United States Patent

[11] **3,550,915**

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[54] **AGITATING APPARATUS**
9 Claims, 7 Drawing Figs.

[52] **U.S. Cl.** **259/110**
[51] **Int. Cl.** **B01f 7/02**
[50] **Field of Search** ..... 259/8, 9, 43, 108, 109, 110, 134, 136, 137 (Paint Stirrers Emulsifiers), 96

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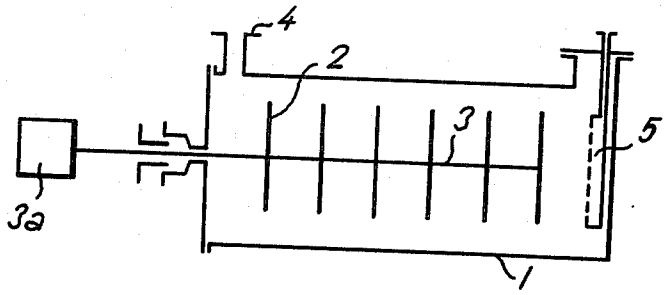
ABSTRACT: An agitating apparatus comprises a vessel having a closed inner cylindrical chamber having a longitudinal axis which includes with the horizontal an angle of at most 45°. An elongated rotary shaft extends through the chamber coaxially therewith. A plurality of agitating discs are mounted coaxially on the shaft longitudinally spaced therealong. Each disc has a diameter ranging between 50 and 95 percent of the chamber diameter. At least one radial face of each disc is provided with a plurality of arcuately curved profiled sections extending substantially tangentially of the shaft.



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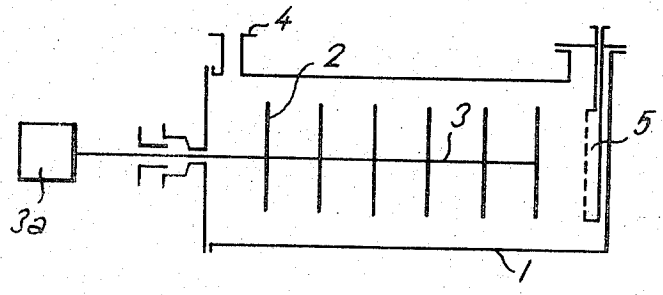

Fig. 1.

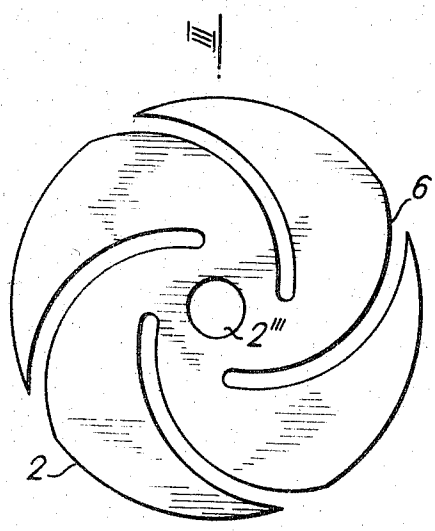

Fig. 2.

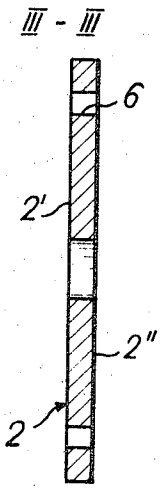

Fig. 3.

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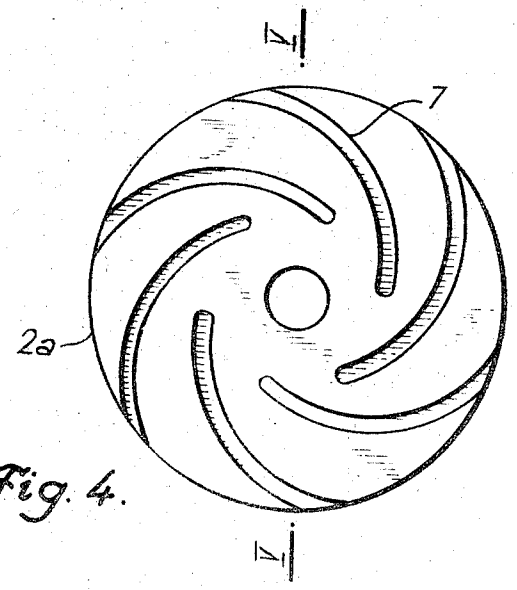

Fig. 4.

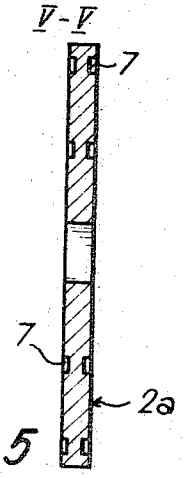

Fig. 5

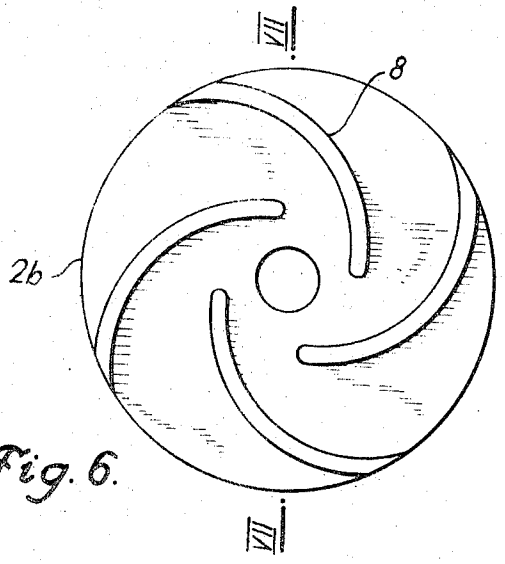

Fig. 6.

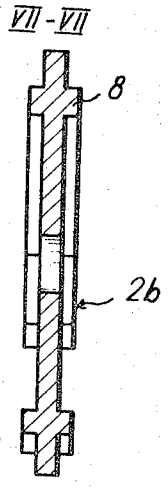

Fig. 7.

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AGITATING APPARATUS

BACKGROUND OF THE INVENTION

The present invention relates to agitating apparatus in general, and more particularly to apparatus for agitating mixtures of dispersing corpuscles and suspensions of solid particles which are to be dispersed.

It is known to disperse solid particles up to colloidal fineness in suspensions by intensely agitating such suspension together with dispersing corpuscles which have been admixed therewith. This agitation is effected by means of a high-speed agitator arrangement consisting of one or more discs mounted for rotation on a rotatable shaft, the diameter of the discs ranging between 50 and 95 percent of the inner diameter of the vessel in which the agitation is to be accomplished. The discs rotate at a circumferential speed of at least 8 m./sec. The dispersing corpuscles are usually less than 3 mm. in diameter, preferably on the order of 0.25—1 mm., and they fill the vessel to between 40 and 60 percent of its total capacity. In other words, the total available volume of space in the vessel, which receives the mixture of suspension and dispersing corpuscles, is filled to between 40 and 60 percent with such corpuscles. On rotation of the agitator arrangement, the dispersing corpuscles are propelled, together with the suspension, along a streamline path through the vessel.

Apparatus of this type is disclosed in Czechoslovakian, British, Austrian, French, Italian and Swiss patents. In all of these patents the axis of the cylindrical vessel, and that of the coaxial shaft lie in a horizontal plane or in a plane which defines with the horizontal plane an angle not exceeding 45°.

In these prior-art constructions, the discs employed in the agitator arrangement have smooth radial faces. It has been found that the intensity of agitation of the dispersing corpuscles in the suspension, which can be attained with these prior-art constructions, depends substantially on the circumferential speed of the discs. However, the maximum circumferential speed which is useful in these apparatuses depends on the viscosity of the suspension and when the circumferential speed exceeds a certain maximum limit, the discs will "skid" with reference to the mixture in which they rotate. This, however, results in a reduction of the dispersion speed. For this reason the prior-art apparatuses disclosed in the above-mentioned patents are capable of obtaining only a limited dispersion speed.

Accordingly, it is an object of the present invention to overcome the disadvantages which have been encountered in the prior art.

A more specific object of the invention is to provide an agitating apparatus of the type here under discussion which is capable of obtaining a significantly increased dispersion speed.

SUMMARY OF THE INVENTION

In accordance with one feature of our invention, we provide an apparatus of the type here under discussion having a vessel provided with a closed cylindrical chamber of predetermined diameter. This vessel has a longitudinal axis which includes with the horizontal an angle of at most 45°. An elongated rotary shaft extends through the chamber coaxially therewith. A plurality of agitating discs are mounted coaxially on the shaft and are longitudinally spaced therealong. Each of these discs has a disc diameter ranging between substantially 50 percent and 95 percent of the predetermined diameter of the cylindrical chamber, and each disc has opposite axial faces.

To this point the apparatus according to the present invention embodies features which are known in this field. However, unlike what is known in this field, at least one radial face of each of the agitating discs of our novel apparatus is provided with a plurality of arcuately curved profile sections which extend substantially tangentially of the rotary shaft.

We have found that the dispersion speed and the overall effect of the dispersion apparatus can be considerably increased by the provision of these profile sections. Specifically, each of the arcuately curved profile sections is shaped so as to resemble a portion of arc whose radius ranges between 50 and 100 percent of the radius of the respective disc. The profiled sections curve inwardly from the outer circumferential edge of the respective disc and the center region, where each disc is connected to the rotary shaft, remains free from the profiled sections.

The optimum radius of curvature of these profiled sections depends upon the viscosity and the density of the suspension. We have established that if the maximum agitation result is to be obtained, the incidence angle of the profiled sections must be between 40 and 50 percent greater than the incidence angle of the streamline which is formed when the suspension is agitated by smooth discs, that is by discs of the type found in the prior art. Under these conditions the corresponding radius of the profiled sections according to the present invention will equal between 50 and 100 percent of the disc radius. The width of each profile section is advantageously between 5 and 15 percent of the disc diameter. The number of profiles of profile sections on each radial face will advantageously be between 2 and 10 such sections. It will be appreciated that the profile sections can be provided on one radial face or on both radial faces. In accordance with the invention these profile sections may be provided in form of shallow grooves provided in one, the other, or both radial faces. In stead of grooves they may also be constituted by arcuately curved ridges projecting from the respective radial face or faces. A further way of providing these profile sections is to provide them in form of cutouts which extend from one to the other of the radial faces.

The novel features which are considered as characteristic for the invention are set forth in particular in the appended claims. The invention itself, however, both as to its construction and its method of operation, together with additional objects and advantages thereof, will be best understood from the following description of specific embodiments when read in connection with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 is a diagrammatic illustration of an apparatus embodying our invention;

FIG. 2 is a top-plan view of an agitator disc for use in the in the apparatus shown in FIG. 1 and in one embodiment of the invention;

FIG. 3 is a section taken on the line III–III of FIG. 2;

FIG. 4 is a view similar to FIG. 2 but illustrating a further embodiment of the invention;

FIG. 5 is a section taken on the line V–V of FIG. 4;

FIG. 6 is a view similar to FIGS. 2 and 4 but illustrating yet an additional embodiment of the invention; and

FIG. 7 is a section taken on the line VII–VII of FIG. 6.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Discussing now the drawing in more detail, and firstly FIG. 1 thereof, it will be seen that we have shown therein in diagrammatic form the basic apparatus according to the present invention for the purpose of dispersing suspensions of solid particles to which dispersing corpuscles have been admixed. A cylindrical vessel is identified with reference numeral 1 and has a longitudinal axis which here is shown horizontal but which may be inclined with respect to the horizontal at an angle not exceeding 45°. A shaft 3 is coaxial with the vessel 1 and is adapted to be rotated by any well known drive means 3*a* which is not further identified because it does not form part of the present invention.

A plurality of agitating discs 2 is mounted on the shaft 3 coaxially therewith and spaced in longitudinal direction of the shaft 3. The suspension is continuously supplied through the inlet 4 and, after having passed through the interior of the vessel 1, it is discharged over a screen 5 or any other type of filtering means. The dispersing corpuscles, which may also be introduced at the inlet 4, are retained by the screen or filter and are then removed by thorough rinsing and finally intermixed with the contents of the vessel.

In accordance with our invention FIGS. 2 and 3 show one embodiment of the agitating discs 2. In this embodiment the agitating discs, of which only one is shown because they may all be identical, is identified with reference numeral 2 and its overall configuration is clearly evident from FIG. 2 and need therefore not be described. The agitating disc 2 is provided with a plurality of throughgoing cutouts 6, that is cutouts which extend from one radial face 2′ to the opposite radial face 2″ of the disc 2. FIG. 2 shows most clearly that the cutouts are arcuately curved and extend substantially tangentially of the shaft 3 which will extend through the center aperture 2‴ of the disc 2.

In accordance with the invention these cutouts 6, of which a plurality is provided, preferably between 2 and 10, have a width which is substantially between 5 and 15 percent of the diameter of the disc and a radius of curvature equal to between 50 and 100 percent of the radius of the disc 2.

In the embodiment of FIGS. 4 and 5 another such disc is shown, here identified with reference numeral 2*a*. It differs from the disc shown in FIGS. 2 and 3 in that more of the curved profile sections are provided than in FIGS. 2 and 3. The sections are identified with reference numeral 7 in FIGS. 4 and 5 and it will be seen that, unlike the cutouts 6 in FIGS. 2 and 3, the curved profile sections 7 in FIGS. 4 and 5 are provided in form of shallow grooves on both radial faces of the disc 2*a*.

Finally, FIGS. 6 and 7 show a further disc, identified with reference numeral 2*b*, on which the curved profile sections are identified with reference numeral 8 and are provided in form of curved projecting ridges as the section in FIG. 7 shows most clearly.

It will be appreciated, of course, that only one radial face of each disc need be provided with the grooves 7 or the projecting ridges 8, and that it is also conceivable to provide one radial face with the grooves and the other with the projections if so desired.

It is clear from FIGS. 2, 4 and 6 that the respective curved profile sections extend inwardly from the outer peripheral edge of the respective discs, but terminate short of the center of the respective discs so that the central portion surrounding the shaft 3 (compare FIG. 1) will be smooth.

The discs, which may be made of steel, wear-resistant rubber, ceramics or any other suitable material, will be rotated at a circumferential speed not substantially less than 8 m./sec. by the drive means 3*a* which must of course be capable of effecting such rotation of the shaft 3 and thereby the discs mounted thereon.

By resorting to the apparatus according to our present invention, we obtain a significantly increased dispersion speed and efficiency in the overall effect of the dispersing apparatus. It will be clear, of course, that the cutouts 6, the grooves 7 and the ridges 8 may be provided in various suitable ways, for instance by milling an originally smooth disc, by stamping, by pressing or in any suitable manner.

It will be understood that each of the elements described above, or two or more together, may also find a useful application in other types of constructions differing from the types described above.

While the invention has been illustrated and described as embodied in an agitating apparatus, it is not intended to be limited to the details shown, since various modifications and structural changes may be made without departing in any way from the spirit of the present invention.

Without further analysis, the foregoing will so fully reveal the gist of the present invention that others can by applying current knowledge readily adapt it for various applications without omitting features that, from the standpoint of prior art, fairly constitute essential characteristics of the generic or specific aspects of this invention and, therefore, such adaptations should and are intended to be comprehended within the meaning and range of equivalence of the following claims.

What is claimed as new and desired to be protected by Letters Patent is set forth in the appended claim.

We claim:

1. Apparatus of the character described, particularly for dispersing solid particles in suspension by admixing and agitating the suspension with dispersing corpuscles, comprising in combination, a vessel having a closed inner cylindrical chamber of predetermined diameter, said vessel having a longitudinal axis which includes with the horizontal an angle of at most 45°; an elongated rotary shaft extending through said chamber coaxially therewith; a plurality of agitating discs mounted coaxially on said shaft longitudinally spaced therealong and each having a disc diameter ranging between substantially 50 percent and 95 percent of said predetermined diameter, each of said agitating discs having opposite radial faces at least one of which is provided with a plurality of arcuately curved profiled sections extending substantially tangentially of said rotary shaft; and drive means associated with said shaft and operative for rotating the same and for thereby rotating said discs at a circumferential speed not substantially less than 8 m./sec.

2. Apparatus as defined in claim 1, wherein said profiled sections each have a width ranging between substantially 5 percent and substantially 15 percent of said disc diameter.

3. Apparatus as defined in claim 2, wherein said profiled sections each have a radius of curvature ranging between substantially 50 percent and substantially 100 percent of the radius of the respective disc.

4. Apparatus as defined in claim 3, wherein said one radial face is provided with a plurality of shallow grooves constituting said profiled sections.

5. Apparatus as defined in claim 3, wherein said one radial face is provided with a plurality of projecting ridges constituting said profiled sections.

6. Apparatus as defined in claim 3; and further comprising an additional plurality of similar profiled sections provided at the other of said radial faces.

7. Apparatus as defined in claim 3, wherein said discs are provided with a plurality of arcuately curved cutouts extending from one to the other of said radial sides and constituting profiled sections at both of said radial faces.

8. Apparatus as defined in claim 1, wherein said plurality comprises at least two of said profiled sections.

9. Apparatus as defined in claim 1, wherein said plurality comprises between two and ten of said profiled sections.