Nov. 30, 1965 J. L. GOOD 3,220,377

CONTROL OF MACHINE COMPONENTS

Filed March 29, 1962 2 Sheets-Sheet 1

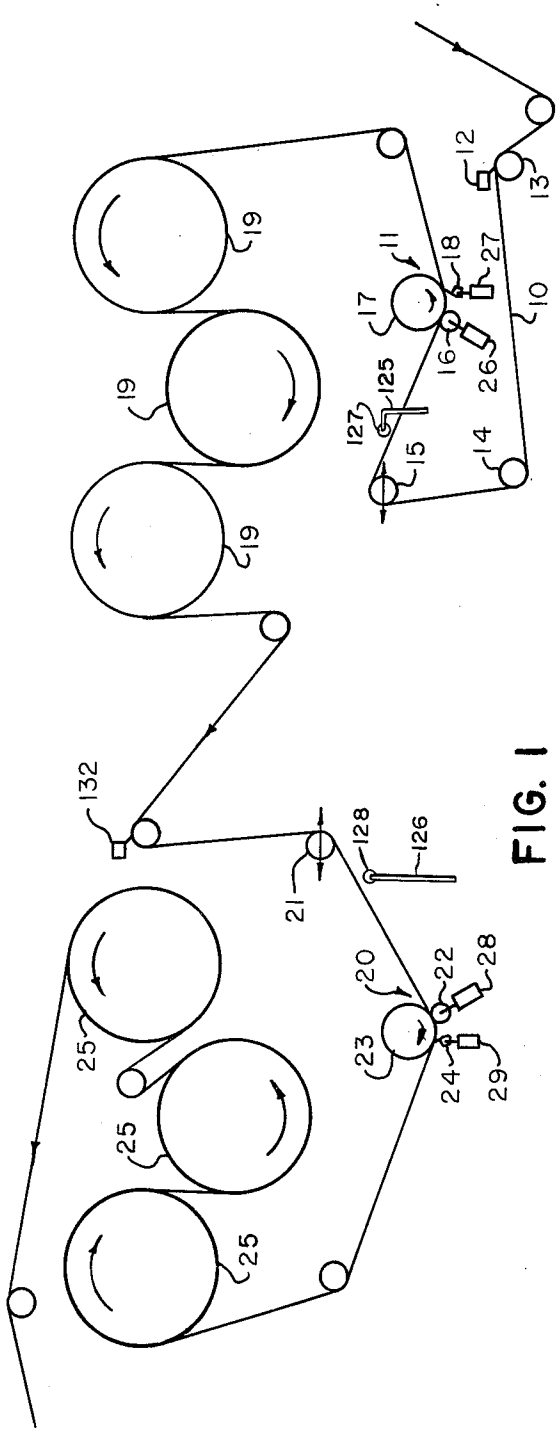


FIG. 1

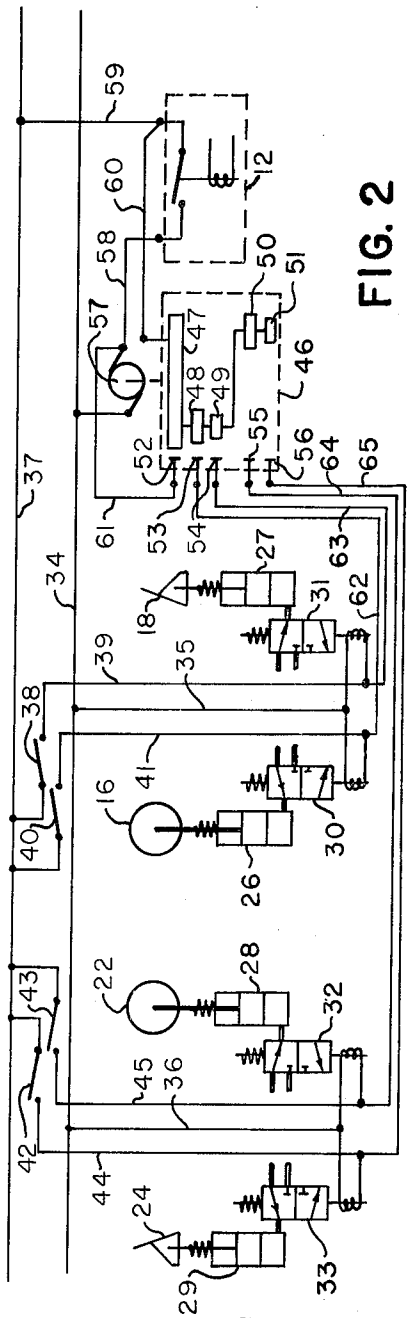


FIG. 2

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CONTROL OF MACHINE COMPONENTS

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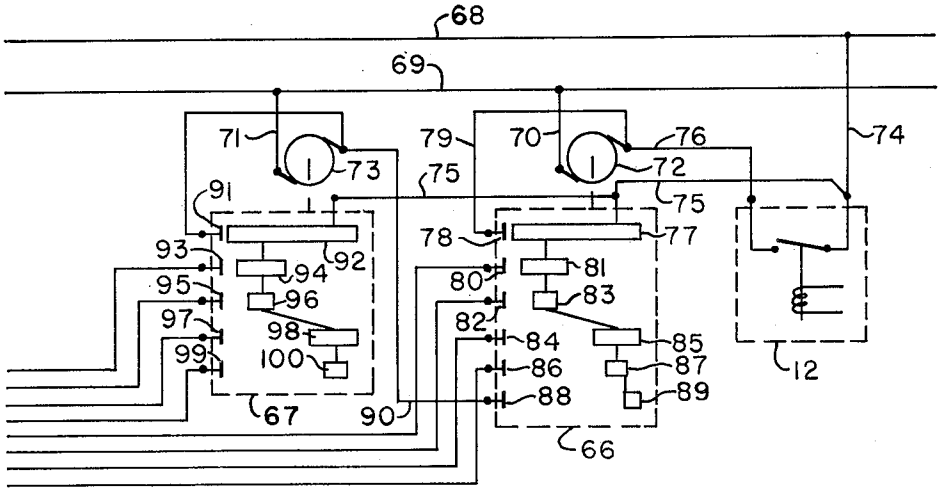


FIG. 3

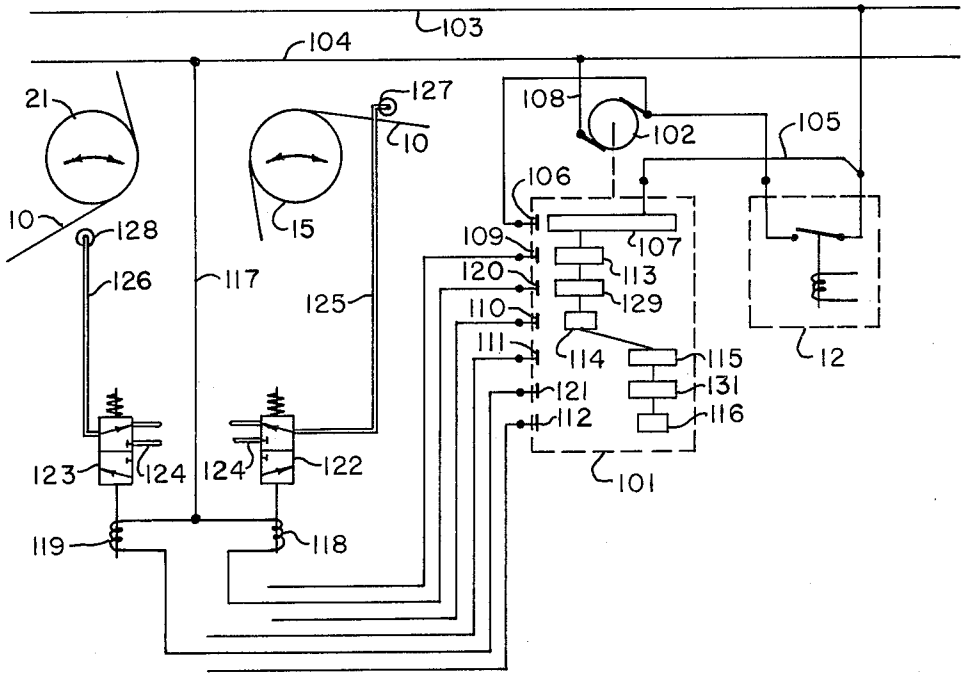


FIG. 4

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3,220,377

CONTROL OF MACHINE COMPONENTS

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Filed Mar. 29, 1962, Ser. No. 183,525
8 Claims. (Cl. 118—8)

This invention relates generally to a method of and apparatus for removing machine components from a traveling web during the passage of a void or similar defect to prevent paper web breaks and more specifically to a method of and apparatus for removing coating components from a paper web during the travel of a defect therethrough, whereby the defect in the paper web will not be further enlarged by the coating components.

On conventional paper machines, the paper web traveling from the forming section, such as a fourdrinier, can be damaged by various machine components. The damages may be in the form of voids, creases, and tears that are not always large enough to break the paper web. However, the defects provide a weakened area in the paper web which can be enlarged by machine components that subject the paper web to a substantial pressure or drag.

Those familiar with the art of coating a paper web are well aware that blade coaters are a continual cause of defect enlargement that results in paper web breaks. The blades employed to meter the coating subjects the paper web to considerable pressure and drag just after the paper web has been wetted and thereby weakened by the coating application.

Those familiar with blade coating are well aware that better coating weight control, lighter coating weights, and improved coating quality are possible with an increase in the coating blade angle. Blade angle as used in the description refers to the acute angle at which the blade approaches the surface of the paper web. In the past, this fact has been compromised because an increase in blade angle also increases the probability of defects in the paper web being amplified, sometimes to the extent of breaking the paper web, as the defect passes under the blade edge. With the invention, the advantages of the higher blade angle can be realized without increasing the machine down-time resulting from a paper web break in the coater.

It should not be interpreted that paper web defects will only be amplified in the blade coaters if the blade angle is large. It is to be understood that the probability of enlargement increases with an increase in the blade angle. Therefore, the invention is applicable for all blade coating operation regardless of the blade angle.

A control system designed according to the invention will automatically detect a defect in the paper web and interrupt the coating operations during the passage of the defect therethrough. Briefly described, the blade and applicator roll of the blade coaters are incorporated into a control circuit that automatically senses the defect prior to the coaters, times the travel of the defect through the paper machine, causes removal of coater components during the passage of the defect therethrough, and causes replacement of the coater components after the passage of the defect therethrough.

The removal of the coating components stops the transfer of coating to the paper web which alters the tension by drastically reducing the moisture content. In some paper machines, the coaters have paper web tension control systems that provide enough control during normal operations. However, especially in the lighter weight paper webs, the sudden drastic change in paper web tension resulting from coater removal cannot be corrected by the tension control systems quickly enough to prevent breakage of the paper web. In such cases, supplemental tension correction controls should be included in the basic control circuit which anticipate the forthcoming need for tension correction and begin to correct the instant the coater components are removed. This is to be contrasted with conventional tension control systems that must sense a change in the paper web tension before beginning correction.

In the past, it was found advantageous in roll coaters to remove the coating applicator rolls from the backing rolls to prevent the transfer of coating during the absence of the paper web. When the paper web was broken prior to the roll coaters, coating material carried on the surface of the applicator roll was in direct contact with the surface of the backing roll. Coating was transferred from the applicator roll to the backing roll where it either transferred to the back side of the restored paper web or formed an irregular surface on the backing roll. In either case, the result was undesirable.

It should be realized that the invention is dealing with distinctly different problems. In roll coaters, the problem has been to prevent the transfer of the coating onto the backing roll during the absence of the paper web. In blade coaters, the problem is primarily to prevent expansion of a defect in the paper web by the blade which could result in a break and necessitate a machine shutdown to clear the coaters.

Since the blade controls the amount of coating that is retained on the paper web, its removal results in the absence of coater metering. The surplus coating would be transferred to the paper web and would travel on the paper web to the dryer rolls immediately following the coater where the coating would adhere to the dryer roll surfaces. To avoid coating transfer, the applicator roll of the blade coater must be removed from the paper web before the operation of the blade ceases. The procedure also prevents the transfer of coating through the defect to the backing roll. Removing the applicator roll does not prevent paper web breaks which result from the coating blade drag and pressure, but prevents coating transfer.

A common occurrence in blade coaters once the paper web has broken is that since the paper web is still being fed from the forming section, it is fed either into the coating pan or is wrapped around the backing roll of the coater. Either case requires considerable time to clean the coaters of the entangled paper web.

On a broader scale, defects in the form of voids, local caliper (lumps) differences, moisture differences, creases, edge cracks, and tears can be detected before they pass through any machine component that exerts considerable exterior force on the paper web such as pressure or drag. For example, it is well known that wet spots in the paper web tend to adhere to the surfaces of the rolls of a calender stack and are frequently torn from the paper web by the adhering action. The void, once created, presents a weakened area in the paper web that is a possible source of breaks. An anticipatory method of controlling the calender rolls according to this invention could be employed to overcome the adhering tendencies by sensing the wet spots and unloading the calender stack during the passage therethrough. Regardless of the component controlled, it will become evident in the following description that similar methods could be employed. The control of calenders and size presses to mention a few are all within the scope of this invention.

It should become evident, therefore, that this invention is concerned primarily with a means for preventing the amplification of paper web defects in the blade coaters of paper machines.

In addition, this invention allows an increase in blade angle which results in better coating weight control without increasing the paper machine down-time.

Further, paper machines manufacturing very lightweight paper webs can have a protected coater system without having tension control problems.

Still further, machine down-time resulting from paper web breaks, regardless of the blade angle, is reduced.

Also, a fully automatic control is obtained that stops the coating during the passage of the paper web defects and starts the coating after the passage of the paper web defects.

Further advantages will hereinafter more fully appear in connection with a detailed description of the drawings in which:

FIG. 1 is a schematic side elevational view of a coater section of a paper machine.

FIG. 2 is a schematic circuit diagram of a control system according to the present invention for the coater of FIG. 1.

FIG. 3 is an enlarged fragmentary schematic circuit diagram of another embodiment of a control system according to the present invention.

FIG. 4 is an enlarged fragmentary schematic circuit diagram of another control system according to the present invention employing a supplementary tension control.

Referring to FIG. 1 of the drawings, the paper web 10 is fed into the first coater, broadly indicated by the reference 11, from the forming section of the paper machine (not shown). The paper web 10 contacts a defect detector 12 as the paper web passes over the idler roll 13. From the idler roll, the paper web travels around another roll 14 and around the tension roll 15 and through the nip created by the applicator roll 16 and the backing roll 17 where the coating is applied to one side of the paper web. The coating is metered by the blade 18, and in this particular embodiment, the paper web then travels around three dryer rolls 19 and enters into the second coater (broadly indicated by reference 20). Prior to passage through the second coater, the paper web engages a second tension roll 21. The paper web travels through the nip created by the applicator roll 22 and the backing roll 23 where coating is applied to the opposite side of the paper web. The coating is then metered by the blade 24 of the second coater. The second coater also has three dryer rolls 25. The paper web leaves the second coater and passes through the machine to a winder stand which is not shown. FIG. 1 is an example of a coater which applies a single coat to both sides of the paper web, and forms no particular part of the invention.

Referring to FIG. 2, notice that the defect detector 12 of FIG. 1 is schematically represented by a normally open solenoid operated single pole-single throw switch. The switch is intended to be illustrative of the action of the defect detector and obviously does not represent the true situation. Suitable void detectors are commercially available, such as those made by Curtiss-Wright. As will become apparent in the following discussion, the defect detector is energized by the passage of a defect usually in the form of a void. The defect energizes the detector, closing the single pole-single throw switch.

The applicator roll 16 of the first coater is positioned by the spring return cylinder 26. The blade 18 of the first coater is positioned by the spring return cylinder 27. In the second coater 20, the applicator roll 22 is positioned by a similar spring return cylinder 28 and the blade 24 by a similar cylinder 29. The applicator roll cylinder 26 of the first coater has a fluid loaded end controlled by a two-way spring return valve 30. The blade cylinder 27 of the first coater is controlled by a similar valve 31. In the second coater, the applicator roll cylinder 28 is likewise controlled by a similar valve 32 as is the blade cylinder 29 controlled by the valve 33. One side of the solenoids controlling the two-way valves 30, 31, 32, and 33 are joined to a common wire 34 by the fed wires 35 and 36. Common wire 34 provides a voltage potential of, for example, 115 volts with the main wire 37. The other side of the solenoids are individually connected to the main wire 37 through switches. The single pole-single throw switch 38 connects through wire 39, the solenoid of the two-way spring return valve 31 and, in a similar manner, the switch 40 through wire 41 connects the solenoid of the two-way spring return valve 30. In the second coater, switches 42 and 43 through wires 44 and 45 connect the solenoids of the two-way spring return valve 33 and the two-way spring return valve 32, respectively. It is to be understood that when any of the switches 38, 40, 42, or 43 are closed, the corresponding two-way spring return valves will be forced into a position which will exhaust the fluid end of the corresponding cylinders. The exhaust will bring about the removal from the paper web of the components positioned by the cylinders. The switches should be conveniently centralized where manual control by the machine operators is easily accomplished.

Up to this point, the circuitry is intended to be illustrative of a standard manual control circuit. Many modifications by those familiar with the art are possible that could still be used in connection with the invention as described in detail in the following description.

Referring again to FIG. 2, a drum timer 46 is composed of 5 contact strips 47, 48, 49, 50, and 51. Each of these contact strips has a corresponding pickup shoe 52, 53, 54, 55, and 56. The drum of the drum timer is driven by the motor 57. Notice that the motor 57 is joined directly to the common wire 34 and indirectly to the main wire 37 through the defect detector 12 by wires 58 and 59. The contact strips 47 through 51 are connected to the main wire 37 through the wires 59 and 60. Wire 61 connects the pickup shoe 52 to the pole of the motor 57 that is also connected by wire 58 to the defect detector 12. Pickup shoes 53 through 56 are individually connected to one end of the solenoids of the two-way spring return valves 30, 31, 32, and 33 through wires 62 through 65, respectively. The drum timer and the defect detector circuits combine with the manual control circuit to form a novel system whereby the passage of paper web defects will not be amplified in the coating section of the paper machine. The two following illustrative examples explain the operating procedure of the system as shown in FIG. 2. The first of these examples will deal with the normal operation of the manual control circuit by the machine operators. The second illustrative example will deal with the operation of the control circuit when the coaters are in operation and the defect detector senses a defect in the paper web.

Assume that the paper web is traveling through the coaters shown in FIG. 1, and that the applicator rolls 16 and 22, and the blades 18 and 24 are not contacting the paper web. Proper paper web tensions are throughout the paper machine and coating operations are to begin. The single pole-single throw manual control switches 38, 40, 42, and 43 which are normally located on a control console in a position relatively close to the coaters are in a closed position. Therefore, from FIG. 2, a voltage potential is applied across the solenoids of the two-way spring return valves 30, 31, 32, and 33. To begin coating, the machine operator opens switch 38 which in turn will deactivate the solenoid of the valve 31 and allow the spring to move the controller 31 into the position as shown in FIG. 2 whereby fluid will be admitted into the fluid end of the cylinder 27. The blade 18 will be forced against the backing roll 17 by the fluid pressure. Next, the operator will open switch 40 which will deactivate the solenoid on the valve 30. The movement caused by the spring of the valve 30 will direct fluid into the cylinder 26 which will force the applicator roll 16 against the backing roll 17. It is to be understood that the angle of the blade 18 is pre-set before the

startup operation as would be obvious to those skilled in the art. Therefore, by placing the blade 18 and the applicator roll 16 against the paper web, the coating of one side of the web has been initiated. It is important to notice that the blade 18 was placed against the web prior to the applicator roll 16. Failure to apply the components in this sequence would result in a transfer of excess coating on the paper web. Excess coating could cause a paper web break because of the excess moisture, or could be transferred to the dryer rolls 19 of the first coater. Either effect is detrimental and would require machine down-time to correct. A similar procedure is carried out to begin the coating operation of the second coater. The operator opens switch 42 which deactivates the solenoid of the two-way spring return valve 33. Fluid will be forced into the cylinder 29 of the blade 24 which will force the blade against the paper web. Next, the operator will open switch 43 which will deactivate the solenoid of the two-way spring return valve 32, thus admitting fluid under pressure into the cylinder 28 which will in turn force the applicator roll 22 against the backing roll 23. Notice that the blade 24 is placed against the paper web prior to the applicator roll 22. The first and second coaters are now in operation and the paper web 10 is receiving a single coat on both sides.

In order to illustrate the part of the control system in FIG. 2 that is an embodiment of the invention, suppose that the defect detector 12 senses a defect in the paper web. The single pole-single throw solenoid operated switch (defect detector) is energized and closed by the sensing of the defect. A voltage potential with respect to the common wire 34 is applied to the motor 57 by the defect detector switch through the wires 58 and 59. In defect detectors, activation occurs during the time the defect is passing by the defect detector, and ceases once the defect has passed. Therefore, the single pole-single throw switch is momentarily in the closed position and returns to the open position once the defect has passed the defect detector. The drum timer 46 and the contact strips are rotated by the motor 57 during the momentary activation of the defect detector to a position where the brush 52 contacts the contact strip 47. Since the strip 47 is tied into the main wire 37 by the wire 60, potential with respect to common wire 34 is applied to the motor 57 by the wire 61. The pickup shoe 52 and the contact strip 47 form a holding circuit which keeps the timer motor 57 running after the defect detector 12 has been deactivated by the passage of the defect. After a pre-determined rotation of the drum timer 46, the contact strip 48 contacts the pickup shoe 53. The voltage potential from main wire 37 is fed through wire 62 to the solenoid of the two-way spring return valve 30 which moves to a position where the fluid loaded side of the cylinder 26 is exhausted. The spring return on the cylinder 26 moves the applicator roll 16 away from the paper web 10, thus ceasing the coating application in the first coater. It is to be understood that the time interval between defect detection and applicator roll removal is substantially equal to the time required for the defect to travel from the defect detector 12 to a position just prior to the applicator roll 16. Once the drum timer 46 has rotated slightly further, contact strip 49 contacts pickup shoe 54 and applies, through wire 63, a voltage potential to the solenoid of the two-way spring return valve 31. The valve 31 is moved to exhaust position whereby the fluid side of the cylinder 27 is exhausted, moving the blade 18 away from the paper web. Once again, the passage of the defect through the paper machine is timed so that the blade is removed from the paper web prior to the passage of the defect under the blade edge. After the drum timer 46 has rotated a circumferential distance equal to the length of the contact strip 48, contact is broken with the pickup shoe 53. The solenoid of the two-way spring return valve 31 is de-energized by the break and the valve 31 is returned by spring action to a position where the fluid is fed into the cylinder 27, thus replacing the blade 18 against the paper web. Notice that as the drum rotates, contact is broken between the contact strip 48 and the pickup shoe 53 after the contact between strip 49 and shoe 54. Therefore, the solenoid of the two-way spring return valve 30 is de-energized after the two-way spring return valve 31 which returns the blade 18 to the paper web prior to the applicator roll 16. The reasons behind this procedure, as explained above, are to remove the possibility of transferring excess coating to the paper web by applying coating without metering.

After an additional pre-determined drum timer 46 rotation, pickup shoe 55 is contacted by contact strip 50, applying to the two-way spring return valve 32 a potential through wire 64. The two-way spring return valve 32 is activated, whereby the fluid loaded side of the cylinder 28 is exhausted. The spring action of the cylinder 28 forces the applicator roll 22 away from the paper web. Slightly further rotation of the drum timer 46 causes the two-way spring return valve 33 to lower the blade 24 from the paper web through the contact of pickup shoe 56 and contact strip 51. Notice that the contact strip 50 will remain in contact with the pickup shoe 55 longer than the contact strip 51 will remain in contact with pickup shoe 56. The second coater operation is therefore exactly the same as the first coater operation, the only difference being that since the second coater is further away from the defect detector than the first coater, the time interval between defect detection and the time that the defect reaches the second coater is longer. The relative position of the contact strips on the drum timer for the second coater are further away from the pickup shoe contacts than those of the first coater which compensates for the longer time interval. Once the drum timer 46 has completed a revolution, pickup shoe 52 breaks contact with the contact strip 47, and de-energizes the motor 57 by removing the voltage applied through the line 61 to a pole of the motor 57.

It is worthwhile to point out that the timer circuit as described herein is an illustrative example of a preferred embodiment and is not intended to be limiting. It is preferred to synchronize the speed of the motor 57 with the speed of the paper machine at the coater section. This could be accomplished by using a synchronous motor 57 which is driven by a generator (not shown) attached to and rotating with the drive (not shown) of the coater section. In addition, cam timers could be substituted for the drum timer.

It is evident from the preceding discussion that a second defect that is detected after the timer cycle has begun will not activate the control circuit. As a result, the applicator rolls and the blades will not be dropped during the passage of the second defect. For example, suppose that a defect is detected which in turn starts the timing cycle. Sometime during the timing cycle, a second defect is detected. It is easily seen that the activation of the solenoid operated single pole-single throw switch (representative of the defect detector activation) will not affect the action of the drum timer 46 and therefore, the coater components will possibly be in operating position when the second of the defects passes through the coaters. The possibility is increased when the number of controlled components increases. To minimize this possibility, FIG. 3 is a modified version of a timer circuit according to the invention in which the number of controlled components is increased and the basic circuit of FIG. 2 has been altered to reduce the possibility of paper web breaks resulting from the occurrence of closely spaced defects.

In FIG. 3, a first drum timer 66 and a second drum timer 67 are cascaded (in series) past the defect detector 12. Pickup shoes and contact strips have been added which, for example, may be for a third and fourth blade

coater or other machine components for which control is desired. Voltage potential is obtained across the main wire 68 and the common wire 69. Jumper wires 70 and 71 lead from the common wire 69 to one of the poles of the timer motors 72 and 73, respectively. Another jumper wire 74 is fed from the main wire 68 to the defect detector 12. A cascade wire 75 joins the contact strips of the first and second drum timers to the jumper wire 74. All of the contact strips of both drum timers 66, 67 receive a common potential from the cascade wire 75. Upon the passage of a defect, the single pole-single throw solenoid operated switch (defect detector 12) is closed, thereby applying a potential with respect to common wire 69 to the first drum timer motor 72 through wire 76. The timer motor 72 is activated and rotates the first drum 66 sufficiently to bring contact strip 77 into contact with pickup shoe 78. In this manner, a potential is applied to the timer motor 72 through wire 79, thus holding the voltage potential from main wire 68 with respect to common wire 69 across the timer motor 72. Therefore, the timer motor 72 of the first drum timer 66 continues to run after the defect detector is deactivated as was explained in connection with FIG. 2. As the drum rotates, it makes and breaks contact with the pickup shoe 80 and the contact strip 81, the pickup shoe 82 and the contact strip 83, the pickup shoe 84 and the contact strip 85, and the pickup shoe 86 and the contact strip 87 much as explained in the discussion of FIG. 2. It should be evident that during the revolution the applicator rolls and the blades of the first two coaters as shown in FIG. 1 have been controlled and to repeat their exact operation would be repetitious and unnecessary. Notice that just prior to the completion of the revolution of the first drum timer 66, pickup shoe 88 contacts strip 89, thereby applying voltage potential to a pole of the second drum timer motor 73 through wire 90. It can be seen that a potential is across the timer motor 73 of the second drum timer 67 and that upon a slight revolution of the first drum timer 66, contact is broken between the pickup shoe 88 and the contact strip 89, and the shoe 78 and the contact strip 77 thereby removing the voltage through wire 90 and stopping the timer motor 72, respectively. No potential is now applied through wire 90 to the pole of the timer motor 73. However, the potential initially applied caused a rotation of the second drum timer 67 so that pickup shoe 91 made contact with contact strip 92. Contact strip 92 has a similar voltage potential and is a similar holding circuit as employed in the first drum timer circuit of FIG. 3 and the drum timer circuit of FIG. 2. It follows that pickup shoe 93 and contact strip 94, pickup shoe 95 and contact strip 96, pickup shoe 97 and contact strip 98, and pickup shoe 99 and contact strip 100 follow a procedure similar to the pickup shoes and contact strips of the first drum timer 66. Although not shown in FIG. 3, it is evident that these contacts could control a similar third and fourth knife coater and to repeat the exact operation would also be repetitious and unnecessary. It should be obvious that upon one revolution of the second drum timer 67, the holding action created by the pickup shoe 91 and the contact strip 92 would cease, and the timer motor 73 would be de-energized.

By cascading the drum timers 66, 67 as shown in FIG. 3, the time per cycle of each drum timer has been halved with respect to a single drum timer handling a like number of components, and therefore the frequency at which defects can pass by the defect detector and still operably be detected has been doubled.

Referring to FIGS. 1 and 4, the tension rolls 15 and 21 are in most cases a necessary and important component of a coater control system designed according to this invention. The tension control roll 15 in the first coater is free to move in the directions indicated by the arrows. A fluid cylinder (not shown) exerts a holding force to the left, as viewed, on the tension roll 15. The force exerted by the cylinder is counteracted by the tension in the paper web which tends to force the tension roll 15 to the right, as viewed. When the forces exerted by the cylinder and paper web are properly balanced, the tension roll is located in approximately the center of its travel. Obviously, since the cylinder exerts a constant holding force, an increase in the tension of the paper web will displace the tension roll to the right, while a decrease in the tension in the paper web will displace the tension roll to the left. The tension control roll 21 in the second coater is similarly free to move in the directions indicated by the arrows. A fluid cylinder (not shown) exerts a constant exterior force on the tension roll 21 so that changes in paperweb tension result in similar tension roll displacement, i.e., increases in paper web tension moves the tension roll 21 to the left as viewed, and decreases in paper web tension moves the tension roll 21 to the right as viewed.

The displacement of the tension rolls 15 and 21 is transmitted to a position transmitter (not shown) that sends a signal proportional to the displacement from a predetermined set point to the coater section speed controller. In operation, when the tension in the paper web changes, the movement of the tension rolls 15 and 21 is transmitted by the position transmitter to the speed controller which alters the coater speed thus holding the paper web tensions substantially constant.

In lighter weight paper webs, the tension control system described above does not operate fast enough to overcome the sudden and drastic tension changes that result from the sudden absence of coating caused by the cessation of coating during the passage of defects in the paper web.

Having now described the operation of a typical tension roll assembly and explained the need for a supplemental tension control, refer to FIG. 4 which is an enlarged fragmentary circuit diagram similar to the circuit shown in FIG. 2 into which a tension control circuit has been incorporated. The tension rolls are referenced 15 and 21 and correspond to those of FIG. 1. In this particular embodiment, the drum timer is broadly indicated by the reference 101. The defect detector is referenced by the number 12. The timer motor is referenced by the number 102. The voltage potential is obtained from main wire 103 and common wire 104. Notice that a jumper wire 105 provides, through the single pole-single throw switch of the defect detector 12, and through a holding circuit formed from the pickup shoe 106 and the contact strip 107 a voltage potential to the timer motor 102 with respect to the common wire 104. Common wire 104 and its voltage potential with respect to the main wire 103 is connected to the other pole of the timer motor 102 through the wire 108. The drum timer 101 contains pickup shoes 109, 110, 111, and 112 which contact as the drum timer 101 rotates the contact strips 113, 114, 115, and 116 respectively, forming a control circuit similar to FIG. 2 and could control a set of blade coaters as explained in connection with FIG. 2. A wire 117 connects one end of solenoids 118 and 119 to the common wire 104. The other ends of the solenoids 118 and 119 are connected to the pickup shoes 120 and 121, respectively. The solenoids 118 and 119 are connected to energize the two-way valves 122 and 123, respectively. The solenoids 118, 119, are de-energized and therefore the two-way valves 122, 123 are in a position where a supply of water under pressure contained within the pipe lines 124 is prevented from entering the pipe lines 125 and 126. The pipe lines 125 and 126 terminate in shower heads 127 and 128, respectively. Water is added to the paper web automatically when the coating operation ceases during the passage of a defect by the activation of the solenoids 122 and 123. Referring to the drum

timer **101**, notice that the pickup shoe **120** energizes the solenoid **118** after the drum timer rotates a predetermined distance by contacting the contact strip **129**. In addition, the contact strip **129** and the contact strip **113** are equal in circumferential length. In this particular embodiment, the contact strip **113** controls the time at which an applicator roll, similar to **16** in FIG. 2, is removed from the paper web. Obviously, the shower head **127** is adding moisture to the paper web for approximately the same time that the moisture is removed from the paper web by the extraction of an applicator roll.

The same general description holds for the pickup shoe **121** and the contact strip **131**. Notice that the same relative position is held between the contact strip **131** and the contact strip **115** which in this particular embodiment would control an applicator roll of the second coater. Is is an essential feature that the shower begin substantially in unison with the cessation of the coating application by the applicator roll.

The essential function of the supplemental tension control is to anticipate the paper web tension changes that occur during the removal of the applicator rolls **16** and **22**, and to begin tension correction immediately. Another form of supplemental tension control is coupled with the standard tension control system described in connection with the tension control rolls **15** and **21** of FIG. 1. Referring to FIG. 4, the circuit energizing the solenoids **118** and **119** of the two-way valves **122** and **123**, respectively, is modified to energize the speed controllers of the first coaters **11** and the second coater **20**, respectively. The speed controllers are energized to alter the coater speed simultaneously with the removal of the applicator rolls **16** and **22**. Unlike conventional tension control systems, the speed controllers are not activated by changes in paper web tension but by the supplemental tension control system during the removal of the applicator rolls **16** and **22**. The speed controller is returned to the conventional tension control system when the applicator rolls **16** and **22** are replaced on the paper web.

Sometimes it is highly desirable to protect against the possibility of down-time that results from web defects made in the coater sections by the coaters. This possibility can be overcome by placing defect detectors between the coaters. FIG. 1 contains a second defect detector **132** that is placed between the first coater **11**, and the second coater **20**. Defects developed by the first coater **11** will energize the defect detector **132**, which in turn will energize a control circuit similar to that shown in FIG. 2. In this particular system, each defect detector will be incorporated into a control circuit that contains a drum timer having only two sets of contact strips and shoes, one for the applicator roll and one for the blade.

It is evident that many more modifications and alterations are possible in this control system that are still within the scope of the invention. No description herein is meant to be limiting, but illustrative of an embodiment according to the present invention. For example, fully pneumatic or electronic control circuts could easily be substituted for the electro-mechanical circuits shown.

I claim:

1. Apparatus of the type described comprising:
(a) Means for coating a moving fibrous web of indefinite length,
(b) said coating means contacting said web during coating thereof,
(c) means for monitoring said web for the detection of defects therein,
(d) said monitoring means being located upstream of said coating means,
(e) means for temporarily removing said coating means from contact with said web upon detection of a defect therein by said monitoring means, and
(f) means responsive to said monitoring means for adjusting the tension of said web simultaneously with the removal of said coating means from said web.

2. The apparatus of claim 1 wherein:
(a) Said adjusting means comprises means for adding moisture to said web at a point on said web adjacent said coating means simultaneously with the removal of said coating means from contact with said web.

3. Apparatus of the type described comprising:
(a) Means for continuously coating a moving fibrous web of indefinite length,
(b) means located upstream of said coating means for continuously monitoring said web for the presence of defects therein,
(c) means for interrupting coating of said web upon detection of a defect therein by said monitoring means, and
(d) means responsive to said monitoring means for automatically adjusting the tension of said web during said interruption of coating.

4. The apparatus of claim 3 wherein:
(a) Said adjusting means comprises means for applying moisture to said web at a point on said web adjacent said coating means upon said interruption of coating.

5. Apparatus for continuously coating a moving fibrous web of indefinite length comprising:
(a) Means for continuously applying a layer of coating to said moving web,
(b) means for continuously metering said layer of coating,
(c) said metering means being located downstream of said applying means and in contact with said web,
(d) means for continuously monitoring said web for the presence of defects therein,
(e) said monitoring means being located upstream of said applying means, and
(f) means responsive to said monitoring means for:
(1) discontinuing coating application upon detection of a defect in said web prior to the passage of said defect past said coating applying means,
(2) removing said coating metering means from contact with said web subsequent to discontinuation of coating application and prior to the passage of said defect past said coating metering means,
(3) replacing said coating metering means into contact with said web after passage of said defect past said coating metering means, and
(4) resuming coating application after replacement of said coating metering means into contact with said web.

6. The apparatus of claim 5 wherein:
(a) Means are provided responsive to said monitoring means for adjusting the tension of said moving web simultaneously with the interruption of coating application.

7. The apparatus of claim 5 wherein:
(a) Means are provided responsive to said monitoring means for adding moisture to said web at a point on said web adjacent said coating applying means simultaneously with the interruption of coating application.

8. Apparatus of the type described comprising:
(a) Means for continuously monitoring a moving web of indefinite length for the detection of defects therein,
(b) said monitoring means including a normally open solenoid operated switch adapted to close upon detection of a defect in said web,
(c) a motor controllable by said solenoid switch,
(d) a drum timer adapted to be driven by said motor,
(e) said drum timer including a plurality of contact strips,

(f) a plurality of pickup shoes corresponding in number to said contact strips and arranged for engagement with said strips upon operation of said drum timer,

(g) an applicator roll normally in contact with said moving web,

(h) a metering blade located adjacent said applicator roll and normally in contact with said web,

(i) pipelines terminating in shower heads located adjacent said applicator roll,

(j) means interconnecting said applicator roll and one of said pickup shoes for removing said applicator roll from contact with said web upon engagement of said one pickup shoe with one of said contact strips,

(k) means interconnecting said metering blade and a second pickup shoe for removing said metering blade from contact with said web upon engagement of said second pickup shoes with a second of said contact strips,

(l) means interconnecting said pipelines with a third pickup shoe for causing moisture to flow through

said pipelines upon engagement of said third pickup shoe with a third contact strip, and

(m) said first and third contact strips being substantially equal in length and longer than said second contact strip.

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