel which starts in the region of the apex formed by said sides and then branches into two legs which extend toward the discharge ends thereof, and a pair of parallelly spaced, closed, elongated pockets in said grinding surface disposed across the discharge end of each of said recesses.

6. A grinding disc having a smooth, annular-shaped grinding surface, said grinding surface being provided with a plurality of recesses extending from its inner peripheral edge, the recesses being substantially V-shaped with one side of each recess disposed at an angle of approximately 45° to a radius of the disc and one side disposed substantially tangential to the inner peripheral edge of said grinding surface, said recesses being provided with an entrance opening along said tangential side adjacent to the apex formed by said sides and being provided with a discharge end along a line connecting the outer ends of said sides and disposed transversely of said grinding surface, the 45° side of each of said recesses and the bottom wall thereof forming a wall which diminishes in height toward the outer end of said side, and said recess for a portion of its width adjacent to said wall extending substantially parallel to said grinding surface and then diminishing in depth towards the tangential side of such recess and a pair of parallelly spaced, closed, elongated pockets in said grinding surface disposed across the discharge end of each of said recesses.

7. A grinding disc having a smooth, annular-shaped grinding surface, said grinding surface being provided with a plurality of recesses extending from its inner peripheral edge, the recesses each having an entrance opening along said inner peripheral edge and increasing in width from such opening to provide a discharge end substantially wider than the entrance opening thereof, each of said recesses having an elongated channel provided in its bottom wall intermediate the side edges thereof and extending from the region of said entrance opening to the discharge end of said recess, and a plurality of parallelly spaced, closed, elongated pockets in said grinding surface disposed across the discharge end of each of said recesses.

8. A grinding disc having a smooth, annular-shaped grinding surface, said grinding surface being provided with a plurality of recesses extending from its inner peripheral edge, the side edges of each recess being substantially straight and disposed at an angle to radii of the disc, the outer ends of such side edges defining the limits of the discharge end of such recess and such discharge end being disposed as a whole transversely of said grinding surface, a closed, elongated pocket in said grinding surface extending substantially entirely across the path of material emitted from the discharge end of each recess, and a second closed, elongated pocket in said grinding surface spaced outwardly from said first mentioned pocket and disposed in substantially parallel relation to the latter, said parallelly arranged pockets being disposed transversely of said grinding surface.

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