April 8, 1952 — G. H. RIDER — 2,591,966

DRIVE SHAFT MEANS FOR COLLOID MILLS

Filed July 31, 1948 — 3 Sheets-Sheet 1

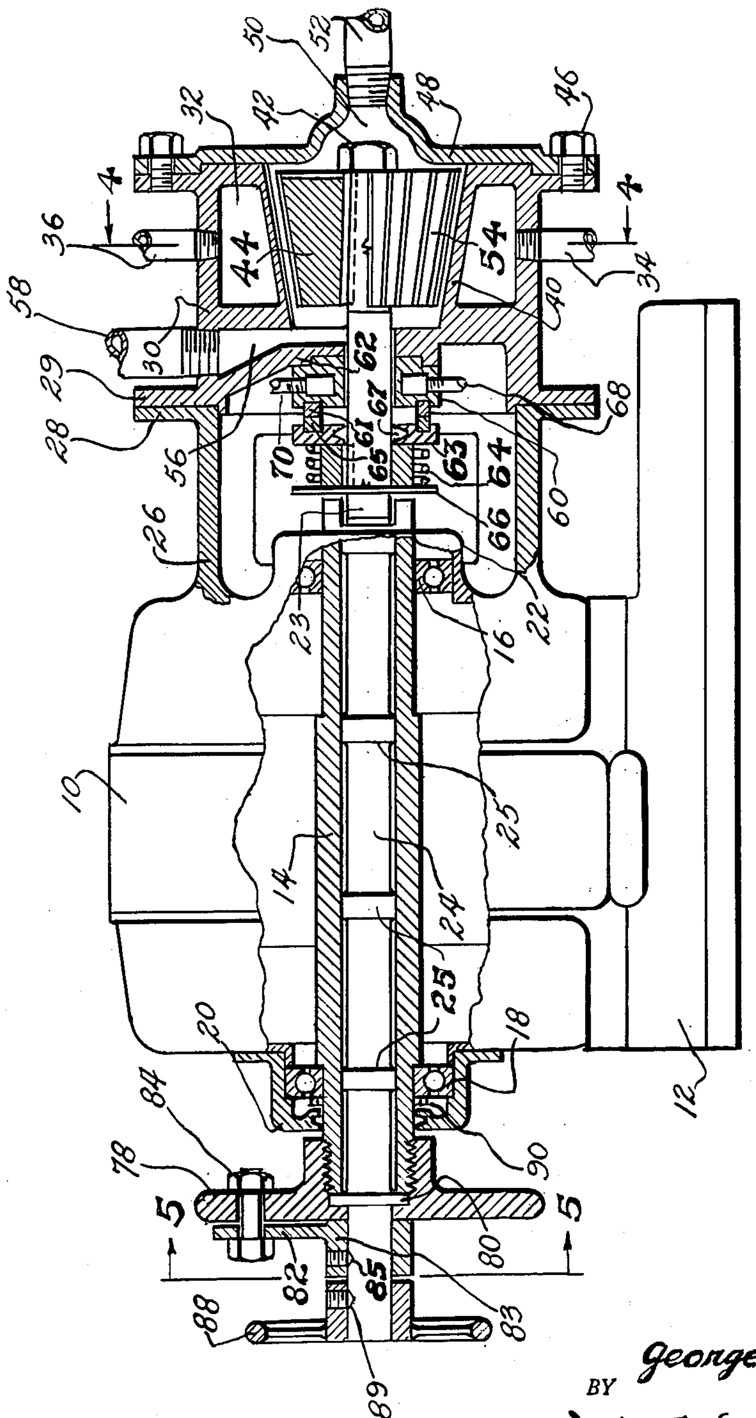

FIG. 1.

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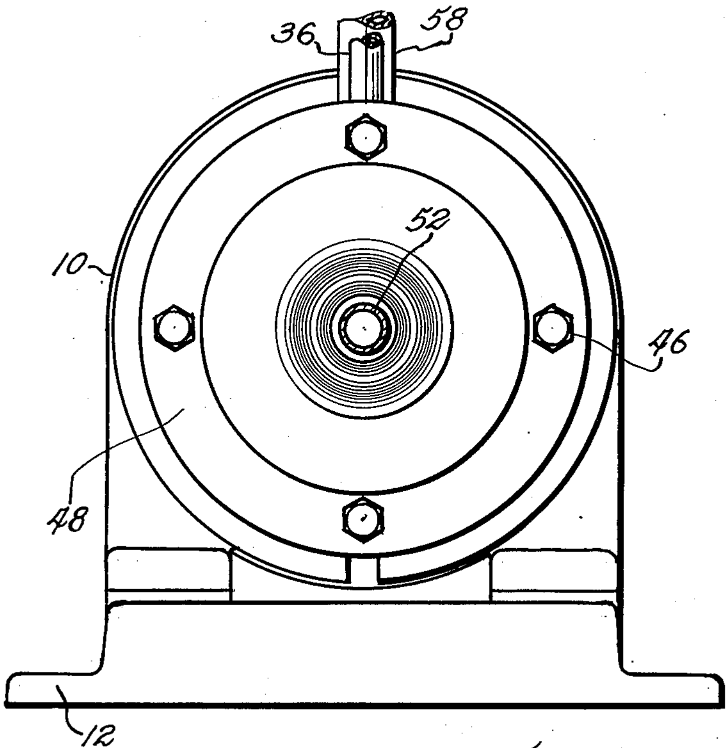

FIG. 2.

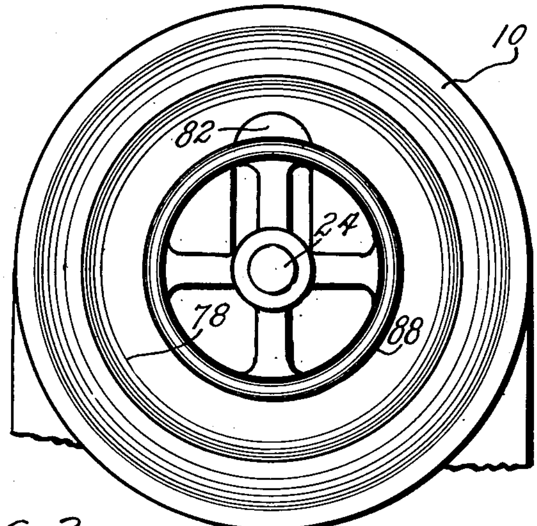

FIG. 3.

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DRIVE SHAFT MEANS FOR COLLOID MILLS

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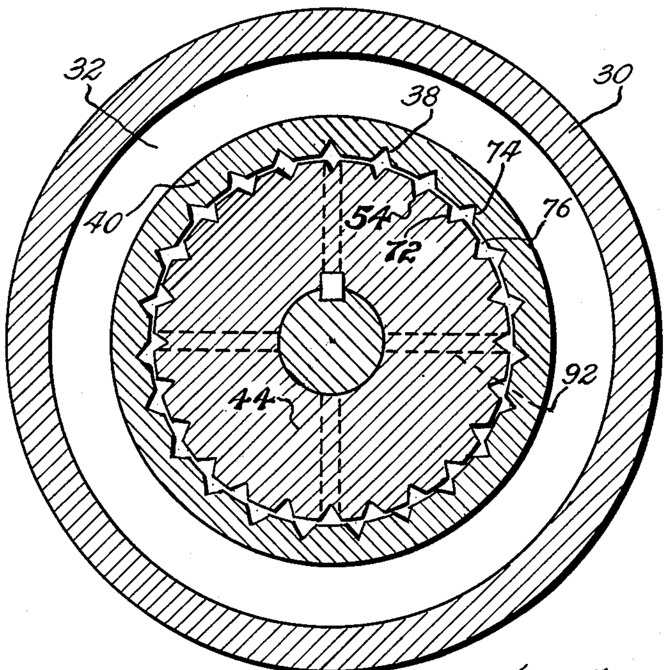

FIG. 4.

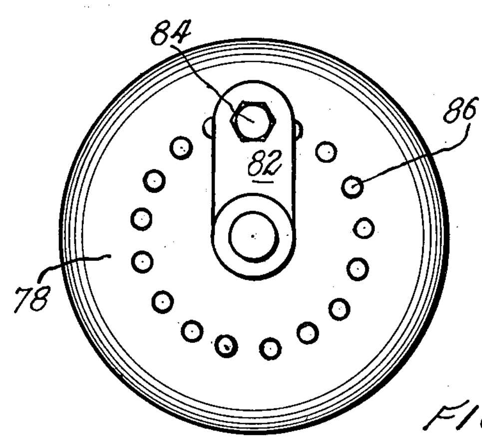

FIG. 5.

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DRIVE SHAFT MEANS FOR COLLOID MILLS

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Application July 31, 1948, Serial No. 41,832

2 Claims. (Cl. 241—256)

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The present invention relates to a colloid mill, which is essentially a relatively high speed disintegrator and emulsifier, in which immiscible liquids, liquids carrying solids in suspension and pastes are finely dispersed, disintegrated and homogenized.

Colloid mills of the type here concerned with have found successful application in a variety of industrial arts for many different purposes. These mills, as an example, have been used in the production of food products, such as tomato juice, catsup, mayonnaise, fruit juice emulsions, baby foods, and other combinations and mixtures; in the manufacture of cosmetics, such as hand and face lotions, cold creams, shaving creams and the like, pharmaceuticals, such as milk of magnesia, mineral oil emulsions and in many other industrial applications, too numerous to mention herein, and wherein a fine blending or reduction in particle or globule size is desirable in the finished product, emulsion or suspension.

The present invention is an improvement to the colloidal mill described and claimed in Pat. No. 1,807,773, granted to B. M. Dawson, on June 2, 1931.

The present invention contemplates the provision of a colloidal mill in which the cooperating members are arranged and constructed to provide a positive action relying upon centrifugal force and hydraulic shear to break up the material and reduce it to a uniform particle or globule dimension and thus produce a resulting homogenization, emulsification or colloid milling not heretofore realized.

The present invention contemplates the provision of cooperating members having grooves cut therein of such shape that the solid or semi-solid that is to be dispersed, disintegrated and suspended in the liquid by the colloid mill will not be pocketed therein and so prevent a product that has a uniform size of globule or particle suspended in the liquid.

By the utilization of such centrifugal force in the construction of the mill here contemplated, particles of the solid or semi-solid are thrown by the rotating member of the mill against a wall in a groove in the stationary member to disintegrate it by the force of impact and the elimination of any pocket through which the material may be passed.

The present invention further contemplates the provision of an integral motor driven colloid mill in which the motor housing is used to support the mill and thus eliminate a coupling and

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a separate mill housing to support the shaft of the mill and its bearings. Thus, my invention eliminates the provision of separate bearings for the mill shaft, the necessity of aligning and keeping in alignment the motor shaft and the mill shaft and reduces the over-all size of the mill.

My invention further contemplates the provision of a novel means of selectively adjusting the clearance between the stationary member of the mill and its rotating member whereby the particle or globule size of the material carried or suspended in the liquid may be fixed.

These, other and further advantages and uses of the present invention will be clear from the following description and the drawings appended thereto, illustrating a preferred embodiment of my invention, and in which drawings,

Fig. 1 is a partial longitudinal cross section of a colloid mill according to my invention.

Fig. 2 is a front end view thereof.

Fig. 3 is a rear end view thereof.

Fig. 4 is a partial section on the line 4—4 of Fig. 1.

Fig. 5 is a partial section on the line 5—5 of Fig. 1.

Referring now to the drawings, the housing 10 of the mill operating or driving means, which is preferably a conventional electric motor, is mounted on the supporting base 12. The motor shaft 14, which for the reasons that I shall describe, is hollow, is mounted for rotation in the conventional bearings 16 and 18, which in the illustration are ball bearings.

The rear bearing 18 is mounted in the end cap 20 of the motor 10 and the front bearing 16 is positioned in the front cap 22 thereof.

The hollow motor shaft 14 extends outwardly of the motor housing 10 at the front and the rear of the motor.

The shaft 24 of the colloid mill is keyed to the hollow shaft 14 of the motor at the front end 23 and is spaced therefrom in the interior thereof by the flats or rings 25 arranged on the internal shaft 24 at selected intervals. This construction permits the internal shaft 24 to be positioned to the rear or front of the device for the purpose of adjusting the clearance as I shall describe, without much binding resistance while preventing any possible bending of the internal shaft with respect to the hollow motor shaft.

The internal shaft is keyed to the hollow shaft so as to permit a longitudinal or axial movement of the internal shaft with respect to the hollow shaft of approximately one-half inch. I have found that this movement permits the clearance between the rotating member of the mill and its stationary member to be sufficiently adjusted to result in the desired limits of globule or particle size of the end product produced by my mill.

Thus the mill shaft 24 and the motor shaft 14 in effect constitute a single shaft which is supported by the motor bearings and the motor housing the present construction, thereby eliminating heretofore required bearings for the colloid mill.

Further, in all motor driven mills heretofore produced as exemplified by the Dawson device, referred to above, and to which the present invention is an improvement, a coupling was required, to connect the shaft of the colloid mill to the shaft of the motor which drove it.

With prior devices, it was therefore necessary to align the two shafts and keep them in operative alignment.

The present invention eliminates the requirement or necessity of a coupling and by its construction does not require that the mill shaft and the motor shaft ever be aligned since they operate as a unit.

At the forward end of the motor integral with the housing 10, I provide the mill carrying support 26 to the flange 28 of which is secured the flange 29 on the housing 30 of the colloid mill, as by bolts and nuts, which need not be shown since this is conventional.

It will now be apparent that the construction proposed thus reduces the over-all size of the colloid mill, because the coupling is eliminated, as are the ball bearings and the housings for the mill itself.

On the interior of the hollow housing 30 and extending inwardly toward the center or axis, I provide the water jacket 32 into which the inlet pipe 34 and outlet pipe 36 are threaded.

The interior surface of the water jacket is in the shape of a truncated cone and is cut to form the grooves 38 (see Fig. 4), to which reference will be further made. In this application, I shall refer to this grooved surface as the stator 40 of the colloid mill.

Secured on the front end of the mill shaft 24, which is threaded by the nut 42, I provide the truncated cone shaped rotor 44, which corresponds in shape to the shape of the stator 40.

The clearance between the rotor and the stator may be selectively adjusted from just less than zero to the desired maximum thousandths of an inch by positioning the shaft 24 longitudinally in the hollow motor shaft 14 in the manner that I shall further describe.

Thus, the rotor carried by the shaft 24 may be moved to the right or left, as viewed in Fig. 1, which because of the cone-shaped members will move it away from or closer to the adjacent surface of the stator 40.

On the front end of the mill housing 30, as by the nuts and bolts 46, I mount the recessed cap or cover 48 on the center of which and communicating with the inlet chamber 50 formed by the stator 40 and the cap or cover 48, I mount the material inlet pipe 52.

The material is fed into the inlet pipe 52 and drawn through the grooves 54 of the rotor by its rotation and there broken up to form the colloidal suspension, as I shall further describe, and after passing through the grooves that extend axially is discharged into the outlet chamber 56 formed in the mill housing 30 and the outlet pipe 58 mounted on the housing in communication with the discharge chamber.

In order to prevent any material ground and pumped by the colloid mill from entering between the hollow motor shaft 14 and the internal main or mill shaft 24, I mount at the front end of the hollow shaft, a two part water cooled stuffing box, the stationary gland 60 of which is seated in a recess in the back face 62 of the mill housing 30.

In the gland 60, I mount the graphite ring 61, against which rides the stainless steel ring 65 mounted in the rotating gland 63. The collar 66 is keyed to the shaft 24 and is positioned at the end of the shaft 14.

Felt rings 67 are inserted between the gland 63 and the shaft 24. As the shaft 24 rotates, the spring 64 is pressed against the gland 63 causing it and the steel ring 65 to rotate.

Cooling water for the stuffing box 60 enters the inlet pipe 68 and is discharged therefrom through the outlet pipe 70.

Heretofore, as shown by the Dawson patent referred to above, the longitudinal or axial grooves in the stator and rotor of colloid mills were semi-circular in cross section and when brought together in aligned position opposite each other form a complete circle.

These semi-circular grooves, while generally effective, are disadvantageous in that there is a tendency to leave the material that is to be suspended in the liquid in the pocket of the groove. This material often traverses through the groove and is discharged at the end of the rotor without being broken up and properly suspended in the liquid.

In order to overcome this tendency to accumulate the solid material without proper action thereon in the groove formed in the stator and rotor, I make the walls of each groove straight and uncurved so that in cross section they form a V with the apex thereof away from the entrance to the groove. These grooves are arranged transversely of the longitudinal axis of the stator and rotor.

Thus, when the grooves in the stator and the rotor are brought into registration or alignment, they form a square groove that is turned on end so that one diagonal thereof is radially disposed. The V-shaped groove does not have the pockets for the material to accumulate in and be by-passed in the groove.

The material entering between the rotor 44 and stator 40 is thrown by centrifugal force from the surface 72 in the rotor groove against the surface 74 in the stator groove and by reason of the uncurved straight surface considerable impingement action is performed to disintegrate the material.

In an effort to move back into the rotor groove 54, the material is subjected to hydraulic shear at the surfaces 76 between the rotor and stator and is thus carried around the rotor and subjected to repeated action in the grooves during its travel therethrough from the entrance 50 to the discharge 56.

There is provided by this action a homogenization, emulsification or colloid milling that forms a definite particle or globule size of uniform dimensions.

In the construction of my colloid mill, I prefer to provide one more groove 38 in the stator than the number of grooves 54 in the rotor as I have found that somewhat better results will be thereby obtained. To put it another way, I prefer to provide an odd number of grooves in the stator and an even number of grooves in the rotor. Of course the same effect could be obtained by providing one more groove in the rotor than the number of grooves in the stator.

The clearance between the rotor and the stator determines the size of the particle or globule suspended in the colloidal or homogenized mixture. For example, a clearance of two thousandths of an inch between the stator and rotor produces in the finished product a particle or globule size that is one to two microns and if this clearance is four thousandths of an inch, the particle or globule size is approximately four microns.

Thus, by selectively adjusting the clearance between the stator and the rotor, the globule or particle size in the resulting product produced by my colloidal mill may be fixed. I shall now describe the means by which the clearance between the stator **40** and the rotor **44** may be adjusted as desired.

At the rear end of the hollow shaft **14** that extends from the motor **10**, I threadedly arrange thereon the adjusting ring **78**. On the colloid mill shaft **24**, I mount the shoulder **80** which fits into a recess in the adjusting ring **78** and is engaged by the end of the hollow shaft **14**.

Thus, as the adjusting ring is turned in a clockwise direction, as viewed in Fig. 5, the adjusting ring **78** and the shoulder **80** move the shaft **24** forward, that is from left to right as viewed in Fig. 1 to thereby obtain a greater clearance between the stator and rotor because of their cone shape.

Extending up from the hollow shaft **14**, I provide the member **82**, the collar **83** of which is secured to the shaft **24** by the set screw **85**. This member **82** is secured to the adjusting ring **78** by the lock nut and bolt **84** inserted in an opening **86** in the ring **78**. This construction prevents the adjusting ring **78** from backing off under the operative rotation of the high speed mill.

Movement of the adjusting ring **78** in a counterclockwise direction, as viewed in Fig. 5, moves the shaft **24** toward the rear, that is from right to left as viewed in Fig. 1 to reduce the clearance between the conical rotor and correspondingly shaped stator.

Thus by proper movement of the adjusting ring **78**, the clearance between the stator and rotor may be selectively fixed so that the desired size of globule or particle in the resulting product may be obtained.

In order to test whether the rotor and stator do not bind, that is, frictionally grip one another, I provide on the end of the internal shaft **24**, the hand wheel **88** secured to the shaft **24** by the set screw **89** and through which the entire assembly including the rotor **44** may be turned.

It will be recognized that the hollow shaft, the internal shaft, the small stuffing box, the adjusting ring and the turning wheel all rotate together and the construction illustrated permits the colloid mill to be run in either direction.

In the construction described, the motor **10** may be provided at the rear with a ball thrust bearing **90**, of the conventional type, locked to the hollow shaft **14** to prevent backward motion of this shaft, that is, from right to left as viewed in Fig. 1. Thus, the entire thrust of the hollow shaft, if any, is forward where it will be of no consequence.

In order to permit the material passing through the mill to more readily flow into the discharge chamber, I prefer to cut the grooves **92** in the end faces of the rotor **44**.

It will now be recognized that I have made possible a colloid mill that is so constructed and arranged that, in effect, only a single shaft is required for both the operating and driving means and the mill and one in which separate bearings for the mill are dispensed with and the requirement of a means to couple the operating shaft and the mill shaft is eliminated with the attendant necessity of aligning and keeping in alignment the two shafts.

It will be further recognized that I have thus provided a colloid mill that is smaller in dimension than previous mills of the same capacity and one that is relatively more compact and of comparatively greater operating strength.

It will still further be recognized that I have provided a colloid mill in which the solid or semisolid material does not collect without being operated upon and thereby produces an end product, the particle or globule size of the materials suspended therein being uniform in magnitude.

While I have described my invention in a preferred embodiment, it is to be understood that modifications thereof may now be made by those skilled in the art and that no limitations upon the invention are intended other than are imposed by the scope of the appended claims.

I claim:

1. In an integral motor driven colloid mill, a motor, a housing for the motor, a colloid mill supported by the motor housing, bearings mounted in the motor housing at each end thereof, a hollow motor shaft mounted for rotation in the bearings, and extending outwardly of the motor shaft, a second shaft for the colloid mill and arranged in the hollow shaft and keyed thereto to permit longitudinal or axial movement of the second shaft with respect to said hollow shaft, a support on the motor housing at one end thereof and extending beyond one of the bearings, said second shaft extending beyond the motor housing into the support, said colloid mill mounted on said support and a rotor in the mill and secured to the end of the second shaft extending beyond the motor housing into the support and driven by said second shaft.

2. The integral motor driven colloid mill of claim 1, said second shaft being spaced inwardly of the hollow shaft and a plurality of spaced flats on said second shaft whereby the said second shaft is spaced inwardly of the hollow shaft.

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