United States Patent [19]

Bard

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[45] **July 10, 1973**

[54] **TURBINE MIXER**

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[22] Filed: **Oct. 28, 1971**

[21] Appl. No.: **193,275**

[52] **U.S. Cl.** **259/96**

[51] **Int. Cl.** **B01f 5/16**

[58] **Field of Search** 259/95, 96, 107, 259/108

[56] **References Cited**

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Assistant Examiner—Philip R. Coe
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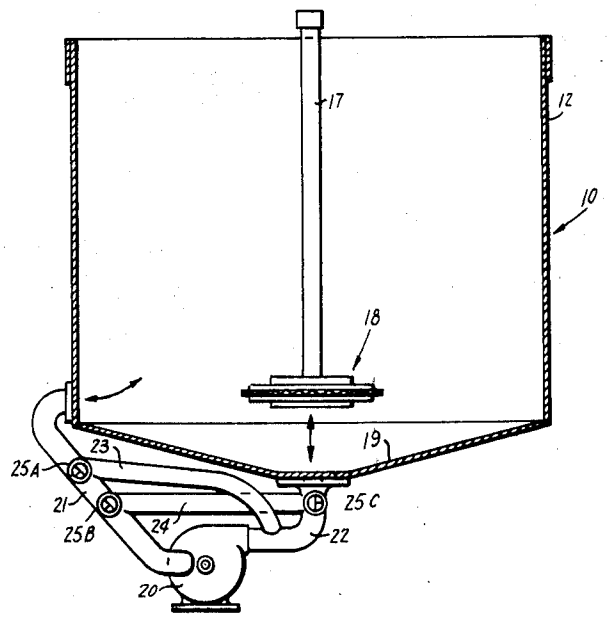
[57] **ABSTRACT**

A turbine mixer in which a turbine type impeller is immersed in a vat containing liquids and solids to be mixed. The turbine when rotating in liquids of differing viscosities tends to either produce a vortex or open space such as would starve the intake side of the turbine and prevent its operation or overfill the vortex producing excessive load factors. A pump is provided to draw material either from the side of the vat or from the bottom of the vortex and pump it to the opposite position to control the vortex so as to be filled to the desired depth.

10 Claims, 13 Drawing Figures



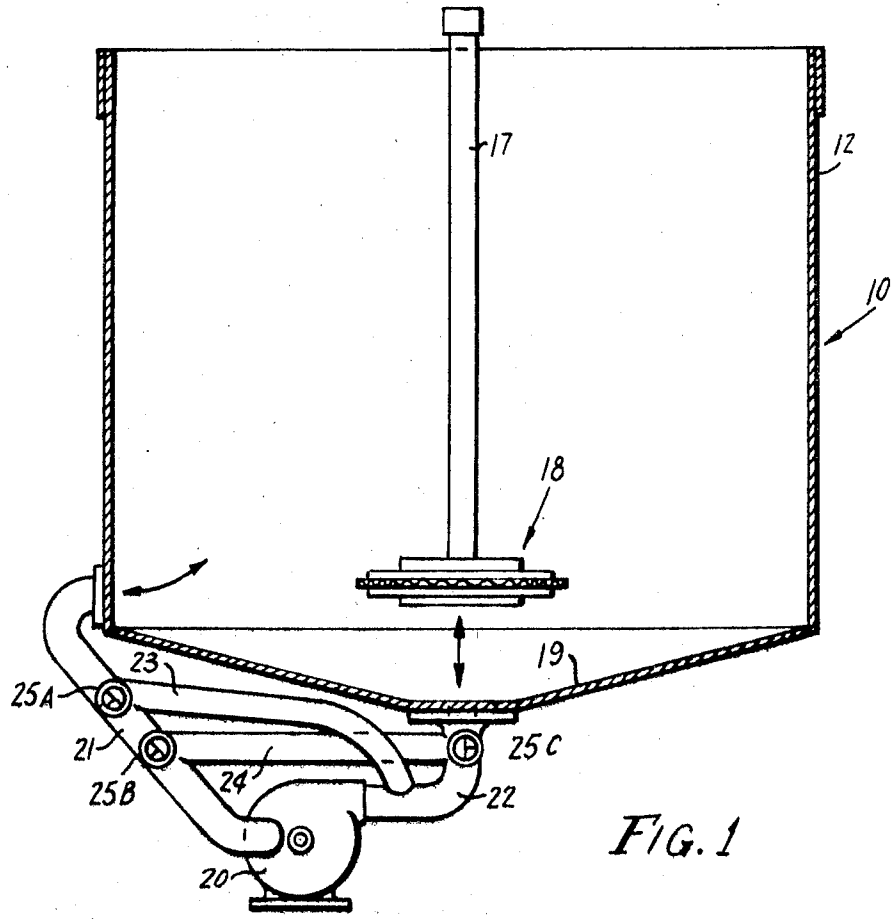


FIG. 1

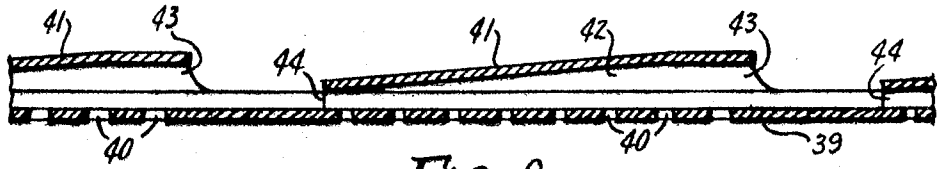


FIG. 8

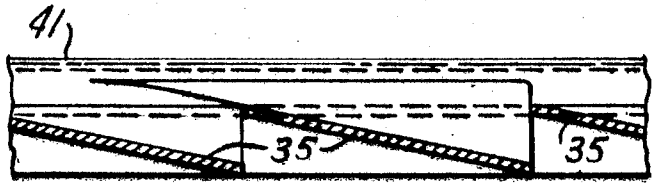


FIG. 9

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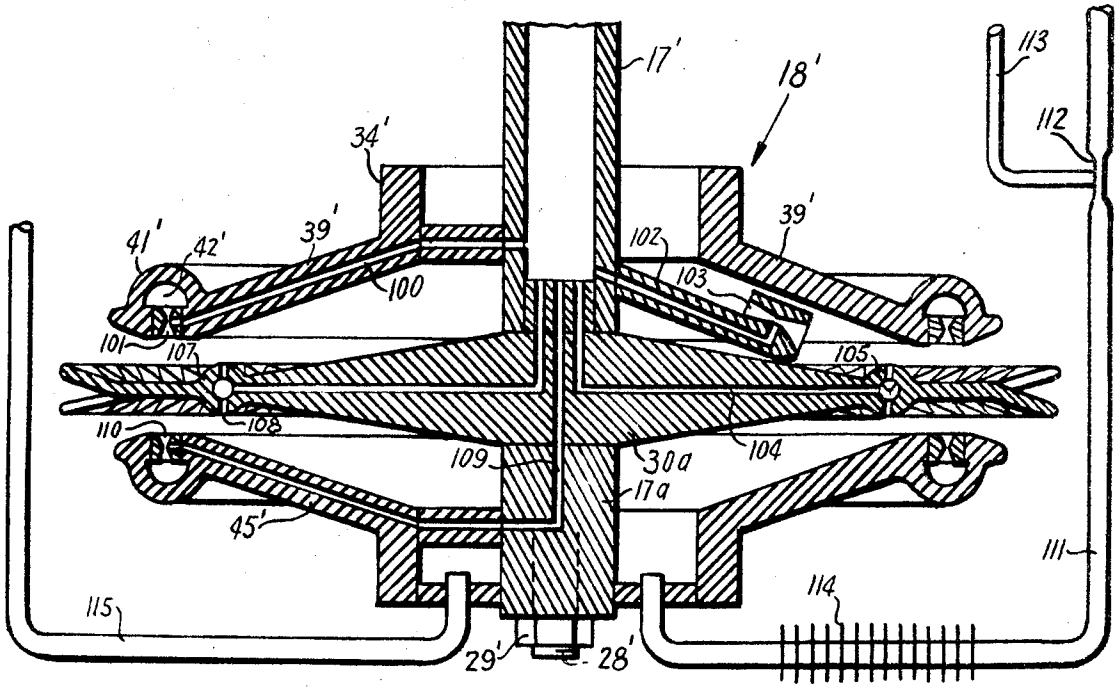

FIG. 13

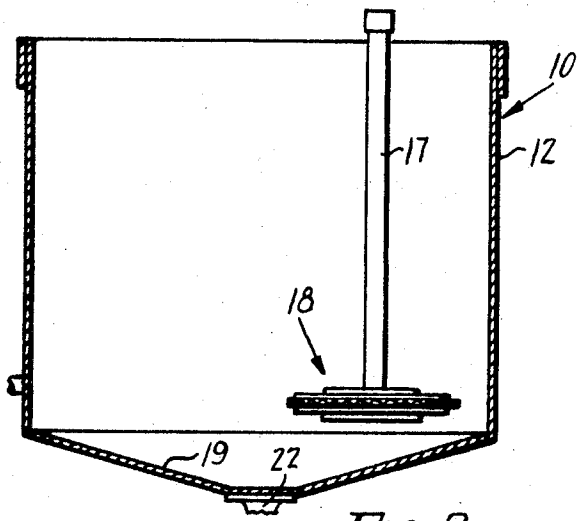

FIG. 2

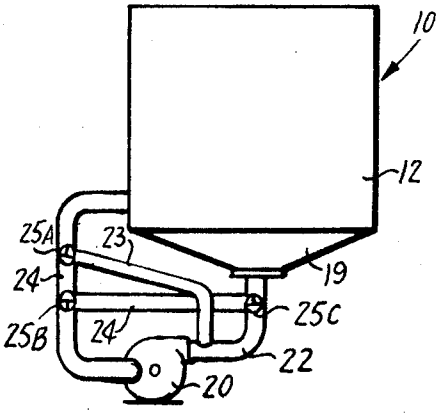

FIG. 3

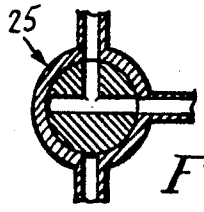

FIG. 4

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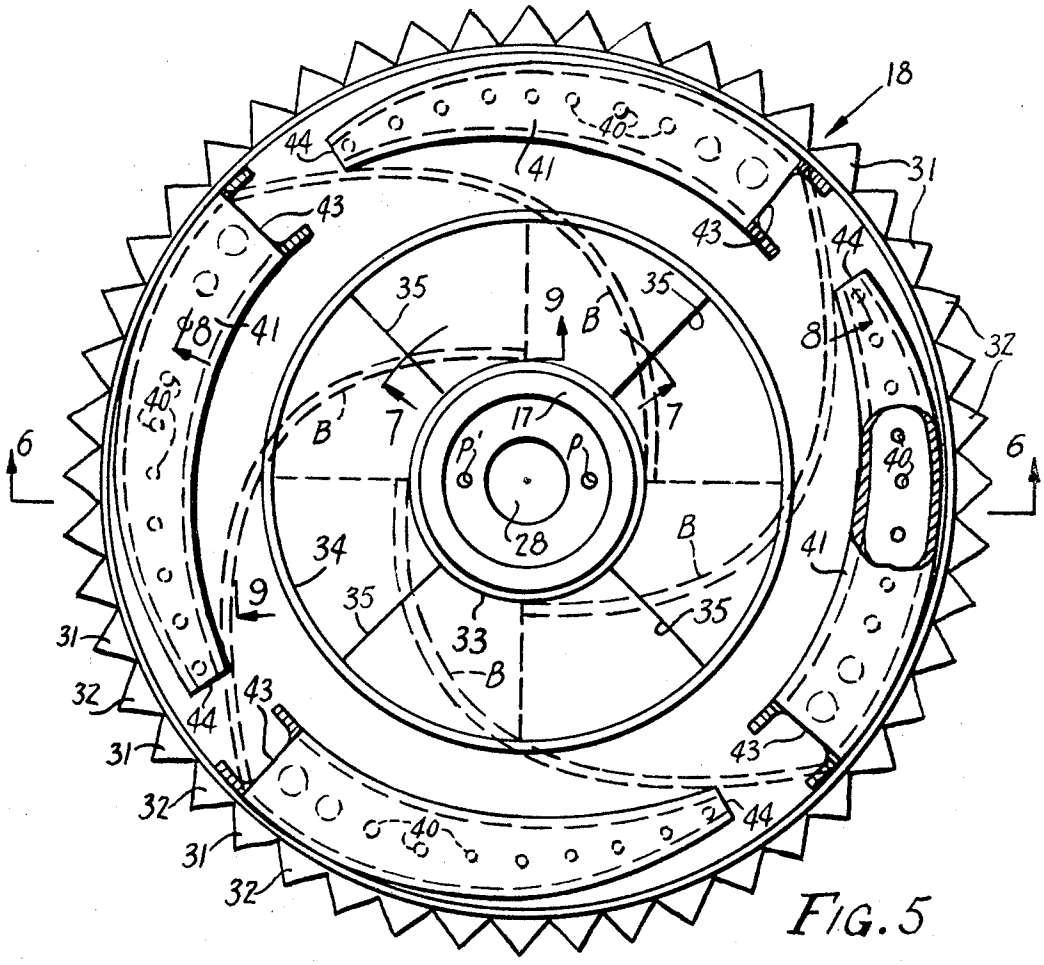

FIG. 5

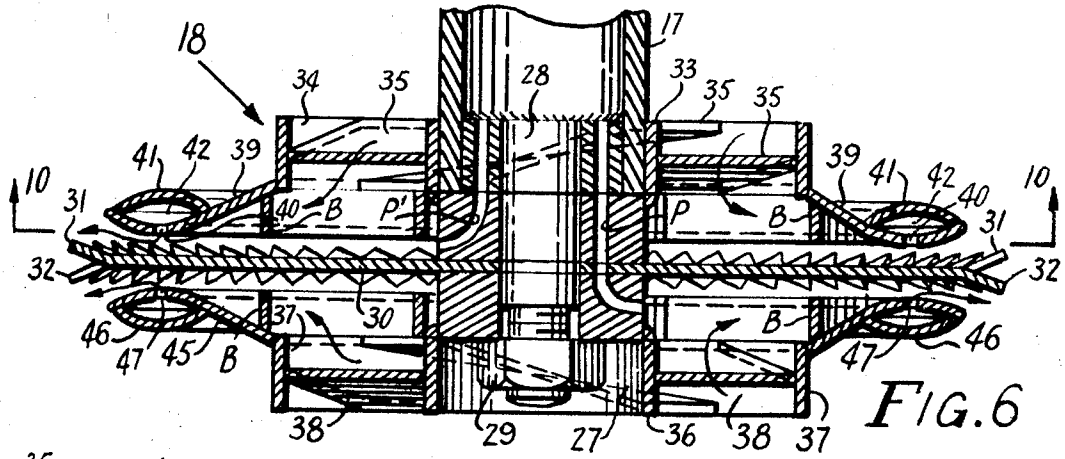

FIG. 6

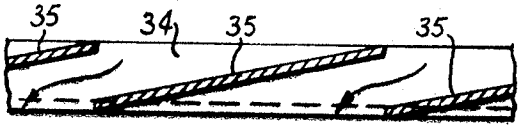

FIG. 7

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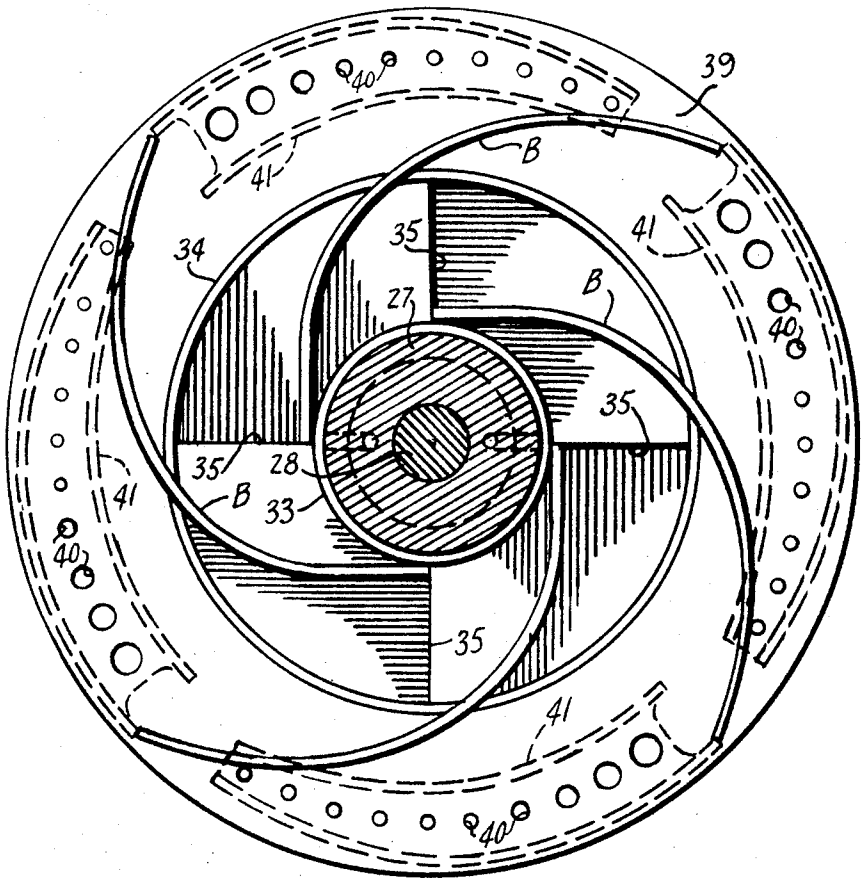

FIG. 10

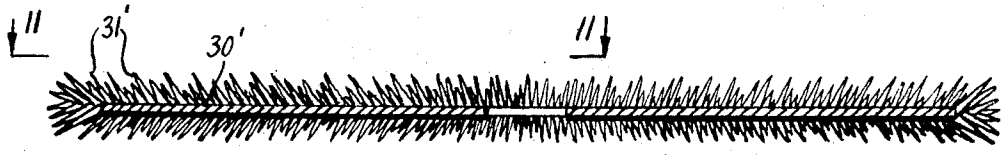

FIG. 12

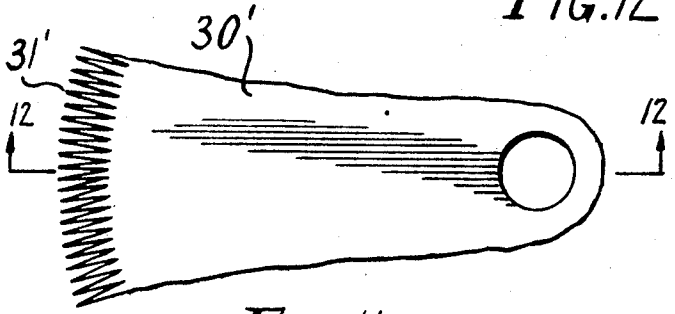

FIG. 11

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TURBINE MIXER

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to rotary mixers of the type for dispersing solids in a fluid.

2. Summary of the Invention

The present invention is directed to a rotary mixer in which a turbine type mixer element is rotated in a vat containing solids and liquids to be thoroughly mixed. The rotating mixing element is of a turbine type and with some viscosities of liquid will normally produce a vortex or hollow as mixing progresses, with other viscosities the vortex is too full. A pump is provided for pumping a part of the contents of the vat from the edge thereof to the center underlying the vortex or in a reverse direction to control the vortex.

The primary object of the invention is to provide a turbine mixer combined with a vortex control system.

Other objects and advantages will become apparent in the following specification when considered in the light of the attached drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a vertical sectional view through the invention;

FIG. 2 is a transverse sectional view through the invention;

FIG. 3 is a side elevation of the invention;

FIG. 4 is a sectional view of one of the control valves;

FIG. 5 is a top plan view of the turbine mixer element shown partially broken away and in section for convenience of illustration;

FIG. 6 is a fragmentary vertical sectional view taken along the line 6—6 of FIG. 5 looking in the direction of the arrows;

FIG. 7 is an enlarged fragmentary sectional view taken along the line 7—7 of FIG. 4 looking in the direction of the arrows;

FIG. 8 is an enlarged fragmentary vertical sectional view taken along the line 8—8 of FIG. 5 looking in the direction of the arrows;

FIG. 9 is an enlarged fragmentary vertical sectional view taken along the line 9—9 of FIG. 5 looking in the direction of the arrows;

FIG. 10 is a transverse sectional view taken along the line 10—10 of FIG. 6, looking in the direction of the arrows;

FIG. 11 is a top plan view of a modified disk;

FIG. 12 is a vertical sectional view taken on the line 12—12 of FIG. 11 looking in the direction of the arrows; and

FIG. 13 is a vertical sectional view of modified air feeding systems of the invention.

BRIEF DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now to the drawings in detail wherein like reference characters indicate like parts throughout the several figures the reference numeral 10 indicates generally a turbine mixer constructed in accordance with the invention.

The turbine mixer 10 includes a vat 12 having a mixer shaft 17 mounted conventionally therein on one side thereof. A turbine mixer element generally indicated at 18 is secured to the lower end of the shaft 17.

The vat 12 has a conical bottom wall 19 as can be seen in FIGS. 1 and 2. A pump 20 is positioned adjacent the vat 12 and has a conduit 21 extending from its inlet side to the side of the vat 12 adjacent the bottom wall 19 thereof. A conduit 22 extends from the outlet side of the pump 20 to the center of the bottom 19 of the vat 12.

A conduit 23 extends from the conduit 21 to the conduit 22 adjacent the pump 20. A conduit 24 extends from the conduit 21 closer to the pump 20 than the conduit 23 to the conduit 22 closer to the vat than the conduit 23. A three-way plug valve 25 connects the conduit 21 to each of the conduits 23, 24 and a three-way plug valve 25 connects the conduit 22 to the conduit 24. By properly aligning the valves 25A, 25B and 25C the pump 20 can pump materials from the side to the bottom of vat 12 or in the reverse while the pump 20 rotates in the same direction.

The turbine mixer element 18 includes a central hub 27 which is adapted to engage over a stub shaft 28 extending out of the bottom of the hollow shaft 17. The stub shaft 28 has a nut 29 threaded onto its lower end clamping the hub 27 to the lower end of the shaft 17. A disk 30 is secured in the hub 27 and extends radially outwardly therefrom. Teeth 31, 32 are integrally formed on the peripheral edge of the disk 30 with the teeth 31 being inclined upwardly from the plane of the disks 30 and the teeth 32 being inclined downwardly from the plane of the disks 30.

A ring 33 is integrally secured to the hub 27 and extends upwardly therefrom to engage around the lower end of the shaft 17. A second ring 34 is arranged concentric to the ring 33 and spaced outwardly therefrom. A plurality of sloping impeller blades 35 extend between and are rigidly secured to the rings 33, 34 so that rotation of the turbine mixer element 18 will cause fluid in the tank 12 to flow into the space beneath the rings 33, 34 onto the disk 30.

A ring 36 having the same dimensions as the ring 33 is rigidly secured to the lower end of the hub 27 and a second ring 37 is arranged concentric therewith and spaced outwardly therefrom. A plurality of sloping impeller blades 38 extend between and are rigidly secured to the rings 36, 37 to move fluids in the vat 12 upwardly to the space above the rings 36, 37 as can be seen in FIG. 5. A downwardly and outwardly sloping venturi plate 39 is secured to the lower edge of the ring 34 and extends downwardly and outwardly therefrom with an arcuate outer portion curving back upwardly. The venturi plate 39 has a plurality of perforations 40 formed therein for reasons to be assigned. An arcuate feeder plate 41 is secured to the venturi plate 39 to form a feeding chamber 42 as can be seen in FIG. 5. The feeding chamber 42 has an open inlet end 43 and tapers toward a reduced cross-section open rear end 44. A plurality of spiral impeller blades B are secured to each side of the disk 30 to assist in moving liquids outwardly.

Rotation of the turbine mixing element 18 causes fluid in the vat 12 to flow into the chambers 42 and to be forced outwardly therefrom through the orifices 40 into the space above the disk30.

A venturi plate 45 identical to the venturi plate 39 is secured to the upper end of the ring 37 sloping upwardly and outwardly therefrom toward the disk 30. A lower arcuate feeder plate 46 identical to the upper arcuate feeder plate 41 is secured to the venturi plate 45 to operate in the same manner as the upper feeder plate

41 to feed fluid materials through the orifices 47 in the venturi plate 45. The venturi plates 45, 47 taper toward the disk 30 so as to form an annular venturi opening which assists in moving material through the orifices 40, 47. The orifices 40, 47 are largest at the inlet end of the feeder plates 41, 46 and become gradually smaller at the opposite end thereof.

As the turbine mixer element 18 rotates liquid and solid material are drawn downwardly between the rings 33, 34 and upwardly between the rings 36, 37 into the spaces above and below the disks 30. The material is thrown outwardly by the blades B through the venturi opening past the orifices 40, 47 where additional material flows into the stream with all of the material then being moved past the combined mixing and pumping teeth 31, 32 on the disk 30 to assist in dispersing the solids in the liquids. Ports P, P' extend from the hollow shaft 17 to to the spaces above and below the disk 30 to supply air or gas when needed.

The nature of the turbine mixer element 18 is such that a vortex or hollow spot in the liquid materials in the vat 12 would normally form in thin materials as soon as high speed rotation thereof occurs. In order to control the vortex and thus improve the efficiency of the mixer element 18 the pump 20 pumps material either from the edge of the vat 12 into the center at the bottom thereof or in a reverse direction to control the vortex by filling or emptying liquid therefrom as required.

By controlling the vortex in the use of the turbine mixer of the present invention sustained high speed operation can be maintained without loss of mixing efficiency due to an improper vortex being formed.

In FIGS. 11 and 12 a modified disk 30' is illustrated. The disk 30' has a plurality of relative fine upwardly sloping teeth 31' integrally formed on the peripheral edge thereof and sloping upwardly at various angles. A plurality of relatively fine teeth 32' are also integrally formed on the peripheral edge of the disk 30' and slope downwardly at various angles. The disk 30' is used as a replacement for the disk 30 with all other features of the invention remaining the same as well as its use and operation.

In FIG. 13 a modified turbine mixer element is indicated generally at 18'. The mixing element 18' is adapted to supply air or gas to the liquid and solid materials being mixed to assist in entraining the air or gas in the liquid.

The turbine mixer element 18' includes a hollow shaft 17' having a relative thick disk 30A secured to its lower end. A shaft extension 17A is secured to the disk 30A by a bolt 28' and nut 29'. A downwardly and outwardly sloping venturi plate 39' is integrally secured to a ring 34' and terminates at its outer end in an annular feeder plate 41'. A passage 100 extends from the hollow shaft 17' through the venturi plate 39' to a venturi throat 101 which opens between the chamber 42' and the space above the disk 30A.

A hollow arm 102 extends from the shaft 17A into the space beneath the venturi plate 39' and above the disk 30A and communicates with a venturi throat 103 arranged parallel thereto and spaced apart therefrom.

A passage 104 extends from the hollow shaft 17' downwardly into the disk 30A and outwardly to a manifold passage 105 formed in an annular enlarged portion 106 of the disk 30A. Ports 107 and 108 extend upwardly and downwardly respectively from the manifold passage 105 to feed air or gas into the space above and below the disk 30A. A passage 109 extends downwardly from the shaft 17A to the disk 30A and the shaft extension 17A and outwardly through a venturi disk 45' identical to the venturi disk 39' to feed air or gas to a throat 110 identical to the venturi throat 101.

A conduit 111 extends from a source of liquid under pressure and has a venturi 112 formed therein to aspirate air through a conduit 113 connected thereto. Heat exchange elements 114 are connected to the conduit 111 for heating or cooling the material flowing therethrough. A conduit 115 is connected to the underside of the turbine mixer element 18' through which to feed air or gas directly when required.

In FIG. 13 a number of ways of feeding air or gas into the turbine mixer 18' have been illustrated and it should be understood that each turbine mixer 18' may be provided with one or more of each of the air or gas feeding structures which may be then used either simultaneously or selectively as desired.

Having thus described the preferred embodiments of the invention it should be understood that numerous structural modifications and adaptations may be resorted to without departing from the spirit of the invention.

I claim:

1. A turbine mixer comprising a vat for containing liquid and solid materials to be mixed, a shaft supported vertically in said vat in offset relation to the axis of said vat for rotation therein, means connected to said shaft for rotating said shaft, a turbine mixer element secured to the lower end of said shaft in said vat, and means for moving liquid materials to and from the outer lower side edges of the vat to and from the bottom center of said vat below said turbine mixer to control the vortex in said vat.

2. A device as claimed in claim 1 wherein the means for moving the material includes a pump, first conduit means connecting said pump to the lower side portion of said vat, second conduit means connecting said pump centrally of the bottom of said vat, and valve means controlling the flow of material through said first and second conduit means for moving material in either direction from the bottom of said vat to the side of said vat.

3. A device as claimed in claim 1 wherein said turbine mixer element is provided with a hub, a central disk secured to said hub and extending outwardly therefrom, a plurality of mixing and pumping teeth formed on the peripheral edge of said disk with at least some of the teeth being sloped upwardly and downwardly from the plane of said disk, and means on said hub for directing fluids in said vat into contact with said teeth.

4. A device as claimed in claim 3 wherein the means for directing fluid against said teeth is positioned above and below said disk.

5. A device as claimed in claim 4 wherein the means for directing fluid against said teeth includes a pair of annular venturi formed adjacent the outer edges of said disk.

6. A device as claimed in claim 3 wherein a pair of annular venturi are formed adjacent the outer edges of said disk between said fluid directing means and said disk and means are provided on said fluid directing means for feeding fluid into each of said annular venturi.

7. A device as claimed in claim 6 wherein means are provided in said turbine mixer element for introducing air or gas into the materials being mixed.

8. A device as claimed in claim 7 wherein the means for introducing air or gas includes a venturi throat at the point of intermix of the air or gas with the materials being mixed.

9. A device as claimed in claim 7 wherein the means for introducing air or gas includes a plurality of conduits formed in said disk and extending from a hollow shaft.

10. A device as claimed in claim 1 wherein the means for moving liquid materials to and from the outer lower side edges of the vat to and from the bottom center of the vat include a pump for supplying the liquid materials under pressure.

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