WEB TENSION CONTROL SYSTEM

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A web tension control system in which the dancer roll shaft mounting block is slidably supported on a rod which extends between a pair of machine frame members and which is formed with a piston head intermediate its ends for cooperation with a cylinder secured to the shaft mounting block for movement therewith. Air under pressure supplied to the interior of the cylinder at one side of the piston head through an axial bore in the rod and an opening in the head normally urges the cylinder and dancer roll against the web tension to a position corresponding to the desired tension. Movement of the dancer roll mounting block and cylinder from the desired position in response to a change in the web tension is sensed to provide a control signal which is employed to restore the web tension to the desired value.

11 Claims, 4 Drawing Figures
WEB TENSION CONTROL SYSTEM

BACKGROUND OF THE INVENTION

Various forms of web tension control systems are known in the prior art. In one arrangement for controlling the tension of a web, the shaft of a dancer roll in engagement with the web is supported on blocks or the like slidably mounted on rods or ways on the machine frame for movement in response to changes in the web tension. The piston rod of an independent piston and cylinder assembly is secured to the mounting block and air under pressure supplied to the cylinder, which is secured to the machine frame, urges the mounting block and dancer roll against the action of the web tension to a position corresponding to a desired tension in the web. Means is provided for sensing movement of the dancer roll in response to changes in tension to generate a signal which may be used to restore the tension to the desired value.

While the web tension control system discussed above successfully achieves the purpose of regulating web tension, it incorporates a number of significant disadvantages. First, owing to the use of an independent piston and cylinder in addition to the dancer roll support system, the arrangement has an excessive amount of friction. In addition, it is more bulky than is desirable and requires that at least a portion of the installation extend outwardly from the side of the web handling system. It is, moreover, relatively expensive to construct.

We have invented a web tension control system which overcomes the disadvantages of web tension control systems of the prior art. Our system has a greatly reduced friction as compared with the friction in systems of the prior art. It is more compact than are systems of the prior art. It has less inertia than do systems of the prior art. It is relatively simple in construction and less expensive than are web tension control systems of the prior art.

SUMMARY OF THE INVENTION

One object of our invention is to provide a web tension control system which overcomes the defects of web tension control systems of the prior art.

Another object of our invention is to provide a web tension control system having a greatly reduced friction as contrasted with web tension control systems of the prior art.

A further object of our invention is to provide a web tension control system which is more compact than are systems of the prior art.

Yet another object of our invention is to provide a web tension control system having reduced inertia over web tension control systems of the pivoted arm type.

Still another object of our invention is to provide a web tension control system which is relatively simple in construction.

Other and further objects of our invention will appear from the following description.

In general our invention contemplates the provision of a web tension control system in which a stationary rod extending between a pair of machine frame members has a piston head formed intermediate the ends thereof for supporting a movable cylinder attached to the dancer roll shaft mounting block which is supported for sliding movement on the rod. Air under pressure is introduced into the cylinder on the side of the head remote from the dancer roll block through an axial bore in the rod and opening in the piston head to urge the assembly of the cylinder, mounting block and dancer roll against the action of web tension to a position at which the desired tension is in the web under normal operating conditions. In response to a change in web tension, the assembly of the mounting block, dancer roll and cylinder moves and the movement is sensed to provide a signal which is utilized to restore the web tension to the desired value.

BRIEF DESCRIPTION OF THE DRAWINGS

In the accompanying drawings which form part of the instant specification and which are to be read in conjunction therewith and in which like reference numerals are used to indicate like parts in the various views:

FIG. 1 is a schematic view of one web handling installation in which our improved web tension control system may be employed.

FIG. 2 is a fragmentary side elevation with parts shown in section of our improved web tension control system.

FIG. 3 is a schematic view of another form of web handling system in which our improved web tension control system can be employed.

FIG. 4 is a schematic view of a further web handling system in which our web tension control system can be employed.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now to FIG. 1 of the drawings, in one type of web handling system in which our improved web tension control can be employed, the web 10 emerges from the nip between a pair of outlet rolls 12 and 14 at a web treating station of any type known to the art. The shaft 16 of roll 14 is adapted to be driven by a motor 18. After leaving the rolls 12 and 14, web 10 passes around a guide roll 20 to a dancer roll 22 which, as will be described more fully hereinbelow, preferably is mounted for movement in a horizontal plane. It will be appreciated, of course, that the dancer roll could be mounted for movement in other than a horizontal plane in certain installations. Upon leaving the dancer roll 22, the web 10 passes around a guide roll 24 and enters the nip between a pair of feed rolls 26 and 28 which may, for example, be at the input of another web treating station of any type known in the art.

In the arrangement illustrated in FIG. 1, the shaft 30 of roll 28 is adapted to be driven by a motor 32. The rolls 26 and 28 are driven so as to provide a desired rate of movement of the web 10 through the nip between the rolls 26 and 28. To achieve this operation, a tachometer 34 coupled to the shaft 30 of motor 32 provides an output signal as a measure of the shaft speed. This signal is fed to a suitable control circuit 36 of any type known to the art which puts out a signal to control the motor 32 so that the shaft 30 thereof is driven at the desired constant speed.

As will be more fully explained hereinbelow, an arrangement, indicated by the linkage 38 in FIG. 1, provides a measure of the movement of the dancer roll 22 in a horizontal plane. This movement is used to actuate a control circuit 40 to provide an output signal which is a measure of the deviation of the position of the dancer roll 22 from the position thereof corresponding to the desired tension in the web when the shaft 30 is driven at the set speed. We feed the output of circuit
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4 to a control circuit 42 which governs the speed of motor 18.

Referring now to FIG. 2 of the drawings, our web tension control system, indicated generally by the reference character 44, includes a rod 46, the ends of which are secured to brackets 48 and 50 carried by a pair of spaced upright frame members 52 and 54. We form a piston head 56 on the rod 46 at a location intermediate the ends of the rod. The central portion of the head 56 is formed with a land 58. An opening 60 in the head 56 is located to the right of the land 58, as viewed in FIG. 2, communicates with an axial bore 62 in the rod 46, which bore extends from the opening 60 to the right end of the rod as viewed in FIG. 2. A bore 64 communicating with the bore 62 is adapted to be connected to a line 66 supplied with air under pressure from any suitable source (not shown).

The cylinder, indicated generally by the reference character 68 of our improved web tension control assembly, comprises a tube 70, the inner surface of which cooperate with the land 58 to restrict the flow of air past the land. We secure the left end of tube 70, as viewed in FIG. 2, in an annular recess formed in the mounting block 72 at one end of the shaft 73 of dancer roll 22. Block 72 carries a linear bearing 74 which mounts the block for sliding movement on the rod 46. We secure the other end of the tube 70 in an annular recess in one end of a second block 76. A second recess in the block 76 receives a linear ball bearing 78 surrounding rod 46. It will readily be appreciated that we provide a suitable seal between block 76 and the rod 46 for preventing the escape of air under pressure fed to the space within tube 70 between head 56 and the block 76. While we have illustrated only one side of the dancer roll support in detail, it will readily be appreciated that, for purposes of a mechanical balance, we provide the same supporting system for the other side of the dancer roll shaft.

Our system includes means for sensing the position of the block 72, and thus of the dancer roll 22, along the rod 46. A cam follower roller 86 having a shaft 88 is rotatably supported on a bracket 90 secured to the upper surface of the block 72 by any suitable means such as, for example, by welding. We pivotally support one end of a feeler rod 92 on a pivot pin 94 carried by a bracket 96 supported, for example, on the bracket 50. Rod 92 is adapted to rest on the roller 86 and to make a slight angle upwardly to the left from the horizontal in all relative positions of the roller 86 and the feeler rod 92.

From the structure just described, it will readily be apparent that the air under pressure fed to the interior of the tube 70 between head 56 and the block 76 tends to urge the assembly of the cylinder 68, block 72 and dancer roll 22 to the right, as viewed in FIG. 2. Owing to the manner in which the web 10 is trained around the roll 22, as illustrated in FIG. 2, the tension in the web 10 acts against the pressure of air fed to the interior of tube 70. As tension in the web increases, the block 72 and the cylinder assembly tend to move to the left, as viewed in FIG. 2, to a first limit position. As the web tension decreases, the pressure of air within the tube 70 moves the assembly to the right to a second limit position. These two limit positions are indicated in broken lines in FIG. 2. Moreover, in response to movement of the dancer roll 22 to the left in FIG. 2, rod 92 pivots slightly in a counterclockwise direction. As the dancer roll 22 moves to the right from the position shown, the rod 92 rotates in a clockwise direction.

We provide any suitable means for sensing movement of the roller 22 as a measure of the position of the dancer roll 22 and for providing an electrical signal indicative of that movement. For example, in one arrangement a slug 98 of magnetic material is urged into engagement when the rod by means of a compression spring 100. A winding 102 forming part of the control circuit 40 is associated with the slug 98. As the dancer roll 22 moves to the right in response to a decrease in web tension, rod 92 pivots in a clockwise direction to move the slug 98 against the action of spring 100 into the winding 102. Conversely, when the dancer roll 22 moves to the left in response to an increase in web tension, rod 92 moves in a counterclockwise direction so that spring 100 tends to move the slug 98 out of the winding 102.

Referring now to FIGS. 1 and 2, when, in a manner described hereinabove, motor 32 drives shaft 30 at a constant speed and the tension in the web 10 decreases so that roll 22 moves to the left as viewed in FIG. 1 and to the right as viewed in FIG. 2, to cause slug 98 to move further into the winding 102. We so arrange the circuit 40 as to provide a signal to control circuit 42 to cause motor 18 to slow down to retard the movement of the web through the rollers 12 and 14, thus to increase the tension in the web to the desired value. Conversely, when web tension increases so that roll 22 moves to the right as viewed in FIG. 1 or to the left as viewed in FIG. 2, to cause spring 100 to move slug 98 out of the winding 102, circuit 40 puts out such a signal to the control circuit 42 as causes motor 18 to speed up until the desired web tension is restored. Referring now to FIG. 3, we have shown a somewhat modified system for regulating web tension, in which a motor 104 controlled by a circuit 106 drives the shaft of a take up roll 108 to draw the web 10 extending from idler roll 20 onto roll 108. In this arrangement as the web leaves a processing station or the like it passes through the nip between a pair of rolls 120 and 122. A motor 126 drives the roll 120. A tachometer carried by the motor shaft provides an input to a control circuit 110 to regulate the motor 126 so that rolls 120 and 122 are driven at constant speed. Further in this arrangement the output of circuit 40 is fed to circuit 106 to control motor 104 to maintain web tension substantially constant.

Referring now to FIG. 4, in yet another arrangement the shaft 128 of roll 122 is driven by a motor 130. Motor 130 drives a tachometer 132 providing an input signal to a circuit 134 which controls the motor 130 to insure that rolls 120 and 122 are driven at a constant speed. In this arrangement the web 10 from the roll 12 passes directly to the idler 20, around the dancer roll 22, over idler roll 24 and around roll 118 to the nip between rolls 120 and 122. We achieve tension control in this arrangement by causing the circuit 40, which puts out a signal as a measure of the position of roll 22, to operate a valve 136 connecting a supply line 138 leading from a suitable source of air under pressure to a line 140 leading to an air brake or the like 142, associated with let off roll 112 to control the tension in the web 10.

The operation of our system will readily be apparent from the structure described. In each of the arrangements shown, air under a predetermined pressure is supplied to line 66 to position the cylinder 68 and dancer roll 22 in accordance with the desired web ten-
sion. It will readily be understood that the tension which is to be set into the web can readily be regulated by changing the pressure of the air supply to line 66. When tension in the web increases, dancer roll 22 moves to the left, as viewed in FIG. 2, to cause rod 92 to pivot in a counterclockwise direction to move slug 98 out of winding 102 to cause circuit 40 to provide a signal calling for a decrease in web tension. Conversely, when the web tension decreases, the dancer roll 22 moves to the right under the influence of the air under pressure, and rod 92 moves in a clockwise direction to move slug 98 into the winding 102 to cause the circuit 40 to provide a signal calling for an increase in web tension. As an alternative to changing the pressure of air fed to line 66 to change the set tension in the web, it will readily be appreciated that circuit 40 could be provided with a suitable control for achieving this same purpose. In a practical embodiment of our arrangement, a movement of approximately 12 inches of the dancer roll 22 is possible, as indicated by the dimension A in FIG. 2. Moreover, the particular sensor we employ requires a movement of slug 98 of only three-eighths of an inch for this range of movement of the dancer roll 22.

It will be seen that we have accomplished the objects of our invention. We have provided a web tension control system which overcomes the defects of web tension control systems of the prior art. Our system has appreciably less friction than do systems of the prior art. It is lighter and less bulky than tension control systems of the prior art. It is relatively simple in construction for the result achieved thereby.

It will be understood that certain features and sub-combinations are of utility and may be employed without reference to other features and sub-combinations. This is contemplated by and is within the scope of our claims. It is further obvious that various changes may be made in details within the scope of our claims without departing from the spirit of our invention. It is, therefore, to be understood that our invention is not to be limited to the specific details shown and described.

Having thus described our invention, what we claim is:

1. Apparatus for regulating the tension in a web including in combination, a rod mounted on said frame, a piston on said rod, a cylinder carried by said rod and said piston for movement relative thereto, a dancer roll adapted to be subjected to tension in said web, means mounting said dancer roll on said rod for movement therealong, means connecting said cylinder to said dancer roll mounting means for movement therewith, and means for biasing said cylinder and piston for relative movement in a direction against the direction of action of said web tension on said dancer roll.

2. Apparatus as in claim 1 in which said rod is generally horizontally disposed.

3. Apparatus as in claim 1 in which said biasing means comprises means for introducing air under pressure into said cylinder at one side of said piston.

4. Apparatus as in claim 1 including means for sensing the position of said cylinder with respect to said piston.

5. Apparatus as in claim 1 including means for sensing the position of said cylinder relative to said piston and means responsive to said sensing means for regulating the tension in said web.

6. Apparatus as in claim 5 in which said sensing means comprises a rod mounted for pivotal movement on said frame and means responsive to movement of said cylinder for pivoting said rod.

7. Apparatus for regulating the tension in a web moving along a path including in combination, a stationary frame, a rod, means mounting said rod on said frame in a generally horizontal disposition thereof, a piston on said rod intermediate the ends thereof, a cylinder carried by said piston for movement relative thereto, a dancer roll, means mounting said dancer roll on said rod for movement therealong, means connecting said cylinder to said dancer roll mounting means for movement therewith, means including first regulatable means for conducting said web to said dancer roll, means including second regulatable means for carrying said web away from said dancer roll, said conducting and carrying means being arranged to subject said dancer roll to the action of tension in said web, means for biasing said piston and cylinder for relative movement in a direction against the action of said web tension, means for actuating one of said regulatable means to move said web at a constant speed, means for sensing the position of said cylinder relative to said piston, and means responsive to said sensing means for actuating the other regulatable means.

8. Apparatus as in claim 7 in which said conducting means comprises a pair of input rolls, said means for actuating said one regulatable means comprises means for driving said input rolls at a constant speed, said carrying means comprises a set of output rolls, and said means for actuating said second regulatable means comprises means for controlling the speed of said output rolls in accordance with the tension in said web.

9. Apparatus as in claim 7 in which said carrying means comprises a take up motor, in which said conducting means comprises a pair of input rolls, in which said means for actuating said one regulatable means comprises means for driving said input rolls at a constant speed, and in which said means for actuating the other of said regulatable means comprises means for controlling said take up motor in accordance with the tension in said web.

10. Apparatus as in claim 7 in which said conveying means comprises a letoff brake, said carrying means comprises a pair of output rolls, said means for actuating said one regulatable means comprises means for driving said output rolls at a constant speed and said means for actuating said other regulatable means comprises means for controlling said brake in accordance with tension in said web.

11. Apparatus as in claim 7 in which said biasing means comprises means for introducing air under pressure into said cylinder at one side of said piston.

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