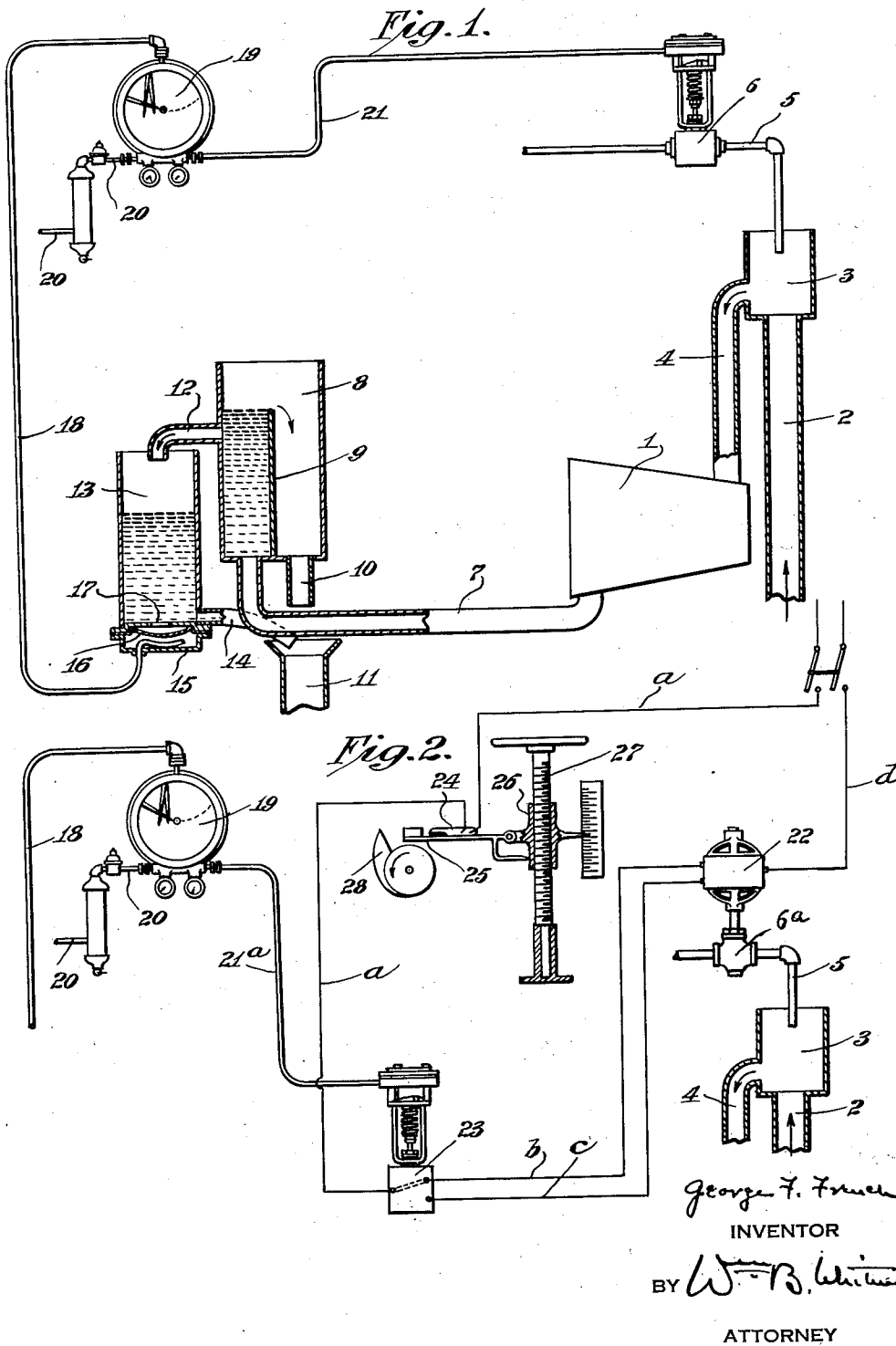


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CONSISTENCY REGULATOR

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This invention relates to a method of and apparatus for determining and regulating the viscosity of a fluid, and while designed specifically for the automatic regulation of the consistency of paper stock in the manufacture of paper is well adapted for use in any analogous art where there is a continuous flow of the fluid to be regulated.

In the manufacture of paper, the pulp or other stock is, or may be, fed to shredders and as it is shredded water is added thereto, and the stock thus started and in aqueous suspension is pumped in stages first from the shredder chest to the beaters, then from the beater chest to the Jordans or other refining engines, and then from the Jordan chest to the machine chest and from the latter to the stuff box of the paper machine; and for various practical reasons it is important to know, and to regulate, the consistency of the stock at these several stages.

Numerous automatic consistency regulators of different types have heretofore been devised, but practical experience with those now on the market has shown that they are all more or less objectionable because they are expensive, or complicated and require undue attention to maintain, or are inaccurate and unreliable, or occupy a great deal of space, or combine several of such undesirable features.

By my present invention I have provided, for the practice of my new method of regulation, an apparatus which is simple in construction, efficient and accurate in its operation, is made up for the most part of standard parts or devices, requires little space, and can be assembled and installed at a relatively low cost.

My new regulatory system comprises, broadly stated, the steps of and means for causing variations in a characteristic of a material, such for example as the consistency of a paper stock, to effect corresponding variations in the compression of a gaseous body like air and then utilizing such pressure variations to automatically control the characteristic of said material.

One practical embodiment of the invention as applied to the determination and regulation of the consistency of paper stock as delivered from the beater chest to a Jordan engine, and a modification thereof, are shown, by way of illustration and not of limitation, in the accompanying drawing, in which—

Figure 1 is a more or less diagrammatic view of an apparatus, with parts thereof shown in vertical section, in which the supply of diluent water to the paper stock is regulated by means

of a pneumatic valve; and Fig. 2 is a view of parts of the same apparatus as modified for the use of an electrically-actuated valve to control the supply of diluent water.

Referring first to Figure 1 of the drawing, the Jordan engine 1, shown by way of example, is fed with stock which, as usual, is pumped from the beater chest (not shown) through the pipe 2 to a head box 3, where it is or may be thinned by the addition of water thereto, and thence flows through the pipe 4 to the engine. The diluent water is supplied by pipe 5 equipped with a valve 6 which, as shown, is a pneumatically controlled valve of standard or any suitable type.

From the Jordan the stock is conducted through pipe 7 first to a constant level and thence in part to a variable level box or chamber, both of which are well known. In the first of these boxes, box 8, the stock, fed to one side thereof, is maintained therein at a constant level by a dam or partition wall 9 over which it overflows and the overflow is discharged through an outlet pipe 10 and thence into the upper end of a pipe 11 and to the Jordan chest (not shown), while a portion of the stock is discharged under constant head end pressure through the spout 12 into the box 13 whence it is discharged through an outlet spout 14 of restricted capacity adapted to maintain within the box a head varying directly with its consistency, into the upper end of the pipe 11.

A diaphragm box 15, of the usual construction, is attached to the lower end of the box 13, the bottom of the box being cut away, as at 17, so that the variable head of the stock therein bears directly upon the diaphragm 16 and as its head rises and falls variably compresses the air within the diaphragm box.

The interior of the diaphragm box is connected by a tube 18, in the usual manner, with a controller 19, preferably, as shown, a combined recorder and controller which both records the varying pressure of the air within the diaphragm box, due to variations in the head of the stock above, and acts as a relay to control a valve regulating the passage of compressed air from a tube 20 connected with a source of supply (not shown) to the tube 21 connected with the pressure head of the pneumatically controlled valve 6 in the water supply pipe. Any standard type of controller can be used for the purpose, but I prefer, and recommend, the recorder-controller known commercially as "Stabilog", which, in addition, is equipped with an anti-hunt capillary; and the recording charts used therewith can, if desired,

be calibrated so as to record the consistency, rather than the level, of the stock in the variable level box 13.

The operation of the apparatus, which will be obvious from the above description thereof, may be briefly summarized as follows: The head of stock within the variable level box compresses the air within the diaphragm box and the pressure of this air, which varies as the level of the stock rises or falls due to changes in its consistency, is communicated to the recorder-controller, which records, in the usual manner, the level and/or consistency of the stock in this box. In case the consistency of the stock increases and rises in the variable level box above a predetermined level, the recorder-controller will open its valve to admit more compressed air to the pressure head of the valve 6 which will thereupon raise the valve against the action of a spring and admit more diluent water to the head box of the Jordan, or, if the consistency decreases and the level of the stock falls, the supply of compressed air to the valve 6 will be throttled down, allowing its spring to close the valve and reduce the supply of diluent water.

The apparatus is a sensitive one and, in practical use, has proven very efficient in maintaining stock at the consistency desired.

In the modification illustrated in Fig. 2, the valve 6^a which controls the supply of diluent water, is operated by a small motor 22, and compressed air under control of the recorder-controller 19 is supplied by the tube 21^a to the pressure head of a pneumatic switch 23, which in turn controls the circuit wires *a*, *b*, *c*, and *d* which operate the motor 22 in one direction or the other as required; and this electric control is provided, as shown, with an anti-hunt device which comprises a mercury switch 24, which controls the circuit wire *a*, carried by an arm 25 pivotally attached to a block 26 adjustably mounted upon a rotatable threaded post 27 and, operatively related to the arm 25, a cam 28 which rotates constantly at slow speed, say, one revolution per minute. Thus, with every revolution of the cam, the mercury switch will be tilted up to close the circuit through the wire *a*, and the length of the time during which the circuit will remain closed may be increased by lowering and decreased by raising the block 26 upon its threaded support. Accordingly, whenever, under control of the recorder-controller, the pneumatic switch 23 is actuated to close the circuit of the motor 22 to connect the wire *a* with either the wire *b* or the wire *c*, the motor 22 will be operated, to open up or throttle down the valve 6^a as the case may be, during such intervals as the circuit of the wire *a* may be closed by the mercury switch and so long as that wire is connected with either wire *b* or *c*. If desired, the arm of the recording pen of the recorder-controller may serve, in known manner, as the movable element of a double-throw switch to directly control the circuits of the motor 22, thereby eliminating the pneumatic switch 23.

What I claim as new, and desire to secure by Letters Patent, is—

1. The method of maintaining substantially constant the viscosity of a fluid which comprises causing variations in the viscosity thereof to effect directly proportionate variations in the head of a columnar body of said fluid and utilizing solely the variations in the static pressure of said fluid body due to variations in its head to correct the variations in the viscosity of the fluid.

2. The method of regulating the viscosity of a

fluid which comprises maintaining a body of the fluid to be controlled under a head varying directly with and proportionately to its viscosity, causing the variable static pressure of said variable head of the fluid to variably compress a fluid body like air, and causing the variable pressure of said fluid body to automatically effect the regulation of the viscosity of the fluid to be controlled.

3. The method of regulating the consistency of stock suspended in water which comprises maintaining a confined columnar body of aqueous suspension of stock under a head varying directly with its consistency, causing the static pressure of the variable head of said body to variably compress a fluid body, and utilizing the variations in the pressure of said fluid body, to automatically control the admission of water to said aqueous suspension of stock.

4. Apparatus for maintaining substantially constant a characteristic of a body of material comprising means for varying the characteristic of said material, means responsive solely to the static pressure of a columnar body of the material having a head varying directly with and in direct proportion to variations in said characteristic for effecting corresponding variations in the compression of a fluid body, and means responsive to variations in the pressure of said fluid body for controlling said means for varying the characteristic of said material.

5. Apparatus of the type described, comprising means for altering the viscosity of a fluid, means for maintaining from a continuous stream of the fluid, a body thereof under a head varying directly with its viscosity, means responsive solely to variations in the static pressure of said body of fluid for effecting corresponding variations in the pressure of a fluid body and means controlled by the varying pressure of said fluid body for controlling said means for altering the viscosity of the fluid to be controlled.

6. Apparatus of the type described, comprising means for supplying varying quantities of a diluent to a material, means for maintaining from a constant stream of the diluent material a confined columnar body thereof under a head varying directly with its consistency, and means controlled by the varying weight of the variable head of said body of diluent material for controlling said means for supplying the diluent to the material.

7. Apparatus of the type described, comprising means for supplying variable quantities of water to a paper stock, means for maintaining from a constant stream of the aqueous suspension of said stock a confined columnar body thereof under a head varying directly with its consistency, means responsive solely to the static pressure of the varying head of said body of aqueous suspension of stock for effecting variations in the pressure of a body of air, and means controlled by the varying pressures of said body of air for controlling the said means for supplying water to the paper stock.

8. Apparatus of the type described comprising, in combination with means for supplying a variable quantity of diluent water to a paper stock, a standpipe, means for feeding to said standpipe under substantially constant pressure a continuous stream of the aqueous suspension of stock, means for maintaining within the standpipe a head of the aqueous solution of stock varying with the consistency thereof, means responsive to variations in the head of the aqueous suspension

of stock within the said standpipe for effecting variations in the pressure of a body of air, and means controlled by such variations in air pressure for controlling the means for supplying the diluent water to the stock.

9. Apparatus of the type described comprising, in combination with a supply of a diluent to a material, a container, means for feeding to the container under a substantially constant head a portion at least of the diluted material adapted to maintain therein a head of such material varying according to its consistency, and means including a fluid pressure relay actuated by the variable head of the diluted material within the container for controlling the supply of the diluent.

10. Apparatus of the type described, comprising a water supply pipe, a power-actuated valve controlling the water diluent through the supply pipe, a standpipe, means for feeding to the standpipe under a substantially constant pressure a portion at least of the stock receiving the water through said valve, a discharge outlet from the standpipe of a capacity adapted to maintain a head of stock therein varying in height according to its consistency, means for compressing a body of air under the varying head of the stock within the standpipe, and means responsive to changes in the pressure of the air so compressed for controlling the actuation of the water-controlled valve.

11. Apparatus of the type described comprising a standpipe, means for feeding thereto under a substantially constant head a portion at least of the stock the consistency of which is to be regulated, a discharge outlet from the standpipe of a capacity adapted to maintain within the standpipe a head of the stock varying according to its consistency, a fluid pressure relay responsive to changes in the head of stock within the standpipe, a valve-controlled supply of diluent water for the stock, and means controlled by the fluid pressure relay for controlling the control valve whereby the quantity of diluent water admitted to the stock will be increased whenever the head of stock within the standpipe rises above a predetermined level and will be throttled down when the head of stock falls below such level.

12. Apparatus of the type described comprising, in combination with a power-actuated valve for regulating the supply of water to a paper stock suspended in water, means for maintaining from a continuous stream of the diluted stock under substantially constant pressure a variable head thereof varying with its consistency, a diaphragm box with diaphragm operatively connected with and responsive to variations in the variable head of diluted stock, and a pressure recorder-controller operatively connected on one

side with the diaphragm box and on the other side with the power-actuated valve adapted to record the pressure and/or consistency of the variable head of diluted stock and to effect the actuation of the power-controlled valve to increase or diminish the supply of water as required for the desired regulation of the consistency of the stock.

13. Apparatus of the type described comprising, in combination with a pneumatically-actuated valve for regulating the supply of water to paper stock suspended in water, means for maintaining from a continuous stream of the diluted stock under substantially constant pressure a variable head thereof varying with its consistency, a diaphragm box with diaphragm operatively connected with and responsive to variations in the variable head of the diluted stock, and a fluid pressure relay operatively connected on one side with the diaphragm box and on the other side with the pneumatically actuated valve adapted to effect the actuation of the pneumatic valve to increase or decrease the supply of diluent water as required for the desired regulation of the consistency of the stock.

14. Apparatus of the type described comprising, in combination with an electrically-actuated valve for regulating the supply of water to paper stock suspended in water, electric circuits for controlling and operating the motor, means for maintaining from a continuous stream of the diluted paper stock a body thereof under a head varying with its consistency, means responsive to variations in the head of said body of diluted paper stock for effecting corresponding variations in the pressure of a fluid body, and means controlled by the varying pressure of said fluid body for controlling the circuits of the motor.

15. Apparatus of the type described comprising, in combination with an electrically-actuated valve for regulating the supply of diluent water to paper stock, electric circuits for controlling and operating the motor, a switch for controlling the motor circuits, means for maintaining from a continuous stream of the diluted paper stock a body thereof under a head varying with its consistency, a diaphragm box with diaphragm operatively connected with and responsive to variations in the variable head of the diluted stock, and a pressure recorder-controller operatively connected on one side with the diaphragm box and on the other side with the switch adapted to record the pressure and/or consistency of the diluted stock and to actuate the switch to effect the operation of the motor to increase or decrease the supply of diluent water as required for the desired regulation of the consistency of the paper stock.

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