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APPARATUS FOR MIXING FLUID MASSES

Original Filed Aug. 9, 1932

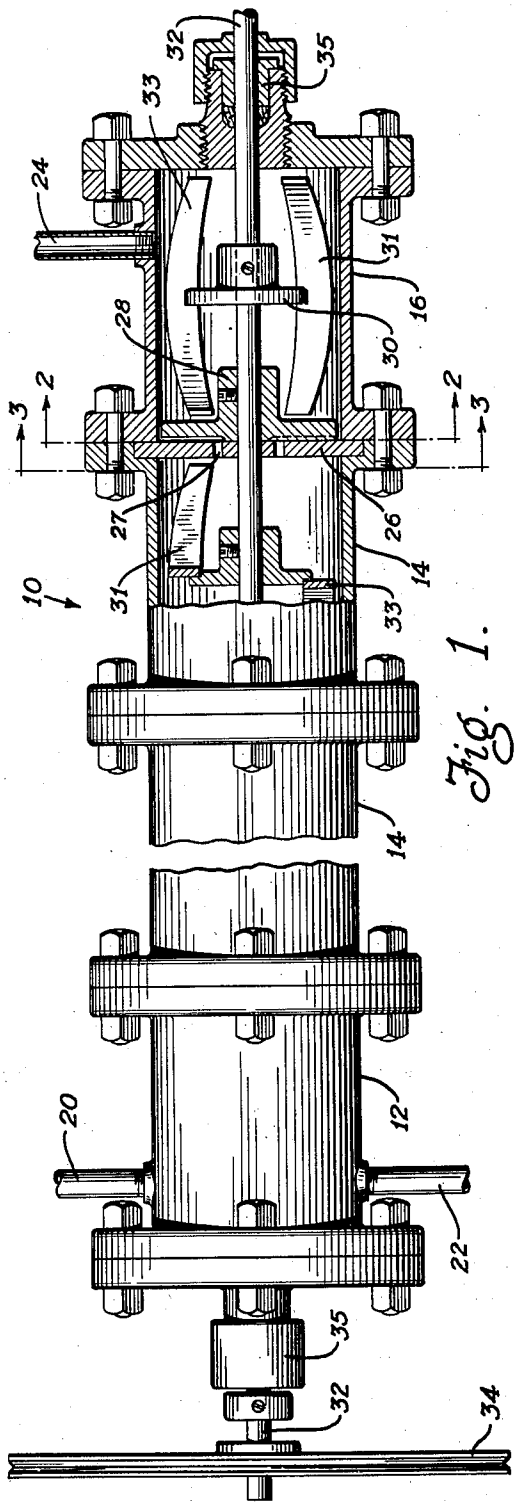


Fig. 1.

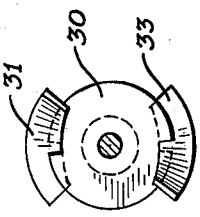


Fig. 4.

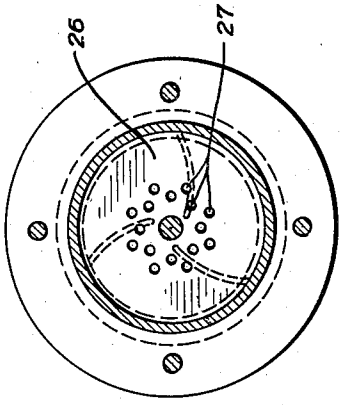


Fig. 3.

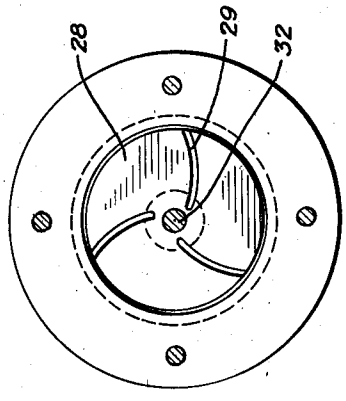


Fig. 2.

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APPARATUS FOR MIXING FLUID MASSES

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Original application August 9, 1932, Serial No. 628,064. Divided and this application May 17, 1933, Serial No. 671,428

3 Claims. (Cl. 259—9)

This invention relates to an apparatus for the agitation or intimate mixing of liquid or semi-liquid masses of two or more materials and more particularly relates to an apparatus which will bring about a shearing action on the respective substances as they pass through the device. This application is a division of our copending application Serial No. 628,064, filed August 9, 1932.

An object of the present invention is to provide an apparatus capable of effecting extremely intimate contact between two or more liquids in minimum periods of time.

Another of the objects of this invention is to provide a multiple series form of agitator having a plurality of separate compartments adapted to progressively receive and intimately mix two or more semi-fluid or fluid substances and to squeeze the substances during passage from one compartment to another in such manner that a shearing action is effected, thereby accomplishing a mixing in which even the smallest particles or portions of the diverse materials are contacted and in which clots of untreated material are prevented from forming.

Another object of our invention is to provide a multiple series agitator comprising a number of separate compartments of substantially identical construction so designed that one or more compartments may be added to or taken away from the complete unit to either increase or decrease the amount of agitation applied to the material passed therethrough.

Another object of the invention is to provide a multiple series agitator including a plurality of separate compartments each of which contains a rotatable paddle constructed in such form that when rotated it progressively forces the substances entering at one end, through the compartment and out at the other end while maintaining a constant rotation and intermixing action.

Another object of the invention is to provide in the multiple-step agitator one or a series of shearing units each consisting of a baffle having one or more apertures near its center and a rotatable solid disk positioned so close to the baffle that the mass of materials to be mixed after being forced through the apertures of the baffle will be forced radially or spirally outward between the baffle and the disk to be discharged from the periphery of the disk into the next compartment, with the result that a shearing and close intermingling of the respective substances is obtained while the material travels a sinuous path through the agitator.

Further objects and advantages of our invention will appear from the following description thereof taken in connection with the attached drawing which illustrates the preferred embodiment of the apparatus.

In many industries the mixing of liquids and semi-liquid masses requires a very intimate admixture of the respective materials not only to make the contact as complete as possible, but also to prevent the formation of clots of untreated material. We have found that the paddles, air blasts and other devices heretofore used to bring treating agents into contact with materials are in many cases very inefficient, and often make necessary the use of large quantities of treating material far beyond the amount theoretically required. In the present apparatus we have provided for such thorough and intimate mixing of liquids and semi-liquid masses that the quantity of treating liquid or agent may be reduced by a surprisingly large percentage.

In the drawing:

Figure 1 is a side elevation of a multiple series agitator with parts broken away and other parts in section to show the internal construction;

Figure 2 is a transverse section taken substantially on the line 2—2 of Figure 1, showing the rotatable disk;

Figure 3 is a transverse section taken particularly on the line 3—3 of Figure 1 showing the fixed baffle;

Figure 4 is an end elevation of the paddle.

The multiple agitator as shown in Figure 1 is composed of a plurality of separate chambers or units 12, 14 and 16. The intermediate units 14 are the same in size and shape. All of the units are standardized as to flanges or other fittings so that they may be bolted together to form a complete agitator. The end units 12 and 16 are similar in size and construction to the intermediate units and differ only in that the inlet end section 12 is provided with intake conduits 20 and 22 and has no rotatable disk, and the outlet end section 16 is provided with a discharge conduit 24 and has no baffle plate. It is not essential to have two intake conduits, for the materials to be mixed may be brought together at an outside point and introduced into the agitator in a single intake conduit. Additional inlet and outlet conduits if desired for any special purpose may be provided and connected directly to any of the compartments, to the end or the intermediate sections.

The multiple agitator, preferably cylindrical in form, has its compartments or units separated by stationary baffle plates 26, as shown in Figures 1

and 3. Each baffle plate preferably has a plurality of holes 27 through which the liquid mass is forced. Mounted on the shaft 32 immediately adjacent each baffle plate there is a rotatable disk 28 having several vane type slots or grooves 29 which extend from near the center to a point at the periphery of the disk which grooves serve as conduits for the mixture passing through the baffle and assist in obtaining the shearing action on the mixture by the rubbing contact between the fixed baffle plate and the rotatable disk. The clearance between the disk and the baffle is preferably small, and while it will vary with different products it should be not more than one-eighth inch for most liquid mixtures for good results. A clearance as little as one-sixty-fourth inch gives best results in many cases.

Each compartment or tank also has a rotatable paddle means having a blade support 30 mounted on the central driving shaft 32 which in turn may be conveniently rotated by the pulley 34 mounted on an outer end thereof. Suitable packing boxes 35 are used on the ends of the agitator to seal the compartments against leakage at the shafting.

The rotatable paddle preferably has two blades 31 and 33 which may be of a curved or ribbon type. With reference to Figure 1 the interior of the compartment 16 is illustrated, the casing being merely broken away thus showing the whole paddle means including both ends of the blades. The adjacent compartment 14 is illustrated as a central section through the blade support and thus shows the blades 31 and 33 broken at the center line. The arrangement of the shaft, the blade support and the blades is more clearly shown in Figure 4.

The blades 31 and 33 extend substantially the whole length of the compartments leaving a small clearance from the interior end and side surfaces thereof. Because of this arrangement of parts, the paddle exerts a conveying or pumping action on the liquid introduced therein, thus agitating the liquid mass and simultaneously pumping the same through and out of the compartment through the holes in the baffle into the space between the disk and the baffle wherein a shearing action is obtained.

The operation of the device is substantially as follows:

The liquid or semi-plastic mass to be treated may be introduced into the first compartment together with the treating liquid through one inlet conduit or the treating liquid may be introduced through a separate conduit. In this compartment the paddle rotates throughout the mass, intimately mixing and stirring the products together. Due to the pumping action of the paddle, the mass is continuously pumped through the compartment, through the apertures relatively near the center of the compartment. As the mixture discharges from the apertures, it comes into immediate contact with the shearing disk which, due to its rotation and close relationship to the baffle causes the mixture to travel to the periphery to be discharged into the second compartment wherein it is again intimately mixed, and again is pumped to the next baffle. In each unit the liquid starts at the periphery of the chamber and in passing therethrough is forced substantially to the center to pass through the apertures in the baffle after which it is squeezed outwardly to the periphery of the following chamber. The action of the shearing disk is to cause a more intimate contact between the liquids passing in the space between the disk and the adjacent baffle, the same being accomplished by increasing the area of surface contact. The area of surface contact is increased by two separate and distinct actions of the disk, the first being to break up the globules of one of the liquids into smaller globules having a greater total surface area, and the second being to distort temporarily the globules from a spherical shape to an elliptical shape whereby the surface area is further increased and a more uniform and thorough action of the treating liquid obtained.

The outward movement along the face of the baffle is accompanied by a shearing action on the liquids aided by the vanes which conduct some of the mixture from the apertures, the whole mixture moving radially in an outward direction and at the same time moving spirally as a result of the disk.

Because of the novel construction of the instant apparatus, the material to be treated and the treating agent are continuously forced therethrough during continuous agitation. The probability that any of the materials being treated escapes without a very intimate contact with the treating agent is at a minimum. This intimate mixing in combination with forced feeding prevents the overtreatment of any part of the material as well as the undertreatment of any part.

Although the apparatus is general in application, it is particularly adapted for the intimate mixing of sulphuric acid and heavy lubricating oils. In such a process the agitator is preferably constructed of a corrosion resisting metal to prevent damage by the acids. It is of course apparent that other treating agents may be agitated in the instant apparatus with any other material of sufficiently fluid quality that can be pumped through the agitator. It is also obvious that the treating agent can be added to more than one unit if sequential addition is desirable. It is also obvious that the size as well as number of the units will depend on the materials to be treated and the treating agent. If necessary or desirable the whole unit, or any portion thereof, may be insulated for the maintenance of heat or cold, or it may be provided with a heating means or a cooling means.

While we have shown only the preferred embodiment of our invention it should be understood that we consider that all modifications coming within the scope and spirit of the description are within the terms of the claims appended hereinafter.

We claim:

1. Agitating apparatus of the class described for intimately mixing substances forming a pumpable liquid mass which comprises, a plurality of communicatively connected mixing compartments, inlet and outlet means for said compartments, baffle members between each of the compartments for restricting the free flow of mass, a driving shaft, rotatable paddles carried by the shaft, said paddles being adapted to force the mass past the baffles from one compartment to another, and disks closely adjacent the baffle members, said disks being adapted to cause a shearing action and a greater surface contact between the liquids passing through the baffles.

2. An agitating apparatus for intimately mixing sulfuric acid and lubricating oil without emulsifying the same comprising a plurality of agitating tanks of similar construction detachably arranged in series, means for introducing sulfuric acid and heavy lubricating oil into the

first tank in the series, a shaft extending through said tanks coextensively therewith, a rotatable impeller paddle mounted on said shaft in each tank, said paddles being adapted to agitate the mixture of liquids in their respective tanks and impel the same progressively from tank to tank, a stationary plate between each tank through which said shaft extends, said plates being provided with comparatively small perforations adjacent their centers and being imperforate adjacent their peripheries thus providing throttling means for retarding the flow of liquids between the tanks and providing baffle means for causing the liquids to converge centrally of the tanks in passing from one tank to another, a disk mounted on said shaft adjacent each plate and adapted to rotate therewith, said plates and disks presenting opposed minutely separated smearing surfaces, the smearing surfaces on said disks being provided with grooves overlying the perforations on said plates whereby the liquids in passing from one tank to another will pass through said perforations and be smeared between said smearing surfaces to increase the area of contact between the oil and sulfuric acid, means to rotate said shaft at a constant speed to cause said paddles to impel the liquids through said tanks at a constant speed, and an outlet for the intimately mixed liquids in the last tank in the series.

3. An agitating apparatus for intimately mixing sulfuric acid and lubricating oil without emulsifying the same comprising a plurality of agitating tanks arranged in series, means for introducing sulfuric acid and lubricating oil into the first tank in the series, a shaft extending through said tanks coextensively therewith, a rotatable impeller paddle mounted on said shaft in each tank, said paddles being adapted to agitate the mixture of liquids in their respective tanks and impel the same progressively from tank to tank, a stationary plate between each tank through which said shaft extends, said plates being provided with comparatively small localized perforations thus providing throttling means for retarding the flow of liquids between the tanks and providing baffle means for causing the liquid to converge in passing from one tank to another, a disk mounted on said shaft adjacent each plate and adapted to rotate therewith, said plates and disks presenting opposed minutely separated smearing surfaces, the smearing surfaces on said disks being provided with grooves overlying the perforations on said plates whereby the liquids in passing from one tank to another will pass through said perforations and be smeared through said smearing surfaces to increase the contact between the oil and sulfuric acid, and means to rotate said shaft, and an outlet for the intimately mixed liquids in the last tank in the series.

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