

Aug. 30, 1927.

1,640,707

W. C. LAUGHLIN

MACHINE FOR SEPARATING SOLIDS FROM LIQUIDS OR LIQUIDS FROM LIQUIDS

Filed Sept. 29, 1923

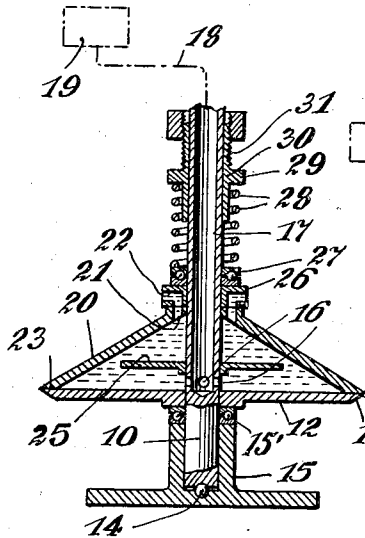


Fig. 1.

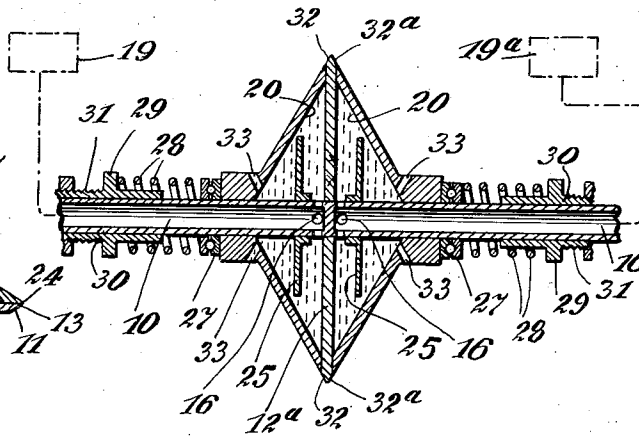


Fig. 2.

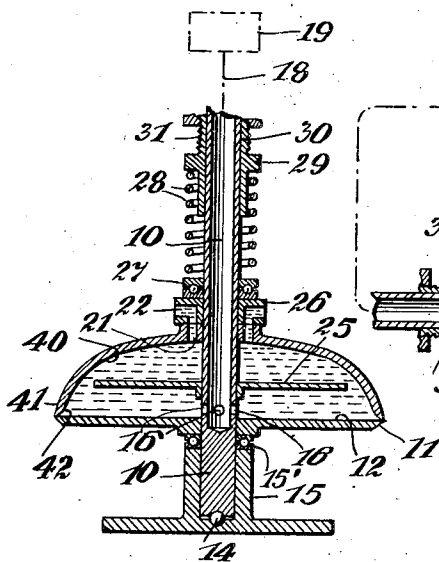


Fig. 3.

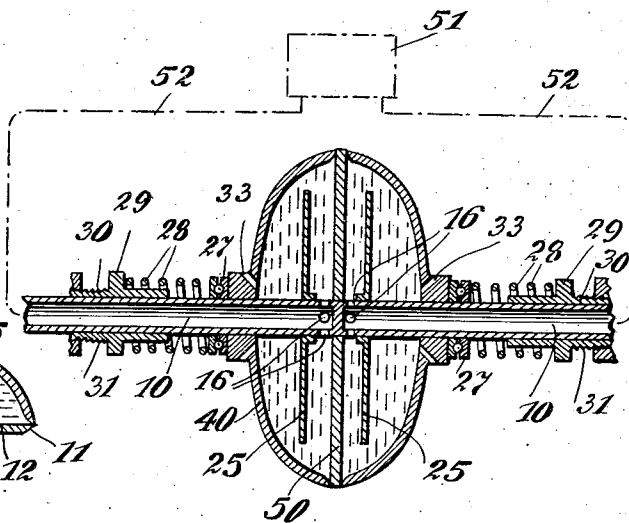


Fig. 4.

INVENTOR

William C. Laughlin

BY

C. P. Loebel

his ATTORNEY

Patented Aug. 30, 1927.

1,640,707

UNITED STATES PATENT OFFICE.

WILLIAM C. LAUGHLIN, OF GLENDALE, CALIFORNIA, ASSIGNOR TO LAUGHLIN FILTER CORPORATION, OF NEW YORK, N. Y., A CORPORATION OF DELAWARE.

MACHINE FOR SEPARATING SOLIDS FROM LIQUIDS OR LIQUIDS FROM LIQUIDS.

Application filed September 29, 1923. Serial No. 665,622.

This invention relates to the art of separating solids from liquids or liquids from liquids, and has for its object to provide efficient means to accomplish such separation and more particularly, relates to subject matter disclosed and claimed in an application filed by me heretofore on June 21st, 1923, under Serial No. 646,810, which is a continuation in part of a former application filed by me on March 20th, 1923, under Serial No. 626,260. This application is in part a divisional application of subject matter disclosed and described and broadly claimed in application, Ser. No. 646,810, and embodies also modifications of such subject matter described and broadly claimed in said application.

In the former application the claims were generic to the various embodiments shown and specific to a structure having the plates each of angular shape. While the specific embodiment of a flat plate with an angular plate was shown in the figures and described, it was not claimed in the application because of the election in that application to claim the two angular plates. For this purpose the present application is filed, directed specifically to structures having one flat plate and another plate of angular configuration either with straight walls or curved walls. In addition the present application discloses two sets of plates directed against a common central plate.

The object of the invention is to provide an efficient device which is of simple construction, uniform in its operation and yieldable by variations in the material to be treated. For this purpose my invention will be hereinafter described, shown in the drawings and finally pointed out in the claims.

In the drawings wherein similar reference characters designate corresponding parts throughout the several views;

Figure 1 is a central section of a vertical shaft machine embodying my invention;

Figure 2 is a central section of a horizontal shaft machine embodying my invention;

Figure 3 is a central section of another form of vertical shaft machine; and

Figure 4 is a central section of another form of horizontal type machine.

Referring to the drawings, the shaft 10 which is arranged vertically but which also

could be arranged horizontally, is suitably operated by a pulley or the like, not shown in the drawings, or a turbine may replace the pulley. Any other means for rotating the shaft may be provided. To the shaft 10 a plate 12 is keyed or otherwise securely fastened to the shaft so as to rotate therewith at the same speed. The plate 12 is of flat shape and has a beveled exterior portion 11 so as to have the plate come to a point at the peripheral portion 13 thereof. The shaft 10 rests upon a bearing 14 in a standard 15 and this standard is also provided with ball-bearing 15' interposed between the standard 15 and the plate 12. Above the plate 12 the shaft is provided with openings 16 serving as communication means between the space above the plate 12 and the interior of the shaft 10 which, above these openings 16, is hollow as indicated by the numeral 17, to permit the material to be separated to pass through the shaft.

The hollow interior of the shaft 10 is connected by means of a pipe 18 with a reservoir 19. Resting upon the plate 12 at and near its peripheral portion, is a plate 20 shown in Figure 1 with straight sides forming a conical plate. These straight sides are inclined to the axis of the shaft 10. At the upper part of the plate 20 channels 21 are provided which communicate with channels 22 of a sleeve and these channels serve to permit a part of the separated material to pass therethrough and to pass out of the machine. It will be noted that the channels 21 are as close to the shaft and to the axis thereof as commercial machining will permit, the general object being to have the outer openings of the material separated as nearly axially to the shaft as is commercially or practically possible. It will be noted that the inlet of the material through the openings 16 is substantially axial and that the outlet of part of the material is substantially axial through the channels 21 and 22, while the other part of the material separated is peripheral of the plates 12 and 20. The plate 20 is provided with a flat portion 23 which seats on and is substantially parallel with the flat face of the plate 12 and the exterior corner 24 of the plate 20 is substantially in line with and in contact with the edge 13 of the plate 12. Interposed between the plate 12 and

the plate 20 is a dividing plate 25 which is secured to the shaft 10 and rotated therewith at the same speed thereof, the plate 20 rotating also at the same speed as that of the shaft. Suitable keys and key-ways or other securing devices may be provided so that the plate 25 and the plate 20 rotate with the shaft at the same speed thereof.

Around the shaft 10 and above the sleeve 26 which is provided with the channel 22, is arranged a ball-bearing 27 and pressing upon this ball-bearing is a coil spring 28 which at its other end presses against a shoulder 29 of a sleeve 30. This sleeve 30 is provided with a screw threaded portion 31 which is adapted to engage an interiorly threaded nut by means of which the shoulder 29 may be moved along the shaft 10 and thereby the spring 28 given various degrees of compression. After the shoulder 29 is moved downwardly the spring 28 will be compressed and it will press the ball-bearing 27 against the sleeve 26 and hence the plate 20 will be pressed against the plate 12. Conversely, an upward movement of the shoulder 29 will release the tension of the spring 28 and hence permit the separation of the plate 20 from the plate 10.

During the operation of the machine the material separated will also have an effect upon the spring in that during the operation of the machine certain portions of the material depending upon its consistency and constituency, may press upon the plate 20 and hence move it upwardly and thereby momentarily compress the spring 28 which will then again assert itself and press the plate 20 back upon the plate 12. This yieldable and flexible action permits of efficient operation of the machine and enables the plates to adjust themselves to the material being separated.

The entire interior of the space or chamber between the plates 12 and 20 is filled with material to be separated and preferably this material is fed to the interior of the shaft 10 under gravity action so that there is a constant flow of the material to be separated from the reservoir into the space between the plates 12 and 20. The conoidal chamber between these plates is thereby always filled with one part of the separating material, namely, the heavier part, or that of greater specific gravity, discharging at the peripheral portions of the plates, and the lighter or material of less specific gravity discharging through the channel 22 in a continuous operation, the operation not being interrupted as long as there is material to be separated in the reservoir.

In Figure 2 I have shown the structure shown in Figure 1 duplicated so as to have the inclined plates act against a common straight plate. The reference characters in Figure 2 are the same as in Figure 1 in that

all the parts operate in the same way. The machine there shown is arranged with a horizontal shaft which is fed at its open ends from reservoirs 19 and 19^a and the central common plate 12^a is keyed to the shaft so as to rotate therewith at the same speed thereof. It will be noted that plates 20 press against opposite sides of the plate 12^a. This machine which is arranged horizontally, but also could be arranged vertically, has the advantage that it doubles the capacity of the machine shown in Figure 1. Preferentially, the plate 12^a is provided with beveled side portions 32 and 32^a. In the embodiment shown in Figure 2 the outlet portions 33 are angularly arranged in respect to the axis of the shaft but can also be arranged as shown in Figure 1.

In Figure 3, the general arrangement of parts as described in connection with Figure 1, is shown, but instead of having a plate 20 with straight sides the plate is curved substantially as shown in Figure 3. This has the advantage in that for certain kinds of material it is better to have the larger contents in the conoidal chamber holding the material which is to be separated and it will be noted that the curved plate 40 has its end 41 beveled as shown at 42 so as to provide substantially a point contact with the plate 12. For certain conoidal walls this point contact is very advantageous. In this embodiment of Figure 3 the straight plate 12 is again provided and as a result the path of the material is so arranged as to be readily moved in a plane at right angles to the axis of the shaft 10.

In Figure 4 the structure of Figure 3 is duplicated and again a common straight plate 50 is provided which is secured to the shaft 10 and rotates therewith with the same speed thereof. This structure may be fed from a common reservoir indicated at 51 having supply pipes 52. It is, of course, clear that the common reservoir may be provided with a structure like Figure 2 or the structure of Figure 4, or may be provided with independent reservoirs.

In the embodiment shown in Figure 4 the common plate 50 is not beveled as shown in Figure 2 but may be beveled if desired, or the plate shown in Figure 2 may be arranged as in Figure 4.

The advantage of the structure shown in the drawings and heretofore described is that one plate is flat or straight or arranged in a plane at right angles to the axis of rotation and this flat plate serves to receive the material to be separated and guide the material in cooperation with the plate 25 so that it may be acted upon by the centrifugal forces operating upon the material due to the rapid rotation of the flat plate and plate 25. These two plates 12 and 25, or the three plates, 12, 12^a and 25, or plate 50

and plate 25, are arranged parallel with each other, all in a plane at right angles to the axis of rotation and as stated, serve to guide the material so as to have it acted upon by the centrifugal forces. The other plates 20 or 40 serve to guide, depending upon the amount of material peripherally discharged and may be formed either of conoidal straight line shape or of conoidal curved shape and the shapes of these plates give capacity to the machine. It is of course clear that the material which is separated, namely, lighter material, passes around the plates 25 and towards the outlet openings or channels 22 or 33. In this invention the incoming material travels in a straight line (guided between the flat lower plate and the dividing plate 25) toward the peripheral outlet, centrifugal force causing the heavy particles to move faster than the lighter fluid, whereby the particles clog up the angle inside the peripheral outlet and force said outlet open. Meanwhile the lighter fluid moves upward toward the axial outlet. As the fluid passes the distributing plate, the constriction formed thereby checks the speed of any particles remaining in the fluid, allowing them to be thrown by centrifugal force toward the peripheral outlet.

The structures shown in the drawings and described hereinafter are very efficient in operation, very simple in construction and lend themselves admirably for the purposes intended. The device described may be used to separate solids from liquids or liquids from liquids and may also be applied to material in colloidal state, bearing in mind that such materials are slightly different than when solid and that the law that centrifugal force increases with the increase of specific gravities, require slight modification. In respect to the particular dimensions of the machine, these have been described in connection with my foregoing application, Ser. No. 646,810, as also the speeds of revolution and it will be clear to any one skilled in the art to make such modifications therein as may be necessary for the commercial operation thereof.

The application of my invention to the arts has also been described heretofore in my former application and that description is made a part of this application.

I do not desire to be limited to the particular embodiments herein shown since they have been shown to indicate the spirit of my invention underlying the same and since changes may be made therein without departing from the spirit and scope of the invention as claimed.

In the operation of the machine, the whirling of the plates with the material filling the conoidal chamber causes the material therein contained to form a small open

space along the shaft. It is in the nature of a vacuum action gap. This formation of the space forces the contents by hydraulic pressure into such a position that the resultant forces acting against the flat plate and reacting against the other plate causes this other plate to be raised against the action of the spring which is set with sufficient tension, so that the horizontally acting centrifugal force can just force the solid matter between the plates, and peripherally away therefrom. The material having been segregated by virtue of the centrifugal forces, has the heavier constituents in a position to discharge peripherally and the lighter to discharge axially. Thus, a method is provided which consists essentially in subjecting the plates to hydraulic pressure and thereby separating them against the action of the spring, and thereby permitting the discharge of the heavier material peripherally of the plates.

Preferably, the respective sizes 11" diameter disk, means minimum shaft 1.78"; 14" diameter, 2 $\frac{3}{8}$ "; 20" diameter 3.40"; 30" diameter 5.08"; 40" diameter, 6.78"; about net less than 1 to 6.

I claim:

1. In a machine for separating solids from liquids or liquids from liquids, the combination of rotary plates facing each other having their peripheral surfaces smooth and unobstructed both radially and circumferentially, and contacting smoothly and circumferentially, one of said plates having a flat interior surface and the other of said plates having an inclined interior surface in respect to the axis of rotation, means for uninterruptedly feeding to the space between the plates, material to be separated and discharging certain of the material between the plates substantially at or near the axis of rotation thereof, a plate rotatable with the rotary plates and rotating at the same speed thereof and arranged parallel with the flat surface of the flat plate, and a spring centrally disposed in respect to one of the plates for causing the smooth peripheral portion of one plate to exert a uniform pressure upon the smooth peripheral portion of the other plate around the peripheral circumference thereof.

2. In a machine for the separation of solids from liquids, or liquids from liquids, the combination of a plurality of chamber forming plates having interior walls unobstructed throughout their length and having smooth abutting peripheral end portions unobstructed radially and circumferentially for discharging a constituent of higher specific gravity at all circumferential points thereof, the interior walls of the plates forming a conoidal chamber, a circular plate within the abutting plates and adapted to rotate at the same speed of rotation

with the abutting plates and forming an angle with the interior wall of one of the plates and arranged parallel with the interior wall of the other plate, means for feeding the material to be separated between the preliminary plate and the plate parallel therewith and substantially at or near the axis of rotation thereof, means for discharging one constituent of the material at the other side of the preliminary plate and adjacent the axis of rotation of the plate and means for yieldingly holding the peripheral portions of the chamber forming plates in abutting relationship and yieldingly permitting separation of the peripheral portions by the constituent discharged therefrom.

3. In combination, feeding means, a preliminary rotating plate arranged in respect to the feeding means so as to receive the material substantially at or near the axis of rotation of the plate, the plane of rotation of the preliminary plate being at right angles to the axis of rotation, chamber forming plates surrounding the preliminary plate and rotatable at the same speed therewith and forming a conoidal chamber therebetween, one of the plates having a plane at right angles to the axis of rotation and the other of said plates having a conoidal configuration and both of said plates being imperforate and both of said plates having their peripheral portions forming a smooth unobstructed surface radially and circumferentially in a plane at right angles to the axis of rotation and normally in abutting contact, and means permitting the chamber forming plates to be moved in respect to each other during the rotation of the same by the material of higher specific gravity discharging unimpededly at the peripheral portions thereof whereby the material fed to the interior of the disc plates is conducted from the central part thereof to the periphery thereof circumferentially continuous.

4. In a machine for separating solids from liquids or liquids from liquids, a hollow shaft adapted to be fed from both ends thereof with material to be separated, and having discharge openings centrally of its length, a plate separating the discharge openings arranged in a plane at right angles to the axis of the shaft and extending outwardly of the shaft in the same plane, plates enclosing the discharge openings of the shaft and rotating at the same speed as the shaft and adapted to contact in a smooth and unobstructed manner with both sides of the first plate and means holding said enclosing plates uniformly against the first plate but separable by the material itself discharging peripherally of the plates.

5. In a machine for separating solids from liquids or liquids from liquids, the combination of a hollow shaft adapted to be fed from both ends thereof with material to

be separated, and having discharge openings centrally of its length, a plate separating the discharge openings arranged in a plane at right angles to the axis of the shaft and extending outwardly of the shaft in the same plane, conoidal plates having curved interior surfaces enclosing the discharge openings of the shaft and rotating at the same speed as the shaft and adapted to contact in a smooth and unobstructed manner with both sides of the first plate, and means holding said enclosing plates uniformly against the first plate but separable by the material itself discharging peripherally of the plates.

6. In a machine for separating solids from liquids or liquids from liquids, the combination of a hollow shaft adapted to be fed from both ends thereof with material to be separated, and having discharge openings centrally of its length, a plate separating the discharge openings arranged in a plane at right angles to the axis of the shaft and extending outwardly of the shaft in the same plane, conoidal plates having curved interior surfaces and having their peripheral end portions terminating in sharpened edges enclosing the discharge openings of the shaft and rotating at the same speed as the shaft and adapted to contact in a smooth and unobstructed manner with both sides of the first plate, and means holding said enclosing plates uniformly against the first plate but separable by the material itself discharging peripherally of the plates.

7. In centrifugal separation apparatus, the combination of flat and conical plates having smooth uninterrupted surfaces and engaging at their peripheral portions to form a conoidal separating chamber, a flat separating plate in said chamber parallel to the flat chamber forming plate, means for holding the chamber plates engaged with a yielding force variable to regulate the internal centrifugal force requisite to separate said plates and means for supplying material into the chamber, the distributing plate being positioned within the chamber to direct the incoming material outwardly to the peripheral discharge outlet.

8. In centrifugal separation apparatus, the combination of flat and conical plates contacting at their peripheral portions to form a separating chamber and having smooth continuous unobstructed surfaces to provide a continuous uninterrupted peripheral discharge outlet as they separate, adjustable means for holding said plates yieldingly engaged, means for continuously feeding material into the axial portion of the chamber and a rotating plate within the chamber parallel with one of the plates forming the chamber for continuously directing the material radially outwardly to the peripheral discharge outlet.

9. In centrifugal separation apparatus, a multiple chambered rotating separator comprising a disc, conical plates yieldably supported and cooperating at their peripheral portions with opposite faces of said disc to provide conoidal chambers at opposite sides of the disc and means for feeding the material to be operated upon into said chambers.

10. In centrifugal separation apparatus, a multiple chambered rotating separator comprising a disc, conical plates yieldably supported and cooperating at their peripheral portions with opposite faces of said disc to provide conoidal chambers at opposite sides of the disc and means for feeding the material to be operated upon into said chambers, including tubular shafting supporting the chamber forming elements and discharging into the chambers.

11. In centrifugal separation apparatus, a multiple chambered rotating separator comprising a disc, conical plates yieldably supported and cooperating at their peripheral portions with opposite faces of said disc to provide conoidal chambers at opposite sides of the disc, means for feeding the material to be operated upon into said chambers and rotary distributing plates within the chambers aforesaid.

12. In centrifugal separation apparatus, tubular shafting and a plurality of separating chambers mounted on said shafting supplied therefrom and consisting in each instance of relatively separable members cooperating to form a closed chamber and yieldably held engaged at their peripheral portions.

13. In centrifugal separation apparatus, supporting shafting and a plurality of separating chambers mounted on and rotated by said shafting and consisting in each case of relatively separable disc-like members cooperating to form a chamber held engaged at their peripheral portions by yielding means adjustable to vary the internal centrifugal force necessary to open that particular chamber.

14. In a centrifugal separator, a rotatable separating chamber formed by a flat plate and a second plate with its periphery extended toward said flat plate, a separating plate in said chamber, said separating plate being arranged parallel to said flat plate and extending toward said second plate to form a constriction in said chamber, said chamber having an inlet and an outlet.

15. In a centrifugal separator, a rotatable separating chamber formed by a flat plate and a second plate with its periphery extended toward said flat plate, a separating plate in said chamber, said separating plate being arranged parallel to said flat plate and extending toward said second plate to form a constriction in said chamber, an axial inlet between said separating plate and said flat plate and an outlet located on the opposite side of said separating plate from said inlet.

16. In a centrifugal separator, a rotatable separating chamber having a peripheral outlet and an outlet which is substantially axial, and an inlet from which material can flow to said peripheral outlet in a straight path normal to the axis of said chamber.

17. In a centrifugal separator, a rotatable separating chamber having a peripheral outlet and an outlet which is substantially axial, an inlet from which material can flow to said peripheral outlet in a straight path normal to the axis of said chamber, and means for decelerating the speed of certain parts of the material between the peripheral outlet and the axial outlet.

18. In a centrifugal separator, a rotatable separating chamber mounted on a shaft, said chamber having a peripheral outlet and an outlet which is substantially axial, an inlet opening from said shaft, said inlet being substantially in the same radial plane as the peripheral outlet.

19. In a centrifugal separator, a rotatable separating chamber mounted on a shaft, said chamber having a peripheral outlet and an outlet which is substantially axial, an inlet opening from said shaft, said inlet being substantially in the same radial plane as the peripheral outlet, and a constriction formed in said chamber between said peripheral outlet and said radial outlet.

20. In a centrifugal separator, a rotatable separating chamber having a peripheral discharge outlet, a dividing plate within said chamber, a substantially axial inlet to said chamber at one side of said dividing plate, said separating chamber having a substantially axial discharge outlet at the opposite side of said separating plate and the peripheral discharge outlet being continuous and uninterrupted.

In testimony that I claim the foregoing as my invention, I have signed my name.

WILLIAM C. LAUGHLIN.