Sept. 5, 1967 R. K. McKIBBEN 3,339,896

STIRRING DEVICE

Filed June 3, 1966

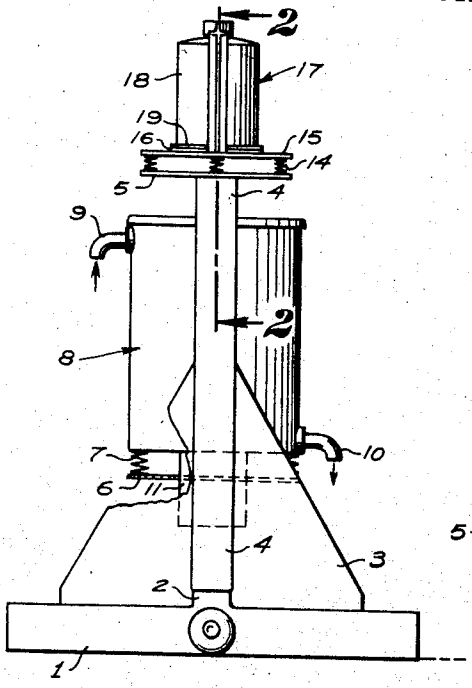

FIG. 1

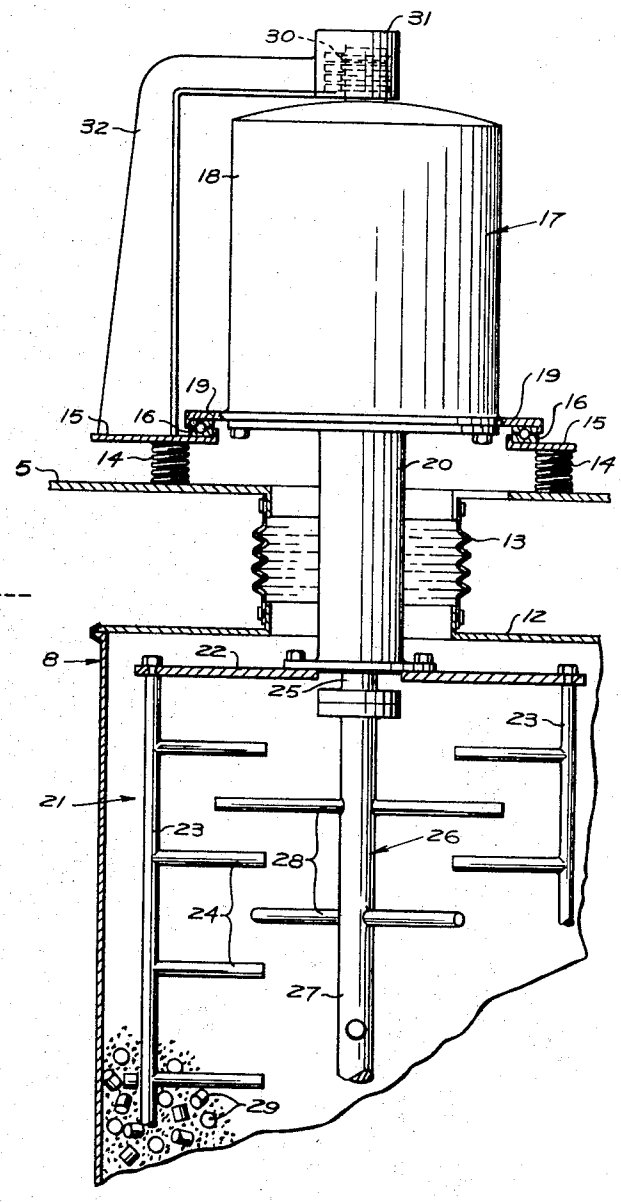

FIG. 2

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United States Patent Office 3,339,896 Patented Sept. 5, 1967

3,339,896

STIRRING DEVICE

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Filed June 3, 1966, Ser. No. 555,127
7 Claims. (Cl. 259—72)

This application is a continuation-in-part of my prior copending application Ser. No. 501,282, filed Oct. 22, 1965, now abandoned.

This invention relates to counter-rotating impeller drives for stirring, blending and mixing devices, and is particularly adapted for incorporation in the type of dispersion mill disclosed in the copending application of John K. Sjogren, application Ser. No. 440,138, filed Mar. 16, 1966, and titled, Means and Method of Treating Material.

In many stirring, blending, mixing and grinding operations it is desired to employ counter-rotating impeller shafts which are vertically disposed in a vessel containing material to be treated, mixed, blended or dispersed. Frequently the mixing or blending device is vertically orientated and is charged with material to be treated when the mixing or blending impeller device is removed from the vessel. The entire impeller drive mechanism is then lowered onto the vessel with the impeller shafts extending into the vessel. Means must be provided to clamp or affix the drive mechanism for the impeller shafts so that it will resist any torque applied by virtue of the fact that the motor casing of the drive motor is ordinarily stationary. Counter-rotating impeller shafts which are frequently used in mixing or blending operations have been driven with separate motors and separate gear drives thus creating a rather cumbersome mechanical aggregation which must be raised and lowered into the treating vessel. It is apparent that a device which applies essentially a zero torque to the mounting means for the drive mechanism would be advantageous in that no sophisticated mounting means would be required to hold the torque mechanism stationary with respect to the vessel.

In the dispersion mill disclosed in application Ser. No. 440,138 it is essential that the drive mechanism for the impeller shafts be independently suspended with respect to the treating vessel because of the independent vibration imparted to the vessel itself.

It is therefore an object of this invention to provide a novel arrangement of counter-roating impeller means useful in mixing, blending and treating apparatus.

Another object of this invention is to provide a counter-rotating impeller shaft and drive means in which essentially zero torque is applied to the means used to mount the drive system and the vessel in which the impellers are immersed.

Still another object of this invention is to provide a counter-rotating impeller drive wherein two sets of impeller or stirring members are immersed in a fluidized charge of grinding or dispersing media and material to be ground or dispersed and rotated in opposite directions in such a manner that no residual torque is applied to the container which receives the charge and the impellers.

A further object of this invention is to provide a novel means of mounting a motor drive which is common to two sets of stirring members, in such a manner that the motor shaft and its set of stirring members may rotate in one direction while the motor casing and its set of stirring members rotates in the opposite direction.

With the above and other objects in view as may appear hereinafter, reference is directed to the accompanying drawings, in which:

FIGURE 1 is a side view of a dispersion mill incorporating the invention.

FIGURE 2 is an enlarged fragmentary sectional view taken through 2—2 of FIGURE 1.

The above and other objects of this invention are in part accomplished by a stirring device comprising a motor including a casing adapted for rotation and a shaft adapted for rotation in a direction opposite the direction in which the casing moves, means for mounting the motor casing for free rotation upon rotation of the shaft, a first set of stirring elements connected to the motor casing, and a secured set of stirring elements connected to the shaft, such that upon activation of the motor the first stirring element rotates in a direction opposite the second stirring element and essentially zero torque is applied to the motor means.

The present invention is particularly adapted to be incorporated in the type of dispersion mill shown in the aforementioned copending application, Ser. No. 440,138, filed Mar 16, 1965. The dispersion mill includes a base frame **1** having a pair of upwardly extending fixed posts **2**, reinforced by gussets **3**. The fixed posts support a pair of extensible posts **4** which are joined together by a top plate **5**.

Supported by the gussets **3** is a mounting plate **6** on which is mounted a ring of springs **7** which support a cylindrical container **8**. The container is provided with a fluid inlet **9** near its upper end and a fluid outlet **10** near its lower end.

The mounting plate **6** is provided with a central aperture and a vibrating unit **11** is suspended from the container **8** and extends through the aperture. The vibrating unit per se may be considered as conventional and comprises a motor having an eccentric weight at one or both ends thereof.

The upper end of the container is provided with a removable cover **12** connected by a flexible sleeve **13** to the top plate **5**. The top plate is provided with an aperture within the flexible sleeve **13** and supports a ring of springs **14** disposed concentrically with respect to the sleeve **13**. The springs, in turn, support a mounting ring **15** on which is mounted a relatively large bearing **16**.

A motor **17** is provided which includes a casing **18** terminating in a flange **19** which is supported on the bearing **16** so that the casing is free to rotate.

Secured to the casing **18** is a sleeve **20** which extends downwardly through the flexible sleeve **13** into the container **8**. The lower end of the sleeve is joined to an outer stirring unit **21** which includes an end plate **22** joined to the sleeve **20** and from it depends a cage of rods **23**. The lower ends of the rods **23** are joined to a second end plate, not shown, similar to the end plate **22**. Extending radially inwardly from the rods **23** are rows of stirring fingers **24**.

The motor **17** is provided with a centered shaft **25** which extends downwardly through the sleeve **20** and is joined to an inner stirring unit **26** which includes a central bar **27** continuing axially from the shaft **25**. The bar **27** is provided with sets of radially outwardly extending stirring fingers **28** which preferably overlap radially the stirring fingers **24**, but are axially spaced therefrom so that one set of stirring fingers moves between the other set of stirring fingers.

The container is adapted to be filled with grinding or finishing media **29** which may vary considerably depending on the nature of the grinding or finishing to be accomplished; for example, the media may comprise ceramic cylinders. Such a media is particularly useful for grinding operations. The ceramic media, if used, need not be limited to cylindrical shapes, but may take other forms.

The container also receives the material to be treated which may be material to be ground, or may be pieces to be deburred or polished.

Current is supplied to the motor through a contact and slip ring unit **30** mounted on the top of the motor **17**. The unit is contained in the housing **31** supported by a bracket **32** extending laterally and then downwardly to the mounting ring.

Operation of the impeller drive is as follows:

The vibration unit **11** subjects the contents of the container to high frequency, high intensity vibration. If the contents comprise grinding media and material to be ground or reduced in particle size, the high frequency, low amplitude impact between pieces of media is particularly effective in reducing the particles of material to micron size. If the contents comprise a deburring or finishing media and work pieces, the high frequency, low amplitude impact is also effective. In addition to the impact effect, there is a relatively slow churning and precession movement of the contents, and the contents, with or without the presence of a liquid, are maintained in a fluid state, materially enhancing movement of the stirring fingers through the media and material to be ground or work pieces.

When the motor **17** is started, a reaction force is produced between the motor shaft **25** and the casing **18**. This causes the outer stirring unit **21** to rotate in one direction while the inner stirring unit **26** rotates in the opposite direction. The rate of rotation of either unit depends upon the resistance encountered. Normally, the outer stirring **21** encounters greater resistance than the inner stirring unit **26** so that the inner stirring unit **26** rotates at a higher speed.

Due to vibration of the container **8**, the contents are maintained in a fluid state and the friction between the contents and the walls of the container is minimized.

Also, due to the fact that the rotation of each stirring unit is dependent on the counter rotation of the other, the stirring means do not transmit any torsional force to the container except the relatively nominal frictional force between the fluidized contents and the container. This is highly important for the container is supported solely by the springs **7** which are not suited to resist torsional forces on the container **8**.

The stirring fingers thoroughly mix and disperse the media and material or media and work pieces. Furthermore, they materially increase a shearing action between the components of the mixture in the container. Still further, the stirring fingers produce a relatively low frequency impact between the components of the mixture. These three effects due to the stirring action superimposed on the vibrating action materially increase the effeciency of the mill.

Although the invention has been described in detail with respect to its utilization with the dispersion mill disclosed in application Ser. No. 440,138, it is to be understood that the slip ring and equal torque-double agitator mixer drive of this invention has application to any mixer and blender where counter-rotation of the impeller shafts is desirable. It has particular application to any such device where the motor and impeller assembly are top suspended, that is projected into a mixing vessel from the top portion thereof and must be lowered into the mixing vessel for operation. The counter-rotating impeller drive of this invention greatly simplifies the problem of securing the drive mechanism either independently of the vessel into which it is lowered, or securing it to the vessel in which the mixing or blending is taking place. Thus, the mounting means for freely rotating the motor casing may in certain cases be integral with the lid or cover of a blending vessel without the requirement that the vessel cover be absolutely securely affixed to the body of the vessel. In operation of the device the torque applied to the mounting means and to the side walls of the vessel is extremely low and there is essentially no tendency for either vessel itself or the mounting means of the impeller drive to rotate or torque.

Thus the device of this invention has application to blending applications which do not utilize the vibratory motion disclosed in application Ser. No. 440,138.

While a particular embodiment of this invention has been shown and described, it is not intended to limit the same to the details of the construction set forth, but instead, the invention embraces such changes, modifications and equivalents of the various parts and their relationships as come within the purview of the appended claims.

I claim:

1. A machine for treating material comprising:
(a) A vertically dispersed container, and
(b) stirring means comprising:
(1) A motor including a casing and a shaft rotatable in opposite direction;
(2) bearing means for mounting said motor casing above said container for free rotation;
(3) a first set of stirring elements connected to said casing and extending into said container for rotation therein; and
(4) a second set of stirring elements connected to said shaft and extending into said container for rotation therein.

2. In a machine for causing media to treat material by interaction between media and material, wherein a container receives the media and material, and means are provided to vibrate the container and its contents, of a stirring means, operable while said container is vibrating, said stirring means comprising:
(a) A first stirring unit peripherally disposed in said container;
(b) a second stirring unit including a central rod and stirring fingers extending radially outwardly therefrom the fingers of said stirring units being in radially overlapping and axially clearing relation;
(c) means for rotating said second stirring unit; and
(d) means responsive to the resistance encountered in rotation of said second stirring unit to cause rotation of said first stirring unit in the opposite direction.

3. The machine of claim **2**, wherein:
(a) Said rotating means comprises a motor including a casing and a shaft rotatable in opposite direction;
(b) said responsive means comprises bearing means for mounting said motor casing above said container for free rotation;
(c) said first stirring unit comprises elements connected to said casing and extending into said container for rotation therein; and
(d) said second stirring unit comprises elements connected to said shaft and extending into said container for rotation therein.

4. The machine of claim **3**, wherein:
(a) Said first set of stirring elements comprises;
(1) a sleeve joined to said motor casing and extending into said casing;
(2) a cage of vertical rods joined to said sleeve and disposed adjacent the walls of said container; and
(3) a set of stirring fingers extending radially inwardly from said walls; and
(b) Second set of stirring elements comprises;
(1) a central bar connected to said motor shaft and extending into said container along the axis thereof; and
(2) a second set of stirring fingers extending radially outward from said bar, and sets of fingers being rotatable in opposite directions by said motor casing and motor shaft.

5. A machine for causing media to treat material by interaction between the media and material, comprising:
(a) A container adapted to receive a freely movable media and material to be treated;
(b) yieldable means for supporting said container and its contents;
(c) means for subjecting said container to vibration;

(d) a motor including a casing and a shaft rotatable by mutual reaction, in opposite directions;

(e) a bearing for journalling said motor casing;

(f) yieldable means for supporting said bearing and said motor over said container in coaxial relation therewith; and

(g) sets of counter-rotating stirring elements affixed respectively to said motor shaft and to said motor casing.

6. The machine of claim **5**, wherein said sets of counter-rotating stirring elements comprise:

(a) First stirring means including a cage of rods connected to said motor casing and peripherally disposed in said container and stirring fingers extending radially inwardly from said rods; and

(b) a second stirring means including a bar connected to said shaft and stirring fingers extending radially outwardly from said bar; said stirring means being rotatable in opposite direction by the reaction force generated between said motor shaft and motor casing.

7. A stirring device comprising:

(a) A first driven stirring unit comprising a set of stirring elements connected to a shaft;

(b) driving means for rotating said driven stirring unit, said means comprising a motor, including a casing and said shaft, said shaft and said casing rotatable in opposite directions;

(c) a second stirring unit comprising a set of stirring elements connected to said casing through a sleeve depending from said casing; and

(d) means responsive to the resistance encountered in rotation of said stirring unit to cause rotation of said casing in the opposite direction, said responsive means comprising bearing means for mounting said motor casing for free rotation.

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