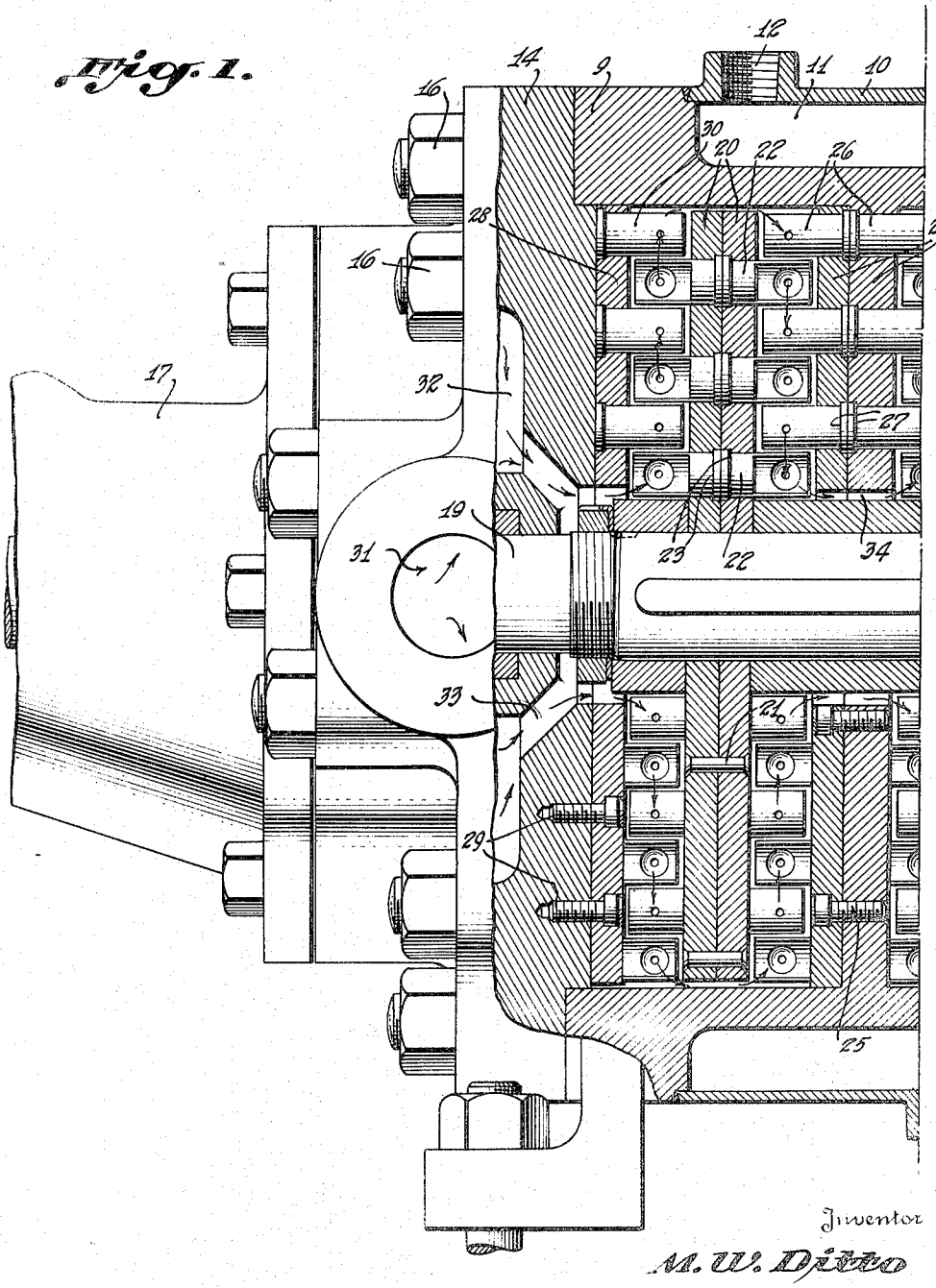
July 2, 1940. M. W. DITTO 2,206,633

DISPERSION MILL

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Fig. 1.



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DISPERSION MILL

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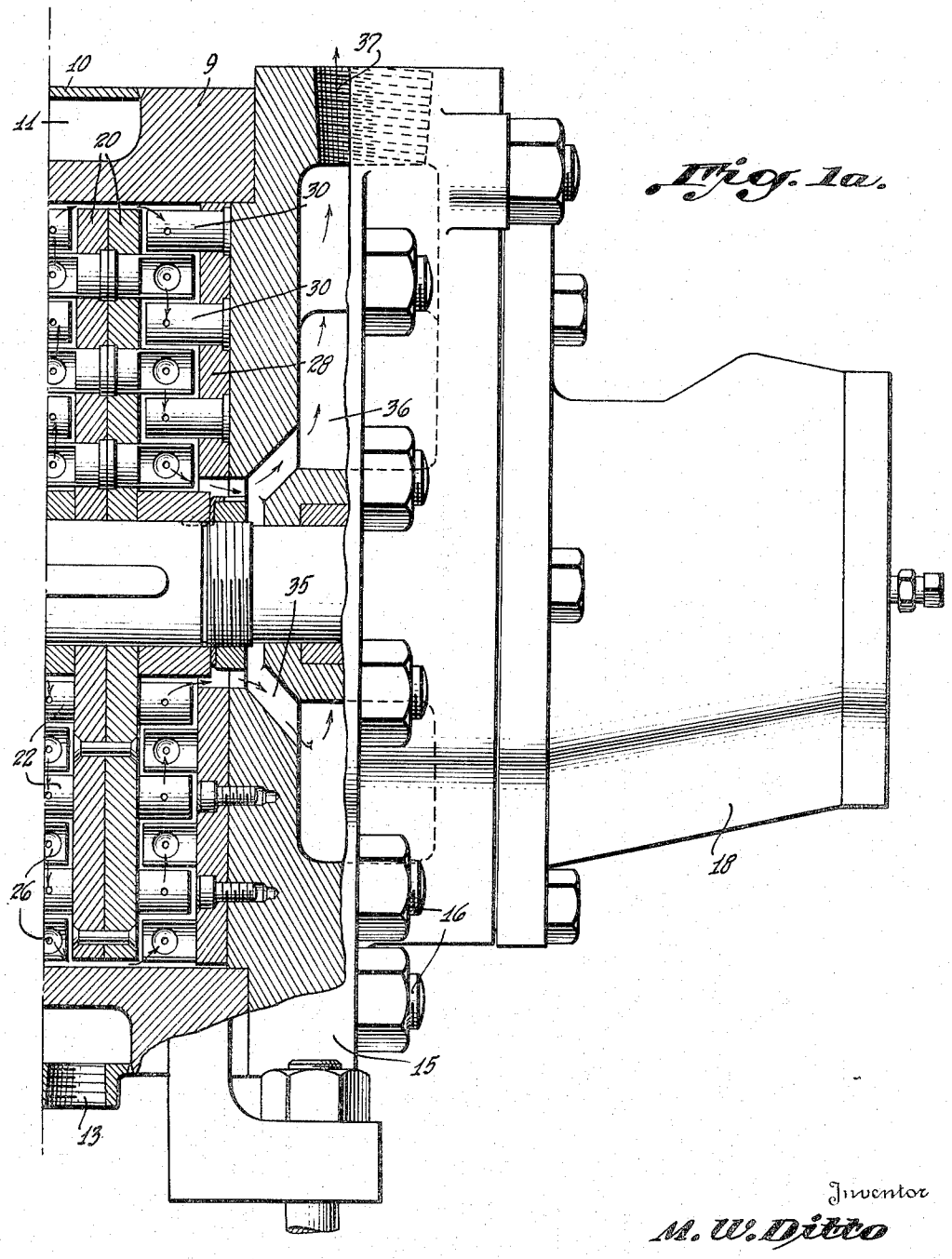


Fig. 1a.

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DISPERSION MILL

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Fig. 7.

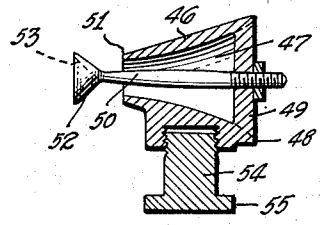


Fig. 8.

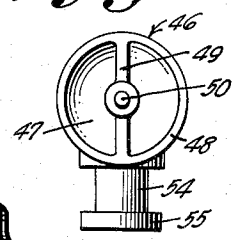
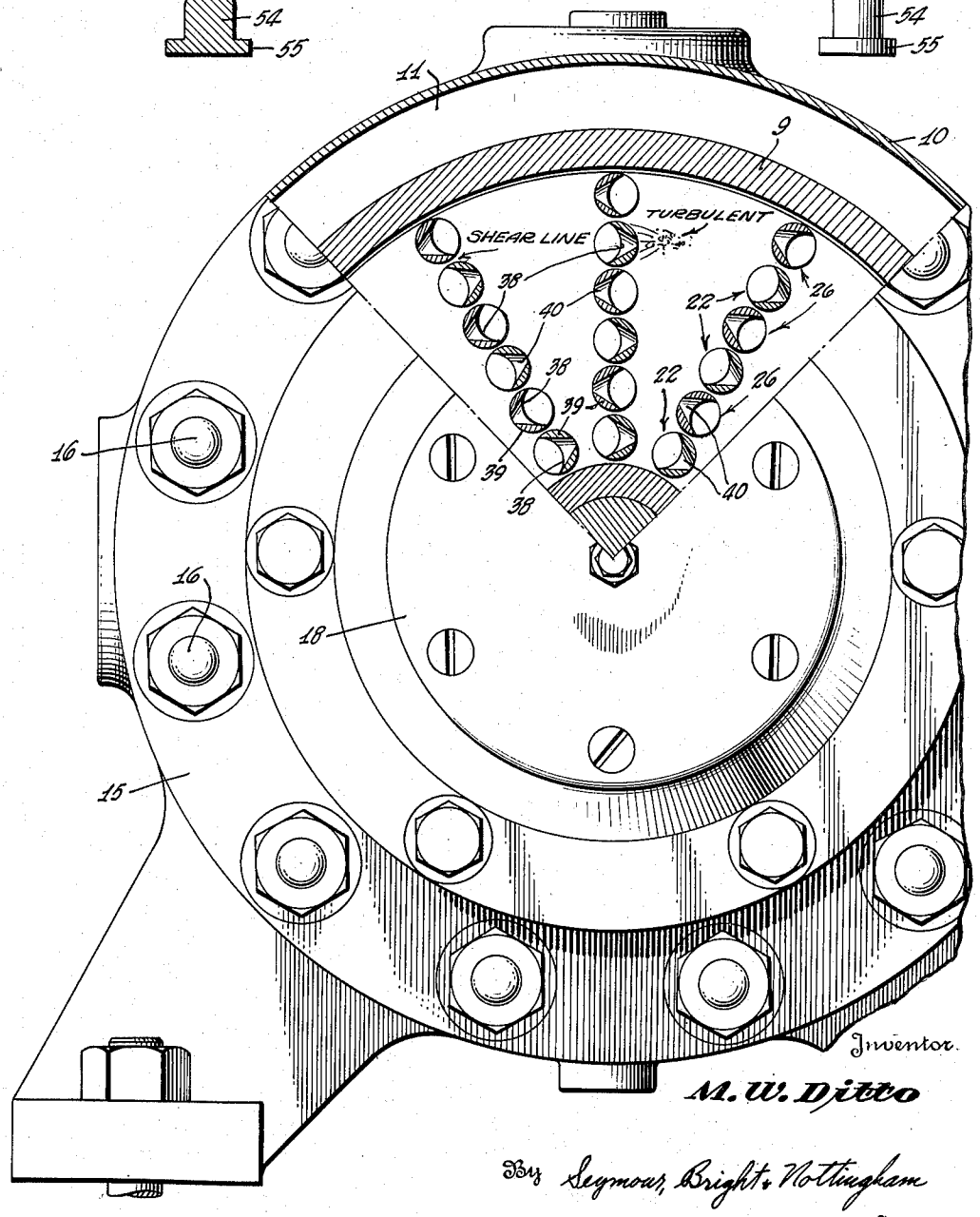


Fig. 2.



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DISPERSION MILL

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Fig. 3.

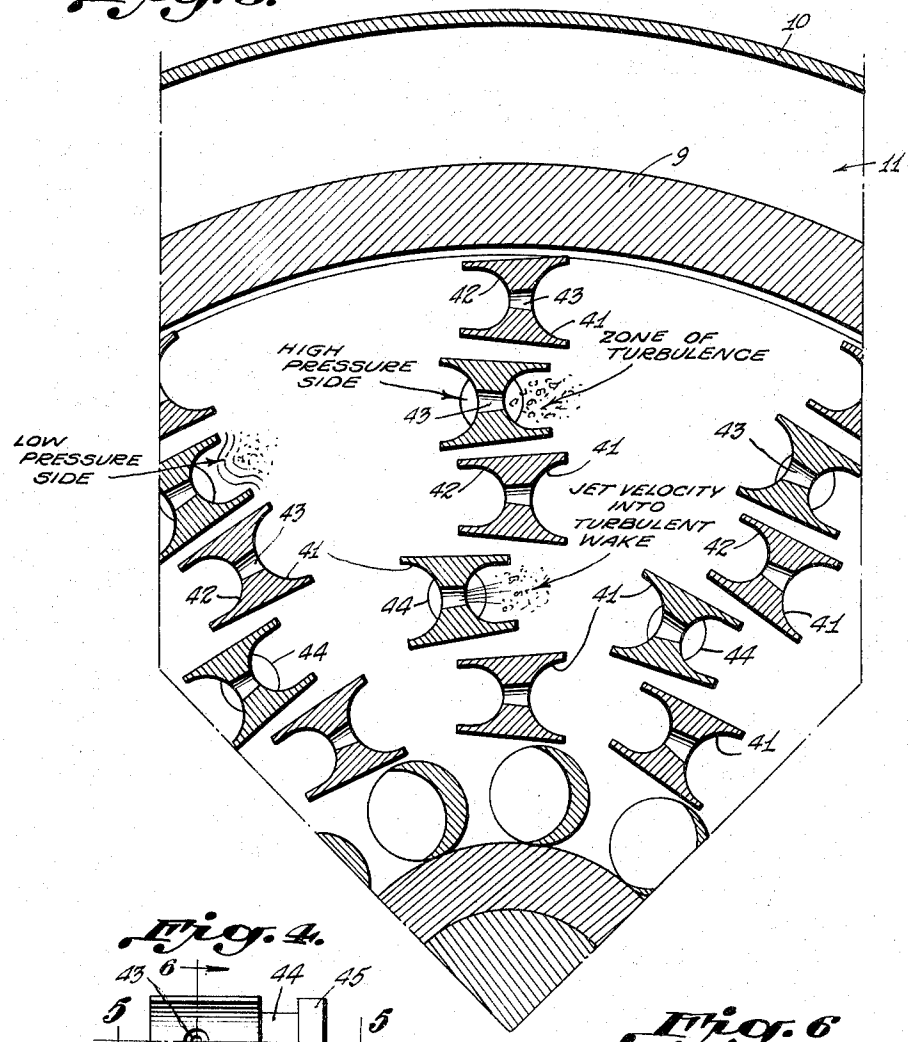


Fig. 4.

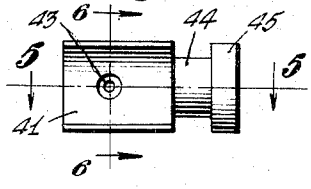


Fig. 5.

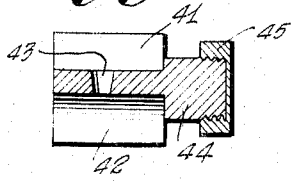
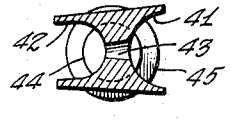


Fig. 6



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2,206,633

UNITED STATES PATENT OFFICE

2,206,633

DISPERSION MILL

Marvin W. Ditto, New York, N. Y., assignor to Emulsions Process Corporation, New York, N. Y., a corporation of Delaware

Application June 27, 1939, Serial No. 281,484

24 Claims. (Cl. 259—9)

This invention relates to improvements in dispersion or emulsification mills.

The primary object of the invention is to provide an improved type of mill designed to finely disperse two or more liquids of different characteristics or incorporate suspended matter such as talc, color pigment or any other finely divided material in one or more liquids passing through the mill.

Another object is to supply a dispersion mill so designed as to render the internal elements self-cleaning due to the fact that such parts are constantly washed by liquid passing through the mill.

A further object is to supply a dispersion mill capable of developing maximum physical reactions of impact, turbulence and shear, factors which are of primary importance in the production of emulsions and the dispersion of liquids within each other and for various other purposes.

With the foregoing objects outlined and with other objects in view which will appear as the description proceeds, the invention consists in the novel features hereinafter described in detail in connection with the accompanying drawings and more particularly pointed out in the appended claims.

In the drawings:

Fig. 1 is a vertical sectional view partly in elevation of the inlet end portion of one embodiment of my improved mill.

Fig. 1A is a similar view of the discharge end portion.

Fig. 2 is an end elevation partly in transverse vertical section.

Fig. 3 is a fragmentary transverse vertical section view of a modification.

Fig. 4 is an elevation of any one of the impulse or repulse arms forming part of the modified mill.

Fig. 5 is a longitudinal sectional view of the repulse arm taken on the line 5—5 of Fig. 4.

Fig. 6 is a transverse section view of such arm taken on the line 6—6 of Fig. 4.

Fig. 7 is a sectional view of another type of repulse or impulse arm.

Fig. 8 is an end elevation of the arm shown in Fig. 7.

Referring first to Figs. 1, 1A and 2, 9 designates a hollow cylinder having a jacket 10 to provide an annular passageway 11 through which a heating or cooling medium may be passed for controlling the temperature within the mill. Such medium may enter the passageway through an inlet 12 and be discharged through an outlet 13.

Plates 14 and 15 close the ends of the cylinder and are rigidly secured thereto by any suitable means, such as stud bolts 16.

Such plates provide bearings 17 and 18 of any suitable type to form journals for the ends of a driven shaft 19, extending centrally through the cylinder and rotated by any suitable prime mover (not shown).

Discs or supporting members 20 are keyed to the shaft and are preferably arranged in pairs, the discs of each pair being secured together by any suitable means such as rivets 21. These discs function as mounting and carrying means for impulse arms 22 which, as best shown in Fig. 2, are arranged in radial rows and project from opposite sides of the discs. Each arm is provided at its inner end with a head 23 that is counter-sunk in one of the discs, and as the heads of aligned arms abut against one another, the arms are held rigidly on the discs by means of the rivets 21.

Between the discs 20, the cylinder is provided with stationary annular flanges or supporting members 24; these flanges also being arranged in pairs, and the flanges of each pair being rigidly secured together by any suitable means such as screws 25. The flanges (like the discs 20) function to support repulse arms 26, arranged in aligned pairs and in radial rows; the repulse arms 26 being staggered relatively to and overlapping the impulse arms 22. Each repulse arm is provided with a head 27 counter-sunk in one of the flanges 24, and as the heads of each pair of repulse arms abut one another, they are rigidly held in position due to the screws 25.

Each of the end plates 14, 15, is provided with a lining plate 28 that is secured to an end plate by any suitable means, such as screws 29, and such lining plates are employed in the mounting of radial rows of repulse arms 30 in a manner similar to the mounting of the repulse arms 26, as will be apparent from an inspection of the drawings.

Before describing the shape and function of the impulse and repulse arms, I will briefly point out the manner in which the liquid or liquid plus suspended solids are passed through the machine under pressure. The stream of materials to be treated enters an inlet port 31 in the plate 14 and is led to an annular passageway 32 in such plate. From such passageway, the stream passes through ports 33 and into the cylinder. Then it flows outwardly from the shaft 19 and around the first pair of discs 20 and then inwardly toward the shaft between said pair of discs and the flanges 24. Upon reaching an annular pas-

sageway 34 at the center of the flanges, it again passes outwardly between the flanges 24 and the second pair of discs 20; then around the periphery of said pair of discs and inwardly until it reaches ports 35 in the end plate 15, which ports lead to an annular passageway 36 having a discharge outlet 37.

Arrows on Figs. 1 and 1A indicate the flow of the stream.

As the stream passes through the mill, it is acted upon by the impulse and repulse arms and, as shown in Fig. 2, each of these arms has a concave face 38 and a convex face 39; the concave faces of the impulse arms facing in the opposite directions from the concave faces of the repulse arms, and the convex faces of the impulse arms facing in the opposite direction from similar faces of the repulse arms.

Each arm has a substantially conical port 40 extending therethrough, the port flaring toward the concave face of the arm so that the liquid under treatment is forced to travel through such ports and effect cleaning of the arms.

As before stated, the repulse arms are stationary and the impulse arms rotate counterclockwise so that the leading edges of the impulse arms approach the leading edges of the repulse arms at a rate of speed equivalent to the rate of rotation of the rotor. Obviously the velocity or peripheral speed of the impulse arms nearest the shaft 19 is slower than the rate of speed of the outer impulse arms, because of the differences in the distances of the various arms from the axis of the shaft.

The purpose of these arms is to obtain three important actions pertaining to the dispersion of liquids or materials within liquids; (1) turbulence, (2) impact, and (3) shear.

I have found in practice that with finely divided materials, such as pigments to be used in paints or lithographic inks to be incorporated in oils, there is a tendency due to impact and viscosity and tackiness of the oils, to build up materials undergoing treatment upon the surfaces and form in stream line contours which would be the equivalent to rotating a solid member of metal instead of a concave face approaching a concave face. Therefore, one purpose of the special shape of each arm is to bleed sufficient liquid through the tapered hole 40 to make it self-cleaning, due to the fact that the inner face of the cups are constantly washed, by liquid passing through the discharge port 40.

It is a well-known fact that when moving a stream line body through an incompressible liquid, such as oil or water, there is (depending upon the shape of the body) a tendency to create laminar flow which produces a minimum amount of turbulence, or if the shape of the body is changed to disturb laminar flow, there will be created a zone of high turbulence in the wake of the moving member. In the type of construction illustrated, the intent is to create high turbulence and then interrupt such turbulence by the amount of liquid bleeding through the hole 40 into the zone of turbulence created by the motion of the arm through the liquid.

It must be kept in mind to fully understand the principles incorporated in the mill, that while liquid is being forced in by a pump with sufficient pressure, to discharge against an outlet back pressure, that the motion of the impulse arms through the liquid is many times higher than the relative flow of the liquid itself. Therefore, as the leading edges of the concave faces approach one another, besides creating turbulence in the liquid, the liquid is tossed from the impulse arms to the repulse arms. This not only imparts a high degree of impact to the materials undergoing treatment but the material in passing the leading edges of the arms is sheared and such shearing is very intense because of the relative velocity.

Normally my mill will be rotated at about 3600 R. P. M. and the materials passing through will be at pressures ranging from 100 to 3000 pounds per square inch depending on the materials undergoing treatment and the result to be accomplished. Therefore, I have by my novel construction devised a means whereby the rotor and the stator are self-scouring or self-cleaning, and the construction is such as to permit the development of the maximum physical reactions of impact, turbulence, and shear, which are so important in the production of emulsions, the dispersion of liquids within each other, and for other purposes, such as the mixing of chemicals to hasten chemical reactions by intimate dispersion of re-agents within the material undergoing treatment. As another example, I mention specifically the treatment of such liquids as wort in which the dispersion of yeast in the manufacture of beer is a typical example, and where it is desirable and important to crack the yeast cells to release the enzymes contained within the cell of yeast.

Instead of making the impulse or repulse arms as shown in Figs. 1, 1A and 2, I may employ the construction shown in Figs. 3 to 6 inclusive. In this case, each arm will have an elongated concave channel 41 in its forward face and a similar channel 42 in its rear face, but the mouth of the channel 41 will be wider than the mouth of the channel 42. Here also each arm will be provided with a substantially conical port 43 extending from one face to the other end with its larger end extending toward the channel 41. As the channels in this construction are wider than the neck 44 of the arm and therefore the arm cannot be inserted through either a disc or flange from the rear thereof, I provide each neck with a nut 45 to facilitate attachment to the disc or flange which carries the same.

Obviously in this construction each arm has a concave surface at its leading side as well as its trailing side and the purpose of this structure is to increase the area exposed to the liquid in the forward motion but exposing it to a relatively wide concave surface, and in the rear of the arm is a pocket, which if moved through the liquid at high enough velocity (in the absence of the port 43) would create a partial vacuum, or if such an arm could be moved through the liquid at high enough velocity, a high vacuum would be created within the area of the rear cup 42.

In the treatment of yeast and/or its dispersion in the wort in the manufacture of beer, it is desirable to open up or crack the wall of the yeast cell to release the enzymes fermented. When this reaction is accomplished in a machine of the type illustrated in Figs. 3 to 6 inclusive, it will be seen that due to high positive pressure on the leading face 41 of the arm, there will be a marked differential in pressure between the front and rear of the arm, and as these two surfaces are inter-communicating due to the presence of the port 43, the yeast cell jetting through the port will give a very high positive pressure to the zone of relatively low pressure and have a tendency, due to the fact that the

cell wall is relatively fragile, to open up and discharge the ferment contained therein.

In Figs. 7 and 8, I have illustrated another type of impulse or repulse arm suitable for my purposes. It comprises a nozzle 46 having a substantially conical port 47 extending therethrough and flaring toward the front end 48 of the nozzle. A spider 49 extends diametrically across the front end of the nozzle and has a threaded connection with a stem 50 which extends therethrough and is provided rearwardly of the outlet or smaller end 51 of the nozzle with a conical head 52, the apex of which faces the outlet end of the nozzle. The cone is preferably hollow as indicated at 53. This form of arm may be mounted on the disc or flange of the mill by means of a threaded neck 54 having a head 55; the threaded neck having a threaded connection with the nozzle. The nozzle in this instance has an interior contour which is the equivalent of the contour of a perfect nozzle giving maximum nozzle velocity when liquid is passing through it from its front end to its rear end.

When such nozzles are attached to the rotor plate and rotated through the liquid at 3600 R. P. M., the nozzle jetting velocity is extremely high and the impingement of the stream passing through the nozzle is deflected by the conical tail piece 52, and as a result of displacement and high velocity, a zone of partial vacuum is obtained behind the tail pieces. As in the former case (Figs. 1, 1A and 2), the velocity of the nozzles is many times higher than the velocity of the liquids, therefore in passing through the repulse arms there is a shearing action resulting in turbulence and impact at the points where the impulse nozzles pass the repulse nozzles. Here again, due to the fact that the velocity of the liquid passing through the nozzle is extremely high, the nozzles are self-cleaning and will not permit the building up of materials which would tend to close over the nozzle openings.

The construction of my impulse arms reduces the drag on the impulse members due to the turbulence created in the wake of these members. Material that is permitted to escape through the ports in such members to satisfy the drag created in the wake, reduces the amount of power required to rotate the rotor.

In each form of the invention it will be noted that the impulse and repulse arms are arranged in overlapping relation and have confronting concave surfaces. Furthermore, each arm has opposite narrow side edge portions, so that such edge portion of the impulse arms, during rotation of the rotor, travel in circular paths adjacent to concentric circular lines defining said side edge portions of the repulse arms, whereby said edge portions act on the materials passing between the adjacent edge portions of the impulse and repulse arms.

From a study of the prior art, I believe I have invented a new type of mill for the purposes intended and that I am utilizing a new principle of dispersion heretofore unknown. The design of my machine renders itself to higher speeds than those indicated because by increasing the diameter of the cylinder 9 and the diameter of the rotor and stator, higher peripheral velocities will be attained at the periphery of the rotor and therefore higher differentials of relative speed between moving members and the liquid can be arbitrarily controlled. As my new design makes available a construction for extremely high speeds, obviously one can obtain a high degree of shear, impact and turbulence without the necessity of rotating the shaft at speeds above the speed of conventional industrial types of motors.

While I have disclosed what I now consider to be preferred embodiments of the invention that the same may be readily understood by those skilled in the art, I am aware that changes may be made in the details disclosed without departing from the spirit of the invention as expressed in the claims.

What I claim and desire to secure by Letters Patent is:

1. A dispersion mill of the character described, comprising a casing, a rotor arranged in the casing, adapted to rotate about an axis, and having a supporting member, impulse arms projecting from one side of said member and having concave leading faces extending lengthwise thereof, a stator arranged in the casing and provided with a stationary supporting member, repulse arms secured to the supporting member of the stator, projecting in a direction opposite to that of the impulse arms and arranged in staggered relation relative to said impulse arms, the repulse arms having concave surfaces extending lengthwise thereof and facing in the opposite direction from that of the concave faces of the impulse arms, means for admitting materials to be treated into said casing, and means for discharging treated materials from the casing, the impulse and repulse arms being arranged in overlapping relation and having confronting narrow edge portions, the edge portions of the impulse arms being arranged in close proximity to the edge portions of the repulse arms to cause shearing of materials passing between aid arms.

2. In a dispersion mill of the character described, a rotor having a rotatable supporting member, spaced impulse arms carried by said supporting member and projecting from one side of the supporting member, the impulse arms having concave leading faces extending lengthwise thereof, a stator comprising a stationary supporting member, stationary repulse arms supported by the supporting member of the stator and projecting from the last-mentioned member in a direction opposite to that of said impulse arms, the repulse arms having concave surfaces extending lengthwise thereof and facing in the opposite direction from that of the concave faces of the impulse arms, the repulse arms being arranged in staggered relation relative to the impulse arms and overlapping the latter, said impulse and repulse arms having confronting narrow edge portions, the edge portions of the impulse arms being arranged in close proximity to the edge portions of the repulse arms to cause shearing of materials passing between said arms and means constraining a stream passing through the mill to travel between said supporting members whereby the stream will be acted upon by said impulse and repulse arms.

3. In a dispersion mill of the character described, a rotor having a rotatable supporting member, spaced impulse arms carried by said supporting member and projecting from one side of the supporting member, a stator comprising a stationary supporting member, stationary repulse arms supported by the supporting member of the stator and projecting from the last-mentioned member in a direction opposite to that of said impulse arms, the repulse arms being arranged in staggered relation relative to the impulse arms and overlapping the latter, and means constraining a stream passing through the mill to travel

between said supporting members whereby the stream will be acted upon by said impulse and repulse arms, each arm having a concave face, the concave faces of said impulse and repulse arms having confronting narrow edge portions, the edge portions of the impulse arms being arranged in close proximity to the edge portions of the repulse arms to cause shearing of materials passing between said arms.

4. In a dispersion mill of the character described, a rotor having a rotatable supporting member, spaced impulse arms carried by said supporting member and projecting from one side of the supporting member, a stator comprising a stationary supporting member, stationary repulse arms supported by the supporting member of the stator and projecting from the last-mentioned member in a direction opposite to that of said impulse arms, the repulse arms being arranged in staggered relation relative to and in close proximity to the impulse arms and overlapping the latter, and means constraining a stream passing through the mill to travel between said supporting members whereby the stream will be acted upon by said impulse and repulse arms, each impulse arm having an elongated concave leading face extending lengthwise thereof, and each repulse arm having an oppositely facing elongated concave face extending lengthwise thereof.

5. In a dispersion mill of the character described, a rotor having a rotatable supporting member, spaced impulse arms carried by said supporting member and projecting from one side of the supporting member, a stator comprising a stationary supporting member, stationary repulse arms supported by the supporting member of the stator and projecting from the last-mentioned member in a direction opposite to that of said impulse arms, the repulse arms being arranged in staggered relation relative to the impulse arms and overlapping the latter, and means constraining a stream passing through the mill to travel between said supporting members whereby the stream will be acted upon by said impulse and repulse arms, each arm having a concave face and a tapered port extending through the arm.

6. In a dispersion mill of the character described, a rotor having a rotatable supporting member, spaced impulse arms carried by said supporting member and projecting from one side of the supporting member, a stator comprising a stationary supporting member, stationary repulse arms supported by the supporting member of the stator and projecting from the last-mentioned member in a direction opposite to that of said impulse arms, the repulse arms being arranged in staggered relation relative to the impulse arms and overlapping the latter, and means constraining a stream passing through the mill to travel between said supporting members whereby the stream will be acted upon by said impulse and repulse arms, the impulse arms having substantially conical apertures extending therethrough with the apex of the cone extending toward the trailing face of the arm.

7. In a dispersion mill of the character described, a rotor having a rotatable supporting member, spaced impulse arms carried by said supporting member and projecting from one side of the supporting member, a stator comprising a stationary supporting member, stationary repulse arms supported by the supporting member of the stator and projecting from the last-mentioned member in a direction opposite to that of said impulse arms, the repulse arms being arranged in staggered relation relative to the impulse arms and overlapping the latter, and means constraining a stream passing through the mill to travel between said supporting members whereby the stream will be acted upon by said impulse and repulse arms, the arms being substantially H-shaped in cross-section.

8. In a dispersion mill of the character described, a rotor having a rotatable supporting member, spaced impulse arms carried by said supporting member and projecting from one side of the supporting member, a stator comprising a stationary supporting member, stationary repulse arms supported by the supporting member of the stator and projecting from the last-mentioned member in a direction opposite to that of said impulse arms, the repulse arms being arranged in staggered relation relative to the impulse arms and overlapping the latter, and means constraining a stream passing through the mill to travel between said supporting members whereby the stream will be acted upon by said impulse and repulse arms, certain of the impulse arms having concave leading faces and convex trailing faces.

9. In a dispersion mill of the character described, a rotor having a rotatable supporting member, spaced impulse arms carried by said supporting member and projecting from one side of the supporting member, a stator comprising a stationary supporting member, stationary repulse arms supported by the supporting member of the stator and projecting from the last-mentioned member in a direction opposite to that of said impulse arms, the repulse arms being arranged in staggered relation relative to the impulse arms and overlapping the latter, means constraining a stream passing through the mill to travel between said supporting members whereby the stream will be acted upon by said impulse and repulse arms, said impulse and repulse arms having confronting grooved faces and narrow edge portions, the edge portions of the impulse arms being arranged in close proximity to the edge portions of the repulse arms to cause shearing of material passing between said arms and each of said arms having a substantially conical port extending therethrough with its large end adjacent to the grooved face of the arm.

10. In a dispersion mill of the character described, a rotor having a rotatable supporting member, spaced impulse arms carried by said supporting member and projecting from one side of the supporting member, a stator comprising a stationary supporting member, stationary repulse arms supported by the supporting member of the stator and projecting from the last-mentioned member in a direction opposite to that of said impulse arms, the repulse arms being arranged in staggered relation relative to the impulse arms and overlapping the latter, and means constraining a stream passing through the mill to travel between said supporting members whereby the stream will be acted upon by said impulse and repulse arms, the arms being of non-circular shape in cross section and provided with tapered ports extending therethrough.

11. In a dispersion mill of the character described, a rotor having a rotatable supporting member, spaced impulse arms carried by said supporting member and projecting from one side of the supporting member, a stator comprising a stationary supporting member, stationary repulse arms supported by the supporting member of the

stator and projecting from the last-mentioned member in a direction opposite to that of said impulse arms, the repulse arms being arranged in staggered relation relative to the impulse arms and overlapping the latter, and means constraining a stream passing through the mill to travel between said supporting members whereby the stream will be acted upon by said impulse and repulse arms, certain of said arms having front and rear elongated concave channels, and tapered ports extending through these arms from one channel to the other.

12. In a dispersion mill of the character described, a rotor having a rotatable supporting member, spaced impulse arms carried by said supporting member and projecting from one side of the supporting member, a stator comprising a stationary supporting member, stationary repulse arms supported by the supporting member of the stator and projecting from the last-mentioned member in a direction opposite to that of said impulse arms, the repulse arms being arranged in staggered relation relative to the impulse arms and overlapping the latter, and means constraining a stream passing through the mill to travel between said supporting members whereby the stream will be acted upon by said impulse and repulse arms, at least one of said arms comprising a nozzle having a substantially conical passageway extending therethrough and provided at the small end of said passageway with a conical tail piece having its apex facing the small end of the nozzle.

13. In a dispersion mill of the character described, a rotor having a rotatable supporting member arranged in a plane substantially perpendicular to the axis of rotation of the rotor, spaced impulse arms carried by said supporting member and projecting from one side thereof, a stator having a stationary supporting member arranged substantially parallel to the supporting member of the rotor and spaced from the latter, stationary repulse arms supported by the supporting member of the stator, projecting toward the supporting member of the rotor and overlapping said impulse arms, said repulse arms being arranged in close proximity to the impulse arms but being staggered relatively to said impulse arms, said impulse and repulse arms having confronting narrow edge portions, the edge portions of the impulse arms being arranged in close proximity to the edge portions of the repulse arms to cause shearing of materials passing between said arms and means constraining a stream passing through the mill to pass between said supporting members whereby it will be acted upon by said impulse and repulse arms, some of said arms having tapered ports extending therethrough.

14. In a dispersion mill of the character described, a rotor having a rotatable supporting member arranged in a plane substantially perpendicular to the axis of rotation of the rotor, spaced impulse arms carried by said supporting member and projecting from one side thereof, a stator having a stationary supporting member arranged substantially parallel to the supporting member of the rotor and spaced from the latter, stationary repulse arms supported by the supporting member of the stator, projecting toward the supporting member of the rotor and overlapping said impulse arms, said repulse arms being arranged in close proximity to the impulse arms but being staggered relatively to said impulse arms, and means constraining a stream passing through the mill to pass between said supporting members whereby it will be acted upon by said impulse and repulse arms, some of said arms having tapered ports extending therethrough and provided at the outer ends of the ports with substantially conical tail pieces.

15. A dispersion mill comprising a casing having an inlet at one end and an outlet at the opposite end, a stator arranged in the casing and provided with oppositely extending spaced repulse arms, a rotor arranged in the casing and provided with impulse arms which extend toward one another, the impulse arms overlapping the repulse arms, being arranged in close proximity thereto and positioned in staggered relation relatively to the repulse arms, said impulse and repulse arms having concave faces terminating in inner and outer confronting narrow edge portions, the edge portions of the impulse arms being arranged in close proximity to the edge portions of the repulse arms to cause shearing of materials passing between said arms, each impulse arm having a tapered port extending therethrough with its larger end arranged at the leading face of the arm.

16. A dispersion mill of the character described, comprising a plurality of disc-like members positioned adjacent to one another, means for rotating one of said members relatively to the other, impulse and repulse arms projecting from said members and arranged in staggered and overlapping arrangement relatively to one another, the arms of said members having confronting, elongated, concave surfaces and narrow edge portions, the edge portions of the arms of one member being arranged in close proximity to the edge portions of the arms of the other member, each arm having a substantially conical aperture extending therethrough from its concave face toward its opposite face, and means constraining a stream passing through the mill to travel between said members whereby said stream will be subjected by said arms to violent turbulence, impact and shear.

17. A dispersion mill of the character described, comprising a casing, a rotor arranged in the casing, adapted to rotate about an axis and having a supporting member, impulse arms projecting from one side of said member and rotatable therewith, a second member arranged in the casing, repulse arms secured to the second member, projecting in a direction opposite to that of the impulse arms and arranged in staggered and overlapping relation relatively to said impulse arms, means for admitting materials to be treated into said casing, and means for discharging treated materials from the casing, each of said arms having opposite elongated grooves, the grooves at one side of the impulse arms facing the grooves at the opposite sides of the repulse arms.

18. A dispersion mill of the character described, comprising a casing, a rotor arranged in the casing, adapted to rotate about an axis and having a supporting member, impulse arms projecting from one side of said member and rotatable therewith, a second member, repulse arms supported by the second member, projecting in a direction opposite to that of the impulse arms and arranged in staggered and overlapping relation relatively to said impulse arms, means for admitting materials to be treated into said casing, and means for discharging treated materials from the casing, each of said arms having opposite elongated grooves, the grooves at one side of the im-

pulse arms facing the grooves at the opposite sides of the repulse arms, each arm having a hole extending therethrough and placing its grooved surfaces in communication with one another.

19. A dispersion mill of the character desribed, comprising a casing, a rotor arranged in the casing, adapted to rotate about an axis and having a supporting member, impulse arms projecting from one side of said member, a second member arranged in the casing, repulse arms secured to the second member, projecting in a direction opposite to that of the impulse arms and arranged in staggered relation relative to said impulse arms, means for admitting materials to be treated into said casing, and means for discharging treated materials from the casing, the impulse and repulse arms being arranged in overlapping relation and having confronting concave surfaces terminating in inner and outer narrow edge portions, the edge portions of the impulse arms being arranged in close proximity to the edge portions of the repulse arms to cause shearing of materials passing between said arms, each arm having an aperture extending therethrough from its concave surface to its opposite surface.

20. In a dispersion mill of the character described, a casing having an inlet and an outlet, a rotor in the casing having a rotatable supporting member arranged in a plane substantially perpendicular to the axis of rotation of the rotor, spaced circular series of spaced impulse arms carried by said supporting member and projecting from one side thereof, a stator having a stationary supporting member arranged substantially parallel to the supporting member of the rotor and spaced from the latter, and spaced circular series of spaced repulse arms supported by the supporting member of the stator, projecting toward the supporting member of the rotor into the spaces between the series of impulse arms, said repulse arms being arranged in close proximity to the impulse arms, the impulse and repulse arms being arranged in the casing between said inlet and outlet and having confronting concave surfaces, each arm also having opposite narrow side edge portions, said edge portions of the impulse arms during rotation of the rotor traveling in circular paths adjacent to concentric circular lines defining said edge portions of the repulse arms to cause materials passing between said edge portions of the impulse arms and repulse arms to be acted upon by said edge portions.

21. In a dispersion mill comprising a casing having an inlet and an outlet, a stator arranged in the casing and provided with spaced circular series of opposite extending spaced repulse arms, a rotor arranged in the casing and provided with circular series of impulse arms which extend toward one another and into the spaces between the series of repulse arms, the impulse and repulse arms being arranged in the casing between the inlet and outlet and having confronting concave surfaces, each arm also having offset narrow edge portions, said edge portions of the impulse arms, during rotation of the rotor, traveling in circular paths in close proximity to concentric circular lines defining said edge portions of the repulse arms to cause materials passing between the impulse and repulse arms to be acted upon by said edge portions.

22. A dispersion mill of the character described, comprising a casing, a stator arranged in said casing and comprising spaced circular series of stationary repulse arms arranged substantially parallel to one another, a rotor arranged in the casing and having circular series of spaced impulse arms arranged substantially parallel to the axis of rotation and extending into the spaces between the series of repulse arms, the impulse and repulse arms having confronting concave surfaces, each arm also having opposite narrow side edge portions, said edge portions of the impulse arms during rotation of the rotor traveling in circular paths in close proximity to concentric circular lines defining said edge portions of the repulse arms to cause materials passing between said arms to be acted upon by said edge portions, means for admitting a stream to be treated to one edge portion of said casing, and means for discharging such stream from the opposite end portion of said casing.

23. A dispersion mill of the character described, comprising a casing having an inlet and an outlet, a rotor member arranged in the casing and adapted to rotate about an axis, a circular series of spaced impulse arms carried by said member and projecting from one side thereof, supporting means arranged adjacent to said member, circular series of spaced repulse arms secured to said means and projecting in a direction opposite to that of the impulse arms, said impulse arms projecting into the space between the series of repulse arms, the impulse and repulse arms being arranged in the casing between the inlet and outlet and having confronting concave surfaces and narrow side edge portions, said edge portions of the impulse arms, during rotation of the rotor, traveling in circular paths in close proximity to concentric circular lines defining said edge portions of the repulse arms to cause materials passing between the impulse and repulse arms to be acted upon by said edge portions.

24. A dispersion mill of the character described, comprising a casing, a rotor arranged in the casing adapted to rotate about an axis and having a supporting member, spaced circular series of spaced impulse arms carried by said member and projecting from one side thereof, a second supporting member arranged adjacent to but spaced from the first supporting member, a circular series of spaced repulse arms secured to the second supporting member and projecting in a direction opposite to that of the impulse arms and into the space between the series of impulse arms, said impulse and repulse arms being arranged in close proximity to one another and having confronting elongated concave surfaces, each arm also having opposite substantially parallel narrow side edge portions, said edge portions of the impulse arms during rotation of the rotor traveling in circular paths closely adjacent to concentric lines defining edge portions of the repulse arms to cause shearing of materials passing between the impulse and repulse arms.

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