(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 1 118 386 A1

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
25.07.2001 Bulletin 2001/30

(51) Int Cl.[7]: **B02C 17/16**, B02C 19/18

(21) Application number: **00830031.1**

(22) Date of filing: **20.01.2000**

(84) Designated Contracting States:
AT BE CH CY DE DK ES FI FR GB GR IE IT LI LU MC NL PT SE
Designated Extension States:
AL LT LV MK RO SI

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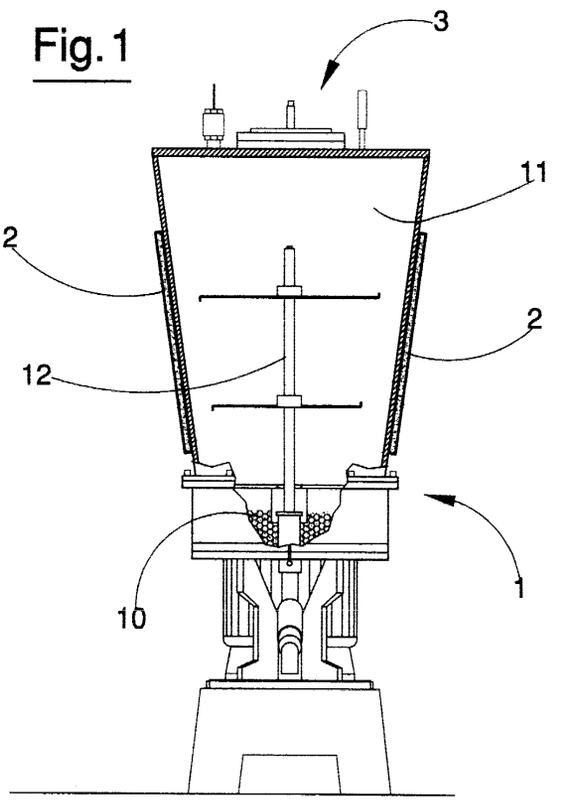
(54) Improved apparatus for finely milling and/or finely suspending substances in liquids

(57) The improved apparatus of the invention comprises a container (1) in which a dispersion and/or a milling is performed by mechanical organs, and also comprises at least one ultrasonic generator (2) which transmits ultrasonic energy to a mass contained in the container (1).

Fig. 1



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Description

[0001] Apparatus for suspending solids in liquids are taught in the prior art, in particular in the field of production of suspended organic and inorganic pigments. These apparatus are usually discontinuously operated and, very briefly, comprise a container for containing the substances and components, in which the dissolving is done, very often in vacuum conditions, by mechanical stirring groups as well as special indented rotors set in rotation.

[0002] Also known are other apparatus (mills) which wet-mill solid components mixed with liquids.

[0003] For numerous production applications such as, for example, production of pigment suspensions, it is of fundamental importance that stable suspensions be produced, with high solid suspension content.

[0004] The degree of suspension influences numerous properties, such as chromatic characteristics, rheological flow characteristics, behavioural characteristics and chemical affinity in mixtures with other products; not to forget stability over a period of time and degree of gloss or matt finish.

[0005] In relation to the above-mentioned characteristics, known realisations exhibit several limitations which appear to be constitutional or organic, in the sense that the results obtainable are not improvable, even by considerably increasing treatment times (for example, in the case of mills, greatly increasing milling time).

[0006] A similar limitation exists in relation to the mass of solid which can be dispersed sufficiently stably in a determined mass of liquid.

[0007] The main aim of the present invention is to obviate the limitations and drawbacks in the prior art in order to obtain high-concentrate suspensions of solids in liquids, characterised by great stability and an extremely homogeneous distribution, including from the point of view of granulometry, of the solid in the liquid carrier. Another main aim is to obtain a liquid/liquid dispersion which is perfectly homogenous, free of microfoam and stable over a period of time.

[0008] Advantages of the invention are that it does not require great use of surface-active agents, it achieves an excellent separation of solid powder aggregates and does not lead to a high wastage of mechanical energy transmitted via rotating organs (rotors) which, in known applications, create high chemical-physical stress in the suspension and resulting solution.

[0009] A further advantage of the invention is that the processes of grinding or milling are much quicker.

[0010] These aims and advantages and others besides are all attained by the invention as it is characterised in the appended claims.

[0011] Further characteristics and advantages of the present invention will better emerge from the detailed description that follows of some preferred but non-exclusive embodiments of the invention, illustrated purely by way of nonlimiting examples in the accompanying figures of the drawings, in which:

figure 1 shows a schematic section made according to line I-I of figure 2, relating to a first embodiment of the invention;
figure 2 is a schematic lateral view from the left of figure 1;
figure 3 is a schematic median section according to a vertical plane of a second embodiment of the invention;
figure 4 is a schematic median section according to a vertical plane of a further embodiment of the invention.

[0012] With reference to the figures of the drawings, 1 denotes in its entirety a container which is destined to contain a fluid mass constituted by a mixture of a solid suspended in a liquid.

[0013] In the embodiment shown in figures 1 and 2, the container 1 is the shell comprising a lower refining chamber 10 and an upper chamber 11 of a ball mill 3 used in particular for refining or fine grinding of silk-screening glazes and, more in general, for the suspension of solids in liquids.

[0014] The lower refining chamber 10 contains the milling balls, which balls grind when moved by the mechanical rotating action of the shaft 12, which shaft 12 is provided with rotors.

[0015] A similar apparatus to the above-described one is constituted by the mill 3' of figure 3, in which the balls are contained in a basket 14 which is solidly constrained to a lid covering the container 1 which will contain a fluid mass constituted by a mixture of a solid in a liquid.

[0016] Figure 4 schematically represents a mixer the function of which is solely that of causing an already at least quite finely-ground solid to disperse without rendering the solid even more finely-ground. The dispersion of the solid is achieved by a mechanical mixing action on the part of a rotor 5 which, immersed in the mass, is rapidly rotated.

[0017] All of the illustrated embodiments exhibit a container 1 to which lateral walls (which have an overall axial-symmetric conformation) two ultrasonic generators 2, in the form of plates, are applied at peripheral positions.

[0018] Other embodiments could involve a different number of ultrasonic generators 2.

[0019] These ultrasonic generators 2 have the specific function of transmitting energy at ultrasonic frequency to the mass contained in the container 1.

[0020] The ultrasonically-emitted energy, which can be modulated and regulated according to needs, exerts a direct dispersant action on the solids in the liquid, exploiting the ability of this form of energy to propagate easily in a liquid carrier.

[0021] The transmission of ultrasonic energy, prefer-

ably in a frequency range comprised between 5 and 70 kHz, has the effect of increasing the contact surface between solid particles and the liquid, favouring wetting.

[0022] In addition to the above, a process of cavitation occurs, which enables efficient expulsion of the air produced during the mechanical diffusion of the solid in the liquid.

[0023] This condition, together with the vacuum action created by the machine and a careful control of the temperature, creates optimal conditions for deagglomeration of clumps and micronisation of the solid particles. This leads to a very high percentage of suspended solids, a level which is certainly not obtainable using traditional systems which do not use ultrasonic techniques, without any ensuing problems connected with rheological high viscosity factors, which would render the resulting suspensions unusable.

[0024] Furthermore, in comparison to the prior art, the processes of breaking-up and micronisation are significantly accelerated.

[0025] The use of ultrasound, which is preferably done at constant frequencies, also activates and optimizes the process of homogenization of the surface-active agents and/or dispersants, This permits production of mixtures with higher concentrations of suspended solids with smaller quantities of surface-active agents, with a consequent reduction in the formation of microfoam, which leads to suspension instability.

[0026] Thus solids (for example, mineral-rich, synthetic, organic and inorganic pigments, colouring earths) can be dispersed in liquids and produce a mixture characterised by a high concentration of solid and a good level of chemical-physical stability over time, leading to ease of use.

[0027] A Further advantage of the invention is constituted by an improvement in the chromatic quality of the products.

[0028] All of the described realisations employ an improved process for finely milling and/or finely dispersing solids in liquids or liquids in liquids, which is essentially characterised by the fact that energy is transmitted in the form of ultrasonic waves to the mass of solids and liquids during the milling of the former and also during the dispersion of one in the other, or of liquids in liquids.

Claims

1. An improved apparatus for finely milling and/or finely suspending substances in liquids, comprising a container (1) in which milling is performed and/or dispersion is performed by mechanical organs, characterised in that it comprises at least one ultrasonic generator (2) for transmitting ultrasonic waves to a mass contained in the container (1).

2. The apparatus of claim 1, characterised in that the at least one ultrasonic generator (2) is associated to a wall of the container (1).

3. The apparatus of claim 2, characterised in that it comprises at least two of said at least one ultrasonic generator (2), associated to walls of the container (1) at peripheral positions.

4. The apparatus of claim 3, characterised in that at least the walls of the container (1) to which the ultrasonic generators (2) are peripherally associated have an axial-symmetric conformation.

5. The apparatus of claim 4, characterised in that the container (1) comprises at least one chamber of a ball-mill (3, 3') containing milling balls.

6. The apparatus of claim 4, characterised in that the container (1) comprises at least one chamber of a mixer (4) internally of which at least one rotor (5) operates.

7. The apparatus of claim 5 or 6, characterised in that the container (1) is provided with a lid which guarantees sealed closure of the container (1) during operation thereof in depression.

8. The apparatus of claim 7, characterised in that the ultrasonic generators (2) can be adjusted to enable regulation and modulation of energy emitted.

9. An improved apparatus for finely milling and/or finely suspending substances in liquids, characterised in that energy is transmitted in ultrasonic waves to a mass of solids and liquids during milling and/or during dispersion of the substances in liquids.

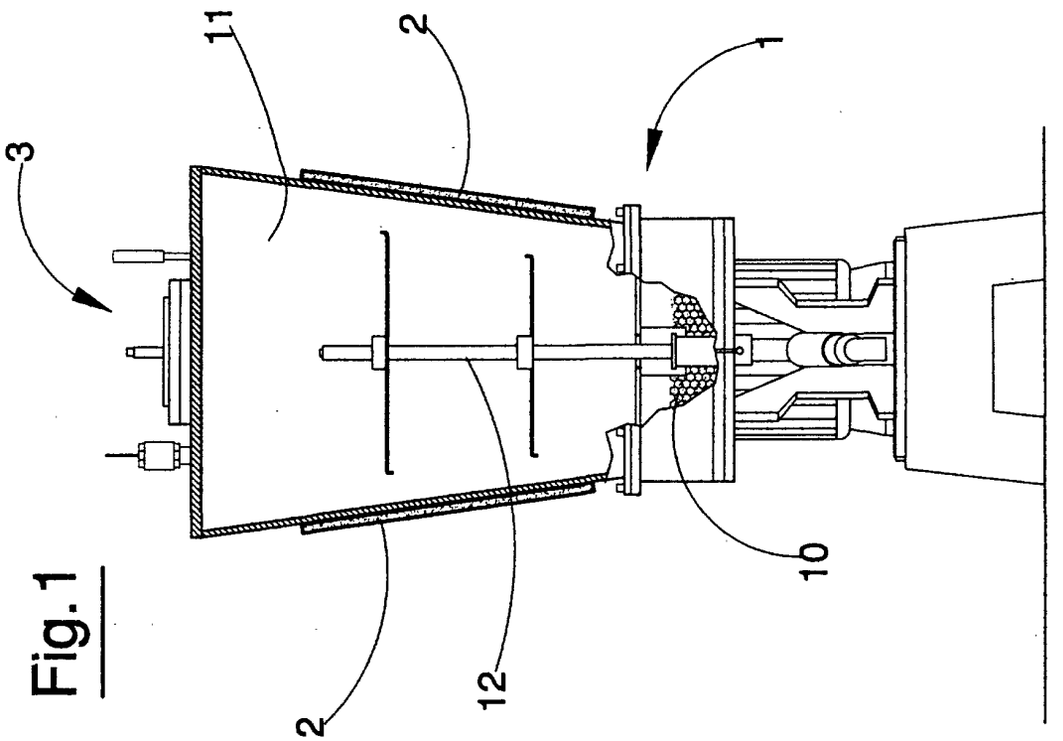


Fig.1

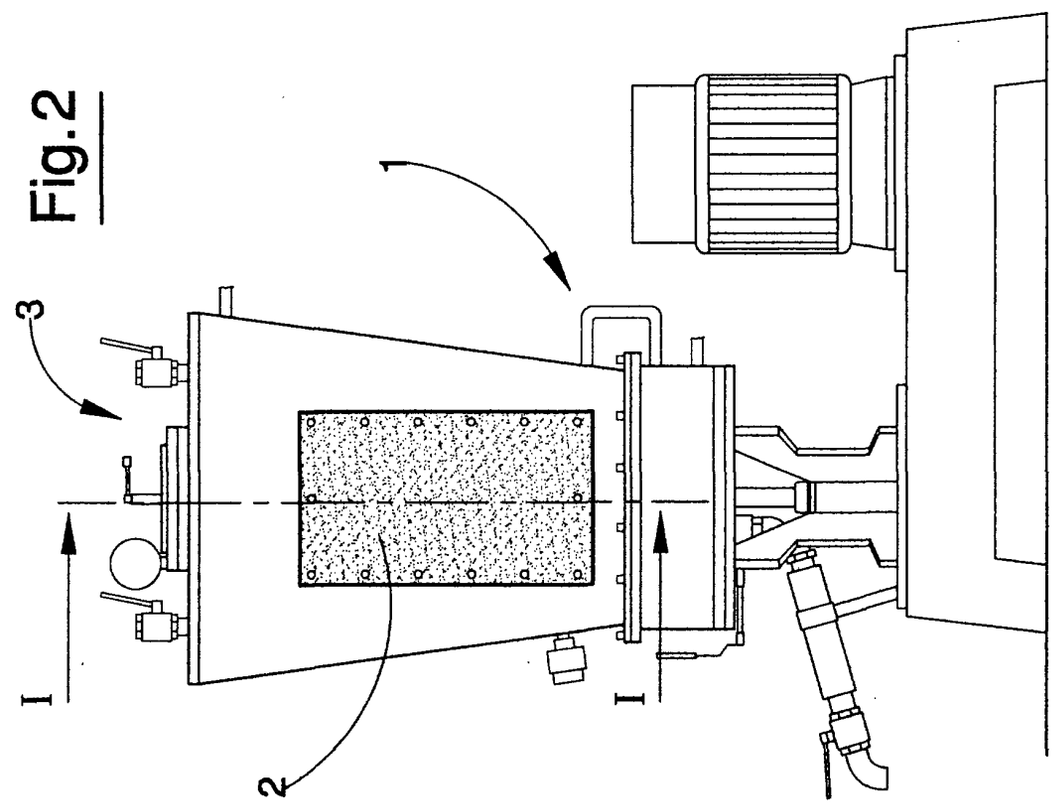


Fig.2

Fig. 3

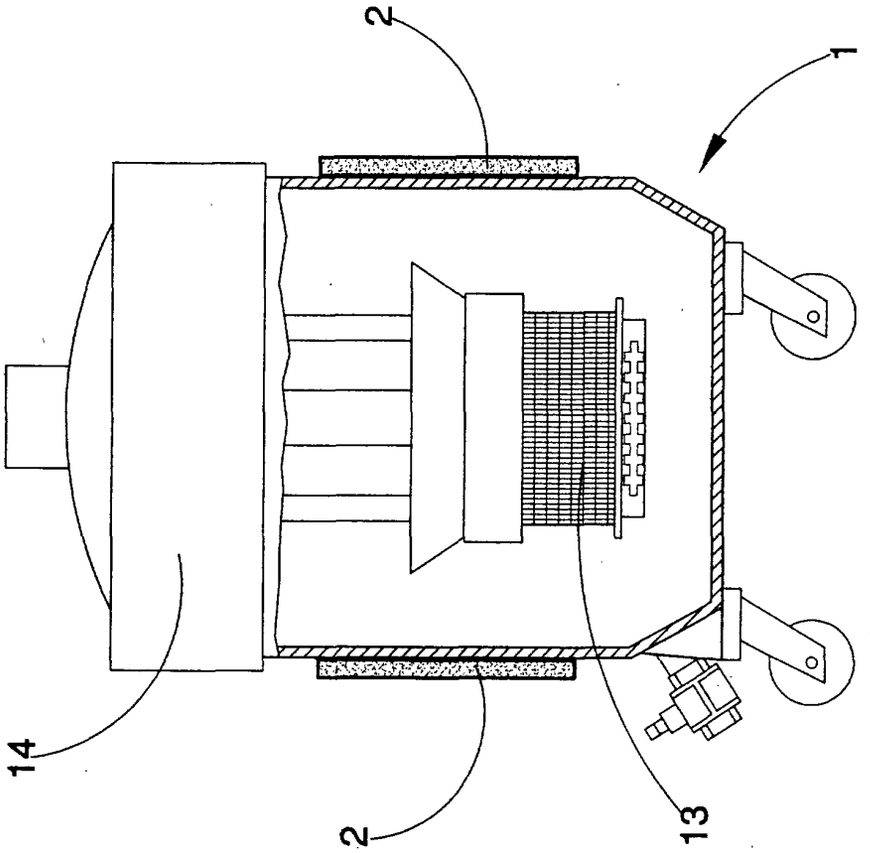
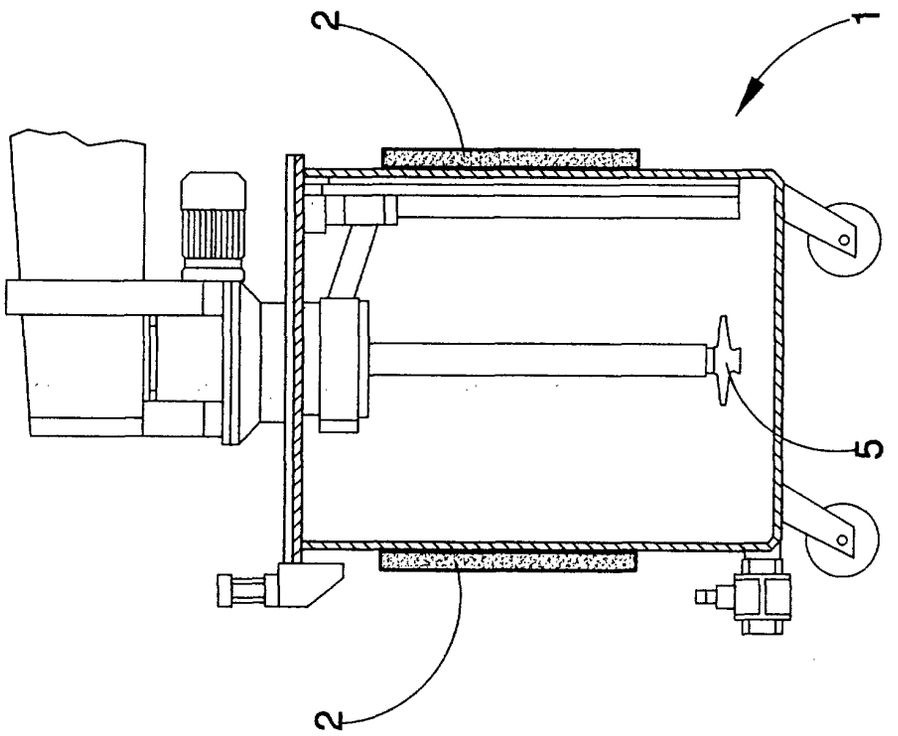


Fig. 4



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EUROPEAN SEARCH REPORT

Application Number
EP 00 83 0031

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
X	US 5 279 463 A (HOLL RICHARD A) 18 January 1994 (1994-01-18) * claims 12,15; figures 11-13 * * column 1, line 6 - line 12 *	1,2,9	B02C17/16 B02C19/18
Y		3,4	
A		5-8	
X	US 4 964 576 A (DATTA RABINDER S) 23 October 1990 (1990-10-23) * claims 1,3,7; figure 1 *	1,2,9	
Y		3-5	
A		6-8	
X	EP 0 686 428 A (EASTMAN KODAK CO) 13 December 1995 (1995-12-13) * column 5, line 24 - line 32; claim 1; figure 4 *	1,2,9	
Y		3-5	
A		6-8	
X	EP 0 065 188 A (BASF AG) 24 November 1982 (1982-11-24) * claims 1,3 *	1,2,9	TECHNICAL FIELDS SEARCHED (Int.Cl.7) B02C
Y	DE 12 54 001 B (DRAISWERKE GMBH.) 9 November 1967 (1967-11-09) * claims 1,2; figures 1-3 *	3-5	
A	DE 15 07 528 B (FRYMA-MASCHINEN AG.) 24 September 1970 (1970-09-24) * claims 10-12; figure 1 *	7	

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	7 June 2000	Verdonck, J

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07-06-2000

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 5279463 A	18-01-1994	DE 69326897 D	02-12-1999
		EP 0656814 A	14-06-1995
		JP 8500524 T	23-01-1996
		WO 9404275 A	03-03-1994
		US 5538191 A	23-07-1996
US 4964576 A	23-10-1990	EP 0469195 A	05-02-1992
		US 5167375 A	01-12-1992
EP 0686428 A	13-12-1995	US 5593097 A	14-01-1997
		DE 69511773 D	07-10-1999
		DE 69511773 T	02-03-2000
EP 0065188 A	24-11-1982	DE 3119078 A	16-12-1982
DE 1254001 B		NONE	
DE 1507528 B	24-09-1970	NONE	

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82