

Aug. 2, 1955

E. A. POIRIER
METHOD AND APPARATUS FOR VOLUME AND CONSISTENCY
CONTROL FOR PAPER MAKING STOCK

2,714,341

Filed Dec. 28, 1950

3 Sheets-Sheet 1

Fig. 1.

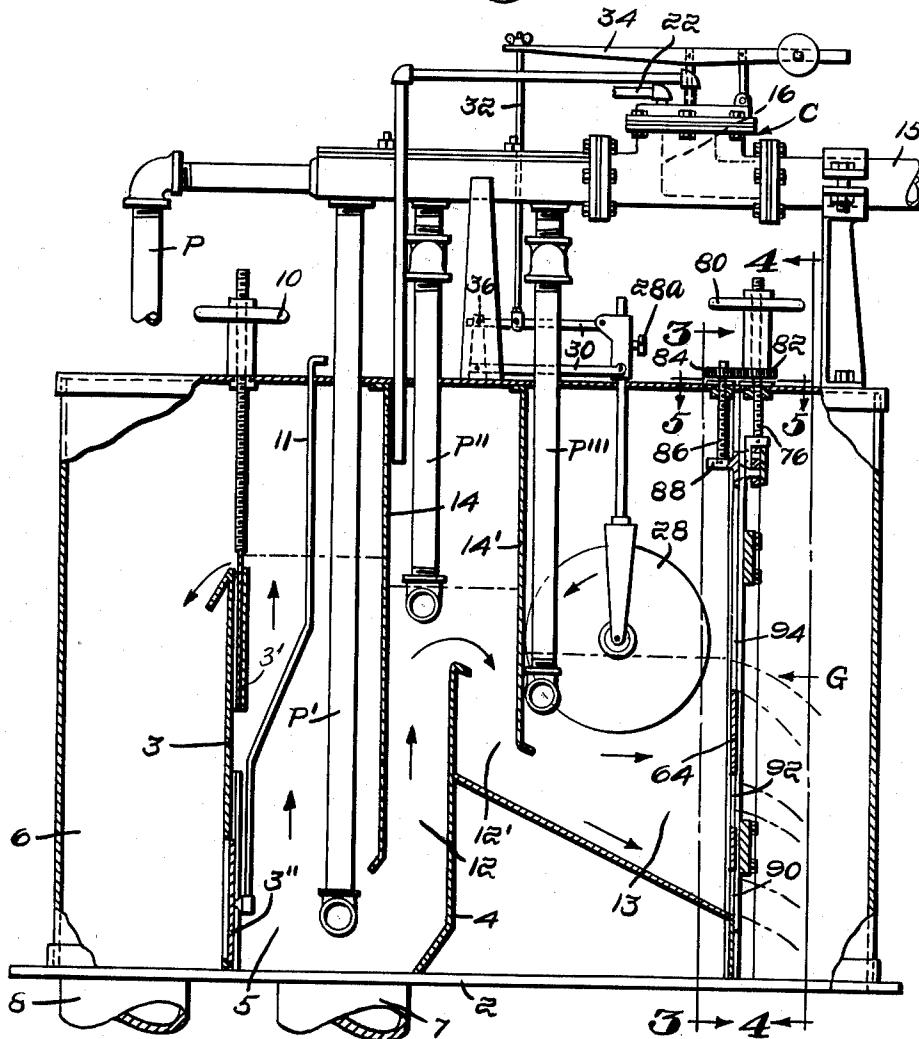


Fig. 5.

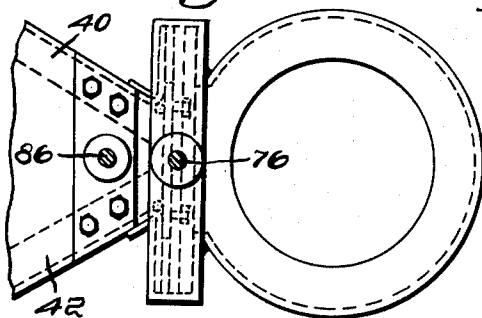
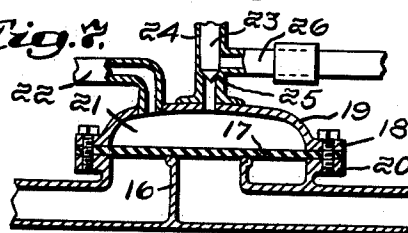


Fig. 2.



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Fig. 2.

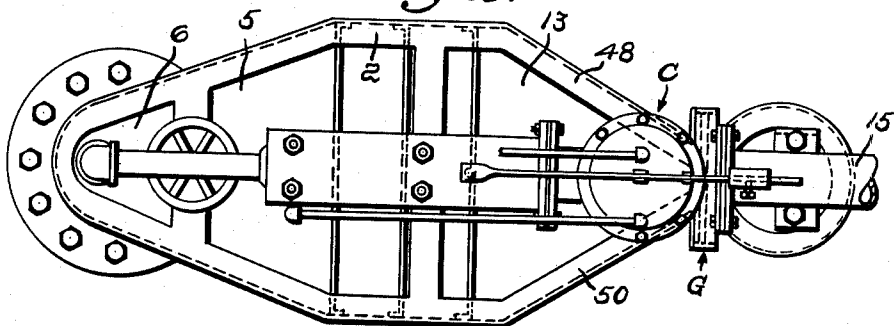


Fig. 4.

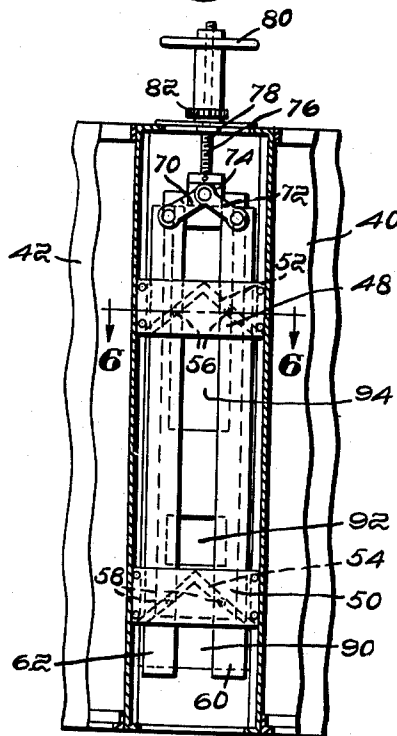


Fig. 3.

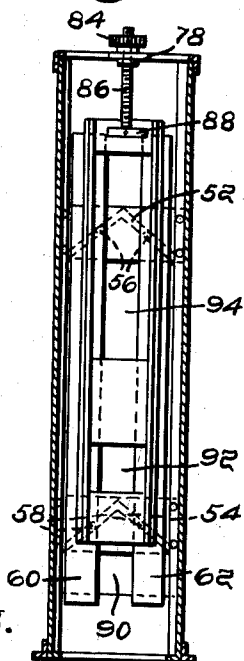
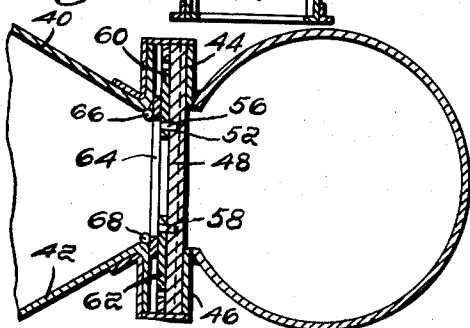


Fig. 6.



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Fig. 9.

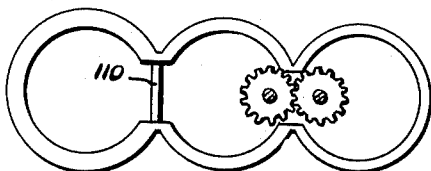
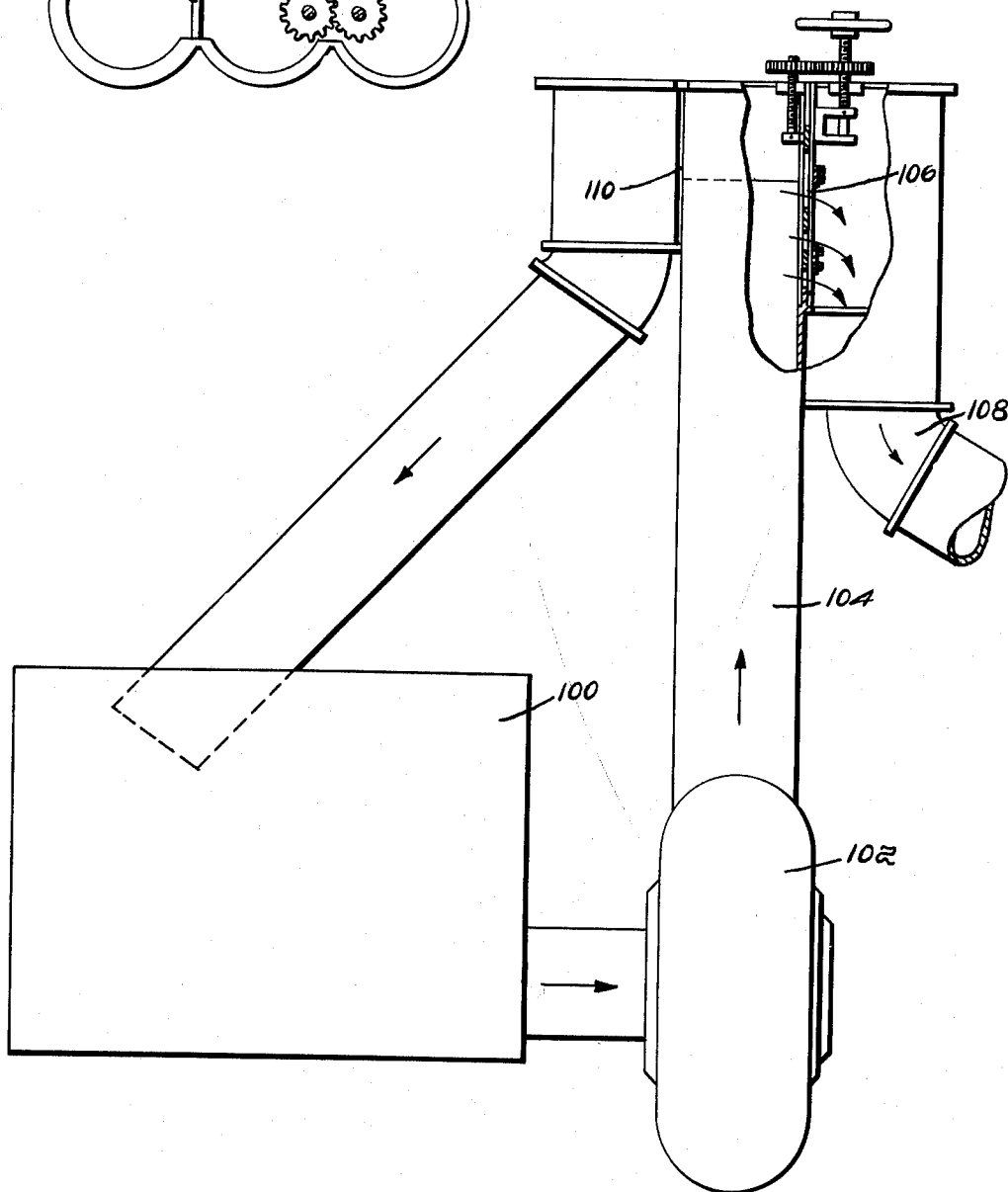


Fig. 8.



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2,714,341

METHOD AND APPARATUS FOR VOLUME AND CONSISTENCY CONTROL FOR PAPER MAKING STOCK

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Application December 28, 1950, Serial No. 203,122

5 Claims. (Cl. 92—46)

In earlier patents I have disclosed various methods and apparatus for treating a stream of paper-making stock to minimize the variations in its consistency, as well as the resultant variations in the weight of solid material which is delivered to a supply point. The present invention is especially concerned with the solution of the problems to which prior methods and apparatus of this general character have been directed and it aims to improve such methods and apparatus with a view to simplifying both. More specifically, the invention aims to devise an improved method of controlling the volume of stock discharged from the stream, which method can be further adapted to provide a means of simultaneously controlling both consistency and volume. It is also an important object of the invention to provide an improved gate mechanism for regulating the flow of a stream of paper making stock and to combine the gate mechanisms with other stock regulating equipment.

These and other objects and novel features will be more fully understood and appreciated from the following description of a preferred embodiment of the invention selected for purposes of illustration and shown in the accompanying drawings, in which

Fig. 1 is a vertical, sectional view of an apparatus embodying features of this invention;

Fig. 2 is a plan view of the apparatus shown in Fig. 1;

Fig. 3 is a vertical, sectional view taken on the line 3—3 of Fig. 1, illustrating a gate mechanism;

Fig. 4 is a vertical, sectional view taken on the line 4—4 of Fig. 1;

Fig. 5 is a fragmentary enlarged plan view of the discharge side of the apparatus shown at the right-hand side of Fig. 1;

Fig. 6 is a plan, cross-sectional view taken on the line 6—6 of Fig. 4;

Fig. 7 is a detailed cross-sectional view of a portion of the control valve mechanism;

Fig. 8 is an elevational view of a modified form of regulator in which the discharge gate mechanism of the invention is employed for the purpose of controlling volume in another way; and

Fig. 9 is a plan view of the structure shown in Fig. 8. Referring first to Figs. 1 and 2, the construction there shown comprises an elongated tank or casing 2 near the left-hand end of the casing. The space in it is partly divided by an adjustable wier structure 3 and by a stationary dam 4 into the tank and overflow compartments 5 and 6, respectively. A supply pipe 7 conducts stock into the former while an overflow pipe 8 carries away the surplus. The wier includes an upper section 3' adjustable by means of the hand wheel 10 and a lower section 3'' which may be raised and lowered by means of a handle 11. The former controls the normal level or head maintained in the supply or intake compartment 5, while the latter is opened only to flush out these sections of the casing.

The compartment 5 forms one section of a conduit which conducts the stock through the entire casing, other elements being two restricted passages 12 and 12' which

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lead the stock into a control chamber 13 from which it may be discharged through the adjustable delivery gate generally indicated by the letter G. The two passages 12 and 12' are conveniently formed by means of two partitions 14 and 14' which are secured to the upper side of the casing and extend downwardly below the dam 4 at either side thereof, as shown in Fig. 1.

Diluting water, which may consist either of clear or "white" water, with certain ingredients added if desired, is supplied to the stream at several points therealong from the pipe 15 shown at the upper right-hand side of Fig. 1. As shown in Figs. 1 and 2, the supply of diluting water is led through the supply pipe 15 which is connected into one side of a control valve, indicated by the letter C. This valve governs the delivery of diluting water in the stream in the tank 2 and includes a special tubular fitting 16 having an upwardly turned end. As illustrated in Fig. 7, the upper end of the fitting 16 is rounded and made smooth to cooperate with a flexible circular diaphragm 17, the margins of which are clamped between the lower face of an annular rim 18 integral with the dome 19 of the valve casing and a similar annular portion 20 of the lower body section of the valve.

Control of the flow of fluid material through this valve may be achieved hydraulically or pneumatically, either liquid or air being conducted into the chamber 21 above the diaphragm 17 by means of a pipe 22. This fluid is under pressure and the degree of such pressure utilized is controlled by a pilot valve 23 slidable in the valve casing 24 mounted on top of the dome 19. The tapered end of this valve 23 cooperates with a correspondingly tapered seat 25 to control the escape of fluid from the dome 27 and into the exhaust or discharge pipe 26. Preferably water is used for this purpose, a very small quantity being required. Consequently, the discharged water is delivered into the casing 2 at the point indicated in Fig. 1.

In accordance with the invention the operating movement of the valve plunger 23 may be produced by a float 28, Fig. 1, which is supported in the stream of paper making stock in the control chamber 13. The stem of this float may, for example, be connected through parallel motion levers 30 and rod 32 with a yoke 34 adjustably secured to valve 23, as shown in Fig. 7. The upper of the levers 30 is fulcrumed at 36, Fig. 1.

Consequently, as the diluting water is led through the pipe 15 from a source under sufficient pressure to make it overflow the upper end of the fitting 16, the float 28 will be raised, if the level of the stock in the control chamber 13 is sufficiently high, thus seating the valve 23 and preventing the escape of fluid from the dome 19. Pressure then builds up in the dome to the full value in the pipe 22, which should be made sufficient to hold the diaphragm 17 seated firmly on the upper end of the fitting 16 at this time. It thus prevents the flow of additional water into the casing 2. When, however, the level of the stream in the chamber 13 drops, the float also will drop, thus cracking the valve 23 open slightly and allowing some escape of fluid from the dome 19. This reduces the pressure on the diaphragm 17 and when that pressure is overcome by the pressure in the supply pipe 15 the diaphragm will be lifted sufficiently to permit a controlled flow of diluting water through the pipes P, P', P'', and P'''.

It will be seen that by retarding the flow of stock from the control chamber 13 by means of a discharge port of limited size, and by causing a resistance to the flow of stock as it enters the control chamber 13, there will result a series of different hydrostatic levels to which succeeding portions of the stream will rise. In Fig. 1 several different levels of this character have been indicated by dot and dash lines, as shown in compartment

5; in restricted passageway 12; and in chamber 13, the direction of flow being indicated by the arrows.

It will also be apparent that the hydraulic head of stock in the inlet compartment 5 and the size of the discharge port means may be so adjusted that the level of the stock in the control chamber 13 and, consequently, the hydrostatic pressure which forces the stock through the discharge port, will vary inversely with changes in consistency of successive portions of the stock flowing through the apparatus. This, of course, is due to the fact that as consistency increases, i. e., as the stock becomes heavier, the resistance to its flow through the restricted passages 12 and 12' will also be increased and the level of stock in control chamber 13 will drop, thus producing less hydrostatic pressure to force stock through the discharge port means. On the other hand, if the consistency decreases, i. e., becomes lightened, the flow assumes more nearly the nature of water. The resistance in the restricted passages decreases and the level of stock in the control chamber 13 rises, thus producing greater hydrostatic pressure to force stock through the discharge port means.

Since there is to be expected a more or less constant change in consistency of the stock entering into the pipe 7, the weight of solids actually delivered through the discharge port means varies materially and obviously may depart from delivery of a desired constant weight of material which should go into the formed web or sheet of paper. It is highly desirable for this reason to provide an automatic weight regulation of stock. Some regulation is, as noted above, automatically achieved by increase or decrease in hydrostatic pressure in the chamber 13 resulting from change in the hydrostatic level which varies the pressure forcing material out, but it is found that the change in volume of stock forced through the discharge port in this way is not sufficient to produce a correct weight regulation.

While it is possible to use hand operated adjusting mechanism for discharge ports to change the volume of stock delivered at any given time, it will readily be appreciated that to attempt to make such changes by hand from one time to another as consistency changes develop in the flowing stock, would scarcely be feasible or practical from an economic standpoint.

In order to overcome this difficulty, therefore, I have devised a special method and structure for discharging stock so as to produce an automatic weight regulation based upon changes in hydrostatic level of the stock. The gate structure is best shown at the right-hand side of Fig. 1 and also in Figs. 3 and 4. As there illustrated the casing 2 is provided with a pair of converging side wall portions 40 and 42 to which is secured a gate frame made up of upper channeled sections 44 and 46. Solidly mounted in the channel sides at the front thereof, as viewed in Fig. 4, are two transverse plate members 48 and 50, one of which is better shown in cross-section in Fig. 6. As noted in the latter figure, the inner surfaces of the plates 48 and 50 are formed with respective diagonally extending slots 52 and 54, in which are transversely disposed keys 56 and 58.

Mounted for sliding movement against the plates 48 and 50 are two outer panel sections 60 and 62 which are formed with two diagonal slots coinciding with the slots 52 and 54 and adapted to slidably engage with the keys 56 and 58, as suggested in Fig. 6. An inner panel 64, better shown in Fig. 6, is also mounted in the frame for vertical slidable movement relative to the panel sections 60 and 62, and being held and guided in the channel members by means of bars 66 and 68 which lie closely adjacent to opposite inner edges of the channel sections, as suggested in Fig. 6.

The outer panel sections 60 and 62 are normally located in a spaced-apart position, such as that shown in Fig. 4, and at their upper ends are provided with a pair of pivoted links 70 and 72 carried in a threaded block

74 in threaded engagement with a screw member 76 which extends through a top frame plate 78, as illustrated in Fig. 4.

The screw member 76 may be rotated by a handle 80. Fixed on the upper end of the screw member 76 at a point above the top frame plate 78 is a gear 82 in mesh with a second gear 84 carried by a second screw member 86. The latter member is rotatably received through an extension of the top frame plate and has its lower end threaded into a bracket 88 which is, in turn, bolted to the inner panel section 64.

With the aid of the double screw arrangement it will be evident that by rotating the handle 80 in one direction or the other, the outer panel sections 60 and 62 may be raised and lowered, and simultaneously are guided toward and away from one another by the keys 56 and 58 acting in the slotted portions of the panels. Also, at the same time, the inner panel section 64 will be moved by the screw 76 in an opposite vertical direction to the direction of vertical movement of the panel sections 60 and 62.

In the fully opened position of the several panel sections illustrated in Fig. 4, these members provide a bottom discharge port 90, a second discharge port 92 located above the first port, and an overflow port 94 located at still a higher level and extending above the hydrostatic level of stock in the control chamber 13. When the outer panel sections 60 and 62 are raised by means of the handle 80, they move toward one another, decreasing the width of the overflow port 94 and thus limiting the volume of overflow from the hydrostatic head in control chamber 13. Simultaneously the inner panel section 64 is moved downwardly to decrease the height of the discharge ports 90 and 92.

The effect of this dual movement is to both reduce the size of ports 90 and 92 and also to maintain a substantially square shape in the areas included by the discharge ports 90 and 92. This square shape better allows the stock to flow through the relatively decreased discharge areas without the likelihood of material stagnating or clogging, as might be the case if the areas were comprised by much higher but narrower shaped discharge ports. It is pointed out that at the overflow opening 94 movement of gates toward and away from one another changes the size of the opening 94 in width only, its height remaining the same.

As noted above, the opening 94 extends well above the level of fluid material indicated in dot and dash lines in control chamber 13. It will thus be apparent that if stock is flowing through the discharge ports 90 and 92 and a change of consistency takes place, resulting in an increase in the hydrostatic head of the fluid in the chamber 13, it is possible to produce an overflow of material between the outer panel sections 60 and 62 in an amount which varies with the spacing between these members.

Consequently, by regulating their spacing for a desired consistency it is readily possible to provide for automatic delivery of a varying volume of stock which supplements the volume discharged from ports 90 and 92 to deliver a total amount of solids normally required. There is thus produced an automatic weight regulator which will deliver a substantially constant weight of solid material as the level of the stock in the chamber 13 rises and falls as a result of changes in consistency in the material being delivered into that chamber.

In thus carrying out weight regulation it should be understood that the discharge outlets 90 and 92 deliver varying amounts of material in accordance with the hydrostatic pressure which is exerted on the liquid flowing through these ports. However, this varying pressure is not sufficient to furnish delivery of the required amount of solid material, and the spacing of the overflow opening 94 is so chosen as to cooperate with these two discharge ports and furnish an additional volume of

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gallorage which, at a point of proper adjustment, will give a correct weight of solids regardless of the changes which may take place in the consistency of the stock.

In conjunction with the above described automatic weight regulation, there may also be carried out simultaneous regulation of the consistency of the stock so that both operations are effected without interference of one with the other as the required changes take place. Consistency regulation by means of the above noted apparatus will now be described.

As stock enters the inlet pipe 7 it overflows the adjustable dam 3 in compartment 5 with a part of the stock flowing upwardly in the restricted area between the partitions 14 and 4, and then downwardly between the members 14' and 4, with the restricted areas causing the stock to assume a hydrostatic level in compartment 12 which is somewhat lower than the hydrostatic level in compartment 5. Since there is a continuous flow of stock into the chamber 13 and out through the discharge ports described, there will be formed another hydrostatic level in chamber 13 slightly lower than the level in the restricted area 12. It will be obvious that if the discharge ports were closed the levels in all three compartments would equalize.

Assuming that the stock is at a relatively heavy consistency, dilution water is introduced through the pipes P, P', P'' and P''' from the supply pipe 15 and the valve C. These pipes operate to furnish dilution water at four points at once, including the overflow compartment 6, the inlet compartment 5, the restricted compartment 12, and the control chamber 13.

When stock enters the inlet 7 at a lighter consistency, the frictional action, namely wall friction and internal friction, of each fiber twisting its way through the restricted chambers 12 and 12' becomes less and less and increases the velocity flowing through said restricted area, and the level or hydrostatic head in chamber 13 rises and causes a displacement of the float 28. The latter member rises and shuts off the supply of dilution water through its arrangement of pilots connected to the hydraulic valve. This immediately retards the dilution water and the stock becomes heavier in consistency. The velocity then decreases, going through the restricted passage, and the float adjusts itself with the level in chamber 13 to maintain proper dilution for the required consistency.

It is pointed out that the consistency regulator may be adjusted to any desired point of consistency by raising or lowering the float through its adjusting stem and wheel 28a shown in Fig. 1. An important feature of the consistency regulator of the invention is the multiple distribution of diluting water for any given consistency setting of the float. The distribution points are so arranged that the several points of delivery cooperate with one another and operate to quickly control consistency deviation at specific localized areas where dilution can be most efficiently realized.

The dilution at P is important under almost all conditions of operation and especially so in keeping the stock in the stock chest at a consistency nearest to the point of efficiency of whatever stock pump is being used. It is found that a centrifugal pump delivers a gallonage which depends upon consistency and has a high point of efficiency at one definite consistency value. Therefore, by more continuously maintaining the consistency at that definite optimum consistency value, a more efficient operation may be realized. Certain other difficulties in connection with pumping, resulting from changes in consistency, may similarly be corrected by introducing dilution water from pipe P into the overflow. It will be seen that introducing dilution water from pipe P creates a more uniform head in compartment 6 and aids either a centrifugal pump or a plunger type pump to handle varying consistencies.

The dilution at P', with the arrangement illustrated in Fig. 1, occurs immediately above the inlet pipe 7 and

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is preferably formed with a T-shaped outlet which is so positioned as to prevent stock from forcing itself into the dilution pipe P', and yet permits a better and more efficient mixing action at the point of entry of the stock into the casing.

Dilution pipe P'' is of similar T-shaped outlet construction and is located in the restricted passageway 12 and, here again, provides for a more efficient mixing action taking place concurrently with mixing at other points, so that a more wide spread correction is quickly carried out throughout the region of restriction.

Dilution from pipe P''' is formed with a T-shaped outlet and is so located as to deliver dilution water directly into the control compartment 13 so that a source of correction from dilution water is available precisely at the point where demand for more or less dilution water originates. In this position pipe P''' may deliver dilution water to any low point desired or a point equivalent to the usual or normal consistency.

It should be observed that in the multiple dilution water supply arrangement described, the consistency control is very closely related to the weight regulation control. Since weight regulation is dependent upon the overflow through the port 94, and since the consistency control is also responsive to changes in the same hydrostatic level, operation of one modifies operation of the other, and of course the change acts instantaneously on both controlling agencies.

It should also be noted that the amount of stock flowing from the several discharge gates to some extent controls the stock overflowing the surplus overflow gate 3, therefore making possible a wide variation in production without need for readjusting the height of the overflow gate.

It is intended that the overflow gate mechanism with its adjustable panel sections may be combined with other types of consistency regulators such, for example, as those employing modified forms of restrictors, examples of which have been described and claimed in my earlier patents.

I may also desire to practice the method of the invention and to utilize the gate mechanism with a conduit for conducting a stream of stock in which consistency changes are present in the absence of a special restrictor device, but where a changing hydrostatic level may be produced. Thus, in Figs. 8 and 9 I have shown a stock chest 100 from which stock is discharged to a centrifugal pump 102 and then pumped into the conduit 104 to provide a hydrostatic level which has been indicated in dot and dash lines.

An overflow gate 106 similar to the improved overflow gate of the invention already described is provided at an upper side of conduit 104 and is so arranged that stock from the hydrostatic level will overflow into an outlet member 108. A surplus overflow port 110 returns surplus material to the chest 100.

In this form of the invention the hydrostatic level of stock will rise and fall in the conduit 104 in accordance with changes in consistency of stock pumped upwardly by the centrifugal pump 102. It should be recognized that a centrifugal pump has a maximum efficiency point at which it will provide a substantially constant delivery at one given consistency value. Since the action of the centrifugal pump is to deliver a relatively greater volume of stock at a low consistency than it does at a high consistency, it will be apparent that the level of stock 12 rises upwardly on light consistency and drops down on heavy consistency in substantially the same manner of variation which has been described with reference to the apparatus shown in Figs. 1 to 7, inclusive. Consequently, by properly setting the adjustable panels of the gate 106 in the manner already described, it becomes possible to deliver a varying volume so limited as to produce a net amount of solids in operation. It is pointed out that this is an extremely efficient and simplified form of gate application which, for some types of installation, is highly desirable and economical.

From the foregoing it will be evident that this invention provides a method of weight regulation as well as weight and volume regulation involving the steps of producing a changing hydrostatic level and producing an overflow in response to changes in hydrostatic level and limiting the overflow in a predetermined manner. These operations may be carried out either separately or in conjunction with the step of creating a high degree of internal friction in a confined portion of a stream of stock, and the speed of response of the consistency control is directly related to the same hydrostatic level which is utilized to deliver an overflow for a required volume correction. The method thus described, by reason of its unusually wide range of control, necessarily can be adapted to fluid materials involving mixtures of solids in a liquid vehicle other than those solids commonly employed in the paper making industry. For example, the method may be practiced in connection with mixing solids such as chemical bodies, either in finely divided or fibrous form, or in other conditions of subdivision.

The invention also involves a highly novel gate mechanism, as well as a combination of novel gate mechanism with a multiple diluting water system, and a specific form of restrictor device combined therewith. The scope of the invention, therefore, is to be understood as being limited only by the extent of the claims appended hereto.

What is claimed is:

1. A volume and consistency regulator for paper making material, comprising a casing having a stock inlet compartment and a control outlet compartment through which a stream of paper making material is passed, wiew means located between the inlet compartment and the outlet compartment for restricting portions of the stream and producing a differential in hydrostatic head in the two chambers, said hydrostatic head in the control compartment varying inversely with changes in consistency of the paper making material, means for supplying dilution water to the stream of paper making material, float means operating in response to changes in hydrostatic head to regulate feeding of dilution water from the supply means, adjustable gate means communicating with the control compartment and adapted to provide for discharge of paper making material therefrom, said gate means including inner and outer panel members movable toward and away from one another to define a plurality of discharge ports located one above another, one of said ports occurring at an upper side of the control compartment in a position to define an overflow outlet, and means including screw adjustment members for varying the position of the panels and thereby limiting the overflow in accordance with changes in hydrostatic level in said outlet compartment so as to maintain delivery of a substantially constant weight of solid material during changes in consistency in the stream.

2. A consistency regulator for paper making stock comprising a conduit for a stream of stock, said conduit being formed with a discharge outlet, means for supplying stock to said conduit under a predetermined head, resistance means in said conduit for creating a frictional resistance to the flow of said stream and so impeding said flow that a hydrostatic head will be created in another part of said stream, which head will vary with changes in the consistency of the stock, means for holding a supply of diluting water under a constant head, means for furnishing the diluting water to the stream in accordance with a demand which varies inversely with changes in consistency of the stock, and outlet means including adjustable panel sections movable into a position to define both an outlet port and an overflow port for discharging stock in amounts which vary inversely with the consistency of the stock and which are so limited as to produce delivery of a substantially constant weight of solid material.

3. A consistency and volume regulator for paper making stock comprising a casing, said casing being separated into a series of connected compartments in which a stream of paper making stock may be caused to assume

successively lower hydrostatic heads varying in accordance with consistency changes of the stock, means for supplying dilution water to the stock in accordance with changes in consistency of the stock and discharge gate means communicating with one of said compartments, said discharge gate means comprising a frame having a pair of outer movable gate panels received at one side thereof, and a third inner panel member slidably supported at an opposite side of said frame therein, said panels being formed with openings for discharge of paper making stock therethrough, two of said panels being movable toward and away from one another to define an overflow passageway normally extending above the level of paper making material in said compartment.

4. A consistency and volume regulator for paper making stock comprising a casing having an inlet compartment adapted to receive and hold the paper making stock at a desired hydrostatic head, wiew means supported in the casing to form a control compartment and a restrictor compartment communicating with both the control compartment and the inlet compartment, outlet means for discharging paper making material from the control compartment, said outlet means including an adjustable gate mechanism having a plurality of discharge openings therein, one above another, and means for varying the size and shape of the openings, said gate mechanism comprising a frame, a plate vertically slidable in the frame, said plate having an opening formed therethrough, a pair of outer cooperating panels and an inner panel movable in the frame in directions vertically and horizontally of the casing to open and close the openings in the said plate, said cooperating panels at their upper sides defining an overflow passageway for discharge of stock from the control compartment, and screw means for simultaneously adjusting both the outer and inner panels to provide for releasing a constant weight of paper stock during changes in consistency of the stock.

5. A consistency and volume regulator for paper making stock, comprising a casing having an inlet compartment adapted to receive and hold paper making stock, wiew means supported in the casing to form a control compartment and a restrictor compartment communicating with the inlet compartment, outlet means for discharging paper making material from the control compartment, said outlet means including an adjustable gate mechanism having a plurality of discharge openings formed therein, one above another, said gate mechanism comprising a frame, a closure section vertically slidable in the frame, said closure section being formed with openings therethrough, a pair of cooperating panels located against the said closure section, means for moving the panels in directions vertically and horizontally of the frame, said closure section being adjustable simultaneously with the cooperating panels and in an opposite direction thereto to vary discharge outlets formed by the panels, and said cooperating panels defining an overflow passageway for overflow stock from the control compartment.

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