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Putterlik

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[54] **METHOD OF AUTOMATIC CONTROL OF THE DISCHARGE OF A CONCENTRATED TRACTION OF SOLID PARTICLES DISPERSED IN LIQUIDS FROM A CENTRIFUGE ROTOR**

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[51] **Int. Cl.** **B04b 11/00**

[58] **Field of Search** ..... 233/19 R, 19 A, 20 R, 233/20 A, 46, 47 R, 27, 28; 137/510

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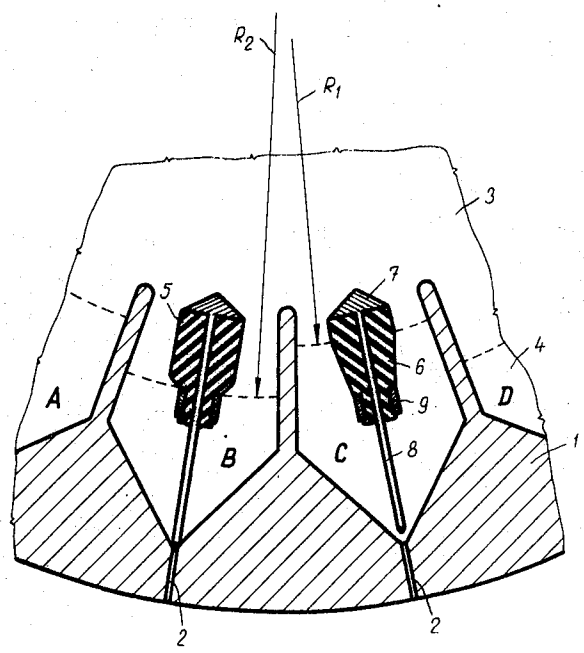
[57] **ABSTRACT**

The control of discharge valves for the discharge of a concentrate from the circumference of a centrifuge rotor is achieved by application of an elastically yieldable body, elongated and shortened in accordance with the increasing and decreasing level of the concentrate in the circumferential part of the centrifuge body.

4 Claims, 3 Drawing Figures



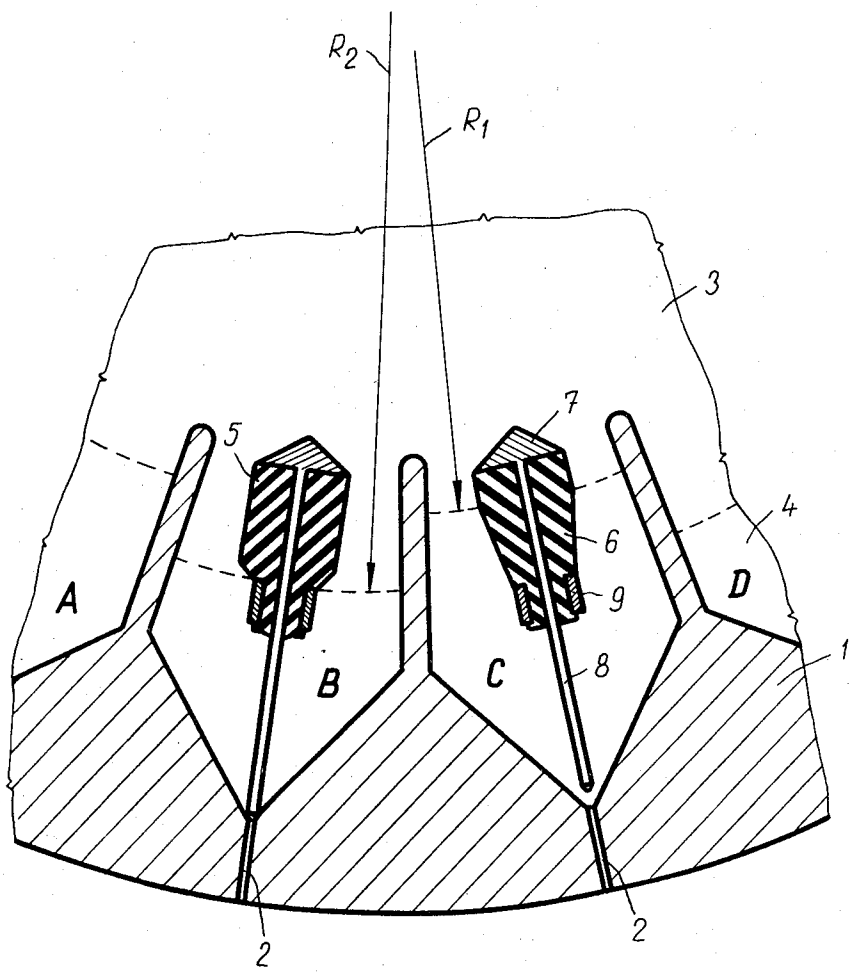


FIG. 1

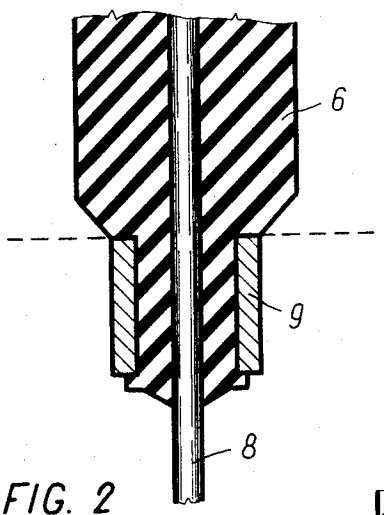


FIG. 2

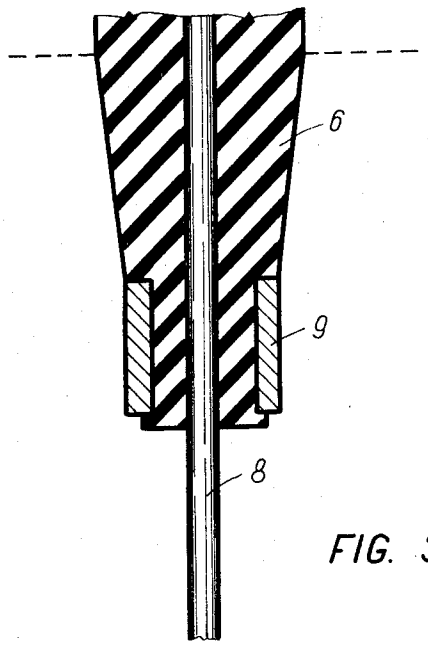


FIG. 3

METHOD OF AUTOMATIC CONTROL OF THE DISCHARGE OF A CONCENTRATED TRACTION OF SOLID PARTICLES DISPERSED IN LIQUIDS FROM A CENTRIFUGE ROTOR

BACKGROUND OF THE INVENTION

This invention relates to a method of automatic discharge of a concentrated fraction of solid particles dispersed in liquids from the rotor of a centrifuge by means of discharge valves and to an arrangement for execution of this method, comprising discharge valves with valve rods, the position of which is controlled by automatic regulators.

Actually used methods for the discharge of concentrated fractions of dispersions of solid particles in liquids by means of independently operating regulators from a centrifuge rotor are generally based on the principle of a hydraulic actuation of the discharge valves.

So far this hydraulic drive of discharge valves is controlled according to a program, for instance within time intervals, it is impossible to achieve a perfect conformity of volumes of the produced and discharged concentrated fraction. In order to prevent any excessive deposit of the concentrated fraction in the centrifuge rotor, a larger volume has to be discharged than is produced so that also a part of a not concentrated fraction is discharged, reducing thus the efficiency of concentrating.

More progressive methods are based on the dependence of the hydrostatic pressure on the concentration of the centrifuged dispersion, or on the changes of volume of the concentraged fraction at an increasing and decreasing level of the concentrate in the centrifuge rotor. But these discharge methods still have drawbacks in a reduced efficiency of the discharge and a reduced output. This is caused by the circumstance, that a constantly adjusted hydraulic drive of valve rods is actuated not solely by pressure or changes of volume of the concentrated fraction, but also by the pressure of the centrifuged dispersion in the space centripetally above the concentrate. This pressure varies considerably due to different irregularities of the operation as for instance due to variations of passage of the dispersion and of the counterpressure of the separated fraction, influencing unfavourably the operation of the valves and the uniformity of concentration of the dishcharged concentrated fraction.

It is an object of this invention to eliminate these drawbacks and to provide an automatic control of the discharge of the concentrated fraction from the centrifuge rotor through discharge valves in dependence on the increasing and decreasing level of the concentrate.

It is another object of this invention to eliminate or at least to substantially reduce the influence of the dispersion which is centripetally above the concentrate on the discharge of the concentrate.

SUMMARY OF THE INVENTION

According to this invention the opening and closing of discharge valves is derived from changes of the shape of an elastically yieldable body, situated within the range of radial changes of the lower and upper level of the concentrate in the rotor, which body is elongated and shortened in the radial direction of the centrifuge rotor due to increasing and decreasing centrifugal pressure of the concentrate, whereby the influence of pressure of the treated dispersion, which is centripetally above the level of the concentrate, on the elastically yieldable body is eliminated by using a material for said body, the volume compressibility of which corresponds to the volume compressibility of liquids.

A notable improvement in the control of discharge valves is thereby achieved, as due to the circumstance that this operation is derived solely from pressure differences caused by variations between an upper and lower level of the concentrate in the centrifuge rotor and by elimination of influences of any pressure variations of the dispersion which is centripetally above the concentrate, a discharge of such a volume of the concentrated fraction is secured, which corresponds exactly to the produced amount of concentrate. Another advantage of this control is, that the regulators required for this control are simple and reliable, using an elastically yieldable body.

Each of these regulators may comprise an elastically yieldable body, capable to be extended and shortened in the radial direction of centrifuge rotor, the volume compressibility of which body corresponds to the volume compressibility of liquids, which body is anchored with its end distant from the rotor axis in a bracket of the centrifuge rotor and which is provided on its end closer to the rotor axis with a strap piece, on which a valve rod is suspended, passing through the axis of the elastically yieldable body.

A substantially simple embodiment of the object of this invention is thus created which is efficient, cheap in manufacture, easy to maintain and particularly reliable in operation as the major parts of the regulator consist of the elastically yieldable body with a valve rod passing through said body.

DESCRIPTION OF DRAWINGS

An exemplary embodiment of the object of this invention is indicated in the attached drawings, where

FIG. 1 shows a are rotor in a section perpendicularly to its rotation axis,

FIGS. 2 and 3 ar longitudinal sectional views of regulators showing a closed and an open valve.

DESCRIPTION OF PREFERRED EMBODIMENT

In FIG. 1 we see a simplified view of part of a centrifuge rotor 1 in a section perpendicularly to the rotation axis of this rotor, passing through the discharge valves 2. The centrifuge space 3 with a not shown centrifuge separator, for instance with a disk separator occupies the central part of the rotor 1, having a supply and a discharge of the centripetally separated fraction. A concentration space 4 occupies the circumferential part of the rotor 1, which space is subdivided into a number of sector compartments A, B, C, D ... where the concentrated fraction is settling, the upper level of which concentrated fraction is indicated by a cylindrical surface of the radius R_1 and its lower level by a cylindrical surface of the radius R_2. Each sector compartment A, B ... of the concentrating space 4 terminates in the radial direction from the rotor axis in a discharge valve 2, the passage through which is controlled by a regulator 5. Each regulator 5 consists of an elastically yieldable body 6, a stiff strap piece 7, a valve rod 8 and a bracket 9.

The elastically yieldable body 6 is with its end distant from the axis of the centrifuge rotor 1 inserted and anchored in a bracket 9, fixed in the rotor 1. This elastically yieldable body 6 must be made of a material

which is sufficiently elastic so as to return to its original shape after forces which caused its deformation have ceased and its volume should depend on pressure in a negligible way only, similarly as liquids, for which this is a characteristic property.

It is furthermore advisable that the specific weight of the material from which the elastically yieldable body **6** is made, is rather close to the specific weight of the treated dispersion in the centrifuge space **3**. Both these requirements are met for instance by full rubber, the volume compressibility of which is practically negligible, which is perfectly elastic and its specific weight can be adjusted by fillers to the required value. Rubber made from natural rubber without fillers has for instance a specific weight about 960 kg m^{-3}, whereby the treated dispersions have generally a higher specific weight and the higher specific weight can be easily adjusted by fillers.

The automatic control of passage of the concentrate through the discharge valves **2** according to the described embodiment proceeds as follows:

The concentrated fraction of the treated dispersion is separated in the centrifuge space **3** and settles due to centrifugal forces in the cause of proceeding concentration in the individual sector compartments A, B ... of the concentrating space **4**, which sector compartments are filled with concentrate within the range of its upper level and lower level, determined by cylindrical surfaces of radii R_1 and R_2.

So far the concentrate does not surpass the lower level, determined by a cylindrical surface of the radius R_2, as indicated for sector B, the surface of the regulator **5** is exposed to the pressure of the treated dispersion, surrounding the regulator **5** and occupying the centrifuge space **3** centripetally above the concentrate. As the volume compressibility of the elastically yieldable body **6** is the same as of liquids, this elastically yieldable body **6** forms an adequate part of the hydraulic content, represented by the treated dispersion. The centrifugal pressure of the treated dispersion therefore causes no deformation of this elastically yieldable body **6** even if it varies due to not uniform conditions of operation. Therefore so far the level of the concentrate does not surpass the lower value determined by a cylindrical surface of a radius R_2 shown in sector B in FIG. **1** and in FIG. **2**, the discharge valve **2** remains closed by the valve rod **8** of the regulator **5**. If however the level of the settled concentrate rises above the lower valve determined by the radius R_2 it starts to surround the elastically yieldable body **6** of the regulator **5** and as the specific weight of the concentrate is larger than that of the treated dispersion, which has been displaced by this concentrate, it acts on the elastically yieldable body on their contact places with increased pressure and starts to compress this elastically yieldable body **6** in direction towards the valve rod **8** at a simultaneous centripetal elongation into the centrifuge space **3** containing the treated dispersion having a lower specific weight and producing therefore a smaller pressure. In sector C of the concentrating space **4** are in FIG. **1** and FIG. **3** shown conditions how the increasing amount of the concentrated fraction reached the upper level with the cylindrical surface having a radius R_1 and how the elastically yieldable body **6** has been thereby deformed.

In this case the settled concentrated fraction with a higher specific weight surrounds the elastically yieldable body **6** with a lower specific weight, compresses it perpendicularly to the axis of the regulator **5** and elongates it by hydrostatic pressure, lifting thereby simultaneously the stiff strap piece **7** with the suspended valve rod **8** and opening thus the discharge valve **2**.

The opening of the discharge valve **2** introduces a centrifugal discharge of the settled concentrated fraction from this sector C from the rotor **1** up to a moment where the concentrate drops to the lower level determined by cylindrical surface of the radius R_2, where again conditions indicated in sector B are prevailing, where the regulator **5** is surrounded by the still not concentrated dispersion, the centrifugal pressure of which does not cause any deformation of the elastically yieldable body **6**, so that this body **6** takes its original shape, lowering the stiff strap piece **7** with the suspended valve rod **8**, which closes again the discharge valve **2**. Thus the centrifugal discharge ceases and the settled concentrated fraction starts again to rise. The described cycle is constantly repeated.

In the course of the described operation of the regulator **5**, axial movements of the valve rod **8** passing through the elastically yieldable body take place, as indicated in FIGS. **2** and **3**, whereby both these parts remain in close contact. That is enabled by the capability of a shearing deformation of the elastically yieldable body **6** which capability is here fully utilized. A perfect tightness of the closed mechanism of the regulator **5** is thereby achieved, where no treated dispersion can enter, so that an operation without failure is safeguarded.

The object of this invention can be used for separating and concentrating fine grain dispersions of solid materials in liquids such as are all suspensions and of heavier components in a combination of liquids. A possibility of extensive application is given by the extraordinary simplicity as shown by the described solution of regulators **5** with elastically yieldable bodies **6**.

It is obvious that the same effect could be obtained with another constructional solution, for instance by suspending the elastically yieldable body **6** instead by its supporting on the bracket **9**. Similarly some other material can be used for the elastically yieldable body **6** than rubber, for instance a yieldable container filled with a liquid.

I claim:

1. A method of automatic control of the discharge of a concentrated fraction of a dispersion of solid particles in a liquid and of a heavier component in a combination of liquids from a centrifuge rotor by discharge valves, in dependence on an increasing and decreasing level of the concentrate, said method comprising the steps of utilizing for this control changes of longitudinal dimensions of a solid elastically yieldable body which changes being caused by the variations in pressure of an increasing and decreasing level of the concentrate at the circumference of a centrifuge rotor, simultaneously eliminating the influence of the treated nonconcentrated dispersion occupying the rotor space centripetally from the concentrate on the elastically yieldable body by employing an elastically yieldable body having a volume compressibility corresponding to the volume compressibility of the liquids.

2. In a centrifuge comprising a rotor for separating a liquid dispersion of solid particles into a concentrated fraction and a heavier component, an arrangement for the automatic control of the discharge of the concentrated fraction comprising a plurality of discharge openings situated at the circumference of the rotor,

each opening having an associate elastically yieldable body mounted to move radially within a circumferential area of said rotor defined by a predetermined upper and lower level of the concentrate, said elastically yieldable body being made of solid material having a volume compressibility corresponding to that of said liquid, thereby to be elongated and shortened in response to changes in pressure caused the change in concentrate level, and a valve rod embedded in said elastically yieldable body and reciprocally extending within said opening to open and close said opening on movement of said elastically yieldable body.

3. An arrangement as set forth in claim 2 the specific weight of the elastically yieldable body adjusted to the specific weight of the dispersion occupying the space of the centrifuge rotor centripetally from the concentrate.

4. An arrangement as set forth in claim 2, the elastically yieldable body anchored with its end distant from the rotor axis on a bracket of the centrifuge rotor and provided on its end closer to the rotor axis with a strap piece, on which the valve rod is suspended.

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