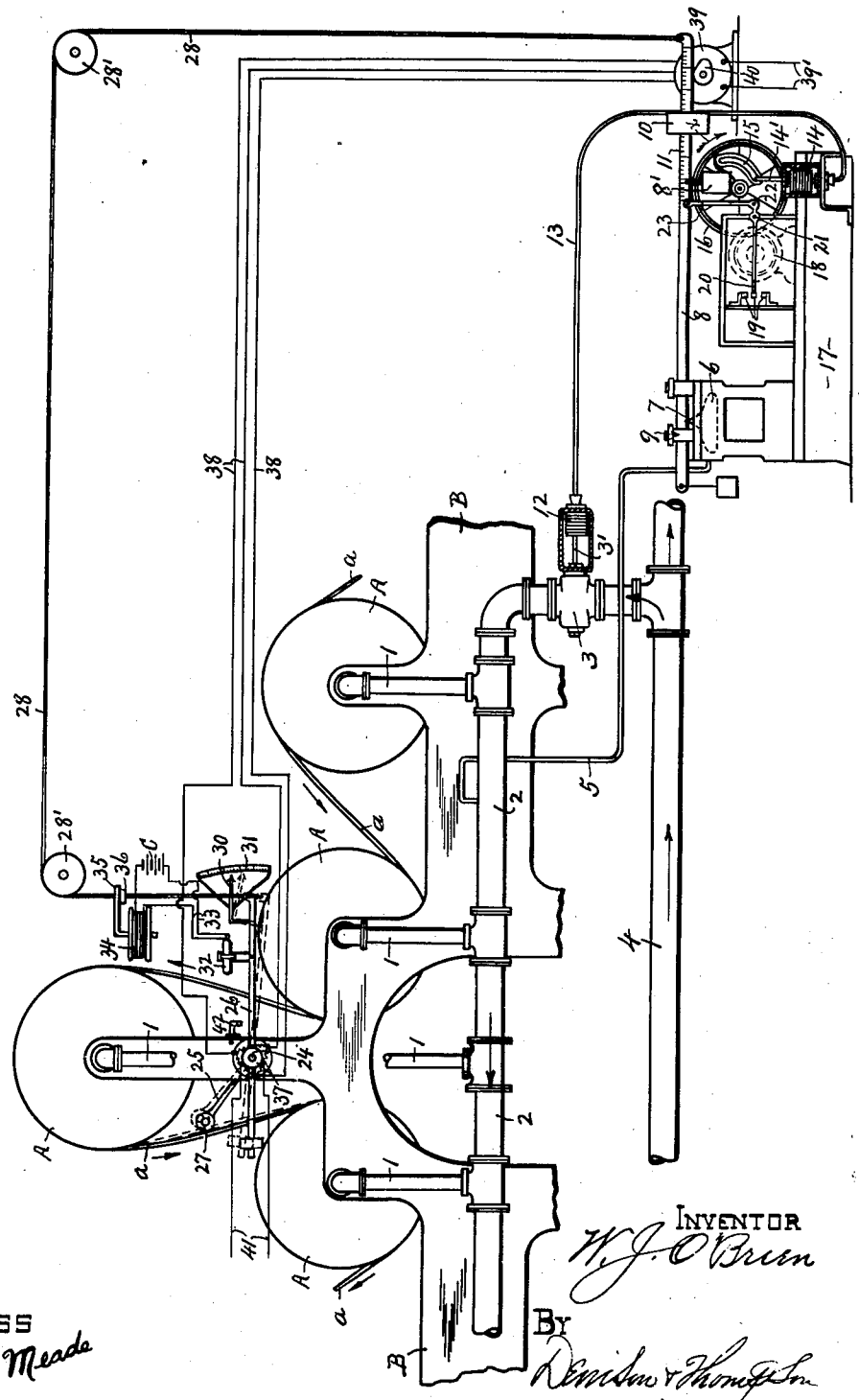
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PAPER MAKING MACHINE

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PAPER MAKING MACHINE

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2 Claims. (Cl. 34—48)

This invention relates to paper making machines in which the paper is passed around one or more rotary steam-heated drying cylinders and refers more particularly to apparatus for automatically controlling the supply of steam to the cylinders and thereby to regulate the moisture content of the paper.

It is, of course, desirable to retain a sufficient amount of moisture in the finished paper to render it pliable and thereby to avoid breakage when folded as would be the case if the finished paper should become excessively dry and the main object of the present invention is to provide simple and highly efficient means for automatically maintaining a relatively small but uniform moisture content in the paper as it is delivered from the machine.

In other words, I have sought to establish a close regulation of the temperature of the cylinders by automatically regulating the amount of steam admitted to the cylinders.

Another object is to provide means for automatically shutting off the steam supply to the cylinders in case the paper should break.

Other objects and uses will be brought out in the following description:

The drawing represents a side elevation of a paper making machine in which the drying cylinders and various portions of the apparatus for automatically regulating the amount of steam passing to the cylinders are shown diagrammatically.

As illustrated, the drying cylinders A are rotatably mounted upon a suitable supporting frame B and are connected by branch pipes 1 to a common distributor pipe or head 2 which, in turn, is connected through the medium of a valve 3 to a main supply pipe 4, the latter being adapted to be connected to a source of steam supply, not shown, the branch pipe 1 leading to the uppermost cylinder being partly broken away.

The distributor pipe or head 2 is connected by a relatively small pipe 5 to a pressure regulator 6 of the diaphragm type having its diaphragm provided with a bearing member 7 adapted to engage the underside of a lever 8 having its fulcrum 9 relatively close to the bearing member 7, said fulcrum 9 being mounted upon the frame of the regulator 6 and engaged with the upper edge of the lever 8.

One arm of the lever 8 is relatively long as compared with the other arm and extends horizontally a considerable distance from its fulcrum 9 and diaphragm bearing 7 and is adapted to receive and support a weight 10 which is slidable along a scale 11 on the lever to partially oppose the steam pressure against the diaphragm tending to raise the weighted end of the lever.

That is, the pressure of the steam passing from the distributing head to the regulator 6 tends to raise the diaphragm and to effect a corresponding elevation of the longer end of the lever 8 against the action of the weight 10 for bringing into action suitable means, presently described, for moving the valve 3 toward its closed position and thereby reducing the amount of steam passing to the cylinders A, it being understood that the period of closing the valve may be regulated by simply adjusting the weight 10 along the scale 11 on the lever 8.

The valve 3 is normally open and preferably of the self-opening type and has its stem 3' connected to a sylphon or bellows 12 which, in turn, is connected by a pipe 13 to a second sylphon or bellows 14.

The stem 14' of the bellows 14 is engaged in a cam slot 15 of a rotary wheel or member 16, which, together with the regulator 6 is mounted upon a supporting base 17 and is adapted to be driven by an electric motor 18 indicated diagrammatically in the drawing.

This motor 18 is preferably of the reversing type and is controlled by any suitable reversing switch 19 having its movable member 20 pivoted at 21 to the motor case on the base 17.

The switch member 20 is provided with an extension 22 which is connected by a link 23 to the lever 8 for transmitting motion from said lever to one or the other of the contacts of the switch 19 and thereby to cause the operation of the motor 18 and cam wheel 16 in one direction or the other.

For example, assuming that the lever 8 is in its normal position and that the valve 3 is open and also that the tube 13 and bellows 12 and 14 are filled with liquid in which case the bellows 12 will be compressed to expel its liquid through the tube 13 into the bellows 14 for distending the latter.

Under these conditions, the weight 10 will have been adjusted to a predetermined position along the lever 8 to substantially counterbalance the steam pressure in the diaphragm chamber 6 and thereby to hold the switch member 20 in a neutral position between the opposed terminals of the switch, the graduations of the scale 11 serving to indicate the steam pressure in pounds per square inch so that the weight 10 may be accurately set to such position as will normally coun-

terbalance the steam pressure in the chamber 6.

It is now clear that if the steam pressure in said chamber should exceed the predetermined degree at which the weight 10 is set, the adjacent end of the lever will be elevated to bring the switch member 20 in contact with the lower terminal of the switch 19 for closing the circuit through the motor 18 for operating the same to transmit its angular motion to the cam wheel 16 in the direction indicated by arrow X.

This angular movement of the cam wheel 16 will cause its cam slot 15 to compress the bellows 14 and thereby to expel its liquid through the pipe 13 to the bellows 12 for distending the latter to move the valve 3 toward its closed position, the effect of which is to reduce the supply of steam to the cylinders A.

As previously intimated, it is desirable to maintain a relatively low but uniform moisture content in the paper as the latter passes around the cylinders A and it is for this purpose that the weight 10 is set to a predetermined position along the scale 11 to normally counterbalance a predetermined steam pressure in the diaphragm chamber 6 and cylinders A which will be most efficient for maintaining the desired moisture content, it being understood that this moisture content is dependent upon the temperature of the cylinders and that the temperature of the cylinders is dependent upon the amount of steam admitted thereto.

For example, if the paper should become excessively dry by reason of excessive temperature of the cylinders, the supply of steam to said cylinders should be reduced while on the other hand if the paper should become excessively moist due to the lower temperature of the cylinders, the supply of steam to said cylinders should be increased, and in order to prevent these widely varying temperatures of the cylinders A and resultant widely varying moisture content of the paper, I have provided means controlled by the steam pressure in the cylinders for limiting these variations within a very small margin determined by the setting of the weight 10 on the lever 8 which setting represents the desired moisture content sought to be maintained in the paper.

With this understanding, it will be seen that if the temperature of the cylinders is above the predetermined degree resulting in reducing the moisture content of the paper below its predetermined amount, it follows that the steam supply to the cylinders is proportionately excessive and that the steam pressure in the diaphragm chamber 6 will be sufficient to raise the lever 8 against the action of its counterweight 10 thereby causing the operation of the motor 18 and cam wheel 16 for forcing the liquid from the bellows 14 to the bellows 12 through the pipe 13 for partially closing the valve 3 and thereby reducing the amount of steam passing to the cylinders and instantly reducing the steam pressure in the diaphragm chamber 6 to allow the weight 1 to return the lever 8 toward its normal position, thus opening the switch member 20 and stopping the further operation of the motor 18 and cam wheel 16.

On the other hand, should the moisture content of the paper exceed the predetermined amount, it means that the temperature of the cylinders A is reduced below its predetermined degree as indicated by the position of the weight 10 on the lever 8.

Under these conditions, the steam pressure in the diaphragm chamber 6 will, of course, be reduced, thereby allowing the weight 10 to depress the adjacent end of the lever 8 and incidentally to cause the switch member 20 to contact with the upper terminal of the switch 19 for reversing the operation of the motor 18 and cam wheel 16 driven thereby, thus distending the bellows 14 and allowing the valve 3 to open and thereby to compress the bellows 12 for expelling the liquid therefrom through the pipe 13 into the previously distended bellows 14.

This opening of the valve 3 allows free flow of the steam to the cylinders for increasing the temperature thereof and correspondingly reducing the moisture content of the paper and at the same time increases the steam pressure in the diaphragm chamber 6 for restoring the lever 8 and parts actuated thereby to their neutral positions thus causing a partial compression of the bellows 14 and resultant partial closing of the valve 3 to its neutral or substantially balanced position.

It is now evident that any slight variation of the moisture content of the paper above or below the predetermined degree indicated by the position of the weight 10 on the lever 8 will incidentally cause the operation of the switch member 20 to its neutral position, thereby establishing a very close regulation of the moisture content in the paper by maintaining a more uniform steam pressure in the cylinders A and in the diaphragm chamber 6 and thus maintaining a more uniform temperature of said cylinders.

It is quite evident, however, that the lever 8 may be operated independently of the steam pressure in the diaphragm chamber 6 and that such operation may be effected automatically by the varying tension of the paper in transit from one roll to another and for this latter purpose I have shown a lever consisting of a rock shaft 24 having crank arms 25 and 26, the crank arm 25 being provided with a roller 27 yieldingly held by its own weight or otherwise against the inner face of the paper between two of the rolls A where the paper is subject to slight sag when its moisture content exceeds a predetermined amount and is adapted to straighten when the moisture content is reduced below that amount.

This alternate sagging and straightening of the paper under varying degrees of humidity is utilized for the operation of the crank arm 25 and its rock shaft 24, the other crank arm 26 being connected to one end of a cable 28 which is passed over suitable sheaves 28' and has its other end connected to the weighted end of the lever 8.

It is now evident that if the paper should sag by reason of excess moisture therein, the crank arm 25 would follow the sagging movement thereby elevating the other crank arm 26 for slackening the cable 28 and allowing the weight 10 to depress the lever 8 for closing the switch member 20 against the upper contact of the switch 19 with the resultant operation of the motor 18 and cam wheel 16 for distending the bellows 14 and allowing the valve 3 to open and thereby to compress the bellows 12 for circulating the liquid in the tube 13 back into the previously distended bellows 14, the effect of which is to increase the volume of steam flowing to the drying cylinders.

If desired, the downward movement of the weighted end of the lever may be retarded by means of a dash pot 8' having its movable member attached to said lever as shown.

On the other hand, as soon as the paper begins to straighten by reason of its reduced moisture content resulting from the increased temperature of the drying cylinders, the crank arm 25 and its rock shaft 24 will be moved inwardly or in a

clockwise direction thereby moving the crank arm 26 downwardly for raising the weighted end of the lever 8 through the medium of the cable 28 thus bringing the switch member 20 into contact with the lower terminals of the switch 19 for reversing the operation of the motor 18 and its cam wheel 16 to compress the bellows 14 and thereby to expel the liquid therefrom through the pipe 13 into the previously expanded bellows 12 for partially closing the valve 3 and thus reducing the volume of steam passing through the cylinders A.

If desired, the movement of the crank arm 26 may be utilized for indicating the amount of such movement from a predetermined position representing approximately the amount of moisture content which it is desired to leave in the paper, and for this purpose the lever is provided with a pointer 30 movable along a relatively fixed graduated dial 31 representing percentages of moisture content of the paper or varying temperatures of the cylinders A according to the election of the user.

When the operation of the lever 8 is to be controlled by the tension of the paper *a* through the medium of the crank arm 25, suitable means is provided for assuring the complete closing of the valve 3 in case the paper should break, thereby cutting off the supply of steam to the several cylinders.

For this latter purpose, a mercury switch 32 is mounted upon the crank arm 26 and is connected by wires 33 to a battery C and a solenoid 34 having its plunger provided with an offset arm 35 which is adapted to engage a button 36 on the adjacent portion of the cable 28 when the solenoid is energized.

This mercury switch 32 is arranged to open when the crank arm 26 is in a substantially horizontal position and to close the circuit through the solenoid 34 when the crank arm is elevated from said normal position thereby energizing the solenoid 34 for raising the weighted end of the lever 8 in the manner previously stated.

That is, in case the paper should break, the crank arm 25 would move downwardly under its own weight, thereby rocking the shaft 24 and crank arm 26 in a counterclockwise direction for closing the mercury switch 32 and thereby energizing the solenoid 34 to draw its plunger downwardly for operating the cable 28 and lever 8 connected thereto, thus causing the closing of the valve 3 in the manner previously described.

This angular movement of the rock shaft 24 may also be utilized for the operation of a three phase synchronous electric generator 37 having one of its elements secured to the shaft or to the crank arm 26 co-axial with the rock shaft for angular movement therewith and its other element in fixed relation thereto and connected by wires 38 to a three phase synchronous motor 39 having a cam member 40 secured to its shaft to rotate therewith and adapted to bear against the underside of the weighted end of the lever 8.

The slip rings of the synchronous generator 37 and the field of the motor 39 may be connected to the same source or to different sources of electric energy, not shown, for supplying current thereto.

Under the construction last described, if the moisture content of the paper exceeds a predetermined amount, it will sag as shown by full lines in the drawing thereby allowing the crank arm 25 to move downwardly by its own weight for rocking the rotary element of the generator 37 and thereby transmitting its current to the motor 39 for moving the cam 40 away from the lever 8 to allow the latter to rock downwardly under its own weight for closing the switch member 20 against the upper contact of the switch 19 to close the circuit through the motor 18 and thereby to cause the operation of the cam wheel 16 in a direction opposite to that indicated by the arrow for distending the bellows 14 and allowing the valve 3 to open for compressing the bellows 12 and instantly forcing the liquid therefrom through the pipe 13 into the previously distending bellows 14.

This opening of the valve 3 will allow free flow of the steam to the cylinders A for raising the temperature of the same and thereby reducing the moisture content of the paper.

Then, as the moisture content of the paper is reduced, the paper tends to straighten thereby rocking the crank arm 25 upwardly and effecting a corresponding angular movement of the rotor of a generator 37 in the opposite direction for reversing the direction of rotation of the motor 39 and its cam 40 for elevating the adjacent end of the lever 8 and thereby closing the contact member 20 against the lower contact of the switch 19 resulting in a reverse operation of the motor 18 and its cam wheel 16 for compressing the bellows 14 and forcing the liquid therefrom through the pipe 13 and into the bellows 12 for closing the valve 3 to reduce the steam supply to the cylinders and also to reduce the steam pressure in the chamber 6, thus allowing the lever 8 and switch member 20 to return to their neutral positions under the action of the weight 10.

A stop shoulder 42 is mounted on the frame B in the path of movement of the crank arm 26 to limit the upward swinging movement of said crank arm and also to limit the downward movement of the crank arm 25 in case the paper should break at which time the mercury switch 32 will have been closed for energizing the solenoid 34 to operate the cables 28 for raising the weighted end of the lever 8 and thereby causing the closing of the valve 3 in the manner described.

The generator 37 is preferably of the "Selsyn" remote control type for synchronously operating the motor 39 while the diaphragm chamber 6, lever 8, switch 19, and motor 18 are similar to corresponding parts of what is commonly known as the "Brooke Constant Pressure Regulator" shown in catalogue V-2 issued by the Brooke Engineering Co. Inc., 1321 Arch St., Philadelphia, Penna., with the additions shown and described for adapting it to the regulation of the moisture content of paper making machines.

It will be seen from the foregoing description and the accompanying drawing that this apparatus is particularly simple, practical and efficient for automatically establishing and maintaining a predetermined and substantially uniform moisture content in the paper and that this moisture content may be varied at will by simply adjusting the weight 10 to different selected positions upon the lever 8, but obviously various changes may be made in the structural details without departing from the spirit of the invention.

What I claim is:

1. In a heat regulator for paper making machines, the combination with a paper-drying cylinder and means including a valve for supplying steam to said cylinder, fluid-containing bellowses and a pipe connecting the same operatively connected to and controlling the operation of said valve, of a lever engaged with and actuated in one direction by the tensioning of the paper when

the latter becomes excessively dry, a second lever, means including a cable for transmitting motion from the first to the second lever, and means brought into action by the operation of the second lever for compressing one of the bellowses and thereby to expand the other bellows for closing the valve.

2. In a heat regulator for paper-making machines, the combination with a drying cylinder, means for supplying steam to said cylinder including a valve, of connected fluid-containing bellowses for operating said valve as the fluid therein is transferred from one to the other, a weighted lever, means brought into action by the movement of the lever under its own weight for operating one of the bellowses and thereby causing the operation of the other bellows for moving the valve in one direction, and means actuated by varying tension of the paper for operating said lever against its weight for reversing the operation of the bellowses and thereby to move the valve in a reverse direction.

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