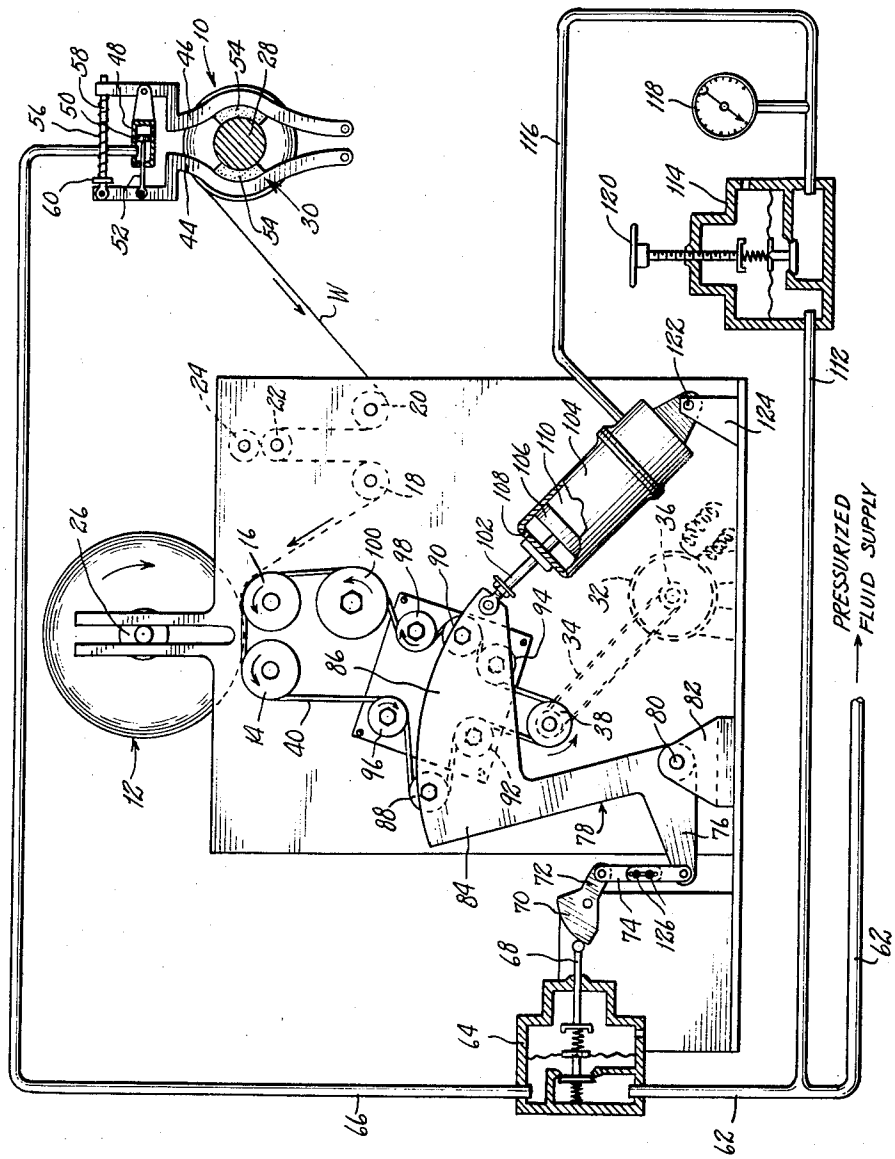
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APPARATUS FOR CONTROLLING THE TENSION IN A RUNNING WEB

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APPARATUS FOR CONTROLLING THE TENSION IN A RUNNING WEB

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5 Claims. (Cl. 242—75.43)

This invention relates to a mechanism useful with or as a part of a web-winding machine for maintaining a substantially constant tension in a web which is being run from a pay-out roll to a take-up roll in such a machine to permit processing of the web as it moves between the two rolls. Such tension control avoids or minimizes web breakage or damage which might occur under excess or non-uniform tension conditions.

More particularly, the present invention relates to improved means for taking advantage of the broad inventive principle disclosed in copending application of Charles Aaron and Leonard Rockstrom, Serial No. 647,558, filed March 21, 1957. Said application discloses the principle of utilizing torque variations which occurs at a motor which is employed to drive a web-winding machine. Such torque variations occur substantially as tension variations occur in the web being run through such a machine. The present invention relates to improved means for utilizing such torque variations for controlling tension in the running web.

An important object of this invention is the provision of simplified means for utilizing torque variations at such a motor for controlling the tension of the running web.

Another important object is the provision of means responsive to such torque variations which, where belt transmission is employed between the motor and the machine, involves only a minor revision in the belt-transmission means.

Another important object is the provision of such torque-responsive means which gives broader latitude as to the type and size of motor which may be used.

Another important object is the provision of such torque-responsive means which are separate from the motor itself but which may be easily adapted for use with different sizes of motors and for machines for winding different types of materials.

Another important object is the provision of such torque-responsive means which avoids the need for providing a floating type of mount for the motor such as is disclosed in the mentioned copending application.

Another important object is the provision of such torque-responsive means wherein the response from torque at the motor is of increased magnitude, thereby providing a mechanism which is simpler and easier to adjust and service.

Another important object is the provision of such torque-responsive means which react more rapidly to web-tension variations than the apparatus disclosed in the said copending application.

Another important object is the provision of such torque-responsive means which function as a cushion or shock absorber between the motor and the winding machine to reduce the possibility of encountering sudden changes in web tension due to sudden changes in motor torque or speed.

The foregoing and other more or less obvious advantages and objects are derived from the present invention of which a preferred embodiment is shown in the accompanying drawing for illustrative purposes without, however, limiting the invention to the particular apparatus disclosed in said drawing.

The drawing is a more or less diagrammatic view of a preferred form of web-tension-controlling apparatus according to this invention; the arrangement of the components of the invention being such as to facilitate an understanding of the invention without regard to the particular location of some of the components in practice and without regard to the particular location of piping that would be employed in an actual installation. Also, no attempt has been made to show the components in their actual relative sizes.

The illustrated apparatus comprises a pay-out roll **10** and a take-up roll **12**, a pair of driving rollers **14** and **16**, guide rollers **18** and **20** and a cutting mandrel **22** between which and a circular cutting knife **24** a web W passes in running from pay-out roll **10** to take-up roll **12** in the process of being slitted into two separate webs each about half of the width of the original web.

The web may be of paper, cellophane, or other plastic, or metal foil or, indeed, any type of web material. The showing of the cutting mandrel **22** and the cutting knife **24** is only to indicate that the purpose of passing the web from roll **10** to roll **12** is merely to process it in some manner. The processing need not necessarily be slitting, but it may be in the form of printing or glazing the surface of the web or otherwise processing the web.

All the mentioned rolls and rollers are so mounted in the frame of the machine that they may turn on parallel axes. In a strict sense, the part of the machine constituting the take-up roll **12** may be merely a shaft or thin drum **26**, and the pay-out roll **10** may be merely a shaft **28** with which is associated a suitable brake device **30**. In this sense, the indicated rolls **10** and **12**, therefore, are largely rolls of web material. Except where essential to an understanding of the invention, shafts and supporting framework have been omitted, as the type, disposition, and conventional manner of supporting such parts are well known to those familiar with this art.

The web W is caused to move from pay-out roll **10** to roll **12** to become a part of the latter by the driving rollers **14** and **16**, which are turned by a suitable motor **32** through a main driving belt **34**, working on a single pulley **36** on the shaft of the motor and one sheave of a double pulley **38**, and a torque-responsive driving belt **40** which works in the other sheave of said double pulley and in sheaves suitably provided on rollers **14** and **16**. Between the pulley **38** and the pulleys on rollers **14** and **16**, the torque-responsive driving belt passes about various stationary and movable guide pulleys as hereinafter described.

The shaft or thin drum **26** is a floating shaft which, with the roll **12** of accumulating web material, is supported upon and turned frictionally by the two rollers **14** and **16**. The brake device **30**, as illustrated, consists of brake-arms **44**, **46** pivoted at their lower ends at fixed points and linked together toward their upper ends by a fluid-pressure-operated assembly consisting of a cylinder **48** pivoted to brake-arm **46** and a piston **50**, within said cylinder, having a rod **52** extending through one end of said cylinder and pivoted to brake-arm **44**.

The brake-arms **44** and **46** are fitted with suitable brake shoes **54**, which engage shaft **28** to exert a braking force upon the latter. The upper ends of the brake-arms **44** and **46** are normally urged apart, tending to relieve the pressure or contact of the brake-shoes with respect to the shaft **28**, by means of a compression coil spring **56**, which extends about a rod **58**, one end of which is pivoted to arm **44**, and the other end of which extends

slidably through the upper end of arm 46. The spring 56 is compressed between the arm 46 and a collar 60 fixed upon rod 58 at a point near arm 44.

It is well understood that tension in a running web in a winding machine arises from the fact that some opposition is presented to the withdrawal of web from the pay-out roll 10. The just-described braking device constitutes such opposition and the tension present in the running web depends largely upon the extent of such opposition presented by said braking device. Also, it should be understood that if the tension in the running web should at any time rise above or fall below approximately the tension desired in said web, the undesirable higher or lower tension may be rectified by suitable variations in the applied braking effect.

According to this invention, such variations in the applied braking effect are brought about through various instrumentalities which are responsive to variations in the torque at the motor 32. If the web tension increases, the increase will be reflected in an increase in the torque at the motor, while if the web tension decreases, the decrease, likewise, will be reflected in a decrease in the torque at the motor. This invention includes an arrangement now to be described, whereby such variations in the torque at the motor are utilized to control the operation of the braking device 30 and thereby control the tension in the running web to keep it substantially at the tension which is desired to be mained throughout a run of web material through the winding machine.

The brake mechanism 30 is operated by fluid pressure from a suitable supply source of pressurized air or other suitable fluid which is conducted by pipe 62 from said fluid supply to a fluid-pressure-regulating valve 64, thence through a pipe 66 to the area within brake cylinder 48 which is in back of or to the left of the piston 50. The regulating valve 64 is one in which endwise movement of a plunger 68 causes variations in the fluid pressure delivered to the brake cylinder 48. When the plunger 68 moves inwardly with respect to valve 64, the pressure delivered to the brake cylinder is increased, and when the plunger 68 moves outwardly with respect to the valve 64, the pressure delivered through the latter to the brake cylinder 48 is reduced.

The plunger 68 is operated by a cam 70, an arm 72 of which is pivotally connected by an adjustable link 74 to the end of one arm 76 of a bell crank 78 which pivots at point 80 on a bracket 82 suitably mounted within or on the casing of the winding machine. The other arm 84 of the bell crank 78 is formed with a segmental extension 86 on its free end serving as a means for carrying two movable belt-guide rollers 88 and 90 which, with stationary but rotatable guide rollers 92, 94, 96, 98 and 100, serve to guide the belt 40 in a circuitous movement between the double pulley 38 and the driving rollers 14 and 16, as illustrated in the drawing. The rollers 88 and 90 are mounted on the segmental extension 86 by suitable stub shafts, and the just-enumerated stationary guide rollers 92, 94, 96, 98 and 100 are similarly mounted by suitable stub shafts upon an adjacent portion of the frame of the winding machine.

The right of free end of the segmental extension 86 is pivotally connected to one end of a piston rod 102 which extends into the upper end of a fluid-pressure cylinder 104. Within the cylinder is a piston 106 suitably fixed on the inner end of the piston rod 102. The cylinder 104 is suitably vented as at 108 at a point above the piston 106 and the latter partially defines below it a pressure chamber 110 within said cylinder. Fluid pressure is suitably supplied to the chamber 110 from the source of supply of pressurized fluid by means of a pipe 112 which is connected to the pipe 62 and to one side of a hand-operable pressure-regulating valve 114. Pressure fluid passing from the pipe 112 into and through the valve 114 is carried by a pipe 116 into the pressure chamber 110. A suitable pressure gauge 118 is preferably connected in the pipe 116 so that an operator by turning handwheel 120 of valve 114 may control the pressure flow through the latter to the chamber 110 and by means of the gauge 118 may be informed as to the pressure in that chamber and, when proper operation is achieved, may know the pressure which may advantageously be used in some later, similar operation of the apparatus.

It may be noted that the brake cylinder 48 is pivotally supported on brake arm 46 and that cylinder 104 is pivotally mounted at pivot point 122 upon a bracket 124 suitably fixed to some stationary part of the winding machine. It may also be noted that the link 74 is in two parts which are slidably interconnected and held together by adjusting screws 126 so that the length of the link 74 may be adjusted to that length which will function best to achieve the desired operation.

In operation, valve 114 is manually adjusted to deliver fluid to the cylinder 104 at such pressure as to cause the piston 106 and the piston rod 102 to push the segmental extension 86 leftwardly to its condition as illustrated in the drawing, at which point the belt 40, in engagement with the guide rollers 88 and 90, limits the extent to which said segmental extension 86 may move leftwardly. If the motor 32 were not in operation when the pressure was thus applied in cylinder 104, it would be possible for the segment 86 to move leftwardly somewhat more than shown in the drawing. However, when the motor is in operation, the torque at the motor operating through the belt to turn the rollers 14, 16 and the take-up roll 12 tends to provide a loop of the belt 40 about the guide roller 90 and to shorten somewhat the loop of the belt around guide roller 88 approximately to the condition of the belt shown in the drawing. Thus, the drawing is approximately illustrative of the positions of the guide rollers 88 and 90 when the machine is in operation.

It will be seen that with an increase in tension in the running web, there will be an increase in torque at the motor 32 and this increase in torque tends to equalize the sizes of the loops of belt 40 at guide rollers 88 and 90, which tendency is opposed by the fluid pressure established in pressure chamber 110. The arrangement is such that, after establishment of such a fluid pressure in chamber 110 as will give rise to and maintain the desired tension in the web, any variation of the tension, as the web runs through the machine, causes the motor torque, operating through the belt 40 in opposition to the pressure in chamber 110, to shift the segmental extension 86 to reestablish the web tension as it existed before such variation.

The reestablishment of the web tension occurs as a result of the mentioned pivotal movement of the segmental extension 86. Thus, if the tension variation is an increase, the resultant increased torque at the motor 32 causes the belt 40 to shift the segmental extension 86 rightwardly, as viewed in the drawing, which causes bell-crank arm 76, through link 74, to turn the cam 70 counterclockwisely. The effect of this movement of the cam is to permit plunger 68 to move slightly outwardly with respect to valve 64, thereby decreasing the fluid pressure controlled by that valve and communicated to brake cylinder 48. The decrease in fluid pressure in cylinder 48 has the effect of enabling spring 56 to reduce the braking effect of the brake shoes 40 upon shaft 48; and, this reduction in the braking effect results in termination of the undesired increase in the web tension.

If the variation in the web tension is a decrease, there would occur a corresponding decrease in the torque at the motor 32, with the result that belt 40 would have only a somewhat reduced tendency to oppose the fluid pressure in chamber 110. Under that condition, the fluid pressure in said chamber would urge the segmental extension 86 leftwardly of valve 64, thereby permitting communication of increased fluid pressure to brake cyl-

inder 48, the effect of which would be to increase the braking effect on shaft 28 and thereby increase the web tension to terminate the undesired decrease in the web tension.

It should be understood that the concepts disclosed and explained herein may be utilized in various other ways without departing from the present invention.

I claim:

1. Apparatus for controlling tension in a running web moving from a pay-out roll to a take-up roll, comprising braking means disposed in braking relation to said web and coacting with the latter to oppose movement of the web toward the take-up roll, a motor, a transmission belt coacting with said motor and said take-up roll to rotate the latter, a guide-supporting member movable transversely across opposite courses of said belt, a pair of guide elements on said member arranged to engage and oppositely deflect said opposite courses and to tend toward equal deflection at said courses in response to torque of said motor transmitted by said belt, yieldable deflector-altering means urging said member in one direction in opposition to said tendency, whereby to establish unequal deflection at said courses, and control means, responsive to movements of said member, caused by such torque, for controlling said braking means.

2. Apparatus according to claim 1, said braking means being connected to said pay-out roll.

3. Apparatus according to claim 1, said deflection-altering means comprising a fluid-pressure cylinder.

4. Apparatus according to claim 1, said braking means being fluid operated and said control means comprising a connection between a source of fluid and said braking means and a fluid-regulating device in said connection, operable in response to movement of said member, for controlling the delivery of fluid to said braking means.

5. Apparatus according to claim 1, said braking means being hydraulically operated and said control means comprising a pipe connection between a source of fluid and said braking means and a regulating valve in said pipe connection, operable in response to movement of said member, for controlling the delivery of fluid to said braking means.

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CERTIFICATE OF CORRECTION

Patent No. 2,925,963 February 23, 1960

Gerrit De Gelleke

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction and that the said Letters Patent should read as corrected below.

Column 3, line 62, for "of", first occurrence, read -- or -- column 5, line 21, for "deflector" read -- deflection --.

Signed and sealed this 16th day of August 1960.

(SEAL)
Attest:
KARL H. AXLINE
Attesting Officer

ROBERT C. WATSON
Commissioner of Patents