

June 5, 1934.

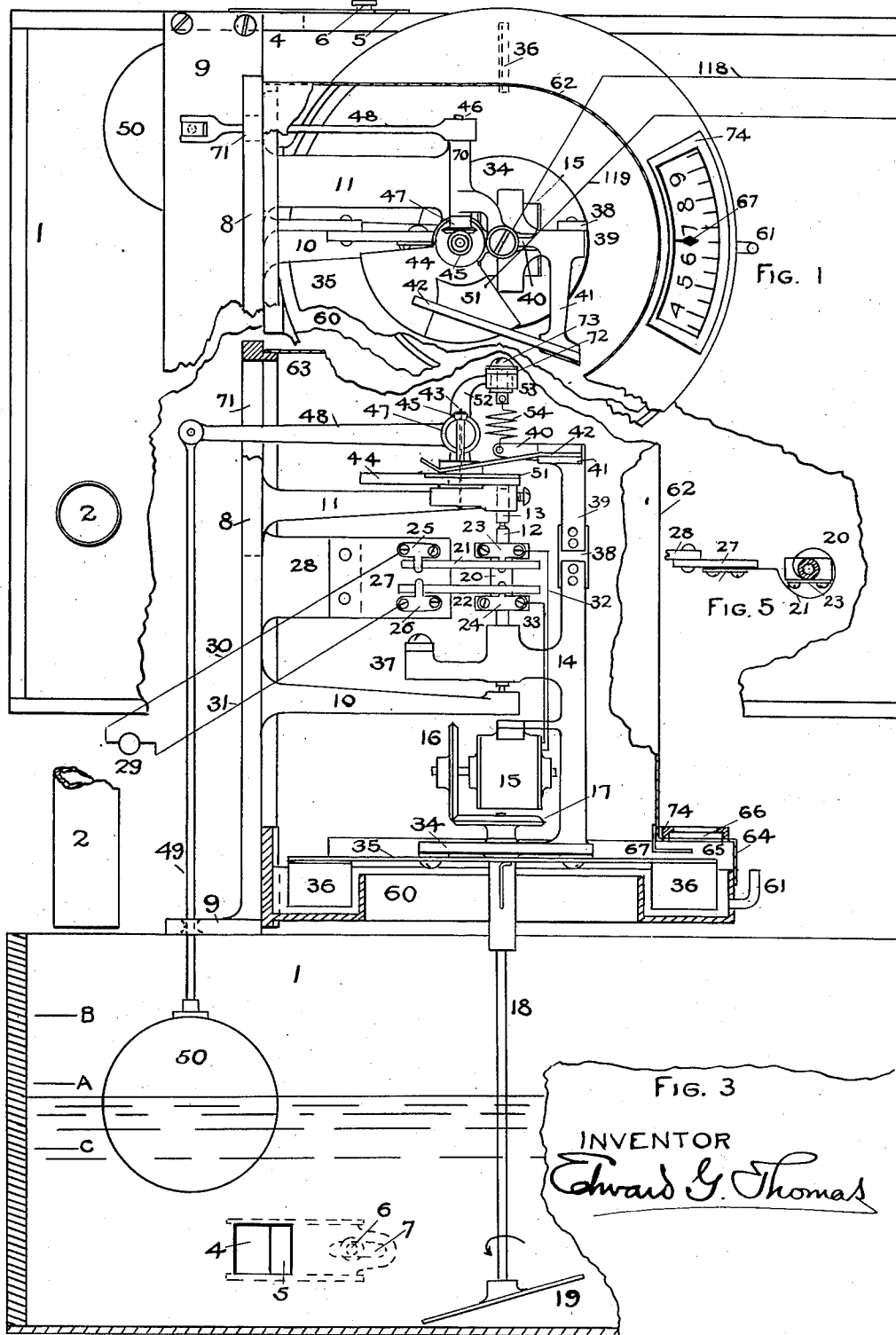
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1,961,178

WEIGHT CONTROLLING APPARATUS

Filed Oct. 23, 1931

3 Sheets-Sheet 1



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3 Sheets-Sheet 2

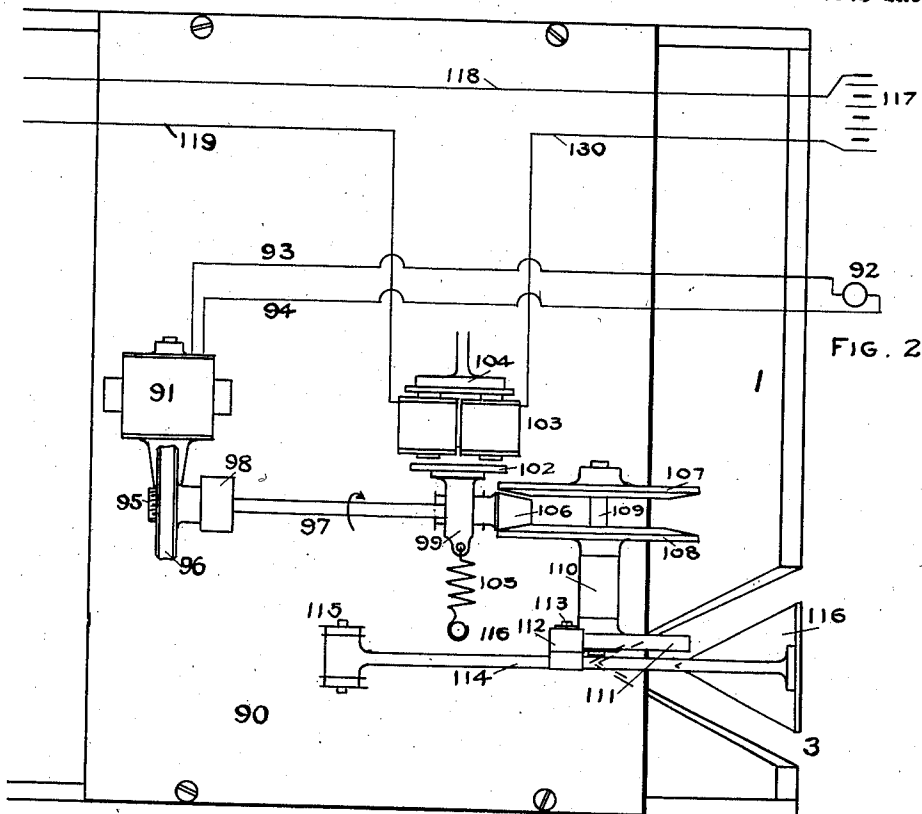


FIG. 2

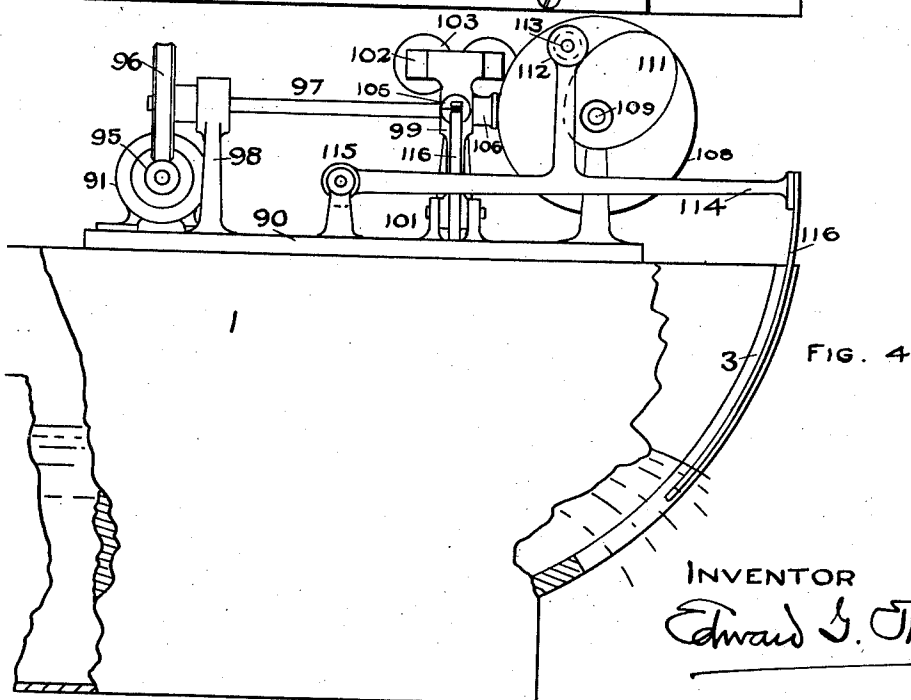


FIG. 4

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June 5, 1934.

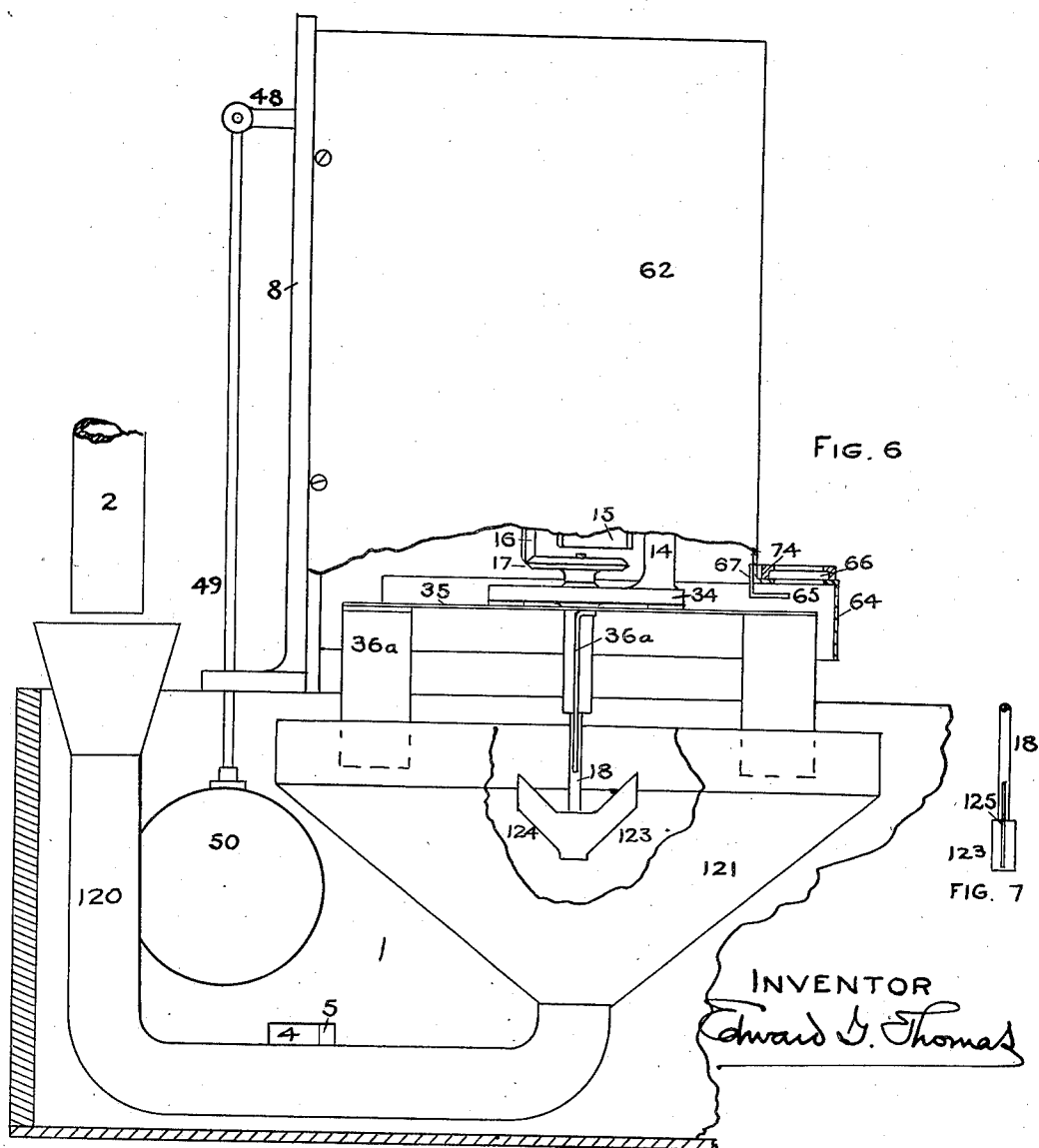
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UNITED STATES PATENT OFFICE

1,961,178

WEIGHT CONTROLLING APPARATUS

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deceased

Application October 23, 1931, Serial No. 570,648

18 Claims. (Cl. 92—46)

My invention is an improvement in mechanism for controlling the flow of mixtures of solid material and a liquid from a feed tank and its object is to provide means for automatically delivering a predetermined weight of the solid material per unit of time even though the percentage of solid material in the mixture is variable. It is particularly applicable to the control of the flow of stock to the wire or cylinders of machines for making paper or similar products in which it is important that the weight of the finished product per unit of area shall be uniform and equal to a standard and my device will be described as applied to the paper machine.

Preferred forms of my invention are shown in the drawings which accompany and form a part of this specification and in the drawings and in the specification similar figures refer to similar parts.

In the drawings, Fig. 1 is a plan view, with some parts broken away, of the left hand end of a feed tank equipped with my apparatus.

Fig. 2 is a plan view of the right hand end of the equipped feed tank and if the left side of the figure is placed in juxtaposition to the right side of Fig. 1 the combined figures constitute a plan view of the entire apparatus.

Fig. 3 is an elevation of the left hand end of the equipped feed tank with some parts broken away and some parts in section.

Fig. 4 is an elevation of the right hand end of the equipped feed tank and if the left side of this figure is placed in juxtaposition to the right side of Fig. 3 the combined figures constitute an elevational view of the entire apparatus. Some parts of Fig. 4 are broken away.

Fig. 5 is a plan view of a spiral spring, used in the device, with the parts to which it is attached.

Fig. 6 shows the apparatus used in connection with a rising column of the mixture.

Fig. 7 is a side view of a stirring device shown in Fig. 6.

In a paper mill a supply of the mixture of solid material and water, which is fed to the paper machine and which is ordinarily termed "stock", is commonly held in a tank, termed the "Jordan chest", from which it is pumped by a circulating pump to an elevated feed tank, termed the "stuff box". The volume of stock so pumped is in excess of the amount fed to the paper machine, the surplus running out of an overflow opening in the stuff box into pipes by which it is carried back to the Jordan chest.

My apparatus comprises a tank 1 which consti-

tutes the stuff box of the installation. It is arranged to receive stock through a supply pipe 2 from the circulating pump and is provided with an overflow opening 3. This opening is shown of triangular shape, but may be rectangular or other shape if a large overflow must be accommodated. In the side of tank 1 is a feed opening 4 through which stock passes to the paper machine. The area of feed opening 4 may be increased or diminished by a slide 5 arranged to cover any desired portion of opening 4 and which may be secured in any position by a thumb screw 6 passing through a slot 7 in the slide.

A vertical base plate 8 having a horizontal flange 9 is mounted on tank 1 and secured thereto. Two arms 10 and 11 project horizontally from base plate 8 and a vertical shaft 12 is pivoted between them in a step bearing in arm 10 and a bearing 13 vertically movable in arm 11. A frame 14 is secured to shaft 12 and carries a motor 15, which, through miter gears 16 and 17 drives a vertical shaft 18, pivotally mounted in frame 14 and carrying a stirrer 19 at its lower end. The stirrer shown consists of a circular plate inclined to its plane of rotation.

An insulating block 20 is also secured to shaft 12. Its central portion is cylindrical and its ends rectangular. Two spiral springs 21 and 22 surround the central portion of block 20 and their inner ends are firmly held against the block 20 by the finger-like projections of metal clips 23 and 24 fastened to block 20 by screws. The outer end of springs 21 and 22 are similarly held by metal clips 25 and 26 secured to an insulating block 27 mounted on a bracket 28 projecting from base plate 8.

Electrical current for motor 15 is furnished by a source of electricity 29 through wires 30 and 31, clips 25 and 26, spiral springs 21 and 22, clips 23 and 24 and wires 32 and 33, the springs constituting a means for carrying the current from the stationary source 29 to the movable motor 15 without friction.

To a flange 34, a part of frame 14, is fastened a circular plate, graduated on its top surface, to which are secured downwardly projecting vanes 36, 36. A counterweight 37 is secured to frame 14 to bring the center of gravity of the frame and attached parts as closely as possible to the center line of shaft 12, thus lessening friction in bearing 13.

A block of insulating material 38 is secured to the upper end of frame 14 and to this is fastened a metal bracket 39. This bracket includes an arm 40 which projects to the axis of shaft 12 and

a member 41 projecting forward to which is secured a light and elastic contact brush 42. On a stud 43 secured to a boss on arm 11 is pivoted a sector 44 of insulating material and a bevel pinion 45 fastened to the sector. A shaft 46 pivoted in a boss 70 on arm 11 carries a bevel gear 47 arranged to mesh with pinion 45 and a lever 48 extending through a slot 71 in base plate 8. The outer end of lever 48 is pivotally attached to a vertical rod 49 which is secured to a float 50 located in tank 1, rod 49 being guided by passing through a hole in flange 9. A metal contact plate 51 is inserted in sector 44 flush with its upper surface and said upper surface is located so as to register with the contact point of brush 42.

Arm 11 also carries an upwardly projecting arm 52 having a boss 53 located in the axial line of shaft 12. Through an insulating bushing 72 there passes a headed stud 73 and through its lower end a hole is drilled. A similar hole is drilled in arm 40 and a helical spring 54 is hooked into these holes. The head of stud 73 is provided with a screw-driver slot and by turning the stud a torsional strain is set up in spring 54, tending to rotate frame 14 and attached parts.

At the bottom of base plate 8 is located an annular trough 60 concentric with shaft 12 and of such dimensions that vanes 36, 36, which dip into the trough and which closely fill its interior section, can rotate freely within it. A pipe 61 communicates with the interior of trough 60 and enables it to be filled with water, oil or other fluid.

The apparatus thus far described is to a large extent enclosed by a cover 62 which registers with and is secured to a flange 63 on base plate 8. In a horizontal protrusion 64 of cover 62 an opening 65 is cut and covered by a glass plate 66 and a glass retainer 74. A fixed indicator 67 projects over the graduations on the top surface of plate 35 and appropriate readings of the relation of the graduations to indicator 67 can be made through the opening.

On the right hand end of tank 1 is located a base plate 90. A motor 91 is secured thereto and receives electrical current from a source of energy 92 through wires 93 and 94. A worm 95 on the motor shaft drives a worm wheel 96 on a shaft 97 pivotally mounted in a stationary bracket 98 and in an armature lever 99 pivoted in lugs 100 and 101 on base plate 90, the bearings being sufficiently loose to permit a slight horizontal movement of the upper end of armature lever 99. An armature 102 is fastened to armature lever 99 and an electromagnet 103 is mounted on a bracket 104 projecting upward from baseplate 90 in such a position as to tend when energized to move armature 102 and the upper end of armature lever 99 in a horizontal direction. A helical spring 105 connecting armature lever 99 and a stud 116 mounted on baseplate 90 tends to move the armature lever and armature in the reverse direction.

On the end of shaft 97 is a friction wheel 106 arranged to contact with one or the other of two friction discs 107 and 108 secured to shaft 109 rotatably mounted in bearing 110 and carrying a cam 111. When the magnet 103 is energized it will pull armature 102 and armature lever 99 toward itself and force wheel 106 into contact with friction disc 107; when deenergized spring 105 will pull armature lever 99 in the reverse direction and force friction wheel 106 against disc 108, thus reversing the direction of rotation of shaft 109 whenever magnet 103 is energized or deenergized. A roller 112 rotatable on a stud 113 secured in a boss on lever 114, pivotally mounted

on baseplate 90 at 115, registers with the working surface of cam 111 and lever 114 will be raised or lowered as the cam rotates in one direction or the other. Lever 114 carries a gate 116 located in the overflow opening 3 of tank 1 and approximately conforming to its shape. Gate 116 is designed to offer an obstruction of greater or less degree according to its position, to the flow of stock through the overflow opening 3.

The circuit of electromagnet 103 includes wire 130, a source of current 117, wire 118, stud 73, spring 54, arm 40, bracket member 41, brush 42, contact plate 51, wire 119 and magnet 103 and this circuit will be closed and the magnet energized whenever brush 42 and contact plate 51 are in such relative positions as to contact with one another and the circuit will be open when brush and plate do not touch.

It has been stated in this specification that the purpose of my invention is to deliver to the paper machine in the stock a predetermined and definite weight of solid material per unit of time notwithstanding variations in the proportion of solids and liquid in the stock. I will assume for example that it is desired to make in one hour 6000 running yards of dry paper weighing one-quarter pound per running yard. This will require that solids be supplied to the machine at the rate of 1500 lbs. per hour. If we assume that the stock contains 3% solids it will be necessary to deliver stock at the rate of

$$\frac{1500 \times 100}{3} = 50000 \text{ lbs. per hour.}$$

If the percentage of solids is 2.9% the rate will be

$$\frac{1500 \times 100}{2.9} = 51779 \text{ lbs. per hour}$$

and if the solids rise to 3.1% the rate will be

$$\frac{1500 \times 100}{3.1} = 48387 \text{ lbs. per hour.}$$

My apparatus therefore is planned to find out the proportion of solids to liquid in the stock and adjust the flow from the stuff box to correspond. The flow of a liquid through an orifice depends on the area of the orifice and the hydraulic head and my apparatus can be used to change either of these factors and thus vary the flow to correspond to variations in the proportions of the stock, but I prefer to accomplish the desired result by varying the hydraulic head and my apparatus is so illustrated.

In operation, slide 5 is set so as to make the area of opening 4 of proper size to permit the stock to flow from tank 1 at exactly the desired rate when the stock has a standard percentage of solids and the level of the stock in tank 1 is at a standard point, marked "A" in Fig. 3, this point being midway between the highest level, marked "B", and the lowest level, marked "C", for which the apparatus is built. Settings of slide 5 will be the result of experimentation in which the settings are noted and marked which permit definite quantities of stock to flow out in a unit of time under standard conditions.

The stock will offer resistance to the turning of stirrer 19 and its rotation by the motor 15 in a clockwise direction as viewed from above will create an equal rotational force in the opposite direction in motor 15 and frame 14 to which it is secured. Since frame 14 is delicately pivoted in arms 10 and 11, it will be rotated until the twisting of spring 54 by the rotation of arm 40, attached to frame 14, results in a torsional force

in spring 54 equal to the torque tending to rotate the frame 14. The motion of frame 14 will now cease and it will remain in this position as long as the resistance to the turning of the stirrer in the stock remains constant. Should the force necessary to turn the stirrer in the stock increase the frame will move in a counter-clockwise direction until the increased twist in spring 54 again furnishes the necessary force to balance the increased torque. If the force necessary to turn the stirrer decreases the torsional force of spring 54 will exceed the torque tending to rotate the frame 14 and spring 54 will turn frame 14 back in a clockwise direction until the forces balance. Frame 14 and graduated plate 35 attached thereto will therefore occupy, when the apparatus is in operation, a rotational position dependent on the resistance offered by the stock to the turning of the stirrer and since it is found that the resistance offered by the stock to the turning of the stirrer at a standard rate varies closely as the percentage of solids in the stock varies the angular position of frame 14 and the reading of the graduations on plate 35 may be used to indicate the percentage of solids. Since variations in the stock are expected to occur on both sides of the selected standard percentage of solids it will be convenient to have the indication representing the standard percentage of solids occupy the center of the angle through which it is planned to permit frame 14 to rotate and an adjustment to bring this about may be made by turning stud 73 and thus changing the position of the normally stationary end of spring 54. It is not contemplated to use a rotational angle much exceeding 90 degrees.

Since the resistance of the stock to the turning of the stirrer will be more or less irregular, quick back and forth oscillations of frame 14 may be objectionable. Under such conditions trough 60 will be filled with water, oil or other fluid which will offer a yielding resistance to movements of vanes 36, 36, thus damping the oscillations of plate 35, frame 14 and attached parts.

In Figs. 1 and 3 the apparatus is shown in a median position corresponding to a standard percentage of solids and frame 14 and brush 42 attached thereto occupy their central positions.

Sector 44, pinion 45, gear 47, shaft 46, lever 48, rod 49 and float 50 are so adjusted in relation to one another that the left hand edge of contact plate 51 will be located at the same place as the contact point of brush 42 when the brush is at its median position as above described and the level of the stock in tank 1 is at level "A". The level of the stock, however, which is assumed to have a standard proportion of solids and water, is shown in the drawings to be slightly below level "A", at which it should stand to deliver the correct amount through opening 4. Float 50 is therefore below its median position and sector 44 slightly rotated in a counter-clockwise direction from its central position, so that contact plate 51 will not contact with brush 42, the circuit of magnet 103 will be open and the magnet deenergized.

Under the action of spring 105 friction wheel 106 will now be forced into contact with friction disc 108, turning the disc, shaft 109 and cam 111 in a clockwise direction. As the cam turns roller 112 and lever 114 will be lowered and gate 116 will be lowered into the area of overflow opening 3. It will offer an increasing obstruction to the flow of the stock through the overflow open-

ing and the level of the stock in the tank will rise until the increased hydraulic head can force the surplus stock through the contracted opening. This rise in the stock will raise float 50 and cause a clockwise movement of sector 44 and contact plate 51 and the latter will finally make contact with brush 42 and close the circuit of magnet 103 energizing the magnet. It will attract armature 102 and overcoming the force of spring 105 will force friction wheel into contact with friction disc 107 and reverse the motion of cam 111. The cam now will raise lever 114 and gate 116 and the obstructing effect of the gate will be diminished and the stock will pass more freely through the overflow opening. This will again lower the level of the stock in the tank and cause float 50 to fall, turning sector 44 in a counterclockwise direction and again break the magnet circuit by moving contact plate 51 out of contact with brush 42, thus again reversing the motion of cam 111 and lowering gate 116. Since changes in the proportions of the stock will occur only at a very slow rate, the motion of cam 111 is made a very slow one, but it will be in motion at all times in one direction or the other.

Should the percentage of solids in the stock rise a greater resistance to the turning of the stirrer will occur and cause the counterclockwise rotation of frame 14 and brush 42 to a new position. If the stock is at level 'A' brush 42 will touch plate 51 and close the magnet circuit and raise gate 116, thus lowering the level in the tank. Float 50 will fall with the lowered level and sector 44 will be turned in a counterclockwise direction until contact plate 51 passes beyond brush 42 and thereby breaks the magnet circuit and reverses the motion of gate 116. The level of the stock will therefore be held at the lower level where the decreased hydraulic head will force a sufficiently smaller amount of stock through opening 4 to offset the increased weight of solids in a unit of bulk.

If the percentage of solids becomes less with a correspondingly less resistance to the turning of the stirrer, frame 14 and brush 42 will rotate in a clockwise direction to a new position where the torsional strength of spring 54 and the torque tending to rotate frame 14 balance. This will open the magnet circuit and cause gate 116 to be lowered, raising the stock level in tank 1 until the accompanying rise of float 50 again brings contact plate 51 into contact with brush 42 again closing the magnet circuit and reversing the motion of gate 116. The increased head of the liquid will now force a greater quantity of stock through opening 4 thus compensating for its diminished contents of solids per unit of bulk.

When the contact point of brush 42 and the left hand side of contact plate 51 are at the same angular position the circuit of magnet 103 will be constantly made and broken and the movement of gate 116 constantly reversed. If the brush and plate are in contact and the magnet energized, the gate 116 will rise and the level of the stock in the tank 1 will fall, immediately lowering float 50 which will move plate 51 out of contact with brush 42 and break the magnet circuit reversing the motion of gate 116 and again causing the level of the stock in the tank to rise. This will lift float 50, close the magnet circuit and again lower the stock level, etc. The level of the stock in tank 1 will therefore be stabilized at a definite level for every angular position of brush 42 and frame 14. Since each position of these parts depends on the percentage of solids

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in the stock, it will be obvious that my mechanism will hold the level of the stock in tank 1 at a definite point for every variation in the percentage of solids.

5 Since the volume of a liquid passing through an orifice varies in proportion to the square root of the variations in the distance from the center of the orifice to the surface of the liquid, appropriate variations in the level of the stock in tank
10 1 for variations in the percentage of solids will be proportional to the squares of the percentages. For instance, hydraulic heads for percentages of 2.7%, 3.0% and 3.3% will be in the proportion of the squares of these numbers or in the relation
15 of 7.290, 9.000 and 10.390. The difference between the first two numbers is 1.71 and between the last two 1.89. It will therefore be found that the necessary changes in the level of the stock will be progressively greater, for equal angular
20 variations in the locations of brush 42, as the percentage of solids falls and the corresponding head increases. In order to accomplish such a progressive change in liquid level, the axis of rotation of section 44 is eccentric to that of brush
25 42, whereby, starting from their extreme position of counter-clockwise rotation, the rotation of sector 44 through progressively greater arcs will be required to register the contact point of brush 42 and the left hand or contact edge of plate
30 51 for equal arcs of rotation of brush 42, thus producing stability of level at a proper height.

A further correction in the stock level may be made by shaping the contact edge of plate 51 to an appropriate contour, since brush 42 con-
35 tacts with the edge of plate 51 at different distances from the axis of rotation of the plate according to the angular position of brush 42.

The horizontal movement of the stock past a stirrer rotating on a vertical axis may, under
40 certain conditions, cause a rhythmic and disturbing variation in the load of the motor 15 and under such circumstances I prefer to arrange the flow of stock passing the stirrer to be substantially parallel with the axis of rotation of the stirrer, as is
45 shown in Fig. 6. Here the incoming stock from the circulating pump is guided by means of a pipe 120 to the bottom of a riser 121 of conical shape and located in tank 1. The upper edge of riser
50 121 is located above the highest level which the liquid in the tank will attain. The incoming stock will therefore enter the bottom of the riser, pass upward and flow over its edge into the tank. The stirrer 122 shown in Figs. 6 and 7 consists of
55 a central boss 123 and two upwardly inclined wings, 124 and 125. The sloping shape of the wings will assist in clearing the stirrer of any lumps of material which might catch against horizontal arms and be held there by the continually
60 rising current.

Vanes 36a, 36a, attached to plate 35 are made long enough to dip into the stock, which having a vertical-radial motion, will not exert a rotational force on the vanes and parts attached thereto but
65 will damp the oscillations of the vanes, plate 35 and frame 14.

The embodiments of my invention herein described and shown are to be regarded as illustrative only and it is to be understood that the inven-
70 tion is susceptible to variation, modification and change within the scope of the subjoined claims.

Having described my invention, I claim;—

1. A proportion finder for liquid mixtures consisting of a bracket, a frame pivoted in said
75 bracket, a motor secured to said bracket, a stirrer

driven by the motor, and torque-offsetting means connecting said bracket and said frame.

2. A proportion finder for liquid mixtures consisting of a bracket, a stirrer, a motor for driving said stirrer, a frame pivoted in said bracket and carrying said motor, torque-offsetting means connecting said bracket and frame, and indicating means.

3. In a weight controlling device for paper machines, the combination of a source of supply of stock, a mechanism for determining the proportion of solids in the stock, and means for varying the amount of stock fed to the paper machine in accordance with the determinations of said proportion determining mechanism, including means for automatically varying the hydraulic head of the stock flow intermediate the source of supply and the paper machine.

4. In a weight controlling device for paper machines the combination of a source of supply of stock, means for varying the rate of flow therefrom, a proportion finder, and mechanism connecting said means and said proportion finder whereby the action of said means is responsive to the motion of said proportion finder.

5. In a weight controlling device for paper machines the combination of a source of supply of stock, means for varying the rate of flow therefrom, a proportion finder consisting of a bracket, a stirrer, a motor driving said stirrer, a frame pivoted in said bracket and carrying said motor, torque-offsetting means connecting said frame and bracket, and mechanism governed by the relative positions of said frame and bracket for controlling the action of said means for varying the rate of flow from the source of supply.

6. In a weight controlling device for paper machines the combination of a tank, a discharge opening in said tank, and regulating means for varying the hydraulic head in the tank to thereby vary the flow through said discharge opening including a proportion finder composed of a bracket, a stirrer, a motor for driving said stirrer, a frame pivotally mounted in said bracket and carrying the motor, and torque off-setting means connecting said bracket and frame.

7. In a weight controlling device for paper machines the combination of a tank, a discharge opening in said tank, mechanism for finding the proportion of solids in the stock in the tank, and means for varying the hydraulic head in the tank to thereby vary the flow through said discharge opening, said means being responsive to the action of said proportion finding mechanism.

8. In a weight controlling device for paper machines the combination of a tank, a discharge opening in the tank, mechanism for finding the proportion of solids in the stock in the tank, and means for varying the level of the stock in the tank to thereby vary the flow through the discharge opening, said means being controlled in its movements by said proportion finding mechanism.

9. In a weight controlling device for paper machines the combination of a tank, an overflow opening in said tank, and means for varying the flow through said overflow opening in accordance with variations in the proportion of solids in the stock in the tank to thereby vary the level of the stock in the tank.

10. In a weight controlling device for paper machines the combination of a tank having an overflow opening, mechanism for determining the proportion of solids in the stock, means for varying the flow through said overflow opening, and

operative connections between said mechanism and said means for causing said means to be responsive to the action of said mechanism.

11. In a weight controlling device for paper machines the combination of a tank, a discharge opening in said tank, mechanism for finding the proportion of solids in the stock in the tank, a float supported by the stock, and means for varying the hydraulic head in the tank to thereby vary the rate of flow through said discharge opening, said means being responsive to the movement of said proportion finder and to changes in the vertical position of said float.

12. In a weight controlling device for paper machines the combination of a tank, an overflow opening therein, mechanism for finding the proportion of solids in the stock consisting of a bracket, a frame pivotally mounted in said bracket, a stirrer, a motor for driving said stirrer secured to said frame, torque-offsetting means connecting said bracket and frame, a contact brush attached to said frame, a float, a contact member operatively attached to said float and adapted to register with said brush, and an electrically operated device including said contact brush and contact member for varying the flow through said overflowing opening.

13. In a weight controlling device for paper machines the combination of a tank, an overflow opening in said tank, mechanism for finding the proportion of solids in the stock including a pivotally mounted frame, a contact brush attached to the frame, a float, a contact member pivoted on an axis not coincident with the axis of rotation of said frame, operatively attached to said float and adapted to register with said contact brush, and an electrically operated device including said contact brush and contact member for varying the flow through said overflow opening.

14. In a weight controlling device for paper machines the combination of a source of supply of stock, means for varying the rate of flow therefrom, an oscillatable proportion finder, and

mechanism connecting said means and said proportion finder whereby the action of said means is responsive to the motion of said proportion finder, and means for damping the oscillations of said proportion finder.

15. In a weight controlling device for paper machines the combination of a tank, means for causing an upward flow of stock, a discharge opening in said tank, mechanism for varying the hydraulic head in the tank to thereby vary the flow through said discharge opening, and a proportion finder, including a stirrer located in the upwardly flowing stock, adapted to govern said mechanism.

16. In a weight controlling device for paper machines, the combination of a source of supply of stock, a tank receiving the stock from the supply source and having a discharge opening therein, a proportion finder, and means controlled by the proportion finder for automatically varying the rate of flow of stock through the discharge opening by varying the hydraulic head of the stock in the tank.

17. In a weight controlling device for paper machines, the combination of a source of supply of stock, a tank receiving the stock from the supply source and having a discharge opening therein, a proportion finder, means for manually varying the area of the discharge opening, and means controlled by the proportion finder for automatically varying the rate of flow of stock through the discharge opening by varying the hydraulic head of the stock in the tank.

18. In a weight controlling device for paper machines, the combination of a source of supply of stock, a tank receiving the stock from the supply source and having a discharge opening therein, mechanism mounted adjacent the tank for determining the proportion of solids in the stock, and means controlled by such mechanism for automatically varying the level of the stock in the tank to thereby vary the rate of flow of stock through the discharge opening.

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