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W. F. HUCK

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TENSIONING MECHANISM FOR MOVING WEBS

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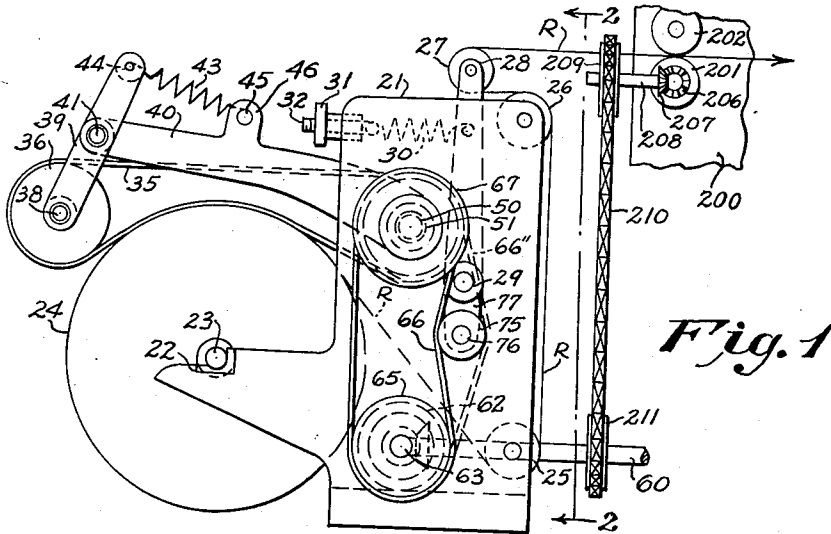


Fig. 1

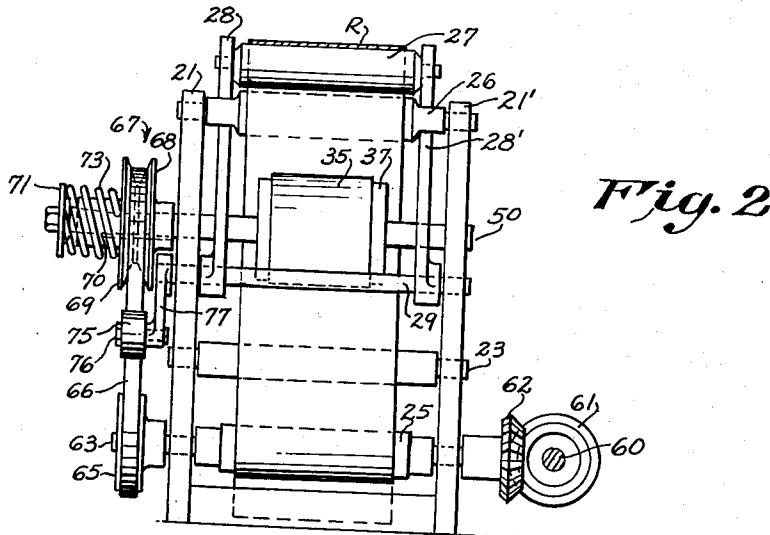


Fig. 2

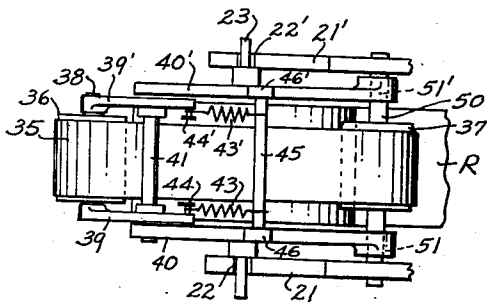


Fig. 3

WILLIAM F. HUCK,
INVENTOR,

BY Ford C. Petrick.

ATTORNEY

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TENSIONING MECHANISM FOR MOVING
WEBS

William F. Huck, Forest Hills, N. Y., assignor to
Huck Co., New York, N. Y., a partnership com-
posed of William F. Huck, Alexander J. Al-
brecht, and Stephen S. Wakeman

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3 Claims. (Cl. 242-75)

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This invention relates to tensioning mechanisms, and more particularly relates to mechanisms for tensioning strips, webs, or strands of various materials, as the said material is processed, or as the material proceeds from one stage to another in a series of processes. The mechanism may be used to tension paper or cloth while it is being wound onto or unwound from a roll during a printing process, or may include tensioning other materials, as for example, the tensioning of wire during the process of drawing or during the process of applying an insulating coating etc.

It is desirable in this type of apparatus that the tensioning mechanism be capable of maintaining a constant tension to a fine degree of accuracy despite the presence of many variables that may operate adversely to affect the tension. Tensioning mechanisms heretofore used, have been complicated, expensive to manufacture, and not always entirely satisfactory. Therefore, one object of the present invention is to provide new and improved tensioning mechanism that will be simple to construct, easy to operate, and inexpensive to build, and which at the same time under all circumstances will produce satisfactory results.

Another object of the invention is to provide an improved tensioning mechanism having a surface that will at all times be in contact with at least a portion of the strand that is being tensioned.

A further object of the invention is to provide an improved tensioning mechanism that includes a drive pulley, a driven pulley, and a V-belt drivingly connecting the said two pulleys, one of which is a variable diameter pulley.

A still further object of the invention is to provide an improved tensioning mechanism having a surface that will at all times be in contact with at least a portion of the strand that is being tensioned and which includes a drive pulley, a driven pulley and a V-belt drivingly connecting the said two pulleys, one of which is a variable diameter pulley.

A further object of the invention is to provide a new and improved tensioning mechanism.

For a more complete understanding of the invention and its mode of operation, reference should be made to the accompanying drawings which form a part of this specification.

In these drawings,

Fig. 1 is an elevational side view showing a first preferred form of tensioning mechanism embodying this invention as applied to an unwinding and rewinding roll stand;

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Fig. 2 is a vertical sectional view of the mechanism shown in Fig. 1, taken on line 2-2 of Fig. 1, and

Fig. 3 is a plan view, to a smaller scale, of a portion of the mechanism shown in Figs. 1 and 2.

Referring to the drawings this invention is shown in a preferred form in Figs. 1, 2, and 3 as applied to an unwinding and rewinding roll stand comprising a pair of spaced side frames 21 and 21' having open bearings 22 and 22' for supporting a spindle 23 that rotatably carries a roll 24. As will presently appear, material in the form of a strand or ribbon R may be unwound from or wound onto the roll 24, according to the service to which the mechanism is put. In Fig. 1, two directional arrows are included to indicate the movement of the ribbon R as it leaves or goes toward the roller 27; depending on whether the ribbon is being unwound from or wound onto the roll 24.

For the moment it will be assumed that a ribbon or strand R is being unwound from the roll 24. Under these circumstances the ribbon R after leaving the roll passes over a freely rotating guide roller 25 and thence over a second freely rotating guide roller 26, both of which are rotatably supported between the side frames 21 and 21'. From the roller 26 the ribbon R passes around a floating roller 27, that is rotatably supported between a pair of spaced, tension-responsive arms 28 and 28', respectively, located adjacent the frames 21 and 21'. The arms 28 and 28' are keyed onto and supported from a cross shaft 29 which is fulcrumed in the frames 21 and 21'. A spring 30, one end of which is attached to the arm 28, and the other end of which is attached to a screw 32 that carries an adjusting hand wheel 31, biases the arms 28 in a counterclockwise direction (as seen in Fig. 1) about the center of the shaft 29.

The speed at which the rewinding roll 24 may rotate is controlled by a wide moving surface in the form of an endless belt 35, which passes around a pair of pulleys 36 and 37 and which also contacts the surface of the ribbon attached to the roll 24. The pulley 36 is carried by a shaft 38 that is freely rotatably supported between the lower ends of a pair of spaced arms 39 and 39'. The arms 39 and 39' are fulcrumed at a point near their center on a shaft 41 that in turn is supported between the ends of a pair of spaced arms 40 and 40'. In order to tension the belt 35, the roller 36 and the arms 39-39', which support this roller, are biased about the shaft 41 by a pair of tension springs 43 and 43'. One end of each spring 43 and 43' is connected to a cross

shaft 45 that extends between front and back spaced lugs 46 and 46', that are formed substantially mid-way of the arms 40 and 40', respectively. The other end of the spring 43 is connected to a pin 44 formed on the upper end (Fig. 1) of the arm 39, whereas the other end of the spring 43' is in like manner connected to a pin 44' carried on the upper end of the arm 39'.

In order to control the speed of the belt 35 and thus control the speed at which the roll 24 rotates, a variable speed driving arrangement for the belt 35 is provided. This includes the shaft 50 and the pulley 37 keyed thereon. The shaft 50, which provides a connection between the moving surface or belt 35 and a pulley 67, hereinafter more fully described, is rotatably supported between the side frames 21-21' and also supports, by means of bearing lugs 51 and 51' at the ends of arms 40 and 40', so that the latter are fulcrumed on the shaft 50 and free to follow the reducing diameter of the roll 24, in a known manner. The weight of the arms 40-40' and the mechanism carried thereby causes the belt 35 to contact the roll 24 over an extended arc, thus assuring firm frictional contact between the belt 35 and the material of the roll 24.

In order to drive the belt 35, there is provided a shaft 60, which preferably is driven from and in direct speed ratio to a machine indicated generally by the numeral 200, which machine processes the unwinding ribbon R. The machine 200 has a pair of pulling rollers 201-202 which tension and pull the ribbon as it leaves the roller 27. The shaft of roller 201 has fixed thereon a bevel gear 206 meshing with another bevel gear 207 secured to a shaft 208 which carries a sprocket 209 connected by a sprocket chain or the like 210 to a sprocket 211 fast on shaft 60. A bevel pinion 61, which is carried on the end of shaft 60, drives a bevel gear 62, secured on the end of a cross shaft 63, which is rotatably supported in the frames 21-21'. A flat drive pulley 65 secured to and rotatable with the shaft 63 drives a comparatively wide V-belt 66. The V-belt drives the two-part variable-diameter V-belt pulley 67, hereinafter mentioned, carried on the previously mentioned shaft 50. One of the parts 68 of the driven pulley 67 is tightly keyed to the shaft 50, while the other part 69 of the pulley 67 is slidably carried but held from rotation thereon by a key 70. A helical spring 73, which surrounds a sleeve on the part 69 and contacts a back-up disc 71, urges the part 69 toward the part 68, and thereby presses against the V-belt 66, urging it to assume a running position as far from the center of the pulley 67 as the length of the belt 66 will allow.

The belt 66 is tensioned by an idler pulley 75. This pulley may contact either the outside or the inside of the belt 66 depending on whether material is being unwound from or rewound onto the roll stand. For the present we will continue to consider the case wherein the ribbon is being unwound from the roll, and thus, the idler pulley 75 will contact the outside of the belt 66. The pulley 75 is rotatably supported on a stud 76 that is carried on one end of an arm 77, the other end of which is keyed to one end of the cross shaft 29, hereinafter mentioned. Thus, since the arm 77 and the arms 28, 28' are all keyed to the shaft 29, oscillation of the arms 28, 28' which carries the floating roller 27, will cause oscillation of the arm 77, which by means of the idler pulley 75 tightens or loosens the tension of the V-belt 66, and this in turn effects the effective pitch diam-

eter of the pulley 67. If tension in the belt 66 is increased, the effective diameter of the pulley 67 is decreased, and vice versa. Furthermore, if the effective diameter of the pulley 67 is decreased, the speed with which the belt 35 is driven will be increased, and vice versa.

The mechanism, shown in Figs. 1, 2, and 3 functions as follows. Rotation of the machine 200, to which the ribbon R is being fed, accelerates and finally drives, by means of the chain 210 and shaft 60, the belt 66 and the belt 35. This causes the roll 24 to accelerate and eventually to rotate at full speed. However, during acceleration or during full speed operation, the speed of the roll 24, due to various causes, may not always keep pace with the machine that drives the shaft 60. In these cases the mechanism of this invention functions to speed up or slow down the rotation of the roll 24, as may be required. This is accomplished by maintaining a balance between three forces acting about the shaft 29 as a fulcrum. These forces are represented by:

(a) The tension in the strand or ribbon R as it leaves the roller 27. Increase of this force causes the arms 28-28' to move clockwise about the shaft 29.

(b) The tension of the spring 30, which acts to turn the arms 28-28' counterclockwise about the shaft 29, and

(c) The reaction of the belt 66 against the idler pulley 75. Increase of this force causes the arm 28 to move counterclockwise about the shaft 29. The spring 30 is adjusted to a tension that will cause the mechanism to maintain just the proper tension in the ribbon R.

In the event that the tension in the ribbon R as it leaves the pulley 27 is decreased, the arm 28 and shaft 29 move counterclockwise. This moves the idler pulley 75 to the right (as seen in Fig. 1) and, thereby, reducing the tension in the belt 66. This due to the spring 30 allows the pitch diameter of the pulley 67 to increase, and this in turn reduces the angular speed at which the shaft 50 is driven. This slows down the speed of the belt 35, which slows down the speed of rotation of the roll 24 and thus allows less ribbon to be fed to the machine. This of course increases the tension in the ribbon as it leaves the pulley 27.

In the event that the tension in the ribbon R as it leaves the pulley 27 is increased, the arms 28-28' and the shaft 29 move clockwise. This moves the pulley 75 to the left (Fig. 1) and thereby increases the tension in the belt 66. This causes the pitch diameter of the pulley 67 to decrease, and this in turn increases the angular speed at which the shaft 50 is driven. This increases the speed of the belt 35, which increases the speed of the rotation of the roll 24, and thus allows slightly more ribbon to be fed to the machine 200. This of course decreases the tension in the ribbon as it leaves the pulley 27.

In either of the above, the mechanism of this invention restores a balance between the three forces a, b, and c, hereinafter mentioned. When this is attained, the ribbon R continues to feed at the proper tension. The corrective action of the mechanism is applied without appreciable lag and the action is damped, due to the characteristic and well known damping action of the belts just described. This damping action, as is well known, becomes less with increase of speed of the ribbon R and becomes infinite at zero speed of the ribbon R. If desirable, this damping action may be supplemented by a separate damping

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means, of any well known type, as for example a dash pot.

As previously intimated, the mechanism shown in Figs. 1, 2, and 3 may also be used to wind material onto the roll 24. When this is done, the direction of rotation of the shaft 60 is reversed, so as to drive the roll 24 in a counterclockwise direction as seen in Fig. 1 and the belt 66 is removed and reinstalled, so that it will operate on the other side of the idler pulley 75. This position of the belt is shown in Fig. 1 by means of dashed lines 66''. With this arrangement the inside of the belt 66'' contacts the pulley 75.

In the event that the tension in the ribbon R, being fed to the roller 27, is decreased the arm 28, and the shaft 29 move counterclockwise. This presses the pulley 75 against the inside of the belt 66'' tensioning it and causing it to run on a smaller pitch line of the pulley 67, thereby increasing the speed of the shaft 50, the belt 35, and the speed of winding roll 24. This increased speed takes up the slack in the ribbon R, and restores the desired tension. In the event that the tension of the ribbon R is increased, the roller 75 is moved away from the inside of the belt 66'', thereby decreasing the speed at which the belt 35 drives the roll 24 and again restores the desired tension.

What I claim as new and desire to secure by Letters Patent of the United States, is:

1. In a device for maintaining tension on a winding or unwinding roll of material including power driven rollers engaging the material and pulling it from or to the roll, roll driving means firmly engaging the surface of the unwinding roll to rotate it positively and substantially synchronously with said power driven rollers, variable speed transmission means, including a fixed diameter pulley, a variable diameter pulley, a V-belt connecting said pulleys, and spring means for urging said variable diameter pulley to its

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condition of maximum diameter, said transmission means being connected between the power driven rollers and said roll driving means; lever means pivoted on a single axis between its ends, an idler pulley at one end thereof engaging said V-belt to vary the tension thereof and adjust said variable diameter pulley, and a roller at the other end thereof in tension-sensing engagement with said material, and a biasing spring connected to said lever means to urge said lever means toward one extremity of its range of movement, whereby to balance the forces produced on said lever means by the tension in said material, said idler pulley and said biasing spring, to maintain a predetermined tension in said material regardless of the speed of said material.

2. A device in accordance with claim 1, in which said roll driving means comprises a relatively wide endless belt in contact with the material on said roll.

3. A device in accordance with claim 1, in which said idler pulley is so mounted as to be engageable selectively with either the front or back surface of said V-belt.

WILLIAM F. HUCK.

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