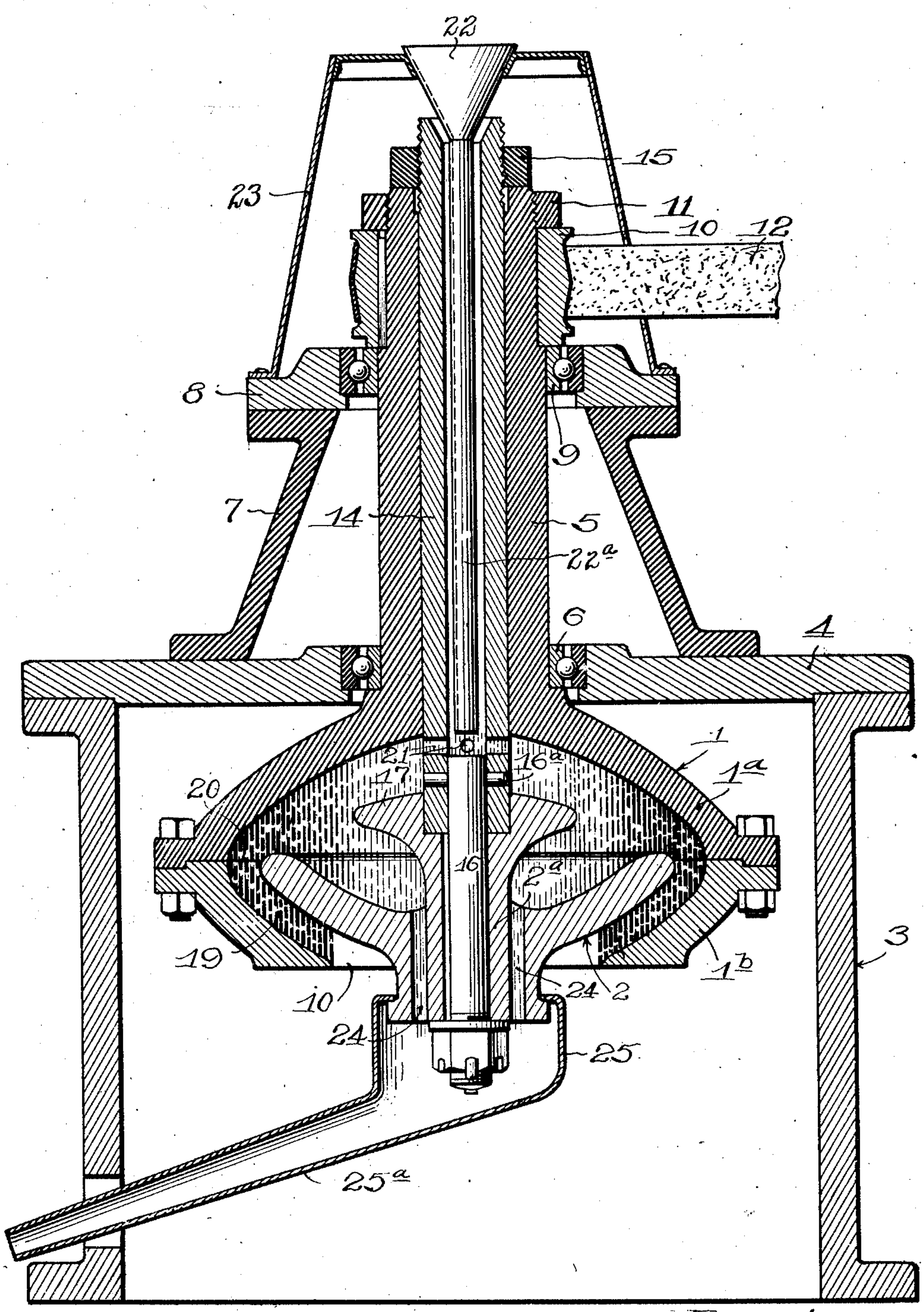
Aug. 13, 1929. J. C. BUCKBEE 1,724,254

CENTRIFUGAL SEPARATOR

Filed April 11, 1928



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Patented Aug. 13, 1929. 1,724,254

UNITED STATES PATENT OFFICE.

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CENTRIFUGAL SEPARATOR.

Application filed April 11, 1928. Serial No. 269,091.

This invention relates to centrifugal separators, and more particularly to devices for separating materials of different specific gravities, such as the removal of liquid from solid materials or the separation of liquids of different densities.

The object of the invention is to provide a simple and efficient separator capable of general utility for separating purposes, although more especially for industrial uses and in manufacturing or chemical processes involving the treating of fluid, semi-fluid or colloid substances.

A preferred embodiment of the invention is disclosed in the accompanying drawing, consisting of a single figure showing the separator in vertical section.

In general, the separator consists of an inverted receptacle or casing 1 revolving at high speed about a vertical axis, and into which the materials to be separated are introduced by gravity through openings or ports at its top. The bottom of the casing is open to form a relatively large opening for the heavier fluid, and above this opening is a separating disc or plate 2 revolving with the housing and acting to retain and dispose of the fluid of less density through separate passages therein.

A more detailed description of the device will now be set forth: The support for the rotative parts of the separator preferably has the form of a cylindric drum or housing 3, a short length of cast iron pipe section set on end being suitable for this purpose. The lower end of the housing is open and its lower edge is flanged so that it can be bolted to any desired form of base or receptacle for the convenient handling of the materials discharged from the separator. The upper end of the drum is also flanged, and bolted over the top thereof is a plate 4 provided at its center with an opening through which the separator spindle 5 extends and is supported by a ball bearing 6. Mounted in the plate 4 is a bearing standard 7 of a frustro-conical shape, carrying at its upper end a bearing ring 8 and a bearing 9 concentric with the bearing 7 and likewise supporting the separator spindle adjacent its upper end.

The separator casing 1 revolves within the upper portion of the housing 3, being suspended at the lower end of the spindle 5 journalled in the bearings 6 and 9 above. The casing is preferably constructed in two sections, namely, an upper section 1^a of bell shape and cast integral with the spindle, and a lower section 1^b forming the lower half of the casing, the two sections being flanged at their adjacent edges and bolted together, thus forming a chamber of spherical shape, somewhat flattened in a vertical direction with the bottom of the lower section cut off at right angles to the vertical axis to form the large discharge opening 10, of a diameter substantially one-half the maximum diameter of the chamber.

The spindle 5 is tubular, its upper end extending a short distance above the upper bearing 9, and opening into the casing at its lower end. A drive pulley 11 is keyed to the upper end of the spindle which is reduced in diameter. A lock ring 12 is threaded on the spindle above the pulley. The spindle is shown as driven by a belt 13, on the pulley 10, although any other desired type of drive may be used.

Extending the length of the spindle 19 is a tube or sleeve 14 fitting snugly therein and having its upper end projecting a short distance beyond the upper end of the spindle 5 and its lower end extending into the casing 1. This tube is normally held against endwise movement by a lock ring 15 engaging a threaded portion at the upper end of the tube, and carries at its lower end a solid stub shaft 16 extending axially of the casing and through the discharge opening 10 at its lower end, said stub-shaft being suitably secured as by a pin 16^a. Mounted on this stub shaft is the separating plate 2 which also includes as an integral part thereof, a distributing plate or flange 17 above the separating plate. These plates are radial projections formed integral with a hub or sleeve 2^a keyed to shaft 16 and held thereon by a nut 18 at the lower end of the shaft. The separating plate 2 is dish-shaped, its central portion being located substantially within the discharge opening 10 where the hub 2^a is increased in diameter and flaring upwardly and outwardly following the contour of the lower section of the casing, its periphery being spaced inwardly from the sides of the casing at the middle or point of maximum diameter. The upper surface of the separating disc thus forms a shallow receptacle, and its under surface forms with the bottom wall of the casing an annular passage 19 of uniform width connecting the

space above the plate with the discharge opening 10, the entrance to this passage being an annular slot 20 between the periphery of the plate and the adjacent wall of the casing.

The distributing plate 17 is a thick radial flange of approximately one-half the diameter of the separating plate and tapering slightly toward its periphery and giving its top surface a downward slope in conformity with the contour of the housing wall immediately above.

The tube 14 is closed at its lower end by the stub shaft 16 and immediately above the distributing plate or flange 17 is a series of radial openings or ports 21 forming the inlet passage for the materials to be separated, and which are fed into the upper end of the tube through a funnel-like hopper 22 having a tubular extension or stem 22^a extending downwardly to the inlet ports 21. The hopper is supported freely of the rotating spindle and tube by means of an arch-like bracket 23, mounted on the bearing plate 8 and straddling the upper end of the spindle. This bracket has a ring 23 in which the funnel 22 seats, its extension 22^a being of a diameter to clear the walls of the tube through which it passes.

Grouped around the inner portion of the separator plate is a series of outlet ports or passages 24 extending axially downward through the hub portion 2^a and open on the under side thereof. Surrounding the lower end of the hub portion 2^a is a receptacle 25 leading into a lateral delivery tube or spout 25^a leading off at an angle through the side wall of the housing. This receptacle is stationary and receives the fluid discharged through the passages 24 from the space above the separating plate.

The separating action is brought about in the following manner: The materials to be separated are fed into the device through the hopper 22 either continuously or intermittently. For the purpose of illustration, it may be assumed that the material being treated is a mixture of solid materials in pulverized form and a liquid of a semi-fluid consistency, and that the purpose of the treatment is to reduce the fluidity, i. e., thicken the mix by removing an excess of the liquid. As the material is fed into the casing, the centrifugal force due to the high speed of rotation of the housing, throws the material outwardly toward the periphery of the housing, with an attendant stratification of the ingredients according to their specific gravities, the heavier or denser particles crowding to the outside, and the lighter or less dense substances forming vertical strata ranging inwardly from the stratum of the heaviest material. The outer stratum or strata of heavier materials, however, are free to pass downwardly beyond the edge of the separating plate and fill the passage 19 leading to the discharge opening 10, as indicated by shading in the drawing. The lighter materials, however, are confined within the space above the separating plate, and their only means of escape is, therefore, through the passages 24, through the separating plate. Hence as more materials are fed into the casing, the heavier substances are gradually forced downwardly and discharged through the opening 10, while the lighter materials are forced inwardly toward the axis of rotation, the lightest and less solid substances innermost, until the action of gravity overcomes the centrifugal force and a downward flow takes place through the passages 24.

As long as fresh material is fed to the casing, this action continues, due to the centrifugal force acting to maintain the strata of uniform thickness, and hence there is a continual overflow of the heavier materials through the discharge opening and dropping downwardly in order to restore the conditions of equilibrium in the strata, and a like constant overflow of the lighter materials through the passages 24 and into the lead-off spout 25. The purpose of the distributing plate 17 is manifest from the foregoing, namely, to direct the incoming material outwardly and prevent any of it from being carried or short-circuited direct to the discharge passages 24.

The same action takes place regardless of the materials introduced, since it is based on the universal principle of centrifugal force, although it may be necessary to shift the position of the separating plate within the casing when different materials are treated. For this reason, the tube 14 carrying the separator plate may be shifted vertically endwise by adjusting the lock ring 15 at the upper end of the tube.

Manifestly, various departures in construction and design may be resorted to without departing from the spirit of the invention. For instance, the separator may be designed with the moving parts rotating about a horizontal axis. Therefore, I do not wish to be limited to the particular type of machine disclosed except in so far as the invention is set forth in the appended claims.

I claim as my invention:

1. A centrifugal separator comprising a substantially spherical casing having a relatively large discharge opening at its bottom and a hollow spindle extending vertically from its top, a bearing support for said spindle, means for driving said spindle, a tube extending through said spindle and into said casing, a separator plate mounted at the lower end of said tube and normally positioned at the bottom thereof covering said discharge opening, a distributor plate located above said separator plate, said tube having inlet ports above said dis-

tributor plate, and said separator plate having vertical passages therethrough adjacent its axis and opening through the discharge opening at the bottom of said casing.

2. A centrifugal separator comprising a vertical spindle, a casing of substantially spherical shape mounted at the lower end of said spindle and having a relatively large outlet opening at its bottom, a support for said spindle and casing, means for driving said spindle, a tube fitting in said spindle and extending into the top of said casing, a separator plate mounted at the lower end of said tube and normally positioned above the bottom thereof, means for adjusting said tube endwise in said spindle, said tube having lateral ports opening into the upper portion of said casing, and said separating disc having a concave upper face and a series of vertical passages adjacent the axis thereof, and a distributing plate integral with said separator plate and located between said inlet ports and said discharge passages in said separator plate.

3. A centrifugal separator comprising an inverted bowl-shaped receptacle mounted to rotate about a vertical axis and having a relatively large discharge opening at its bottom, a separator plate mounted axially within said receptacle and rotative therewith, said plate consisting of a hub and a radial web spaced above the bottom of said receptacle, and forming a radial passage therebetween connecting the space above said web with said opening, said hub extending through said opening and having a separate discharge passage extending vertically from the space above said web.

4. A centrifugal separator comprising an inverted bowl-shaped receptacle mounted to rotate about a vertical axis and having a downwardly facing opening, a hollow tube projecting axially into the upper portion of said receptacle and communicating therewith, and a separator member consisting of a hub extending axially of said receptacle and fixed to the lower end of said tube, a radial web spaced above and extendingg beyond the opening in said receptacle to form a passage between said opening and the space above said web, and vertical passages through said hub adjacent the axis of said receptacle.

5. A centrifugal separator comprising an inverted bowl-like receptacle mounted to rotate about a vertical axis and having a relatively small inlet opening at its top, a relatively large discharge opening at its bottom, a separator member extending axially of said receptacle and including a hub, a radial web spaced above the bottom wall and inwardly from the internal periphery of said receptacle, and a plurality of vertical discharge passages through said web adjacent the internal axis thereof, and a discharge spout below said receptacle and communicating with said discharge passages.

Signed at Chicago, Ill., this 9th day of April, 1928.

JOHN C. BUCKBEE.