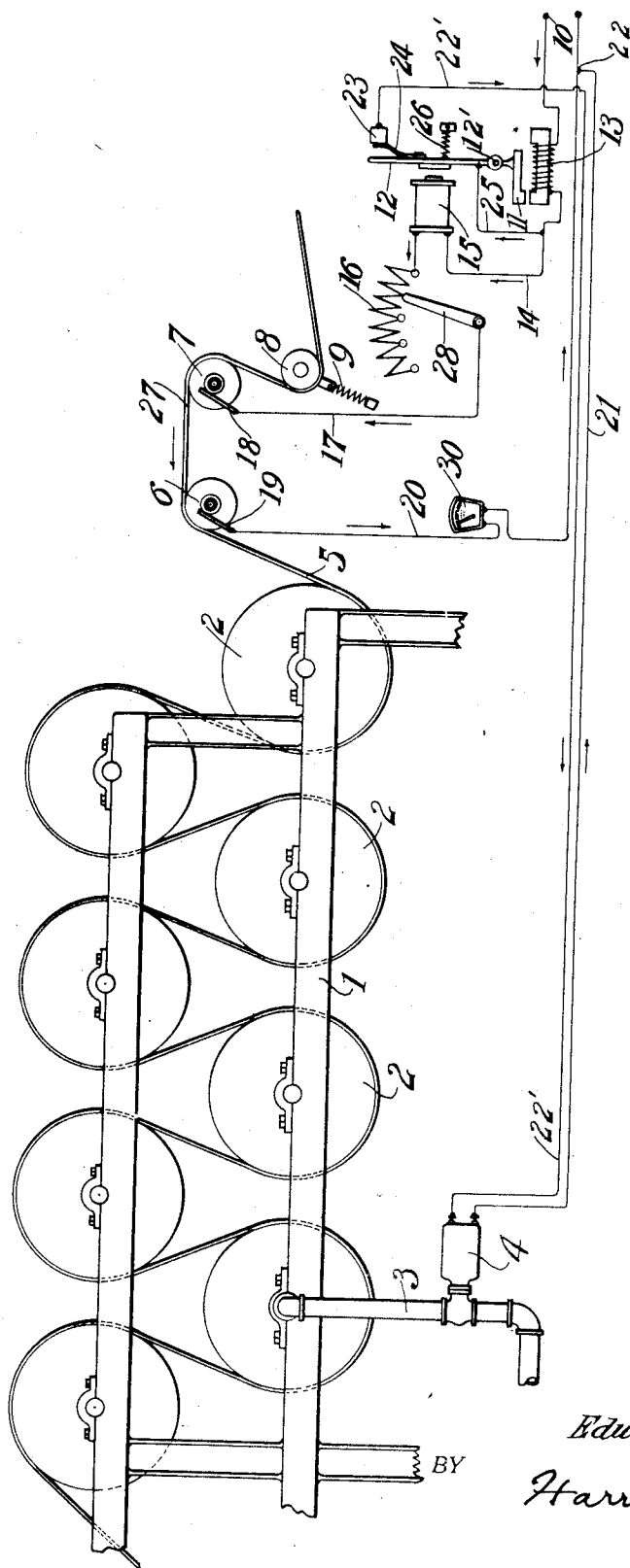


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PROCESS AND APPARATUS FOR DRYING.
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Specification of Letters Patent.

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To all whom it may concern:

Be it known that I, EDWARD P. BUTTS, a citizen of the United States of America, residing in the city of Springfield, county of Hampden, and State of Massachusetts, have invented certain new and useful Improvements in Processes and Apparatus for Drying, of which the following is a specification.

This invention relates to improvements in drying processes.

Specifically, it is designed for causing the web of paper, as it leaves the last drying drum of the paper drying machine, to retain a definite quantity of moisture.

In common practice paper is dried by admitting live or exhaust steam, or both, to the drying cylinders. Attempts have been made to control the resultant degree of drying by maintaining a constant temperature or pressure in the drying cylinder, or by varying the steam supply with the tensile strength or stretch of the web. It is plain, however, that a constant temperature or pressure is not necessarily related to the amount of heat required for a certain purpose, and the tensile strength or stretch varies with the web and weight of sheet in its relation with the resistance of its resilient members in the actuating device.

My invention is based upon the electric conductivity of the paper as determined by the amount of moisture in the web as it leaves the last drying drum or cylinder. By taking advantage of the change in the electric conductivity of the web of moving paper, I employ suitable electric connections and electro-magnetic devices for operating the valve which opens and closes the connection between the boiler, or other source of steam supply, to the drying rolls or drums in order to maintain the drums at a temperature which will cause the web of paper, as it leaves the last drum, to contain the desired percentage of moisture. It is a well known fact that when there is a large percentage of moisture in the web of paper, there is greater electric conductivity than when the paper is drier, since dry paper forms a high resistance to the free passage of the electric current therethrough.

The accompanying drawing of which only one figure is shown, clearly illustrates the principle of my invention and one means or apparatus for carrying out my invention.

Referring to this figure, the framework

of the machine is indicated at 1, the drying rolls or drums of which several are shown, are indicated at 2.

The steam pipe connection, shown conventionally, is indicated at 3, and a suitable valve for varying the flow of the steam through the pipe 3 is indicated at 4.

The web of paper as it leaves the last drying drum 2 is indicated at 5. This web passes over the spaced idler web supporting pulleys 6 and 7 which are preferably composed of some material that conducts the electric current readily, preferably with central width contact faces suiting most widths of web.

8 is the usual tension roll under which the web passes after leaving the roll 7. The usual spring, indicated at 9, is employed for imparting the desired tension to the web. A suitable source of electric current is supplied at the point 10. This current controls the movement of the armature 11 to which an arm 12 is rigidly or integrally connected. The arm 12 and armature 11 are pivotally mounted at 12'. The armature 11 and arm 12 are therefore rocked or moved about pivot 12' by means of an electro-magnet, indicated at 13.

14 is a wire connected to one terminal of the electro-magnet 13 which leads to a second electro-magnet 15. Connected to the electro-magnet 15 is a rheostat 16 from which leads a wire 17 to the roll 7 which has electric connection therewith by means of the brush 18 that is in electric contact with the shaft of the roll 7. 19 designates a second brush that has an electric contact with the shaft of the roll 6 to which the wire 20 is connected that extends back to the other pole of the source of electrical energy.

21 is a wire extending from the wire 20 at the point 22, and leads to one terminal of the electrically operated steam valve 4 which controls the supply of steam or other heating medium to the heating drum or cylinders. 22' is a wire extending from the other terminal of the valve 4 to the contact point 23 with which the spring arm 24 engages. Connected to the wire 14 is a shunt wire 25 that extends to the arm 12. A spring 26 is attached to the arm 12 and normally holds the spring 24 in contact with the terminal 23.

The operation of the device is as follows: Current from the source of energy at 10 energizes the magnet 13 and normally flows

through the wires 25, arm 12, wire 22', electric valve 4, and wire 21 back to the source of energy. It also normally flows by means of the wire 14, magnet 15, rheostat 16, wire 17, brush 18, roll 7, to the web of paper 27, which extends between the rolls 6 and 7, and thence by the wire 20 back to the source of energy. The variation in moisture of that portion of the web of paper indicated at 27 determines the strength of current flowing through the electro-magnets 13 and 15. The rheostat arm 28 is adjustable for the purpose of determining the correct strength of current that should flow through the magnet 15 in order to open the circuit at the point 23, or, in other words to maintain the valve 4 open the correct amount, whereby the drying drums 2 will be maintained at the proper temperature.

If, for any reason the web of paper, indicated at 27, is too moist, whereby a stronger current is permitted to flow through the electro-magnets 13 and 15, the arm 12 and armature 11 which move therewith will be strongly attracted by the electro-magnets 13 and 15 and the contact 23 will be opened causing the valve 4 to be opened to a greater extent in order to increase the supply of steam and raise the temperature of the drying drums 2. This condition will be maintained until the web of paper, as it passes between the pulleys 6 and 7 contains less moisture, when the resistance of the web 27 will be increased, thus cutting down the current flowing through the magnets 13 and 15. The spring 26 will then operate against the action of the electro-magnets to again close the contact 23, whereby current will again flow from the source of energy at 10, wire 25, arm 12, and wire 22', to the valve 4, causing the same to close again and thus lower the temperature of the drying drum 2. It will thus be seen that by means of the rheostat arm 28, the operation of the movements of the armature 11 and the integral arm 12 can be very accurately controlled and in turn, the operation of the valve 4, to admit or shut off more or less steam to the drying drum 2, the controlling means being based primarily on the resistance to the flow of the electric current through the web 27, since the current constantly flows through the web. That is to say, when there is considerable moisture the resistance of the web is lower, and when there is a small percentage of moisture the resistance is increased, or the flow of current is inversely proportioned to the percentage of moisture in the web varying inversely as the steam supply.

It is obvious that either one of the electro-magnets 13 or 15 could be dispensed with but I have shown the two electro-magnets for the purpose of rendering the device more sensitive to the small variation of current.

which is employed to control the movements of the arm 12, which in turn, controls the operation of the valve 4. It is, of course, obvious that an ammeter may be inserted in either of the wires 17 or 20 in order that the machine attendant may know exactly just what the strength of current is when the moisture in the web is the proper amount. Such an instrument is conventionally indicated at 30 in the wire 20 and will materially assist the attendant when the machine is first started and avoid delays in experimenting. It is, of course, apparent that the location of my improvement is not necessarily confined to the precise position as shown, which is directly back of the last drying cylinder, as the same may, if desired, be located between any two of the drying cylinders.

Having thus described my invention, what I claim is—

1. In a paper making machine the combination with the drying drums thereof, a pair of spaced supports for receiving the web of paper, means for conducting the web of paper across a pair of spaced supports, the source of electrical energy, connections therefrom to the pair of supports for permitting an electric current to flow through the web of paper between said supports, an electro-magnetically controlled valve to vary the supply of the heating medium to the drying drums, electrical connections for controlling the operation of the valve, means in the connections between the supports and said valve for controlling the flow of current to said valve dependent upon the strength of the current flowing through the web of paper on said supports.

2. In a paper making machine, the combination with the drying drums, spaced supports to receive the web of paper as it leaves a drying drum, a source of electrical energy, connections therefrom to the spaced supports for permitting the electric current to flow through the web of paper between said supports, an electrically controlled shut-off device for varying the flow of the heating medium to the drying drums, means for opening and closing the connections to said shut-off, an electro-magnet interposed in the connections from the source of energy to the spaced support for controlling said means, the movements of said controlling means depending upon the variation of moisture in the movable web of paper as it passes through the web of paper from one support to the other, whereby the quantity of heat supplied to the drying drums is automatically varied, as described.

3. In a machine of the kind described, the combination with the heating drums, means to support the web of paper as it passes from a drying drum, a source of electric energy, connections therefrom to said means for

causing the current to pass through the web from the support, electro-magnetic means in the connections and controlled by the current therein, an electric valve for controlling the flow of the heating medium to the drums, connections from the valve to the first named connections, the current flowing to the valve for operating the same being dependent upon the conductivity of the web of moving paper, whereby the temperature of the drums may be automatically maintained for determining the moisture or dryness of the web.

4. In a device for controlling the supply of steam to the heating drums of a paper making machine, comprising in combination, supporting devices for receiving the web of paper as it leaves the last drying drum, a source of electric energy, connections from the supporting devices to said source, an electrically operated valve for controlling the supply of steam to the drums, connections from the valve to the source of energy, electro-magnetic devices in the first-named connections for controlling the operation of said valve, the operation of the electro-magnetic devices being dependent upon the electric conductivity of the moving web of paper on the supporting devices.

5. In a machine of the kind described, for automatically maintaining the electric conductivity of a web of paper constant, means to support a definite length of the web, a

source of electric energy, connections therefrom to the supports, a movable member, means in the connections for controlling the movements of the member, means to control the supply of heat to the drying drums, connections therefrom and controlled by said member, whereby the conductivity of the web on the supports will control the heat controlling means.

6. The method of drying a moving web of material which consists in subjecting the material to the action of a drying medium, determining the electrical conductivity of the material after treatment and controlling the supply of the drying medium inversely to such electrical conductivity.

7. The method of drying a moving web of material which consists in subjecting the material to the action of a drying medium, determining the electrical conductivity of a section of definite length of the material after treatment and controlling the supply of the drying medium inversely to such electrical conductivity.

8. A method of drying a web of moving material which consists in determining the electrical conductivity of the web as it passes from the influence of the drying mechanism and controlling the drying medium by varying the supply of the drying medium in direct proportion to the electrical conductivity of the web.

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