

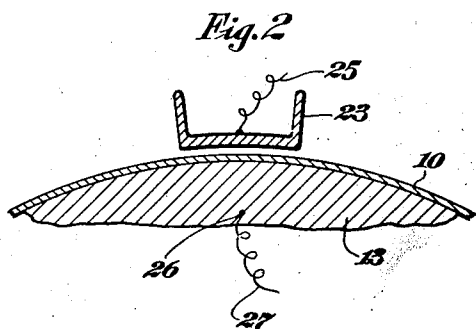
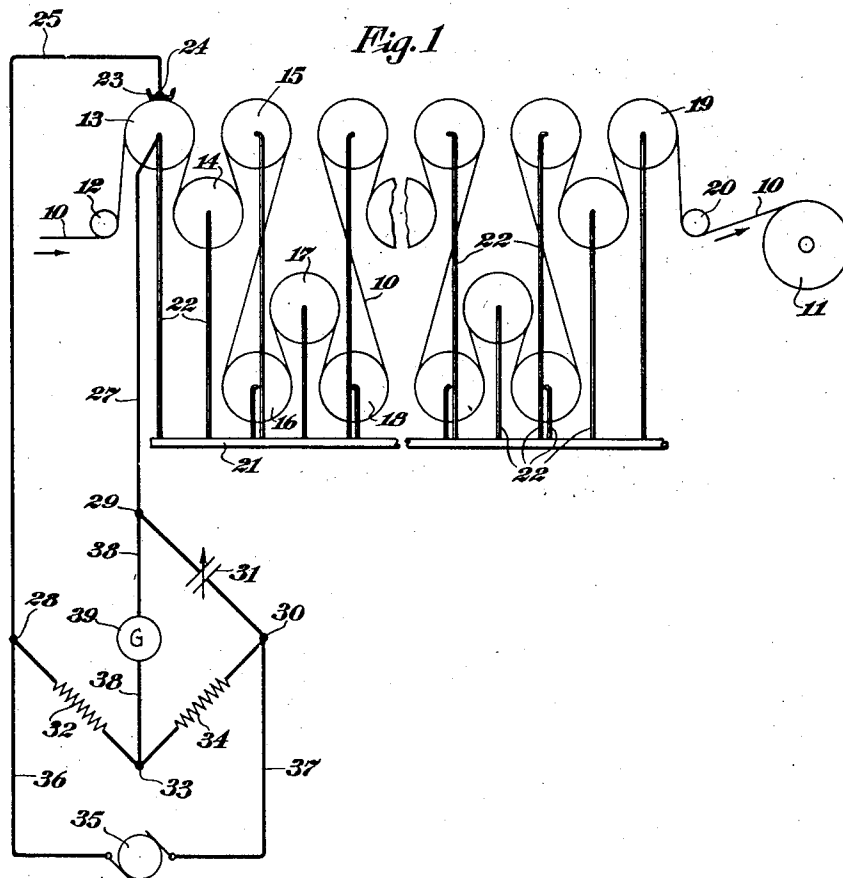
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APPARATUS FOR INDICATING AND CONTROLLING WEB VARIATIONS

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APPARATUS FOR INDICATING AND CONTROLLING WEB VARIATIONS

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My present invention relates generally to traveling webs of material, and has particular reference to a method and apparatus for indicating and/or controlling deviations of such a web from a condition of desired normal uniformity.

Although I have herein illustrated and shall hereinafter describe an apparatus and method for employing my invention in connection with the manufacture of paper, nevertheless it will be understood that many phases of my invention are not restricted to a specific application of this character.

The manufacture of paper involves the formation and travel of a paper web which is a typical example of the kind of web whose characteristics of uniformity my present invention seeks to indicate and control. In paper manufacture, for example, it is customary to form a web of paper upon a wire, or by other means; thereupon to advance the web to cause it to travel through various stages of treatment; and finally to wind the completed web in the form of a continuous strip or roll upon a suitable mandrel or similar support. It is, of course, desirable that the completed web of paper be substantially uniform in characteristics, and under certain circumstances such uniformity is of extreme importance.

Due to a variety of factors and circumstances, the characteristics of a web of this character are subject to deviations from a normal condition of uniformity. For example, the thickness of the web may vary because of variations in rate of formation or constituency of the pulp. Similarly, the moisture content or condition of dryness of the paper may vary due to a variety of factors, as, for example, variations in mechanical or thermal-dehydrating mechanisms that may be employed.

It is a general object of my invention to provide an apparatus and method for indicating the deviations in characteristics of a web of the foregoing character from a desired condition of uniformity or normalcy; and also to provide a method and means for correctively regulating various portions of the

apparatus to reestablish the desired normalcy.

More particularly, in the application of my invention to paper manufacture, it is an object to indicate, and, if desired, control, the possible variations in the characteristics of a continuously formed and advanced paper web; and, more especially, to indicate, and, if desired, control variations in the moisture content or relative dryness of the paper.

One of the main features of my invention lies in providing an electrical means for accomplishing these general objects, and, more especially, an electrical means which is responsive to variations in the dielectric strength of the web.

A further and more particular feature of my invention lies in employing the characteristics of an electrical condenser for the purposes hereinbefore illustratively specified; and, in brief, I aim to provide an apparatus and method whereby the variations in the dielectric strength of a web, such as a traveling web of the character mentioned, are caused to affect the characteristics of an electrical condenser, the variations of such condenser being suitably indicated. For example, the condenser may advantageously be arranged in an electric circuit wherein current variations and fluctuations may be indicated and measured.

Another object of my invention is to provide an apparatus and method whereby the variations of current in a circuit of the foregoing character may be employed, if desired, to control the operations of mechanism which correctively adjust those portions of the web-forming and/or advancing and/or treatment apparatus, thereby automatically reestablishing the desired condition of uniformity.

A further and more particular feature of my invention resides in the employment of a Wheatstone bridge circuit wherein a pair of condensers are arranged, respectively, in a pair of adjacent arms, and, more especially, wherein one of the condensers is adjustable and the other of the condensers embodies a pair of terminals which are arranged with the traveling web between them.

I achieve the foregoing objects and such

other objects as may hereinafter appear or be pointed out in the manner illustratively exemplified in the accompanying drawing, wherein—

5 Figure 1 is a diagrammatic representation of a typical thermal-dehydrating apparatus employed in the manufacture of certain types of paper, showing one manner in which my present invention may be applied; and

10 Figure 2 is an enlarged fragmentary cross-sectional view through a portion of the apparatus illustrated in Figure 1.

In Figure 1, I have shown a paper web 10 which may, for example, be approaching the apparatus of Figure 1 from any conventional type of paper-forming and advancing apparatus, the web having a substantial amount of moisture therein and being adapted to be dried or dehydrated during its passage through the apparatus of Figure 1 to the completed and final roll 11. By way of example, I have shown the web 10 passing under a suitable guide roller 12 and thereupon entering upon a devious passage around a plurality of drying drums or rollers which may, for example, be heated by means of steam or the like. More particularly, it will be noted that the web 10 passes successively around the drums 13, 14, and 15, and thence downwardly to a second set of three drums 16, 17, and 18, this travel being continued over, around, and underneath any desired number of additional drums so that ultimately the web, upon leaving the final drying or heating drum 19, may pass under a suitable guide roller 20 and thereupon wind itself upon the finished roll 11.

Although my invention is not restricted to any specific type of mechanism, I will mention, for illustrative purposes, that the general arrangement of Figure 1 may in certain cases embody as many drying rollers or drums as may be accommodated in a total length of approximately two hundred feet, each drum being approximately four feet in diameter and about two hundred inches long. The drums may, and are in many cases, arranged in tiers, as shown in Figure 1, the lowest tier being usually arranged in a depression or trough beneath the floor line, the second tier being arranged approximately at the level of the floor, and the third and fourth tiers being arranged, respectively, along two superposed galleries from which access to the respective drums may be had. The drums may be heated by any suitable means; and it is possible and customary to employ steam, which may, for example, be supplied from a main header 21 with branch lines 22 extending upwardly to the several drums. The header may be arranged in sections, so that different sections or banks of the drums may be individually and separately controlled.

The paper web may, of course, be advanced by any suitable means and may travel at any

desired speed. For example, a web traveling at approximately three hundred feet per minute may take anywhere from three to ten minutes to pass through a thermal-dehydrating series of rollers of the character illustrated in Figure 1, and the output of a machine of this character may be of the order of one hundred eighty tons of paper a day.

Since the purchaser of the paper usually pays for the same on the basis of weight, the amount of moisture in the finished paper is of extreme importance because of the possible large tonnage, representing nothing more than water, for which payment may have to be made. On the other hand, dryness beyond a predetermined limit may seriously affect the qualities or capabilities of the paper. My present invention may be employed to indicate deviations of such paper from any desired condition of normal moisture content; and, if desired, my invention may also be employed for the purpose of correctively regulating the drying apparatus, or other portions of the plant mechanism, to automatically maintain the desired conditions.

In accordance with my invention, I cause the paper web 10 to pass between two complementary terminals of an electrical condenser; more especially, between two fixedly arranged terminals, the variations in the characteristics of the condenser, induced by variations in moisture content of the paper, for example, being suitably indicated and being caused, if desired, to control a corrective apparatus or mechanism.

I prefer to employ, as one terminal of the condenser mentioned, one of the rollers over which the paper passes, since these rollers are usually of electrically conductive material. In the illustrated embodiment, I have shown by way of example the manner in which the roller 13 may be employed for this purpose. Adjacent to this roller and slightly spaced therefrom is a relatively fixed, electrically conductive member 23 which may, for example, be in the form of a metallic channel, as more clearly illustrated in Figure 2. An electrical connection is made with this channel at any suitable point, as diagrammatically illustrated by the reference numeral 24, a lead 25 extending to the electrical indicating and/or controlling apparatus. Similarly, an electrical connection is made with the roller 13, or, in any event, with the peripheral portion thereof with which the web 10 is in contact, as diagrammatically represented by the reference numeral 26, a lead 27 extending to the electrical apparatus.

Upon viewing Figure 2, it will be noticed that the roller 13 and the member 23 define an electrical condenser, it being understood, of course, that they are mutually insulated one from the other. With no paper traveling over the roller 13, a pure air condenser is pro-

duced, the gap between the roller 13 and the undersurface of the member 23 being filled with air, which serves as the dielectric. With a paper web 10 traveling over the roller 13 in the manner illustrated, the dielectric of the condenser is in part air and in part paper. It is obvious, therefore, that variations in the characteristics of the web 10, as, for example, variations in its moisture content, will affect the characteristics of this condenser by causing variations in the dielectric thereof.

In accordance with my invention, I provide a Wheatstone bridge electric circuit, as illustrated more clearly in Figure 1. One arm of the bridge extends between the points 28 and 29 and is constituted of the electrical condenser hereinbefore mentioned and described. An adjacent arm extends from the point 29 to the point 30, and in this arm an adjustable electrical condenser 31 is arranged.

A third arm includes the resistance or impedance 32 and extends from the point 28 to the point 33; and the fourth arm, between the points 33 and 30, includes the resistance or impedance 34.

An electric current, as, for example, an alternating current of any desired frequency, preferably a relatively high frequency, is generated at a relatively low voltage, preferably between twenty-five and fifty volts, by a power source 35, and leads 36 and 37 apply this voltage across the bridge circuit between the points 28 and 30. A connection 38 extends between the points 29 and 33, in which a galvanometer 39 or other apparatus, hereinafter to be referred to, is arranged.

In operation, the paper-making apparatus is caused to function in the desired manner with the desired condition of moisture content or with any other desired characteristics of predetermined normalcy or uniformity. The condenser 31 is then adjusted to balance the bridge circuit so that if a galvanometer 39 is employed, the current through the line 38 will be zero. If desired, an adjustable resistance leak may be arranged in parallel with the condenser 31 to render the control more accurate or more desirable; or any other means may be arranged in the arm between the points 29 and 30 to establish the desired balance.

Thereafter, it is obvious that variations in the characteristics of the web 10, as, for example, variations in moisture content, will cause the bridge circuit to be thrown out of balance, whereby a current will be caused to flow in one or the other direction through the line 38, this current being usable not only as an indicating current but being capable, if desired, of amplification by any suitable means to operate a relay and/or a control mechanism for correctively regulating the paper-making apparatus.

In its simplest application my invention serves as a means for indicating at the galvanometer 39 or its equivalent the existence of variations in the dielectric strength of the paper web 10. If the thickness of the paper is controlled by any suitable means to maintain a certain predetermined uniformity, and if other variable factors are controlled, this variation in dielectric strength may be justifiably attributed to variations in moisture content. The indications on the galvanometer 39 may then serve to indicate to an operator that the heating means, such as the steam supply, should be varied in one or the other direction, or that other portions of the paper-making apparatus should be suitably adjusted or regulated to correct the deviation from the desired uniformity of moisture content.

If desired, the current in the line 38 may, as mentioned, be passed through a suitable amplifying device and then through a relay, whereby a suitable control mechanism may be operated automatically to accomplish these corrective adjustments in an automatic manner. Such control mechanism may, for example, automatically regulate the supply of steam to all or groups of the heated rollers; or, where these rollers are heated by electrical or other means, the control mechanism referred to may automatically regulate such means. An arrangement may, if desired, be provided whereby the control mechanism will automatically regulate any other portion or portions of the paper-making and/or forming and/or advancing and/or treatment apparatus for the accomplishment of the same general objective of maintaining or endeavoring to maintain a condition of uniformity.

It will be understood, of course, that a condenser of the character I have illustrated in connection with the roller 13 may, if desired, be arranged with any one or more of the rollers illustratively shown in Figure 1. For example, if such rollers are arranged in banks and are separately controllable, a condenser arrangement of the character mentioned may be arranged with each bank. Or, if a single condenser is used, it may be mounted in association with any one of the rollers, and not necessarily with the initial roller 13.

Furthermore, the member 23 may be of any desired character or construction, and it is preferably of a character which will permit the web 10 to be properly threaded into position when the machine is first set into operation. With this object in view, a channel of the character shown at 23 may advantageously be arranged to extend for almost the entire length of the roller 13, with its supporting means at only one end, so that the paper web may be accessible for threading purposes beneath the opposite or free end of the member 23.

It will also be understood that although I have illustrated my invention as it relates to a specific type of paper manufacture, it may have equally advantageous applicability to other types of web material, and it may be employed for indicating and/or controlling variations in a wide range of characteristics, not necessarily moisture content characteristics. It may, for example, be used to indicate and/or control any variations in web characteristics which induce corresponding variations in the dielectric strength of the web material.

Furthermore, it will also be understood that the two complementary condenser terminals may be provided in any other suitable or desired manner, as, for example, by arranging the two terminals as channels or the like on opposite sides of the web during any stage of its travel; or by causing the web to pass over a special additional roller serving as one terminal, with a channel or the like, or a similar member, serving as a complementary terminal.

In general, it will be obvious that changes in the details herein described and illustrated for the purpose of explaining the nature of my invention may be made by those skilled in the art without departing from the spirit and scope of the invention as expressed in the appended claims. It is therefore intended that these details be interpreted as illustrative, and not in a limiting sense.

Having thus described my invention and illustrated its use, what I claim as new and desire to secure by Letters Patent is—

1. The combination with an apparatus for continuously forming and advancing a web of material of substantially uniform characteristics, of electrical means responsive to variations in the dielectric strength of the web for indicating deviations of the web material from a condition of uniformity; said means comprising a Wheatstone bridge circuit having an electrical condenser in each of two adjacent arms, one of said condensers being an adjustable condenser, the other having a pair of terminals arranged with the web between them.

2. The combination with a paper-making apparatus which continuously forms, advances, and dries a web of paper, said apparatus including a metallic roller over which said web travels; of an electrical means responsive to variations in the dielectric strength of said paper web for indicating deviations of the paper web from a normal condition of moisture content uniformity; said means comprising a conductive member adjacent to said roller and on the opposite side of the web, an electric circuit including said roller, web, and member as a condenser therein, and means for indicating the variations of current characteristics in said circuit due to

variations in the capacity of said condenser.

In witness whereof I have signed this specification this 10 day of March, 1931.

FREDERICK WIERK.

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