

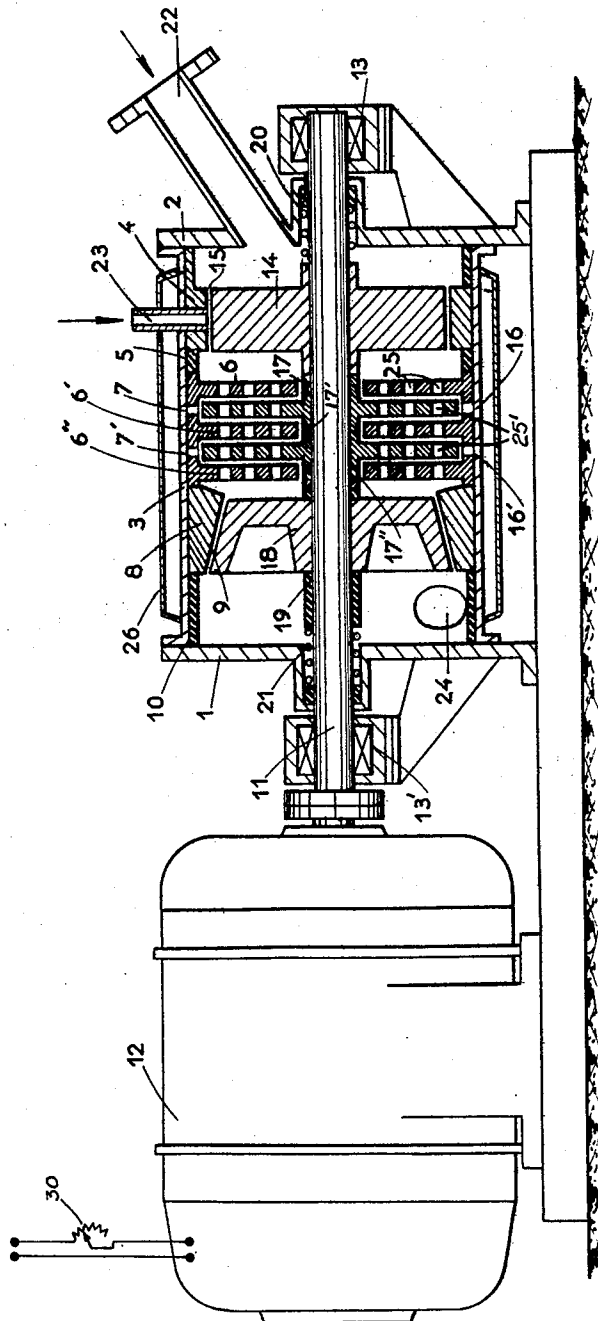
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MIXING, EMULSIFYING, HOMOGENIZING AND THE LIKE MACHINES

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MIXING, EMULSIFYING, HOMOGENIZING AND THE LIKE MACHINES

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The present invention has for its object improvements in mixing, emulsifying, homogenizing and the like machines providing in particular, but not exclusively, for the execution of homogeneous mixtures of two or more liquids and of emulsions.

It has more particularly for its object the execution of apparatus of this type which are of a simple manufacture and of a high efficiency while the power required is comparatively small.

The invention has also for its object to produce such a mixture in a continuous manner.

It has for its still further object the introduction and the homogeneous distribution of a liquid suspension or the like into another liquid, in particular when the liquid or suspension to be introduced into said other liquid forms a comparatively small fraction of the volume of the latter.

To this end, the mixture according to the invention includes a series of rotary plates provided with openings or perforations and alternating with a series of stationary plates also provided with openings or perforations, the liquids to be treated being fed in succession through the openings in the different stationary and movable plates and being sheared as they pass from one plate to another. This arrangement may be constituted for instance in a simple manner by a rotor carrying the different movable plates and revolving inside a correspondingly shaped vat or casing carrying the different stationary plates alternating with the rotor plates.

Furthermore and in accordance with the invention, the apparatus may include, chiefly when it is used for mixing two liquids in very different amounts, a preliminary mixing device including a cylindrical or conical member revolving inside a stationary element of a similar shape so as to leave between them a sufficient passage for the flowing through it of the main fluid or liquid, the auxiliary fluids or liquids being introduced into said gap or passage through lateral ports.

The apparatus may also include in conformity with the invention a final homogenizing arrangement comprising, as well known per se, a rotary cylinder or cone revolving inside a stationary member of corresponding shape.

Further objects and features of my invention will appear in the reading of the following description, reference being made to the accompanying drawings illustrating diagrammatically and by way of example a preferred embodiment of the invention as applied to a mixer having a horizontal rotary axis.

The single figure of said drawing is a longitudinal cross-section of such an apparatus.

As illustrated, the frame of the machine includes two terminal plates 1 and 2 between which is fitted a cylindrical member 3 having a horizontal axis and secured in any suitable manner between the two terminal plates.

Inside said drum shaped casing or cylindrical member 3 are fitted in succession starting from the right hand side a hollow cylindrical element 4 forming the stationary sup-

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port of the preliminary mixer, a spacer 5 and a plurality of plates 6, 6' and 6'' separated by further spacers 7 and 7' and a ring 8 the inner surface 9 of which is frustoconical and lastly a final spacer 10. These different members and in particular the members 3, 4, 6, 6', 6'' and 8 are preferably provided with ribs fitted inside corresponding grooves of the casing 3, which ribs and grooves, not illustrated, are designed in a manner such that when said members are fitted inside the drum-shaped casing 3, they cannot rotate with reference to the latter. A shaft 11 extending along the axis of the casing 3 is driven by the motor 12, possibly with the interposition of a speed-reducing gear. Said shaft revolves inside the bearings 13 and 13' and carries the different rotary members. These rotary members include a cylinder 14 revolving inside the hollow cylindrical member 4 with a gap 15 therebetween, perforated plates 16 and 16', adjustable spacers 17, 17', 17'', a frustoconical member 18 inside the frustoconical ring 8 and a spacer 19 while 20 and 21 designate rotary stuffing box springs. The shaft 11 is provided advantageously with ribs engaging corresponding grooves in the rotary members 14, 16, 16' and 18, so as to make the latter rotate in unison with said shaft.

22 designates the input pipe for the liquid which is fed in any suitable manner at the desired rate of flow, said pipe 22 being rigid with the flange 2. 23 designates the pipe for the admission of the auxiliary liquid or fluid, said pipe opening transversely into the gap 15 between the cylinder 14 and the hollow cylindrical member 4, said auxiliary liquid or fluid being fed through any suitable pumping means.

The output of the mixture obtained is performed preferably in a direction tangential to the drum through the opening shown at 24.

The stationary plates 6, 6', . . . are provided with a multiplicity of ports 25, while the movable plates 16, 16', . . . are provided with a multiplicity of ports 25', the ports 25 and 25' being arranged in coaxial annular series, the radii of which are the same for the stationary plates and for the movable plates.

The radii of the series of ports or perforations 25, 25' are the same for all the stationary and rotary plates 6 and 16, respectively, and the walls thereof are defined by generating lines parallel with the axis of the casing.

The sizes of said ports are irrelevant and these ports are distributed uniformly or otherwise over the surface of the corresponding plates or discs and the ports in the different discs form annular series registering with each other in the different stationary and movable plates.

26 designates a sleeve or jacket for the heating or cooling of the apparatus as required.

The apparatus described operates as follows: the main stream of liquid enters the pipe 22 as mentioned hereinabove. Said liquid flows into the drum through the gap between the rotary cylinder 14 and the cylindrical ring shaped member 4. It will be noted that said gap is substantially in registry with the outermost series of plate perforations so that there is provided a substantially eddyless cylindrical stream of fluid to be sheared by the co-operating plate perforations lying in longitudinal registry. As the liquid flows through said gap, it receives the auxiliary liquid fed into the pipe 23. It should also be remarked that although a single pipe 23 has been illustrated, it is possible to provide a multiplicity of such pipes which are distributed at the periphery of the cylinder 4. The auxiliary fluid entering the gap 15 is carried along by the main stream of fluid and is admixed therewith. In the present case, it is assumed for instance that the input of the auxiliary liquid is comparatively small with reference to the throughput of the main fluid. The preliminary mixture obtained flows towards the left hand side of the figure and is fed in succession through the

ports 25 in the different plates and it is subjected each time it passes from one plate to the next to a shearing action between the stationary and the rotary plate or disc. This being provided, the mixture or emulsion becomes perfectly homogeneous and after passing through the ports in the different discs, the liquid is subjected to a final throttling between the frustoconical members 8 and 9.

It should be remarked that a considerable advantage of the arrangement according to the present invention consists in the fact that no input of air is possible and that consequently no air is emulsified with the mixture as may happen frequently with all prior apparatus.

Furthermore, the adaptability of the apparatus described is considerable since for obtaining an emulsion, a mixture or the like, it is possible to act on two parameters which are entirely independent of each other, to wit on the one hand the total throughput of the liquid passing through the machine and, on the other hand, the rotary speed of the latter so that a modification of these two data within a large range allows obtaining extremely satisfactory results. The rotary speed of the apparatus may be adjusted by conventional devices, such as for example, rheostat 30. The apparatus is of interest not only for mixing liquids but also for suspending solid material inside a liquid and for introducing gases into liquids, these different operations being adapted to serve in particular for the execution of chemical reactions of various types; it is sufficient as a matter of fact to introduce into the pipe 23 either a pulverulent material in the case where it is desired to provide a suspension of the latter or again gases to be introduced into the main liquid. It is also possible when producing a suspension to prepare a first concentrated suspension through a mere stirring of the auxiliary material in a small fraction of the liquid which is to form the final suspension and then to introduce said concentrated suspension into the pipe 23, the remainder of the main liquid being fed into the pipe 22.

It is also possible to mix more than two components together and it is sufficient to this end to insert in series a number of apparatus of the type illustrated. The first apparatus provides for the mixing of the two first components which are then admixed with a third component in the following apparatus and so on. It is also possible to associate in a single arrangement the series of apparatus considered, for instance by providing a shaft and a cylindrical casing which are sufficiently long for it to be possible to insert in series inside the casing and over the shaft several groups of plates provided with ports, the different groups of plates being separated by means for introducing further components into the mixture.

Lastly, it should be remarked that the arrangement, according to the invention, is of an easy execution and assembly and, as a matter of fact, it is sufficient to insert the shaft 11 inside the casing 3 and to remove one of the terminal flanges of the casing so as to stack over the shaft inside the said casing 3 the different parts of the apparatus in the sequence corresponding to their relative final position, this being an easy matter since said members are provided with positioning grooves or ribs for cooperation with the shaft or with the casing 2. This arrangement allows furthermore fitting selectively in the same casing and over the same shaft different numbers of plates or plates of different types as required by the operation it is desired to provide.

Furthermore, the different members such as the plates, discs and the like parts carried inside the apparatus may be readily executed if required by means of plastic material, since the rotary members revolve at slow speed; a suitable selection of these plastic materials allows executing an apparatus adapted to operate with any corrosive liquid.

Obviously, it is possible to bring various modifications to the arrangement disclosed without widening the scope

of the invention as defined in the accompanying claims. In particular, it is possible to use the apparatus as a mere homogenizer in which case the input pipe 23 for the additional liquid will be cut out. In the case where, in contradistinction, the apparatus is used as a contacting, mixing or the like apparatus, the various components may be introduced into it through pumps or the like suitable measuring means.

What I claim is:

1. A fluid-handling apparatus chiefly for mixing, emulsifying, homogenizing and contacting purposes comprising a cylindrical casing, at least one series of stationary annular plates coaxially rigid with the inner wall of the casing and perpendicular to the casing axis, spaced from each other by gaps, and provided with perforations distributed in annular coaxial series around the axis of the casing and a central perforation, a rotary shaft extending through said central perforation of each of the stationary plates and revolvably carried along the axis of the casing, rotary circular plates rigid with said shaft, extending inside the successive gaps between the stationary plates in each series and provided with perforations distributed in annular coaxial series, the radii of the series of perforations being the same for all the stationary and rotary plates and the walls of the perforations in all the plates being defined by generating lines parallel with the axis of the casing, a solid large radius plate rigid with the rotary shaft and defining with the inner surface of the casing an annular gap to the front of the stationary plates, the radius of said annular gap being substantially equal to the radius of the outermost series of plate perforations, means for feeding, unobstructedly and independently of the speed of the shaft, the fluid to be treated into and through said gap and the perforations in the successive stationary and rotary plates and outlet means coaxial with the fluid-tight casing at the rear end thereof beyond the other extreme stationary plate in the latter.

2. A fluid-handling apparatus chiefly for mixing, emulsifying, homogenizing and contacting purposes, comprising a cylindrical casing, at least one series of stationary annular plates coaxially rigid with the inner wall of the casing and perpendicular to the casing axis, spaced from each other by gaps, and provided with perforations distributed in annular coaxial series around the axis of the casing and a central perforation, a rotary shaft extending through the central perforation of each of the stationary plates and revolvably carried along the axis of the casing, rotary circular plates rigid with said shaft, extending inside the successive gaps between the stationary plates in each series and provided with perforations distributed in annular coaxial series, the radii of the series of perforations being the same for all the stationary and rotary plates and the walls of the perforations in all the plates being defined by generating lines parallel with the axis of the casing, a solid plate rigid with the rotary shaft at the input end of each series of plates, the radius of which is substantially equal to that of the outermost series of plate perforations and defining with the inner surface of the casing an annular gap to the front of the associated stationary plates, means for feeding, unobstructedly and independently of the speed of the shaft, the fluid to be treated into and through said gap and the perforations in the successive stationary and rotary plates and outlet means coaxial with the fluid-tight casing at the rear end thereof beyond the other extreme stationary plate in the latter, and means for feeding an auxiliary fluid into the gap surrounding the solid plate ahead of the first series of plates, the fluid passing from one series of plates to the next through the gaps surrounding the solid plate at the input of the said next series.

3. A fluid-handling apparatus chiefly for mixing, emulsifying, homogenizing and contacting purposes, comprising a cylindrical casing, at least one series of stationary annular plates coaxially rigid with the inner wall of the casing and perpendicular to the casing axis, spaced from

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each other by gaps, and provided with perforations distributed in annular coaxial series around the axis of the casing and a central perforation, a rotary shaft extending through the central perforation of each of the stationary plates and revolvably carried along the axis of the casing, rotary circular plates rigid with said shaft, extending inside the successive gaps between the stationary plates in each series and provided with perforations distributed in annular coaxial series, the radii of the series of perforations being the same for all the stationary and rotary plates and the walls of the perforations in all the plates being defined by generating lines parallel with the axis of the casing, a solid plate rigid with the rotary shaft and defining with the inner surface of the casing an annular gap to the front of the stationary plates, the radius of said annular gap being substantially equal to the radius of the outermost series of plate perforations, means for feeding, unobstructedly and independently of the speed of the shaft, the fluid to be treated into and through said gap and the perforations in the successive stationary and rotary plates and means facing the outer peripheral area of the extreme stationary plates at the rear of the casing through which the fluid passing out of the plates passes directly out of the casing and including

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a frusto-conical member rigid with the shaft, having its smaller base facing inwardly of the casing in registry with the outermost series of perforations in the stationary plates and a ring outwardly rigid with the inner wall of the casing and the inner frusto-conical surface of which matches the outer surface of said frusto-conical member to form therewith a frusto-conical outlet gap for the fluid which has passed through the plates.

References Cited in the file of this patent

UNITED STATES PATENTS

1,727,753	Bethune	Sept. 10, 1929
2,092,992	Thalman	Sept. 14, 1937
2,125,455	McLean	Aug. 2, 1938
2,498,209	Iredale	Feb. 21, 1950
2,627,394	Spencer	Feb. 3, 1953
2,734,728	Myers	Feb. 14, 1956
2,753,472	Schott	July 3, 1956
2,798,698	Dooley	July 9, 1957

FOREIGN PATENTS

52,829	Denmark	Mar. 1, 1937
902,798	Germany	Jan. 28, 1954