

[54] **APPARATUS FOR DISPERSING PIGMENTS IN A LIQUID PHASE**

[75] Inventor: **Carlos Oliver Pujol**, Badalona, Spain

[73] Assignee: **Oliver and Batlle, S.A.**, Badalona, Spain

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[58] Field of Search ..... **241/67, 98, 171, 172, 176, 241/179, 79.1; 233/7; 259/31-33, 122**

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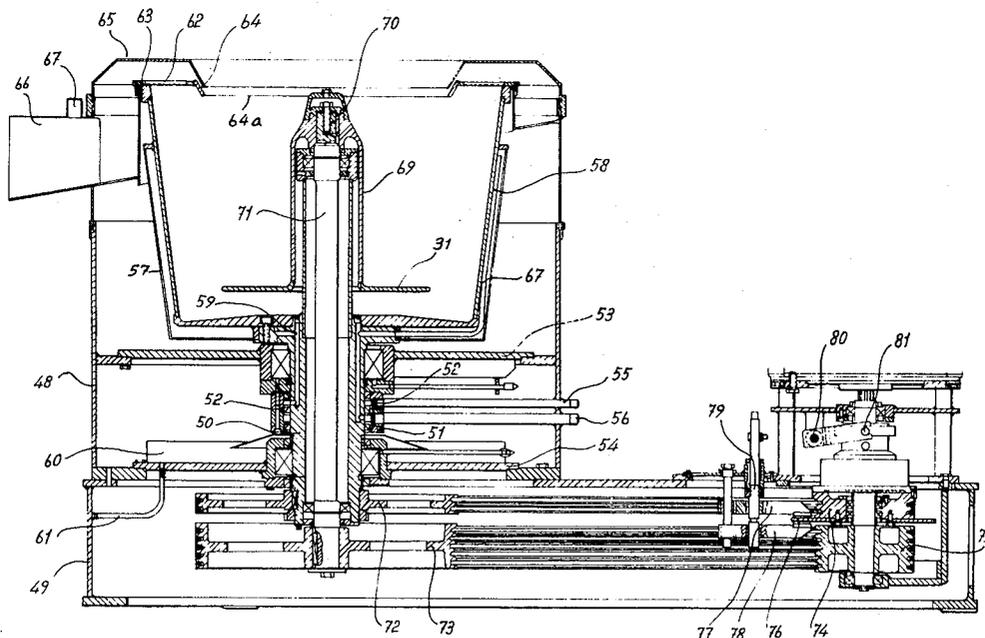
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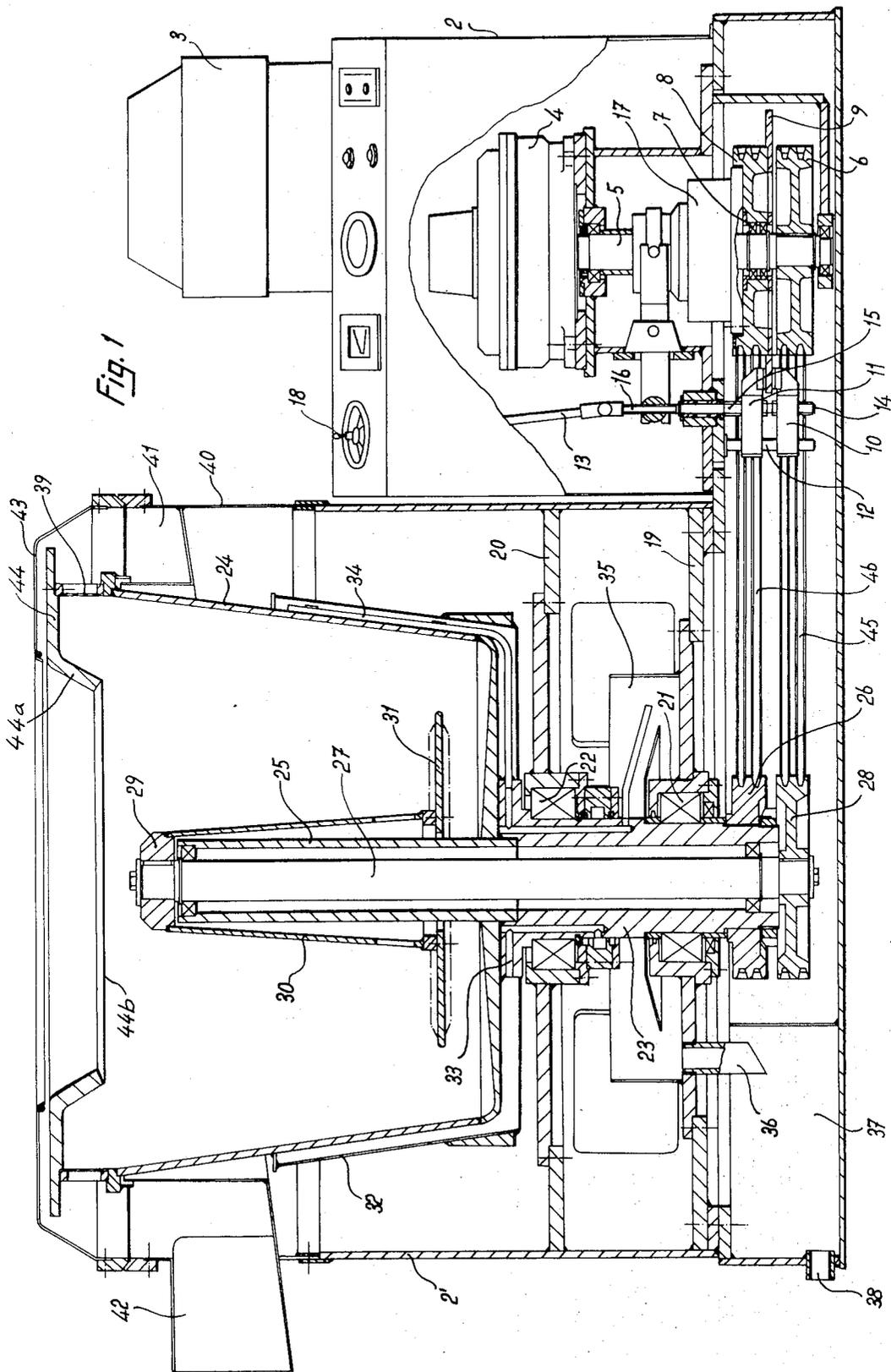
*Primary Examiner*—Al Lawrence Smith  
*Assistant Examiner*—K. J. Ramsey  
*Attorney, Agent, or Firm*—Woodhams, Blanchard & Flynn

[57] **ABSTRACT**

A ball mill for dispersing a pigment in a liquid carrier, which ball mill includes an upwardly opening cup-shaped tub mounted for rotation about a substantially vertical axis. A hollow exterior drive shaft is fixed to the bottom wall of the tub and projects upwardly and downwardly therefrom, and rotatably supports in the interior thereof a drive shaft which has the upper end thereof fixed to a downwardly projecting skirt having a stirring disk secured to the lower edge thereof. A single drive motor is provided for rotating the interior and exterior shaft. A first transmission means drivingly connects the drive motor to the interior shaft, and a second transmission means drivingly connects the drive motor to the lower portion of the exterior shaft, said second transmission means including a disengageable clutch device.

**9 Claims, 8 Drawing Figures**





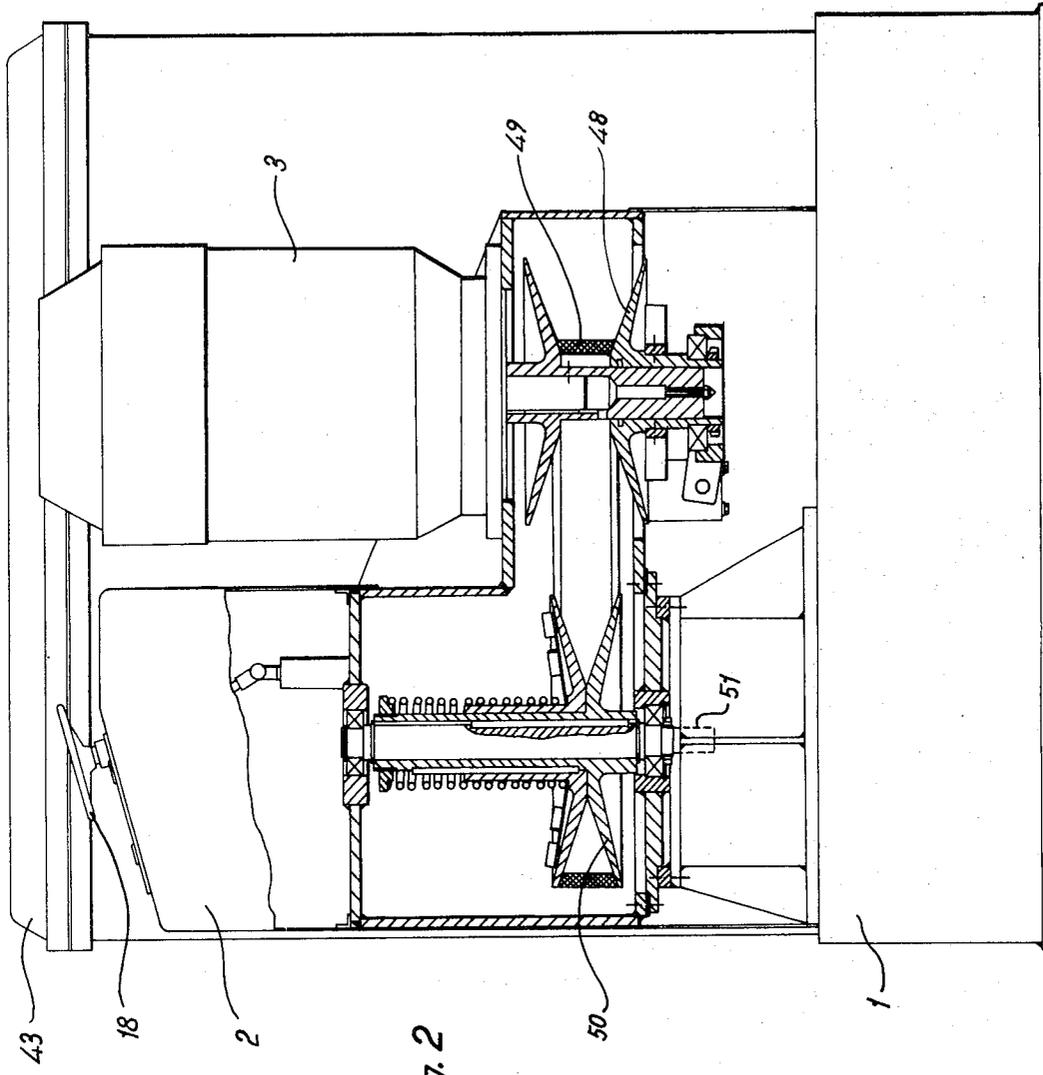
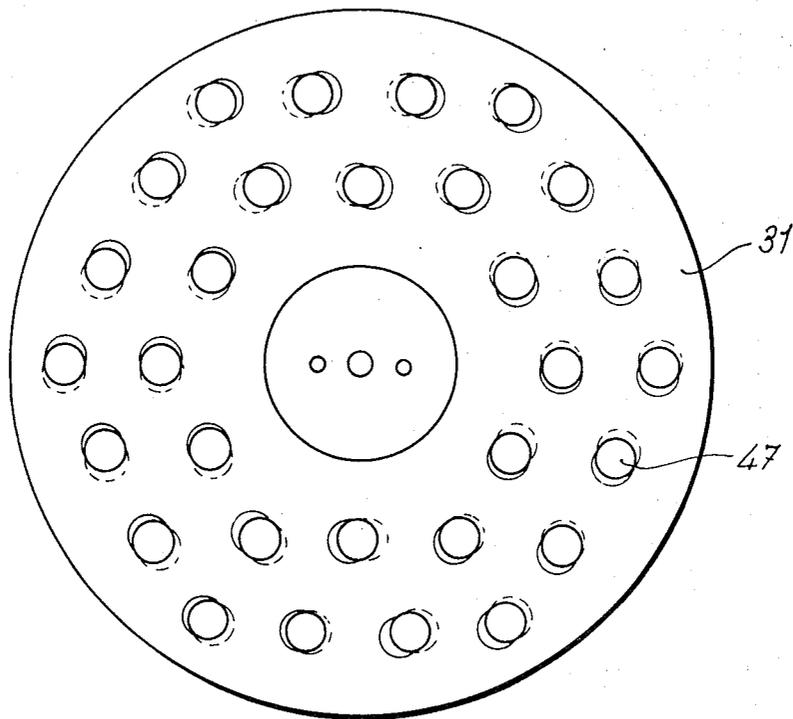


Fig. 2

*Fig. 3*



*Fig. 4*

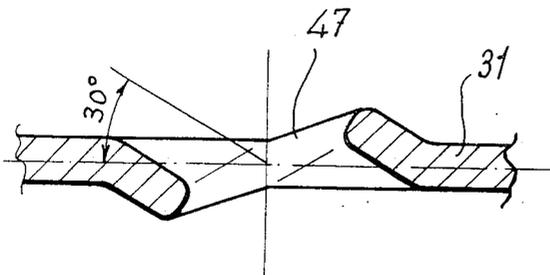
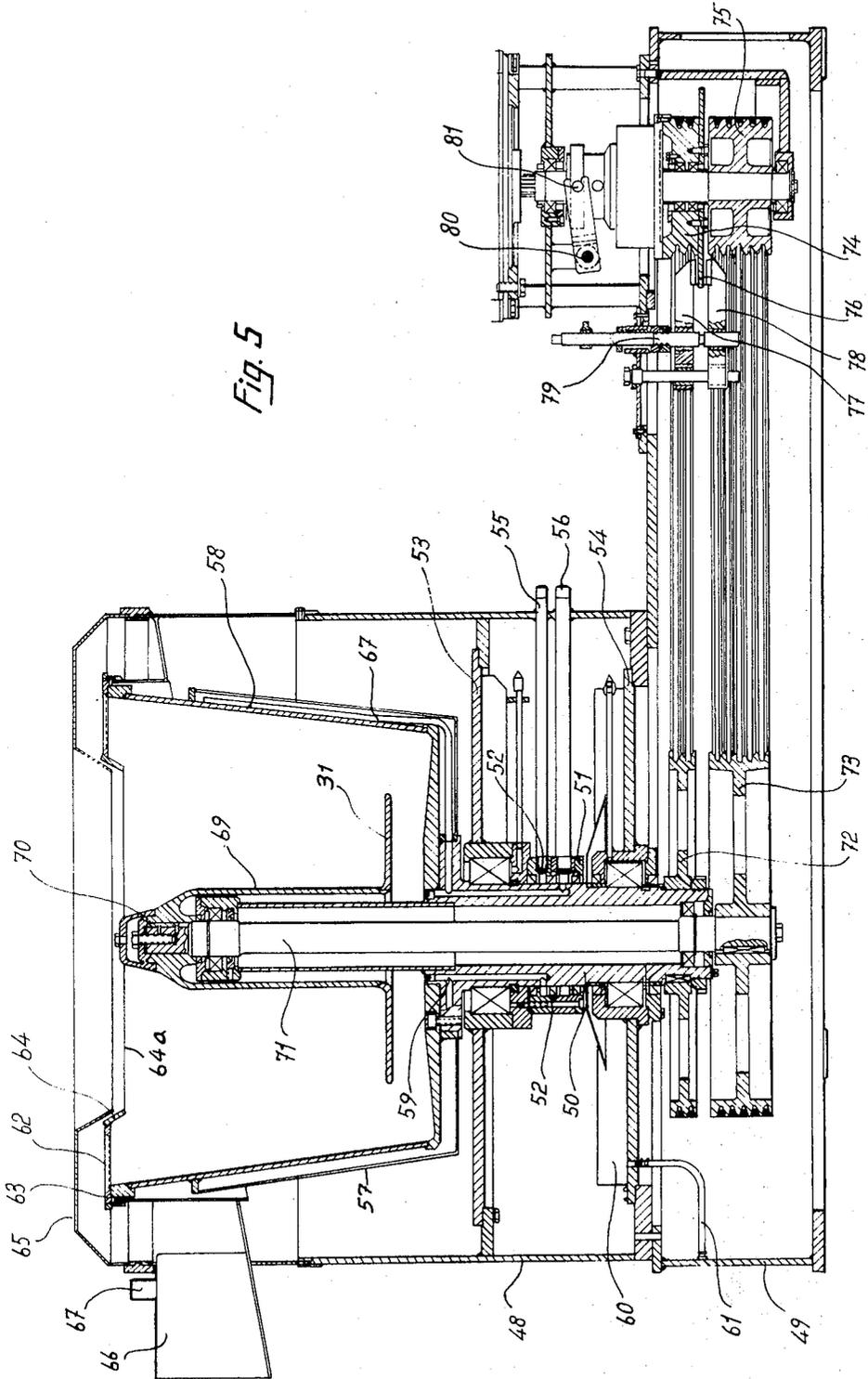
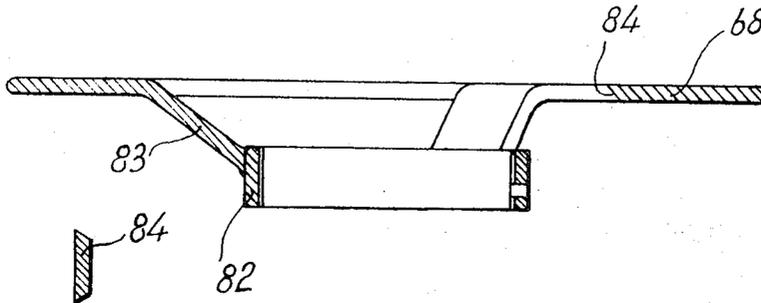


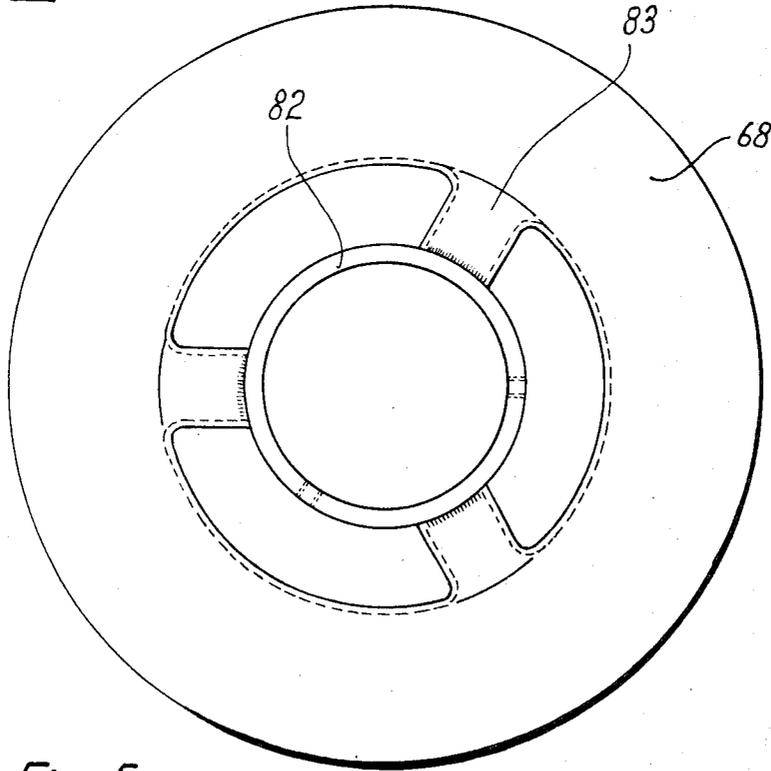
Fig. 5



*Fig. 7*



*Fig. 8*



*Fig. 6*

# APPARATUS FOR DISPERSING PIGMENTS IN A LIQUID PHASE

## DESCRIPTIVE MEMORANDUM

The present invention refers to improvements in homogeneous desintegrator machines, particularly a ball mill for dispersing a pigment in a liquid.

In order to obtain perfect homogeneity of materials which have been finely divided in powder form, such as pigments, so that a high dispersion can be obtained in a liquid phase that acts as a supporting medium for said pigment, it is necessary that the powder material, whose small particles are greatly cohesive due to their own electrostatic charges, be agitated together with the supporting medium.

Such agitation is usually performed in devices comprising a cylindrical or truncated cone shaped tank which is in a vertical arrangement and is called a cask or tub, within which there is a disk or rotating blades that stir or mix the contents of the tank, i.e., the pigment, the supporting medium, and an assembly of small balls of appropriate hardness. Usually these balls are made of glass, and act as a desintegrator means. Although the purpose of this apparatus is not to grind, it is generally known within the industrial field as a ball-mill.

The object of the invention are some improvements in such devices or apparatus, which comprise a housing with horizontal supporting plates mounted on bearings on a footing, a tubular shaft secured to the bottom of the tub, such tubular shaft having an extending portion also tubular, a second shaft mounted on bearings whose two ends protrude, the top one remaining in a position appropriated for attaching a tub, which continues downwards in a flap or skirt provided with a stirring disk on its lower portion, and both shafts mentioned above having on their lower ends their corresponding drive pulleys which are attached by means of transmission belts to corresponding pulleys or drive wheels which are set on the same drive shaft, the first of which, i.e., the one which is coupled to the second shaft, is in a set position, and that which transmits the rotating motion to the tubular shaft having free motion and provided with a clutching system.

Said tub-actioning shafts, and that of the stirring disk, are coaxial and penetrate the tub through the bottom part of same, the tub having a feeding mouth or opening on its top part with a vertical strainer contiguous to its edge for unloading the finished material by centrifugal force, said strainer having some windows with reinforcing frames provided with detachable threaded covers so as to be able to extract the balls by means of centrifugation, the feeding mouth or opening also having a closing ring with its interior edge turned inwards thus forming an arrester for the material which is to be centrifugated. Also, the free pulley which is set on the driving wheel is to be secured to a protruding disk which is retained by clamps, which are actioned by means of a screw with an actioning wheel, being set on same screw an actioning lever for the clutch device of the free drive-wheel or pulley in reference to said drive shaft, the actioning of the clutch being slightly retarded in relation to the actioning of the clamps, in an operative form so that the free pulley or drive wheel initiates and finishes its rotation at a lower speed than that of the machine.

In one of the embodiments of the machine, variations are introduced in the three main components of same, i.e., in the body of the homogenizer-desintegrator element, in the drive unit device, and on the transmission elements between both previous parts, according to the following points:

The homogenizer body or element has, in this modification, a structure attached to the exterior tubular shafts by means of retainers, which comprise inlets and outlets for the tub cooling liquid, communicating with the casing of same by means of ducts which allow for the establishment of a closed refrigerating circuit. For any eventual breakdown, the outlet of the refrigerating casing is alternatively communicated with a sump device and form here to a drainage.

This same homogenizer component also exhibits, as a variation, the fact that the top discharge strainer of the tub is in a horizontal disposition on the same retaining ring of the tub mouth or opening, which has a protruding interior edge in order to avoid the loss of material during centrifugation. When the material goes through the strainer due to centrifugal force, it communicates with a spillway provided with a vertical aeration passage so as to allow the flow of liquid without turbulence; the liquid flow being directed towards the spillway by the same top opening of the housing, through which the materials are fed into the tub.

The interior tubular shaft comprises, on its top end, the tub whose skirt or flat extension towards the bottom of the tub comprises the stirring disk. In said variation, the disk is made up of a flat horizontal crown, with radial arms facing inwards angled and fixed by a fixing ring to the flat or skirting. The inner edge of the arms and of the disk are chamfered at a 45° angle in relation to the vertical, and with its opening pointing towards the bottom of the tub. The disk thus structured forms an element of high dispersion power.

The driving unit or element, in this modification or variation, has the free pulley or drive wheel of the exterior tubular shaft of the homogenizer assembly attached to a protruding disk which is retained by means of clamps. These clamps are actioned, whether to brake or free the rotating motion, by means of a screw driven from a drive wheel. In this modification, the clutch of said free pulley of the drive shaft is to be actioned by an independent control lever, separate from the drive wheel and screw which work the braking system. With this, independence is achieved between both systems, and avoids any overheating or breakdown when starting or stopping the tub of the machine.

In order to simplify the description, some drawings are adjoined to the present description in which some embodiments of the invention are shown.

FIG. 1 shows a vertical section of a machine assembly actioned hydraulically.

FIG. 2 shows a vertical section at 90° from the section line of FIG. 1 taken through the section of the electric motor, showing a modification with a mechanical drive.

FIG. 3 is a plan view of a stirring disk.

FIG. 4 is a detail section, on a larger scale, of the section of one of the disks of FIG. 3.

FIG. 5 shows a vertical section of one of the variations of the machine, and showing the homogenizer element, the transmission device, and the drive unit including the clutch and brake elements.

FIG. 6 shows a plan view of a modification of the stirring disk.

FIG. 7 shows a cross-section of the stirring disk of FIG. 6.

FIG. 8 is a section of the chamfered edge of the radial arms of the disk of FIGS. 6 and 7.

With special reference to FIG. 1, the apparatus according to the invention comprises a main footing or base 1, on which two adjacent bodies or housings 2 and 2' are mounted. The electric motor 3 projects from body or housing 2, said motor driving, by means of a hydraulic circuit, a hydraulic motor 4, the drive shaft or output shaft 5 of which has a first pulley 6 fixed thereon. Shaft 5 also supports bearing 7 which rotatably support a second pulley 8 which is fixed to a projecting disk 9 that can be retained between two clamps or grips 10 and 11. The grips 10 and 11 are slidably mounted on a spindle 12, and operated by means of the rotatable screw 13 which is screw-threaded in opposite direction in areas 14 and 15.

Also, a third screw-threaded area 16 is provided on the spindle for operating the clutch 17, which engages and disengages the pulley 8 from the motor 4. The spindle or screw 13 is operated from the outside of the body or housing 2, by means of a control wheel 18. The body or housing 2' has two horizontal plates 19 and 20 on its lower half (which for construction reasons are made up of several pieces), on which bearings 21 and 22 are to be found, which support a tubular shaft 23 solidly fixed to the tub 24. Said shaft 23 has a top extension 25, also tubular, which extends vertically inside the tub. The lower part of said shaft carries a pulley or drive wheel 26. In the interior of the tubular shaft 23 and extension 25 there is a solid shaft 27 which is supported on same by bearings. This shaft 27 has projecting ends, the lower end carrying a solidly fixed pulley 28, and the top end a hub 29 from which a skirt or flap 30 extends carrying a stirring disk 31 on its lower extremity, which disk is positioned adjacent the bottom of the tub.

On its bottom part, and part of its side walls, the tub is provided with a cooling jacket or casing 32, which is made up by a watertight compartment, into which water or another refrigerating liquid is fed by means of a passage or conduit 33. When said liquid has accomplished its mission, it drains through the overflow tube 34 into a collector tank 35 and, from here, by means of outlet 36, into compartment 37 to outlet 38 to the drain.

On the top part of the tub wall, a vertical strainer or sieve 39 has been provided as a border, which extends around the entire cylindrical periphery. The sieve or strainer has circular windows reinforced with a frame, and provided with threaded closure stoppers. The purpose of the sieve or strainer is to allow the output of the finished product from the tub, and the circular windows for the output of the balls used in the manufacture of the product, when this is considered necessary.

As an extension of the body or housing 2' a screen 40 is provided which includes a collector channel 41 for the finished product, set in a slightly inclined position towards a drain outlet 42.

On the upper end of the screen 40 there is a top inlet hoop 43 through which the raw materials are loaded, and the tub also has its mouth provided with a hoop 44 with its inner edge turned inwards in order to prevent the escape of materials.

For the operation of stirring disk 31, pulleys 6 and 28 are connected by means of transmission belts 45; and for the operation of the tub 24 pulleys 8 and 26 are connected by means of transmission belts 46. The stirring disk 31, of FIGS. 3 and 4, is characterized by a series of circular openings 47, which have their edges bent in a 30° angle to the horizontal plane in the running direction, so as to exhibit a downwardly directed inlet and an upwardly directed outlet.

In an alternative embodiment of the invention, shown in FIG. 2, the hydraulic motor is replaced by a mechanical transmission. In this case the electric motor 3 has a pulley 48 on its output or drive shaft, which by means of a transmission belt 49, drives pulley 50, the shaft 51 of which, as in the shaft 5 of FIG. 1, has set on same all the elements of the clutch 17 and the pulleys 6 and 8, the rest of the machine being identical to that of FIG. 1.

The machine works in the following manner:

With the machine or apparatus at rest, and the tub provided with the glass balls or alike, the raw materials are loaded through the mouth of the tub. Once the tub has been loaded to its proper level, the electric motor is started up which, through the hydraulic transmission (FIG. 1) or mechanical transmission (FIG. 2), drives pulley 6 which, by means of transmission belts 45, drives pulley 28, shaft 27, and through this last, the stirring disk 31. During said working step, the agitation and grinding of the material in powder form is carried out by the balls, and also by the effect of the 30° angle of the edges 47. During all this step or phase, the tub remains static. Once the mixture is carried out, the tub must be put into action, so that the finished material can be poured out by centrifugal force. For this purpose, and without stopping the electric motor 3, the control wheel 18 is turned in such a way that by rotation of the spindle or screw 13 the retainer clamps or grips 10 and 11 are separated and release the disk 9, whereby the pulley 8 is released on the shaft 5, and at such moment, by friction on bearings 7, the pulley 8 is gently set in motion dragging pulley 26 and, consequently, the tub 24 by means of shaft 23. The rotation of screw or spindle 13, through its threaded area 16, operates the clutch 17, in such a manner that it engages solidly with pulley 8 which is forced to rotate at the same speed as shaft 5. In this way, the pulley 8 is caused to rotate initially at a slow speed before the clutch is engaged, thereby avoiding shocks which would occur if the clutch were engaged with the pulley 8 at rest.

When the pulley 8 is fully engaged, the tub runs at its maximum speed, with the effect that the centrifuged material climbs the walls of the tub to leave through the sieve or strainer 38, the balls being retained within the tub owing to their diameter being larger than the openings of the sieve or strainer.

Once the finished material has been unloaded, the tub and the balls may be cleaned by pouring a solvent into the tub, which eliminates the remainder of the material which has not been centrifuged, the dirty solvent of which leaves the tub also by centrifugation through passage 41 and 42. Afterwards, the machine may be stopped in order to start a new work cycle.

In case the balls must be eliminated or removed from the inside of the tub, in such moment one must proceed to disengage the covers which are over the strainer or sieve, with the machine stopped, leaving the corresponding windows uncovered so that the balls may be

expelled through same due to centrifugal force when the tub is again rotated, collecting them in the passage 41.

According to the alternative embodiment of FIG. 5, the homogenizer component mounted on the body or housing 48, fixed to the main footing or base 49 of the machine, has the external tubular shaft 50 with a structure 51 fixed to same by means of retainers 52; in said structure 51, inserted between supporting plates 53 and 54 are conduits 55 and 56 for the inlet and outlet of the refrigerant liquid towards the jacket or casing 57 of the tub 58. Both conduits communicate with passages 59 which are formed in the external tubular shaft 50. In case of breakdown, the refrigerating liquid drains towards collector 60 and from here, through passage 61 into a drain.

In this modification, the tub 58 has the upper discharge sieve or strainer 62 set on a horizontal plane and mounted on the hoop 63 which defines the mouth of the tub 58, which hoop has an extended inner edge 64 which retains the material flowing through the sieve or strainer 62 due to centrifugal force.

The product expelled from the tub 58 in this operation, once it has gone through the strainers or sieve 62, is directed by the top hoop 65 towards the drain 66, which has a vertical passage 67 in order to avoid turbulences.

In the present alternative embodiment the stirring disk 68 of FIGS. 6 to 8 can be used, such disk 68 being fixed to the skirt or flap 69, parallel in the case of the tubular shaft 50, set on the hub 70 of the upper end of the internal shaft 71.

The transmission pulleys 72 and 73, fixed on the external shaft 50 and on the internal shaft 71 of the homogenizer element, are in connection by means of corresponding pulleys with the free pulley 74 and set pulley 75 of the motor or drive unit. The free pulley 74 has the disk 76 inserted between the clamps or grips 77 and 78, which grip during braking or free during operations by means of the spindle 79 controlled by a hand-wheel not shown in the Figure. The clutch of said pulley 74, through which the motion is transmitted to the tub 58, in this modification is carried out independently from the operation of the clamps or grips 77 and 78, by means of a control lever 80 for the clutch system 81.

In its operation, free pulley 74 is un-clutched and its motion stopped by clamps or grips 77 and 78. The drive force transmitted between the set pulleys 75 and 73 rotate the internal shaft 71 carrying the stirring disk 68. When the finished product is to be expelled from the tub 58 through the strainers or sieves 62, the disk 76 fixed to the free pulley 74 is released by separating the clamps or grips 77 and 78 by rotating the spindle 79. Once disk 76 is freed, the pulley 74 is clutched to the drive shaft by means of the clutch system, and the tub 58 is set in motion little by little until it reaches its maximum speed, and enough centrifugal force is developed by rotation so as to allow the ascension of the product and its discharge through the top part of the tub.

In FIGS. 6, 7, and 8 the structure of the stirring disk 68 can be seen. This disk has a central hoop 82 for its fixture to the bottom end of the skirt or flap 69. Disk 68 and hoop 82 are connected by the inclined arms 83, and the internal edges 84 of arms 83 and disk 68 are chamfered as shown in FIGS. 7 and 8, which provides a high homogenizing power.

The tub structure illustrated in FIG. 1 is advantageous since the upper outer edge of the tub effectively defines an annular ringlike chamber for controlling the flow of the product which is centrifugally discharged from the tub. For this purpose, the ringlike chamber is defined by the upper wall or hoop 44 and additionally has the inner periphery thereof defined by the inwardly turned annular flange 44a. The outer periphery of the ringlike chamber is defined by the upper edge of the tub sidewall 24, which sidewall has the screen 39 associated therewith. Due to this annular ringlike chamber which is formed around the upper outer free edge of the tub, the product can thus be controlled so as to be centrifugally discharged into the surrounding passage 41, while at the same time the upper end of the tub can be left continuously open, namely due to the presence of the central opening 44b defined by the annular rib 44a. The continual presence of this opening 44b greatly facilitates the charging of the pigment and liquid substance into the tub, and additionally facilitates cleaning of the tub.

The embodiment of FIG. 5 possesses the same advantages possessed by the embodiment of FIG. 1, as described above, since the upper edge of the sidewall of the tub cooperates with the annular flange 64 and the upper hoop 63 to define a ringlike annular chamber adjacent the upper free edge of the tub, which chamber permits the product to be centrifugally discharged through the sieve 62 associated with the upper wall 63. As in the embodiment of FIG. 1, the annular flange or ring 64 again defines a continuous opening 64a.

What we claim is:

1. A ball mill, such as for dispersing pigments in a liquid substance, comprising in combination:
  - upwardly opening, cup-shaped tub means defining a mixing chamber, said tub means including a bottom wall and an annular sidewall fixed to said bottom wall and projecting upwardly therefrom;
  - frame means rotatably supporting said tub means in an upwardly opening manner for rotation about a substantially vertical axis;
  - drive shaft means fixed to said tub means for rotating same, said drive shaft means including a vertically elongated tubular drive shaft fixed to said bottom wall and having an upper shaft portion projecting upwardly from said bottom wall into said chamber and a lower shaft portion projecting downwardly from said bottom wall;
  - rotatable stirring means associated with said tub means for mixing the contents of said chamber, said stirring means including an elongated driving shaft concentrically and rotatably supported within said tubular drive shaft, said driving shaft having upper and lower end portions thereof disposed adjacent the upper and lower ends of said tubular drive shaft, respectively;
  - said stirring means further including skirt means fixed to the upper end portion of said driving shaft and extending downwardly toward said bottom wall, said skirt means being positioned externally of said tubular drive shaft, and an annular stirring disk fixed to said skirt means adjacent the lower end thereof; and
  - drive means for rotating said drive shaft and said driving shaft, said drive means including (1) a single drive motor of the rotating type, (2) first transmission means drivingly connecting said motor to

the lower end portion of said driving shaft for rotating same, and (3) second transmission means drivingly connecting said motor to the lower shaft portion of said tubular drive shaft for rotating same, said second transmission means including disengageable clutch means.

2. A ball mill according to claim 1, wherein said tub means includes wall means defining an annular ringlike chamber adjacent the upper outer edge of said tub means for controlling the discharge of product from said tub means due to centrifugal force, said wall means including a first annular wall portion defined by said sidewall adjacent the upper edge thereof, said first wall defining the outer radial periphery of said ringlike chamber, said wall means including a second ringlike wall portion fixedly connected to the upper edge of said first wall portion and projecting radially inwardly therefrom, said wall means including a third annular wall portion fixedly connected to said second wall portion adjacent the inner edge thereof, said third annular wall portion projecting axially inwardly into the interior of said tub and being spaced radially inwardly from said first annular wall portion so as to define the inner radial periphery of said ringlike chamber, said third annular wall portion defining a central opening providing continuous communication with the interior of said tub means, and said wall means including discharge opening means associated with one of said first and second wall portions for permitting the contents of said tub means to be discharged therefrom due to centrifugal force caused by rotation of said tub means, said discharge opening means having strainer means associated therewith.

3. A ball mill according to claim 2, wherein said discharge opening means is formed in said first wall portion.

4. A ball mill according to claim 2, wherein said discharge opening means is formed in said second wall portion.

5. A ball mill according to claim 1, wherein said drive motor includes a motor drive shaft, said first transmission means including a first rotatable drive member fixedly secured to said motor drive shaft and a first rotatable driving member fixedly secured to said driving shaft and drivingly connected to said first drive member, and said second transmission means including a second rotatable drive member freely rotatably supported on said motor drive shaft and a second rotatable driving member fixedly secured to said tubular drive shaft and drivingly connected to said second drive member, and said clutch means coacting between said

motor drive shaft and said second drive member for permitting selective rotation thereof.

6. A ball mill according to claim 5, further including brake means coacting with said second drive member for selectively maintaining same in a stationary position, and bearing means rotatably supporting said second drive member on said motor drive shaft for permitting said second drive member to slowly rotate due to frictional forces transmitted through said bearing means during rotation of said motor drive shaft after disengagement of said brake means but prior to engagement of said clutch means.

7. A ball mill according to claim 1, further including casing means at least partially surrounding said tub means for defining a cooling compartment extending around at least a portion of the external surface of said tub means for permitting a cooling fluid to be supplied thereto, and said tubular drive shaft having a first passageway formed axially thereof for permitting a cooling fluid to be supplied to said compartment and a second passageway formed axially thereof for permitting said cooling fluid to be discharged from said compartment.

8. A ball mill according to claim 1, wherein said stirring disk comprises a substantially horizontal platelike member disposed within a substantially horizontal plane and having a plurality of openings extending therethrough, said openings extending in a direction which is inclined at an angle of approximately 30° with respect to the horizontal plane of said disk, said direction being substantially perpendicular to a radial line drawn from the center of rotation of said disc through the respective opening, said disk having portions thereof disposed adjacent the opposite edges of each opening which define the leading and trailing edges of the respective opening, the portion defining the leading edge of each opening being bent downwardly from the horizontal plane defined by the lower surface of the disk, and the portion defining the trailing edge of the opening being bent upwardly from the horizontal plane defined by the upper surface of the disk.

9. A ball mill according to claim 1, wherein said stirring disk includes an annular hub portion fixed to the lower end of said skirt means and a platelike ring portion disposed within a substantially horizontal plane and spaced outwardly and upwardly from said hub portion, said platelike ring portion being fixedly interconnected to said hub portion by a plurality of inclined radially extending arms, said arms having their opposite edges chamfered.

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