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E. J. WILSON ET AL

METHOD AND MACHINE FOR MANUFACTURING PAPER

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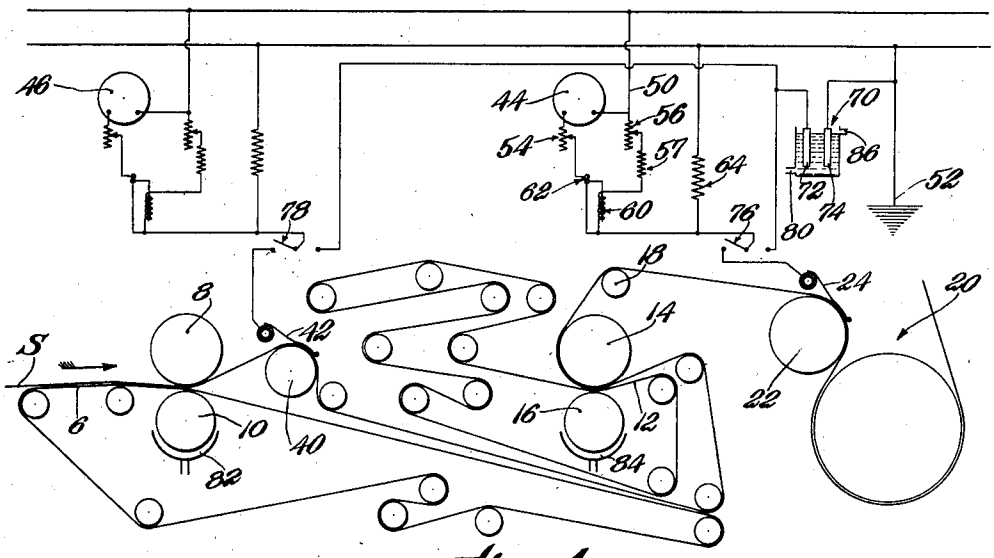


Fig. 1.

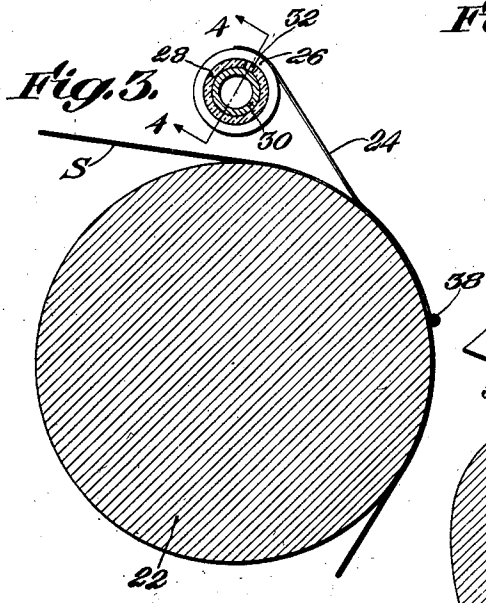


Fig. 3.

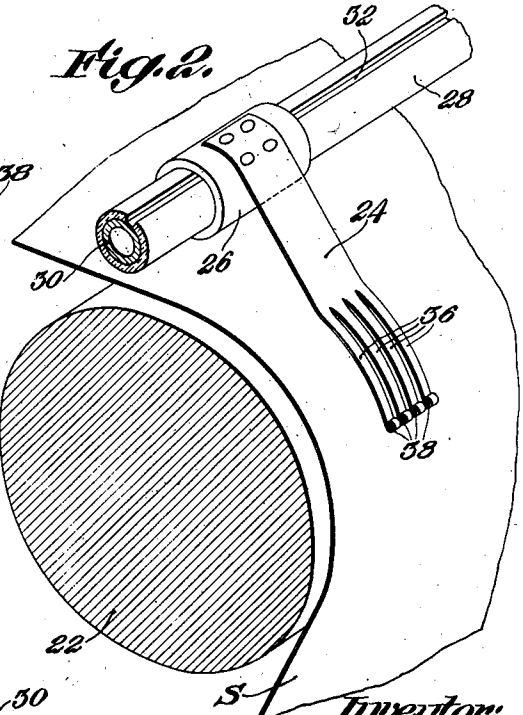


Fig. 2.

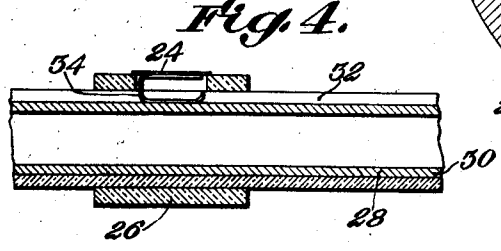


Fig. 4.

Inventor:
Ezekiel J. Wilson
Edwin A. Rees
by Van Everen, Fish, Hildreth & Heavy
Attys.

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UNITED STATES PATENT OFFICE.

EZEKIEL J. WILSON, OF EAST GREENBUSH, AND EDWIN A. REES, OF ALBANY, NEW YORK, ASSIGNORS TO F. C. HUYCK & SONS, OF RENSSELAER, NEW YORK, A CORPORATION OF NEW YORK.

METHOD AND MACHINE FOR MANUFACTURING PAPER.

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The present invention relates to the manufacture of paper, this application being a continuation in part of the application of Wilson and Rees, Serial No. 595,541, filed October 19, 1922.

In the manufacture of paper on a paper making machine a continuous travelling web of paper stock is formed on the Fourdrinier wire, or otherwise, and passes between a pair of couch rolls to a series of presses which act to express a portion of the surplus water therefrom, after which the web is subjected to the drying action of a series of heated calender rolls which finally dry and finish the web. For the most efficient operation, the web of paper stock, as it comes from the couch rolls, not only should contain a certain percentage of moisture, but also should have certain percentages of this moisture removed therefrom during each successive pressing operation, so that as little as possible of the moisture will remain to be removed by the heated cylinders of the dryers, and yet without such operation of the presses as to crush the stock or deleteriously affect the fibres. The mechanisms which operate successively upon the web of paper stock during its passage through the machine should therefore, for the most efficient operation, be adjusted and regulated to maintain substantially uniform percentages of moisture in the web of stock at the points in its travel between the successive operations thereon, and to effect maximum permissible diminutions in moisture content of the web in its passage through successive operations. They should also be so adjusted and regulated that at every point in its travel the moisture will not vary greatly throughout the width of the web.

The present invention provides for the regulation of the operations to which the web of paper stock is successively subjected to maintain the proper progressive decrease in moisture in the stock between successive operations and this is accomplished by indicating or indicating and recording the moisture and variations in the moisture in the stock at points in its travel and regulating the mechanisms for operating on the web in accordance with such indications or records. The moisture and variations in the moisture in the web of stock traveling through the machine are preferably measured or indicated by passing a current of electricity through the web from one side to the other and indicating the resistance offered by the web to the passage of the current, since it has been found that the conductivity of this thin layer of damp paper stock varies with variations in the moisture therein, and since it has also been found that even after a large part of the moisture has been removed, this thin layer of stock does not offer sufficient resistance to the passage of an electric current to preclude the use of currents of measurable intensity.

According to a feature of the present invention, the indicating means includes a novel type of electrode or contact member, which is adapted to have a smooth, unvarying engagement of large area with the web and serves to permit an accurate indication of the electrical resistance of the web without being thrown off or otherwise influenced by any irregularities in the stock. The contact member has provision for adjustment into various positions across the width of the web, to detect an excessive or subnormal moisture content in a portion of the web, caused by improper crown conditions in any of the rolls, non-uniform pressures or unequal weighting of the presses, or a dirty streak in the felt.

In applying the invention to the manufacture of paper on a paper making machine, a moisture indicating or indicating and recording mechanism is preferably installed after each point at which a change in moisture content occurs, for example, between the couch rolls and the first press, between successive presses, and at the entrance to the dryers. The condition of the web of stock after passing each operation and particularly its progressive changes in moisture content in passing through the machine are thus indicated so that any variation in the operation of any of the mechanisms operating successively on the web of stock may be detected and the proper adjustments or replacements made to restore such mechanism to normal and most efficient operation. The measuring and indicating of the moisture in the web of stock or the indication of a variation from the normal and desired moisture therein not only enables the requisite adjustments to be made to secure ef-

ficient operation of the mechanisms operating on the stock but also enables the operator to determine when a felt or jacket has become worn out and should be replaced and thus avoids the premature removal of a felt or jacket or the continued use of a felt or jacket after it has ceased to operate efficiently. This contributes to the efficient operation of the machine and reduces the cost of production.

The invention has been illustrated in and will be readily understood from the accompanying drawings in which Fig. 1 illustrates diagrammatically the application of the invention to a Fourdrinier paper machine; Fig. 2 is a perspective detail view illustrating the preferred form of the moisture measuring mechanism; Fig. 3 is a side elevation of the measuring device shown in Fig. 2; and Fig. 4 is a section on line 4—4 of Fig. 3.

In Fig. 1 the paper stock which is indicated at S coming from the Fourdrinier wire and the couch rolls passes onto the felt 6 by which it is carried between the upper and lower press rolls 8 and 10 of the first press, where a part of the moisture is removed from the stock by pressure applied to the top roll. This pressure may be regulated by the usual means not indicated. The felt is carried on the usual supporting and tension rolls illustrated in Fig. 1. The web of stock from which part of the moisture has been removed by the press rolls and felts of the first press passes therefrom onto the felt 12 to be carried between the upper and lower press rolls 14 and 16 of a second press, where additional moisture is expressed from the web in the same manner. From this second press the web passes over a guide roll 18 to a dryer which is indicated generally at 20, the web initially passing over the first dryer of the dryer stack, which is commonly known as the "baby dryer" and indicated in Fig. 1 at 22.

In passing through the machine the web of paper stock is subjected to successive operations, each of which removes a part of the moisture in the stock and changes its condition. Means is provided for indicating the moisture of the stock between successive operations thereon, so that each of the mechanisms operating on the web may be so regulated that uniform and efficient operation is insured. As illustrated in the drawings, the moisture indicating and recording mechanism is arranged to engage with the web after it leaves the first press roll and also while it is passing over the baby dryer. Also a similar mechanism may, if desired, be applied to the web as it leaves the couch rolls.

Each moisture indicating mechanism comprises a pair of electrodes, which in the illustrated embodiment of the invention are in the form of a roll over which the paper passes, and a spring contact engaging the opposite sides of the web. The device shown in Fig. 2 is the one applied to the baby dryer, the roll 22 of the dryer constituting one electrode which engages over a large surface contact with the web of paper stock. The contact on the opposite side of the sheet comprises a phosphor bronze sheet 24, preferably about .005 of an inch in thickness, the upper end of which is connected to a fibre sleeve 26 slidingly received upon a fibre supporting bar 28 arranged directly above the baby dryer. Provision is made for conduction of electrical currents to the electrode 24 through a brass tube 30 received within the fibre tube 28, the latter being slotted at 32 to receive a contact spring 34 which connects between the electrode 24 and the brass tube 30. The fibre and brass tubes constituting a supporting bar may be received in suitable brackets on the sides of the machine and an electrical connection made directly to the brass tube 30. The electrode 24 has a series of slits at its lower end to provide a series of fingers 36 which rest upon and insure electrical contact with a large surface of the web of paper stock. The fingers are curled or bent over at the lower ends, the curled portions being filled with solder, as indicated at 38, to lend weight to the phosphor bronze sheet, which, being flexible, readily conforms to the shape of the roll. This type of electrode not only gives a contact of large area, but also possesses the advantage of not being subject to disturbance or irregular operation by reason of inequality or roughness in the paper stock, the fingers 36 closely conforming to the web regardless of the characteristics of the latter. Moreover, the fingers are self-cleaning to a lage extent, the movement of the web directly under them serving to prevent accumulation of any fibrous material thereupon. The sleeve 26 upon which the electrode is mounted may be moved transversely to any position on the supporting bar. This is most conveniently accomplished by an operative through the use of a pole engaging one side or the other of the sleeve 26. Variations in moisture content transversely of the sheet may thus be measured, in order to detect faults due to improper crowning, dirty or worn felts, or improper pressure conditions. The fingers of the contact electrode slide easily over the web of paper stock and are not required to be lifted during this operation.

The baby dryer lends itself readily to the application of the moisture recording instrument inasmuch as the roll 22 may be used as a lower electrode, it being necessary merely to apply the electrode 24 to the opposite surface of the web. The moisture content of the web between the first and

second presses may also be indicated by a second pair of electrodes consisting of a metal roll 40 over which the web passes and a phosphor bronze electrode 42 contacting with the opposite side of the web and of exactly similar construction to the electrode 24. This measuring device is arranged to engage with the web directly after the latter passes through the press rolls 8 and 10. A similar arrangement may be applied to indicate the moisture content of the web immediately after its pasage from the couch rolls, not shown in the figure.

The electrical connections for measuring the moisture content are described as follows: Associated with each pair of electrodes is a registering meter indicated at 44 and 46 respectively, although one meter may be used for both measuring circuits in an obvious manner if desired. The meters 44 and 46 operate by measurement of the current through the web of stock to indicate and record the electrical resistance offered by the web to the passage of current therethrough. The connections to the meter 44 only will be described, and it will be understood that those to the meter 46 will be identical therewith. Current comes from a 110-volt alternating current line, one side of which connects by a conductor 50 with the meter circuit and thence with the brass sleeve 30, the other side of the line being grounded at 52. The circuit is completed through the roll 22 of the dryer, which being a part of the machine is at ground potential. The meter circuit includes a variable series resistance 54 and a shunt circuit including a variable resistance 56, a fixed resistance 57 and a relay 60, the contacts 62 of which are in the series circuit of the meter. The shunt circuit serves to divide off a determinable portion of the current from the meter so that the readings thereof may be properly controlled and kept within proper limits. A resistance 64 of approximately 800 ohms is connected between the ground connection and the electrode 24 so that it shunts the web of paper stock which is being measured, and by carrying a portion of the current protects the meter from sudden shocks which might occur owing to sudden variations in the resistance of the web. The relay 60 is normally closed during the operation of the machine, but upon occurrence of an abnormal current therethrough, as when the paper breaks so that the contacts 22 and 24 are short circuited, it opens the contacts 62 and holds them open to protect the meter from the additional rush of current. The relay, which may be of any usual or preferred form is preferably spring-controlled, so that upon normal operation by the insertion of a web of paper between the electrodes the relay contacts will close and permit normal operation of the meter to take place again.

The meters are preferably of the recording type, carrying suitable charts which may be available for permanent record of the variations in resistance of the web. From the measurement of known samples the relation between the moisture content of the web and its electrical conductivity may be determined so that the measurement of resistance in the meter may be used to determine the moisture content upon reference to the predetermined statistics.

Inasmuch as it is desirable that the meter should give a true indication of the moisture content of the web, regardless of the electrical conductivity of the water which is being used, it is necessary to compensate for any changes in conductivity due to changes in the salt content or concentration in the water. For this purpose a calibrating element indicated at 70 is provided. This element comprises two electrodes 72 and 74 which are adapted to be connected into the circuit in place of the web of paper stock passing between the electrodes 22 and 24. A double-throw switch 76 serves to connect either the web of paper or the calibrating element in circuit. A similar switch 78 associated with the meter 46 permits this meter also to be connected with the calibrating element. The electrodes 72 and 74 are received in a container through which circulates the water which for the present is being used in the operation of the machine. The water enters the container through a pipe 80 which is adapted to be connected with either one of the usual savealls 82 or 84 associated with the presses. The cell has an overflow pipe 86 above the level of the electrodes 72 and 84 so that the amount of current which is passed when the switch 76 is thrown to its right-hand position is determined by the conductivity of the water which circulates through the calibrating cell. It will be seen that inasmuch as this water is expressed from the stock the use of the calibrating element determines the operation of the meter for the particular water which is being used. The meter may now be adjusted so that it comes to a known reading which may have been predetermined from measurements under normal conditions of operation. When the switch 76 is thrown to its left-hand position so as to include the web of paper stock in the circuit, the variations of conductivity of the water will have been compensated for so that the meter will give a true indication of the percentage of moisture in the paper stock.

What is claimed is:

1. The method of manufacturing paper which consists in subjecting a traveling web of paper stock to succesive operations, passing a current of electricity through the web at points in its travel between operations thereon, indicating the resistance offered by

the web to the passage of the current at said points, and regulating the operations to maintain said resistance substantially constant.

2. The method of manufacturing paper which consists in subjecting a traveling web of paper stock to successive operations, passing an electric current through the web at points in its travel between operations thereon, measuring the resistance offered by the web to the passage of the current at each of said points, and regulating the operations to vary the resistance readings and consequently the moisture content progressively in passing through successive operations.

3. In a paper making machine, the combination with the mechanisms for forming and operating on the web of paper stock, of means for measuring the moisture in the web at a point in its travel through the machine comprising electrodes at opposite sides of and supported by the web, a meter for indicating the resistance offered by the stock to the passage of a current between the electrodes, and means for laterally adjusting the measuring means from one side of the machine to the other.

4. In a paper making machine, the combination with the mechanisms for forming and operating on the web of paper stock, of means for measuring the moisture in the web comprising an electrode contacting with the web, means cooperating with the electrode to permit passage of an electric current through the web from one side to the other, a meter for indicating the resistance offered to the passage of current through the web, and means permitting lateral adjustment of the electrode between the sides of the machine.

5. In a paper making machine, the combination with the mechanisms for forming and operating on the web of paper stock, of means for measuring the moisture in the web comprising a roll over which the web passes and a contact member engaging the opposite side of the web, an electrical circuit including the roll and the web for causing passage of a current through the web, a meter for indicating the resistance offered by the stock to the passage of the current therethrough, and a support on which the contact member is slidingly received above the web to permit lateral adjustment for measurement of moisture content at different parts of the web.

6. In a paper making machine, the combination with the mechanisms for forming and operating on the web of paper stock, of means for measuring the moisture in the web comprising a roll over which the web passes and a contact member engaging with the opposite side of the web and comprising a thin flexible sheet of conducting material supported above the web and adapted to conform thereto for a substantial portion of its length, and a meter for indicating the resistance offered by the stock to the passage of the current therethrough from between the roll and the contact member.

7. In a paper making machine, the combination with the mechanisms for forming and operating on the web of paper stock, of a roll over which the web passes, an electrode contacting with the opposite side of the web from the roll and comprising a thin flexible sheet of conducting material supported at one end above the roll and weighted at the other end to cause it to conform to the web over a substantial surface, means for passing an electric current between the roll and the contact electrode, and means for indicating the resistance offered to the passage of current.

8. In a paper making machine, the combination with the mechanisms for forming and operating on the web of paper stock, of a roll over which the web passes, an electrode support above the web, a contact electrode mounted on the electrode support and comprising a thin flexible sheet of conducting material extending from the support directly to the web and arranged to conform to the latter for a substantial length, the contact electrode being adjustable on a support transversely of the machine, means for passing an electric current between the roll and the electrode, and means for measuring the resistance offered to the passage of current.

9. In a paper making machine, the combination with the mechanisms for forming and operating on the web of paper stock, of means for measuring the moisture in the web comprising a roll over which the web passes and a plurality of weighted flexible contact fingers engaging with and conforming to the roll for a substantial length, means for passing an electric current between the roll and the electrode, and means for measuring the resistance offered to the passage of current.

10. In a paper making machine, the combination with the mechanisms for forming and operating on the web of paper stock, of means for measuring the moisture in the web including means for passing an electric current through the web at a point in its travel, a meter for measuring the resistance offered by the web to the passage of the current, calibrating means responsive to variations in the conductivity of the water used in the manufacture of the paper, and means for connecting the calibrating means with the meter to permit adjustment of the latter to compensate for changes in the conductivity of the water.

11. In a paper making machine, the combination with the mechanisms for forming and operating on the web of paper stock,

of means for measuring the electrical conductivity of the web at a point in its travel to determine the moisture content of the web, a calibrating device comprising electrodes immersed in water of the same conductivity as that used in the manufacture of the paper, and means for connecting the calibrating element with the measuring means to permit adjustment of the latter to compensate for variations in the conductivity of the water.

EZEKIEL J. WILSON.
EDWIN A. REES.