

[54] DEVICE FOR STIRRING AND AERATING LIQUIDS IN MASS-EXCHANGE APPARATUS

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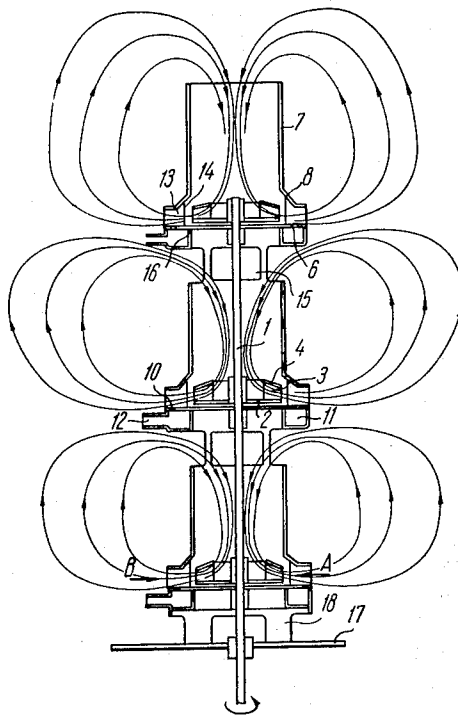
[52] U.S. Cl. 261/93, 261/84
[51] Int. Cl. B01f 7/26
[58] Field of Search 261/84, 93

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[57] ABSTRACT
A device wherein disks (2) parallelly fixed on shaft (1) are supplied with blades (3) and separated from each other with baffles (6), each of said baffles carrying a cylinder (7) having beading (8) which in combination with the baffle (6) forms an annular slot (9) providing a directed liquid circulation in the apparatus.

5 Claims, 3 Drawing Figures



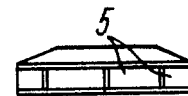
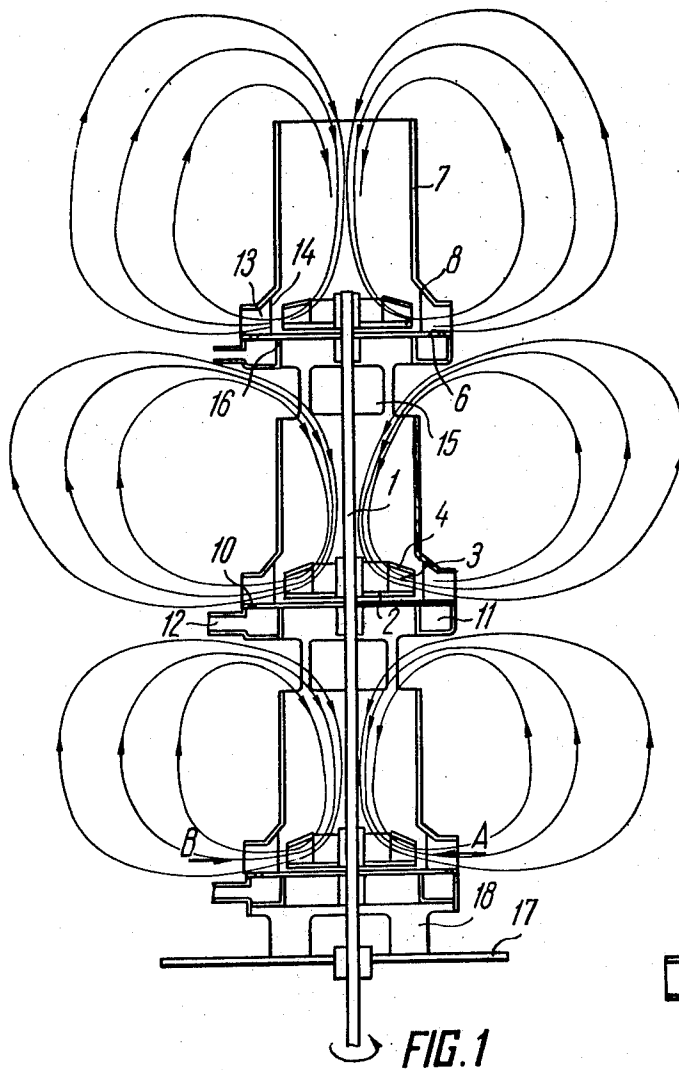


FIG. 2



FIG. 3

DEVICE FOR STIRRING AND AERATING LIQUIDS IN MASS-EXCHANGE APPARATUS

BACKGROUND AND SUMMARY OF THE INVENTION

The present invention relates to chemical equipment used for conducting mass-exchanging processes and, more particularly, to devices for stirring and aerating liquids in mass-exchanging apparatus.

The invention may be successfully used in apparatus for micro-biological applications, in chemical reactors for mass-exchanging processes, in apparatus for hydro-metallurgical industry and in other areas.

Known in the art is a device for stirring and aerating liquids in mass-exchanging apparatus which comprises a shaft with disks parallelly fixed thereon at a certain distance therebetween, each disk being provided around the periphery with blades, and an inlet provided under the lower disk for the aerating agent.

The disadvantage of the known device resides in the non-uniform dispersion and distribution of the aerating agent throughout the apparatus volume and the lack of the directed liquid circulation, which results in a low intensity of the mass-exchange between the liquid and the aerating agent and finally in a low effectiveness of the apparatus in which said device is used.

Among the principal objects of the present invention is the development of a device for stirring and aerating the liquid in mass-exchanging apparatus which is able to provide a uniform dispersion and distribution of the aerating agent throughout the entire volume of the apparatus.

A further object of the invention is to develop a device for providing a directed liquid circulation which in turn results in an intensification of the mass-exchanging processes between the liquid and the aerating agent and finally in an increase of the effectiveness of the apparatus in which the device according to the invention is used.

The above objects are accomplished by the use of a device for stirring and aerating a liquid in mass-exchanging apparatus comprising a shaft with a number of disks parallelly fixed thereon at a certain distance therebetween, each of the disks being provided around its periphery with blades, and an inlet means for supplying the aerating agent. In accordance with the present invention, each of the disks with blades is separated from the other by a baffle on which there is mounted a cylinder provided with a beading which, in combination with the baffle, forms an annular slot opposing the end plane of the disk and providing a directed liquid circulation in the apparatus, the baffles being provided around the periphery with holes for passing the aerating agent supplied thereto from the baffle opposing the side on which the cylinder is mounted to provide an improvement in the dispersion and distribution of the aerating agent.

In order to accomplish an intensive and directed exhaust of the liquid, a more effective dispersion of the aerating agent and, consequently to achieve a more intensive mass-exchange, this device is preferably made in such a manner that the blades fixed at one of their ends to the disk carry a conical ring on their opposite ends, the larger base of the conical ring facing the disk and in combination with the blades and the disk forming passages for the liquid flow.

To provide a directed liquid circulation and a more uniform distribution of the aerating agent across the apparatus section, between the baffle and the cylinder beading there may be mounted a number of plates directing the liquid movement, which face the liquid flow with one of their ends.

For providing local circulation loops of the liquid, in order to increase the mass-exchanging intensity of the apparatus, it is advisable to provide each cylinder in the advanced device with apertures for the liquid flow.

It is good practice to make the device in such a way that each cylinder positioned on the baffle will be connected therethrough with the unbeaded end of the subsequent cylinder, the terminal baffle being fixed to the apparatus bottom and the terminal cylinder positioned at the opposite end of the device being open at the unbeaded end.

Such a construction of the device provides an intersection of the local circulation loops, an improved stirring and distribution of the aerating agent which generally results in an intensification of the liquid mass-exchanging processes in the apparatus.

BRIEF DESCRIPTION OF THE DRAWINGS

The following example illustrates a specific embodiment of the present invention with reference to the accompanying drawings wherein:

FIG. 1 is a cross-sectional elevational view illustrating diagrammatically a device for stirring and aerating the liquid;

FIG. 2 is a view taken along the arrow A of FIG. 1; and

FIG. 3 is a view taken along the arrow B of FIG. 1.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

The device for stirring and aerating liquids comprises a shaft 1 (FIG. 1) with disks 2 fixed on the latter at an equal distance from each other. Around the periphery of the disks 2 there are fixed blades 3, carrying on their ends, which are opposite to the disk 2, a conical ring 4 the larger base of which faces the disk 2, said ring 4 together with blades 3 and the disk 2 forming passages 5 (FIG. 2) for the liquid flow. In this way, there is ensured an intensive and directed exhaust of the liquid, an improved dispersion of the aerating agent and an intensification of the mass exchange.

Each of the disks 2 with blades is separated from the other with a non-rotating baffle 6 (FIG. 1) on which there is mounted a cylinder 7 having a beading 8 which in combination with baffle 6 forms an annular slot 9 (FIG. 3) opposing the end of the disk 2 and providing a directed liquid circulation in the apparatus. Around the periphery the baffles 6 have holes 10 (FIG. 1) for passing the aerating agent supplied from the side of the baffle 6 which is opposite to the beaded end of the cylinder 7 provided with an annular chamber 11 which is fed with the aerating agent through a pipe end 12.

Such a relative arrangement of the cylinder 7 and the holes 10 for passing the aerating agent provides an improved dispersion and distribution of the latter in the apparatus.

Between the baffle 6 and the beading 8 of the cylinder 7 there are fixed plates 13 for directing the liquid movement which, with one of their ends 14, face the liquid flow shown in FIG. 1 by arrows. This provides a

directed liquid circulation and a uniform distribution of the aerating agent across the section of the apparatus in which the device of the present invention is used. Each of the cylinders 7 has apertures 15 for passing the circulating liquid to provide for the formation of local circulation loops.

A local circulation loop should be understood as a liquid flow which circulates through the annular slot 9 and apertures 15 within the limits of one cylinder 7.

Each cylinder 7 mounted on the baffle 6 is connected by the latter with the unbeaded end 16 of the subsequent cylinder 7, the terminal baffle 6 being fixed to the bottom 17 of the apparatus by means of a special support 18 and the terminal cylinder 7 positioned at the opposite end of the device being open at the unbeaded end 16.

Such a relative arrangement of the cylinder 7 and the baffles 6 provides for an intersection of local loops which improves the liquid stirring and distribution of the aerating agent resulting in an intensification of the mass exchange as a whole. For the sake of simplicity in mounting the device, the shaft 1 may be formed of several elements which are connected by means of special clutches. In such an embodiment, every section of the shaft rests on bearings fixed in the cylinder and baffles.

The device according to the invention operates as follows:

The apparatus being charged with the liquid and prepared for operation is fed through pipes 12 with the aerating agent entering the holes 10 which are disposed around the periphery of the baffles 6. Then the shaft 1 with disks 2 thereon is made to rotate. The liquid is sucked through the apertures 15 in the cylinder 7, fed through passages 5 of the rotating disks 2 and forced through the annular slot 9 between the beading 8 of the cylinders 7 and baffles 6 along the directing plates 13 one of the ends 14 of which faces the liquid flow.

The gas bubbles leaving the holes 10, which are on the periphery of the baffle 6, are caught by powerful turbulent streams leaving the annular slot 9 between the beading 8 and the baffles 6, then splintered and scattered through the whole apparatus section. When the gas bubbles are splintered with the turbulent streams, there takes place an effective renewal of their surfaces which results in a mass-exchanging intensification. Then the bubbles enter the intersecting circulation loops. Because of this, the whole liquid volume is uniformly filled with bubbles continuously moving in turbulent streams of the circulation loops which provides a more uniform and intensive mass-exchange through the whole volume of the liquid being stirred. A part of the aerating agent reaches the liquid surface, is released and leaves the apparatus while a part of the

bubbles involved by the circulating liquid is sucked into the directing cylinders 7 through the apertures 15 and subjected to a repeated powerful treatment with turbulent streams in the zone of the liquid exhaust from the slot 9 between the beading 8 and the baffles 6. All this provides a high and uniform intensity of the mass exchange over the entire volume of the apparatus.

The studies of the given construction conducted on models in laboratories and pilot-plants under the conditions of simulated and real media have shown a high effectiveness of the construction in comparison with that known in the art.

What is claimed is:

1. A device for stirring and aerating liquids in a mass-exchanging apparatus comprising: a rotatable shaft with a drive; disks with their peripheries parallelly and rotatably fixed at a certain distance from each other on said shaft; blades disposed around the periphery of each disk; non-rotating baffles mounted on said shaft in a fluid flow blocking arrangement between each of said disks and supplied with aerating agent inlet holes disposed around the peripheries of said baffles; a cylinder surrounding said shaft and positioned at one side of and mounted on each of said baffles and supplied with a beading which in combination with each said baffle forms an annular liquid outlet slot, the opening of said slot opposing the periphery of said disk to provide a directed liquid circulation in the apparatus; and an inlet means for supplying the aerating agent to the apparatus through said inlet holes which is positioned at the side of each said baffle opposing the side carrying said cylinder for improving the dispersion and distribution of the aerating agent.

2. A device according to claim 1 wherein the blades, with one of their ends fixed to the disk, carry on the opposite ends a frusto-conical ring the larger base of which faces the disk, said conical ring together with the blades and the disk forming passages for the liquid flow.

3. A device according to claim 1 wherein between the baffle and the cylinder beading there are fixed plates directing the liquid movement and facing the liquid flow with one of their ends.

4. A device according to claim 1 wherein each cylinder is provided with apertures for passing the circulating liquid flow.

5. A device according to claim 1 wherein each cylinder positioned on the baffle is connected thereby with the unbeaded end of the subsequent cylinder, the terminal baffle being fixed to the bottom of the apparatus and the terminal cylinder positioned at the opposite end of the device being open at the unbeaded end.

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