Feb. 12, 1935. E. POIRIER 1,990,501

PAPER STOCK CONTROLLING METHOD AND APPARATUS

Filed Feb. 2, 1934 2 Sheets-Sheet 1

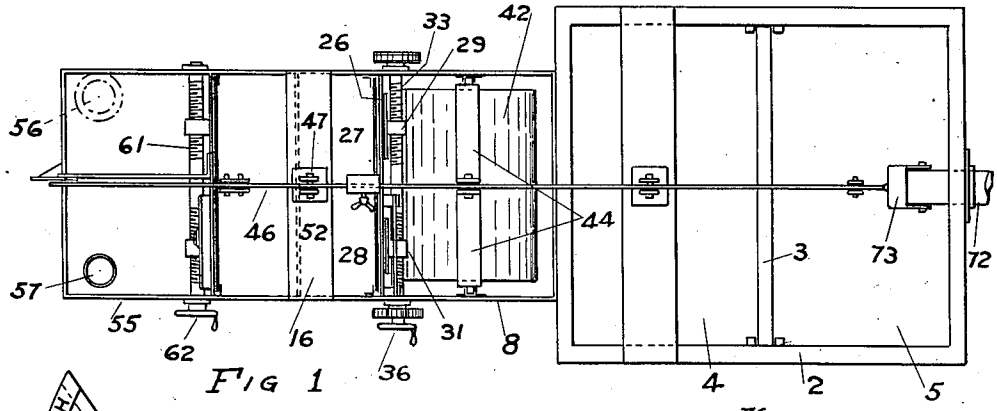


FIG 1

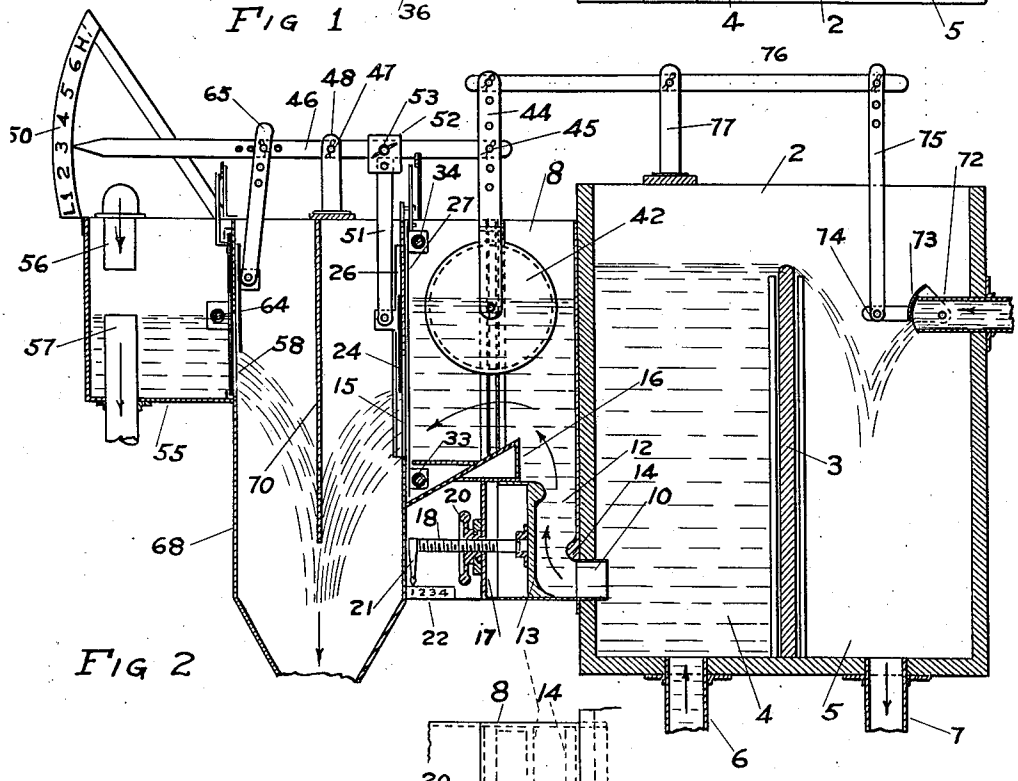


FIG 2

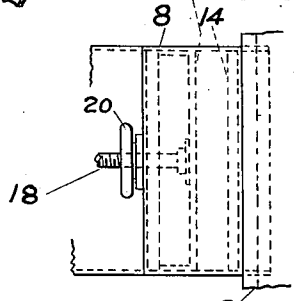


FIG 3

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PAPER STOCK CONTROLLING METHOD AND APPARATUS

Filed Feb. 2, 1934 2 Sheets-Sheet 2

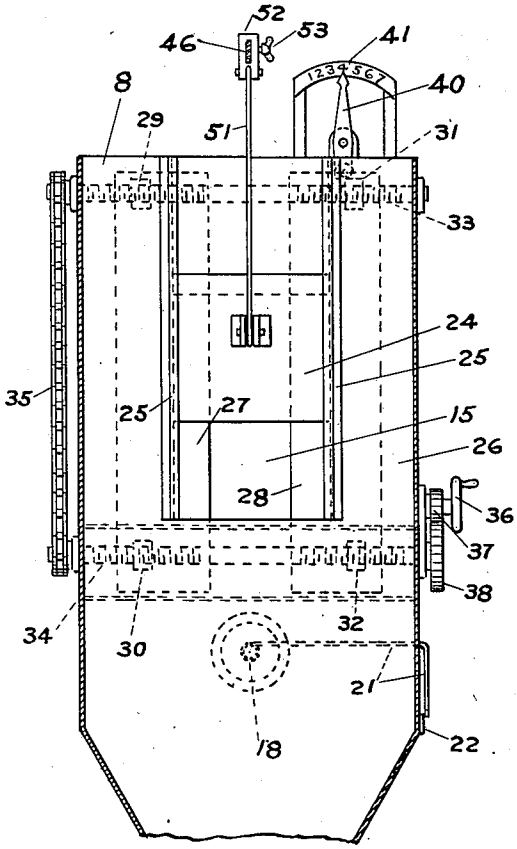


FIG 4

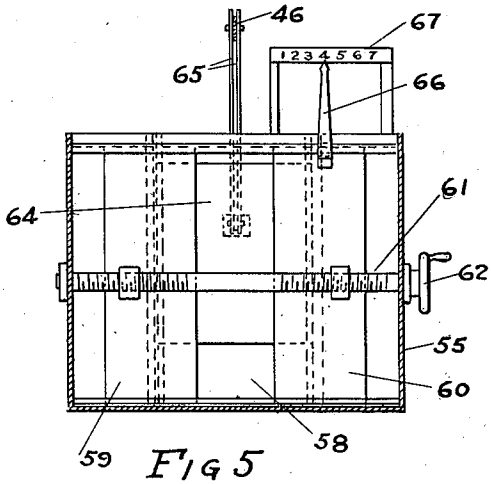


FIG 5

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PAPER STOCK CONTROLLING METHOD AND APPARATUS

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Application February 2, 1934, Serial No. 709,447

19 Claims. (Cl. 92—46)

This invention relates to steps in the process of manufacturing paper and to apparatus used in such processes. It is more especially concerned with the control of, or the compensation for, variations in consistency of the stock from which the paper is to be made.

As is well understood by those skilled in the art of manufacturing paper, the stock or pulp delivered to a Fourdrinier wire, or other paper making surface, contains a relatively small proportion, by weight, of solid constituents, such as fiber, fillers, and the like, the remainder of the stock consisting of water. While the percentage of solid constituents varies substantially in different mills and in different grades of paper, it is very common for the proportion of these materials to run in the neighborhood of 2% to 4% of the total weight of the stock. In making most papers it is important to control the variations in successive portions of the sheet within very narrow limits, and for this purpose it is essential that the consistency of the stock delivered to the paper making surface be accurately controlled. According to the prior practice the control of the weight and formation of a sheet depends very largely on the care, skill and judgment of the machine tender. He watches the web closely, takes weighings at suitable intervals, and makes such changes in the rate of delivery of stock to the wire as may be required to correct any variations which he discovers.

A further factor closely related to that of consistency is the rate at which the water leaves the fiber as the web passes over the suction boxes and during the formation of the sheet. In a Fourdrinier machine the wire is vibrated laterally during this period, such movement assisting in causing the fibers to arrange themselves uniformly and to felt together in the desired relationship. If the water leaves the stock too rapidly, stock is said to run too "free." This action interferes with the proper formation of the sheet, tends to make it run "wild", and is usually compensated for by adding more water to the stock. On the other hand, if the water does not leave the sheet rapidly enough, it will be too wet when it reaches the couch rolls, and the fiber will be crushed and the web will take on an undesirable surface appearance. Such a stock is said to be "slow", and the operator attempts to compensate for it by reducing the quantity of water added to the stock.

While much care is given to the beating and preparation of the stock preparatory to delivering it to the paper making wire, the variables involved in the process are so numerous that it seems to be practically impossible to maintain a stock of a uniform character for any great length of time. Consequently, the nature of the final sheet will depend, in a large degree, on the care, skill, judgment and experience of the machine tender.

The present invention aims to improve both the apparatus for and the methods of handling paper stock prior to its delivery to the paper machine with a view to compensating for the variations in the character of the stock and delivering to the machine a more uniform product, thus relieving the machine tender of much of the care and attention required by him, and also producing a better sheet of paper than can reasonably be expected of any machine tender.

The nature of the invention will be readily understood from the following description when read in connection with the accompanying drawings, and the novel features will be particularly pointed out in the appended claims.

In the drawings,

Figure 1 is a plan view of an apparatus embodying features of this invention;

Fig. 2 is a vertical, sectional view of the apparatus illustrated in Fig. 1;

Fig. 3 is a bottom view of a portion of the apparatus shown in Figs. 1 and 2;

Fig. 4 is a vertical, sectional view through the float chamber showing the discharge gates and the means for adjusting them; and

Fig. 5 is a similar view of the gates for controlling the delivery of water to be added to the stock.

Referring first to Figs. 1, 2 and 3, the apparatus there shown comprises a head box 2 which is divided by a wier 3 into a supply chamber 4 and an overflow chamber 5. The paper making stock is pumped from the stuff chest, or other preparing apparatus, through a supply pipe 6 into the supply chamber 4, the surplus overflowing the wier 3 and being carried back to the stuff chest through the return pipe 7. Such a head box is very commonly used in paper making processes.

Secured to one side of the head box is a tank or container 8 provided with a long narrow intake piece 10 projecting through the wall of the head box into the supply chamber 4. This container has a somewhat tortuous inlet channel or conduit 12, the front wall of which consists of a member 13, while its rear wall is formed chiefly by the wall of the tank 8, the latter wall, however, being provided with a transversely extending piece 14 having a rounded surface to cooperate with the

member 13 in compelling the stream of stock flowing into it from the supply chamber 4 to follow a crooked path. This stock rises to a level in the container 8 somewhat lower than that maintained in the supply chamber 4, and it is discharged through an outlet opening 15, the dimensions of which may be adjusted by means of suitable gates.

By properly adjusting the resistances offered to the flow of stock into and out of the container, the level of the stock may be made to rise and fall automatically with changes in the consistency and freeness of the stock. For this purpose the member 13 which forms one wall of the inlet conduit, is made adjustable backward and forward to vary the dimensions of this inlet and consequently, change the resistance to the flow of stock through it. This member 13 is made hollow, it rests on the bottom of the container 8, fits snugly between the side walls of the container, and slides between the bottom and a shaped hollow partition member 16 that extends across the container from one side wall thereof to the other. A part of the bottom of this tank or container is bent upwardly to provide an upright rigid wall 17 to which the partition 16 is secured. The adjusting mechanism for the member 13 comprises a screw threaded rod 18 secured at its right-hand end, Fig. 2, rigidly to said member and projecting horizontally through the partition 17. Threaded on to this member is an adjusting nut 20 so fastened to the wall 17 that it can rotate relatively to this wall and to the rod 18, but cannot move axially of the rod. Consequently, rotation of this nut will adjust the member 13 toward the right or left, depending upon the direction in which the nut is rotated. A pointer 21 fastened to the rod 18 slides over a scale 22 and designates the various positions of adjustment of the member 13.

The devices for adjusting the dimensions of the outlet 15 comprise a gate 24, Figs. 1 and 4, slidable in vertical guideways 25—25 secured to the front wall 26 of the tank or container, these guideways being located at the opposite edges of an opening formed in said front wall. Located just inside this wall are two plates 27 and 28, mounted to slide horizontally toward and from each other to adjust the width of the outlet 15. Projecting rearwardly from the plate 27 are upper and lower lugs 29 and 30, Fig. 4, while similar lugs 31 and 32, rigid with the plate 28, project rearwardly from the upper and lower portions of it. The upper lugs 29 and 31 of these two plates are internally threaded to receive the right and left-hand threaded portions, respectively, of a shaft 33, while the lower lugs 30 and 32 are similarly threaded to receive right and left-hand threaded portions of another shaft 34. A sprocket and chain mechanism 35 connects both shafts so that they can be driven simultaneously by a hand wheel 36, through a pinion 37 on said wheel and a gear 38 on the shaft 34, the gear meshing with the pinion. Rotation of the hand wheel 36 thus moves the gates simultaneously toward or from each other, depending upon the direction of such rotation, to adjust the width of the discharge opening 15, as desired. An indication of the degree of adjustment so produced is provided by the pointer 40, Fig. 4, pivoted to the upper end of the plate 28, and arranged to swing over a graduated scale 41.

In using this apparatus the stock in the supply chamber 4 of the head box 2 is maintained at substantially a constant level by the arrangement above described. This stock can flow freely through the inlet 12 into the tank 8 and out through the discharge port or opening 15. By properly adjusting the wall 13 of the inlet conduit, and the plates 27 and 28 of the outlet, the resistance imposed on the inflow and discharge of the stock to and from this container can be so regulated that when the stock is running at a normal consistency there will be a substantial difference between the level or head of the stock in the container 8 and that in the supply chamber 4 of the head box. This difference may conveniently be made six inches or eight inches, or more, if desired. It should also be observed that in such an arrangement if the consistency of the stock increases, or, in other words, its percentage of solid constituents rises, the level of the stock in the container 8 will drop. On the other hand, if the concentration or consistency of the stock drops, the level in the container 8 will rise.

This change in hydrostatic head of the stock in the container 8 may be utilized in several ways to compensate for changes in consistency, or to substantially correct such changes. In the arrangement shown a relatively large float 42 is mounted in the container 8 to rise and fall with the changes in the level of the stock therein. Preferably this float is made cylindrical in form and is provided with short stub shafts projecting axially from its opposite ends and running in vertical guides secured to, or formed in, the walls of the tank 8. Two upright arms 44—44, Figs. 1 and 2, are carried by the stub shafts on the float and are pivoted at 45 to one end of a lever 46 which is fulcrumed at 47 on a stationary bracket 48. As shown in Fig. 2, the left-hand end of this lever is shaped to form a pointer cooperating with a scale 50 suitably graduated to indicate variations in consistency. A connection is also provided between this lever and the vertically slidable gate 24 to adjust this gate automatically in response to variations in the hydrostatic head of the stock in the container 8, and consequently, in response to changes in consistency of the stock. These connections comprise a link 51 pivoted at its lower end to the gate 24 and at its upper end to a block 52 which is mounted on the lever 46 to slide longitudinally thereof, and is equipped with a thrumb screw 53 by means of which it may be secured in any adjusted position on said lever.

It will be clear from the foregoing description that when the consistency of the stock rises and its level in the container 8 consequently drops, the connections just described will automatically lower the gate 24, thus reducing the rate of discharge of the stock through the outlet 15. Such a reduction is desirable in order to maintain a constant rate of delivery of solid constituents of the stock to the paper making wire. An opposite action occurs upon a decrease in consistency, resulting in increasing the area of the outlet 15, and thereby causing the discharge of the stock at a higher rate in order to compensate for the reduced proportion of solid constituents which it carries. The apparatus thus compensates automatically for variations in consistency.

It is a common practice to mix a certain proportion of "white water", that is, water which has previously been drained from the fiber at the paper making surface, with the stock discharged through the outlet 15, partly for the purpose of recovering some of the fillers or other constituents carried by the white water, and also in order to afford a better control of the formation of the sheet on the Fourdrinier wire or other paper making surface. In some cases clear water may be

added to the stock instead of white water. In either event it is desirable to vary the quantity of water so added to the stock in accordance with changes in consistency of the stock in order to maintain a substantially constant composition of stock flowing to the wire, or, in other words, to correct the variations in consistency. In the apparatus shown provision is made for effecting such an addition of white water or clear water and automatically controlling its rate of delivery to the stock in accordance with variations in consistency.

For this purpose a head box 55, Figs. 1 and 2, is closely associated with the container 8, and water is delivered continuously to it through the supply pipe 56, the level being maintained substantially constant by virtue of an overflow pipe 57. The dimensions of the outlet 58, Fig. 5, from this box are determined partly by the adjustment of two vertical plates 59 and 60 slidably mounted at the front wall of the box and operatively associated with a shaft 61 provided with right and left-hand screw threaded portions and with a hand wheel 62, so that these plates can be adjusted toward and from each other to vary the width of the outlet 58 in essentially the same manner that the plates 27 and 28 are adjusted, as previously described. The vertical dimension of the outlet is controlled by a gate 64, mounted in guideways in essentially the same manner as the gate 24 previously described. A pair of links 65 adjustably connect this gate with the lever 46, so that as the float 42 rises and falls with variations in the consistency of the stock and adjusts the gate 24, it will also produce opposite adjustments of the white water gate 64. In other words, the rate of delivery of white water or other water added to the stock will be varied inversely with changes in consistency.

An indicator comprising a pointer 66, Fig. 5, secured to the plate 60 and operating over a scale 67 serves to designate the width of the discharge port 58.

It should be noted that, due to the adjustability of the connections between the float 42 and the gates 24 and 64, the extent of the movement of the slide 24 produced by a given change in consistency can be varied, and the proportion of white water added for a given change in consistency can also be regulated, as desired.

Due to the fact that it is customary to add white water or clear water to the stock, it is preferable to construct the container 8, head box 55, and an intermediate discharge spout 68, all in one unit, locating the members 8 and 55 at opposite sides of the spout so that they will deliver their streams into it at opposite sides, and the stock and white water thus will become mixed as they travel toward the wire or the machine to which they are to be delivered. Preferably a partition 70 is placed in the spout 68 to prevent any undue interference of the streams of stock and white water with each other. This entire unit, including the elements 8, 55, 68 and the parts above described which go with them, may be manufactured and assembled as a unitary structure which can be applied to a head box which may be made by the customer. In some cases it is desirable to add either clear water or white water to the stock in the stuff chest, or at some point preceding its delivery to the head box in the event that the consistency rises above a substantially predetermined point. This object may be conveniently realized in the construction shown by running a supply pipe 72, Figs. 1 and 2, for the water into the overflow chamber 5 of the head box 2, mounting a swinging valve 73 on the end of the pipe 72, and connecting it with the float 42, so that this valve normally will be kept closed, but it will be opened automatically and will admit water to the overflow chamber whenever the apparatus indicates that the consistency has risen to a predetermined value. The operating connections between the float and the valve include an arm 74, rigidly secured to the valve and adjustably connected by a link 75 to a lever 76 which is fulcrumed on the stationary bracket 77 and is also adjustably connected to the arms 44—44 carried by the float 42. Such an arrangement not only controls the delivery of the water to be added to the stock in the stuff chest, but regulates such delivery or addition in accordance with changes in the consistency of the stock. The two white water feeding mechanisms may be used either in conjunction with each other, or either may be used without the other, as circumstances require.

As above pointed out, the question of freeness or slowness of the stock is important aside from changes in consistency due to its effect on the formation of the sheet being made. This apparatus automatically compensates for variations in freeness or slowness in the same way that it does for changes in consistency. In other words, a slow stock will rise to a higher level in the float chamber 8 than does a free stock, and consequently, this apparatus will automatically reduce the rate of delivery of white water or clear water to the stock as it tends to run more slowly and will automatically increase said rate as the stock becomes freer. The conditions desired for the proper formation of the sheet therefore are maintained by this apparatus when it is properly adjusted.

The apparatus provided by this invention thus can be used to compensate automatically for variations in consistency of successive portions of the stream of stock flowing through it, or to correct such variations by the addition of water at a controlled rate to the stock, either before it reaches the apparatus or after it has been discharged therefrom, or both. Furthermore, the apparatus responds automatically to small variations in consistency which would be impossible for a machine tender to detect without actually taking weighings at intervals too frequent to be practical. Consequently, it not only relieves the machine tender of much of the care, attention and skill which has formerly been required of him, but it affords an automatic control over the characteristics of the stock which could not possibly be expected of any machine tender. It has been demonstrated in practice that this apparatus will effect a material saving in the operation of a paper machine because of holding the weight of the paper within closer limits, preventing the manufacture of paper that must be returned to the beater as "broke", and maintaining those conditions necessary to the proper formation of the sheet.

While I have herein shown and described a typical embodiment of my invention, it will be understood that the invention may be embodied in other forms without departing from the spirit or scope thereof. Also, that it is useful in other relationships than that specifically described where essentially the same functions are to be performed.

Having thus described my invention, what I desire to claim as new is:

1. That improvement in methods of compensating for variations in the consistency of successive portions of a stream of paper making stock, which consists in continuously flowing a stream of said stock through a container under a substantially constant head, opposing such resistances to the flow of said stock into and out of said container that the level of the stock in the container will drop with an increase in consistency and will rise with a decrease in consistency, and causing the variations so produced in the hydrostatic head of the stock in said container to vary the rate of discharge of the stock from said container inversely with changes in consistency of said stock.

2. That improvement in methods of compensating for variations in the consistency of successive portions of a stream of paper making stock, which consists in continuously flowing a stream of said stock through a container under a substantially constant head, opposing such resistances to the flow of said stock into and out of said container that the level of the stock in the container will drop with an increase in consistency and will rise with a decease in consistency, and causing the variations so produced in the hydrostatic head of the stock in said container to change the resistance to the discharge of the stock from said container in such a manner as to increase the rate of discharge of the stock when the consistency drops and to reduce said rate upon a rise in consistency.

3. That improvement in methods of compensating for variations in the consistency of successive portions of a stream of paper making stock, which consists in continuously flowing a stream of said stock through a container under a substantially constant head, opposing such resistances to the flow of said stock into and out of said container that the level of the stock in the container will drop with an increase in consistency and will rise with a decease in consistency, and causing the variations so produced in the hydrostatic head of the stock in said container to change the dimensions of the outlet through which the stock is discharged from said container in such a manner as to increase the rate of discharge of the stock when the consistency drops and to reduce said rate upon a rise in consistency.

4. That improvement in methods of compensating for variations in the consistency of successive portions of a stream of paper making stock, which consists in continuously flowing a stream of said stock through a container under a substantially constant head, opposing such resistances to the flow of said stock into and out of said container that the level of the stock in the container will drop with an increase in consistency and will rise with a decrease in consistency, and causing the variations so produced in the hydrostatic head of the stock in said container to add water to the stock at a rate varying with said changes in hydrostatic head.

5. That improvement in methods of compensating for variations in the consistency of successive portions of a stream of paper making stock, which consists in continuously flowing a stream of said stock through a container under a substantially constant head, opposing such resistances to the flow of said stock into and out of said container that the level of the stock in the container will drop with an increase in consistency and will rise with a decrease in consistency, and causing the variations so produced in the hydrostatic head of the stock in said container to change the rate of discharge of the stock from said container inversely with changes in its consistency and to add water to said discharged stock at a rate varying directly with said changes in consistency.

6. That improvement in methods of compensating for variations in the consistency of successive portions of a stream of paper making stock, which consists in continuously flowing a stream of said stock through a container under a substantially constant head, opposing such resistances to the flow of said stock into and out of said container that the level of the stock in the container will drop with an increase in consistency and will rise with a decrease in consistency, and causing the variations so produced in the hydrostatic head of the stock in said container to add water to said stock before it reaches said container when the consistency of the stock rises above substantially a predetermined value.

7. That improvement in methods of compensating for variations in the consistency of successive portions of a stream of paper making stock, which consists in continuously flowing a stream of said stock through a container under a substantially constant head, opposing such resistances to the flow of said stock into and out of said container that the level of the stock in the container will drop with an increase in consistency and will rise with a decrease in consistency, and causing variations of substantially predetermined extent so produced in the hydrostatic head of the stock in said container to add water to the stock prior to its delivery to said container and also to the stock discharged from said container, and controlling the rate of delivery of the water so added in response to variations in the hydrostatic head of the stock in said container.

8. In an apparatus of the character described, the combination of a container having an inlet and an outlet for the flow therethrough of paper making stock, means for producing a continuous flow of stock under a substantially constant head through said inlet into said container, the inlet and outlet for said container being constructed and proportioned to maintain a head of stock in said container which varies with changes in the consistency of the stock flowing therethrough, said inlet comprising a conduit adjustable to vary the resistance offered by it to the flow of said stock into said container.

9. In an apparatus of the character described, the combination of a container having an inlet and an outlet for the flow therethrough of paper making stock, means for producing a continuous flow of stock under a substantially constant head through said inlet into said container, the inlet and outlet for said container being constructed and proportioned to maintain a head of stock in said container which varies with changes in the consistency of the stock flowing therethrough, said inlet comprising a conduit having a wall adjustable to vary the resistance offered by said conduit to the flow of stock into said container.

10. In an apparatus of the character described, the combination of a container having an inlet and an outlet for the flow therethrough of paper making stock, means for producing a continuous flow of stock under a substantially constant head through said inlet into said container, the inlet and outlet for said container being constructed and proportioned to maintain a head of stock in said container which varies with changes in the consistency of the stock flowing therethrough,

and means responsive to changes in the hydrostatic head in said container for adjusting the rate of discharge of the stock from the container.

11. In an apparatus of the character described, the combination of a container having an inlet and an outlet for the flow therethrough of paper making stock, means for producing a continuous flow of stock under a substantially constant head through said inlet into said container, the inlet and outlet for said container being constructed and proportioned to maintain a head of stock in said container which varies with changes in the consistency of the stock flowing therethrough, said inlet and outlet being adjustable to vary the rate of inflow of the stock into said container and its rate of discharge therefrom.

12. In an apparatus of the character described, the combination of a container having an inlet and an outlet for the flow therethrough of paper making stock, means for producing a continuous flow of stock under a substantially constant head through said inlet into said container, the inlet and outlet for said container being constructed and proportioned to maintain a head of stock in said container which varies with changes in the consistency of the stock flowing therethrough, means for delivering water to the stock, and means responsive to variations in the hydrostatic head of the stock in said container for controlling the rate at which water will be so delivered to the stock.

13. In an apparatus of the character described, the combination of a container having an inlet and an outlet for the flow therethrough of paper making stock, means for producing a continuous flow of stock under a substantially constant head through said inlet into said container, the inlet and outlet for said container being constructed and proportioned to maintain a head of stock in said container which varies with changes in the consistency of the stock flowing therethrough, and means responsive to changes in the hydrostatic head of the stock in said container for adjusting the dimensions of the outlet through which the stock is discharged from said container.

14. In an apparatus of the character described, the combination of a container having an inlet and an outlet for the flow therethrough of paper making stock, means for producing a continuous flow of stock under a substantially constant head through said inlet into said container, the inlet and outlet for said container being constructed and proportioned to maintain a head of stock in said container which varies with changes in the consistency of the stock flowing therethrough, a float in said container, a device adjustable to control the rate of discharge of stock from said container, and connections for causing said float to control said device and thereby to effect adjustment of said rate.

15. In an apparatus of the character described, the combination of a container having an inlet and an outlet for the flow therethrough of paper making stock, means for producing a continuous flow of stock under a substantially constant head through said inlet into said container, the inlet and outlet for said container being constructed and proportioned to maintain a head of stock in said container which varies with changes in the consistency of the stock flowing therethrough, a float in said container, a gate adjustable to control the rate of discharge of stock from said container, and connections for causing said float to adjust said gate in response to changes in the level of the stock in said container.

16. In an apparatus of the character described, the combination of a container having an inlet and an outlet for the flow therethrough of paper making stock, means for producing a continuous flow of stock under a substantially constant head through said inlet into said container, the inlet and outlet for said container being constructed and proportioned to maintain a head of stock in said container which varies with changes in the consistency of the stock flowing therethrough, a float in said container, and means under the control of said float for adding water to the stock at a rate determined by the position of the float.

17. In an apparatus of the character described, the combination of a container having an inlet and an outlet for the flow therethrough of paper making stock, means for producing a continuous flow of stock under a substantially constant head through said inlet into said container, the inlet and outlet for said container being constructed and proportioned to maintain a head of stock in said container which varies with changes in the consistency of the stock flowing therethrough, a float in said container, means under the control of said float for varying the rate of discharge of stock from said container in response to changes in the position of said float, and additional means under the control of said float for adding water to the stock at a rate determined by the position of the float.

18. In an apparatus of the character described, the combination of a container having an inlet and an outlet for the flow therethrough of paper making stock, means for producing a continuous flow of stock under a substantially constant head through said inlet into said container, the inlet and outlet for said container being constructed and proportioned to maintain a head of stock in said container which varies with changes in the consistency of the stock flowing therethrough, a float in said container, and means under the control of said float for adding water to the stock discharged from the container at a rate determined by the position of the float.

19. In an apparatus of the character described, the combination of a container having an inlet and an outlet for the flow therethrough of paper making stock, means for producing a continuous flow of stock under a substantially constant head through said inlet into said container, the inlet and outlet for said container being constructed and proportioned to maintain a head of stock in said container which varies with changes in the consistency of the stock flowing therethrough, a float in said container, and means under the control of said float for adding water to the stock at points both before it reaches said container and after its discharge therefrom, and at a rate determined by the position of the float.

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