

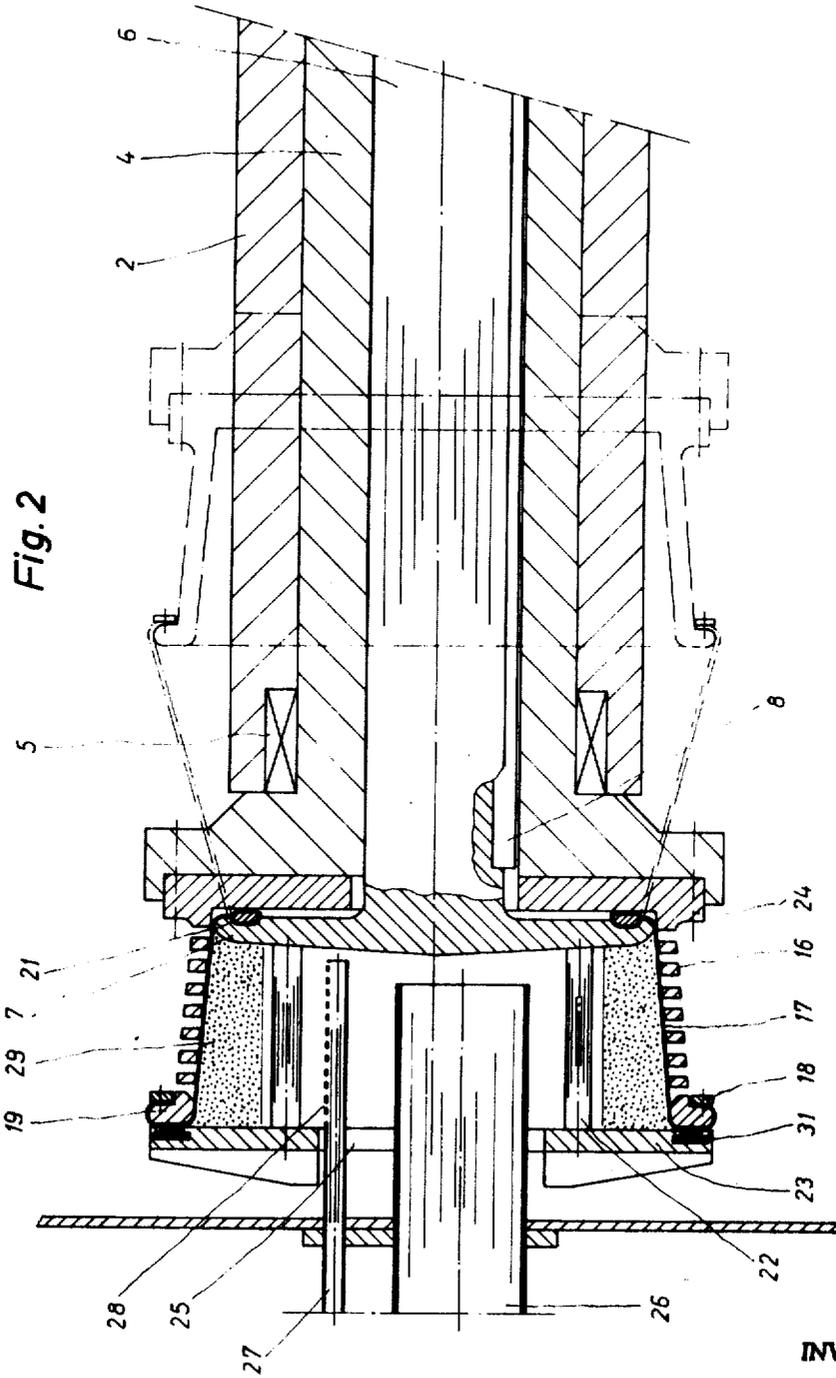
Fig. 1

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# 1

## CENTRIFUGE

### BACKGROUND OF THE INVENTION

The present invention relates to a centrifuge capable of separating solid and liquid components from a suspension, and more particularly to a centrifuge with a perforated centrifugal drum or basket and a filter bag insertable therein. One boundary edge of this filter bag is attached to the discharge end, which is preferably flange-shaped, of the centrifugal drum and the other boundary edge of this filter bag is affixed to a mushroom-shaped or buffer-type bottom piece. The centrifugal drum and the bottom piece are arranged coaxially with respect to each other and can be put into rotation together, and can be subjected to an axial relative motion with respect to each other during this rotation.

In the conventional pendulum centrifuges preferably employed for the treatment of suspensions having extremely fine solid components, the removal of the centrifugate or centrifuge cake must be effected either manually or by means of a clearing device in the lid of the centrifugal drum, i.e., top discharge, or in the bottom, i.e., bottom discharge.

However, all types of discharging processes are problematic when the products to be treated have a tendency to "cement" after the hydroextraction step and can be discharged only under the greatest difficulties. In this procedure, but also in the case of "well-behaved" substances, the filter bags are very often damaged and become unusable. Under certain circumstances, the structure of sensitive material can be damaged during a mechanical discharging operation.

The peeling or paring centrifuges likewise employed heretofore for the separation of solid and liquid components exhibit the disadvantage that they cannot completely remove the centrifuged solid material. The peeling device, which can be adapted with respect to its clearing speed to the material properties present in each particular case, always leaves a residual layer on the filter. This layer becomes denser and harder with each operating cycle, thus causing conditions which become worse from charge to charge. Furthermore, the filter element can easily be damaged by the peeling device, in addition to the damage which can be caused by the disassembly necessary for the required cleaning of the filter insert, and during the subsequent rinsing operation.

### SUMMARY OF THE INVENTION

It is an aim of the present invention to avoid the aforementioned problems and disadvantages and to provide a centrifuge which has a simpler construction as compared to peeling centrifuges and pendulum centrifuges with automatic removal.

Furthermore, the present invention also aims at solving the separating problems which, by the use of the above-mentioned conventional centrifuges, could not be overcome or which permitted only unsatisfactory results at best. Additionally, it is an object of the present invention to provide a centrifuge which permits a utilization in many boundary cases wherein previously only filter presses could be employed and which filter presses are much more expensive than the device of the present invention.

It is another object of the present invention to provide a centrifuge, use of which affords great savings, a greater efficiency per time unit, and the elimination of manual operating steps.

The underlying problems are solved in accordance with the present invention by mounting a lid to the bottom piece, particularly by way of connecting members, which lid contacts the discharge flange of the centrifugal drum, when the bottom piece is disposed at the bottom of the centrifugal drum as provided during the centrifuging process proper. The drum is axially displaceable for the purpose of discharging, whereas during this procedure the bottom piece with the lid, at least at first, maintains an unchanged position with respect to parts of the centrifugate formed during the centrifuging.

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In another suitable embodiment in accordance with the present invention, the connecting members can consist of at least two pins or bolts or the like, the length of which is approximately equal to the difference of the inner depth of the centrifugal drum and the thickness of the bottom piece. In addition, the lid can be provided with a gasket or seal preferably inserted in an annular groove, which gasket contacts the discharge flange of the centrifugal drum when the bottom piece is disposed at the bottom of the centrifugal drum.

In order to fill the centrifugal drum, the lid can be provided with a central opening into which a fill pipe or feedpipe and, optionally, also a pressure pipe extend, which pressure pipe is used for supplying washing fluid and has apertures extending at right angles to the axis of the centrifugal drum; these apertures are oriented toward the periphery of the centrifugal drum.

In order to readily remove the centrifugate after the termination of the centrifuging step, from the centrifugal drum, the lateral walls of the drum are tapered conically to a minor extent or degree toward the bottom at an angle which is of such a magnitude that the removal of the centrifugal drum from the filter bag can still be accomplished in a satisfactory and easy manner.

Furthermore, the centrifugal drum can be axially displaced approximately by twice the length thereof and can be seated on a hollow shaft, which is connected to the stem of the bottom piece extending into the hollow shaft. This connection is effected by means of at least two keys. Thereby, the hollow shaft and, consequently, also the centrifugal drum can be driven at the same speed as the stem of the bottom piece and thus the bottom piece proper. In this connection, the hollow shaft can be displaced with respect to the stem in the axial direction of the latter.

The centrifuge can best be driven by way of the nondisplaceable stem. Thus, this stem represents the drive shaft effecting the entrainment of the hollow shaft, on which the centrifugal drum is seated, by means of the keys. However, these keys still permit the displacement of the hollow shaft with the centrifugal drum even during the driving thereof in the longitudinal or axial direction of the shaft for the purpose of emptying the filter bag.

### BRIEF DESCRIPTION OF THE DRAWING

These and further objects, features and advantages of the present invention will become more apparent from the following description when taken in conjunction with the accompanying drawing which shows, for purposes of illustration only, an embodiment in accordance with the present invention, and wherein:

FIG. 1 is a partial sectional view of the centrifuge; and

FIG. 2 is an enlarged section through part of the centrifuge with the filter drum.

### DETAILED DESCRIPTION OF THE DRAWING

Referring now to the drawings, and in particular, to FIG. 1, the centrifuge in accordance with the present invention is disposed in a housing 1. A sleeve or bushing member 2 is mounted in an axially displaceable manner in housing 1, but is secured against rotation by means of keys 3 engaging in corresponding grooves in the housing 1 and in grooves in the sleeve. In the sleeve 2, a hollow shaft 4 with three bearings 5 is disposed. The bearings rotate within the sleeve 2, and can be axially displaced together with the sleeve. In the hollow shaft 4, in turn, the stem 6 of a mushroom-shaped or buffer-type bottom piece 7 is disposed and the hollow shaft 4 is mounted to be displaceable with respect to the bottom piece 7. The hollow shaft 4 and the stem 6 of the bottom piece 7 are secured against mutual rotation by means of keys 8. The stem 6 of the mushroom-shaped or buffer-type bottom piece 7 simultaneously serves as the drive shaft and thus is provided with a V-belt pulley 9 driven via the V-belts 11 by a motor 12 seated on a bracket 13 attached to the housing at the end of the stem 6 facing away from the bottom piece 7.

At the free end of the sleeve 2, a chamber 14 is arranged which can be axially displaced together with the sleeve 2, but the chamber is not rotatable. This chamber 14 is in communication with a drainpipe 15 for the discharge of the centrifuged liquid.

On a steplike widened portion 20 of the hollow shaft 4, a perforated centrifugal drum 16 is disposed and rotates together with the hollow shaft 4 as well as being displaceable together with the shaft in the longitudinal direction of its axis. A filter bag 17 is inserted in the perforated centrifugal drum 16. One boundary edge 18 of this filter bag is attached to the flangelike discharge end 19 of the centrifugal drum and the other boundary edge 21 thereof is affixed to the mushroom-shaped or buffer-type bottom piece 7. In addition, a lid 23 is attached to the bottom piece 7 by means of connecting members fashioned, for example, as pins or bolts 22. The connecting members or pins have a length which is approximately equal to the difference between the inner depth D of the centrifugal drum 16 and the thickness T of the bottom piece. Accordingly, the lid 23 contacts the flangelike discharge end of the axially displaceable centrifugal drum 16 when the bottom piece 7 is disposed at the bottom 24 of the centrifugal drum 16 as provided during the centrifuging process proper.

The lid 23 has a central opening 25 into which a fill pipe 26 extends. Furthermore, a washing pipe 27 is extended into the central opening 25 of the lid 23, which washing pipe has apertures 28 extending at right angles to the axis of the centrifugal drum. Through these apertures 28, a washing liquid can be sprayed when the centrifugate 29 is additionally to be treated with an appropriate washing liquid after the centrifuging step. The lid 23 furthermore is provided with an annular groove into which a gasket or seal 31 is placed. This gasket contacts the discharge flange 19 of the centrifugal drum 16.

The lateral walls of the centrifugal drum 16 taper conically to a minor extent to degree toward the bottom. The taper is provided at such an angle which still barely permits the satisfactory withdrawal of the centrifugal drum from the filter bag 17. In the case of too large an inclination of the lateral surfaces of the centrifugal drum, the individual parts of the filter bag are put under too great a stress as a consequence during the discharging thereof. With a cylindrical extension of the lateral surfaces, the withdrawal of the centrifugal drum from the filter bag would become too difficult and the drum would be damaged under certain circumstances, such as is also the case, when the lateral surfaces of the centrifugal drum have too large an inclination.

The displacement of the centrifugal drum in the axial direction approximately corresponds to twice the length thereof, so that the filter bag can be completely inverted.

The operation of the centrifugal drum proper takes place as follows: The centrifugal drum, that is the centrifugal basket 16 and the filter bag 17, are driven by way of the stem 6, that is the drive shaft of the mushroom-shaped or bufferlike bottom piece 7; by means of the connecting members 22, the lid 23 is likewise rotated. The centrifugal drum and the lid rotate together, as illustrated in full lines in FIGS. 1 and 2, and in such a manner that the lid 23 contacts, along with gasket 31, the discharge flange 19. By means of the fill pipe 26, the suspension to be separated is filled in metered amounts through the lid opening 25 into the centrifugal drum wherein the filter bag is disposed. After the termination of the filling procedure, a feed valve disposed in the filling pipe (not shown) is shut off, and the drum is maintained in rotation until the desired residual moisture is attained. During the centrifugation process, the centrifuged liquid flows, via the chamber 14 and the drainpipe 15, into a filtrate trap (not shown) intended for the liquid. A washing process can follow thereafter, wherein a preselected liquid is fed through the washing pipe 27, which liquid is sprayed onto the centrifugate cake 29 through the apertures 28. After this liquid has likewise been removed by centrifuging, the centrifugal drum is placed, together with the sleeve 2, into the position shown in dot-dash lines in FIGS. 1 and 2 by shifting the hollow shaft 4. Due to the conical shape of the centrifugal drum, the centrifugal basket

can readily be pulled off the filter bag and the centrifugate. In this procedure, the filter bag is gradually inverted more and more toward the outside, starting with its upper end, in correspondence with the path of the centrifugal drum and thus releases, starting with the lid 23 and continuing toward the bottom piece 7, one portion after the other of the filter cake, which latter is thereby flung into the space 32 formed by the housing 1 and is removed therefrom. At the end of the axial movement of the centrifugal basket 16, the filter bag 17, which is attached to the discharge end 19 of the centrifugal basket and at the bottom piece 7, has been inverted toward the outside along its entire breadth with its internal operating surface. Thus, under the effect of the rotation of all parts, the entire amount of solid material has then been centrifuged into the chamber 32 intended therefor.

After this procedure is terminated, the centrifugal basket is again placed into its starting position, the filter bag retreating into the centrifugal drum. Upon abutment of the discharge flange 19 of the centrifugal drum against the gasket 31, the lid 23 seals the centrifugal basket.

The above-described operating cycle takes place with hydraulic or pneumatic regulation. For this control step which entails shifting of the hollow shaft 4, conduit systems are provided, of which the conduit sections 33, 34 and 35 are illustrated in FIG. 1, and a pump 36 is likewise arranged for this purpose.

In the present invention, the filter insert is pulled off from the material and inverted; the material, during the rotation, is removed by centrifugation from the filter insert without leaving any residue thereon and is disposed in a space provided for this purpose. No residual layer remains on the filter, and the disadvantages incurred thereby, as well as any damage to the filter by the peeling blade, are avoided.

While I have shown and described one embodiment in accordance with the present invention, it is to be clearly understood that the same is susceptible to numerous changes and modifications as will be apparent to a person skilled in the art, and I, therefore, do not wish to be limited to the details shown and described herein but intend to cover all such changes and modifications that are encompassed by the scope of the present invention.

I claim:

1. Centrifuge adapted to separate solid and liquid components of a suspension, comprising:

a housing;

perforated centrifugal drum means rotatably mounted in said housing and having a flanged-shaped discharge end;

means for rotating said centrifugal drum means;

bottom means coaxially arranged and operatively associated with respect to said centrifugal drum means and rotatable therewith, said bottom means being in a fixed axial position relative to said housing;

said centrifugal drum means and said bottom means being axially movable with respect to each other;

filter bag means insertable in said centrifugal drum means, having first and second boundary portions operatively connected to said discharge end of said centrifugal drum means and said bottom means, respectively;

lid means arranged at the discharge end of said centrifugal drum means and operatively associated with said bottom means;

said centrifuge constructed so that for purposes of discharging, said centrifugal drum means is axially displaced while said bottom means if retained in a relatively fixed position along with said lid means with respect to centrifugate portions formed during the centrifuging process.

2. Centrifuge according to claim 1, which further comprises connecting members joining said bottom means and said lid means, said connecting members including at least two bolts, the length of each being approximately equal to the difference resulting from the inner depth of the centrifugal drum means and the thickness of the bottom means.

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3. Centrifuge according to claim 1, wherein said lid means is provided with a gasket means inserted in an annular groove thereof, said gasket means adapted to sealably contact said discharge end of said centrifugal drum means when said bot-  
tom means and said centrifugal drum means are juxtaposed.

4. Centrifuge according to claim 1, wherein a fill pipe means is provided for feeding said suspension to said centrifugal drum means, said fill pipe means extending into a central opening in said lid means.

5. Centrifuge according to claim 4, wherein a washing pipe means is provided and extends into a central opening of said lid means for further treating the centrifugate, said washing pipe means being provided with apertures extending at sub-  
stantially right angles to the axis of said centrifugal drum

means.

6. Centrifuge according to claim 1, wherein said centrifugal drum means includes lateral wall portions which taper conically to a minor degree toward the bottom at an angle such that said centrifugal drum means can be withdrawn satisfac-  
torily from said filter bag means.

7. Centrifuge according to claim 1, wherein said centrifugal drum means is axially displaceable by approximately twice its axial length.

8. Centrifuge according to claim 1, wherein a hollow shaft is operably connected by key means with a portion of said bot-  
tom means extending into said hollow shaft, said centrifugal drum means being seated on said hollow shaft.

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