May 27, 1969 H. R. WILCOX 3,446,451

SYSTEM FOR CONTROLLING WEB TENSION

Filed Aug. 22, 1967 Sheet 1 of 2

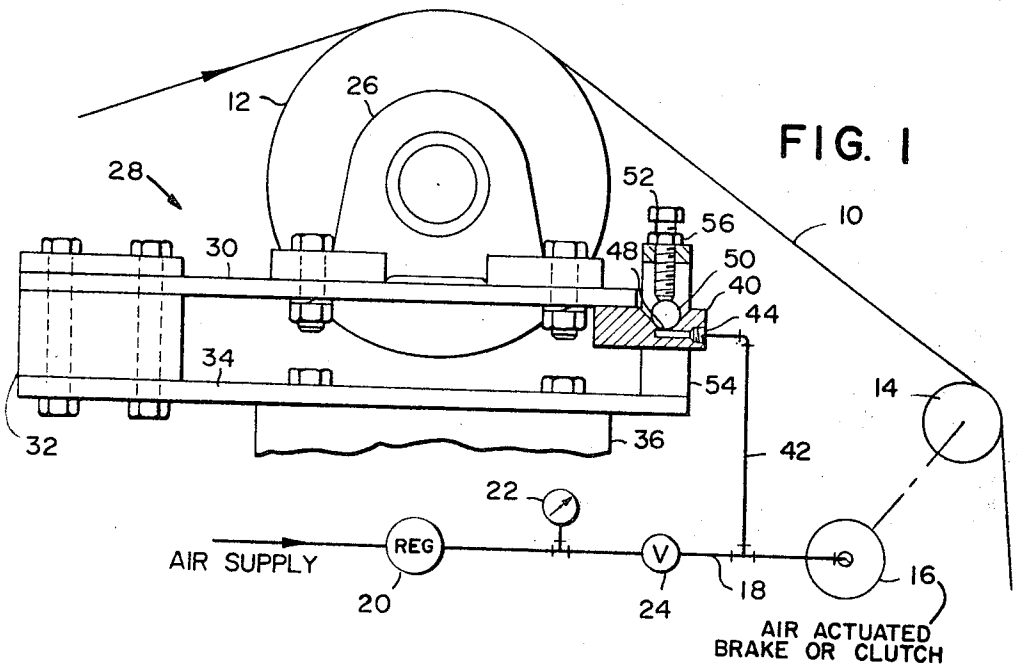


FIG. 1

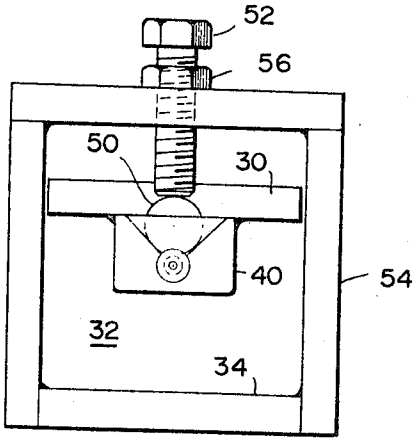


FIG. 2

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Sheet 2 of 2

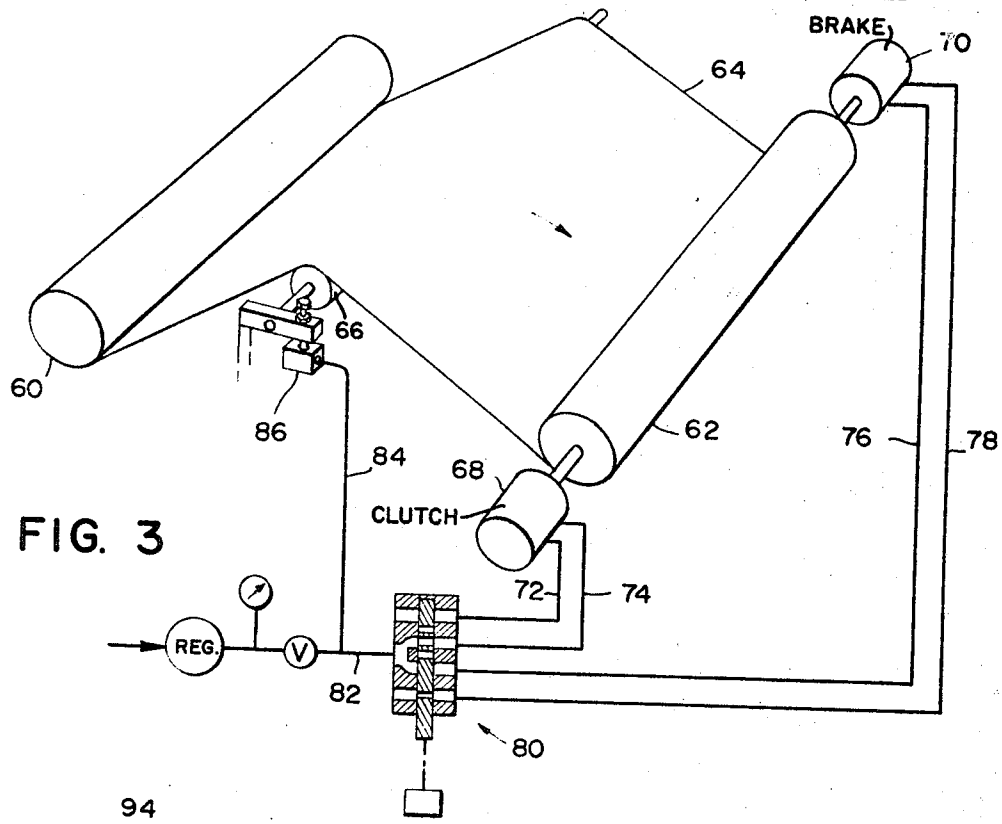


FIG. 3

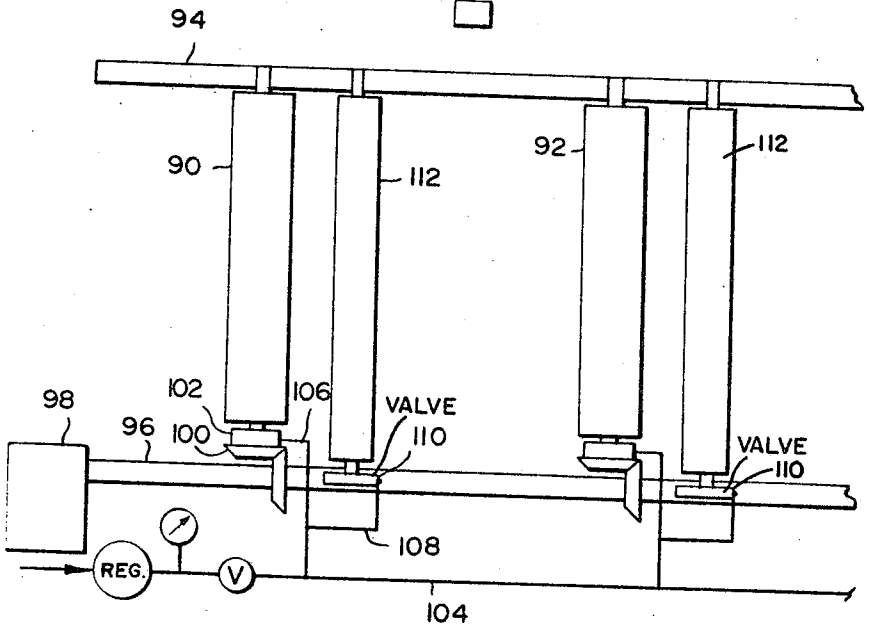


FIG. 4

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SYSTEM FOR CONTROLLING WEB TENSION

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U.S. Cl. 242—75.43
10 Claims

ABSTRACT OF THE DISCLOSURE

A beam carries a tension detecting roller to actuate a ball valve also carried by the beam. The valve is connected to a clutch or brake which controls a roller in engagement with the web. As the tension changes, the beam is moved causing the valve to be actuated and vary the braking or clutching action.

BACKGROUND OF THE INVENTION

Field of the invention

This invention relates generally to web control systems and more particularly is directed towards a new and improved system for maintaining a uniform longitudinal tension on a moving web.

Description of the prior art

There are a great many processes and apparatus which involve a running web where it is desirable to maintain a constant and uniform longitudinal tension on the web as it moves along. For example, in the manufacture of textiles maintenance of web tension is important at various stages of production. Various mechanisms have been developed heretofore for the purpose of controlling the web tension in a predetermined manner. Systems presently available have been found to be generally unsatisfactory for one reason or another. For example, most systems are highly complicated installations involving a great many interacting components all of which must be working perfectly for the system to operate as intended. Generally, systems of this type are highly expensive and because of their complexity tend to be unreliable particularly for long periods of operation. Furthermore, systems presently available are not readily adjustable to accommodate different types of webs. It is therefore an object of the present invention to provide a new and improved system for controlling longitudinal tension on a moving web and one which is of a simple, low-cost construction and which is readily adjustable.

Summary of the invention

This invention features a system for controlling web tension comprising a roller mounted on a resilient beam and engaging the moving web. The beam carries a movable nozzle element which is connected to the air supply for an air-actuated clutch or brake. The movable nozzle is provided with a valve element which is positioned by means of a screw adjusting device mounted on a fixed portion of the frame whereby manipulation of the screw adjusting device preloads the beam and allows the valve to bleed air from the system when the web tension reaches a predetermined level. As the web tension increases the valve opens and bleeds air from the air system. This in turn modifies the action of the air brake or clutch which in turn corrects the web tension.

Brief description of the drawings

FIG. 1 is a partially sectional view in side elevation and somewhat diagrammatic view of a web tension control system made according to the invention,

FIG. 2 is a detail view in end elevation thereof,

FIG. 3 is a somewhat diagrammatic view in perspective showing a modification of the system, and,

FIG. 4 is a top plan view, also somewhat digrammatic, showing a further modification of the invention.

Description of the preferred embodiments

Referring now to FIGS. 1 and 2 of the drawings, the reference character **10** generally indicates a moving web running about a tension detecting roller **12** and thence to a second roller **14** which may be a take-up roller for winding up the web **10** or a driven roller for advancing the web further along. In either event, the roller **14** is drivingly connected to an air-actuated speed control device such as a slip clutch or brake depending upon the particular application. The air-actuated device **16** is connected via a conduit **18** to a source of compressed air with a pressure regulator **20**, a gauge **22** and a needle valve **24** being located in the line. Typically the unit **16** will operate at 60 p.s.i. for which will be set on the pressure regulator **20** and the needle valve will be set to pass 1 c.f.m. of air when operating. These values are only typical and obviously may be varied according to the specific requirements.

The tension detector web roller **12** is supported at its ends by means of bearings **26** one of which bearings is mounted in turn upon a resilient support generally indicated by reference character **28**. The resilient support includes a beam arm **30** on the upper surface of which is mounted the bearing **26** and which beam arm extends out from a spacing block **32**. The block in turn is fastened to a parallel beam **34** fixed to a mounting stand **36**. The block **32** is located off to the side of the vertical center line of the roller and insofar as the beam arm **30** is of a slightly resilient material, such as steel, it will deflect to a certain extent upon the application of a load to the roller **12** as occasioned by tension on the web **10**. Typically deflection of the beam will be on the order of .008"–.009".

Carried on the outer end of the beam arm **30** is a nozzle **40** which is connected by a flexible conduit **42** to the conduit **18** which delivers air to the air-actuated device **16**. The conduit **42** serves as a bleeder line for the system with the air being delivered into the nozzle at inlet opening **44** and out of the nozzle through an outlet port **46** formed at the base of a conical valve seat **48** formed in the upper face of the nozzle. Trapped in the conical seat **48** of the nozzle is a ball element **50** which is held by means of an overhead screw **52** threaded through a fixed bracket **54** mounted on the lower fixed beam **34**. The screw **52** is provided with a locking nut **56** for locking the screw in a selected position.

With the screw holding the ball fully down against the valve seat the nozzle will be shut off and no air will escape from the bleeding line **42**. Under these conditions the air being delivered to the air-actuated device **16** will remain constant and the system will be stable. Assuming that for one reason or another, the tension on the web **10** changes. An increase in the web tension will place a greater load on the tension detecting roller **12** and will cause the beam **30** to deflect downwardly. This movement of the beam **30** will cause the nozzle **40** to drop down to an extent corresponding to the movement of the roller **12** and the beam **30**. When the nozzle drops down the air in the bleeder line **42** will be released past the ball element **50**, this in turn creating a drop in the pressure in the main air line **18**. The decrease in the pressure to the air-actuated unit **16** will cause a reduction in the braking or clutching action imparted to the roller **14** and this, in turn, will decrease the tension on the web **10**. As the web tension decreases the beam **30** will rise reducing the amount of air escaping from the nozzle **40** or shutting it off altogether depending upon the amount of correction

that takes place in the web tension. In any event, the system will return to a stable condition and the tension on the web will be maintained. In practice, the response is extremely fast and once the tension has been set it will normally remain constant with corrections taking place automatically.

The use of the resilient beam along with a simple flow control valve minimizes air loss and the ball relief type of valve attached directly to the beam has the further advantage in that with the screw adjustment on top to clamp down the ball it is possible to pre-stress the beam and allow the ball valve to bleed only when additional tension occurs on the cloth or web.

The single air line **18** connects with the air-actuated device **16** which typically may be either a disc type of brake or a slip clutch depending upon whether the system is being used in an arrangement for controlling the tension in a brake type of let-off unit or whether it is in use to control tension in the case of rolling up a web. The system has many other uses. For example, for controlling the tension in a let-off unit it may be connected with an air brake. For a centerline type of roll-up or a surface type of roll-up the air pressure to a slip clutch may be controlled in order to maintain a constant controlled tension on the web.

Another use of the system would be in connection with a closed vessel using a fixed shaft with a roll mounted on the fixed shaft. The shaft may be sealed within the sides of the vessel and a sensor of the type disclosed above located on the outside of the unit. The roll can then rotate on the shaft itself within the unit.

In certain applications, as in the textile industry, it is common practice to unroll the web from one roll onto another and then reverse the direction of the web to rewind the web back onto its original roll. In such applications it is desirable to utilize the slip type of clutch on a specific roll when rolling up and likewise to use an air brake on the same roll when the fabric is being pulled off of this particular roll. Such a system is shown in FIG. 3. In FIG. 3 the reference character **60** indicates a feed roll and reference **62** indicates a take-up roll with the reference character **64** indicating a web passing over a web tension roller **66** mounted in the manner disclosed in FIGS. 1 and 2. As shown in FIG. 3 the take-up roll **62** is operatively connected to an air-actuated slip clutch **68** at one end and an air brake **70** at the opposite end. The units **68** and **70** are provided with conduits **72**, **74**, **76** and **78** which connect with a solenoid actuated four-way valve **80**. The valve **80**, in turn, is connected via a conduit **82** to a source of compressed air. As in the principal embodiment a bleeding line **84** connects with the main line **82** and to a resilient beam actuated nozzle relief valve **86** of the same type as in FIGS. 1 and 2.

The conduits **72** and **78** are bleeding lines which are kept open when either of the units **68** or **70** is inoperative. Depending upon which direction the web **64** is moving the solenoid actuated valve **80** will be shifted to one side or the other to actuate either the clutch or the brake. In winding up a web, the clutch **68** will be employed and the four-way valve will be in the position shown in FIG. 3. This will actuate the clutch and will at the same time bleed air from the brake **70**. When the web is being moved in the reverse direction the valve will be shifted to cut off the clutch and deliver air to the brake **70** with the bleeding line from the clutch being open.

Referring now more particularly to FIG. 4 there is shown another modification of the invention and in this embodiment the web tension system is employed in a range drive arrangement. In FIG. 4 a range comprising a series of drive rolls **90** and **92** mounted on a frame **94** is driven by a common drive shaft **96** running along the length of the range. The shaft **96** is drivingly connected to a motor **98** or the like and is employed to transmit driving power to the individual rolls **90** and **92** as through bevel gearing **100**. Each roller **90**, etc., is provided with an air clutch **102** of the slip type with each air clutch operatively connected to a common air supply line **104** by means of a branch line **106**. Connected to each branch line is a bleeder line **108** connected to a resilient beam bleeding valve **110** of the sort disclosed in FIGS. 1 and 2. Each valve is operatively connected to a web tension detecting roller **112** and functions in the same manner as in the principal embodiment. The individual sensors are used for controlling the air pressure to the individual slip clutches so that the web may be run through the machine in a synchronized condition.

While the web tensioning system has been disclosed with respect to different specific applications, numerous other applications will appear to those skilled in the art.

Having thus described the invention, what I claim and desire to obtain by Letters Patents of the United States is:

1. A system for controlling web tension, comprising
- (a) a web-engaging member about which said web travels,
- (b) a fixed frame,
- (c) a resilient beam mounted at one end to said frame and supporting said member,
- (d) a valve having a movable portion carried by said beam and a fixed portion mounted to said frame,
- (e) said valve being adapted to open and close upon deflection of said beam in response to changes in web tension,
- (f) a pressure responsive fluid actuated device for controlling the speed of said web,
- (g) means supplying pressurized fluid to said device and,
- (h) a conduit connecting said valve to said means to vary said pressure upon actuation of said valve.

2. A system according to claim **1** wherein said web-engaging member is a roller.

3. A system according to claim **1** wherein said valve includes a ball element trapped between the fixed and movable portions of said valve and a screw threaded through said fixed portion of the frame and engaging said ball element.

4. A system according to claim **1** wherein said fluid actuated device is a brake.

5. A system according to claim **1** wherein said fluid actuated device is a clutch.

6. A system for controlling web tension, comprising
- (a) a first roll having a length of web wound thereon,
- (b) a second roll spaced from said first roll and adapted to wind the web from said first roll,
- (c) a pressure responsive fluid actuated clutch operatively connected to said second roll,
- (d) a pressure responsive fluid actuated brake operatively connected to one of said rolls,
- (e) a multi-position valve connecting said clutch and brake,
- (f) control means for operating said multi-position valve for selectively actuating said brake or said clutch,
- (g) a pressure relief valve operatively connected to said multi-position valve,
- (h) a resilient beam supporting a portion of said relief valve in operative relation to a fixed portion of said relief valve,
- (i) web engaging means carried by said beam and adapted to bias said beam and operate said relief valve in response to tension in said web,
- (j) operation of said relief valve adapted to alter the pressure to said brake and clutch to maintain tension on said web.

7. A system according to claim **6** wherein said web engaging means is a roller.

8. A system for controlling the tension on a web moving through a range comprising,
- (a) a plurality of rollers drivingly engaging said web,
- (b) a common drive source for rotating said rollers,
- (c) a pressure-responsive fluid-actuated speed control

device operatively connected between said source and each of said rollers,

(d) a pressure relief valve for each roller and operatively connected to each device,

(e) means responsive to changes in web tension for actuating said valve whereby pressure at each device will be controlled to maintain tension on said web through said range.

9. A system according to claim **8** wherein said means includes a web engaging member and a resilient beam supporting said member and fixed to said range, said beam supporting one portion of said valve and said range supporting another portion whereby movement of said member and beam in response to web tension will actuate said valve.

10. A system according to claim **9** wherein said member is a roller.

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