

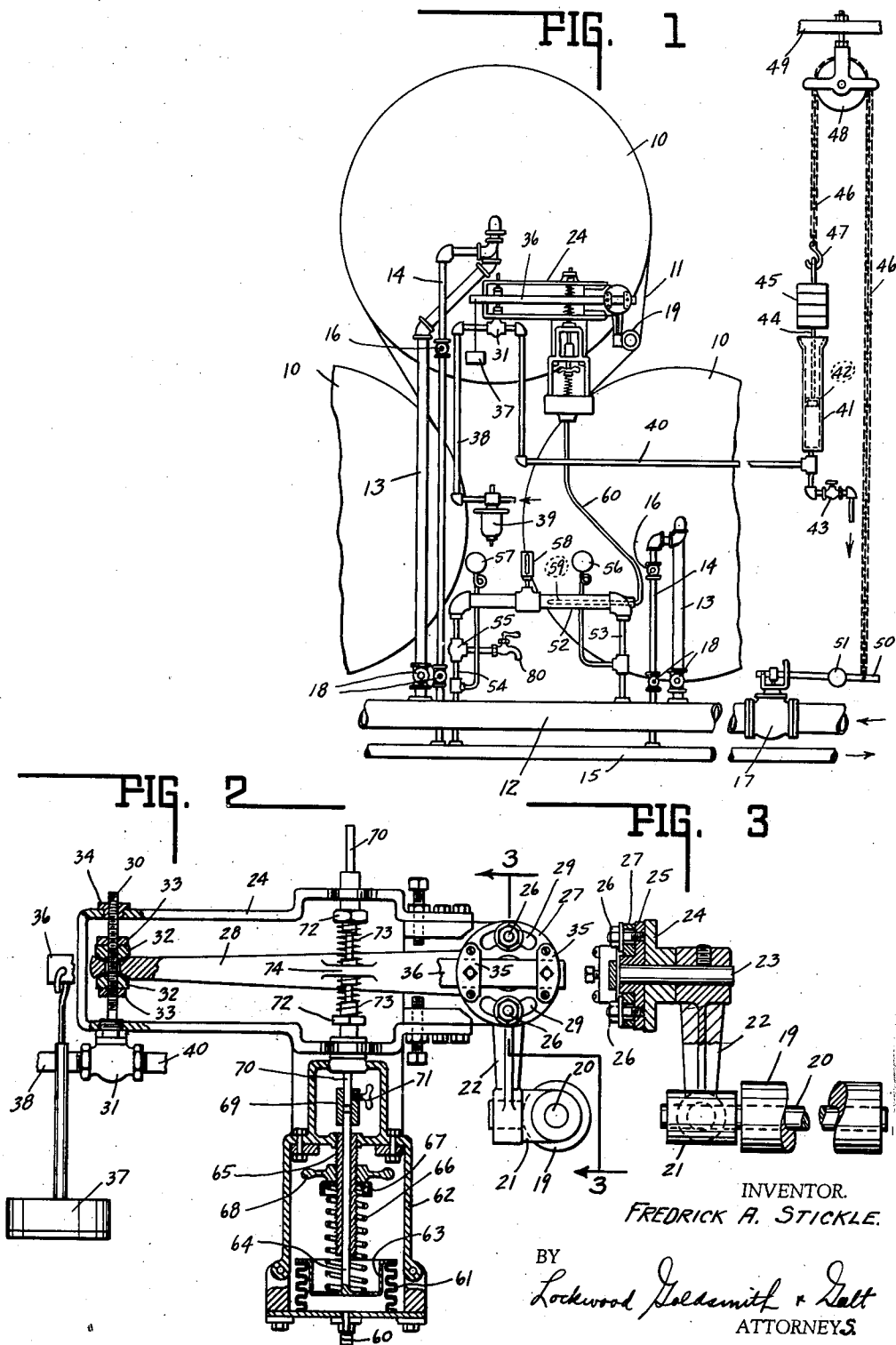
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AUTOMATIC STEAM CONTROL FOR PAPER MACHINES

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AUTOMATIC STEAM CONTROL FOR PAPER MACHINES

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This invention relates to an automatic steam control for paper machines.

In the manufacture of paper, a continuous web of paper is dried by passing it about a series of rotating drying rolls heated by steam admitted to the interior of the rolls. The water content of the incoming paper is subject to variation from time to time, making it necessary to vary the pressure and temperature of the steam supplied to the rolls to secure a uniformly dried finished product. When the web of paper is not thoroughly dried in the process, it becomes slack on the rolls, and when over-dried, it becomes excessively tight and may even break. This variation in tension is utilized to automatically control the steam supply. The steam control is accomplished by means of a tension roll engaging the web of paper in a position to be moved in one direction when the web tightens and in the other direction when the web slackens. The movement of the roll is transmitted through suitable mechanism to the steam throttle valve controlling the steam supply to the drier in such manner as to admit more steam when the paper is too wet and less when too dry. The tension roll must necessarily be at a point where the paper has reached a sufficiently dry state to withstand the pressure of the tension roll upon the web and this point must be somewhat remote from the receiving end of the machine. For that reason, a change in the water content of the incoming paper will not be reflected immediately in a change in tension of the web at the tension roll. There is, thus, a time lag between cause and effect which results in a certain amount of over-control if changes in moisture content of the paper are abnormally sudden or temporary. With this prior art control, when the web breaks, for any reason, the pressure roll is free to move to an extreme position, which results in fully opening the steam valve. Since it is not desirable to overheat the rolls during the shut down resulting from a break in the web, it is necessary to close the valve by hand as soon as such a break occurs.

In the present invention, the tendency to over-control is reduced and the necessity for manually shutting off the steam when the web breaks is eliminated by superimposing upon the tension control of the prior art a control based on the physical condition,—that is, the temperature or pressure of the steam supplied to the rolls. This superimposed or auxiliary control acts to modulate the tension control in such manner as to prevent excessively rapid changes in the steam

supply which might be caused by sudden or temporary changes in the moisture content of the paper. In case of a break in the web, the tension control ceases to function and the superimposed auxiliary control operates to maintain the steam pressure in the drier between predetermined maximum and minimum limits. These limits are so chosen that the rolls are neither overheated nor permitted to cool unduly and are, therefore, immediately ready for a resumption of operation when the web has again been fed through the machine.

Other objects and features of the invention will be understood from the accompanying drawing and the following description and claims:

Fig. 1 is an elevational view of a portion of a paper machine having the invention applied thereto. This figure is substantially diagrammatic, the frame of the machine and other supporting parts being omitted to disclose the invention more clearly. Fig. 2 is an enlarged elevational view with parts in section of a portion of Fig. 1. Fig. 3 is a sectional view taken on the line 3—3 of Fig. 2.

In the drawing, there is shown, by way of illustration, a preferred form of the invention. Three drying rolls 10 of a multiple roll paper machine are shown. A web 11 of the paper being dried is trained about the rolls in the usual manner. The drying rolls are supplied with steam by means of a steam main 12 and supply pipes 13. Condensate is removed from the rolls by means of condensate pipes 14 and a return main 15. The escape of condensate is regulated by orifice valves 16 of the usual form placed in the condensate lines 14. The pressure of steam within the rolls, and therefore, the temperature of the rolls, is controlled by a throttle valve 17 in the steam main 12. Valves 18 are provided in the steam pipes 13 and return pipes 14 to cut out the operation of an individual roll when desirable.

A tension roller 19 engages the web of paper between two of the drying rolls 10. The tension roll is mounted on a shaft 20 in turn, mounted in a fitting 21 secured to the end of a lever arm 22. The lever arm 22 is fixed to a stub shaft 23 rotatably mounted on a suitably supported stationary frame 24. The stub shaft 23 has fixed thereto a bushing or collar 25 to which there is secured, by means of bolts 26, the hub 27 of a lever arm 28. The bolts 26 operate in slotted openings 29 in the hub 27 and may thus be used to adjust the angular relationship between the lever arm 28 and the tension roll 19. The lever

arm 28 is provided at its outer end with a suitable opening through which extends the valve stem 30 of a pilot valve 31. Said stem has threadedly engaged therewith a pair of seats 32 engaging the end of the lever arm and a pair of lock nuts 33 retaining said seats in proper position. The valve 31 is secured to the frame 24 and the valve stem 30 is slidably guided at its upper end in a bushing 34 secured to said frame.

The hub 27 has secured thereto by means of clamps 35, a lever arm 36 on the outer end of which there are hung counterweights 37 by means of which the pressure of the tension roll 19 on the web of paper may be adjusted.

The valve 31 is connected to a suitable source of water or other motive fluid under pressure by a pipe 38 in which there is placed a common form of pressure regulator 39 which insures a uniform fluid pressure at the valve 31. The discharge side of the valve 31 is connected by a pipe 40 to the lower end of a cylinder 41 in which there is operating a piston 42. A leak-off valve 43 is also connected to the pipe 40 and is adjusted to permit the fluid passed by valve 31 to escape at a predetermined rate, depending upon the pressure in the pipe 40 and cylinder 41. The piston 42 is connected to a piston rod 44, on the upper end of which there are carried a number of weights 45. A chain 46 is connected by a hook 47 to the upper end of the piston rod 44. The chain 46 passes over a pulley 48 suitably supported on an overhead support 49 and is connected at its opposite end to a lever 50 serving to open and close the valve 17. The lever 50 carries a counterweight 51 which insures the closing of the valve when the chain 46 is slackened by an increase of pressure in the cylinder 41.

In the operation of the apparatus so far described, the parts are adjusted to assume a normal position when the web of paper in the tension roll has the proper tension. In this normal position, the valve 17 is opened the proper amount to maintain a steam temperature in the drying rolls which will maintain the web in the desired state of dryness so long as the moisture content of the incoming paper remains unchanged. If the water content increases, the web slackens and the weights 37 operate to draw the lever 36 and the lever 28 downwardly, thus partially closing the valve 31. The movement of this valve decreases the supply of water to the cylinder 41. The water, therefore, escapes through the valve 43 at a more rapid rate than it is supplied and permits the piston 42 to move downwardly under the action of the weights 45. The downward movement of the piston is transmitted through the chain 46 to the lever 51 which is lifted to partially open the valve 17 and to admit more steam to the drying rolls. The increase in steam pressure thus caused results in an increase in temperature which serves to dry the paper at a more rapid rate and to restore the normal condition of the web.

Similarly, if the water content of the incoming paper decreases, the web, before reaching the roller 19, becomes more thoroughly dry. It, therefore, tightens and forces the roller 19 to the left in Figs. 1 and 2. This movement elevates the lever 28, opens the valve 31 and causes a building up of pressure in the pipe 40 and cylinder 41 which forces the piston 42 upwardly. The upward movement of the piston slackens the chain 46, permitting the weight 51 to partially close the valve 17. Thus, a lower pressure

and temperature is produced in the drying rolls and this change tends again to restore the normal condition of the web.

In order to modulate the action of the tension control just described, to prevent over-control and to prevent full opening of the valve 17, if the web breaks, there is provided an auxiliary control which operates in response to the physical condition of the steam supplied to the drying rolls. In the example shown herein, this auxiliary control operates in response to the temperature of such steam, but it may be operated equally well in response to pressure since there is a definite relation between the temperature and pressure of the unsaturated steam used for drying. In the example shown herein, there is provided a sampling pipe or tube 52 supplied with steam from the main 12 by a pipe 53. The pipe 52 is drained of condensate by a pipe 54 supplied with an orifice valve 55 similar to that used for the drying rolls. The steam in the pipe 52 is thus maintained at the same temperature and pressure as the steam in the drying rolls. Suitable pressure gauges 56 and 57 are supplied to indicate the supply pressure and drainage pressure respectively and a thermometer 58 is supplied to indicate the temperature of the steam in the sampling pipe. A test cock 80 connected to the orifice valve 55 is opened periodically to determine whether or not the sampler is being properly drained.

A thermostat bulb 59 is inserted in the pipe 52 and is connected by a flexible tube 60 to the interior of a thermostat bellows 61 carried upon a frame 62 secured to the frame 24. The bulb 59 and tube 60 are supplied with the usual volatile fluid which expands upon heating and causes a corresponding expansion of the bellows 61. A seat 63 forms the upper part of the bellows chamber 61 and has secured thereto a vertical stem 64 slidably guided in a threaded tube 65 secured to the frame 62. A compression spring 66 abuts against the cap 63 and against a cup 67 which is retained in an adjusted position by an adjusting screw 68 threadedly engaging the tube 65. At its upper end, the stem 64 has secured thereto a collar 69 in which there is slidably retained a second stem 70 which may be clamped in place by a thumb screw 71. The stem 70 is slidably guided in suitable bushings mounted upon the frame 24 and carries spring abutments 72 threadedly engaged therewith. Compression springs 73 surround the stem 70 and abut upon the abutments 72 and upon opposite faces of a lug 74 formed on the lever 28.

In the operation of the apparatus, the thumb screw 71 is first loosened to permit the stem 70 to slide upwardly and downwardly in the collar 69. The adjustments of the tension roll and valve 17 are then made to establish the normal condition of steam supply and web tension. When these conditions have been established, the thumb screw 71 is tightened. Thereafter, a change in the condition of the web results in a corresponding change in the pressure and temperature of the steam supplied to the drying rolls as before, but the change is opposed and modulated by the movement of the stem 70 and its associated springs 73 under the influence of the change in temperature in the sampler 52. For example, a slackening of the web 11 calling for increased temperature results first in the opening of the valve 17 to supply steam at this temperature. This in turn results in an increase of temperature at the thermostat bulb 59. The

expansion of the volatile fluid in said bulb pushes the stems 64 and 70 upwardly and exerts an upward pressure on the lever 28 through the springs 73, thus opposing the movement of said lever due to the slackening of the web. The springs 73 and 66 are so adjusted that the opposing force prevents over-controlling on abnormally sudden and temporary changes but does not prevent sufficient movement of the lever 28 to correct for normal changes in the water content. If an extreme change in the water content of the paper occurs, the adjustment of the thermostatic control is such that it prevents a corresponding extreme change in the temperature of the steam supplied. Such abnormal changes in the condition of the web are usually of short duration and, if permitted to influence the steam control unhindered, would result in excessive changes in the steam pressure.

If for any reason, the web 11 breaks, the springs 73 act on the lever 28 under thermostatic control to prevent the full opening of the valve 17 which would normally result from the downward movement of said lever. The control operates to maintain the steam pressure and temperature in the drying rolls within predetermined limits until normal conditions can be restored.

The foregoing specification describes a preferred form of the invention, the details of which may be varied by those skilled in the art without departing from the scope thereof as defined by the appended claims. For example, the auxiliary control may be accomplished in response to pressure changes in the steam supply as well as temperature changes. Since there is a definite fixed relation between the temperature and pressure of steam, such a pressure control is considered the mechanical equivalent of the temperature control herein described.

In another variation, the thermostat bulb 59 may be placed within one of the drying rolls instead of in the sampler as shown herein. However, it is often necessary to take one or more of the drying rolls out of operation by shutting off its steam supply. The use of one of these rolls as a sampler makes it impossible to cut out the operation of that particular roll without destroying the operation of temperature control. For that reason, I much prefer to use the sampler.

The invention claimed is:

1. Control apparatus for paper machines having drying rolls including a steam line supplying steam to the drying rolls, a valve in said line controlling the flow of steam therein, a tension roll engaging a web of paper passing through said machine and tending to be moved in one direction when said web slackens and in the other direction when said web tightens, a movable member operatively connected to said tension roll and movable thereby, means operatively connecting said movable member and said valve and tending to close said valve when said member is moved in response to a tightening of the web and to open the same when said member is moved in response to a slack-

ening of the web, and a thermostat responsive to the temperature of the steam supplied to said drying rolls and operative connections between said thermostat and said movable member tending to move said movable member in the direction to close said valve when the temperature of said steam increases and to open said valve when said temperature decreases.

2. Control apparatus for paper machines having drying rolls including a steam line supplying steam to the drying rolls, a valve in said line controlling the flow of steam therein, a tension roll engaging a web of paper passing through said machine and tending to be moved in one direction when said web slackens and in the other direction when said web tightens, a movable member operatively connected to said tension roll and movable thereby, means operatively connecting said movable member and said valve and tending to close said valve when said member is moved in response to a tightening of the web and to open the same when said member is moved in response to a slackening of the web, an expansible element, means responsive to the condition of the steam supplied to said drying rolls and tending to expand said element when the temperature of said steam increases and to contract the same when said temperature decreases, a stem movable by expansion and contraction of said element, and opposed compression springs interposed between said stem and said movable member and tending to move the same in the direction to close said valve when said expansible member is expanded and to close the same when said member is contracted.

3. Control apparatus for paper machines having drying rolls including a steam line supplying steam to the drying rolls, a valve in said line controlling the flow of steam therein, a tension roll engaging a web of paper passing through said machine and tending to be moved in one direction when said web slackens and in the other direction when said web tightens, a movable member operatively connected to said tension roll and movable thereby, means operatively connecting said movable member and said valve and tending to close said valve when said member is moved in response to a tightening of the web and to open the same when said member is moved in response to a slackening of the web, an expansible element, means responsive to the condition of the steam supplied to said drying rolls and tending to expand said element when the temperature of said steam increases and to contract the same when said temperature decreases, a stem longitudinally movable by expansion and contraction of said element, said stem being manually adjustable as to length, and opposed compression springs interposed between said stem and said movable member and tending to move the same in the direction to close said valve when said expansible member is expanded and to close the same when said member is contracted.

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