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METHOD AND DEVICE FOR CONTROLLING FEED IN A CENTRIFUGAL SEPARATOR

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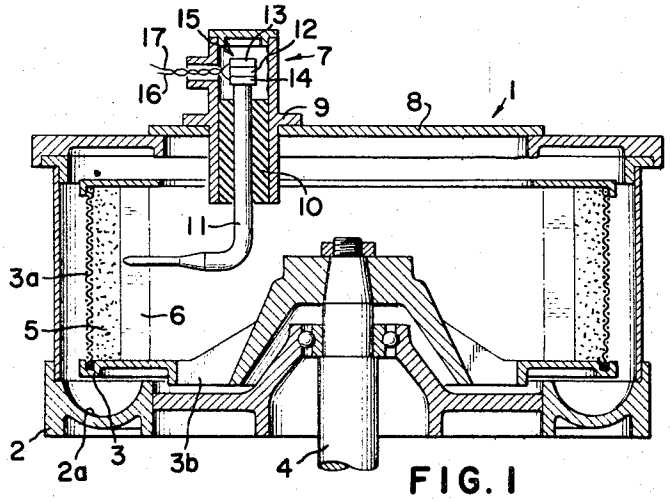

FIG. 1

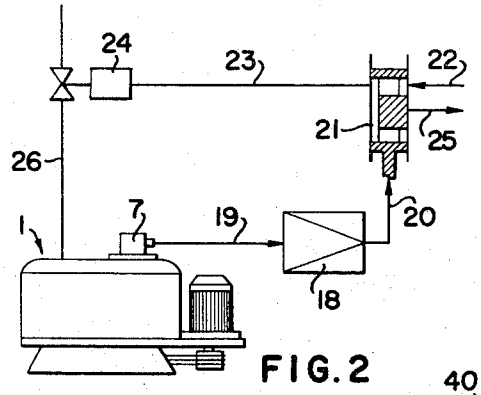

FIG. 2

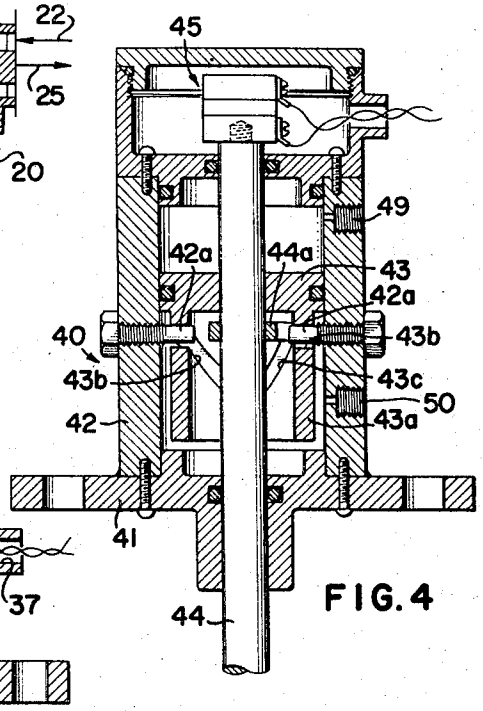

FIG. 4

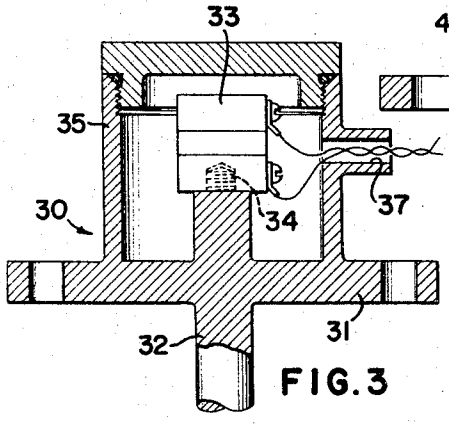

FIG. 3

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METHOD AND DEVICE FOR CONTROLLING FEED IN A CENTRIFUGAL SEPARATOR

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ABSTRACT OF THE DISCLOSURE

A detecting device for a centrifugal separator capable of detecting the thickness of a cake in a basket after having reached a predetermined value by detecting ultrasonic waves emanated upon contact of a detecting lever with the cake when the cake has grown up to a predetermined thickness.

The present invention relates to a centrifugal separator and more particularly to a method and a device for controlling feed of liquid or slurry into the centrifugal separator.

In solid-liquid separating operation using a batch type centrifugal separator, it has been a common practice to perform the various steps of the operation, starting by feeding of slurry and ending by removal of separated solids, in sequence on a continuous basis by means of the so-called sequence control. Although it is customary to use a timer for the sequence control because, in many instances, the steps in the operation of a centrifugal separator are carried out in a timed relation, there may be cases wherein use of a timer for feeding operation is difficult due to the characteristics of a slurry to be processed. More specifically, in processing a mixture of a solid and a liquid by the use of a centrifugal separator, the working ratio of the separator will be lowered when feeding of the mixture is stopped before the cake formed as a result of separation has reached a predetermined value, whereas the centrifugal separator will be overloaded when feeding of the mixture is not stopped even after the amount of the cake has exceeded a tolerable limit. Furthermore, variation in amount of the solid substance in each batch will result in lowering of efficiency in the succeeding step, e.g. the step of drying the separated solid substance. For the foregoing reasons, it is desirable to control feeding of a slurry based on the amount of a cake separated and not by the use of a timer.

In order to attain this purpose, there has been proposed a method in which feeding of a slurry is stopped when the slurry has reached a predetermined level, by detecting a drastic change in electric resistance or electrostatic capacity between an electrode fixed interior of a separation basket and an earthing electrode occurring upon contact of the end extremity of the electrode with the surface of the slurry in the basket. This method, however, is not satisfactory in that the liquid level and the amount of the cake separated vary depending upon the characteristics and feeding rate of a slurry being handled. Another drawback of the method described is that maintenance of a device by which the method is operated is troublesome because the electrode and the earthing electrode must be electrically insulated from each other completely.

Another device which has been proposed heretofore is one in which feeding of a slurry is stopped by the action of a microswitch which is adapted to be actuated by a rocking detector lever provided in a basket in such a manner that it is displaced from its normal position by

the slurry in the basket when the surface of the slurry has reached a predetermined level. The device of this type, however, has the same drawback as that possessed by the preceding device using electrodes, since the feeding of the slurry is controlled by detecting the liquid level in the basket, and the further drawback that the contruction is rendered complicated due to the existence of moving parts.

It is, therefore, the primary object of the present invention to eliminate the aforementioned drawbacks of the conventional devices.

It is another object of this invention to provide a method and device for controlling feeding of a slurry in accordance with the position of a cake surface and not with the level of the liquid in a basket.

It is still another object of this invention to provide a method wherein feeding of a slurry is stopped by detecting ultrasonic waves emanated upon contact of the tip end of a lever, disposed in the basket of a centrifugal separator and supported by the casing of the separator, with a cake of solid substance separated in the basket, and a device for practising the method. The term "ultrasonic" as used herein is intended to include audible sonic.

These and other objects and advantages of the present invention will become apparent from the following detailed description when taken in conjunction with the accompanying drawings, in which:

FIGURE 1 is a vertical cross section of a centrifugal separator illustrating an embodiment of the present invention;

FIGURE 2 is a schematic diagram illustrating an embodiment of the feed control system used in the present invention;

FIGURE 3 is an enlarged cross section showing a detecting unit of the type using no vibration-preventive rubber; and

FIGURE 4 is an enlarged cross section showing a detecting unit provided with means by which a detecting lever is moved from an actuating position to a non-actuating position immediately after detecting a cake having reached a predetermined thickness.

Referring to FIG. 1, a centrifugal separator generally indicated at **1** includes a fixedly supported casing **2** and a separation basket **3** rotatably mounted within said casing **2**. The basket **3** is secured to the top end of a drive shaft **4**, extending through the center of the casing **2**, by a key or other suitable means, so that it is driven from a suitable power source (not shown) through said drive shaft **4**. The casing **2** has a feed port (not shown) for a slurry. The slurry introduced into the basket **3** through the feed port is rotated, for the basket is rotating at high speeds. Thus, the slurry is pressed against a cylindrical screen **3***a* of the basket **3** due to the centrifugal force developed therein. In this case, a solid substance in the slurry, which has a greater mass than the liquid, is gathered in a radially outside portion of the basket **3** as indicated at **5** in FIG. 1, while the liquid remains in a radially inside portion as indicated at **6** in said figure. When the layer or cake **5** of the solid substance formed in the basket **3** has reached a predetermined thickness, supply of the slurry is interrupted, with the basket **3** rotating continuously. As a result, the liquid only is discharged from the basket **3** radially outwardly through the cake **5** which is prevented from moving in a radially outward direction by the screen **3***a*. The liquid discharged from the basket **3** conflicts against the peripheral side wall of the casing **2**, flows downwardly on the side wall and drains to the outside through a drain hole (not shown) in the casing after flowing through a passage **2***a* formed at the bottom of the casing **2**. When the liquid is substantially removed from the cake **5** of the solid substance formed in the basket **3**, the cake is scraped down

by means of a scraping blade (not shown) while rotating the basket **3** slowly and removed from the basket through a discharge port **3***b* in the lower portion of the basket. The construction and operation of the centrifugal separator as described above are well known and will not be described in further detail.

The centrifugal separator according to the present invention is provided with a detector for detecting the thickness of the cake **5** after having reached a predetermined value, which detector is generally indicated by numeral **7** in FIG. 1. The detector **7** includes a housing **9** fitted to a cover **8** for the casing **2** of the centrifugal separator and a detecting lever **11** held in the housing **9** through a vibration-preventive rubber bush **10**. The detecting lever **11** is extending downwardly from the lower end of the housing **9** and flexed into L-shape with its end extremity arranged for contact with the surface of the cake **5** in the basket **3** when the cake has grown up to a predetermined thickness. The upper end of the detecting lever **11** is protruding upwardly from the rubber bush **10** and with a piezo-electric unit **15** fixed thereto, said piezo-electric unit **15** consisting of a piezo-electric element **12** and electrodes **13** and **14** attached to both sides thereof. The electrodes **13** and **14** have lead wires **16** and **17** connected thereto respectively.

When the cake **5** has grown up to a predetermined thickness during operation of the centrifugal separator **1**, the solid substance constituting the cake **5** comes in contact with the end extremity of the lever **11**, emanating ultrasonic waves. The ultrasonic waves are transmitted through the lever **11** to the piezo-electric unit **15**. As a result, a voltage is developed in the piezo-electric unit **15** and this voltage is taken out through the lead wires **16** and **17** in the form of an electric signal indicating that the thickness of the cake has reached a predetermined value. The electric signal is amplified in a known manner to actuate the feed control system and thus the feeding of the slurry is interrupted.

An embodiment of the control system for controlling feeding of the slurry in response to the electric signal from the piezo-electric unit **15** is schematically shown in FIG. 2. Referring to this figure, an electric signal from the detecting unit **7** is fed to an amplifier **18** through a line **19**, wherein it is amplified and sent to a hydraulic control valve **21** through a line **20** to act on the same. The control valve **21**, therefore, is actuated by the output from the amplifier **18** and connects a hydraulic circuit **22** with a line **23**. A pressure oil from a pressure source (not shown) is thus led into a shut-off valve **24** to close the same and consequently the slurry being fed through a line **26** is interrupted.

The detecting lever **11** is preferably made of a metal but may be made of any other material which is capable of conducting ultrasonic waves. It is also preferable that the detecting lever **11** is shaped into such a configuration as to provide a small fluid resistance so as to avoid scattering of the slurry.

In the embodiment described above, the ultrasonic waves generated by the rotation of the basket **3** of the centrifugal separator will be transmitted to the detector unit **7** through the casing **2**, however the waves from the casing **2** to the lever **11** will be substantially absorbed by the vibration-preventive rubber bush **10** and extremely attenuated. The rubber bush **10** is not always necessarily used in the position shown but the same effect may be obtained, for example, by interposing an absorber between the cover **8** and the casing **2**. Such an arrangement is advantageous in avoiding rocking of the lever caused by a solid substance abutting thereagainst, due to the fact that the lever **11** is fixed to the housing **9** with a high rigidity at the joint.

In handling a slurry of relatively raw solid such as that of sodium glutamate, the ultrasonic generated upon contact of the cake **5** with the lever **11** generally has an amplitude far larger than that generated by the rotation of the basket **3** and conducted through the casing **2**. Therefore, the ultrasonic from the lever **11** is sufficiently detectable without using the vibration-preventive rubber.

An embodiment of the detector unit wherein a detecting lever is fixed without using a vibration-preventive rubber is shown in FIG. 3. In this embodiment, the detector unit **30** has a flange **31** for securing said detector unit to the cover **8**, and a detecting lever **32** similar to the detecting lever **11** is formed integrally with the flange **31**. Provided at the top end of the lever **32** is a piezo-electric unit **33**, similar to the piezo-electric unit **15**, which is mounted thereto by means of a stud **34**. A housing **35** is provided integrally with the flange **31** and covers the piezo-electric unit **33**. Electric wires from said piezo-electric unit are led to the outside through an aperture **37** formed in the housing **35**.

FIG. 4 shows another form of the detector unit. In this form, a pneumatic cylinder **42** having a floating piston **43** therein is fixedly mounted on the top surface of a housing **41** of the detector unit **40** and a detecting lever **44** is carried for rotation with respect to the housing **41** and the cylinder **42**. A piezo-electric unit **45** is the same as that shown in FIG. 3.

The piston **43** in the cylinder **42** has a skirt portion **43***a* having a pair of spiral cam slots **43***b* provided at the diametrically opposed position. Each slot **43***b* is engaged with a cam follower pin **42***a* secured on the cylinder **42**. Between the slots **43***b*, the skirt **43***a* of the piston **43** is formed with a pair of opposed cam slots **43***c* (only one of which is shown in FIGURE 4), each of which is engaged with a pin portion (not shown) formed at each end of a transverse member **44***a* fixed on the lever **44**. The slots **43***c* are similar to the slots **43***b* but their direction of spiral is reverse to that of the latter, so that, when the piston **43** is moved vertically, the lever **44** is rotated. The cylinder **42** has ports **49** and **50** connected thereto through which a compressed air is introduced into or discharged from the chambers formed above and below the piston **43**.

In this embodiment, when an ultrasonic is generated upon contact of the end extremity of the lever **44** with the cake formed in the basket of the centrifugal separator, indicating that the cake has grown up to a predetermined thickness, a compressed air is introduced through, e.g. the port **49** depressing the piston **43** downwardly. Then, the lever **44** is rotated about its axis whereby the tip end of the lever **44** is moved from the operative position in which it is in contact with the cake within the basket, radially inwardly into a position in which it will not come in contact with the cake **5**. Thus, it will be understood that the tip end of the lever **44** is not contacted by the cake **5** during the separating period after interruption of the feeding, with the result that wearing of the detecting lever can be reduced remarkably.

Although the present invention has been described and illustrated in detail in terms of the specific embodiments, it is of course to be understood that these embodiments are only illustrative and are in no way restrictive in respect of details of the construction and arrangement.

What is claimed is:

1. A method of automatically controlling feeding of a slurry into a centrifugal separator by detecting a cake of a solid substance having grown up to a predetermined thickness in a rotary basket in said centrifugal separator, said method comprising the steps of converting an ultrasonic wave generated upon contact of the tip end of a detecting lever, fixed in a predetermined position in the centrifugal separator, with the solid substance into an electric signal and amplifying said signal to actuate slurry feed control means.

2. A centrifugal separator comprising a fixed casing, a separation basket rotatably mounted in said fixed casing, means to rotate said basket, means to feed a slurry into said basket and means to detect the amount of a cake formed of a solid substance in the slurry upon

separation from a liquid in the basket and having reached a predetermined value, said detecting means including a housing mounted on a fixed portion of the centrifugal separator and a detecting member retained in said housing, one end of said detecting member being positioned at a location at which it is engageable with said cake as said cake has grown up to a predetermined thickness, and said detecting member being combined with means to convert ultrasonic waves generated upon contact of said one end of the detecting member with said cake into an electric signal and provided with means to control said slurry feed means in response to said electric signal.

3. A centrifugal separator according to claim 2, in which said converting means is a piezo-electric unit having a piezo-electric element.

4. A centrifugal separator according to claim 2, in which the housing of said detecting means is mounted on the top cover of said fixed casing and said detecting member consisting of a L-shaped lever extending downwardly from the housing of said detecting means and then radially outwardly with its tip end located at a point a predetermined distance spaced radially inwardly from a cylindrical screen in said separation basket.

5. A centrifugal separator according to claim 4, in which said L-shaped lever is supported by said housing through the intermediary of buffer means.

6. A centrifugal separator according to claim 4, in which said L-shaped lever is fixed directly to said housing.

7. A centrifugal separator according to claim 4, in which said L-shaped lever is arranged within said housing so as to be rotatable about its vertical axis and there being provided means to turn said lever after the ultrasonic waves are generated upon contact of the tip end of said lever with the cake and to move the tip end of said lever into an inoperative position in which it will not come in contact with the cake.

8. A centrifugal separator according to claim 7, in which said means to move said lever into the inoperative position comprises a cylinder fixed to the housing of said detecting means, a piston disposed axially movably and rotatably in said cylinder, cam means for rotating the lever upon axial movement of the piston, and means to selectively introduce a compressed air into chambers formed within the cylinder at both sides of said piston.

9. A detecting device for detecting the amount of solid substance separated from a slurry and having reached a predetermined value in a centrifugal separator comprising a separation basket, said device comprising a detecting member capable of transmitting ultrasonic waves, a housing for retaining and suspending said detecting member into said basket, the distal end of said detecting member being positioned at a location at which it is engageable with said solid substance as said solid substance has grown up to a predetermined thickness in said basket, means combined with said detecting member to convert the ultrasonic waves transmitted to said detecting member upon contact of the distal end of said member with said solid substance, into an electric signal, and means controlling the flow of said slurry to said centrifugal separator responsive to said electric signal.

10. A detecting device according to claim 9, in which said detecting member is an L-shaped lever extending from one end of said housing and said converting means includes a piezo-electric unit having a piezo-electric element.

11. A detecting device according to claim 10, in which said lever is supported by said housing through the intermediary of buffer-means.

12. A detecting device according to claim 10, in which said lever is fixed directly to said housing.

References Cited

UNITED STATES PATENTS

2,524,579	10/1950	Taylor	340—261 X
2,912,110	11/1959	Stoltenberg	210—86 X
3,044,625	7/1962	Smith et al.	210—86
3,141,846	7/1964	Laven	210—86 X

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118—8; 210—86, 377; 340—261