Aug. 6, 1940. H. G. CRAM 2,210,027

APPARATUS FOR REGULATING THE CONSISTENCY OF PULP OR STOCK

Filed Sept. 28, 1936 3 Sheets-Sheet 1

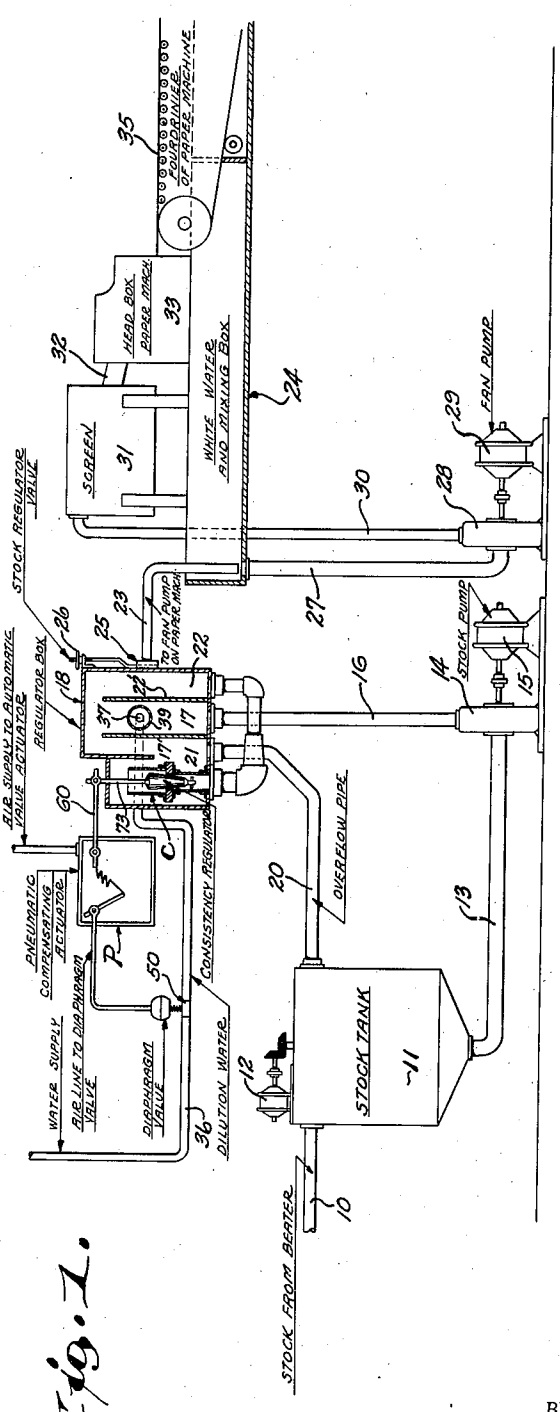


Fig. 1.

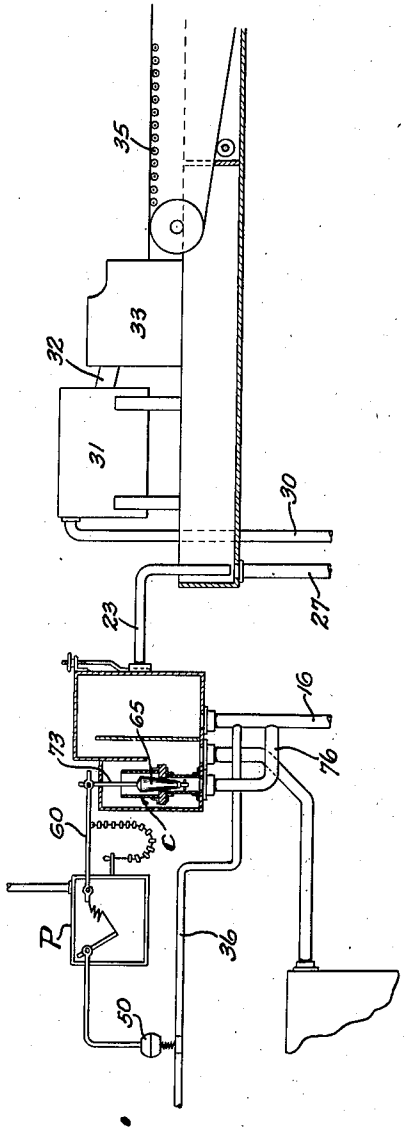


Fig. 2.

INVENTOR.
Henry G. Cram

BY

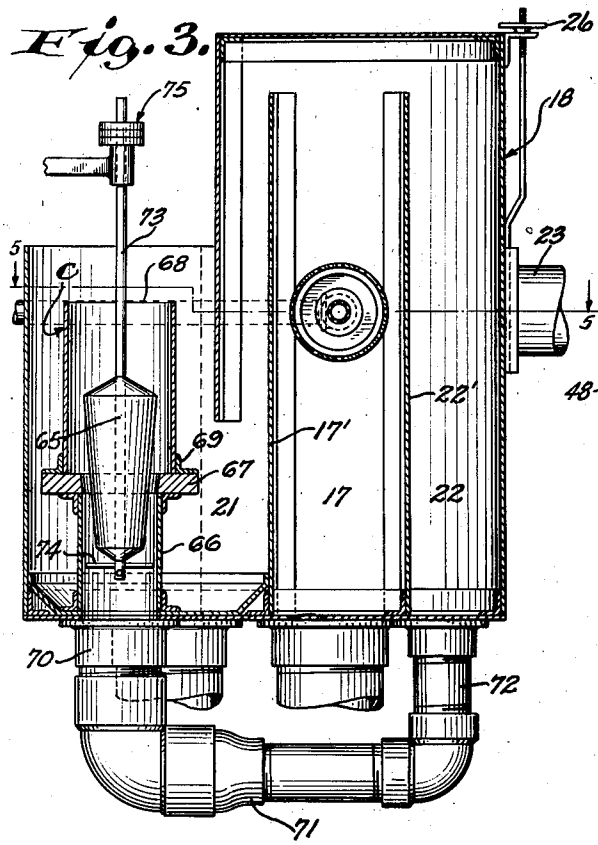
John W. Michael
ATTORNEY.

Aug. 6, 1940. H. G. CRAM 2,210,027

APPARATUS FOR REGULATING THE CONSISTENCY OF PULP OR STOCK

Filed Sept. 28, 1936 3 Sheets-Sheet 2

Fig. 3.



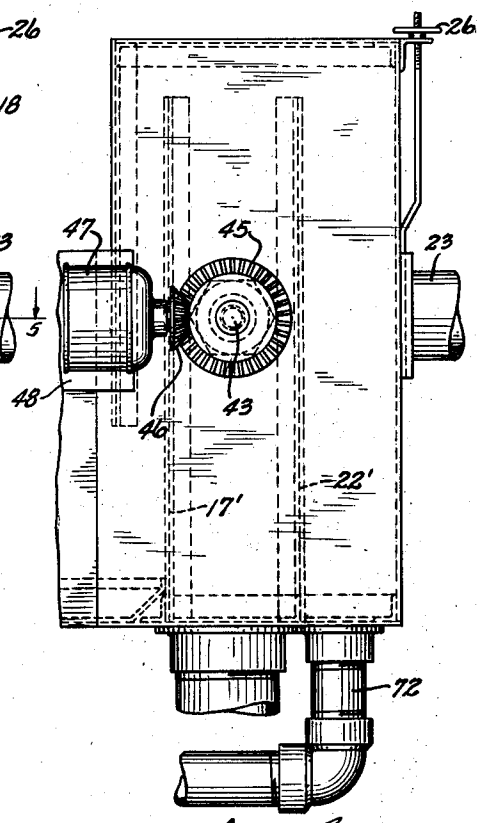


Fig. 4.

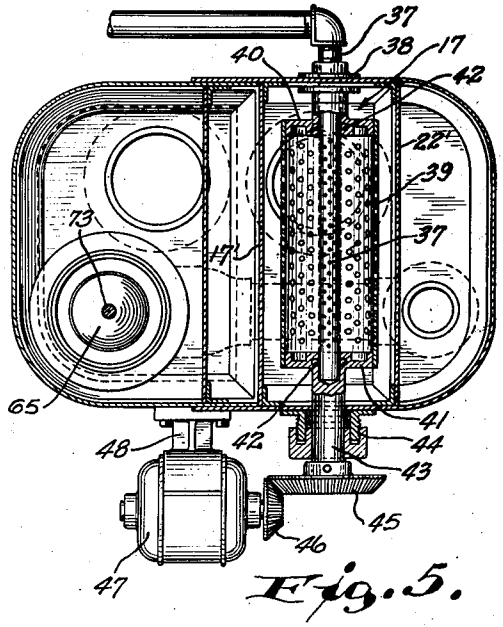


Fig. 5.

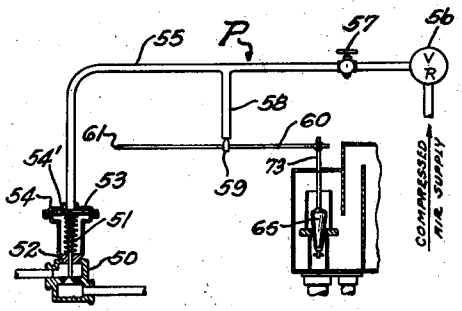


Fig. 6.

INVENTOR.
Harvey G. Cram
BY
John W. Michael
ATTORNEY.

Aug. 6, 1940. H. G. CRAM 2,210,027

APPARATUS FOR REGULATING THE CONSISTENCY OF PULP OR STOCK

Filed Sept. 28, 1936 3 Sheets-Sheet 3

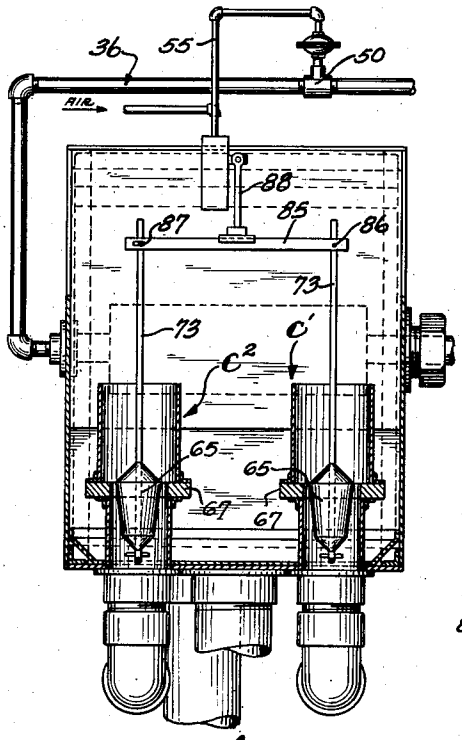


Fig. 7.

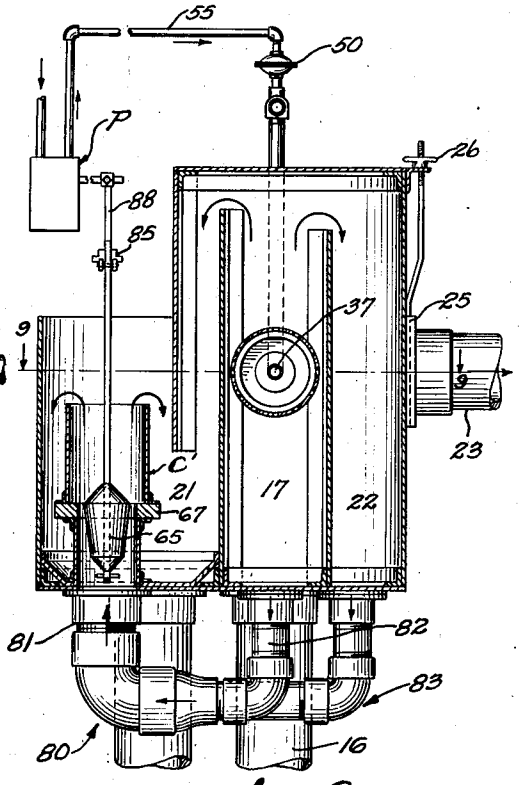


Fig. 8.

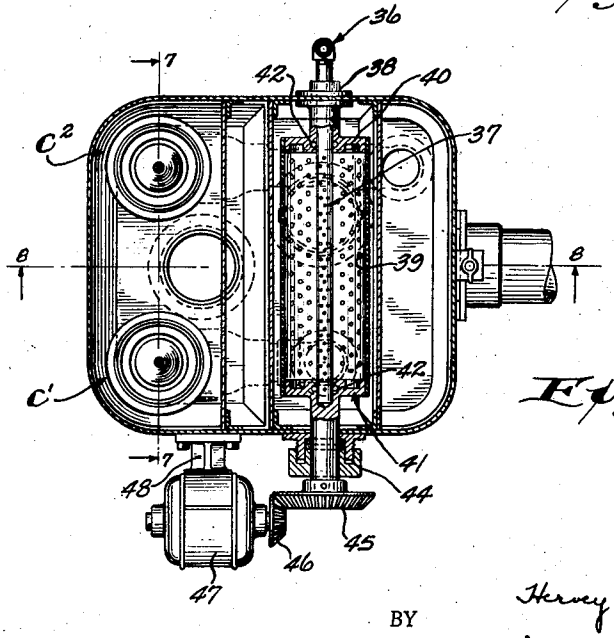


Fig. 9.

INVENTOR.
Harvey G. Cram
BY John W. Michael
ATTORNEY.

Patented Aug. 6, 1940 2,210,027

UNITED STATES PATENT OFFICE

2,210,027

APPARATUS FOR REGULATING THE CONSISTENCY OF PULP OR STOCK

Hervey G. Cram, Appleton, Wis.

Application September 28, 1936, Serial No. 102,913

3 Claims. (Cl. 137—78)

This invention relates to an apparatus for regulating the consistency of pulp or stock for use in the making of paper or similar fibrous products.

The present application is a continuation in part of my application for Apparatus for and method of regulating the consistency of pulp or stock, filed November 18, 1935, Serial No. 50,397.

One of the objects of the invention is to obtain close regulation of the consistency of the pulp or stock and thereby increase the uniformity of the finished product.

Another object of the invention is to provide an apparatus which is capable of automatically maintaining a substantially uniform consistency and of maintaining any selected consistency over a rather wide range of available consistency.

Another object of the invention is to provide an apparatus of the character mentioned and having the advantages referred to and which is simple and durable in its construction, reliable and sensitive in operation and easy and comparatively inexpensive to manufacture, install and maintain.

Other objects and advantages reside in certain novel features of the construction, arrangement and combination of parts which will be hereinafter more fully described and particularly pointed out in the appended claims, reference being had to the accompanying drawings, forming a part of this specification, and in which:

Figure 1 is a diagrammatic view partly in elevation and partly in vertical section showing one type of apparatus embodying the present invention;

Figure 2 is a fragmentary view similar to Figure 1 but illustrating another embodiment of the invention;

Figure 3 is a view partly in side elevation and partly in longitudinal vertical section and on an enlarged scale and illustrating one construction of the regulator box;

Figure 4 is a fragmentary view in front elevation illustrating the drive for the dispersing drum of the regulator box;

Figure 5 is a view in horizontal cross section taken on line 5—5 of Figure 3;

Figure 6 is a fragmentary diagrammatic view illustrating the general character of the compensating pneumatic actuator interposed between the float of the regulator and the valve which controls the supply of diluting water to the stock;

Figure 7 is a view in transverse vertical section taken on line 7—7 of Figure 9, parts being shown in section for the sake of illustration;

Figure 8 is a view in longitudinal vertical cross section taken on line 8—8 of Figure 9, parts being shown in elevation for the sake of illustration; and

Figure 9 is a view in horizontal cross section taken on line 9—9 of Figure 8, parts being shown in top plan for the sake of illustration.

The general construction of the apparatus is the same in all embodiments of the invention and is illustrated in Figure 1. As there shown, the stock is supplied by a pipe 10 to a stock tank 11 equipped with a suitable motor driven agitator diagrammatically illustrated at 12. Usually the stock is fed through the pipe 10 from a beater (not shown) or other suitable source of supply. From the outlet of the stock tank 11 a pipe 13 leads to a stock pump 14 which may be driven by an electric motor 15. The stock pump 14 discharges into the lower end of a vertical pipe 16 which communicates at its upper end with the lower end of a compartment 17 of a regulator box designated generally at 18. The regulator box 18 is fabricated of sheet metal as illustrated in the drawings and is provided with internal partitions 17' and 22' to define the compartments or chambers referred to. An overflow pipe 20 leads back from another compartment 21 of the regulator box to the stock tank 11. Still another compartment 22 of the regulator box has a pipe 23 leading therefrom and discharging into a white water and mixing box indicated diagrammatically at 24. A valve 25 provided with a hand wheel adjustment 26 may be employed to regulate the flow through the pipe 23. A pipe 27 leads from the box 24 to the suction side of a pump 28 driven by an electric motor 29 and having its outlet connected to a pipe 30 which leads to a screen 31. From the screen 31 the stock or pulp is delivered by a conduit 32 to a head box 33 of the paper making machine and in accordance with the usual practice flows from the head box onto the Fourdrinier wire 35 of the paper making machine.

The description thus far applies to all forms of the invention. In fact, the several forms differ principally in the manner of supplying diluting water to the stock and in the particular character of the structure by virtue of which the regulating action is had.

In the forms of the invention illustrated in Figures 1, 3 to 4, inclusive, and 7 to 9, inclusive, the water or other liquid used for diluting the stock is supplied to the compartment 17 of the

regulator box. For this purpose a water supply pipe 36 is provided and terminates in a perforated inlet pipe 37, the pipe 37 extending through a suitable packed bearing 38 provided on the regulator box and projecting into and horizontally across the compartment 17 near its upper end. A dispersing drum 39 surrounds the portion of the perforated inlet pipe located within the compartment 17. As illustrated in Figures 5 and 9, the body portion of this dispersing drum is cylindrical and is carried by circular and suitably flanged end plates 40 and 41. Between the hubs or inner portions of these end plates and smooth imperforate sections of the inlet pipe 37 suitable bearings 42 may be provided. The end plate 41 has a short shaft 43 integral therewith and rotatably fitted in a packed bearing 44 provided therefor on the front wall of the regulator box. Outwardly beyond the bearing a beveled gear wheel 45 is pinned or otherwise fixed to the short shaft 43 and meshes with a beveled driving pin 46 secured to the armature shaft of an electric motor 47 which may be supported on a bracket 48 carried by the regulator box.

In the operation of the machine the motor 47 rotates the dispersing drum 39 and this, together with the perforated character of the drum and the inlet pipe, insures the uniform distribution of the diluting liquid as well as an agitation of the stock or pulp.

Flow of the diluting liquid through the pipe 36 and to the dispersing drum is regulated by a valve designated generally at 50. As illustrated in Figure 6, the valve 50 is biased to closed position by means of a spring 51 which encircles its stem and bears at its lower end against a shoulder 52 and at its upper end against a diaphragm 53 which is connected or suitably secured to the valve stem. A suitably shaped casing section or cover plate 54 coacts with the diaphragm 53 to provide a pressure chamber 54' thereabove. Pressure is supplied to the chamber above the diaphragm by means of a pipe 55 which leads to the chamber from a suitable source of supply of compressed air. In this pipe 55 a reducing valve 56 and shut-off valve 57 are incorporated. The pipe 55 has a branch 58 which communicates with the atmosphere to vent the pipe 55. The venting action of the branch 58 is regulated by a suitable valve 59 which is controlled by an operating lever 60 suitably fulcrumed as at 61 and appropriately connected to the floats of the regulator as will hereinafter more fully appear. The illustration in Figure 6 is a schematic one to designate the fundamentals of the pneumatic control P actually used. In actual practice this control may be obtained on the open market. One suitable type is manufactured by the Mason-Neilan Regulator Company of Boston, Massachusetts, and is shown and described in detail in their Bulletin 3000–C, published in revised form in 1934.

The float controlled consistency responsive device which controls the movement of the operating lever 60 and consequently the amount of diluting liquid supplied is substantially the same in the structures shown in Figures 1 and 2 and, in fact, differs principally only in the provision made for supplying the stock from the system to the float controlled consistency responsive device.

As best illustrated in Figure 3, the consistency responsive device comprises an elongated tapered float 65 which is submerged at all times in a column of the pulp or stock being handled, the column being designated generally at C. The column in which the float 65 is submerged is constituted by a lower pipe section 66 and an intermediate internally tapered ring 67 and an upper and larger pipe section 68, which are suitably fastened together and which may be suitably strengthened by connecting angles 69. The upper end of this column is open and the lower end freely communicates with one leg 70 of a U-shaped conduit 71, the other leg 72 of which communicates with the lower end of the compartment 22.

Secured to the float and extending axially therethrough is an elongated stem or rod 73 which is of very small diameter. The lower end of this stem or rod projects beyond the lower end of the float and carries angularly spaced and transversely extending guide pins 74 which coact with the inner wall of the lower column section 66 to constrain the float to proper movement under the influence of the pulp rising up through the column. The stem 73 also projects a substantial distance above the upper end of the float and also above the top of the column and is appropriately interconnected with the lever 60. It may also be suitably weighted as indicated at 75. By varying the number of weights the action may be varied.

In the operation of the apparatus shown in Figure 1, the pulp is pumped by the stock pump 14 through the pipe 16 into the compartment 17 and overflows over the upper ends of the partitions 17' and 22' which define this compartment, the partition 22' being slightly lower most of the pulp flows into the compartment 22 and from this compartment flows through the pipe 23 to the machine and also through the U-shaped conduit 71 to the column C. If the pulp is of the consistency for which the machine is set this operation will go on in the manner stated, the pulp which spills over the partition 17' and over the upper end of the column C flowing back to the stock tank through the overflow pipe 20. If, for example, the consistency desired is 3% and the pulp supplied to the regulator box rises to 4% the increase in the consistency of the pulp rising up through the column C will cause the float 65 to be elevated a certain distance or increment, thereby swinging the lever 60 in a counter-clockwise direction as viewed in Figure 6, and closing the vent 58. Pressure then builds up in the chamber 53' and opens the valve 50 against the action of the spring. This allows diluting water to flow through the pipe 36 and the dispersing drum 39 into the pulp in the compartment 17 to dilute it and bring it down to the proper consistency. Thereupon the float resumes its former position and the water supply valve 50 is closed. If pulp of higher consistency is again supplied the action is repeated. Generally speaking, the operation may be characterized as sample and check, sample and check.

In the type of structure shown in Figure 2 the pulp supplied to the column C is taken from the pipe 16 by means of a pipe 76 which leads from the pipe 16 to the lower end of the column C. The diluting water may be supplied as before or it may be carried into the pipe 16 at some point between the regulator box and the point at which the pipe 76 communicates with the pipe 16, as shown in Figure 2. In the latter case partition 22' may be omitted. With either arrangement the stock is always supplied to the column C before it has been diluted and correction for consistency variations are made continuously.

The type of apparatus shown in Figures 7 to 9, inclusive, is a combination of both types hereinabove described. Generally speaking, a double float arrangement is utilized, one float being responsive to pulp which has been diluted and the other to the pulp of its original consistency, that is, the consistency which it has when it is pumped from the stock tank. As shown in Figures 7 to 9, inclusive, the regulator box is internally partitioned as before to provide the compartments 17, 21 and 22. The diluting water is supplied to the compartment 17 through the perforated inlet pipe 37 of the rotating dispersing drum 39. Pulp is supplied to the compartment 17 through the pipe 16 and is taken from the compartment 22 by pipe 23. However, instead of having only one column C two such columns designated at C^1 and C^2 are provided. They are of identical construction and correspond exactly to the column C shown in Figure 3. However, the column C^1 is supplied with pulp by a U-shaped conduit 80, one leg 81 communicating with the lower end of the column C^1 while the other leg 82 communicates with the bottom of the compartment 17. Inasmuch as the pulp being supplied to the compartment 17 from the stock tank is continuously rising upward in this compartment it is not diluted at the bottom so that the pulp taken to the column C^1 is of the same consistency as the pulp in the stock tank. The pulp supplied to the column C^2 is carried over from the compartment 22 by means of a U-shaped conduit 83 and, of course, this pulp has been diluted to the extent that water is supplied to the pulp by the perforated dispersing drum 37.

The stems 73 of the floats of the columns C^1 and C^2 are suitably connected to a cross bar or cross head 85. One type of connection contemplates a pivotal connection 86 to one of the stems and a pin and slot connection 87 to the other. Through suitable motion transmission mechanism, such as indicated at 88, the cross head 85 is utilized to operate the vent controlling valve 56.

This type of structure gives much closer and more sensitive regulation than the other two types disclosed although the other two find very advantageous application in some instances and under some conditions.

With a structure such as shown in Figure 9, if the consistency of the pulp increases above that required the float in column C^1 will be elevated to open the water supply valve and dilute the pulp down to its proper consistency but if for any reason this dilution proceeds too far the pulp flowing up through the column C^2 will lower immediately to close the water supply valve and allow the necessary correction to occur in the consistency of the pulp. Of course, it is also true that if the float C^1 should fail to open the valve enough or maintain it open long enough to bring about the desired dilution the pulp flowing through the column C^2 would act on its float to supplement the action of the float in the column C^1.

In all embodiments of the invention, the floats are entirely submerged. This is an important feature of the invention as it increases the accuracy and sensitivity of the regulator.

In this connection it should be observed that the floats in any embodiment of the invention are entirely submerged in any of their positions and that there is a minimum and uniform transverse area, namely, the upper portion of the stem 73, projecting up through the surface of the stock at all times. This means there is a minimum and fixed uniform increment or change in weight of the regulator per unit rise for the reason that the decrease in displacement of liquid per unit rise of the regulator is uniform. The floats in all embodiments of the invention are special in their nature in that they are entirely submerged in all positions and in that were it not for the velocity in the upward flow of the pulp in the columns in which these floats are positioned they would immediately sink.

The volume rate of flow between each float 65 and its cooperating ring 67 is established by the constant differential in head between the compartment 22 and the overflow of the column in which the float is operating. The taper of each of the floats determines the area of opening between it and its ring 67 in any particular vertical position of the floats. And the mechanism which actuates the valve 50 is such to obtain a correspondence between the float positions and the valve positions. For example, if the float is considered as having seven different vertical positions and the valve is also considered as having seven different positions between its fully open and its fully closed positions then the valve positions will always correspond exactly with the float positions.

An increase in the fiber solid content of the liquid passing through the opening between any ring 67 and its float acts as a deterrent to the flow because of friction set up thereby between the float and its ring 67 and this results in an increased upward pressure on the float. As a consequence the float will rise vertically until the area of the opening between it and its ring 67 is sufficient to compensate for the increased consistency. The rise vertically of the float as effected by increase in consistency is transmitted to the valve 50 in the water line to inject the proper amount of water into the stock.

With the thinning water entering the stock ahead of the regulator or float 65 it is simply a matter of sample and adjust to the required consistency with the thinning water. If the water is added after the stock is past the float the supply of dilutent water is co-ordinated to the consistency of the stock passing the float to reduce the stock to the required predetermined consistency.

From the foregoing it is obvious that the compartment 17 serves as a main supply compartment, that the compartment 21 provides an overflow compartment and that the compartment 22 functions as a discharge or delivery compartment or chamber.

From the foregoing, it will be understood that the present invention involves an apparatus for regulating the consistency of fibrous stock in liquid suspension and that the method consists basically in continuously bypassing a sample of said stock through a vertical column submerging in the column a float whose vertical position varies directly as changes in consistency and utilizing the changes in the vertical position of the float to control the amount of diluting liquid supplied to the stock. In its most advanced and refined form this apparatus is somewhat more elaborate in that instead of by-passing a sample through a single column two separate samples are bypassed through separate columns, one sample being of the stock as it is taken from the source of supply and the other being the stock after the diluting liquid has been added thereto. As in the basic form of the apparatus a float is submerged in each of the two columns and the float is so constituted as to vary in its vertical position directly in accordance with variations in the consistency of the stock. The resultant of the combined vertical

motion of the two floats is utilized to exercise the control over the supply of the diluting liquid.

While I have shown and described several types of apparatus it is to be understood that these have been selected for the sake of illustration or example and are not intended as restrictive, various changes being contemplated within the spirit of the invention and the scope of the subjoined claims.

The invention claimed is:

1. An apparatus for regulating the consistency of fibrous stock in liquid suspension comprising a regulator box having internal partitions defining a supply compartment, a delivery compartment and an overflow compartment, a pipe line for supplying stock to the lower end of the supply compartment, said stock flowing over one of said partitions into said delivery compartment, means for supplying diluting liquid to the upper portion of the supply compartment, means in the overflow compartment defining two vertical columns, the upper ends of which discharge into said overflow compartment, a connection between one of said columns and the lower end of the delivery compartment, a connection between the other of said columns and the lower end of the supply compartment, a float submerged in the stock in each of said columns and adapted to individually change their vertical positions in accordance with the changes in the consistency of the stock in their respective columns, and means utilizing the resultant of the vertical movement of the two floats to regulate the action of the liquid supply means to cause it to vary the amount of liquid dilutent supplied to the stock.

2. A device responsive to variations in pulp consistency comprising a vertical conduit open at its upper end, a ring incorporated in the conduit below the top of the discharge end thereof and having its inner wall upwardly and outwardly tapered, a substantial length of said conduit above said ring being of uniform cross sectional area, and a correspondingly tapered float cooperable with said ring, said float rising and falling vertically in accordance with variations in the consistency of the stock flowing past it and the ring, said ring and said float being so designed that as the float rises the area of the passage between the float and the ring will be increased whereas when the float lowers the area of the passage between the float and the ring will be decreased.

3. A pulp consistency regulator comprising means for supplying diluting liquid to the pulp, operating mechanism for said means, and a control device responsive to variations in pulp consistency and governing the action of said last-named mechanism and comprising a vertical conduit open at its upper end and having a portion of its inner wall below said open upper end upwardly and outwardly tapered, a substantial length of said conduit above said tapered portion being of uniform cross sectional area, and a weighted float disposed in said conduit and having its periphery downwardly and inwardly inclined whereby upon variations in pulp consistency the float will be raised and lowered and the area of the passage between the float and the tapered portion of said wall varies, said float being interrelated with said operating mechanism.

HERVEY G. CRAM.