

Dec. 18, 1951

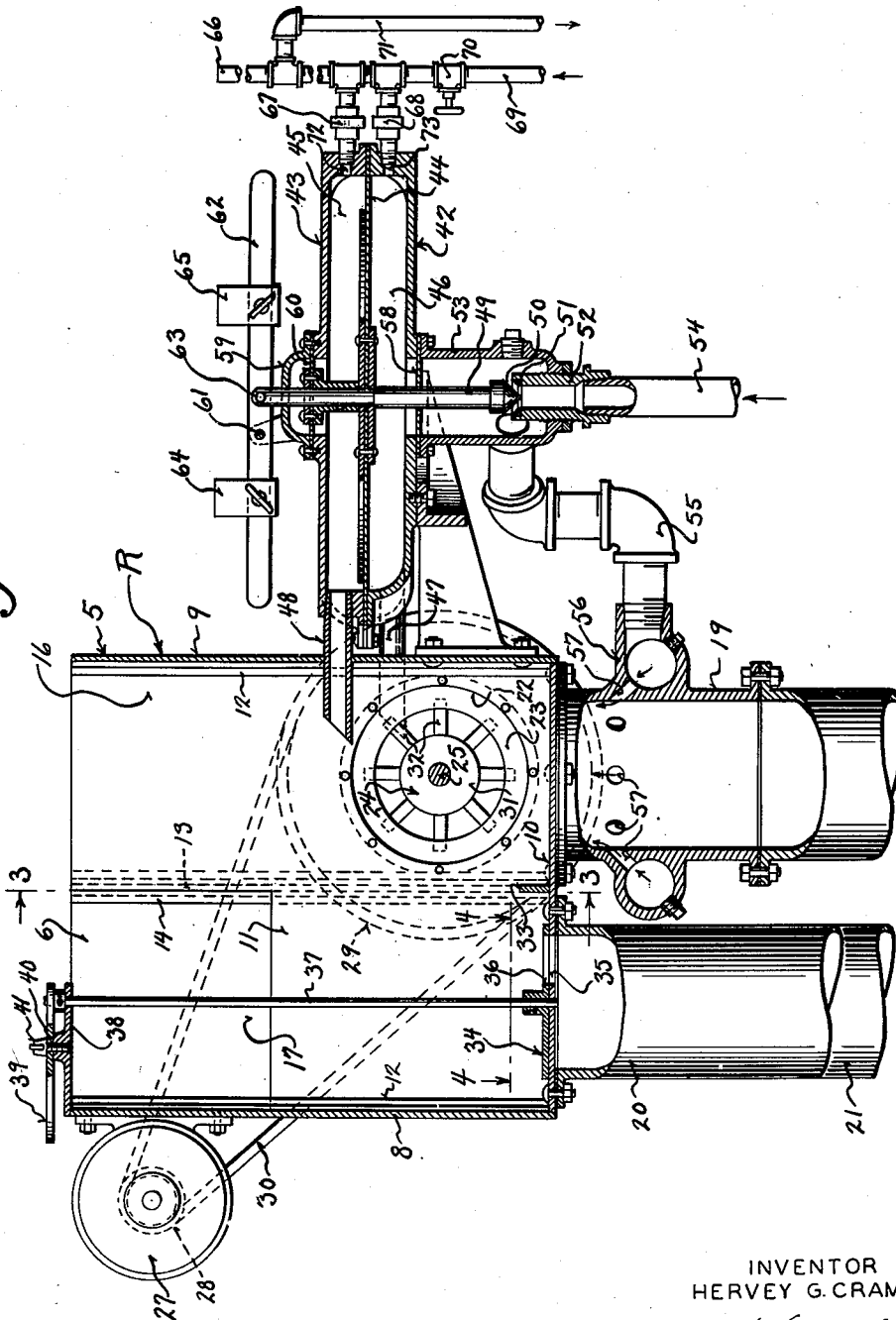
H. G. CRAM  
STOCK REGULATOR

2,579,226

Filed Aug. 26, 1948

3 Sheets-Sheet 1

Fig. 1.



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BY

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ATTORNEYS

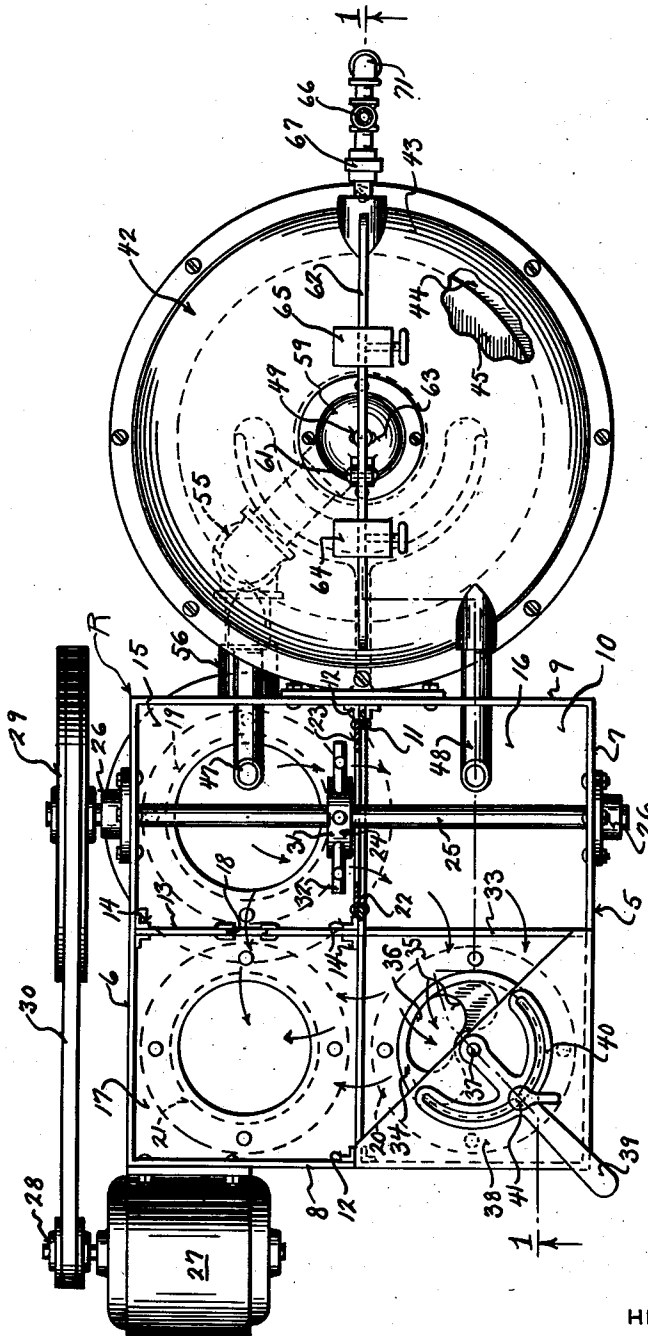
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*Fig. 3.*

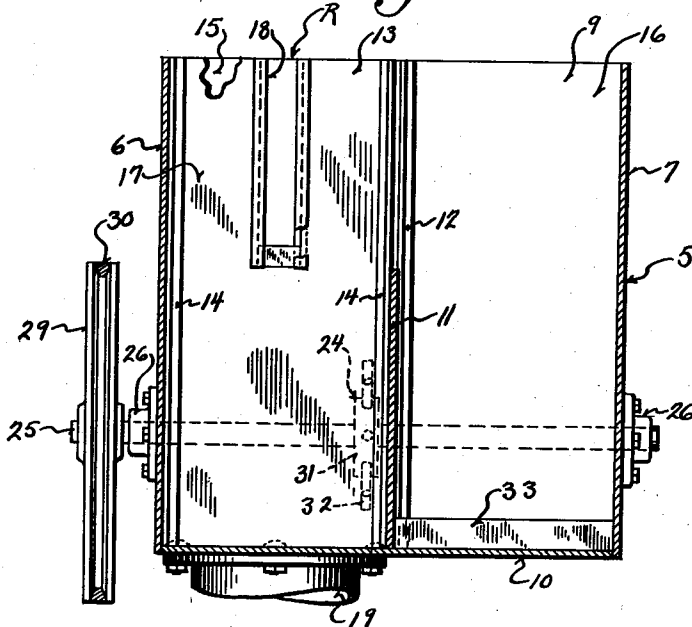
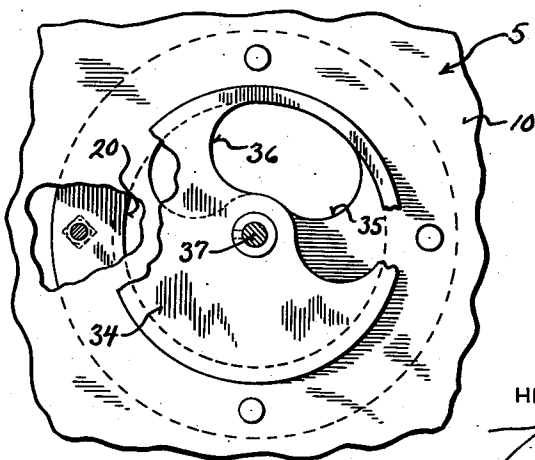


*Fig. 4.*



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## UNITED STATES PATENT OFFICE

2,579,226

## STOCK REGULATOR

Hervy G. Cram, Appleton, Wis., assignor to Combined Locks Paper Co., Combined Locks, Wis.

Application August 26, 1948, Serial No. 46,229

8 Claims. (Cl. 137—78)

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This invention appertains to the manufacture of paper, and more particularly to a novel stock regulator for paper making machines.

In the manufacture of paper, it is essential to deliver to the paper-making machine, a predetermined rate of flow of paper-making solids in liquid suspension (hereinafter referred to as stock), in order to assure a predetermined and constant weight of sheet with relation to the surface area of the sheet.

The disturbing factors which affect the weight of the sheet are, irregularities in the rate of volume flow of the stock; variation in the consistency or percentage of solids in the stock; variations in the speed of the machine, etc.

By far the most difficult of these variables to control is, the rate of flow of the stock, and, the consistency thereof as delivered to the machine.

It is, therefore, the primary object of this invention, to provide a mechanical arrangement which will deliver a predetermined rate of volume flow of stock to the machine, by means of a novel gate mechanism, and to effect a constant weight of paper-making material per unit volume of stock as delivered to and through the gate mechanism by means of the consistency regulating mechanism.

Another salient object of this invention is to provide a stock box having a novel adjustable discharge gate arranged directly in the outlet of the box, whereby the rate of flow of the volume of stock from the box to the paper-making machine can be accurately controlled.

A further important object of the invention is to provide a stock box embodying an inlet chamber and a discharge chamber for stock with a communicating opening therebetween and having located therein a power driven impeller rotating at a predetermined speed functioning to assure thorough mixing of the solids with the dilution water at the communicating opening, which is in fact, the point or medium of regulation, thereby assuring consistency regulation of all the stock passing to the discharge chamber and thence to the paper machine.

A still further important object of my invention is to provide novel means for reflecting the differential in the head of stock in the inlet compartment and in the discharge compartment on a diaphragm, the movement of the diaphragm actuating a valve for controlling the admittance of dilution liquid with incoming stock, whereby the stock can be maintained at a set, desired consistency.

With these and other objects in view, the in-

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vention consists in the novel construction, arrangement and formation of parts, as will be hereinafter more specifically described and claimed, and illustrated in the accompanying drawings, in which drawings:

Figure 1 is a vertical, longitudinal sectional view through my novel stock regulator, taken on the line 1—1 of Figure 2, looking in the direction of the arrows.

Figure 2 is a top plan view of the stock regulator, parts of the figure being shown broken away and in section to illustrate certain structural details.

Figure 3 is a transverse, sectional view through the stock box, taken on the line 3—3 of Figure 1, looking in the direction of the arrows.

Figure 4 is an enlarged, fragmentary detail sectional view, taken on the line 4—4 of Figure 1, looking in the direction of the arrows, illustrating the novel discharge gate.

Referring to the drawings in detail, wherein similar reference characters designate corresponding parts throughout the several views, the letter R generally indicates my novel stock regulator for a paper-making machine. While I have stated that the regulator is to be used in conjunction with a paper-making machine, it is to be understood that the regulator can be used for regulation of stock at any place in a paper-making plant where such regulation is necessary or desirable.

The stock regulator R, includes a stock box 5, preferably located in close proximity to the paper-making machine. The box 5 is arranged in a predetermined manner to form a series of compartments, the purpose of which will later more fully appear. As shown, the box 5 includes side walls 6 and 7, end walls 8 and 9 and a bottom wall 10. Disposed centrally within the box is a vertical partition 11. This partition is preferably held in place by guides 12 secured to the end walls 8 and 9. The box is further divided by a partition or weir 13 mounted in guides 14 carried by the side wall 6 and the partition 11. The partition 11 and the weir 13 divide the box into a stock inlet compartment 15, a stock outlet compartment 16 and an overflow compartment 17. By mounting the partition 11 and the weir 13 in guides, the partition and the weir can be easily removed to permit the cleaning of the box. The weir 13 is provided with an overflow slot 18 and the weir and its slot maintain a predetermined head of stock in the inlet chamber 15. The height of the head of stock in the inlet chamber 15 can be varied by changing the depth

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of the slot 18 in the weir 13. The partition 11 adjacent to the end wall 8, is cut and this part of the partition also forms a weir to allow surplus stock to overflow the outlet chamber 16 and into the overflow chamber 17.

Communicating with the bottom of the inlet chamber 15 is the stock inlet pipe or conduit 19, leading from any suitable source of supply of stock, such as a machine chest (not shown).

Communicating with the discharge chamber 16 adjacent to the end wall 8, is a discharge pipe or conduit 20, leading to the paper-making machine. The overflow chamber 17 has communicating with its lower end, the overflow or return pipe 21, which leads back to the machine chest.

The partition 11 near the end wall 9 and at one side of the weir portion of the partition is provided with a circular orifice 22 for passage of the stock from the inlet compartment 15 to the discharge compartment 16. If desired, the partition can have detachably secured thereto a plate 23, having an orifice therein of a certain definite size, and plates having different sized orifices can be associated with the partition.

An impeller 24 is keyed, or otherwise secured, on a shaft 25 and this impeller is located in the compartment 15, in close proximity to the orifice 22. The shaft 25 is rotatably mounted in suitable bearings 26, carried by the side walls 6 and 7 of the stock box. The shaft 25 is driven by means of an electric motor 27. This motor can be secured directly to the stock box 5, if such should be desired. Any suitable drive mechanism can be employed between the motor and the shaft such as, as shown, a drive pulley 28, a driven pulley 29, and a belt 30. The motor is preferably of the variable speed type and the shaft 25 is driven at a certain predetermined speed best suited for the special character of work being done.

The impeller 24 includes a hub 31 and radially extending arms or blades 32. The arms or blades are preferably flattened on one side. A low weir 33 is provided transversely across the compartment 16 between the shaft 25 and the discharge pipe 20. This weir merely acts to prevent the too rapid flow of the stock from the orifice 22 to the discharge pipe.

Attention is now directed to the novel gate 34 employed for regulating the flow of volume of stock from the box, and this gate is disposed directly above the discharge pipe 20. The lower wall 10 of the box 5 has formed therein an arcuate discharge orifice 35. The gate 34 is in the nature of a flat disc and can fit directly against the bottom wall. This gate is provided with a discharge orifice 36, which is of the same size and shape as the orifice 35 in the bottom wall. When the opening or orifice 36 completely registers with the opening or orifice 35, full flow of stock from the discharge chamber is had and movement of the gate from this position will close, or partially close, the active size of the orifice 35. Any preferred means can be provided for rotating the gate 34 and, as shown, the gate is keyed to an operating shaft 37. The shaft 37 is journaled in the lower end of the box and in a bracket plate 38 at its upper end. This bracket plate 38 can be secured directly to the box 5. Keyed, or otherwise secured, to the upper end of the shaft 37 is a manipulating lever 39 and obviously, by moving the lever the shaft will be turned and the gate 34 therewith. The lever is preferably located in a certain selected, predetermined position and a scale plate (not shown) can be provided for indicating the position of the

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gate. As shown, the lever 39 has formed thereon or secured thereto, a semicircular slotted arm 40, and a winged screw 41 extends through the slot into the bracket plate 38. By tightening the winged screw 41 down against the arm 40 the lever can be held in a selected position against accidental movement. As heretofore stated, any preferred means can be provided for rotating the shaft 37, or actuating the gate 34.

Stock is delivered from the machine chest through the pipe 19 to compartment 15. Stock in compartment 15 is delivered through orifice 22 to compartment 16, thence over the low weir 33 to the gate 34. The gate controls the required rate of volume of flow of stock to the pipe 20 and thence to the paper-making machine.

The high weir part of the partition 11 provides a means for surplus discharge to compartment 17 and thence through the return pipe 21 to the machine chest.

Consistency regulation is based on the differential in head of the stock in compartments 15 and 16, such differential varying with the consistency, in that, the rate of volume of flow through the orifice 22 and the rotating impeller 24 is relative to the consistency of the stock. The impeller also serves the additional purpose of mixing the stock and the dilution liquid, admitted by means, as will now be described.

The admittance of dilution liquid is controlled by the differential of the head of stock in the compartments 15 and 16 and the differential of the head of stock in the compartments actuates a novel control mechanism 42. The control mechanism 42 is provided for the regulation of the consistency of the stock as delivered to compartment 16. The control mechanism includes a diaphragm casing 43 divided centrally by a diaphragm 44 into an upper compartment 45 and a lower compartment 46. Communicating with the lower compartment 46 is a stock inlet tube 47 which communicates with and extends into the compartment 15. Communicating with the upper compartment 45 is an inlet tube 48, which extends into the compartment 16. Secured to the diaphragm 44 for movement therewith is a valve rod 49. The lower end of the valve rod has fixed thereto a valve body 50, adapted to be moved on and off a valve seat 51. This valve seat is carried by the upper end of a tube 52, which is threaded in a valve housing 53, secured to the lower wall of the diaphragm casing 42. By threading the tube up or down, the position of the valve seat relative to the valve body can be accurately set. In threaded union, with the tube 52, is the liquid supply pipe 54 and the valve, of course, controls the flow of this dilution liquid into the valve casing 53. In communication with one side of the valve casing is a liquid conduit pipe 55, and this pipe communicates with an annular manifold 56, which surrounds the stock inlet pipe 19. The manifold 56 is provided with a plurality of inclined inlet ports 57, so that the dilution liquid will be supplied equally around the interior periphery of the pipe 19. This particular dilution inlet forms the subject matter of another application for patent. The valve rod 49 is guided in its vertical movement by a guide plate 58, adjacent to its lower end. This guide plate is held in place by the valve housing 53 and the diaphragm casing 42. The upper end of the valve rod is guided in its vertical movement by a closure cap 59, secured to the upper wall of the diaphragm casing. It is to be also

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noted that the valve rod has also secured thereto a flexible disc 60, which is held in position between the cap 59 and the diaphragm casing and this disc functions to prevent the leakage of material out of the top of the diaphragm casing. Rockably mounted on the cap, as at 61, is a lever 62, and this lever at a point intermediate its ends, is pivotally connected to the valve rod 49 by pivot pin 63. Adjustable weights 64 and 65, are slidably mounted on the lever 62 on opposite sides of the pivot point 61. These weights are adjusted back and forth so as to initially set the valve, for adjustment to effect a required consistency.

The valve rod actuates with a minimum amount of friction and the guides have been so designed as to carry this out.

A stand pipe 66 of a predetermined height is provided and is arranged to one side of the diaphragm casing 42. This stand pipe has communication with the diaphragm chambers 45 and 46 through fittings 67 and 68. Water is supplied to the stand pipe at a predetermined pressure through a water supply pipe 69 and this pipe is provided with a valve 70 in its length to control the amount of flow of water to the stand pipe. An overflow pipe 71 communicates with the stand pipe above the fittings 67 and 68. The purpose of the stand pipe is to maintain a fixed head on the orifices 72 and 73, with which the fittings 67 and 68 communicate and to assure a constant flow of water to and through the top and bottom diaphragm chambers 45 and 46, and the communicating pipe 47 and 48, and to the stock flowing through the inlet compartment 15 and the discharge compartment 16. By having a normally fixed water pressure head on the opposite sides of the diaphragm 44 any change in consistency of stock will be instantly reflected on the diaphragm.

Reflection of the head of stock in compartment 15 to the bottom side of the diaphragm 44 and of the head of stock in compartment 16 to the top side of the diaphragm 44, positions the valve body 50 with relation to the valve seat 51 corresponding with the consistency of the stock passing through the regulator box 5.

Dilution is delivered through valve seat 51 from a fixed head.

The supply of dilution liquid, to and through the valve seat 51, is from a fixed head, as stated, therefore in the closed position of the valve, the upward pressure (tending to open the valve body 50) will be the hydrostatic head in pounds per square inch, times the area of the passage through the valve seat 51 in square inches; therefore, with a zero upward pressure (valve body 50 in wide open position) this upward pressure (resistance to closure) will progressively increase as the valve body 50 approaches the valve seat 51, or toward the closed position.

It will be apparent that in order to operate the valve body 50 through its full range (open to closed position), the effective area of the diaphragm 44 must be such as to effect this result with a comparatively slight change in the differential in head across the diaphragm 44, as reflected from the head in compartments 15 and 16.

The following is an example of one calculation involved in a typical installation:

Dilution supplied to valve seat 51 from a constant head of 6 ft., or 2.58 lbs. per square inch.

Diameter of passage through valve seat 51—1¼" or 1.23 sq. inches in area.

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Therefore: The upward lift on the valve 50 in the closed position would be:

$$1.23 \times 2.58 \text{ or } 3.19 \text{ lbs.}$$

Effective area of diaphragm 44 is 315 square in. Based on a 1" differential in head across the diaphragm, the resultant vertical pressure lift would be  $315 \times .036$  or 11.34 lbs.

Therefore: The required change in differential in head across the diaphragm 44, which is in effect, the change in differential in the heads in compartments 15 and 16 to effect movement of the valve 50 through its complete range, is:

$$\frac{3.19}{11.34} \text{ or } 0.28''$$

It will be obvious from the above that this valve action is compensatory, i. e., the valve 50 cannot over-shoot or under-shoot the requirement of a head (differential) change between the compartments 15 and 16, as:

Assuming 0.28" to be the required increase in head differential between compartments 15 and 16 to close the valve 50, then, a head change of 0.14" would move the valve 50 to the half open position, as:

$$315 \text{ square inches (effective diaphragm area)} \times 0.142 \text{ "H"} = 1.595 \text{ lbs.}$$

Resistance to complete closure of valve 50 due to dilution pressure is 3.19 lbs.

Therefore:

$$\frac{1.595}{3.19}$$

is .5 or the half open position.

In other words, any change in the head differential between compartments 15 and 16, is not only relative to, but is counterbalanced by the equivalent pressure effect of the dilution supply on the valve 50.

Changes in details may be made without departing from the spirit or the scope of the invention, but what I claim as new is:

1. In a stock regulator, a stock box having an inlet compartment, a discharge compartment and an overflow compartment, weirs of a predetermined height between the inlet compartment and the overflow compartment and between the discharge compartment and the overflow compartment, means for supplying stock to the inlet compartment, means for carrying stock from the discharge compartment, means for carrying stock from the overflow compartment to the source of supply, the inlet compartment and the discharge compartment having a communicating orifice, a power driven impeller arranged in close proximity to the orifice, a line for supplying dilution liquid to the means for supplying stock to the inlet compartment, means for regulating the supply of dilution liquid in accordance with the differential in head in the inlet compartment and the discharge compartment, including a diaphragm casing, a diaphragm dividing said casing centrally into an upper and a lower compartment, means connecting the inlet chamber with one compartment, and means connecting the discharge compartment with the other chamber, a valve in the supply line for dilution liquid, and means operatively connecting the valve to the diaphragm for actuating the valve according to the position of the diaphragm in the casing.

2. In a stock regulator, a stock box having an inlet compartment, a discharge compartment and an overflow compartment, weirs of a predetermined height between the inlet compartment and

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the overflow compartment and between the discharge compartment and the overflow compartment, means for supplying stock to the inlet compartment, means for carrying stock from the discharge compartment, means for carrying stock from the overflow compartment to the source of supply, the inlet compartment and the discharge compartment having a communicating orifice, a power driven impeller arranged in close proximity to the orifice, a line for supplying dilution liquid to the means for supplying stock to the inlet compartment, means for regulating the supply of dilution liquid in accordance with the differential in head in the inlet compartment and the discharge compartment, including a valve in the supply dilution liquid line, a diaphragm casing, a diaphragm arranged centrally in said casing dividing the casing into an upper and a lower chamber, means connecting the valve to the diaphragm for movement therewith, means setting up communication between the inlet compartment and the one chamber of the diaphragm casing, and means setting up communication between the other chamber and the discharge compartment.

3. In a stock regulator, a stock box having an inlet compartment, a discharge compartment and an overflow compartment, weirs of a predetermined height between the inlet compartment and the overflow compartment and between the discharge compartment and the overflow compartment, means for supplying stock to the inlet compartment, means for carrying stock from the discharge compartment, means for carrying stock from the overflow compartment to the source of supply, the inlet compartment and the discharge compartment having a communicating orifice, a power driven impeller arranged in close proximity to the orifice, a line for supplying dilution liquid to the means for supplying stock to the inlet compartment, means for regulating the supply of dilution liquid in accordance with the differential in head in the inlet compartment and the discharge compartment, including a valve in the supply dilution liquid line, a diaphragm casing, a diaphragm arranged centrally in said casing dividing the casing into an upper and a lower chamber, means connecting the valve to the diaphragm for movement therewith, means setting up communication between the inlet compartment and the one chamber of the diaphragm casing, means setting up communication between the other chamber and the discharge compartment, and means supplying liquid under a predetermined head to both of said chambers.

4. In a stock regulator, a stock box having an inlet compartment, a discharge compartment and an overflow compartment, weirs of a predetermined height between the inlet compartment and the overflow compartment and between the discharge compartment and the overflow compartment, means for supplying stock to the inlet compartment, means for carrying stock from the discharge compartment, means for carrying stock from the overflow compartment to the source of supply, the inlet compartment and the discharge compartment having a communicating orifice, a power driven impeller arranged in close proximity to the orifice, a line for supplying dilution liquid to the means for supplying stock to the inlet compartment, means for regulating the supply of dilution liquid in accordance with the differential in head in the inlet compartment and the discharge compartment, including a valve in the supply dilution liquid line, a diaphragm cas-

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ing, a diaphragm arranged centrally in said casing dividing the casing into an upper and a lower chamber, means connecting the valve to the diaphragm for movement therewith, means setting up communication between the inlet compartment and the one chamber of the diaphragm casing, means setting up communication between the other chamber and the discharge compartment, means supplying liquid under a predetermined head to both of said chambers, including a stand pipe of a predetermined height, means for supplying water to the stand pipe, and an overflow pipe for the stand pipe.

5. In a stock regulator, a stock box having an inlet compartment, a discharge compartment and an overflow compartment, weirs of a predetermined height between the inlet compartment and the overflow compartment and between the discharge compartment and the overflow compartment, means for supplying stock to the inlet compartment, means for carrying stock from the discharge compartment, means for carrying stock from the overflow compartment to the source of supply, the inlet compartment and the discharge compartment having a communicating orifice, a power driven impeller arranged in close proximity to the orifice, a line for supplying dilution liquid to the means for supplying stock to the inlet compartment, means for regulating the supply of dilution liquid in accordance with the differential in head in the inlet compartment and the discharge compartment, including a valve in the supply dilution liquid line, a diaphragm casing, a diaphragm arranged centrally in said casing dividing the casing into an upper and a lower chamber, means connecting the valve to the diaphragm for movement therewith, means setting up communication between the inlet compartment and the one chamber of the diaphragm casing, means setting up communication between the other chamber and the discharge compartment, means supplying liquid under a predetermined head to both of said chambers, and adjustable weights for controlling the operation of the valve under certain pressures.

6. In a device for regulating the delivery of stock to a paper-making machine of the type having a stock box provided with an inlet compartment and an outlet compartment; means for regulating the flow of dilution liquid to the inlet compartment in accordance with the differential of head of stock in the compartments comprising a casing, a diaphragm sensitive to changes in pressure in said casing dividing the casing into an upper chamber and a lower chamber, means connecting the inlet compartment with one chamber and means connecting the other chamber with the discharge compartment, an inlet pipe for dilution liquid, and a valve secured to the diaphragm for controlling the flow of liquid through said pipe.

7. In a device for regulating the delivery of stock to a paper-making machine of the type having a stock box provided with an inlet compartment and an outlet compartment; means for regulating the flow of dilution liquid to the inlet compartment in accordance with the differential of head of stock in the compartments comprising a casing, a diaphragm sensitive to changes in pressure in said casing dividing the casing into an upper chamber and a lower chamber, means connecting the inlet compartment with one chamber and means connecting the other chamber with the discharge compartment, an inlet pipe for dilution liquid, a valve secured to the diaphragm

for controlling the flow of liquid through said pipe, and means for supplying water of equal pressure to the opposite sides of the diaphragm.

8. In a device for regulating the delivery of stock to a paper-making machine of the type having a stock box provided with an inlet compartment and an outlet compartment; means for regulating the flow of dilution liquid to the inlet compartment in accordance with the differential of head of stock in the compartments comprising a casing, a diaphragm sensitive to changes in pressure in said casing dividing the casing into an upper chamber and a lower chamber, means connecting the inlet compartment with one chamber and means connecting the other chamber with the discharge compartment, an inlet pipe for dilution liquid, a valve secured to the diaphragm for controlling the flow of liquid through said pipe, said valve including a valve rod extending beyond the upper end of the casing, a lever pivoted intermediate its ends to the casing, means pivotally connecting the lever at one side of its pivot to the valve rod, and adjustable weights on

the lever on each side of its pivot movable toward and away from said pivot.

HERVEY G. CRAM.

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