

[54] **HOMOGENIZER-MIXER**

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[58] **Field of Search**..... 259/95, 96, 107, 108;
415/149, 126, 157, 158; 417/424

[56] **References Cited**

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[57]

ABSTRACT

A homogenizer-mixer characterized by umbrella and vortical flow patterns includes a high speed rotor and a stator disposed along a common axis. The rotor is formed with a plurality of vanes at a lower end defining a bladed portion. The stator has a fixed body and a mating head movable for engagement and disengagement with the fixed body. The blades are surrounded by the mating head in the engaged position and are exposed when the mating head and fixed body are disengaged. With the rotor rotating at high speed and the mating head in the energized position, liquid in a vessel is drawn through an opening in the lower face of the head and is directed through passages in the body towards a deflector plate which disperses the liquid into an umbrella flow pattern. With the rotor rotating at high speed and the mating head in the disengaged position, the umbrella flow pattern is converted to a vortical flow pattern.

15 Claims, 5 Drawing Figures

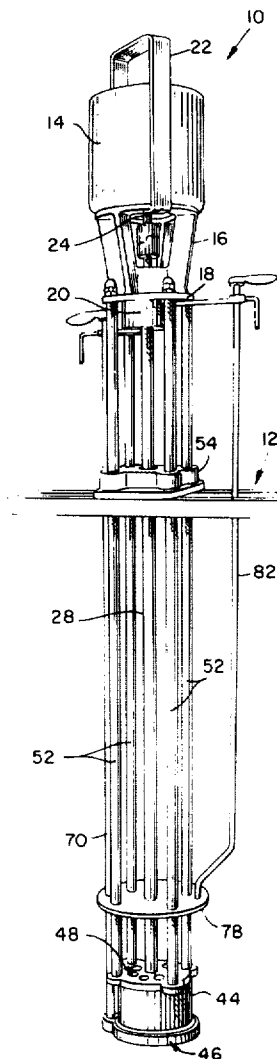


FIG. 1

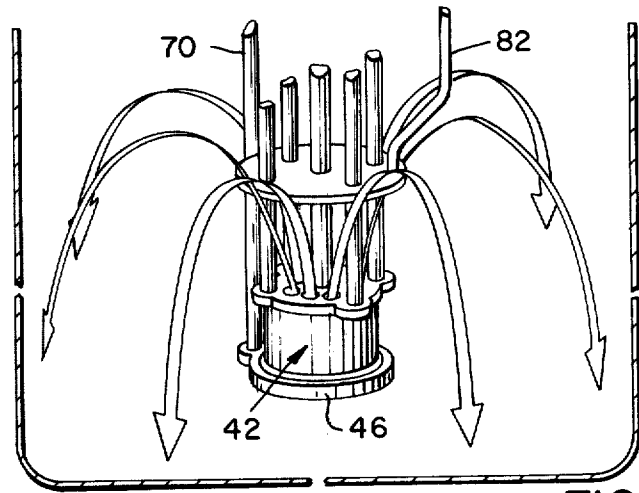
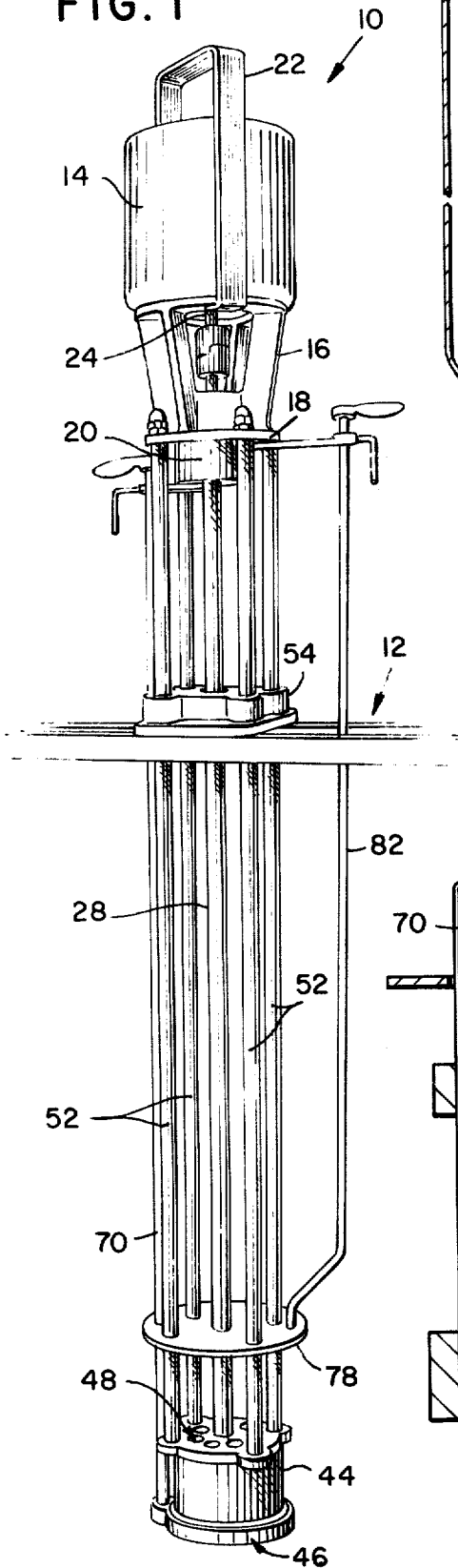


FIG. 4

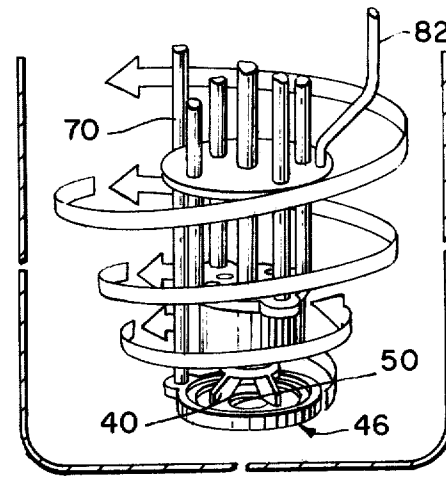


FIG. 5

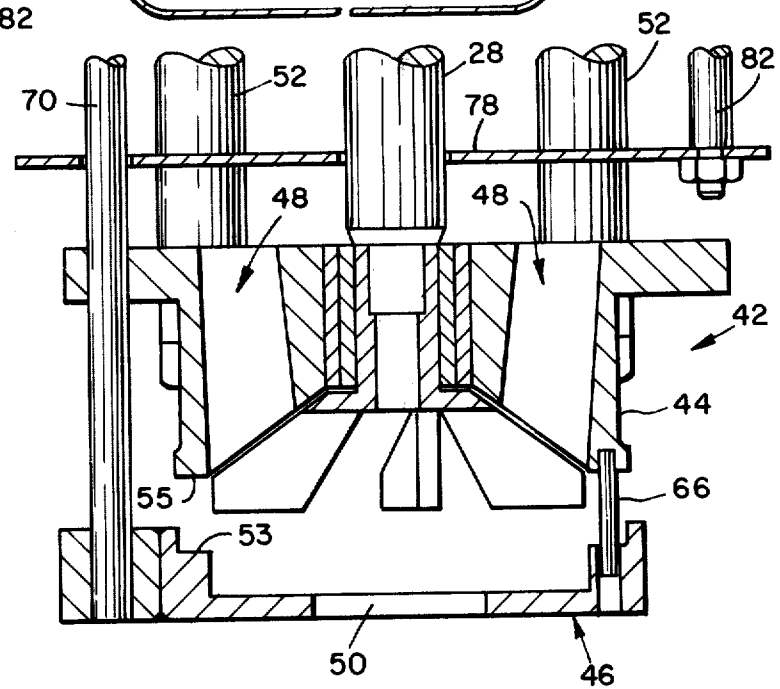


FIG. 3

HOMOGENIZER-MIXER

BACKGROUND OF THE INVENTION

1. Field of Invention

The present invention relates to homogenizer-mixers and, more particularly, is directed towards homogenizer-mixers capable of producing umbrella and vortical flow patterns.

2. Description of the Prior Art

Mixers of various types have been used for blending and homogenizing of materials through a wide range of viscosities. The turbine mixer produces a flow pattern for dispersions and emulsions with minimum entrainment of air in the mix. Propeller mixers produce a flow pattern particularly adapted to wet out dry powders. Turbine mixers suffer from the disadvantage of minimum wetting out of dry powders and propeller mixers suffer from the disadvantage of minimum refinement of solids and globules.

SUMMARY OF THE INVENTION

It is an object of the present invention to provide a homogenizer-mixer which overcomes the heretofore mentioned and other disadvantages. The homogenizer-mixer is characterized by a high speed rotor and a fixed stator disposed along a common axis. The rotor includes a plurality of vanes defining a bladed structure at a lower end thereof. The stator includes a fixed body and a mating head movable for engagement and disengagement with a lower portion of the fixed body. The blades are surrounded by the mating head when the head and body are engaged and the blades are exposed when the head and body are disengaged. With the rotor rotating at high speed and the mating head in the disengaged position, a liquid in a vessel is made to flow in a vortical pattern for wetting out. The mating head is raised into engagement with the fixed body and the liquid is drawn through an opening formed in the lower face of the head and is directed towards a deflector plate mounted above the head and is dispersed into an umbrella pattern for complete dispersion and emulsion. The arrangement is such as to provide a homogenizer-mixer that is capable of producing and converting between a vortical flow pattern for wetting out and an umbrella flow pattern for complete dispersion and emulsion with minimum entrainment of air in the mix.

Other and further objects of the present invention will in part be obvious and will in part appear hereinafter.

The invention accordingly comprises the device possessing the construction, combination of elements, and arrangement of parts that are exemplified in the following detailed disclosure, the scope of which will be indicated in the appended claims.

BRIEF DESCRIPTION OF THE DRAWINGS

For a fuller understanding of the nature and objects of the present invention, reference should be had to the following detailed description taken in connection with the drawings wherein:

FIG. 1 is a perspective view, of a homogenizer-mixer constructed in accordance with the present invention;

FIG. 2 is a perspective view, partly in cross section, of the homogenizer-mixer of FIG. 1 with the stator in the engaged position;

FIG. 3 is a cross-sectional view of the working end of the homogenizer-mixer of FIG. 1 with the stator in the disengaged position;

FIG. 4 is a schematic representation of an umbrella flow pattern; and

FIG. 5 is a schematic representation of a vortical flow pattern.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now to the drawings, particularly FIG. 1, there is shown a homogenizer-mixer 10 embodying the present invention in the form of a high speed, turbine stator, batch type homogenizer-mixer that is adapted to be suspended by means of a support 12 from the top of a vessel containing a mix. Homogenizer-mixer 10 is designed primarily for producing and converting between a vortical flow pattern and an umbrella flow pattern for complete dispersion and emulsion with minimum air entrainment in the mix.

Homogenizer-mixer 10 comprises a motor 14 that is carried on a support 16 which is secured to a flange 18 of a bearing housing 20. A strap 22 defining a handle for carrying and positioning homogenizer-mixer 10 is mounted to support 16. An output shaft 24 of motor 14 is connected through a coupling 26 to a shaft 28 which passes through bearing housing 20 and is journaled by bearings 30,32. A seal ring 34 is retained at the lower end of bearing housing 18 by means of a thrust cap 36. A rotor 38 having a plurality of chordally projecting vanes 40 is mounted to the free end of shaft 28. Rotor 38 is surrounded by a stator 42 having a fixed body 44 and a movable head 46, an internal cavity 47 formed between body 44 and head 46. A sleeve 47 and a stator bushing 50 are interposed between rotor 38 and stator 42. Movable head 46 is formed with an inner annular shoulder 53 which mates with a lower shoulder 55 of fixed body 44. The upper face of stator 42 is disposed in a plane that is substantially perpendicular to the axis of rotation, the lower face of stator 42 is tapered upwardly and inwardly from shoulder 55 towards shaft 28. A portion of the outer edge of each vane 40 is disposed in close proximity and in parallel relationship with the lower face of stator 42, the remaining portion of the outer edge of each vane 40 is disposed in a plane that is disposed in registration with the inner edge of shoulder 55 and in parallel relationship with the longitudinal axis of shaft 28. The inner edge of each vane 40 is disposed in a plane that diverges downwardly with respect to the plane of the lower face of stator 42. The bottom edge of each vane 40 is in perpendicular relationship with the axis of rotation. The upper face of stator 42 is disposed in a plane that is substantially perpendicular to the axis of rotation, the lower face of stator 42 is tapered upwardly and inwardly from shoulder 55 towards shaft 28. A portion of the outer edge of each vane 40 is disposed in close proximity and in parallel relationship with the lower face of stator 42, the remaining portion of the outer edge of each vane 40 is disposed in a plane that is disposed in registration with the inner edge of shoulder 55 and in parallel relationship with the longitudinal axis of shaft 28. The inner edge of each vane 40 is disposed in a plane that diverges downwardly with respect to the plane of the lower face of stator 42. The bottom edge of each vane 40 is in perpendicular relationship with the axis of rotation. The outer edges of vanes 40 are closely adjacent

to the inner surface of head 46. Body 44 is formed with an annular array of passages 48 and head 46 is formed with an orifice or mouth 50 having a diameter which corresponds to the diameter of a locus of revolution described by the lower inner corners of vanes 40.

Motor 14, rotor 38, and stator 42 are held in fixed relationship by means of a plurality of supporting rods 52 that extend between flange 18 and body 44. A bridge plate 54 which carries support 12 is mounted to rods 52 and secured thereto by means of a clamp screw 56. A pair of slidable space blocks 58 and 60 are mounted to bridge plate 54, space blocks 58 and 60 being provided with inner annular shoulders 62 and 64, respectively, that rest on the upper rim of the vessel when homogenizer-mixer 10 is suspended.

Head 46 is axially movable between an engaged position shown in FIG. 2 and a disengaged position shown in FIG. 3, head 46 being in the engaged position when in mating relationship with body 44 and in the disengaged position when separated therefrom. Head 46 is slidable along a guide pin 66 vertically extending from a lower face of body 44. Head 46 is moved by means of a handle 68 that is connected to one end of a rod 70, the other end of rod 70 being pinned to a flange 72 of head 46. Rod 70 passes through a bar 74 that is bolted to the lower side of bearing housing 18. An angle clamp screw 76 is threaded into bar 74 for locking the position of head 46 relative to body 44.

An axially movable deflection plate 78 is positioned above stator 42, the deflection plate being slidable along rods 52. Deflection plate 78 is movable by means of a handle 80 that is connected to one end of an offset rod 82 the other end of rod 82 being attached to deflector plate 78. Rod 82 passes through a bar 84 that is mounted to the underside of flange 18. An angle clamp screw 86 is threaded into bar 84 for locking the position of deflector plate 78 relative to stator 42.

The rotor-stator arrangement hereinbefore described is such that homogenizer-mixer 10 is capable of producing and converting between an umbrella flow pattern and an intense vortical flow pattern. When head 46 is in the engage position shown in FIG. 2 and rotor 38 is turning at high speed, for example 3550 to 8000 rpm, liquid from the bottom of the vessel is drawn through mouth 50 and is directed through passages 48. The flow continues upwardly and impinges on deflector plate 78 which disperses the flow outwardly and downwardly into an umbrella pattern as suggested in FIG. 4. The umbrella pattern entrains a minimum of air in the mix and draws solid from the bottom of the vessel and disperses them.

When head 46 is in the disengaged position shown in FIG. 3 and rotor 38 is turning at high speed, the umbrella flow pattern is converted to a vortical flow pattern as suggested in FIG. 5. Head 46 is moved to the disengaged position by simply flipping angle screw 76 and lowering head 46 by handle 68 to create a vortex. Floatable powders or oils introduced into the vortex are immediately dispersed. Head 46 can now be raised and locked in the engaged or up position which converts the flow to an umbrella pattern for complete dispersion without air entrainment. The variable flow patterns produced by homogenizer-mixer 10 is particularly useful for producing a gum dispersion. Gums, such as carboxy methyl cellulose, tragacanth, accacia and the like, which are fine, dry powders that are hard to wet out, but once wetted out produce a thick gelatinu-

ous, viscous solution which entrains air readily. With the homogenizer-mixer of the present invention, it is possible to wet out and disperse such powders without air entrainment by utilizing two distinctly different flow patterns.

Since certain changes may be made in the foregoing disclosure without departing from the scope of the invention herein involved, it is intended that all matter contained in the above description and depicted in the accompanying drawings be construed in an illustrative and not in a limiting sense.

What is claimed is:

1. A device for mixing a liquid in a vessel, said device comprising:

- a. a frame disposed along an axis, and
- b. means for producing flow patterns, said means including:
 - i. a shaft disposed for rotation along said axis within said frame, said shaft having projecting vanes disposed for rotation about said axis,
 - ii. a stator mounted to said frame and disposed about said axis, said stator having a body and a head, said body and said head axially movable with respect to each other between first and second positions, said body and said head being engaged when in said first position and disengaged when in said second position, said vanes disposed within said stator when said head and said body are in said first position, at least a portion of said vanes exposed when said head and said body are in said second position, and
 - iii. drive means mounted to said frame and operatively connected to said shaft, said drive means rotating said shaft,
- c. with said vanes rotating and said body and said head in said first position, said device produces a first flow pattern;
- d. with said vanes rotating and said body and said head in said second position, said device produces a second flow pattern, said first flow pattern distinguishable from said second flow pattern.

2. The device as claimed in claim 1 wherein said first flow pattern is an umbrella flow pattern and wherein said second flow pattern is a vortical flow pattern.

3. The device as claimed in claim 1 wherein said means for producing flow patterns includes deflector means mounted to said frame about said axis and wherein said body and said head are formed with communicating holes, with said vanes rotating and said head and said body in said first position, liquid from the bottom of said vessel is drawn through said holes and directed towards said deflector means which disperses the liquid towards the sides and bottom of said vessel into said first flow pattern, said first flow pattern being an umbrella flow pattern.

4. The device as claimed in claim 1 wherein said means for producing flow patterns includes positioning means operatively connected to said head means for moving said head means between said first position and said second position.

5. The device as claimed in claim 1 wherein said frame includes support means for suspending said device from the top of said vessel.

6. The device as claimed in claim 1 wherein said body is formed with at least one passage and wherein said head is formed with a mouth, said passage communicating with said mouth.

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7. The device as claimed in claim 6 wherein said means for producing flow patterns includes deflector means mounted to said frame about said axis, said deflector means disposed between said drive means and said body, when said body and said head are in said first position and said vanes are rotating, liquid from the bottom of said vessel is drawn in a flow through said mouth and directed through said passage towards said deflector means which is operative to disperse the flow into an umbrella flow pattern.

8. A device for mixing a liquid in a vessel, said device comprising:

- a. a frame disposed along an axis;
- b. a shaft disposed for rotation along said axis;
- c. a rotor mounted to said shaft, said rotor disposed for rotation along said axis, said rotor including projecting vanes;
- d. a stator mounted to said frame, said stator disposed about said rotor, said stator including a body and a head, an internal cavity formed between said body and said head, the outer edges of said vanes in close proximity with the inner surface of said stator, said body formed with at least one passage, said head formed with at least one aperture, said head axially movable between a first position and a second position, said head and said body in contact with said head is in said first position, said head and said body separated when said head is in said second position, said vanes disposed in said interior cavity when said head is in said first position, a portion of said vanes exposed when said head is in said second position;
- e. deflector means mounted to said frame about said axis, said deflector means disposed above said stator; and
- f. drive means mounted to said frame and operatively connected to said shaft, said drive means rotating said rotor and said vanes;
- g. with said vanes rotating and said head in said first position, the liquid in the bottom of said vessel is drawn in a flow through said aperture and directed through said passage towards said deflector plate which disperses the flow into an umbrella flow pattern;
- h. with said vanes rotating and said head in said second position, said device produces a vortical flow pattern.

9. The device as claimed in claim 8 wherein an upper face of said body is in a plane that is substantially perpendicular to said axis, a lower face of said body tapering upwardly and inwardly towards said axis.

10. The device as claimed in claim 9 wherein an upper portion of the outer edge of each said vane is disposed in close proximity and in parallel relationship with the lower face of said body, the remaining portion of the outer edge of each said vane is disposed in spaced parallel relationship with said axis, an inner edge of each said vane is disposed in a plane that diverges downwardly with respect the plane of the lower face of said stator, a lower edge of each said vane is disposed in a plane that is in perpendicular relationship with said axis.

11. A device for mixing a liquid in a vessel, said device comprising:

- a. a frame disposed along an axis;

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- b. a shaft disposed for rotation along said axis;
- c. a rotor mounted to said shaft, said rotor disposed for rotation along said axis, said rotor including projecting vanes;
- d. a stator mounted to said frame, said stator disposed about said rotor, said stator including a body and a head, an internal cavity formed between said body and said head, the outer edges of said vanes in close proximity with the inner surface of said stator, said body formed with an annular array of passages, said head formed with at least one aperture, said head axially movable between a first position and a second position, said head and said body in contact with said head is in said first position, said head and said body separated when said head is in said second position, said vanes disposed in said interior cavity when said head is in said first position, a portion of said vanes exposed when said head is in said second position;
- e. means operatively connected to said frame and said head for moving said head between said first and second positions;
- f. deflector means mounted to said frame about said axis, said deflector means disposed above said stator; and
- g. drive means mounted to said frame and operatively connected to said shaft, said drive means rotating said rotor and said vanes;
- h. with said vanes rotating and said head in said first position, the liquid in the bottom of said vessel is drawn in a flow through said aperture and directed through said passages towards said deflector plate which disperses the flow into an umbrella flow pattern.
- i. with said vanes rotating and said head in said second position, said exposed vanes producing a vortical flow pattern.

12. The device as claimed in claim 11 wherein said body is formed with a shoulder at a lower portion thereof and wherein said head is formed with a shoulder at an upper portion thereof, said shoulders in mating contact when said head is in said first position.

13. The device as claimed in claim 12 wherein an upper face of said body is in a plane that is substantially perpendicular to said axis, a lower face of said body tapering upwardly and inwardly towards said axis.

14. The device as claimed in claim 13 wherein an upper portion of the outer edge of each said vane is disposed in close proximity and in parallel relationship with the lower face of said body, the remaining portion of the outer edge of each said vane is disposed in spaced parallel relationship with said axis, an inner edge of each said vane is disposed in a plane that diverges downwardly with respect the plane of the lower face of said stator, a lower edge of each said vane is disposed in a plane that is in perpendicular relationship with said axis.

15. The device as claimed in claim 14 wherein said means for moving includes a positioning member and a guiding member, said positioning member slidably received in said frame and fixed to said head, said guiding member slidably received in said head and fixed to said body.

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