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 APPARATUS FOR CONTINUOUSLY DISPERSING
 SUSPENSIONS OF SOLID ARTICLES
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Fig. 1

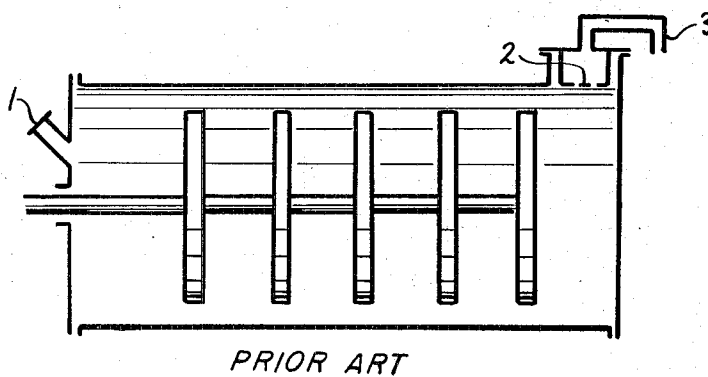


Fig. 2

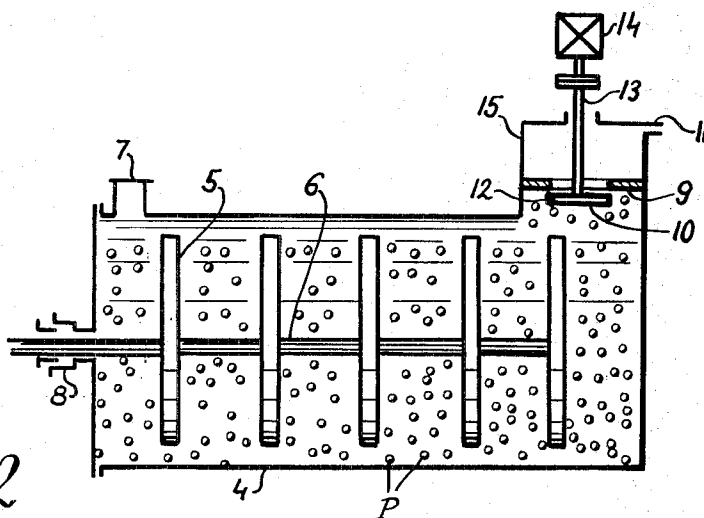
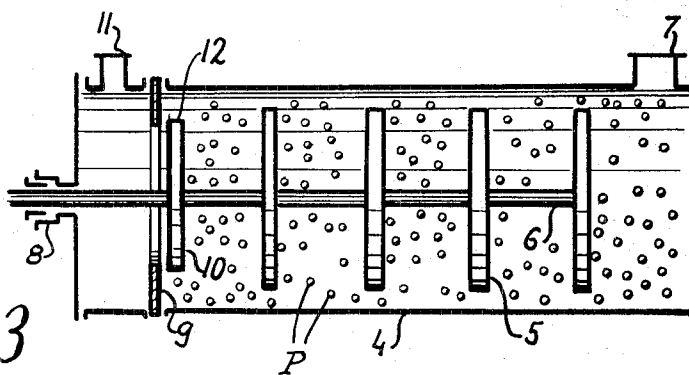


Fig. 3



INVENTORS:
 Jan Kaspar
 Vladislav Bieik
 BY Michael S. Shiker,
 Attorney

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APPARATUS FOR CONTINUOUSLY DISPERSING SUSPENSIONS OF SOLID ARTICLES

Jan Kašpar, 1332 U Kostelicka, and Vladislav Bičík, 150
Stavbaru, both of Pardubice, Czechoslovakia

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9 Claims

ABSTRACT OF THE DISCLOSURE

An apparatus for continuously dispersing suspensions of solid particles in which a suspension to be dispersed passes together with dispersing corpuscles or grinding particles through a substantially horizontally disposed vessel provided with a system of agitating means comprising a shaft and a set of agitating discs supported thereon. Moreover, on the said shaft there is secured a circular plate cooperating with an annular plate fixed to the inner wall of said vessel. The aforementioned system of plates may, according to another embodiment of the invention, be located in a particular extension forming a portion of said vessel and communicating therewith, the rotary circular plate being keyed on a separate shaft having its own drive and being received in said extension. The rotary circular plate has a diameter which is smaller or at the most the same as the diameter of said agitating discs, and is positioned relative to the stationary annular disc at the side of the mixture of the suspension and the dispersing corpuscles.

BACKGROUND OF THE INVENTION

The present invention relates to a dispersing apparatus in general, and to an apparatus for continuously dispersing solid particles up to colloidal fineness, in particular, wherein the dispersing corpuscles are separated from the suspension by means of a special separating device hereinafter referred to as dynamic separator.

Well-known apparatuses for continuously dispersing solid particles comprise a sealed vessel in which there is axially arranged a rotary shaft having a set of spaced agitating discs secured thereto and rotating at a relatively high circumferential speed. The interior of the vessel is partially filled up with auxiliary grinding particles, the grain size of which being three millimeters at the most. The axis of the vessel as well as of the shaft lies as a rule in a horizontal plane or in a plane declined therefrom at any angle up to 45 degrees. In the past it has been found out that the position of the vessel axis as hereinbefore referred to possesses an advantage over arrangements having their axes oriented vertically, consisting in a higher grinding efficiency resulting from different physical conditions. These enable to distribute the grinding particles homogeneously in the entire charge suspended in the vessel so that their action in the entire suspension volume may be utilized in full rate. The main drawback of the arrangements used heretofore consists in that the suspensions have to pass, when being discharged, through screen or other filtering inserts or paddings which at high flow rates, particularly with suspensions having relatively high viscosity values, are liable to be clogged.

SUMMARY OF THE INVENTION

It is therefore a general purpose of the invention to overcome the disadvantage outlined above with respect to the prior art.

In accordance with one feature of the invention we provide the above mentioned device with auxiliary separating means hereinafter referred to as dynamic separa-

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tor designed for separating the grinding particles from the suspension to be processed, which separator being disposed adjacent the outlet portion of the dispersing vessel.

By means of the said dynamic separator it is possible to prepare suspensions containing particles of colloidal fineness. According to the invention the dispersing effect is attained by combining impact and friction action of the auxiliary grinding particles which are together with the suspension subject to a thorough permanent agitation and which simultaneously are moved on stream-lined paths through the suspension volume. The starting stock to be processed is constituted by mixtures of solid particles having grain sizes ranging between 0.01 and one millimeter, and a liquid component.

Moreover this additional device for separating the grinding particles from the suspension makes possible to cast the same back into the operating space of vessel, the grinding particles being caught by said device and then remixed with the suspension.

The apparatus according to the invention equipped with the aforementioned dynamic separator for separating the grinding particles can be used for processing even highly viscous suspensions regardless of their rheological characteristics, and without any problems being encountered with the discharge of the suspension and with separation of the grinding particles from the suspension. It is particularly suitable for the preparation of fine suspensions of dyestuffs, chemical compounds, and the like.

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 INVENTION

FIG. 1 shows an axial section of a known arrangement of a continuously operating dispersing apparatus, comprising a screen as detention means for grinding particles through which screen the suspension is discharged;

FIG. 2 shows an axial section of a preferred embodiment of the apparatus according to the invention, the additional separating device or dynamic separator being disposed in an extension room;

FIG. 3 shows an axial section of an alternate embodiment of the apparatus according to the invention, the dynamic separator being located in the dispersing vessel itself.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Discussing now the drawings in detail, and firstly FIG. 1 thereof, it will be seen that a conventionally used apparatus for dispersing suspension of solid particles comprises a cylindrical sealed vessel provided with covers, a neck 1 for supplying the suspension, a shaft coaxially arranged therein and carrying a plurality of spaced agitating discs to rotate in the vessel, and with an outlet portion, wherein the suspension is discharged through a screen or filter 2 into a delivery tube 3.

In FIG. 2 there is shown a preferred embodiment of the apparatus according to the invention, wherein the reference numeral 4 designates the cylindrical vessel containing the grinding particles P, 6 the coaxial shaft in the vessel, and 5 a set of spaced agitating discs designed for agitating the suspension charge in the vessel as well as the grinding particles located therein. The entering shaft portion is sealed by means of a gasket 8. 7 designates the supply neck or inlet means for the suspension. As herein-

before set forth, the axis of the vessel is preferably disposed in a horizontal plane or in a plane declined therefrom at any angle up to 45 degrees. The vessel is partially filled up with the suspension to be processed and with a charge of auxiliary grinding particles taking 40 to 60 percent of the entire vessel capacity, the grain size of the grinding particles being three millimeters at the most, preferably 0.25 to one millimeter. The agitating discs 5 have a diameter amounting 50 to 95 percent of the inner vessel diameter. The shaft 6 together with the agitating discs 5 secured thereon is adapted to rotate at a relatively high circumferential speed of 8 m./sec. The separation of the grinding particles from the suspension is carried out by means of an additional separating device or dynamic separator constituting a feature of the present invention. The dynamic separator is located in a special extension 15 provided adjacent the outlet portion of the dispersing vessel 4 and communicates with the interior thereof; it comprises two plates, a rotary circular plate 10 in form of a flattened cylindrical body adapted to rotate together with a separate shaft 13 arranged coaxially in said extension 15 and provided with its own driving means 14, and a stationary annular plate 9 secured at its external circumferential portion to the inner wall of said extension 15. The diameter of the rotary circular plate 10 is preferably larger than that of the central opening provided in the stationary annular plate 9, and the same or smaller than the diameter of said agitating discs 5. Between the two plates 10 and 9 there is provided an axial gap of which the thickness corresponds to 50-70 percent of grain size of the smallest grinding particles used. The cylindrical surface of the rotary circular plate 10 is designated in FIG. 2 by numeral 12. One of the novel features of the present invention consists in that the rotary circular plate 10 is positioned, relative to the stationary annular plate 9, at the side of the mixture of the grinding particles and the suspension of solid particles. The reference numeral 11 designates the delivery tube or outlet means.

In the aforementioned embodiment it is possible to move the rotary circular plate 10 at a substantially lower circumferential speed than necessary for the rotation of the agitating discs 5. An advantage of such a practice resides in the fact that the reduction of the rotation speed of the circular plate 10 prevents the suspension from being heated in the gap between the two plates 10 and 9, and thus the operating surfaces from being worn out. Moreover this embodiment enables a more precise manufacture of the apparatus according to the present invention as well as to check more easily the entire operation, more particularly by adjusting the relative positions of both rotary circular plate 10 and the stationary annular plate 9.

Another embodiment of the apparatus according to the invention is shown in FIG. 3. In this case the dynamic separator is provided in the very interior of the dispersing vessel 4 and comprises similarly the rotary circular plate 10 having a cylindrical surface 12, and the stationary annular plate 9. The rotary plate 10 is secured directly on the shaft 6 of the agitator while the stationary plate 9 is supported on the inner wall of the vessel 4.

The apparatus according to the invention operates as follows:

A suspension of milled material is supplied through the supply neck into the interior of the dispersing vessel where it is intensively agitated together with the auxiliary grinding particles. A desirable dispersing effect is attained by a combined impact and friction action of the grinding particles which are moved in the vessel content along streamlined paths. In operation the whole vessel capacity is uniformly filled up with the grinding particles and the suspension. The milled material is led successively from the supply neck towards the outlet portion of the vessel where a separation of the suspension from the auxiliary grinding particles by means of an additional separating device or dynamic separator takes place.

At the beginning of the dispersing process the mixture

of the suspension and the auxiliary particles reaches the space adjacent the cylindrical surfaces of the rotary circular plate of the dynamic separator. Due to the rotation thereof the grinding particles are partially separated from the suspension on said cylindrical surface so that the gap between the rotary and the stationary plate is fed with the suspension already partially freed from the grinding particles. Thus the total separating efficiency of the dynamic separator is greater than if depending solely upon the action of the gap between the plates. Due to the permanent agitation the grinding particles detained by the separator are continuously returned back into the operating space of the vessel. Said partial separation of the grinding particles from the suspension already on the cylindrical surface of the rotary circular plate influences desirably the rate of remixing these particles back into the suspension. The suspension after having passed the dynamic separator is kept by agitating in permanent movement and in fluid state. Due to the continuous rotation of the circular plate the suspension is kept in permanent movement in the gap zone, which movement contributes to a considerable extent lest even highly viscous suspensions, with their rheological characteristics in view, might lose the fluidity. In this way the passage of the processed suspension through the gap is facilitated, and the tendency of the rather narrow passage between the plates of getting choked may be suppressed unlike with screens or similar filtering means.

While the invention has been illustrated and described as embodied in an apparatus for continuously dispersing suspensions of solid particles, 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 aspect 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.

We claim:

1. Apparatus for continuously grinding solid particles to colloidal fineness and for dispersing said particles in a liquid, said apparatus comprising, in combination, a substantially closed cylindrical vessel having opposite ends and being provided in the region of said opposite ends with inlet and outlet means for respectively supplying to the interior of said vessel a suspension of said solid particles in a liquid and for discharging a suspension with particles of reduced size therefrom; grinding particles in the interior of said vessel; means for agitating said suspension and said grinding particles in the interior of said vessels; and means upstream of said outlet means for separating said grinding particles from said suspension and for preventing discharge of said grinding particles from the interior of said vessel, said separating means comprising a stationary annular plate fixed to said vessel upstream of said outlet means and a rotary plate axially displaced in a direction away from said outlet means with regard to said annular stationary plate, said rotary plate having an outer diameter greater than the inner diameter of said annular plate and said plates having respectively overlapping annular front and rear face portions parallel to each other and substantially normal to the axis of rotation of said rotary plate and defining between themselves an annular gap of thickness smaller than the size of the smallest grinding particle in said vessel.

2. An apparatus as defined in claim 1, wherein said vessel has a substantially horizontal axis, said agitating means rotating about said horizontal axis.

3. An apparatus as defined in claim 1, wherein said grinding particles fill 40-60% of the interior of said vessel.

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4. An apparatus as defined in claim 1, wherein said grinding particles have a grain size of less than 3 mm. and wherein said axial gap has a thickness of 50-70% of the smallest grinding particle.

5. An apparatus as defined in claim 1, wherein said agitating means comprise a drive shaft substantially coaxial with the axis of said cylindrical vessel and a plurality of circular disks axially spaced from each other and coaxially fixed to said drive shaft for rotation therewith, said disks having peripheral surfaces spaced from the inner surface of said vessel.

6. An apparatus as defined in claim 5, wherein the outer diameter of said disks is 50-95% of the inner diameter of said vessel.

7. An apparatus as defined in claim 5, wherein said rotary plate of said separating means is mounted on said drive shaft downstream of said disks of said agitating means and wherein said annular plate is fixed to the peripheral wall of said cylindrical vessel between said rotary plate and said outlet means.

8. An apparatus as defined in claim 1, wherein said vessel is provided at the end thereof distant from said inlet means with a hollow extension extending transverse to the axis of said vessel, said extension having an outer end, said outlet means communicating with the interior

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of said extension in the region of said outer end, said annular plate being fixed in the interior of said extension inwardly spaced from said outer end and said rotary plate being axially spaced from said annular plate in a direction away from said outer end of said extension.

9. An apparatus as defined in claim 8, and including drive means coaxially fixed to said rotary plate and comprising a draft shaft extending beyond said outer end of said extension and a drive motor connected to a portion of said drive shaft outside said extension.

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ROBERT C. RIORDON, Primary Examiner

D. G. KELLY, Assistant Examiner