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CENTRIFUGAL BOWL

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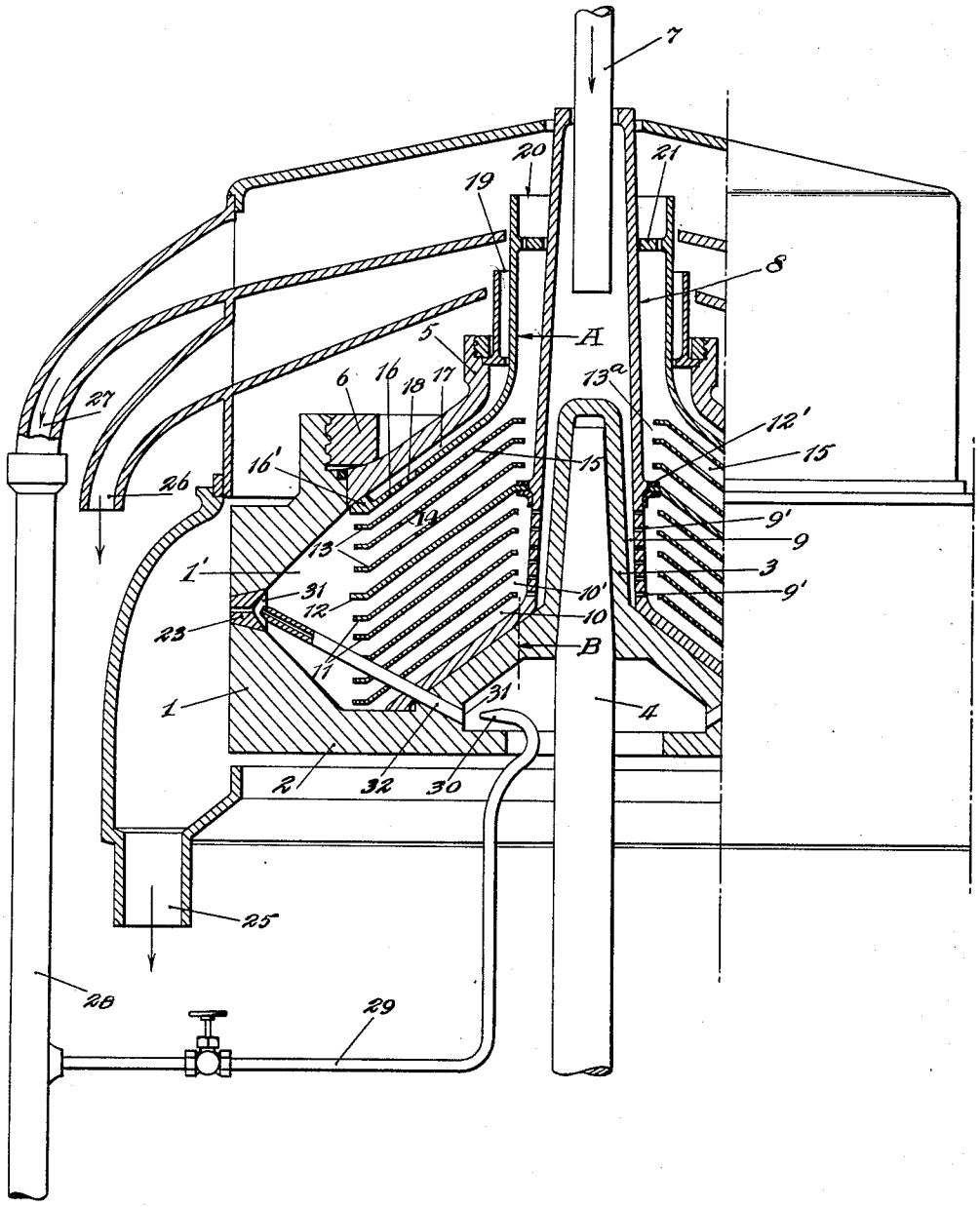

INVENTOR

GEORGE J. STREZYNSKI

BY

Byrne & Ragsdale

ATTORNEY

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CENTRIFUGAL BOWL

George J. Strezynski, Chicago, Ill., assignor to The De Laval Separator Company, New York, N. Y., a corporation of New Jersey

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8 Claims. (Cl. 233—28)

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This invention relates to centrifuges for separating a mixture of three constituents of different specific gravities, each from the other, and has for its object to provide an improved centrifuge for this purpose which is especially adapted for the separation of two solids of different specific gravity, each from the other and from a common carrier liquid.

The new centrifuge may be used for effecting a separation of various mixtures. For illustrative purposes, however, it will be described in connection with the production of starch, in a form suitable for separating the starch, gluten and water constituents of the tailings from standard starch tables. A process for effecting such separation is disclosed in my co-pending application Serial No. 689,669, filed August 10, 1946, Patent No. 2,488,747, granted November 22, 1949; and the present invention may be used to advantage in the practice of that process.

One feature of the present invention resides in a centrifuge for effecting a three-way separation of a mixture, in which the heaviest constituent is separated from the mixture in a primary separating chamber, and the lighter constituents are then separated in a secondary separating chamber to which they are fed from the primary chamber through a region of relatively large centrifugal force.

Another feature is a centrifuge of the character described, in which the lighter constituents in the primary chamber are directed outward along a blind disc dividing the chambers and flow around the edge of the disc, near the peripheral region of the bowl where the heaviest constituent accumulates, into the secondary separating chamber, whereby a scrubbing action is obtained.

Still another feature is a centrifuge of the character described having a series of conical blank discs in the primary separating chamber and between which the heaviest constituent is separated from the two lighter constituents, the latter then moving to one surface of the blind disc from near the inner edges of the blank discs, and outwardly along the blind disc and around its outer edge into the secondary chamber which, in turn, contains a second series of conical discs but perforated to allow separate discharge of the two lighter constituents separated between these discs.

An additional feature is a centrifuge, especially adapted for separating the tailings from starch tables, in which the separated water constituent is used to dilute and flush the separated starch through peripheral outlets in the bowl, by returning at least part of the discharged water

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through a flushing tube to the peripheral portion of the bowl outside the separating region, whereby the flushing water is not admixed with the separated gluten.

These and other features of the invention may be better understood by reference to the accompanying drawing, in which the single figure is a vertical sectional view of part of a centrifuge made in accordance with the invention.

The centrifuge comprises a bowl shell 1 having a bottom 2 with a central socket 3 for receiving the driving and supporting spindle 4. An annular bowl top 5 is secured to the shell 1 by coupling ring 6.

The tailings from the starch tables, consisting of a mixture of water, starch and proteins (commonly called "gluten") and possibly other impurities, is fed into the bowl through a stationary tube 7. The tube 7 extends into a tubular distributing shaft 8 which is arranged on the bowl axis and rotates with the bowl. At its lower end portion, the tubular shaft forms with the socket 3 an annular distributing chamber 9 having a series of radial holes 9' leading outward to a primary separating chamber 10. As shown, the holes 9' are spaced throughout substantially the entire height of the separating chamber 10.

Within the primary chamber 10 is a series of conical discs 11 partly defining at their inner edges a plurality of generally vertical passages 10', the outer edges of the discs being spaced a substantial distance from the peripheral portion of the bowl. The discs 11 are blank, that is, they are imperforate except for central openings for the tubular shaft 8 and the passages 10'. At their upper ends, the passages 10' are terminated by a blind conical disc 12, likewise imperforate, sealed at its inner edge to the tubular shaft 8, as shown at 12'. The blind disc 12 also has a substantial clearance between its outer edge and the peripheral portion of the bowl.

Above the discs 11 and separated therefrom by the blind disc 12 is a secondary separating chamber having a series of conical discs 13 similar in size and shape to the discs 11. The discs 13, however, have two groups of distributing holes, one group 14 being located near the outer edges of the discs, and the other group 15 being located nearer the bowl axis. It will be apparent that the upper or secondary separating chamber has communication with the lower chamber 10 only around the extreme outer edge of the blind disc 12, because of the liquid-tight joint provided by the seal 12'.

A top disc 16 provides a division wall between

the upper separating chamber and a discharge passage 17, the upper chamber having communication with the passage 17 only through holes 18 arranged directly over the disc distributing holes 14. The top disc 16 is so constructed that it makes at its outer extremity a liquid-tight joint with the bowl top 5, as shown at 16'. At its inner end, the passage 17 leads upward between the bowl top 5 and a neck on the top disc 16, to an outlet 19.

The inner edges of the upper discs 13 and the tubular shaft 8 define generally vertical passages 13a leading upward, within the neck of top disc 16, to a second discharge outlet 20 which may be restricted by a discharge ring 21.

Nozzles 23 in the wall of the bowl shell provide a third discharge outlet from the peripheral portion of the bowl, a substantial distance outward from the edge of blind disc 12.

In the operation of the bowl, the tailings fed to the interior of tubular shaft 8 flow outward through the distributing holes 9' to the inner portion of the primary separating chamber 10 and into the spaces between the blank discs 11, where a separation of the major portion of the relatively heavy starch solids takes place. Since starch will separate readily from the gluten and water, it is practicable to direct the feed by holes 9' to a zone of relatively small centrifugal force. The starch separated between the blank discs 11 is forced directly outward, with some water, into the peripheral portion 1' of the separating chamber of the bowl and is continuously discharged through the nozzles 23. The remainder of the feed, comprising primarily gluten and water of lower specific gravity than the starch, flows inward toward the bowl axis and then upward along the passages 10', until it reaches the blind disc 12. The flow of the lighter constituents is then directed along the lower surface of disc 12 to its extreme outer edge. This passage of the lighter constituent through a zone of greater centrifugal force than that to which it was originally subjected will remove the last traces of starch which may have been present in the water and gluten mixture. Moreover, some of the water which is forced directly outward from the discs with the separated starch will tend to flow upward along the outer edges of the discs and rejoin the lighter separated constituents flowing around the disc 12, whereby a washing or scrubbing action of the starch particles is obtained.

After passing around the outer edge of blind disc 12, the mixture of gluten and water flows inwardly between the upper discs 13 to the distributing holes 14. Between the discs 13, a separation of the gluten from the water takes place, the heavier gluten passing through holes 14 and outlet holes 18 in the top disc and then along the discharge passage 17 to the outlet 19. The water flows inward toward the bowl axis and then upward along passage 13a through the discharge ring 21, finally escaping at the outlet 20. However, in the event that any portion of the gluten is carried inward beyond the distributing holes 14, it may pass upward through the next series of distributing holes 15 and then flow outward along the disc surfaces to rejoin its proper discharge stream passing through the outlets 18. In this outward movement of the gluten particles from the distributing holes 15, they are subjected to a washing or scrubbing action by the inflowing water between the discs. It is to be understood that the discs 13 may be provided without the holes 15, particularly if the internal radius A of

the neck of the top disc 16 is less than the radius B of the center holes in discs 13, which holes provide the generally vertical passages 13a.

The discharges through outlets 23, 19 and 20 may be collected in suitable covers having spouts 25, 26 and 27 respectively.

I have found that in separating starch in a relatively pure condition from the tailings, there is a strong tendency for the starch to clog its discharge outlets 23. Accordingly, I prefer to utilize the relatively pure separated water from the outlet 20 for diluting the separated starch and flushing it from the bowl. To this end, at least part of the water from the spout 27 is led through pipes 28 and 29 to a nozzle 30 which feeds the water into an inwardly facing annular recess 31 in the bottom of the bowl. From the recess 31, the water is forced outwardly by centrifugal force through flushing tubes 32, mounted in the bottom 2 and extending into the bowl, the tubes 32 terminating at their outer ends near the entrances to the nozzles 23. It will thus be apparent that the separated flushing water is fed to the bowl at a region where it is effective to flush the separated starch solids through outlets 23, but in a region outside the separating zone in the bowl. Accordingly, the separated flushing water is not admixed or further contaminated with the separated gluten flowing around the outer edge of the blind disc 12, whereby the flushing water may be more readily recovered or reconditioned for further use.

It will be apparent that the holes 9' in the distributing chamber 9 provide an inlet to the primary chamber 10 for feeding thereto the mixture to be separated, and that the opening 18 in the top disc provide an outlet from the secondary chamber for discharging the separated constituent of intermediate specific gravity. The peripheral outlet from the primary chamber 10 is the annulus lying between the outer edge of blind disc 12 and the bottom of the bowl, and the throughflow area of this peripheral outlet is at least equal to the throughflow area of the primary chamber inlet provided by the holes 9'.

Certain features of the centrifuge disclosed herein are the subject matter of a co-pending application of G. F. Wheelwright, Jr., Serial No. 689,738, filed August 10, 1946, patented August 16, 1949, No. 2,478,922, and I make no claim to such features.

I claim:

1. A centrifuge for separating a mixture of three constituents of different specific gravities, each from the others, which comprises a centrifugal bowl having primary and secondary separating chambers, an inlet to the primary chamber for feeding thereto the mixture to be separated, an outlet from the secondary chamber for discharging the lightest separated constituent and located near the bowl axis, an outlet from the secondary chamber for discharging the separated constituent of intermediate specific gravity and located radially between the bowl periphery and the first outlet, and a blind disc for separating said chambers and extending outward beyond said outlets but having a substantial clearance space between its outer edge and the bowl periphery, the primary chamber having a peripheral outlet partly defined by the outer edge of the blind disc and of at least the throughflow area of said inlet to the primary chamber, whereby the heaviest separated constituent is forced outward directly through the peripheral outlet from the primary chamber and toward the bowl periphery,

and the two lighter constituents are forced against said blind disc and flow outward along the surface, through the adjacent part of said last outlet, and through said clearance space to the secondary chamber for separation and discharge of the lighter constituents through their respective outlets.

2. A centrifuge as defined in claim 1, comprising also a series of conical discs in the primary chamber partly defining near the bowl axis a generally vertical passage for the lighter constituents separated between the discs, the passage terminating at the blind disc.

3. A centrifuge as defined in claim 1, comprising also a series of conical discs in the primary chamber with their inner edges disposed radially outward from said inlet, the discs partly defining near the inlet a generally vertical passage for the lighter constituents separated between the discs, the passage terminating at the blind disc.

4. A centrifuge as defined in claim 1, comprising also a series of conical discs in the secondary chamber partly defining a generally vertical passage for the heavier constituent separated between the discs, said last passage being within the outer limit of the secondary chamber and at the same radius as said second outlet.

5. A centrifuge as defined in claim 1, comprising also a series of conical discs in the secondary chamber partly defining three generally vertical passages at different radii from the bowl axis and located within the outer limit of the secondary chamber, the innermost passage being for the lighter constituent separated between said discs and leading to said first outlet, the outermost passage being for the heavier constituent separated between the discs and alined vertically with said second outlet, and the third passage communicating with said outlets only along the disc surfaces.

6. A centrifuge as defined in claim 1, comprising also a series of conical discs in the primary chamber, and a tubular shaft for receiving the mixture to be separated and having, as said inlet, a series of peripheral distributing holes arranged at different levels and leading outward to the primary chamber at the inner edges of said discs.

7. A centrifuge for separating a mixture of three constituents of different specific gravities, each from the others, which comprises a centrifugal bowl having primary and secondary separating chambers, said chambers opening outwardly into the peripheral portion of the bowl chamber and the primary chamber being of at least the height of the secondary chamber at such peripheral portion, the bowl having an inlet to the primary chamber for feeding thereto the mixture to be separated, an outlet from the secondary chamber for discharging the lightest separated constituent and located near the bowl axis, an outlet from the secondary chamber for discharging the separated constituent of intermediate specific gravity and located radially between the bowl periphery and the first outlet, and a blind disc for separating said chambers and extending outwardly between the chambers but having a substantial clearance between its outer edge and the bowl periphery, and a series of spaced conical discs in each of said chambers, whereby the heaviest separated constituent is forced outward directly through the peripheral portion of the primary chamber and toward the bowl periphery, and the two lighter constituents are forced against said blind disc and flow outward along the surface thereof and through said clearance space to the secondary chamber for separation and discharge of the lighter constituents through their respective outlets.

8. A centrifuge as defined in claim 7, in which the discs in the secondary chamber have two sets of vertically alined holes, one set located inwardly from the outer edge of the blind disc and at the radius of said secondary chamber outlet for the separated constituent of intermediate specific gravity, the other set located inwardly from the first set but outwardly from the secondary chamber outlet for the lightest constituents.

GEORGE J. STREZYNSKI.

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Certificate of Correction

Patent No. 2,500,100 March 7, 1950

GEORGE J. STREZYNSKI

It is hereby certified that errors appear in the printed specification of the above numbered patent requiring correction as follows:

Column 4, line 50, for the patent number "2,478,922" read *2,478,992*; column 6, lines 33 and 34, for "constituents" read *constituent*;

and that the said Letters Patent should be read with these corrections therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 11th day of July, A. D. 1950.

[SEAL]

THOMAS F. MURPHY,
Assistant Commissioner of Patents.