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## CONSISTENCY RESPONSIVE DEVICE

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The present invention relates generally to control apparatus for regulating the consistency of fluid material, and more particularly to a novel and improved apparatus for regulating the consistency of stock to be used in paper-making.

In conventional paper-making, fluid stock, after beating and refining, is deposited in a layer upon a moving mat or screen, where the water is eventually removed to transform the fluid stock into a continuous web of paper. As will be readily apparent, the consistency of the stock will materially affect the manner in which it is deposited upon the screen, and if there are variations in the stock consistency from time to time there will be resulting variations in the nature and quality of the paper produced. Accordingly, the present invention seeks to provide an improved and simplified apparatus for incorporation in a continuous paper-making installation for accurately and sensitively controlling the consistency of the stock.

It is acknowledged that proposals have been made heretofore for automatically controlling the consistency of paper-making stock. The present invention is therefore directed primarily to improvements having the effect of rendering consistency control more accurate and dependable than has been possible in the past.

The several specific improvements of the invention will be best understood by making reference to the following detailed description and accompanying drawing, in which:

Fig. 1 is a simplified schematic representation, partly in section, of a consistency regulator apparatus constructed in accordance with this invention; and

Fig. 2 is a fragmentary top plan view of the apparatus of Fig. 1.

In Fig. 1, the numeral 10 designates a pipe for transferring paper-making stock from suitable beating or refining apparatus, not shown, into an open chamber or tank 11. The stock passes from the tank 11 into a consistency controlling device 12 and from there into a stock chest 13. Eventually, the refined stock in the chest 13 is deposited on a moving screen or mat, not shown, for further operations in the paper-making process.

The device 12 comprises a hopper 14 having an open top and a funnel-like bottom 15. A restricted passage 16 is connected to the bottom of the hopper 14 and is adapted to receive stock from the hopper and direct it into the chest 13. The hopper 14 is supported by means of a lever 17 which is pivoted at 18 to a suitable frame 19 and has a counterweight 20 at its free end. The arrangement is such that the stock passing from the tank 11 through the hopper 14 and restricted passage 16 will build up to a certain level in the hopper, as determined by the rates of flow of the stock into the hopper and out of the restricted passage 16. Thus, if the stock is thick or has a high consistency it will flow less freely through the passage 16 and will therefore tend to collect more in the hopper 14. This will cause

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the lever 17 to become unbalanced, raising the counterweight 20. By means of suitable interconnections between the balance lever 17 and a valve 21, raising of the counter-weighted end of the lever 17 will increase the admission of dilution liquor such as water into the stock pipe 10, through a liquor inlet 22. This will increase the dilution of the stock, lowering its consistency and permitting a freer flow through the restricted passage 16 until the lever 17 is again balanced.

To control the rate of flow of the diluted stock from the tank 11 into the hopper 14, the tank is provided with an outlet opening 23 in its bottom wall positioned directly above the hopper. In addition, the tank is provided with an interior wall 24, of lesser height than the walls of the tank, which forms a weir to regulate a level of the stock in the tank over the outlet 23. Stock overflowing the weir 24 flows into a chamber 25, which has an outlet 26 leading directly to the stock chest 13.

So much of my apparatus as has been described above has been heretofore generally known; see for example J. R. Spoor Patent No. 1,689,755. One of the difficulties encountered with the use of it alone, however, in regulating the consistency of paper stock has been that the diluted stock tends to separate in the tank 11, with the dilution liquor settling toward the bottom and the stock floating toward the surface. In such cases, a large percentage of stock flows over the top of the weir 24, while dilution liquor flows through the main outlet 23 into the measuring device 12. As will be readily apparent, it is difficult, if not impossible, to obtain accurate and dependable regulation under such conditions.

To overcome the difficulties mentioned above, the apparatus of the present invention incorporates a baffle 27 which is mounted on the bottom wall of the tank 11 directly in front of the discharge outlet of the stock inlet pipe 10. The baffle 27 intercepts and disperses the inflowing stream of stock so that the diluted stock is maintained in a turbulent condition to insure that the stock and liquor are thoroughly mixed together and maintained in a mixed condition. The baffle 27, in the illustrated apparatus, is of less width than the tank 11 so that the diluted stock may flow around as well as over the baffle.

Between the baffle 27 and the measuring outlet 23 there is a second baffle 28 which is secured to the opposite side walls of the tank 11. The upper edge of the baffle 28 extends to the top of the tank 11, or at least to such a height that the incoming stock is prevented from flowing over the baffle. The lower edge of the baffle is spaced slightly from the bottom wall of the tank and thereby forms a passage 30 for the flow of diluted stock into the central chamber 29 of the tank, as defined by the baffle 28 and weir 24.

In the improved arrangement, the stock flowing into the tank 11 is mixed and maintained in a turbulent state and then forced to pass into the main chamber 29 through the narrow opening 30. It is thus assured that the material flow through the outlet 23 is of a representative consistency so that accurate and dependable regulation may be effected by means of the consistency controlling device 12.

To further improve the accuracy of the regulating apparatus, there is provided at the outlet 23 a sharp-edged orifice plate 31 which is removably secured to the bottom wall of the tank by means of bolts 32. The flow of fluid through the sharp-edged orifice plate 31 under the pressure of the fluid head determined by the height of the weir 24 has been found to more accurately reflect the consistency of the diluted stock than if the stock were permitted to pass through a conventional outlet pipe.

To accommodate wide ranges of stock consistencies

such as may be employed in the production of papers of various types and qualities, provisions are made for adjusting the height of the weir 24 as well as for replacing orifice plate 31, so that the pressure head may be increased or decreased and the size of the orifice opening may be enlarged or reduced. In the illustrated apparatus, the weir 24 is comprised of a plurality of elongated elements 24a, such as boards, for example, which are engaged at their ends in grooved vertical tracks 33 provided on opposite side walls of the tank. As will be readily apparent, the height of the weir and thus the head of stock may be quickly altered by adding or removing one or more elements 24a.

In order to render the control apparatus highly responsive to the stock consistency variations, so that the proper dilution is quickly effected, the dilution control valve 21 is of a type having a pneumatic actuating mechanism 21a, whereby the valve 21 changes its position in response to changes in the pressure of air applied to the actuator 21a. In the illustrated arrangement, the actuator 21a is supplied with air under pressure from a conduit 34 connecting with a control valve 35. The valve 35 may be of a conventional type, having a control member 36 which is movable to regulate the flow of air to conduit 34 from inlet conduit 39. The control member 36 is connected by a link 37 to the balance lever 17, so that movements of the latter operate to adjust the valve 21 to either increase or decrease the flow of dilution liquor to the material in the inlet pipe 10.

It is advantageous to employ the pneumatically actuated valve 21 for controlling the flow of dilution liquor since the system is more responsive to movements of the balance lever 17, and it is possible to control larger volumes of the dilution material with a balance mechanism of moderate size.

Perhaps the most important advantage of the invention resides in the new arrangements for handling the diluted stock in such manner that the stock measured is accurately representative of the entire volume. Thus, means are provided for initially dispersing and mixing the stream as it enters the tank, so that the base stock is thoroughly mixed with the dilution liquor. As the diluted material moves toward the outlet 23 of the tank, it is caused to flow in a course near the bottom of the tank, and this assures that the stock surrounding the outlet is a representative sample.

Another advantageous feature of the invention resides in the provision of a readily adjustable weir, in combination with an orifice plate which is removably secured over the outlet of the tank. This enables the apparatus to accommodate stock of a wide range of consistencies.

The apparatus herein shown and specifically described is intended to be illustrative only, and reference should be

made to the following claims in determining the full scope of the invention.

#### I claim:

1. A consistency responsive device for use in a system for regulating the consistency of paper making stock, comprising a tank for containing a supply of stock, means dividing said tank into first and second chambers, one wall of said first chamber being of predetermined height whereby said first chamber maintains a stock supply at a predetermined height from the bottom wall of said first chamber, means in said bottom wall forming an orifice through which stock is discharged from said first chamber, said orifice being of predetermined size substantially smaller than the effective area of said bottom wall, a source of substantially uniformly mixed stock for discharge into said second chamber through an inlet in a side wall thereof, baffle means positioned intermediate the side walls of said second chamber and in the line of flow of stock from said inlet to divide the inflowing stream of stock and maintain said stock in a turbulent state, said dividing means being spaced from the bottoms of said first and second chambers and providing substantially the only communication between said chambers for the flow of stock from said second to said first chamber, said orifice forming means being positioned closely adjacent said means of communication, whereby stock flowing into said first chamber is directed generally along its bottom wall and a portion of the stock is caused to flow directly over said orifice forming means, and overflow means for receiving excess stock from the upper portion of said first chamber.

2. The consistency regulator of claim 1, in which said bottoms of the first and second chambers form a common bottom wall, and said dividing means providing said communication is formed by a wall supported from opposite sides of said tank and extending substantially but not entirely to said common bottom wall.

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