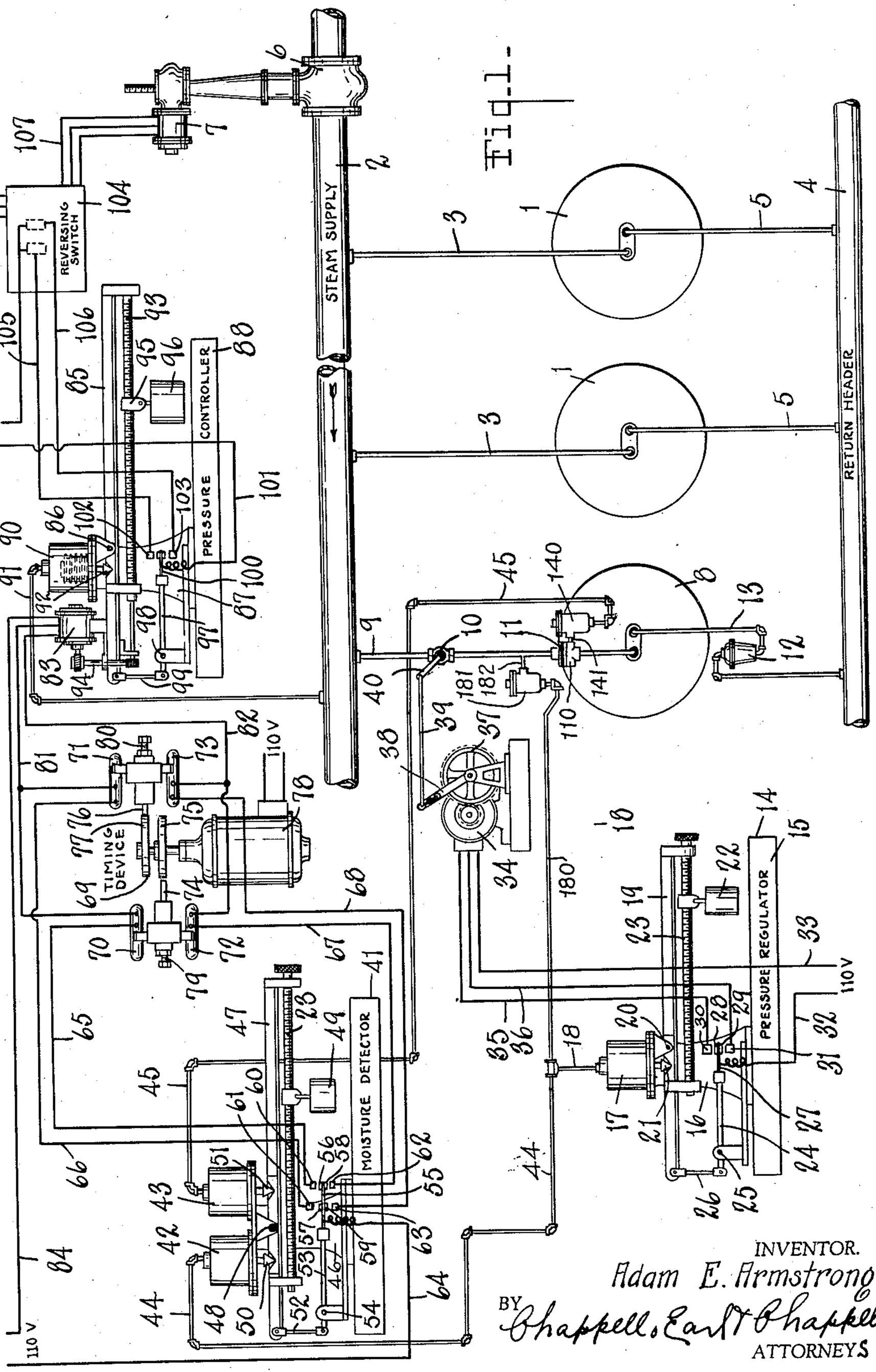
Feb. 28, 1939. A. E. ARMSTRONG 2,148,720

MOISTURE CONTROL SYSTEM FOR PAPER DRYING MACHINES AND METHOD

Filed March 27, 1936 2 Sheets-Sheet 1

Fig. 1.



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Filed March 27, 1936 2 Sheets-Sheet 2

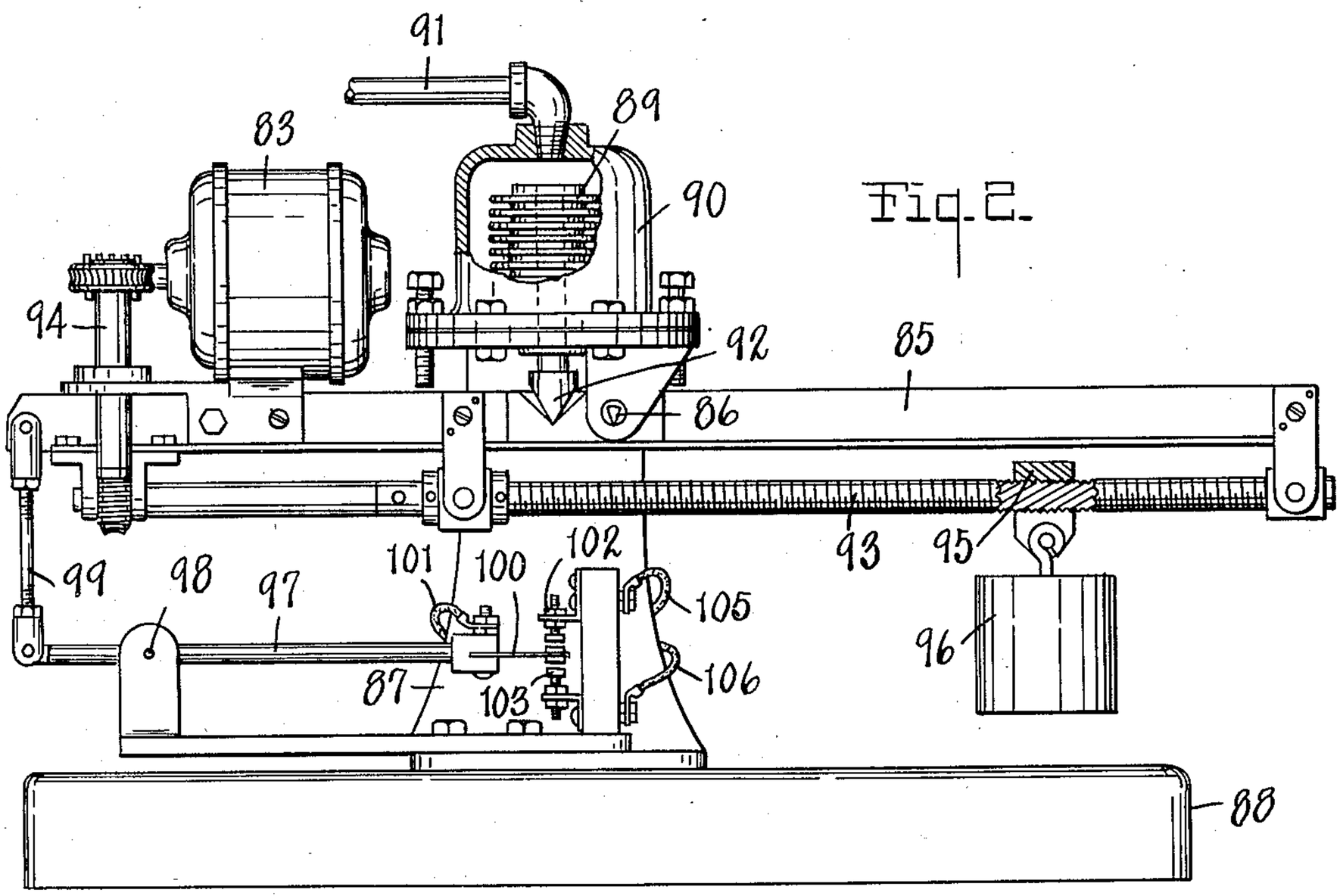

Fig. 2.

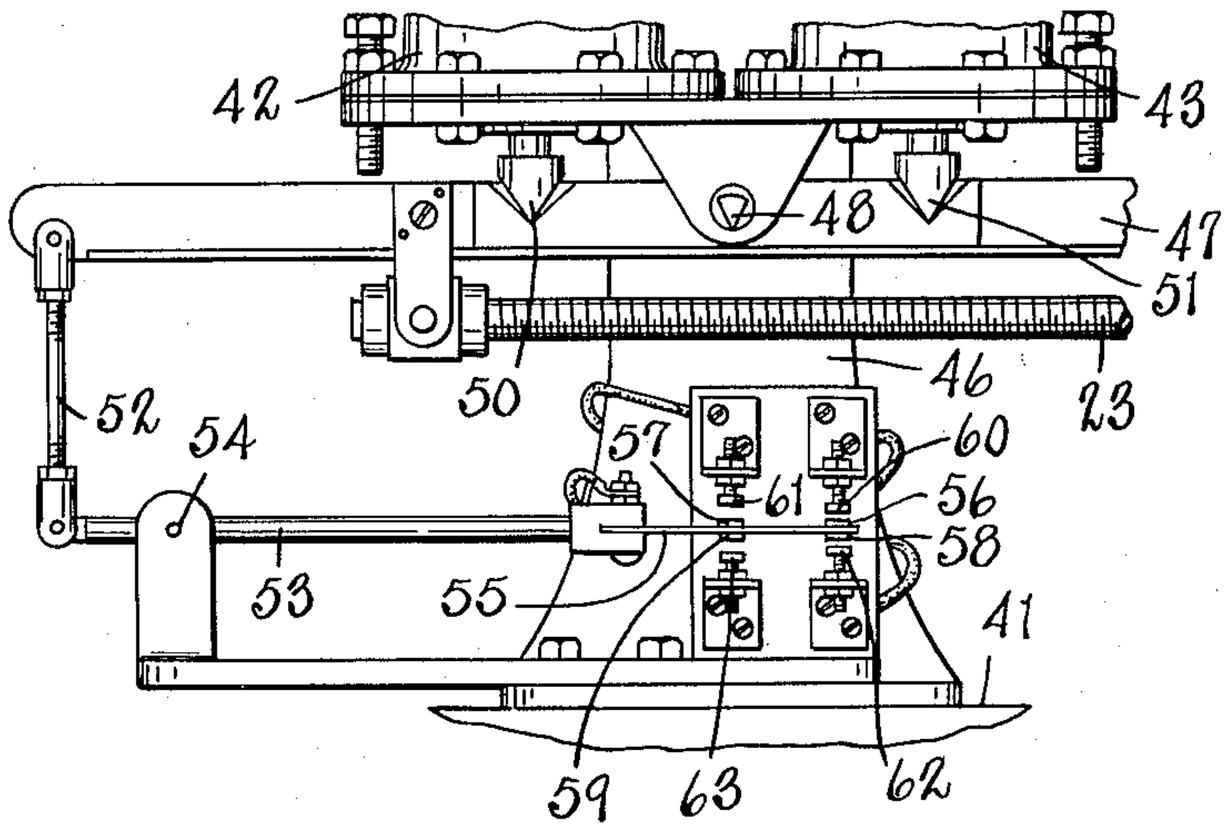

Fig. 3.

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MOISTURE CONTROL SYSTEM FOR PAPER DRYING MACHINES AND METHOD

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16 Claims. (Cl. 34—48)

This invention relates to improvements in moisture control systems for paper drying machines and method.

The main objects of my invention are:

First, to provide a moisture control system for a paper drying machine, adapted to regulate the supply of steam or other heating medium to the machine according to the requirements of the paper to be dried passing therethrough.

Second, to provide a control system of the type described operative on the principle that the rise or drop in pressure to a given drying unit therein is in proportion to the amount of heat radiated thereby, assuming the temperature is constant, and that in turn the amount of heat radiated is in proportion to the moisture content of a paper web at the given drier unit.

Third, to provide a system of the type described in which the steam pressure in the main header is brought to a desired value, depending upon the heat requirements of the web, by increments or steps rather than in a prolonged surge, whereby "hunting" of the pressure control system is eliminated.

Fourth, to provide a system of the type described characterized by an indicating drier unit provided with a constant steam supply and an orifice in the supply line thereto together with means for sensing variations in pressure difference at opposite sides of the orifice for the purpose of regulating the steam supply to the entire system.

Fifth, to provide a system having novel and highly efficient means for maintaining constant pressure in an indicating drier unit.

Sixth, to provide a novel and efficient timing or interrupting device for a system of the type described, whereby changes in pressure in the main steam header are brought about periodically and by increments or steps whereby "hunting" is avoided.

Seventh, to provide a system of the type described having a novel and improved pressure control communicating with the main steam header and connected to a reversible motor operated regulating valve in the header whereby the valve may be opened or closed to admit more or less steam to the system until the heat requirements of a web passing through the system are completely satisfied.

Eighth, to provide a system of the type described having novel means for detecting variations in moisture content of a web passing therethrough.

Ninth, to provide a novel and improved method for controlling pressure in a web drying apparatus.

Further objects relating to details and economies of my invention will definitely appear from the description to follow. The invention is defined in the claims.

A preferred embodiment of my invention is illustrated in the accompanying drawings, wherein:

Fig. 1 is a conventionalized diagrammatic view of a paper web drying machine and details of my pressure control system associated therewith, the elements thereof being in side elevation except for the timing device which is shown in plan for convenience of illustration.

Fig. 2 is a front elevational view of the automatic pressure control for the main steam header valve.

Fig. 3 is a fragmentary front elevational view illustrating details of an element of my system, namely, the moisture detector.

In the operation of a continuous drying machine for a moisture laden paper web passing therethrough, the following general principles have been established:

(1) If, in a closed vessel supplied with steam at constant pressure, the outside radiation of the vessel is varied by some effect, such as changes in heat requirements of a web being dried by the vessel, due to variations in moisture content, thickness or speed of the web, the steam flow to the vessel will vary with the change in rate of radiation.

(2) If an orifice of the correct diameter be installed in the supply line of the vessel, changes in flow thereto will be reflected in changes of differential pressure over the orifice, and these changes in differential pressure will be proportional to the changes in radiation, assuming that the temperature of the drier be maintained constant.

The above principles may be used in connection with a paper drying machine for detecting changes in the moisture content of a web of paper passing over the machine. It has been found by practical use that the rate of heat transfer for a given weight of paper and speed of machine depends upon the difference in temperature between the drier element and the paper and upon the percentage of moisture carried by the paper. It is also known that the amount of steam condensed in the drier, and therefore the steam flow to the drier, depends on the rate of heat transfer. Inasmuch as either temperature differential or moisture can vary the steam flow to the drier, I

eliminate one of these variables, namely, temperature change, by maintaining a very accurate uniform temperature within the drier element. This I accomplish by maintaining a constant pressure within the element and by providing a means for removing air from the drier element by using a dependable steam trap with sufficient air handling capacity. Inasmuch as saturated steam temperatures are governed by pressure, it is entirely satisfactory to maintain constant temperature by maintaining constant pressure in the indicating drier element.

In the paper web drying machine and pressure control system therefor to be hereinafter described, reference numeral 1 indicates a plurality of drier units or cylinders connected to a main steam supply header 2 by pipes 3 and provided with a return header 4 to which they are connected by drain pipes 5. The steam header is provided with a regulating valve 6 actuated by a reversible motor 7 whereby more or less steam is admitted to the header, depending on the heat requirements of the web passing through the machine, in a manner to be hereinafter described.

A drier 8 is selected near the dry end of the machine, which will be referred to as the indicating drier, and the supply line 9 therefor is provided with a regulating valve 10 and an orifice or restriction, generally indicated by the reference numeral 11, which is mounted in a fitting 110. A suitable steam trap 12 is placed in the exhaust line 13 of the indicating drier for the purpose of removing air from the drier, and, as explained above, by maintaining constant pressure in indicating drier unit 8, the variations in moisture content of the web at that unit will be accurately reflected in variations of pressure differential over orifice 11 in a manner to be hereinafter described.

For actuating valve 10 to maintain a constant pressure in indicating drier 8, I employ a pressure regulator generally indicated by the reference numeral 14 and comprising a suitable base 15 upon which is mounted a standard 16 carrying fixedly a casing or housing 17 in which is mounted a metal bellows or diaphragm (not shown), the housing being in communication with the pressure in indicating unit supply pipe 9 through a pipe 18 connected by a T-fitting with a tube 180 joined to the bottom of a water reservoir 181, which reservoir is in turn connected to supply pipe 9 above orifice 11 by nipple 182. The water reservoir 181 provides a water seal between the steam in pipe 9 and the tube leading to housing 17 and is of sufficient diameter to prevent serious changes in water level which would cause changes in the hydrostatic head on the bellows. Any variations in that pressure therefore will impart a movement to the bellows referred to, which movement will be transmitted to a beam 19 pivoted on a knife edge to standard 16 at 20 through a hardened knife edge 21 bearing against the beam at one side of the fulcrum thereof. Movement of the beam in response to the force transmitted from the bellows is opposed by a weight 22 adjustably mounted on a screw 23 rotatably carried by the beam in a manner which will be obvious from the disclosure of Fig. 1.

A switch lever or arm 24 is pivotally mounted at 25 and connected to beam 19 by a link 26 and carries at one end thereof a resilient conducting strip 27 provided with upper and lower contacts 28, 29. Stationary contacts 30, 31 cooperate with contacts 28, 29, respectively, when arm 24 is rocked to upper or lower position in response to variations in the indicating drier pressure transmitted by the bellows. Arm 24 has the effect of greatly multiplying the movement of beam 19, wherefore it will be seen that slight variations in pressure in the indicating drier are sufficient to bring contacts 28 and 30 or 29 and 31 together, depending upon the nature of the pressure change. A conductor 32 connects contacts 28 and 29 to a source of electrical energy and a further wire 33 leads from the source of energy to a reversing motor generally indicated at 34. The contacts 30, 31 are likewise connected to motor 34 by means of conductors 35, 36 respectively. Motor 34 is adapted to drive a gear 37 in either direction of rotation to actuate a crank 38 controlling valve 10 through a link 39 and arm 40. The reversing motor is provided with limit switches (not shown) connected to arm 38, thus eliminating danger of damage to valve 10 due to overrun. Valve 10 is preferably equipped with throttling disks of known type.

From the above description, it will be seen that changes in pressure in indicating drier 8 are immediately compensated for by a reversal of the field of motor 34 to open or close valve 10, depending upon whether the variation is an increase or a decrease in the pressure. The weight 22 is positioned so as to just balance the pressure influencing the bellows when the pressure is of the desired value and thus to maintain contacts 28, 29 midway between contacts 30, 31. Thereafter, the pressure is automatically maintained at that value by the apparatus described.

Constant pressure in indicating drier 8 having been provided for, variations in moisture content of the web will be accurately reflected in variations of pressure differential at orifice 11, and these variations are communicated to a moisture detector, generally indicated at 41, consisting of a pair of metal bellows or diaphragms (not shown) encased in housings 42, 43. The bellows in housing 42 is communicated with the steam pressure above orifice 11 through a pipe 44, tube 180, water reservoir 181, and nipple 182, and the bellows in housing 43 is communicated with the pressure below the orifice through a pipe 45, water reservoir 140 and nipple 41 communicating with the pressure on the downstream side of orifice 11. Water reservoir 140 is similar to and performs the same function as reservoir 181. The housings 42, 43 are mounted on a standard 46 and a beam 47 is pivotally mounted on the standard at 48 on a hardened knife edge. A weight 49 is adjustable lengthwise of beam 47 by means similar to the construction provided for adjusting weight 22 of the pressure regulator.

The bellows in housings 42, 43 are capable of transmitting forces exerted by the pressures on the two sides of orifice 11 to beam 47. Weight 49 having been set for a given pressure differential over the orifice, a change in the pressure differential will cause movement of one of the bellows and this movement will be transmitted to beam 47 through hardened knife edges 50, 51 acting on the beam at opposite sides of the fulcrum thereof. Weight 49 functions to balance the beam against the unbalanced bellows forces which are in direct relation to the up and down variations in steam pressures at the orifice. Attached to the beam through a link 52 is an arm or switch lever 53 pivoted at 54 and carrying at its outer end a conducting spring contact member 55. Member 55 has mounted thereon upper contacts 56, 57 and lower contacts 58, 59 to be referred to as movable contacts. The proportion-

ing of arm 53 results in considerable movement of the arm in response to very small bellows movements, and this feature, coupled with the fact that all the moving parts are supported on hardened knife edges, makes the moisture detector sensitive to very small variations in differential pressures over the orifice in the indicating drier, and accordingly proportionately sensitive to moisture changes in paper passing over the indicating drier.

Directly above and below movable contacts 56, 57, 58, 59 are upper stationary contacts 60, 61 and lower stationary contacts 62, 63. Contacts 56, 58, 60 and 62 may be designated primary contacts, while contacts 57, 59, 61 and 63 may be designated secondary contacts. As indicated in Fig. 1, the stationary contacts are so mounted that as the switch arm 53 moves up or down the primary movable contacts close with the primary stationary contacts directly above or below it, as the case may be, before the secondary movable contacts close with their respective stationary contacts. Member 55 is a light spring element which will yield when additional force is exerted on it after the primary contacts are closed, whereby the secondary contacts may be closed. This arrangement of primary and secondary contacts makes it possible for the moisture detector 41 to differentiate between small changes in pressure differential over the orifice and more violent changes. This feature is made use of for changing the pressure in the supply header 2 to the entire machine by a small or large amount depending upon the demand due to moisture in the paper, as will be explained later. Spring member 55 is connected to a source of power by a lead wire 64, and conductors 65, 66, 67, 68 connect stationary contacts 60, 61, 62 and 63 respectively to a timing device generally indicated at 69.

The timing device is provided with mercury switches 70, 71, 72 and 73 to which conductors 65, 66, 67 and 68 are respectively electrically connected. Switches 70, 72 are pivotally mounted as a pair and associated with a cam follower 74 adapted to make contact with a cam 75, while switches 71, 73 are pivotally mounted as a pair and associated with a cam follower 76 contacting a cam 77. Both cams 75 and 77 are mounted on the shaft of a constantly rotating motor 78 or are otherwise driven from a suitable separate source of power.

Followers 74 and 76 are adjustable by means of screws 79, 80 respectively, whereby the period in each revolution of the cams during which the followers are actuated by the cams may be regulated or varied.

Conductors 81, 82 are electrically connected to switches 70, 71 and 72, 73 respectively, and lead to a small reversible motor 83, the purpose of which will be hereinafter described.

The speed of rotation of cams 75, 77 is preferably such that one revolution thereof is made in a length of time corresponding approximately to the length of time required for the paper to travel from the front or wet end of the drier to the indicating drier unit. Rotation of the cams causes the mercury switches to be tilted during a certain period, depending on the setting of followers 74, 76, which may extend over any desired fraction of a cam revolution or for nearly a full revolution. Thus, assuming that, due to a change in pressure difference over orifice 11, contact 56 is brought against contact 60, current will flow through conductor 65, switch 70 and conductor 81 to motor 83 during the time that switch 70 is tilted by cam 75. If the change in pressure differential is so great that contact 57 is caused to engage contact 61, current will flow through conductor 66, switch 71 and conductor 81 to motor 83. Corresponding circuits will be completed through primary or secondary contacts 62, 63 when the change in pressure differential at the orifice is in an opposite direction. Since they are connected with primary stationary contacts 60 and 62, switches 70 and 72 may be designated primary switches, while switches 71 and 73 may be designated secondary switches. Cams 75 and 77 respectively may also be designated primary and secondary timing or interrupting cams. The secondary cam 77 and follower 76 associated therewith are designed to maintain switches 71, 73 tilted or closed throughout a longer period during the rotation of the cam, wherefore current is supplied to motor 83 through the last named switches for a longer period, assuming that a circuit has been completed through the secondary contacts by a relatively violent change in pressure differential at the orifice. Further adjustment of the period of contact for either primary or secondary switches may be made by the setting of screws 79, 80 as above described.

A third conductor 84 leads to reversing motor 83 from a source of electrical energy, and it will be appreciated that the field of motor 83 will be reversed depending upon the nature of the change in pressure differential at the orifice, assuming that one exists. However, motor 83 will be energized intermittently rather than continuously due to the effect of the timing or interrupting device 69. The purpose of this arrangement will be hereinafter referred to.

Motor 83 is suitably mounted on a beam 85 pivoted on a knife edge at 86 to a standard 87 mounted on a base 88. A bellows or diaphragm 89 is likewise mounted on standard 87, being encased by a housing 90 into which a pipe 91 communicating with steam header 2 is tapped.

Therefore, it will be seen that bellows 89 is under the pressure of the steam in header 2 and movement imparted to the bellows is transmitted to beam 85 through a hardened knife edge 92 bearing against beam 85 to one side of the fulcrum thereof. Motor 83 is operative to rotate a threaded member 93 suitably journaled in the beam through a vertical shaft 94 rotatably mounted in the beam and operative to transmit the rotation of the motor shaft to the threaded member. A split nut 95 is employed to suspend a weight 96 on the threaded member.

Movement of the beam 85 is transmitted to an arm or switch lever 97 pivoted to a fixed point at 98 through an adjustable link 99 as shown in Figs. 1 and 2. The arm 97 is provided with a movable contact 100 at its free end, the contact being electrically connected through a lead 101 to a source of electrical energy. A pair of stationary adjustable contacts 102, 103 are suitably mounted above and below contact arm 100 and are connected respectively to a reversing switch 104 through conductors 105, 106, the reversing switch connecting conductors 101, 105 and 106 to conductors 107 leading from a source of increased electrical energy to the terminals of reversible motor 7, which is operative to actuate regulating valve 6.

The operation of the pressure controller just described, in conjunction with the remainder of

the mechanisms of my improved control system, may be summarized as follows:

For a given weight of paper passing over indicating drier 8 and containing the amount of moisture desired, a definite pressure differential will be set up over orifice 11 and a definite differential in pressure will exist between the two bellows of moisture detector 41, and the resulting difference in pressure on beam 47 of the detector may be balanced by weight 49 on the beam. In this condition of the system, the primary and secondary movable contacts will be balanced intermediate the stationary contacts and no current will flow to reversing motor 7. If we now assume that the percentage of moisture being carried by the paper varies from the desired condition just described, the differential pressure due to flow will vary and the beam will be thrown out of equilibrium, causing one or the other of the contacts on switch arm 53 to close. For example, if the percentage of moisture in the paper passing over the indicating drier increases a small amount, a rise in pressure, which means a rise in temperature in all of the driers, must be accomplished provided the speed of the machine has not changed. Assuming the moisture in the paper has increased, this results in an increase in differential over the orifice by a small amount. This change throws beam 47 out of equilibrium and causes primary movable contact 56 to close with the primary stationary contact 60, due to the fact that, as the flow increases, the pressure at the down stream side of orifice 11 decreases, resulting in a drop in pressure acting on the bellows at the right of fulcrum 48 in Fig. 1. When this occurs, current flows through mercury switch 70 to reversible motor 83 on the beam of the pressure controller, causing the motor to run in a direction which moves the weight out on beam 85. The distance through which the weight moves is governed by the setting of switch 70 of the timing device.

Since it is assumed that the moisture in the paper has increased by a small amount, it is necessary to raise the pressure in the main steam header to compensate for the additional moisture. When the weight 96 moves out on the beam 85 a small distance, as just described, the equilibrium of the beam is disturbed and contact 103 is engaged by spring contact 100. This energizes the pilot coil (not shown) in reversing switch 104 and causes the main contacts in the switch to close, whereby the motor 7 causes valve 6 to open by a small amount, raising the pressure in header 2 and accordingly the temperature in all of the driers of the machine, except indicating drier 8 which, as before mentioned, must be maintained at constant pressure.

Raising of the pressure in header 2 tends to counterbalance weight 96 due to movement transmitted from bellows 89 to beam 85 and thus break the contact of contacts 100 and 103. When the heat requirements of the paper are not satisfied, the weight will continue to be shifted outwardly since motor 83 will be intermittently energized. When the heat requirements are satisfied, bellows 89 will counterbalance weight 96 and the current supply to motor 7 will be interrupted.

Obviously, if the pressure differential were in the opposite direction, i. e., if less heat were required by the paper, primary contacts 58 and 62 would engage and motor 7 would be energized in the opposite direction.

If the moisture content of the paper had changed by a considerable amount instead of by the small amount described, a still greater differential would have been set up over the orifice, throwing moisture detector 41 farther out of balance and causing the secondary contacts of the detector to close, and current would have been supplied to motor 83 through the long time or secondary mercury switches 71, 73 of timing or interrupting device 69. This circuit would have caused the reversing motor 83 to operate for a longer period as explained above, and would have moved the beam weight through a greater distance, resulting in a more rapid pressure rise in the main header 2.

As explained, the cams on the timing or interrupting device 69 are preferably set to rotate at a speed such that one revolution is approximately equal to the time required for the paper to travel from the wet end of the drier to the indicating drier. The mercury contacts are tilted or closed during only a part of the revolution of the cams 75 or 77 to make it possible for current to flow to motor 83. In other words, the current supply to motor 83 is intermittent or interrupted, thus providing a waiting period after a pressure change has been accomplished and allowing the paper to travel from the wet end to the indicating drier before a new pressure condition is tested by moisture detector 41 and additional change made with respect to regulating valve 6, if necessary. The feature of the timing device just described represents a valuable means for approaching a desired pressure condition in the drying machine; in other words, the desired pressure and temperature condition is approached by increments. Previously, so far as I am aware, pressure changes have been effected by means of a continuous surge of steam to the main header, with the inevitable occurrence of objectionable "hunting". Such action is not possible in my improved construction, which is characterized by its stability.

My timing or interrupting device 69 is further characterized by its flexibility, inasmuch as the time interval during which current is supplied to motor 83 may be selected over a large range, in order to determine the length of time that motor 83 operates and thus determine how far the weight 96 is moved out on beam 85.

The moisture detector 41 embodied in my system is highly sensitive to changes in pressure differential over orifice 11 due to the magnified movement imparted to arm 53 by such changes. Hence, my device is further characterized by remarkable sensitivity. The drier unit pressure regulator 14 is likewise characterized by a high degree of sensitivity for the same reason, hence a constant pressure, which is essential to the efficient operation of the system, may be maintained at all times in indicating drier unit 8.

I have illustrated and described my improvements in an embodiment which I have found very practical. I have not attempted to illustrate or describe other embodiments or adaptations as it is believed this disclosure will enable those skilled in the art to embody or adapt my improvements as may be desired.

Having thus described my invention, what I claim as new and desire to secure by Letters Patent is:

1. In a moisture control system for a web drier a plurality of drier units and an indicating drier unit; a steam header supplying said units; a regulating valve for said header; means responsive to rise or fall in pressure in said header for actuating said valve, comprising a bellows com-

municating with the header, a pivoted beam, means transmitting motion of said bellows to the pivoted beam, an adjustable weight on said beam counterbalancing the force transmitted from said bellows, a movable reversing contact to which movement of said beam is transmitted in magnified degree, said contact being adapted to initiate actuation of said valve, and a reversible motor controlling the position of said adjustable weight, means for energizing said motor in response to heat requirements of said drier units whereby said weight is shifted on said beam to oppose return of the beam to balance until said requirements are fully satisfied, comprising a pair of bellows, a pivoted weighted beam, and means transmitting movement of said last named bellows to said last named beam on opposite sides of the pivot point thereof, movement of said last named beam in either direction being effective to complete a circuit to said motor; and a timing or interrupting device interposed between said energizing means and said motor for causing current to be supplied to the motor at intermittent periods whereby hunting of the regulating valve will be eliminated.

2. In a moisture control system for a web drier, a plurality of drier units and an indicating drier unit, a steam header supplying said units, a regulating valve in said header, a reversible motor drive for said valve, means responsive to rise or fall in pressure in said header for energizing said motor, a reversible motor controlling said energizing means, means for energizing said last named motor in response to heat requirements of said drier units, comprising a moisture detector, and a timing or interrupting device interposed between said moisture detector and said last named motor for causing current to be supplied to the motor at intermittent periods whereby hunting of the motor driven regulating valve will be eliminated, comprising a pair of constantly driven cams, mercury switches in the circuit between said moisture detector and the last named motor, and followers associated with said switches and contacting said cams, the switches being periodically opened and closed during the rotation of the cams.

3. In a moisture control system for a web drier, a plurality of drier units and an indicating drier unit, a steam header supplying said units, a regulating valve in said header, a reversible motor drive for said valve, means responsive to rise or fall in pressure in said header for energizing said motor, a reversible motor controlling said energizing means, means for energizing said last named motor in response to heat requirements of said drier units, comprising a moisture detector, and a timing or interrupting device interposed between said moisture detector and said last named motor for causing current to be supplied to the motor at intermittent periods whereby hunting of the motor driven regulating valve will be eliminated.

4. In a steam control for a paper web drier, a plurality of drying cylinders, a steam header therefor, a regulating valve in said header, and means actuated by variations in pressure caused by increased or decreased moisture content in the web for actuating said valve to raise or lower steam pressure in the header to a desired value and satisfy heat requirements of the paper, including pairs of primary and secondary stationary contacts, a pair of contacts mounted for movement therebetween to complete a circuit to said valve, a resilient arm carrying said movable contacts, and a timing or interrupting device interposed between said means and valve and connected to said contacts, said device being adapted to interrupt said circuit at predetermined periods, whereby the steam pressure in the drier may approach the desired value by increments and without hunting, said resilient arm contacting said movable contacts with said primary or said secondary stationary contacts depending on the extent of variation of pressure influencing the actuating means.

5. In a steam control for a paper web drier, a plurality of drier units including an indicating unit, a steam header supplying said units, an electrically actuated control valve in said header, a restricting orifice in the supply line for the indicating unit, means responsive to changes in pressure differential at opposite sides of said orifice for completing an energizing circuit to said control valve when said pressure differential varies beyond predetermined limits, means interposed between said last named means and said control valve for interrupting flow of current in said circuit for predetermined periods whereby the pressure in the header reaches a desired value by increments, and means for automatically varying the duration of said periods in proportion to the extent of the change in pressure differential.

6. In an automatic control system for a web drying device, an indicating drier unit, a supply line supplying steam to said unit, and means for maintaining a predetermined constant pressure in said unit, comprising a beam, means pivotally supporting said beam, a weight supported by the beam, means in communication with the supply line and active in opposition to the weight, a movable electrical contact connected to the beam, stationary contacts with which said movable contact engages to complete a circuit, a reversible motor means in said circuit, and a regulating valve in said supply line actuated by said motor means.

7. In a control system for a web drying machine, an electrically actuated steam control valve, a moisture detector comprising a pair of pressure responsive members, a pivoted beam, means transmitting movement of said respective pressure responsive members to said beam at opposite sides of the pivot point thereof, an indicating drier unit, a steam supply line for said unit having a restricted orifice therein, said pressure responsive members being in communication with said line at opposite sides of said orifice, whereby the higher and lower pressures on the opposite sides influence said respective pressure responsive members, changes in pressure differential at opposite sides of the orifice unbalancing the beam, a movable contact pivotally connected to the beam, and stationary contacts in position for cooperation with the movable contact to complete a circuit for actuating the steam control valve.

8. In a web drier, the combination of a plurality of drier units including an indicating unit, an electrically actuated main steam supply valve common to all of said units, means between said main valve and said indicating unit for maintaining constant pressure in said indicating unit, there being a restricting orifice between said pressure maintaining means and said indicating unit, energizing circuit control means responsive to changes in differential pressure at opposite sides of said orifice, and means interposed between said last named means and said electrically actuated valve for interrupting the flow of current for

causing step by step actuation of said valve.

9. In a drier for a web, the combination of a plurality of drier units including an indicating unit, an electrically actuated main steam supply valve common to all of said units, means between said main valve and said indicating unit for maintaining constant pressure in said indicating unit, there being a restricting orifice between said pressure maintaining means and said indicating unit, and energizing circuit control means for said valve responsive to changes in differential pressure at opposite sides of said orifice.

10. In a web drier, the combination of an advance drying unit and a succeeding drying unit successively traversed by the web to be dried, means for supplying steam to said drying units including a main control valve, the connection from said main valve to the succeeding drying unit being provided with a restricting orifice and with pressure regulating means in advance of the restricting orifice, control means for said main valve including a circuit closing means controlled by pressure differentials in advance and at the rear of said restricting orifice, and an electrical means for actuating said control valve including a reversing motor operatively associated with said circuit closing means.

11. In a web drier, the combination of a plurality of drier units arranged to be successively traversed by the web, one of the units constituting a control unit, a steam supply regulating valve, a steam supply connection for the control unit, and means operatively associated with the steam supply connection for the control unit and responsive to variations in the steam flow to the unit for controlling the steam supply regulating valve, said means including a timing means whereby the valve is actuated with a step by step movement.

12. In a web drier, the combination of a plurality of drier units arranged in series to be successively traversed by the web to be dried, a control unit at the delivery end of the series, means for supplying steam to the units in advance of said control unit, means for delivering steam to said control unit, a steam supply valve for all said units, and means for controlling said steam supply valve including a pressure responsive means operatively associated with the steam delivery means for said control unit.

13. The method of controlling the supply of heating medium in a web drying machine, comprising supplying a fluid heating medium to the machine, detecting variations in moisture content of a web passing through the machine by variations in the flow of a heating medium to a predetermined point in the machine, initiating regulation of the flow of heating medium to a point in the machine in advance of said predetermined point in response to said variations in flow, and interrupting the regulation for predetermined periods sufficient to allow the condition of the web to be altered by the regulated flow of heating medium and to permit the web in altered condition to reach the point at which the detecting operation takes place in order to determine if further regulation is necessary.

14. The method of controlling a heating medium in a web drying machine, comprising feeding the web, detecting variations in moisture content of the web at a predetermined point during the feeding thereof, initiating regulation of the flow of heating medium for the machine in response to the detected variations, and interrupting the regulation for predetermined periods sufficient to allow the condition of the web to be altered by the regulated flow of heating medium and to permit the web in altered condition to be fed to the point at which the detecting operation takes place in order to determine if further regulation is necessary.

15. The method of controlling pressure of a heating medium in a web drying machine, comprising supplying a heating medium, detecting variations in moisture content of a web passing through the machine, determining the nature and extent of the regulation of the flow of heating medium required to offset said variations, initiating regulation of the flow of heating medium in response to said determination, and effecting the requisite regulation incrementally by interrupting the regulation for predetermined periods sufficient to allow the web as altered in condition by such incremental regulation to reach the detecting means.

16. In a web drier, a drier unit, means for supplying heating medium thereto, a valve controlling said supply of heating medium, means for detecting variations in moisture content of the web at said drier, means for determining the nature and extent of the regulation of the flow of heating medium required to offset said variations, and means for actuating said valve by successive predetermined fractions of the requisite regulation and at intervals sufficient to allow the web as altered in condition by such incremental regulation of the flow to reach said detecting means.

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