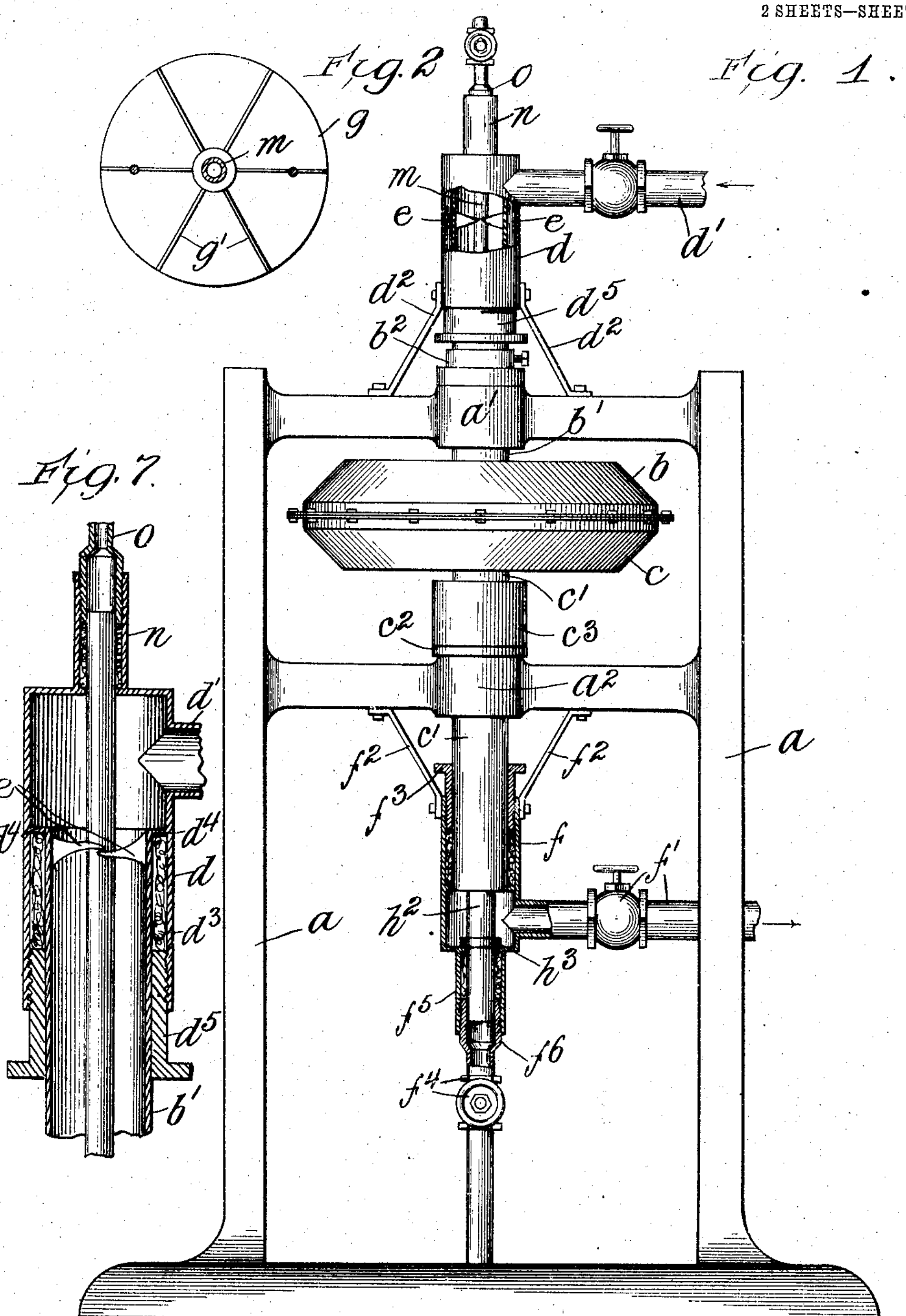
No. 778,355. PATENTED DEC. 27, 1904.

T. B. FREAS.

CENTRIFUGAL MACHINE.

APPLICATION FILED SEPT. 6, 1904.

2 SHEETS—SHEET 1.



Witnesses:

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Fig. 3

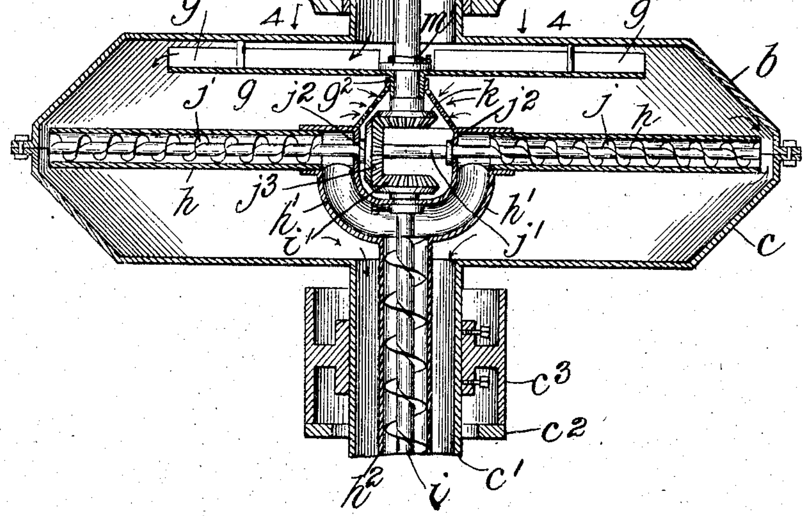


Fig. 4.

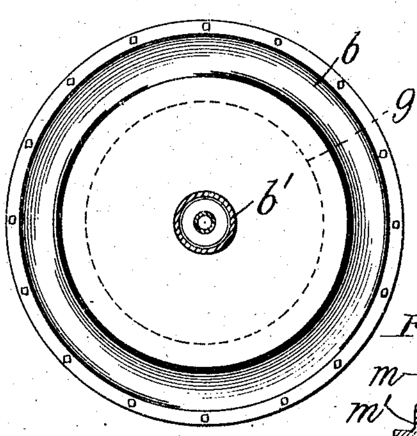


Fig. 5.

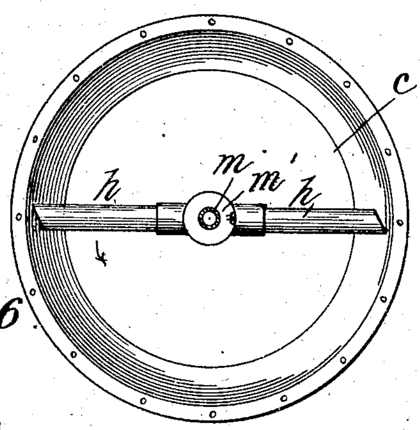
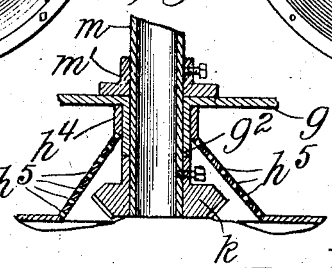


Fig. 6.



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UNITED STATES PATENT OFFICE.

THOMAS B. FREAS, OF CHICAGO, ILLINOIS.

CENTRIFUGAL MACHINE.

SPECIFICATION forming part of Letters Patent No. 778,355, dated December 27, 1904.

Application filed September 6, 1904. Serial No. 223,472.

To all whom it may concern:

Be it known that I, THOMAS B. FREAS, a citizen of the United States, residing in the city of Chicago, in the county of Cook and State of Illinois, have invented a certain new and useful Improvement in Centrifugal Separators, of which the following is a specification.

My invention relates to centrifugal separators adapted to operate either under gage pressure or atmospheric pressure and also adapted to operate upon liquids of various kinds, such as boiler-water, mother-liquors, &c.

The objects of the invention are to provide a mechanism which shall be simple in construction, efficient, easily regulated, and positive in its circulation. I attain these objects by the mechanism illustrated in the accompanying drawings, in which—

Figure 1 is a general side elevation of the complete machine. Fig. 2 is a plan view of the shield and starting-vanes located at the top of the revolving shell. Fig. 3 is an elevation, chiefly in the central section, of the revolving shell or casing, together with the parts therein contained. Fig. 4 is a plan view of the shell, taken on line 4 4, Fig. 3. Fig. 5 is a plan view of the shell with the upper part removed, showing the arrangement of the discharge-tubes. Fig. 6 is a vertical section view of a portion of the gearing for operating the discharging-screws. Fig. 7 is a fragmentary view, in vertical section, showing the preferred construction of the parts adjacent to the tubular inlet portion of the rotating shell.

Similar reference characters denote similar parts throughout the several views.

The main framework a may be of any suitable design and is provided with the vertical journal-bearings a' and a^2. The tubular portions b' and c' and shell parts b and c, respectively, are journaled in said bearings a' and a^2, so as to rotate about a vertical axis. The collars b^2 and c^2 are rigidly secured to the parts b' and c', respectively, by set-screws or other suitable means and rest upon the bearings a' and a^2, respectively, for supporting the separator-shell. A band-wheel c^3 is also rigidly secured to the portion c' of the rotating shell; but any other suitable means for rotating and supporting said shell may be employed. The tubular portion b' constitutes the passage through which the fluid is to be supplied to the machine, and the preferred manner of connecting it to the feed or supply pipe d' is best shown in Figs. 1 and 7. The stationary casing d connects with the pipe d' and is rigidly supported upon the main frame by means of the braces d^2 or in any other suitable manner. Said casing is tubular and of a greater diameter than the part b', so as to afford room for the packing d^3. This packing is held in position between the annular collar d^4 on casing d and the stuffing-nut d^5, which screws into the lower extremity of said casing around the rotating inlet part b'. The vanes e are secured to and rotate with the part b' for forcing liquid through the machine. The construction is similar at the discharge portion of the machine, where f represents the casing connected to the discharge-pipe f' and supported by braces f^2. The stuffing-nut f^3, as before, prevents leakage between the stationary casing f and the rotating tubular portion c'.

The shell consists of the parts b and c, above mentioned, adapted to be bolted or otherwise secured together at the periphery and receive motion from the pulley c^3 or other suitable driving means. The shell is preferably tapered at the peripheral edge, so that its greatest diameter lies in a horizontal plane between the top and bottom walls. By preference a portion of the inside surface of the walls at the point of greatest diameter of the shell is cylindrical to better coöperate with the receiving-openings of the tubular arms located within the shell in a manner hereinafter described. Near the upper portion of the upper shell part is secured a deflector g, consisting of an annular plate having a set of vanes g', adapted to impart a rotary motion to the water or other liquid entering the shell through the tube b'. Inside of the shell, at a height corresponding to the greatest diameter thereof, are located the tubular arms h, which are preferably two in number, as shown in Figs. 3 and 5, and so constructed that their open mouths approach to within a short distance of the vertical inner surface of the walls of the shell. Said arms rotate relatively to the shell for drawing off from all points of the periphery thereof the heavier matter there collected, and to facilitate the action the outer extremity of said arms are cut obliquely, the part which is last to reach any given point of the shell approaching more nearly to the periphery than does the part first reaching such point. The arms should be evenly balanced to avoid vibration in the machine, and this is one reason for so arranging the arms that they extend in diametrically opposite directions from the center. Said arms *h* are supported upon and communicate at their inner extremities with the preferably U-shaped pipes *h'*, which in turn communicate with the upper extremity of the downtake-pipe h^2. Said pipes *h*, *h'*, and h^2 are braced, so as to remain in position and yet rotate independently of the shell, by means of the collar h^4, which encircles the annular flange g^2, formed upon the deflector *g*, as best shown in Fig. 6. Collar h^4 is rigidly connected to arms *h* in the present instance by the perforated cone h^5, although any kind of bracing will answer. Said downtake h^2 is of considerably smaller diameter than the tube *c'*, to thereby afford a passage outside of said downtake for the purified liquid to the outlet-pipe *f'*. Said downtake h^2 and the arms *h* secured thereto are rotatably supported by means of the collar h^3, which is rigidly secured to downtake h^2 and bears upon the contracted lower portion of the lower casing *f*, as shown in Fig. 1. Said downtake discharges into the valved drain f^4, and in the preferred construction a stuffing-box is formed around the lower extremity of said downtake by means of the nut f^6, which forms a part of the drain f^4 and which screws into the lower extremity of the extension f^5, formed upon the lower casing *f*. By this construction the downtake h^2 discharges into the drain f^4; but the purified liquid passing directly from the shell itself into the tube *c'* will pass through the discharge-pipe *f'* without becoming mixed with the liquid in said downtake.

A helical worm or conveyer *i* is mounted within the downtake h^2 and is rotatably supported by the hub of the bevel-gear *i'*, which is rigidly secured to the upper extremity of said downtake and bears upon the upper surface of the pipes *h'*. The rotation of said conveyer within the downtake causes the downward flow of the matter therein. In the discharge-arms *h h* are rotatably mounted the helical worms or conveyers *j j*, which are formed "right" and "left." By preference both of said conveyers are mounted upon the same shaft *j'* and are held in their proper position by means of the thrust-collars j^2 j^2, which bear against the inner closed extremities of the discharge-arms *h*, as shown in Fig. 3. The purpose in forming both of the conveyers *j* upon the same shaft is to reduce friction by relieving the said collars j^2 of lateral thrust when said conveyers are rotated within said arms, for with the present construction the tendency of the conveyers to shift toward the outer extremities of arms *h* is overcome by the shaft *j'* itself, which thus becomes subjected to tensional strain.

The bevel-gear j^3 is rigidly secured to the shaft *j'* in such position as to mesh simultaneously with the bevel-gear *i'* at the bottom and the bevel-gear *k* at top. Said gear *k* is vertically apertured in its center to receive the lower open extremity of the escape-pipe *m*, to which it is rigidly secured, as best shown in Fig. 6. In the construction shown the pipe *m* is held at its proper elevation in the machine by means of said bevel-gear *k*, which prevents said pipe from rising, and the collar *m'*, which is rigidly secured to pipe *m* above deflector *g*, prevents said pipe from descending. However, any construction which holds the parts in proper relationship and at the same time permits the shell and pipe *m* and gear *k* all to rotate at different speeds from each other may be substituted. The upper extremity of pipe *m* passes into a stuffing-box formed of the cylindrical extension *n* of the tube *d* and a nut *o*, which screws into said extension, as best shown in Fig. 7. This construction at the upper extremity of pipe *m* has two functions—first, to prevent the escape of liquid, and, second and most important, to provide means whereby the friction tending to prevent rotation of pipe *m* may be regulated.

The operation of the machine in the form here illustrated is as follows: By means of the pulley c^3 the shell *b c* is caused to rotate at high speed, and the water or other liquid to be acted upon is introduced through the pipe *d'*. The liquid will be drawn into the shell by the action of the rotating vanes *e* unless the liquid itself is forced into pipe *d'* under pressure, in which case said vanes would not be required. As the liquid enters the shell it strikes the deflector *g* and is directed toward the periphery of the shell, and at the same time the rotating vanes *g'* impart a rotary motion to the liquid. By reason of centrifugal action the heavier particles of matter in the liquid tend to gather at the point of greatest diameter of the shell, this being opposite to the mouths of the tubular arms *h*. If there were no friction to retard the rotation of said arms, the rotating liquid in the shell would cause said arms to rotate at substantially the same speed as said shell and the mouths of said arms would remain opposite to the same point in the periphery of the shell and would not remove all of the heavier matter gathered there. The stuffing-nut f^6, however, affords means for producing as much friction as is necessary in addition to the unavoidable friction of the bearings of said arms, and by means of said nut the arms can be slowed down as much as desired. Under ordinary conditions the arms h would be permitted to rotate at a speed almost as high as that of shell b c, so that there will be only a slight drag, and the mouths of said arms will revolve relatively to the shell and gradually pass around the entire periphery thereof, so as to enable them to receive all of the heavier material there collected. The heavy material will be drawn into arms h by the conveyers j. To more readily understand the action which causes the conveyers to rotate in said arms, suppose that the stuffing-nut d^5 be screwed up so tight as to prevent the pipe m from rotating. Bevel-gear k would then stand still and the rotation of the arms h about the vertical axis of the machine would carry the bevel-gear j^3 around with them and cause said gear j^3 and shaft j' to rotate about the axis of said shaft. This would cause the conveyers j to rotate, and the more nearly the speed of the arms h approaches that of the shell the greater will be the speed of the conveyers in their arms. This latter speed, however, may be reduced in two ways, either by slowing down the arms h by tightening the stuffing-nut f^6 or by loosening the nut d^5 and permiting the friction from the rotating shell to rotate pipe m. These methods may be employed separately or both simultaneously. The purified liquid being lighter will remain at the center of the shell and pass down through the tubular outlet c' outside of the intake h^2. The passage of the heavy material down through downtake h^2 will be assisted by the conveyer i, which derives it rotary motion from bevel-gear j^3. Suppose, as before, that gear k stands still. The gear i' being on the opposite side of gear j^3 would rotate twice as fast as gear j^3 rotates about its own axis, but as the liquid is also rotating the net effect would be diminished; but the speed of rotation of conveyer i may be reduced either by reducing the speed of arms h or by permitting pipe m and gear k to rotate. Thus by suitably regulating the friction of the stuffing-nut f^6 and stuffing-nut d^5 the parts may be brought to rotate at the desired relative speeds. The employment of a conveyer in downtake h^2 is only necessary as an auxiliary to the conveyers in arms h, and under certain conditions of running and liquid to be operated upon conveyer i may be entirely omitted. It is possible also to operate the machine with more or less efficiency without any conveyers in the arms h if the liquid is forced into pipe d' and through the machine. Under these conditions the flow through the tubular arms and downtake would be regulated by the valve in the drain f^4. If there is oil or other light material in the liquid, it will be collected at the upper central part of the rotating shell, and by sufficiently diminishing the flow through the pipes f' and f^4 the lighter material will be forced up through the escape-pipe m. If the machine be intended to operate on liquids not containing light material or if it is not desired to separate the light material, it is obvious, of course, that the escape-pipe m may be omitted and that bevel-gear k may be supported upon a solid rod.

Although this machine is intended primarily to operate upon liquids, it may be adapted to act as a dust-collector for separating dust from gases laden therewith. In such case rotation would be imparted to the arms h by the friction of the dust particles gathered at the periphery of the rotating shell.

It has been pointed out that the stuffing-nuts d^5 and f^6 furnish the means whereby the friction of the pipe m and downtake h^2 may be regulated; but it would be equally possible to provide separate devices for regulating the friction and permit the said stuffing-nuts to perform merely their functions in preventing leakage.

What I claim as new, and desire to secure by Letters Patent, is—

1. In a centrifugal separator the combination of a rotating shell, a tubular arm rotatable within said shell independently thereof, and means within said arm for drawing off matter from the shell through said arm.

2. In a centrifugal separator the combination of a rotating shell having a tapered periphery; a tubular arm rotatable within said shell independently thereof, the open mouth of said arm approaching the point of greatest diameter in said shell, and rotatable means within said arm for drawing off matter from the shell through said arm.

3. In a centrifugal separator the combination of a rotating shell; a tubular arm rotatable within said shell independently thereof; a screw conveyer within said arm, and means for rotating said conveyer.

4. In a centrifugal separator the combination of a rotating shell; a tubulur arm rotatable within said shell independently thereof; a screw conveyer within said arm, a bevel-gear rigidly secured to the shaft of said conveyer, a second bevel-gear in mesh therewith and having its axis coincident with the axis of the said separator-shell and means for controlling the rotation of said second bevel-gear.

5. In a centrifugal separator the combination of a rotating shell; a tubular arm rotatable within said shell independently thereof; a screw conveyer within said arm, a bevel-gear rigidly secured to the shaft of said conveyer, a rotatable escape-pipe leading from within the separator-shell and coinciding with the axis thereof, means for controlling the rotation of said pipe, and a second bevel gear-wheel meshing with the first and rigidly secured to said escape-pipe.

6. In a centrifugal separator the combination of a rotating shell; a tubular arm rotatable within said shell independently thereof; a screw conveyer within said arm, a bevel-gear

rigidly secured to the shaft of said conveyer, a rotatable escape-pipe leading from within the separator-shell and coinciding with the axis thereof, a friction device for controlling the rotation of said pipe, and a second bevel gear-wheel meshing with the first and rigidly secured to said escape-pipe.

7. In a centrifugal separator the combination of a rotating shell; a tubular arm rotatable therein independently thereof; a screw conveyer in said arm; a tubular passage communicating with the inside of the shell and coincident with the axis thereof; a rotatable escape-pipe of smaller diameter than said tubular passage, said escape-pipe passing through said tubular passage; a pair of bevel-gears, one rigidly fixed, on said escape-pipe; and the other on said conveyer, and a stuffing-box between said escape-pipe and said tubular passage for preventing leakage and controlling the speed of rotation of said escape-pipe.

8. In a centrifugal separator the combination of a rotating shell, a pair of tubular arms arranged in the same straight line in said shell and rotatable independently thereof; a right-hand screw conveyer in one of said arms, a left-hand screw conveyer in the other of said arms, and means for regulating the speed of rotation of said conveyers.

9. In a centrifugal separator the combination of a rotating shell, a pair of tubular arms arranged in the same straight line in said shell and rotatable independently thereof; a right-hand screw conveyer in one of said arms, a left-hand screw conveyer in the other of said arms, both of said conveyers being rigidly attached to a common shaft for neutralizing the thrust of the conveyers; a bevel-gear rigidly attached to the conveyer-shaft and means for regulating the rotation of said bevel-gear.

10. In a centrifugal separator the combination of a rotating shell having a downwardly-extending outlet for the purified liquid; a tubular downtake for heavier matter leading downwardly from said shell through the said outlet thereof, said downtake being small enough to not obstruct the passage through said outlet; a rotatable screw conveyer located within said downtake; and means for regulating the rotation of said conveyer.

11. In a centrifugal separator the combination of a rotating shell; a tubular arm rotatable therein independently thereof; a member attached to and rotatable with said arm; means for regulating the rotation thereof; a conveyer in said arm; a bevel-gear on said conveyer; a second bevel-gear meshing with the first; and means for regulating the rotation of said second bevel-gear.

12. In a centrifugal separator the combination of a rotating shell; a tubular arm rotating therein independently thereof; a downtake communicating with said arm and rigidly connected thereto; a friction device for regulating the rotation of said downtake; a conveyer in said arm; an escape-pipe communicating with the interior of said shell and having geared connection with said conveyer; and a friction device for regulating the rotation of said escape-pipe.

13. In a centrifugal separator the combination of a rotating shell having a tubular inlet and tubular outlet communicating therewith; a deflector near the inner mouth of the inlet for imparting a rotary movement to the entering liquid; a pair of tubular arms in said shell rotatable independently thereof for drawing off matter; a downtake communicating with and rotating with said arms and passing out through the said tubular outlet of the shell; means for regulating the rotation of said downtake; screw conveyers in said arms; an escape-pipe passing out of the shell through the said tubular inlet of the shell, said escape-pipe being in geared connection with said conveyers, and means for regulating the rotation of said escape-pipe.

In witness whereof I have hereunto subscribed my name in the presence of two witnesses.

THOMAS B. FREAS.

Witnesses:
M. C. HUTCHINGS,
HOWARD M. COX.