

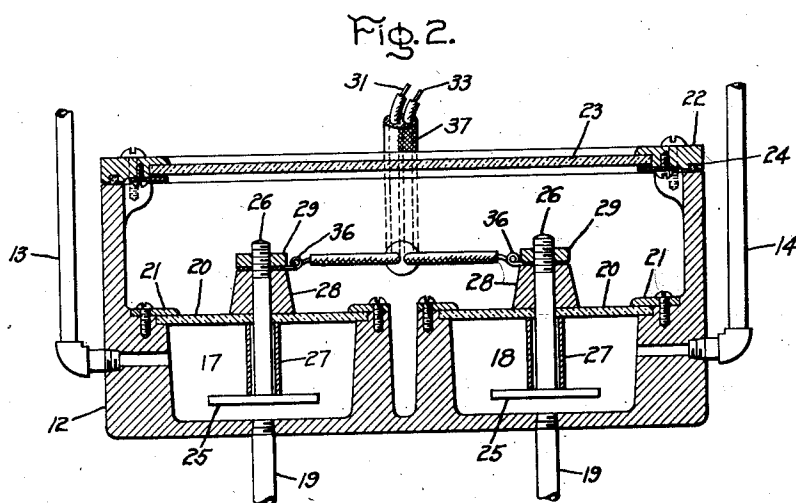
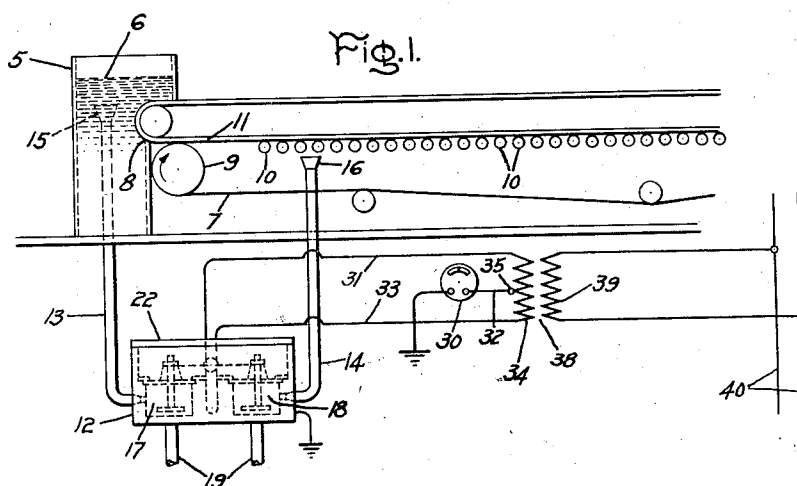
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CONSISTENCY METER

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UNITED STATES PATENT OFFICE.

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CONSISTENCY METER.

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The present invention relates to consistency meters for use with paper-making machines to determine the proper amount of stock flowing in the water from the flow box to the machine, and has for its object the provision of an improved electrically operated meter of this type, which is simple in structure and reliable in operation.

While the invention is applicable to paper-making machines generally, it will, by way of example, be described and illustrated herein in its application to the Fourdrinier type of machine, and for an understanding of what is believed to be novel and the invention, attention is now directed to the accompanying drawing, the description thereof and the appended claims.

In the drawing, Fig. 1 is a diagrammatical representation of the flow box or head end of a Fourdrinier machine provided with a consistency meter installation embodying the invention, and Fig. 2 is a cross-sectional view, on an enlarged scale, of a portion of Fig. 1.

Referring to Fig. 1, 5 is the flow box of a Fourdrinier machine, in which the stock, that is the mixture of pulp and water, is maintained at a certain head 6 above the traveling Fourdrinier wire 7, onto which the stock passes at 8. The wire travels over an idler or breast roll 9 and is supported by table rolls 10. The direction of rotation of the breast roll is indicated by the arrow and is such that the wire 7 carries the stock away from the stock box. 11 is one of two deckle straps which lie on the wire adjacent the edges of the latter and serve to retain the stock thereon. As the stock travels with the wire it drains free of the water with which it was mixed in the flow box.

Now in accordance with the invention, by a continuous sampling process, the water, called white water, which drains from the stock, is continuously compared by electrical means with the mixture in the flow box. It has been found that a comparison of the electrical resistances of the flow box mixture or stock and the white water gives a very accurate comparison of their respective consistencies. Since the white water is practically clear water and is the same as that in the flow box, the consistency of the stock, that is, the proportion of water to pulp in the flow box, may be compared with the consistency of

the white water, with the latter as a base or standard.

In bringing about this comparison in accordance with the invention, the stock and white water are continually sampled by suitable means connected with the Fourdrinier machine and caused to flow therefrom in separate streams through conduit means providing resistance units wherein the flowing samples form the resistance elements or create resistance paths between insulated electrodes depending into the conduits and the walls of the latter which form the opposing electrodes. The resistance units are connected into an electrical circuit which is responsive to changes in their relative resistances, such as a branched or divided electrical circuit having the resistance paths in the branches and a common return wire in which is placed a current-responsive device.

The stock has the higher resistance because of the pulp which it contains, and the resulting unbalance in resistance causes a current substantially proportional thereto to flow in the current-responsive device. This current varies proportionally with variations in the consistency of the stock and such variations are shown by the current-responsive device.

The resistance of the white water remains constant with respect to that of the stock, since it is the drainage from the stock. Therefore, as above stated in part, any change in its quality affecting its resistance will also correspondingly have affected the resistance of the stock, with the result that such changes will not appear in the indications of the current-responsive device.

In carrying out the above arrangement, in the present example, the resistance units provided in the path of the stock and of the white water are carried in a common metering box or casing 12 which is placed below the sampling points on the Fourdrinier machine. The casing is connected with the machine by a pair of sampling tubes or conduits 13 and 14. Tube 13 extends upwardly into the flow box and is provided with a bell-shaped intake end 15 located below the level of the stock and adjacent the outlet 8 to the Fourdrinier wire. Tube 14 extends upwardly from casing 12 and inwardly between the upper and lower stretches of the Fourdrinier wire. It is provided with a bell-shaped in-

take end 16 positioned to receive a sample of the white water which drains through the wire at a point adjacent the first table rolls. The drainage is heavy at this point and provides a flow sufficient in volume for a measurement sample.

With the casing located below the sampling points, samples flow to it by gravity, which simplifies the installation. The resistance units, to which tubes 13 and 14 are connected, are indicated at 17 and 18, and are in the form of cups integral with the casing. The interior construction of the casing and the cups is more fully shown in Fig. 2, to which, along with Fig. 1, attention is now directed.

Each of the resistance cups is provided with a drain outlet conduit 19 at the bottom and with a tight fitting cover or window 20 of glass, or similar insulating and transparent material, held down by a clamping ring 21. Casing 12 is also provided with a removable cover 22 in which is mounted a tightly fitted glass window 23. Cover 22 is provided with a packing strip 24 along its edge and is secured to the casing by clamping screws, as indicated, so that it seals the top of the casing tightly.

Each resistance cup is further provided with a centrally located electrode 25 of conducting material, such as brass, which is provided with a threaded shank 26 extending upwardly therefrom through the cover. The electrodes are provided with spacing tubes 27 which surround the shanks below the cover and with spacing rings 28 which are placed on the shanks above the cover. The electrode assemblies are then tightly clamped to the cover by clamping or terminal nuts 29 threaded onto the upper end of the shanks.

The arrangement is such that the sample of stock taken through tube 13 flows in a continuous stream through cup 17 and out through conduit 19, surrounding in its passage through the cup, the electrode 25 therein and providing an electrical resistance path between the electrode and the walls and bottom of the cup which form an opposing electrode. In a similar manner the white water taken through tube 14 flows about the electrode in cup 18 and provides a second electrical resistance path between said electrode and the electrode provided by the walls and bottom of the cup. In the present example the metering box or casing 12 and cups 17 and 18 are integral and thus provide a common conducting body or electrode between which and the separate insulated electrodes the samples flow in separate streams, although it should be understood that while this arrangement is at present considered to be the best, the invention is not limited thereto and that other equivalent arrangements may be provided.

The electrodes are insulated from each other and from the common conducting body

by the glass covers, which, in conjunction with the glass window for the meter box, permit the interiors of the resistance cups to be observed. This is a desirable feature in that faulty operation due to clogging in the resistance cups may be quickly detected.

As indicated in the drawing, the electrodes are uniformly spaced from the walls and bottoms of their respective cups; hence the length and area of the resistance path are the same in both cups. With this arrangement, the same fluid in both resistance cups will give the same resistance between the electrodes and the walls of the cups.

The resistance of the stock and hence its consistency with respect to that of the white water may be indicated or recorded by any suitable circuit and metering arrangement which includes the resistance cups as the variable means. In the present example, by way of illustration, a simple current-responsive device, such as an ammeter 30, and a three wire circuit 31, 32, 33, is employed, with a divided voltage source of electrical energy 34 connected at its terminals with circuit wires 31 and 33 which lead to the electrodes in resistance cups 17 and 18 respectively. A mid-tap 35 on voltage source 34 leads through circuit wire 32 to the casing of the meter box. In the present example this connection is made by grounding the casing and circuit wire 32, as indicated, with ammeter 30 in this grounded circuit.

Circuit wires 31 and 33 enter casing 12 above the resistance cups and are secured to the electrodes by terminal lugs 36 which are clamped between nuts 29 and spacing rings 28. In order that no moisture may enter the space about the terminals 36, that is, the terminal chamber, to cause electrical leakage and thus introduce errors in the consistency readings, the glass covers 20 are cemented when seated in place, as are also the electrode assemblies at the point where the shanks 26 pass through the covers 20. As the circuit wires are carried in a conduit 37 to the meter box, the terminal chamber is practically hermetically sealed and moisture proof.

It will be seen that the circuit arrangement is such that a resistance cup or unit is located in each outer leg of the divided voltage source 34 and that a common grounded return is provided through the ammeter 30. In the present example the divided voltage source 34 is the secondary of a transformer 38. The primary 39 of the transformer is connected with alternating current mains which supply energy to the transformer at a constant voltage. This permits a constant voltage to be maintained at the terminals of the secondary 34.

The transformer ratio is such that only sufficient voltage is applied to circuit wires 31 and 33 to cause a current of low value to flow through the resistance cups when in op-

eration, that is, only sufficient current to cause the ammeter to assume approximately half scale deflection when the stock is of the desired consistency.

Although any suitable source of electrical energy may be used, the transformer and circuit arrangement shown provides that the sampling tubes 13 and 14 and connected apparatus are isolated from the mains 40, and grounded. This minimizes the danger from electrical shock to the operator of the machine in addition to providing for adapting the metering circuit to any alternating current supply source through the use of a transformer of proper ratio.

The operation of the arrangement shown is as follows: With the Fourdrinier machine in operation and the supply mains 40 energized at constant voltage, stock will flow through sampling tube 13 and resistance cup or unit 17, while white water will flow through sampling tube 14 and resistance cup or unit 18.

The resistance of the stock will be greater than that of the white water and will cause the three-wire circuit to become unbalanced, with the result that a certain current will flow in the grounded return or neutral leg 32. This will be indicated by a certain scale indication of the ammeter. The latter is then calibrated in connection with the Fourdrinier machine by obtaining the desired consistency in the flow box and observing or marking the ammeter reading. As the consistency determines the weight of the paper produced, the consistency for a paper of a certain grade or weight is obtained by weighing samples of the paper produced, while varying the consistency until the desired weight is obtained.

As the consistency changes from this value, corresponding to the desired weight in the product, the change is indicated by the ammeter which responds to the corresponding changes in the resistance in cup 17. The operator then corrects the mixture to bring the consistency reading of the ammeter back to the original value.

It has been found that this arrangement is very sensitive and that the meter responds to changes in consistency well within limits corresponding to the permissible limits in weight variations of the paper produced. It should be understood that the arrangement shown is not limited to the use of an ammeter as a current-responsive device and that it is shown and described only by way of example.

In the case where a variety of papers are produced by the same machine, the ammeter scale is ordinarily marked for each reading corresponding to the various consistencies as found by the initial weighing. This renders the matter of changing the consistency to produce any of the desired grades of paper very simple, as the consistency corresponding to the desired weight or grade of paper may

be very closely obtained by the meter and the exact reading determined by a few weighing trials.

It will be noted that the only connection between the metering arrangement and the Fourdrinier machine, which would be true in connection with any other paper machine, is made by sampling tubes 13 and 14 which are easily attached thereto. This renders the installation of the metering arrangement extremely simple and permits its use with any existing installation of paper-making machines without serious or costly change in the latter.

The use of a grounded return wire 32 for the meter 30 permits the latter to be located at any desired point, such as at the control point of the machine, with only one circuit wire leading to it, as the return wire may be grounded at any convenient point.

While the invention has been described and illustrated in its specific application to Fourdrinier paper-making machines, it is not necessarily limited thereto as is obvious and accordingly may be put to other uses wherever found applicable.

What I claim as new and desire to secure by Letters Patent of the United States is:—

1. The combination with a paper-making machine having a flow box in which is maintained a supply of paper stock and means providing white water drainage from the stock, of means for continuously sampling the stock and the white water, said means comprising a pair of conduits one of which is inserted in the flow box to receive sample stock therefrom and the other of which is positioned to receive sample white water from the means providing the same, an insulated electrode in each conduit, means in each conduit providing a grounded electrode adjacent the insulated electrode therein, means for providing electrical energy of substantially constant voltage having terminals connected with the insulated electrodes and having a mid-tap, a ground connection for said mid-tap whereby said last-named means is connected with the grounded electrodes, and a current-responsive device in said ground connection.

2. The combination with a paper-making machine having a flow box in which is maintained a supply of paper stock and means providing white water drainage from the stock, of means for continuously sampling the stock and the white water, said means comprising a pair of conduits one of which is inserted in the flow box to receive sample stock therefrom and the other of which is positioned to receive sample white water from the means providing the same, an insulated electrode in each conduit, means in each conduit providing a grounded electrode adjacent the insulated electrode therein, a transformer having secondary terminals connected with the

insulated electrodes, and having a secondary mid-tap, means providing a circuit between said mid-tap and the grounded electrodes, and a current-responsive device in said circuit.

3. A consistency meter for a paper making machine comprising in combination a casing, a pair of electrically connected metallic cups located in the casing, insulated electrodes in said cups, said electrodes being spaced from the walls and bottom of said cups, a sampling tube connected with each of said cups

and extending in a vertical direction therefrom for conducting thereto by gravity sample stock and white water from the machine, means providing a drain outlet for each of said cups, an electrical energy source of constant voltage connected at its terminals with the electrodes and having a mid-tap, and a current-responsive device connected in circuit between said mid-tap and the cups.

In witness whereof I have hereunto set my hand this 25th day of August, 1925.

WILBUR L. MERRILL.