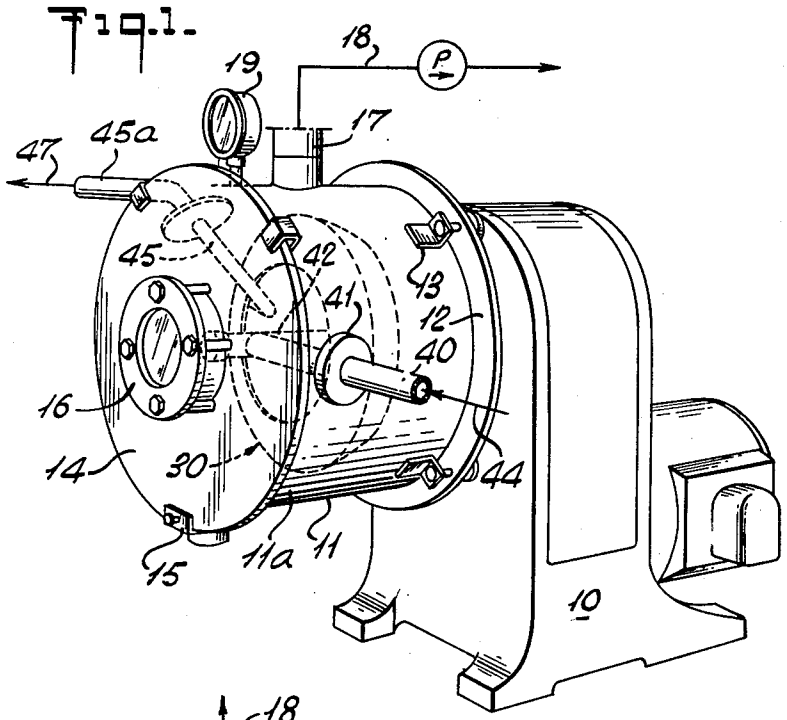
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DISC FOR CENTRIFUGE

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Fig. 1.



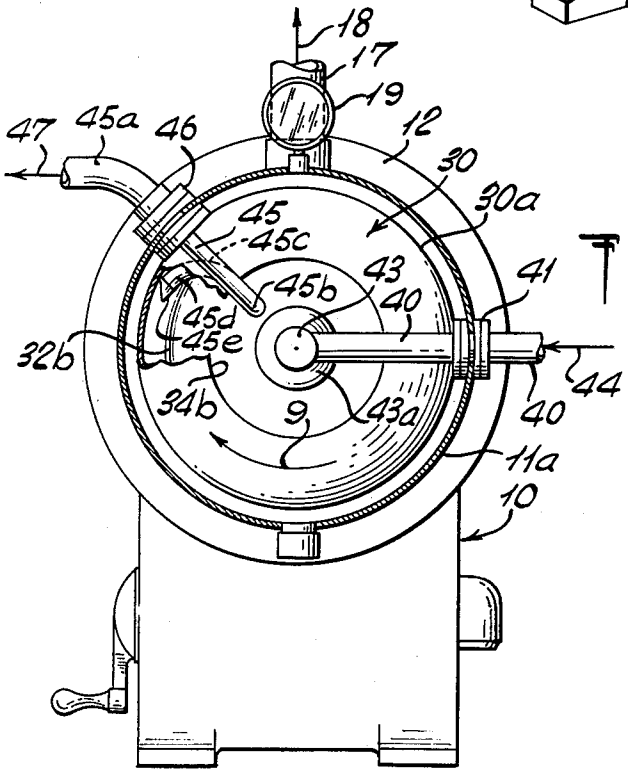


Fig. 2.

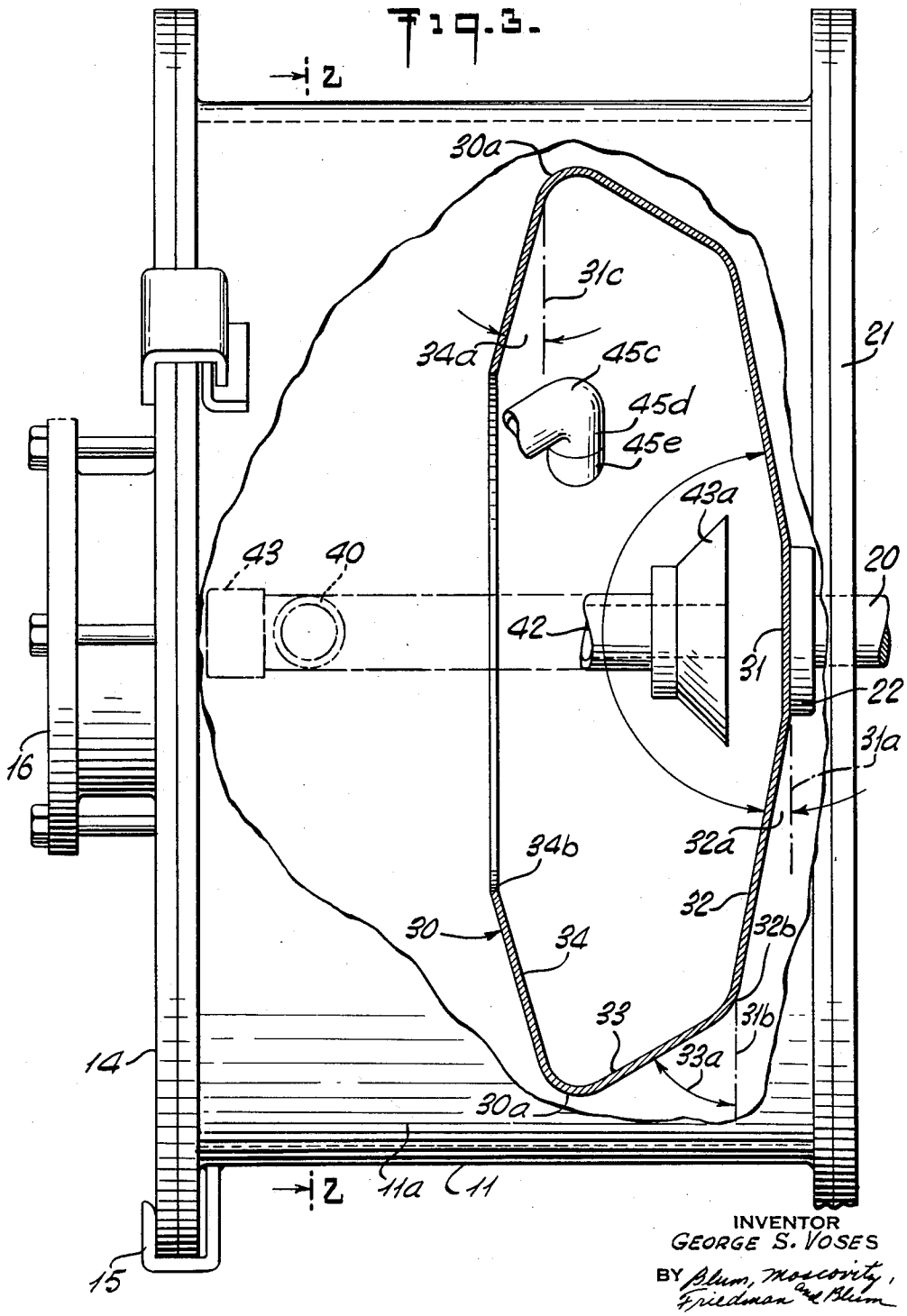
INVENTOR
GEORGE S. VOSES
BY Blum, Moscovitz Friedman & Blum
ATTORNEYS

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FIG. 3.



INVENTOR
GEORGE S. VOSES
BY Blum, Moscovitz, Friedman and Blum
ATTORNEYS

United States Patent Office

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DISC FOR CENTRIFUGE

George S. Voses, Flushing, N.Y., assignor, by mesne assignments, to The Cornell Machine Company, Springfield, N.J., a corporation of New Jersey

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3 Claims. (Cl. 259—3)

This invention relates to an improved centrifugal disc and in particular relates to an improved centrifuge disc shaped for improved control of the homogenization of materials such as liquid suspensions impelled upon the spinning disc.

In accordance with a well-known type of centrifuge, a relatively flat disc is spun at selected speeds with material to be homogenized being impelled upon the center of the disc. The disc is shaped so as to form a film of material over the surface of the disc and extending to the outer periphery thereof, where the material is delivered to an outlet tube or other collection means. During the flow of the material in film form over the surface of the disc, the particles are abraded and sheared as the result of friction thereof against the surface of the disc, and as the result of attrition of one particle against the other, with resulting homogenization of the particles in the material.

This invention makes use of the principle that the friction exerted upon the particles of the material depends upon the speed of movement thereof and the angle of the disc surface over which they move.

An important object of the invention is to provide a centrifugal disc of the above-described type which can be of reduced size and of greater efficiency in forming the film and in homogenizing the particles. It is particularly advantageous to be able to reduce either the diameter and mass of the disc, or the speed of rotation thereof, or both, depending upon the desired conditions of operation of the centrifuge. This results in a centrifuge which is more economical to produce and more efficient in operation. Furthermore, in many instances, with a smaller device and lower speed of operation, it is possible to achieve degrees of homogenization previously requiring very large, high speed devices.

In accordance with a preferred embodiment of the invention, the centrifugal disc has a flat center portion mounted on a hub for rotation at selected speed about an axis, the disc being transverse to said axis. The material to be homogenized can be impelled upon the front face of said center portion of the disc.

In accordance with the invention, the centrifugal disc further comprises an annular intermediate portion or film-forming portion connecting with the periphery of the center portion and extending forwardly outwardly therefrom at a shallow acute angle to the transverse. The disc further comprises an annular outer portion connecting with the outer periphery of the intermediate portion and extending forwardly outwardly therefrom at a relatively large acute angle to the transverse. The center and intermediate portions of the disc are adapted to form a film of liquid material applied to the front of the center portion by rotation of the disc at its selected speed and to sustain this film to the outer periphery of the outer portion or principal homogenization portion of the disc.

The angle of the intermediate portion of the disc is such that the component of centrifugal force on the liquid along the surface of the intermediate portion is much greater than the component of centrifugal force on the liquid normal to the surface of the intermediate portion. As a result, there is only a small amount of friction and resulting breakdown of particles in the liquid along the intermediate portion of the disc.

On the other hand, the angle of the outer portion is preferably such that the component of centrifugal force on the liquid normal to the surface of the outer portion is greater than the component of centrifugal force on the liquid along the surface of the outer portion. This will result in production of high friction and high resulting breakdown by abrasion or attrition of particles in the liquid at the outer portion of the disc.

The respective angles and diameters of the intermediate and outer portions of the disc, together with the selected speed of rotation, are such as to insure delivery of the liquid film to the outer periphery of the disc with most of the desired homogenization of the liquid occurring over the surface of the outer portion.

The advantage of this shape of the disc is that most of the breakdown of the particles occurs in the region of the disc at which they have achieved the necessary high speed for effective breakdown. The intermediate portion of the disc is present to assure the effective formation of the film and achievement of the desired high speed thereof, with partial homogenizations. With the relative separation of the film forming and homogenization functions of the disc into the respective intermediate and outer portions or zones thereof, it is possible to achieve the desired homogenization of the particles at a relatively favorable combination of speed of rotation and diameter of the disc, as compared to centrifugal discs previously known.

Other objects and advantages of the invention will become apparent from the following description, in conjunction with the annexed drawing, in which preferred embodiments of the invention are disclosed.

In the drawing,

FIG. 1 is a perspective view of a centrifuge in accordance with the invention.

FIG. 2 is a transverse section on line 2—2 of FIG. 3.

FIG. 3 is a longitudinal section of the centrifuge.

Upon reference to the drawing in detail, it will be noted that certain details of the device as a whole are not shown since the overall device is substantially conventional, with the main improvement being in the centrifugal disc.

FIGS. 1 and 2 show a casing **10** adapted to be supported upon the floor, such casing **10** being omitted in FIG. 3. Casing **10** contains the drive motor and associated parts, vacuum pump, etc., all of these being conventional. An auxiliary casing **11** is shown as mounted on the front of casing **10**. This casing **11** is generally cylindrical, with its axis extending longitudinally. In this embodiment, but without limitation thereto, the axis of casing **11** is shown as extending horizontally. Since the details of casing **11** are conventional, they are not described in detail. It is sufficient to state that the rear end of casing **11** is secured by flange **12** and clamps **13** to casing **10** by any suitable means. Casing **11** has a tubular peripheral wall **11***a* which is closed at the front by annular plate **14** removably secured thereto by clamping means **15**. A sight glass **16** is secured over the center opening of plate **14**. A tube **17** is connected to the top of casing **11** an dis connected through line **18** and pump P or other suitable device (both shown diagrammatically) to the atmosphere so as to exhaust air from casing **11** to maintain a selected vacuum, as measured by vacuum gauge **19** or other suitable device.

Horizontal shaft **20** extends longitudinally through the rear plate **21** of casing **11** and into the rear thereof. Shaft **20** is coaxial with the peripheral wall **11***a* of casing **11**. Shaft **20** extends rearwardly of casing **11** into the interior of casing **10** where it is connected to the drive means (not shown) so that shaft **20** may be rotated at selected speed. Optionally, but without limitation thereto,

shaft 20 may be rotated in the clockwise direction of arrow 9 (FIG. 2).

The front end of shaft 20 is located at the rear of casing 11. Transverse mounting disc 22 is fixed to the front end of shaft 20. Centrifugal disc 30 is mounted upon the front face of mounting disc 22.

Said centrifugal disc 30 comprises a center portion 31 which is fixedly mounted upon mounting disc 22 or any suitable means (not shown), intermediate or film-forming portion or zone 32 and outer or principal homogenization portion or zone 33. Disc 30 also comprises a protective return portion 34 connecting with the outer periphery of portion 33.

The center portion 31 of disc 30 is circular, flat, and of approximately the same diameter as mounting disc 22. Said center portion 31 extends transversely to the longitudinal axis of shaft 20, and the plane of disc 31 is indicated diagrammatically by the broken line 31*a*.

The intermediate portion 32 of disc 30 connects with the outer periphery of center portion 31 and extends forwardly outwardly therefrom at a shallow acute angle to the transverse. This is the angle 32*a* between portion 32 and plane 31*a*.

The annular outer portion 33 connects with the outer periphery of intermediate portion 32 and extends forwardly therefrom at a relatively large acute angle 33*a* to the transverse. For convenience, the angle 33*a* of portion 33 is shown relative to a plane 31*b* which is parallel to plane 31*a* and which is taken at the junction 32*b* between disc portions 33 and 32. Angle 33*a* preferably exceeds 45 degrees. The outer periphery 30*a* of disc 30 is located slightly inwardly radially of the tubular peripheral wall 11*a* of casing 11. The disc portion 33 is optionally curved slightly inwardly just before the peripheral point 30*a* so as to accommodate the discharge tube. The return portion 34 extends inwardly outwardly from periphery 30*a* at an angle 34*a* to the transverse reference plane 31*c* shown diagrammatically at the periphery 30*a*. The front and inner edge 34*b* of return portion 34 defines a central opening and is located approximately halfway between the ends of casing 11, this position being not critical and being selected so as to accommodate the intake and discharge tubes.

For intake of liquid, a radial tube 40 is extended through wall 11*a* by any suitable fitting means 41 and extends to the center of casing 11. There, tube 40 connects with an axially extending tube 42. This tube 42 extends forwardly of tube 40 and is closed by front cap 43, with tube 40 extending into the side of tube 42. Tube 42 extends rearwardly to a point slightly forwardly of disc central portion 31. A flared spout 43*a* is fitted over the rear of tube 42, as best shown in FIG. 3. The material to be homogenized may be fed into tube 40 by any suitable means (not shown), under any desired pressure velocity conditions, in the direction of arrow 44. The material is discharged or impelled from tube 42 onto disc center portion 31. Any conventional delivery means can be provided.

The material treated upon disk 30 is taken off at periphery 30*a* by means of discharge tube 45. The main portion of discharge tube 45 extends radially, by means of any suitable fitting 46, through wall 11*a* of casing 11, forwardly of disc 30. Outwardly of wall 11, tube 45 is optionally bent forwardly longitudinally at 45*a*, and connected to any suitable receptacle (not shown), with the material which has been treated passing through the discharge tube in the direction of arrow 47. Tube 45 extends inwardly of edge 34*b*, and is there bent rearwardly at 45*b* and extends to a point level with the periphery 30*a*. There, the tube is bent radially outwardly at 45*c* to extend toward the periphery 30*a*. Finally, the tube is bent so as to begin to approach the circumferential, as shown at 45*d*, with the free end 45*e* of the tube being located adjacent the periphery 30*a*. As a result, as material reaches the periphery 30*a* it passes into the mouth or end 45*e* and then is gently directed away from the circumferential through the curved tube portion 45*d* and ultimately through all of the sections of the tube 45.

Disc 30 may be spun or otherwise formed from any suitable metal, such as carbon steel or stainless steel. As stated above, the portion 31 is flat. The portion 32 may optionally be frusto conical, and optionally may be part spherical. However, in view of the shallow or small angle 32*a*, the portion 32 has such a large radius of curvature as to approach the flat for practical purposes. The portion 33 may also optionally be generally frusto conical, although with rounded peripheral portions. The return portion 34 may also be generally frusto conical.

The disc 30 is rotated at selected speed, so that the material impelled upon center portion 31 is formed by the center portion 31 and intermediate portion 32 into a film which is sustained to the periphery 30*a* of intermediate portion 33. The film may form on intermediate portion 33 radially outwardly of its junction with center portion 32. The angle 32*a* of intermediate portion 32 is such that the component of centrifugal force on the material along the surface of intermediate portion 32 is much greater than the component of centrifugal force on the liquid normal to the surface of intermediate portion 32. The result is to minimize friction and resulting breakdown of particles of the material along the surface 32. This is advantageous in that the centrifugal speed of particles along the surface 32 is ordinarily not sufficient to provide the desired frictional abrasion thereof. Accordingly, by making the angle 32*a* small, the minimum friction of the material along surface 32 insures optimum conditions of delivery of the film to the principal homogenization outer portion 33. On the other hand, the angle 33*a* of outer portion 33 is such that the component of centrifugal force on the liquid normal to the surface of outer portion 33 is comparable to the component of centrifugal force on the liquid along the surface of outer portion 33. The result is to produce a very high amount of friction upon the particles along surface 33, with high resulting breakdown of particles in the liquid. This is advantageous in that the surface 33 is oriented so as to produce high friction of the particles when they are traveling at a speed such as to insure a high degree of abrasion and attrition and resulting breakdown of the particles. This makes possible maximum favorable design factors of the disc as a whole. The respective angles and diameters of intermediate and outer portions 32 and 33 relative to the selected speed of rotation of the disc are such as to insure delivery of the liquid film to the outer periphery 30*a* of disc 30 with the principal portion of the desired homogenization of the liquid occurring over the surface of outer portion 33.

While a preferred embodiment of the invention has been disclosed, and various possible changes, omissions and additions have been disclosed, it will be apparent that various other changes, omissions and additions may be made in the invention without departing from the scope and spirit thereof.

What is claimed is:

1. In a centrifuge of the type described, a centrifugal disc for operation at selected speed comprising a flat center portion for rotation at said selected speed about an axis, said disc being transverse to said axis, an annular intermediate portion connecting with the outer periphery of said center portion and extending forwardly outwardly therefrom at a shallow acute angle to the transverse, and an annular outer portion connecting with the outer periphery of said intermediate portion and extending forwardly outwardly therefrom at a large acute angle to the transverse, said center and intermediate portions being adapted to form a film of liquid material impelled upon the front of said center portion by rotation of said disc at said selected speed and to sustain said film to the outer periphery of said outer portion, the angle of said intermediate portion being such that the component

of centrifugal force on the liquid along the surface of said intermediate portion is much greater than the component of centrifugal force on the liquid normal to the surface of said intermediate portion so as to minimize friction and resulting abrasion and attrition of particles in said liquid, the angle of said outer portion being such that the component of centrifugal force on the liquid normal to the surface of said outer portion is greater than the component of centrifugal force on the liquid along the surface of said outer portion so as to produce high friction and high resulting abrasion and attrition of particles in said liquid, the respective angles and diameters of said intermediate and outer portions relative to said selected speed being such as to ensure delivery of said liquid film to the outer periphery of said disc with the major portion of the desired homogenization of the liquid occurring over the surface of said outer portion, and means for taking material from said disc positioned to receive said material beyond the outer periphery of said outer portion.

2. In a centrifuge of the type described, a centrifugal disc for operation at selected speed comprising a center portion for rotation at said selected speed about an axis, said disc being transverse to said axis, an annular intermediate portion connecting with the outer periphery of said center portion and extending forwardly outwardly therefrom at a shallow acute angle to the transverse, and an annular outer portion connecting with the outer periphery of said intermediate portion and extending forwardly outwardly therefrom at a large acute angle to the transverse, said center and intermediate portions being adapted to form a film of liquid material impelled upon the front of said center portion by rotation of said disc at said selected speed and to sustain said film to the outer periphery of said outer portion, the angle of said intermediate portion

being such that the component of centrifugal force on the liquid along the surface of said intermediate portion is much greater than the component of centrifugal force on the liquid normal to the surface of said intermediate portion so as to minimize friction and resulting abrasion and attrition of particles in said liquid, the angle of said outer portion being such that the component of centrifugal force on the liquid normal to the surface of said outer portion is greater than the component of centrifugal force on the liquid along the surface of said outer portion so as to produce high friction and high resulting abrasion and attrition of particles in said liquid, the respective angles and diameters of said intermediate and outer portions relative to said selected speed being such as to ensure delivery of said liquid film to the outer periphery of said disc with the major portion of the desired homogenization of the liquid occurring over the surface of said outer portion, and means for taking material from said disc positioned to receive said material beyond the outer periphery of said outer portion.

3. Centrifugal disc in accordance with claim 2, the angle to the transverse of said outer portions being greater than 45 degrees.

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