June 16, 1931. S. E. MEYERS 1,810,111

CONSISTENCY RESPONSIVE DEVICE

Original Filed Nov. 12, 1928 3 Sheets-Sheet 1

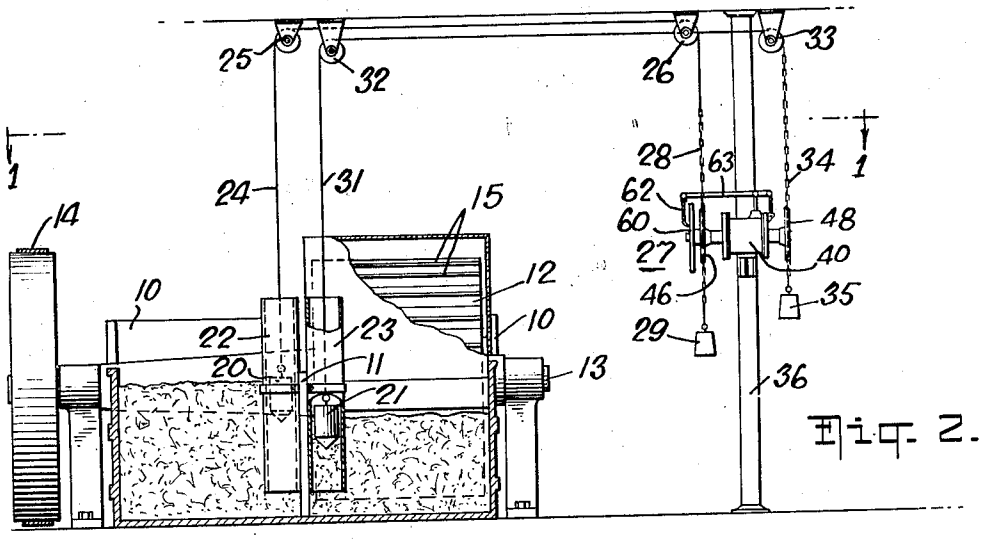


Fig. 2.

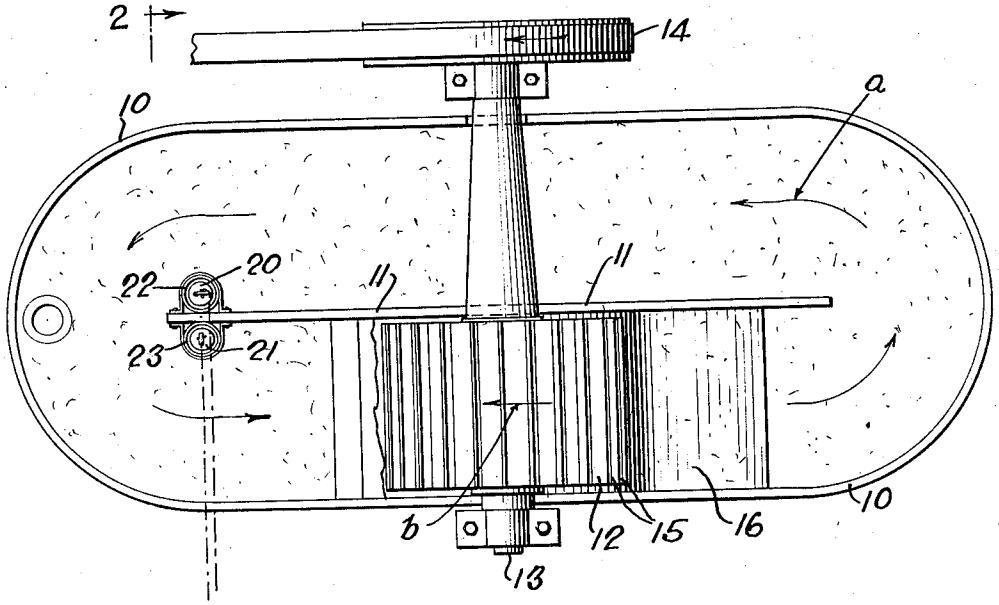
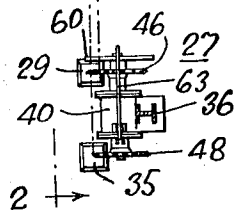


Fig. 1.



Inventor

Sidney E. Meyers

By Attorney

Warfield & Watson

June 16, 1931. S. E. MEYERS 1,810,111

CONSISTENCY RESPONSIVE DEVICE

Original Filed Nov. 12, 1928 3 Sheets-Sheet 2

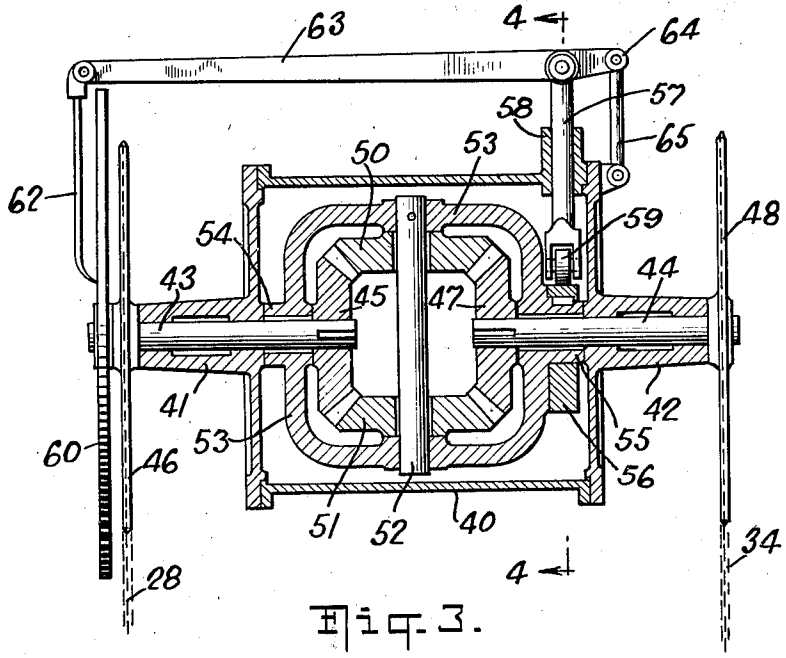


Fig. 3.

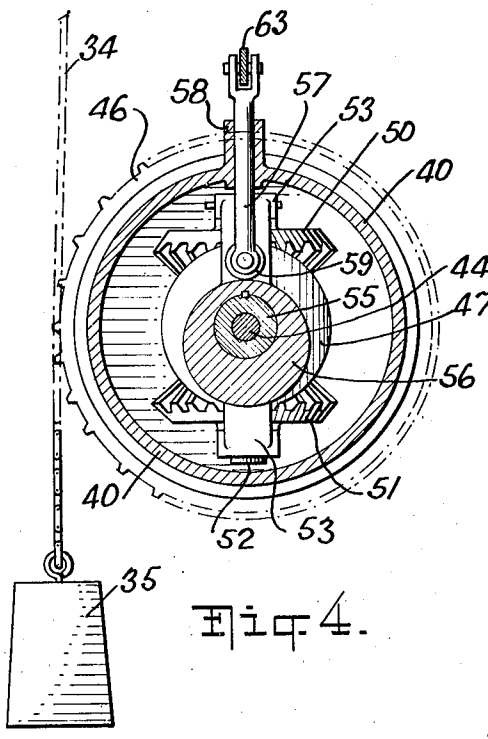


Fig. 4.

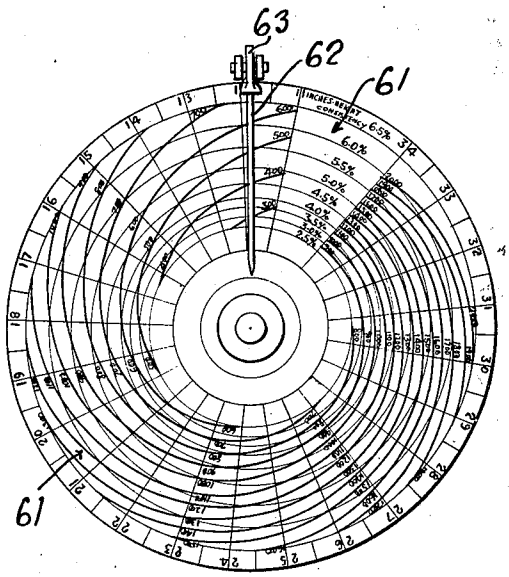


Fig. 5.

Inventor

Sidney E. Meyers

By Attorney

Warfield & Watson

June 16, 1931. S. E. MEYERS 1,810,111

CONSISTENCY RESPONSIVE DEVICE

Original Filed Nov. 12, 1928 3 Sheets-Sheet 3

Fig. 6.

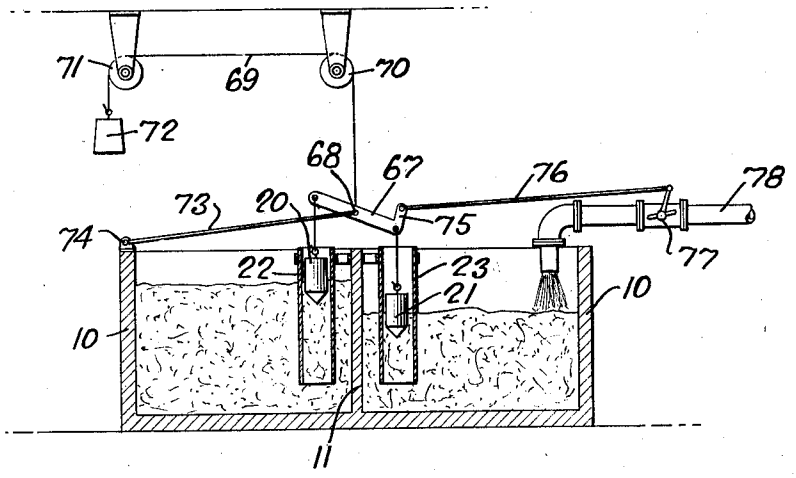
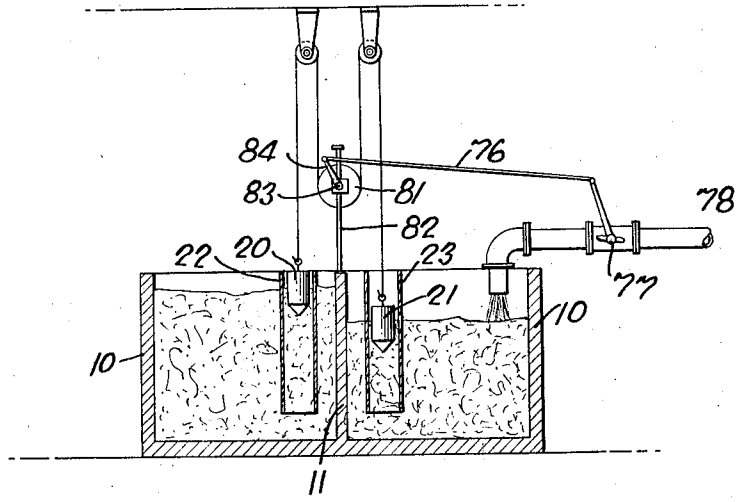


Fig. 7.



Inventor
Sidney E. Meyers
By Attorney
Warfield & Watson

Patented June 16, 1931 1,810,111

UNITED STATES PATENT OFFICE

SIDNEY E. MEYERS, OF LOCKPORT, NEW YORK, ASSIGNOR OF ONE-HALF TO ERICSSON H. MERRITT, OF LOCKPORT, NEW YORK

CONSISTENCY RESPONSIVE DEVICE

Application filed November 12, 1928, Serial No. 318,676. Renewed July 15, 1930.

This invention relates to devices responsive to consistencies of fluid suspensions, and, more particularly, to devices adapted to indicate and regulate the consistency or degree of suspension in mixtures of solids and liquids, such, for example, as the measurement of the amount of fibrous and other materials in the stock used in the manufacture of paper and like sheet material.

The invention has for its object generally the provision of a device of the character described which responds to the amount of the suspended material present with precision, and which can be economically and readily manufactured and installed.

More particularly an object of the invention is to provide means responsive directly to the percentage of solid material held in fluid suspension in a manner which is independent of the velocity or average mass movement of the stock material.

Another object is to provide a differential hydraulic-level actuated responsive device which indicates the slope as a function of consistency during flow between two points in the line of flow of stock material.

A still further object is to provide a device which is adapted to indicate and to regulate—as the case may be—the consistency of the stock material in paper mill beaters and the like, the device being made responsive solely to the difference in the hydraulic level of the stock material at two points in the direction of the flow in the beater.

Other objects of the invention will in part be obvious and will in part appear hereinafter.

The invention accordingly comprises the features of construction, combination of elements and arrangement of parts which will be exemplified in the construction hereinafter set forth, and the scope of the application of which will be indicated in the claims.

For a fuller understanding of the nature and objects of the invention reference should be had to the following detailed description taken in connection with the accompanying drawings, in which:

Figure 1 shows a horizontal plan view of a paper mill beater provided with a consistency-responsive device constructed in accordance with the invention;

Fig. 2 is a view mainly in vertical section showing the paper mill beater illustrated in Fig. 1, the plane of the section being taken on the line 2—2 in Fig. 1, looking in the direction of the arrows;

Fig. 3 is a view, mainly in vertical section, showing details of the indicating mechanism employed in conjunction with the device illustrated in Figs. 1 and 2;

Figs. 4 and 5 are views showing details of the device illustrated in Fig. 3, Fig. 4 being taken on the line 4—4 in Fig. 3;

Fig. 6 shows a modified form of the device shown in Fig. 1 arranged to regulate the consistency of the material in a beater; and

Fig. 7 shows a still further modified form of a device similarly adapted to regulate the consistency of the beater stock.

Referring now to the drawings, and particularly to Figs. 1 and 2, there is here illustrated a typical beating engine adapted for accomplishing the process known as "beating" in the manufacture of paper and the like. Such beating engines are more commonly referred to as "beaters".

The beater shown comprises a tub 10 having a central partition or midfeather 11 adapted to extend from a point near one end of the tub to a point near the other end and about which the stock material is made to circulate in the direction of the arrows *a*. This movement of the stock is produced by a driven roll 12 which extends substantially across one side of the beater and has a driving shaft 13 disposed horizontally and adapted to revolve so that the top portion of the roll has the motion indicated by the arrow *b*; the shaft 13 being driven from any convenient source of power, for example, a belt-driven pulley, as shown at 14. In order to accomplish the so-called beating action the roll 12 has a plurality of blades 15 disposed parallel about its cylindrical circumference, which blades engage with the oncoming stock as the roll revolves in the beater and forces the stock downwardly along the bottom of the tub, and then out over the backfall shown at 16. By reason of this action of the roll

12 there is a normal difference in the hydraulic level of the stock at the backfall in the beater and that which flows into and is engaged by the blades 15. This difference in the level of the stock on the two sides of the roll produces the flow in the stock about the tub.

In the practice of the present invention the slope between two points in the line of flow of the stock in the beater is taken as the index of the consistency to be indicated, recorded and controlled, as the case may be. This slope has been ascertained to be proportional to the internal friction between the solid particles suspended in the stock circulating in the tub, which friction increases with the relative amount of such particles present, so that it is a true function of the consistency or percentage of solid material suspended in the stock. The two points in the line of flow between which the slope is to be ascertained may be chosen arbitrarily, but preferably are convenient of access in the tub. As here illustrated, these points are on opposite sides adjacent one end of the midfeather 11, for example, the end adjacent the approach to the roll 12. The slope between the two points adjacent this end is preferably ascertained by means responsive to the difference in hydraulic level of the stock at these two points. From this it is seen that the slope is not dependent upon the total height of the stock on the two sides of the midfeather but is proportional to the difference in height of the surface of the stock at these points. The means responsive to this difference in the hydraulic level comprises floats 20 and 21 which are suspended freely in guard-pipes 22 and 23 that are secured respectively on opposite sides of the midfeather. These guard-pipes are of such diameters that the liquid level of the stock within them is substantially that of the stock on the exterior of the same. It is thus seen that the floats 20 and 21 within these pipes are protected against the effects of the rate or velocity of movement of the stock past these points and respond substantially accurately to the difference in hydraulic levels at the points selected; the floats being themselves of such diameters as not to interfere in any way with their free rise and fall within the guard-pipes.

The float 20 is suspended by means of a suitable flexible cable 24 which passes upwardly over the suspension pulleys 25 and 26 and is connected to actuate a differential responsive device shown generally at 27. The connection includes a sprocket-actuating chain 28 held under tension by means of a weight 29 and a sprocket wheel on the device to be hereinafter described. The float 21 has a similar flexible cable 31 passing over pulleys 32 and 33 to a sprocket-actuating chain 34 also having a tensioning weight 35 and connected similarly to actuate the device 27. The differential responsive device may be supported in any convenient manner, for example, rigidly upon a post or standard 36.

The construction of the differential responsive device is more clearly shown in Figs. 3, 4 and 5, where 40 denotes a casing having bearing housings 41 and 42 projecting from the ends thereof and in which the shafts 43 and 44 are journaled respectively. Rigidly secured upon the inner end of shaft 43 is a gear 45, shown as of the bevel variety. Upon the outer end of the shaft 43 is secured a sprocket 46, which is adapted to be engaged by the sprocket chain 28, here indicated in broken lines. The shaft 44 similarly has secured on its inner end a gear 47 and a sprocket 48 on its outer end, which sprocket is engaged by the other sprocket chain 34. Differentially-actuated bevel gears 50 and 51 are operatively secured between the bevel gears 45 and 47 and arranged to turn upon the shaft 52 secured in the differential yoke 53 which has journal sleeves 54 and 55 arranged to turn upon the shafts 43 and 44 within the housing 40. Secured upon the exterior of the sleeve 55, and turning with the differential yoke 53, is an actuating member 56. This actuating member may have any convenient form, for example, that of a cam or eccentric disc, shown more clearly in Fig. 4, which, when turning, is adapted to transmit motion to a reciprocating plunger 57 disposed to pass through a sleeve 58 that is formed on the upper side of the casing in order to actuate a suitable exteriorly located mechanism. The motion of this cam is preferably transmitted to the plunger 57 through anti-friction means, for example, the anti-friction roller on the inner end of the plunger shown at 59.

Where it is desired to indicate the consistency of the stock, the exterior mechanism to be actuated by the plunger 57 is arranged to this end. A typical indicating mechanism is shown in Figs. 3 and 5. Here a rotatable disc 60 is secured on the outer end of one of the sprocket-driving shafts, for example, the shaft 43, which is at the side of the housing opposite to that at which the plunger 57 is located. The disc 60 has on its face suitable indicating marks or indicia secured in any suitable manner, for example by means of a suitable chart 61 shown in Fig. 5. This chart is preferably marked to read directly the quantities desired to be ascertained. Cooperating with the chart is a suitable stylus or indicating hand 62 supported by the lever 63, which is pivoted at 64 to the link 65 that is pivoted to the casing 40, this lever having operatively attached thereto the plunger 57, by which it is moved in response to the movement of the actuating member 56.

In order to readily determine the total weight of stock contained in the beater, the

chart 61 is provided with radial lines drawn to represent the height or depth of stock at the left hand side of Fig. 2, and the rotation of chart 61 is a function of and directly proportional to the height. However, the degree of consistency modifies the total weight so that the movement of the stylus 62 in conjunction with float differentials is elevated or depressed as the case may be and in effect provides an automatic means of correction for various consistencies. In other words, if the consistency were always constant, the differential gearing and stylus 62 would be unnecessary, and the height of the stock at any point would be a linear function of the weight within the beater.

When the consistency of the stock circulating in the beater is constant, the slope of the surface of the stock between the two guard-pipes 22 and 23 is constant, so that the differential in the elevation of the floats 20 and 21 stays constant, i. e., assuming that the hydraulic level of the stock causes the float 20 to rise through a given distance, with a constant slope there is a corresponding rise in the float 21. These two floats thus elevated would transmit the rising movement through the flexible cables 24 and 31 to rotate the sprockets 46 and 48 through equal but opposite arcuate distances. Such rotation of the sprockets 46 and 48 would turn the bevels 45 and 47 through equal but opposite arcs and no motion would be transmitted to the differential yoke 53. As a result, chart 60 would only be rotated to bring a different radial line under the indicator 62 to show an increase in the total volume of stock circulated. The tip of the indicator 62 would in this case not be moved. Consequently, the chart 61 is also ruled with concentric circles to show constant consistencies.

When the consistency of the stock in the beater increases, then the slope between the two points at which the guard pipes 22 and 23 are located would increase, with the result that the difference in level between the two floats 20 and 21 would be increased, for example, a drop in elevation of the float 21 without a corresponding drop in the float 20. As a result of such movement the sprocket 48 would be rotated relatively to the sprocket 46, through an arc which is proportional to the travel of the float, with the result that gears 50 and 51 turn but with reference to the fixed base circle on gear 47. Consequently, the differential yoke 53 turns through an angle which, measured on an arc corresponding to the base circles of gears 45 and 47, is equal to half of the relative difference in their arcs. Actuating member 56 consequently is turned by the yoke 53 and a movement transmitted to the plunger 57 which would be an upward movement, assuming that the actuating member 56 is moving from the position shown in Fig. 4. The indicator 62, in consequence, would be moved so that its pointer rises to a higher concentric circle on the chart 61 to indicate an increase in the consistency and total weight of the stock circulating in the tub. The circles drawn on the chart by way of illustration represent consistencies ranging respectively from 2.5% at the bottom to 6.5% at the top.

In order that this chart may also indicate the total amount of bone dry or so-called "air dry weight" of the fibrous or other materials suspended in the stock, spiral lines are drawn on the chart which, for the same consistency for different depths of stock, increase from one to the next of the radial lines on the chart so that a series of such spirals appear on the chart corresponding to different depths of stock in the measuring plane.

Where consistency only is to be indicated by the device of the present invention, a stationary chart and supporting disc would of course be arranged to cooperate in connection with the indicator 62.

Where the consistency is desired to be controlled, the exterior mechanism to be actuated by the differential device comprises some mechanism for subtracting from, or changing the consistency of the stock, for example, means for actuating a valve which is adapted to admit or shut off a supply of water to the tub. Arrangements adapted to this end are shown in Figs. 6 and 7.

In Fig. 6 the tub 10 of a beater has floats 20 and 21 adapted to actuate a relatively simple form of differential device, here shown as comprising a so-called floating lever 67. This lever has its fulcrum 68 connected to a flexible cable 69, which passes over pulleys 70 and 71 to a counterbalancing weight 72, the fulcrum 68 being prevented from turning relatively to the tub 10 by means of the link 73, which extends from the fulcrum to a pivot 74 on one side of the tub. This floating lever has an arm 75 which is connected to the link 76 that is adapted to actuate a valve 77 in a conduit or pipe 78 which conveys water or the like into the tub 10 for the purpose of controlling the consistency as dry fiber stock is added. While the differential device here employed is not intended directly to indicate visually the condition or consistency of the stock, since the means shown is adapted to control the valve 77, which, for example, when the differential in height between the two floats is not greater than a certain value, causes the lever 67 to be in such a horizontal position as to maintain closed the valve 77, still visual indication may be taken from the position of the lever 67. This effect may be enhanced by the provision of a suitable arm or pointer on the lever. When, however, this differential increases so as to cause the lever 67 to turn about its fulcrum in a clockwise direction it would thereby transmit a movement through the link 76 to open the valve 77

whereby water is admitted to the tub until the consistency of the stock is changed sufficiently to restore the slope desired.

A still further modified form of differential device is shown in Fig. 7, where a wheel 81, which is rotatably and slidably mounted on a vertical member 82, is adapted to be differentially turned by a relative rise and fall of the floats 20 and 21. This wheel has a shaft 83 upon the outer end of which is an arm 84 connected to actuate a link corresponding to 76, which is connected to the water-controlling valve 77. The angular position of the arm 84 in this arrangement corresponds to the consistency of the stock and may be taken as a visual indicator thereof as well as a mechanical means for controlling the consistency, where desired.

Since certain changes may be made in the above construction, and different embodiments of the invention could be made, without departing from the scope thereof, it is intended that all matter contained in the above description or shown in the accompanying drawing shall be interpreted as illustrative and not in a limiting sense.

It is also to be understood that the following claims are intended to cover all of the generic and specific features of the invention herein described, and all statements of the scope of the invention which as a matter of language might be said to fall therebetween.

Having described my invention, what I claim as new and desire to secure by Letters Patent is:

1. In condition-responsive devices, the combination comprising means adapted to indicate the hydraulic level in moving mediums at two successive points in the line of flow, and means responsive to the differential in said heights.

2. In condition-responsive devices, the combination comprising a conduit through which a mixture of liquid and solids in suspension is passing, float members disposed at two successive points in the line of flow in said mixture, and means actuated by said floats adapted to be responsive to the differential of the heights of said floats.

3. In condition-responsive devices, the combination comprising a conduit through which a mixture of liquid and solid materials is passing, velocity screening members disposed at two successive points in the line of movement of said mixture in said conduit, floats associated with each of said screening devices, and a differential device operatively connected to said floats for actuation in response to the relative difference in heights of said floats.

4. In condition-responsive devices, the combination of a conduit through which a slurry of paper-manufacturing stock is passing, guarding members disposed at two successive points in the line of movement in said conduit, float members associated with each of said guarding members and adapted to be responsive to the hydraulic levels of said slurry at said guard member, and an actuating member operatively connected to each of said floats, whereby said actuating member moves in response to the relative difference in the respective heights of said float members.

5. In condition-responsive devices, the combination comprising a conduit through which paper pulp stock is adapted to pass, a pair of tubular members disposed in said conduit at two successive points in the line of movement of said stock, said tubular members being positioned above the bottom of said conduit, and adapted to permit the stock to rise therein substantially to the liquid level on the exteriors thereof, float members in said tubular members adapted to be raised and lowered by the variation of the liquid level within said tubular members, and a device operatively connected to said float members including a rotatable member adapted to be turned in response to the relative difference in the heights of said float members.

6. In a consistency-responsive device, the combination comprising a conduit through which a mixture of paper pulp stock is adapted to pass, a pair of tubular members disposed respectively at the two successive points in the line of movement in said conduit, said tubular members being disposed above the bottom of said conduit and of a diameter such that said mixture rises to substantially the same liquid level on the interiors thereof as on the exteriors thereof, a float member in each of said tubular members arranged to rise and fall with the fluctuation of the liquid level in said tubular members, and a differential device comprising a rotatable member adapted to be turned through an arc proportional to the relative difference in the heights of said float members.

7. In a consistency-responsive device, the combination comprising a conduit through which paper pulp stock is adapted to pass, a pair of tubular members disposed respectively at successive points in the line of movement in said conduit, said tubular members being disposed above the bottom of said conduit and of diameters sufficient to permit the rise of stock therein to the liquid level on the respective exteriors thereof, a float member in each of said tubular members, a differential device having a movable yoke and gears associated therewith adapted to move said yoke in response to the arcuate differential in the movement of said associated gears, sprockets for driving said gears, and flexible means extending from said sprockets to said float members whereby said yoke is moved in response to the relative difference in the heights of said float members.

8. In a consistency-responsive device, the

combination comprising a conduit through which a mixture comprising paper pulp stock is adapted to pass, tubular members disposed in said conduit at two successive points in the line of passage, said tubular members being arranged to have a level of the stock therein which is an index of the level of the stock without the same, float members adapted to move in said tubular members in response to the variation in the liquid level in said tubes, an indicating device having a movable member and associated gears for moving the same in response to the differentials of the arcs traversed by said gears, sprockets for driving said gears, actuating means whereby operative connections between said floats and said sprockets are applied for moving said sprockets in response to the relative difference in the height of said float members, and means associated with said movable member for indicating the percentage of solid materials in said mixture.

9. In devices adapted to indicate the consistency of paper pulp and the like, the combination with a beater tub having a midfeather therein, tubular members secured to said midfeather adjacent one end thereof, a float member in each of said tubular members, and means adapted to be actuated by the differential in the height of said float members.

10. In devices adapted to indicate the consistency of paper pulp and the like, the combination with a beater tub having a midfeather therein, tubular members secured to said midfeather adjacent one end thereof, a float member in each of said tubular members, and means including a rotatable member having flexible connections to said float members whereby said rotatable member is moved in response to the relative difference in the height of said float members.

11. In devices adapted to indicate the consistency of paper pulp and the like, the combination with a beater tub having a midfeather therein, tubular members secured to said midfeather adjacent one end thereof, a float member in each of said tubular members, a device including a rotatable member having gears and driving sprockets therefor associated therewith, said gears being connected to move said rotatable member in response to the differential in the arcs traversed by said gears, and flexible connections operatively connecting said float members respectively with said sprockets whereby the differential gears are actuated respectively by the movements of said float members.

12. In devices adapted to indicate the consistency of paper pulp and the like, the combination with a beater tub having a midfeather therein, tubular members secured to said midfeather adjacent one end thereof, a float member in each of said tubular members, and an indicating device comprising a rotatable yoke member having gears pivoted therein and shafts secured to said gears, and driving sprockets on said shafts adapted to cause said yoke member to move through an angle whose arc is proportional to the differential in the arcs traversed by said gears, flexible connections respectively connected between said sprockets and float members so that the former are actuated by the latter, an indicating arm adapted to be actuated by the movement of said yoke member, and a cooperating indicating disc adapted to be moved by the rotation of one of said sprockets.

13. In a device responsive to the consistency of paper pulp stock and the like, the combination with a beater tub, of means producing movements proportional to the true hydraulic level at successive points in said tub, a rotatable member connected to the first-named means and adapted to be rotated through a turn proportional to the relative difference in the heights of said stock at said points, and means associated with said rotatable member for indicating the percentage of solid matter suspended in said stock.

14. In a device responsive to the consistency of paper pulp stock and the like, the combination with a beater tub, of means producing movements proportional to the true hydraulic level at successive points in said tub, a rotatable member connected to the first-named means and adapted to be rotated through a turn proportional to the relative difference in the heights of said stock at said points, and means for indicating the weight of solid material in the tub and the percentage of solid materials in suspension.

15. In a device responsive to the consistency of paper pulp stock and the like, the combination with a beater tub, of means associated with said tub and adapted to be responsive to the slope of the hydraulic level of the stock at two successive points in said tub, means for screening said slope-responsive means from the effects of the velocity of the movement of stock in said tub, and means operatively connected to said slope-responsive means for indicating the percentage of solid material held in suspension in said stock.

16. In a device responsive to the consistency of paper pulp stock and the like, the combination with a beater tub, of means associated with said tub and adapted to be responsive to the slope of the hydraulic level of the stock at two successive points in said tub, means for screening said slope-responsive means from the effects of the velocity of the movement of stock in said tub, and means actuated by said slope-responsive means for restoring the consistency of said stock when a predetermined consistency is departed from.

17. The process of determining with precision the percentage of solid material in moving mixtures of liquids and solids, which comprises generating a motion the magnitude

of which is proportional to the slope of the hydraulic level between two successive fixed points in the path of the movement of mixture, and causing said movement to actuate a responsive device in a degree proportional to the amount of said generated motion.

18. The process of determining with precision the percentage of solid materials in a slurry of paper pulp stock, which comprises generating a motion responsive in magnitude to the difference in the hydraulic level of said stock at two successive points in the path of the movement of said stock, and causing a responsive device to give an indication proportional to the magnitude of said generated motion.

19. An indicating device for indicating the condition of paper pulp stock and the like passing in conduits, which comprises a rotating disc having a chart adapted to be rotated relatively with respect to a point adjacent the circumference thereof, means for rotating said chart in response to the absolute height of the stock passing a given point in the conduit whose contents is to be measured, and an indicating arm adapted to move radially with respect to said rotating disc, said radially-moving arm being connected to move an amount proportional to a relative difference in the height of the stock between two successive points in said conduit.

20. A chart adapted to cooperate with an indicating arm in a device for indicating the consistency of paper pulp stock and the like, passing in conduits, the chart being adapted to be laterally displaced with respect to the arm and the arm to have movement transversely of the chart, said chart having a series of parallel lines indicating successive transverse movements of said arm, and a series of parallel lines drawn parallel to the direction of lateral displacement, and a third series of generally parallel curved lines on said chart drawn diagonally across the spaces demarked by the first and second groups of parallel lines, said first series of parallel lines having affixed thereto graduation marks adapted to indicate the depth of the paper stock in said conduit, the second series of parallel lines having graduation marks affixed thereto reading directly the consistency of the stock, and a third series of parallel curves having affixed thereto graduation marks indicating the dry weight of materials in said stock.

21. In condition-responsive devices, the combination comprising means responsive to the pressure of the hydraulic level of a moving medium disposed at two successive points in the line of movement, and means responsive to the differential in said hydraulic pressures.

22. In condition-responsive devices, the combination comprising a conduit through which a mixture of liquid and solids in suspension is passing, devices disposed at two successive points in the line of flow of said mixture, said devices being responsive to the pressure of the hydraulic level of said mixture at such points, and means actuated by said devices responsive to the differential in height of said hydraulic levels.

23. In condition-responsive devices, the combination comprising a conduit through which a mixture of liquid and solid materials in suspension is passing, tubular members disposed in said conduit at two successive points in the line of flow of said mixture, and means associated with each of said tubular members arranged to move in response to the hydraulic level of said mixture on the exterior of said tubular member, and a differential device operatively connected to said last named means to be actuated jointly thereby for indicating the relative difference in the height of said hydraulic levels.

In testimony whereof I affix my signature.

SIDNEY E. MEYERS.