April 17, 1962 H. A. STIFFLER 3,030,083

AGITATOR WHEEL

Filed March 25, 1959 2 Sheets-Sheet 1

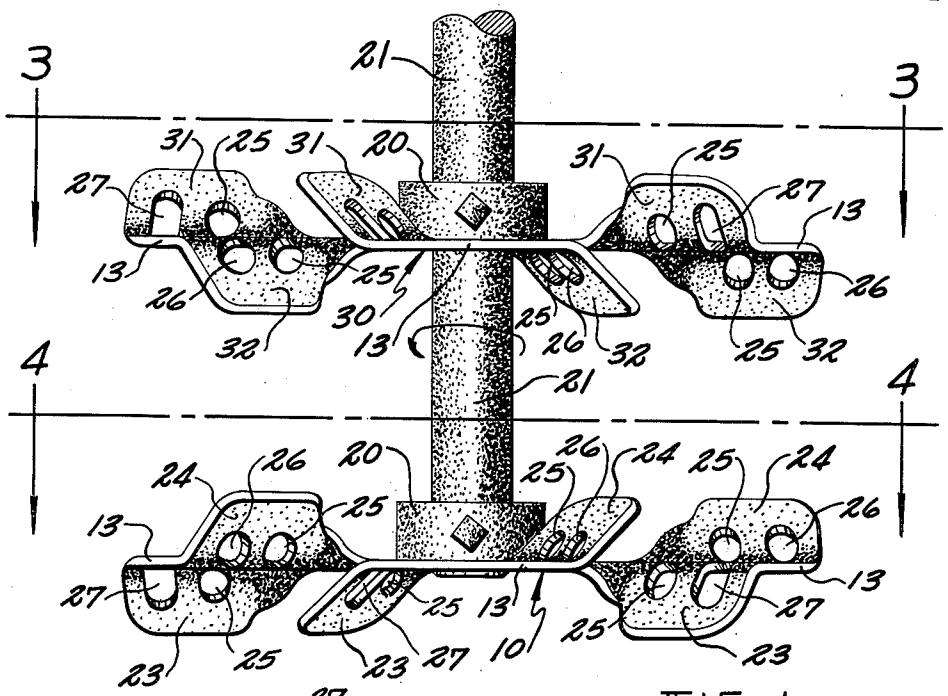


FIG.-1

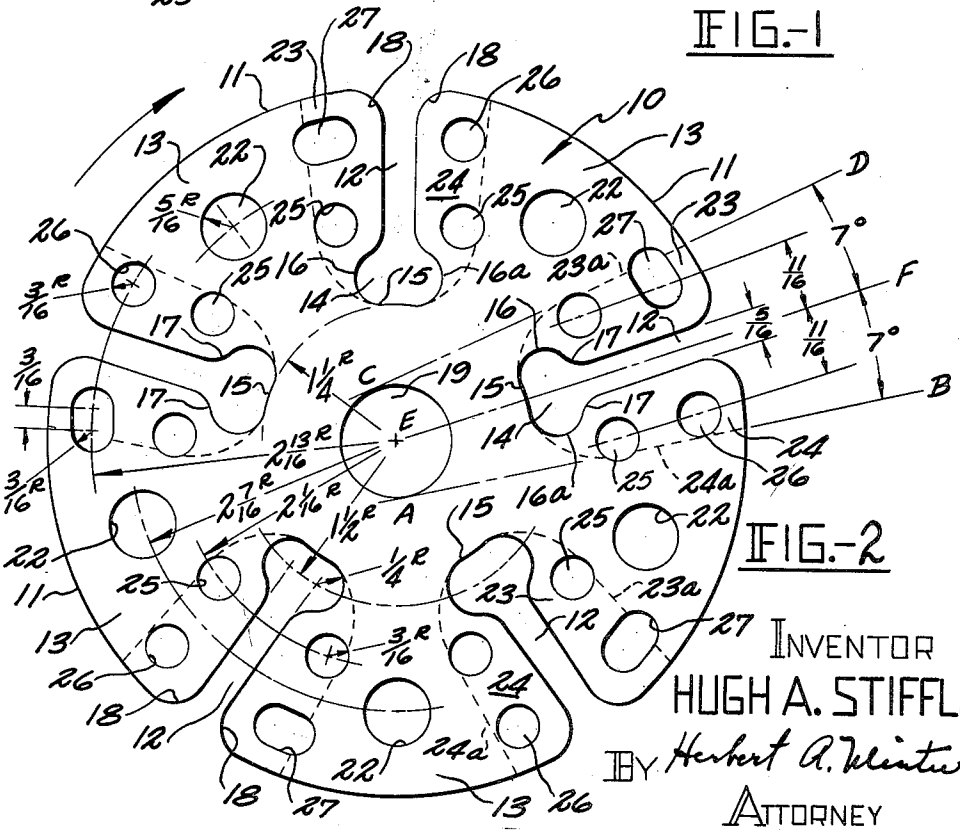


FIG.-2

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AGITATOR WHEEL

Filed March 25, 1959 2 Sheets-Sheet 2

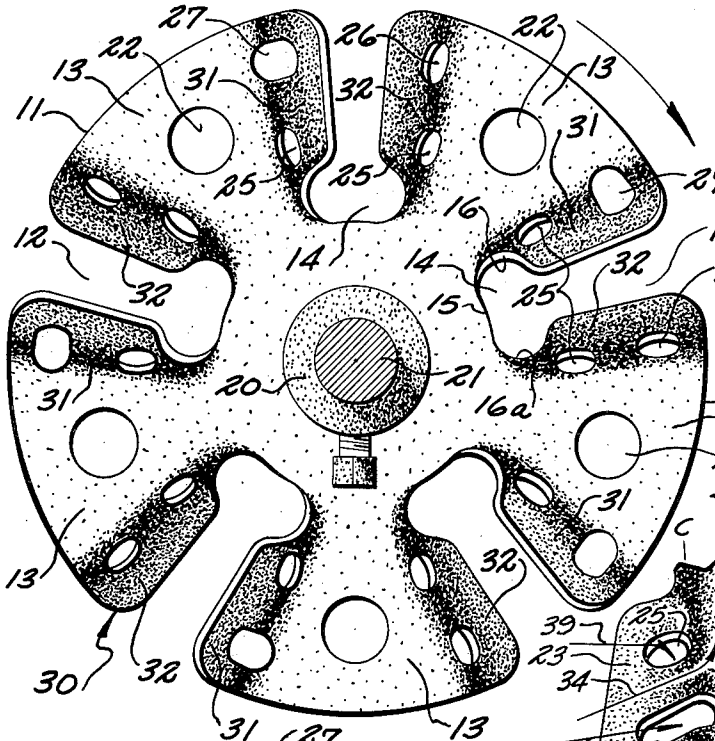


FIG.-3

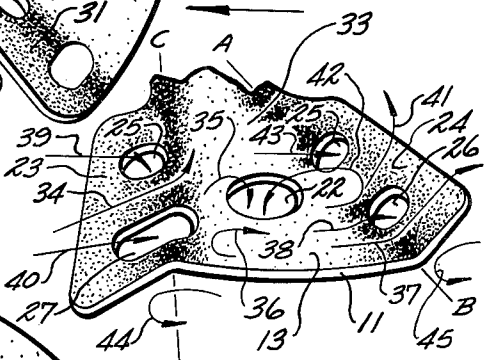


FIG.-5

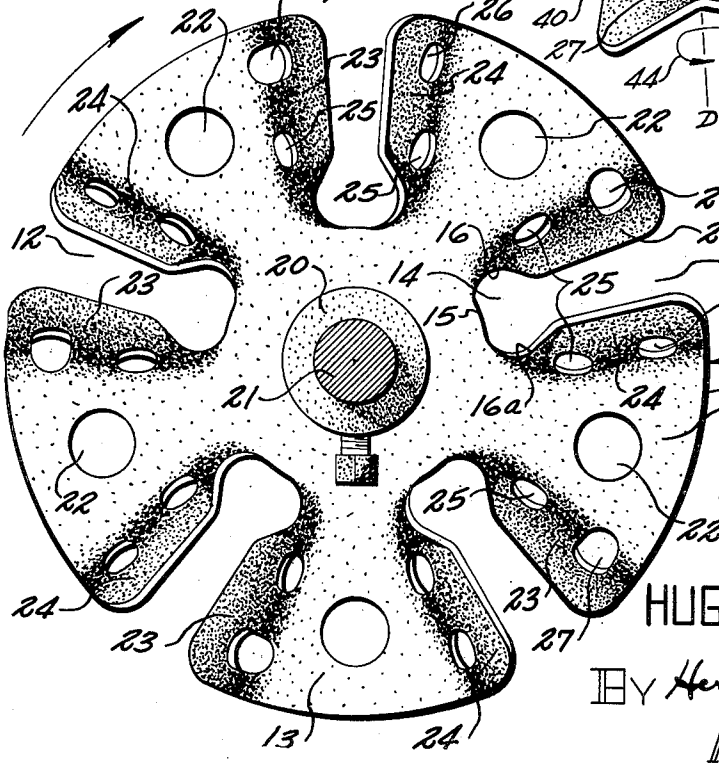


FIG.-4

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3,030,083
AGITATOR WHEEL

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Filed Mar. 25, 1959, Ser. No. 801,943
2 Claims. (Cl. 259—134)

This invention relates to a device for agitating and mixing fluids ranging in viscosity from that approaching water up to and including thick viscous material such as paints and tars. The device embodying the invention comprises essentially one or more wheels to be rotated in the fluids as opposed to being reciprocated, and the efficacy of the wheel depends upon its creating a considerable turbulence inducing eddy currents wherein the individual particles of the materials being agitated or mixed will cross and recross each other repeatedly over a rather wide range of wheel rotating speeds.

The individual wheel comprises primarily a plate rotatable in a plane of direction of rotation, with leading and trailing edges extending from discrete blades radially extending from the plate, at forty-five degree angles to the plate, and having holes of specific arrangement and sizes through the individual blades for the setting up of eddy currents and cavitation pockets further inducing eddy currents all to the end that the fluid will be turbulent within local zones rather than any dependence being placed upon moving the liquid as a body in circumferential travel within a container.

In addition to the above indicated purposes of the invention of producing the high degree of turbulent eddy motion of the fluid being worked upon, there is the advantage of the relative low cost of production of the device embodying the wheel, and also the requirement of a relatively low power input to turn the wheel. As to the fluids being mixed, it is within the scope of the invention to employ the wheel or wheels in forming solutions of various elements or compounds in solutes as may be required.

This application is a continuation in part of applicant's application Serial No. 721,486, filed March 18, 1958, and now abandoned.

With the foregoing objects and advantages of the invention in mind, reference is made to the accompanying drawings, in which—

FIG. 1 is a view in side elevation of a structure embodying the invention involving two wheels;

FIG. 2 is a view in top plan of a blanked wheel before forming;

FIG. 3 is a view in top plan of the upper wheel in FIG. 1;

FIG. 4 is a view in top plan of the lower wheel in FIG. 1; and

FIG. 5 is a view in perspective of a fragmentary portion of a blade of the lower wheel.

Referring first to the blank form of the wheel as illustrated in FIG. 2, the description will be confined to one particular size of wheel, namely a six and one-half inch wheel. The wheel may be made in innumerable sizes, depending upon the job to be performed, and primarily the size of the container of the fluid within which the wheel is to be employed.

For this one particular size of wheel, the blank generally designated by the numeral **10** is primarily circularly formed to have the outer circumferential edge **11**. Slits **12**, five-sixteenths of one inch wide, are provided to extend radially inward from the outer circumferential line **11** at regular intervals around the blank **10**, herein shown as five in number to produce between slits in each instance a blade **13**, there being five in all in this particular form. The slit **12** in each instance opens by its inner radial end into a generally elliptical opening **14** having an inner

arcuate edge **15** defined by the circumference of a circle of one and one-quarter inch radius from the center E of the blank, this curvature of the edge **15** merging into the substantially semicircular ends **16** and **16***a* of one-quarter inch radius from which the edge of the opening continues through a radius **17** in each instance merging into the sides of the slits **12**. The outer ends of the edges of the slit **12** merge through arcuate portions **18** into the circumferential edge **11**. The central portion of the blank **10** is provided with an opening **19** to receive a hub **20**, FIG. 1, the opening through the hub **20** being of that diameter which will receive a driving shaft **21**.

Each of these blades **13** has a major truncated, approximately triangular planar area disposed in a plane common to all of said blade areas and extending from the central portion of the blank **10** and lying between the lines AB and CD (below located), FIG. 5, and the outer periphery **11**. This plane of the blades **13** is at a right angle to the axis of rotation of the wheel with the shaft **21**. The major width or base portion of each blade **13** lies within the outer peripheral margin of the blade.

Each blade **13** is provided with a generally central hole **22** therethrough, the center of which in each instance is located on a circle having a radius of two and seven-sixteenths inches from the center E. Each blade **13** will have a leading edge portion **23** and a trailing edge portion **24**. These portions **23** and **24** will be bent from the planar plate, preferably at forty-five degrees thereto, the portion **23** being bent downwardly on the dash line **23***a* and the portion **24** being bent upwardly on the dash line **24***a*. These dash lines **23***a* and **24***a* will curve at their inner ends to terminate in the edge **15**.

As indicated in FIG. 2, the bend line **23***a* if extended will be identified as a line C—D being tangential to the one inch circle of the opening **19** at C, and being disposed at an angle of seven degrees from the center line E—F of the slit **12**. Likewise the line **24***a* will be identified as the line A—B if extended, and it will be tangential to the circle of the opening **19** at A, and it will slope from the line E—F by seven degrees also. The side portions **23** and **24** so formed with the wheel-non-radial bend lines are substantially parallelograms.

A plurality of holes which may be termed inner holes **25**, each three-eighths of one inch in diameter, are centered on the circumference of a circle having a radius of two and one-sixteenths inches from the center E, and these holes **25**, in relation to the blank shown in FIG. 2, are centered eleven-sixteenths of one inch to each side of the line E—F. This positions the holes **25** in each instance to have the side most removed from the line E—F substantially on the bend lines **23***a* and **24***a*. In fact, there is a slight overlapping of these holes across the bend lines as indicated in FIG. 2. Thus, there are two of these holes **25** for each blade **13**, being located adjacent the openings **14**.

In each of the edge portions **24**, there is a second hole **26** three-eighths of one inch in diameter, centered on a circle of two and thirteen-sixteenths inches radius from the center E, and located in each instance eleven-sixteenths of one inch from the line E—F.

In the edge portion **23**, toward the outer circumferential edge **11**, there is positioned in each blade an elliptical hole **27** having ends of three-sixteenths inch radius spaced apart from centers three-sixteenths of one inch. This hole **27** extends across the bend line **23***a* by one end portion at least three thirty-seconds of one inch so that the bend line **23***a* if extended traverses the end of the hole **27** in each instance. The edge portions **23** and **24** are maintained in planar shape with exception of their inner ends which of course are curved into the edge **17** where it

merges with the edge 15. This curvature is confined within the radial length cross the opening 14.

The blank 10 thus formed may for the sake of convenience carry the same numeral 10 to identify it as the lower wheel as shown in FIG. 1. The upper wheel 30 which will be carried by the shaft 21 is identical with the wheel 10 with the important exception that the blade edge side portions are reversed in their directions of bending from the plate. That is to say, assuming that the shaft 21 is rotating in the direction of the arrow, the upturned edge portion 31 of each blade 13 becomes the leading edge whereas the downturned edge portion 32 becames the trailing edge.

As indicated in FIG. 1, the wheel 30 will be spaced a distance above the wheel 10, this distance depending of course upon the depth of the vessel containing the fluid to be agitated, and the speed of rotation of the shaft 21. Additional wheels may be positioned along the shaft 21 for deeper vessels. The speed of rotation of the shaft 21 may range from a relatively low speed such as five hundred revolutions per minute or even less and on up to higher speeds again depending upon the nature of the material to be handled. For example, the six and one-half inch diameter wheel as has been above described will operate satisfactorily between speeds of five hundred to one thousand r.p.m. It is to be understood that the wheels may be employed in mixing plasters, cement, sand and water mixtures and the like. In any event, it is intended that all the wheels which may be on the shaft 21 will remain submerged during operation, and that the lower wheel such as the wheel 10 will be near the bottom of the container. Where materials such as paint, are to be mixed, the speeds may go up to fifteen hundred r.p.m.

There will be no vortex appearing in the fluid, and hence there will be no air introduced during the mixing or dissolving process as the wheels turn. Furthermore, there will be no flow out nor splashing of the material. The speeds above indicated apply to the more viscous materials, but when the viscosity is greatly reduced, speeds may go up to three thousand r.p.m. Colloidal solutions as well as emulsions are readily produced with a minimum amount of foaming. As previously indicated, there will be different diameter sizes of wheels for particular jobs.

The source of power has not been shown nor described since the shaft 21 may be turned by ordinary drill motors, air motors, and the like in which case the shaft 21 would be engaged by the chucks of such motors. Obviously other power sources may be employed.

Operation

The wheels 10 and 30 combine translatory and turbulent eddy motion over the range of the wheel rotating speeds. The use of the holes or orifices in the plate and in the turned planar surfaces particularly aid in this motion of the material being agitated. As the wheel in either case, or in both cases, wheels 10 and 30, are rotated, cavitation behind the up and downturned marginal edges of the blades would occur were it not for the orifices presented, and the particular sizing and locations of these orifices set up the eddy currents induced by the velocity and flow of the material therethrough or thereover, setting up a difference between the intensity of the pressure on one side of the wheel in comparison to the other side with the opening through the orifices therebetween, and contrary to good orifice design, the location and sizes of these orifices have been designed to set up the maximum eddy currents rather than the minimum. It is to be considered that these orifices are at all times submerged so that the ordinary concepts in hydraulics are not to be employed since it is the intended purpose of the design of these wheels to go to the contrary of good design for maximum unidirection of flow in the ordinary propeller wheel.

What goes on during the rotation of a wheel may be visualized somewhat in referring to FIG. 5, and assuming that the blade 13 is moving in the direction of the main arrow thereabove.

Defining the blade 13 more in detail, between the lines A—B and C—D, FIG. 5, there is the triangular portion 33, truncated in effect, with the base of the triangle in the circumferential line 11. The edge portions 23 and 24 are essentially parallelograms planar each in its forty-five degrees angle slope, whereas the triangular portion 33 is planar, in a plane lying in the direction of rotation of the wheel.

Arrows have been applied in FIG. 5 to indicate relative motion of the fluid in relation to the individual blade 13 as it travels through the fluid. The fluid will be generally lifted in the direction of the arrow 34, sliding up the inclined portion 23, and tending to continue upwardly somewhat above the plane of the section 33, leaving a slight pressure built up under that upwardly directed current, causing some of the fluid to reverse in the direction of the arrow 35 and curl around through the hole 22 to the under side of the section 33. Some of the reverse current will follow the direction of the arrow 36 around and over the plate section 33 tending to exit through the hole 26 to the back side of the trailing edge portion 24. The major portion of the fluid will take the direction of the arrow 37 while that going through the hole 26 will be indicated by the arrow 38.

Some of the fluid being pressed against by the leading downturned edge portion 23 will follow the directions of the arrows 39 and 40 through the holes 25 and 27 respectively again going to the under side of the plate section 33. Some of the fluid upon striking the trailing upturned edge portion 24 will continue on upwardly and tend to curl over and forwardly in the direction of the arrow 41, while some will completely curl over in the direction of the arrow 42 and escape through the hole 22. Other portions of the fluid will tend to escape through the hole 25 in the section 24 as in the direction of the arrow 43.

Under the blade 13, there will tend to be some cavitation particularly under the line C—D, but this is promptly filled in by fluid coming through the holes 25 and 27, as well as by the fluid entering through the hole 22 under a slightly increasing pressure, and the fluid thereunder will tend to curl around in the direction of the arrow 44. The fluid under the major area of the triangular section 33 will be in a state of turmoil, turbulent and eddying about, further augmented by reason of the fact that there will be a downflow behind the trailing inclined portion 24 somewhat in the direction of the arrow 45. Then again, there will be some slippage of the fluid radially of the blade 13 further augmenting the crossing and recrossing of the particles of fluid and mixture being agitated. In other words, the wheel 10 of which this blade 13 is a part as shown in FIG. 5 is not a propeller in the true sense, but is strictly an agitating device intending to lift and drop and recirculate the fluid locally over the individual blade 13, in part through it, so that there is no major single current of fluid set up.

The upper wheel 30 does the same thing as has been described in relation to the wheel 10 and its blade 13 of FIG. 5, but doing so in reverse since that wheel is a reverse counterpart of the wheel 10, and therefore the agitation between the wheels is considerable with this turbulence produced by the eddying therebetween as well as above.

Therefore it is to be seen that I have produced an exceedingly simple and yet most effective wheel design for the purpose as indicated, and the various elements including the orifices have been arranged to augment the turbulent effect in the fluid. Therefore while I have described the individual wheel in minute detail, it is obvious that structural changes might be made without departing from the spirit of the invention, and I therefore do not de-

sire to be limited to that precise form beyond the limitations which may be imposed by the following claims.

I claim:

1. For mixing, blending, and emulsifying fluid compositions, a rotary wheel comprising a central driving portion; a plurality of individual blades extending from said portion, each blade having a major truncated, approximately triangular planar area in a plane common to all of said blade areas, said plane being at a right angle to the axis of rotation of said wheel, and said area having its major width lying in the outer peripheral margin of the blade; a blade side portion sloping at approximately forty-five degrees from along one side of the planar area of each blade; and a second blade side portion sloping at approximately forty-five degrees from the other side of the blade planar area and in an opposite direction from the first side portion; the junctures of said side portions with said planar areas being on lines non-radial of said wheel; each of said blade planar areas having a major size hole located approximately centrally of the area,

and a pair of lesser sized, spaced apart holes in each of said side portions located at said junctures, the hole in one of said pairs most remote from said wheel center portion being generally elliptical and extending in part by an end portion across said juncture to enter through said planar area.

2. The structure of claim 1 in which the major axis of said elliptical hole extends substantially circumferentially of the wheel; the other of said lesser sized holes are approximately tangential to said juncture lines; and said blade side portions being substantially planar parallelograms.

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