

Aug. 16, 1960

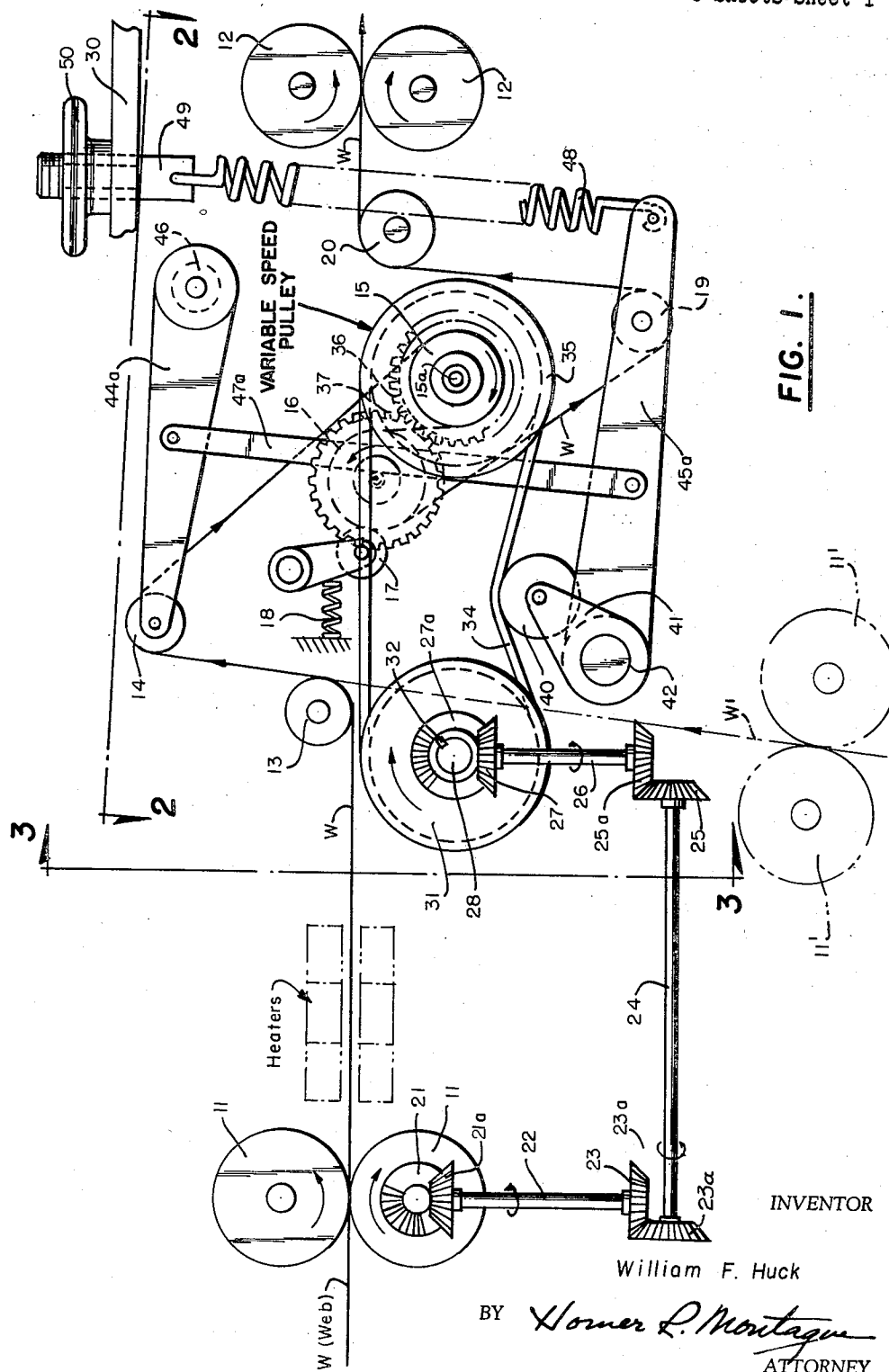
W. F. HUCK

2,949,295

WEB TENSION CONTROL MECHANISM

Filed Aug. 8, 1957

3 Sheets-Sheet 1



Aug. 16, 1960

W. F. HUCK

2,949,295

WEB TENSION CONTROL MECHANISM

Filed Aug. 8, 1957

3 Sheets-Sheet 2

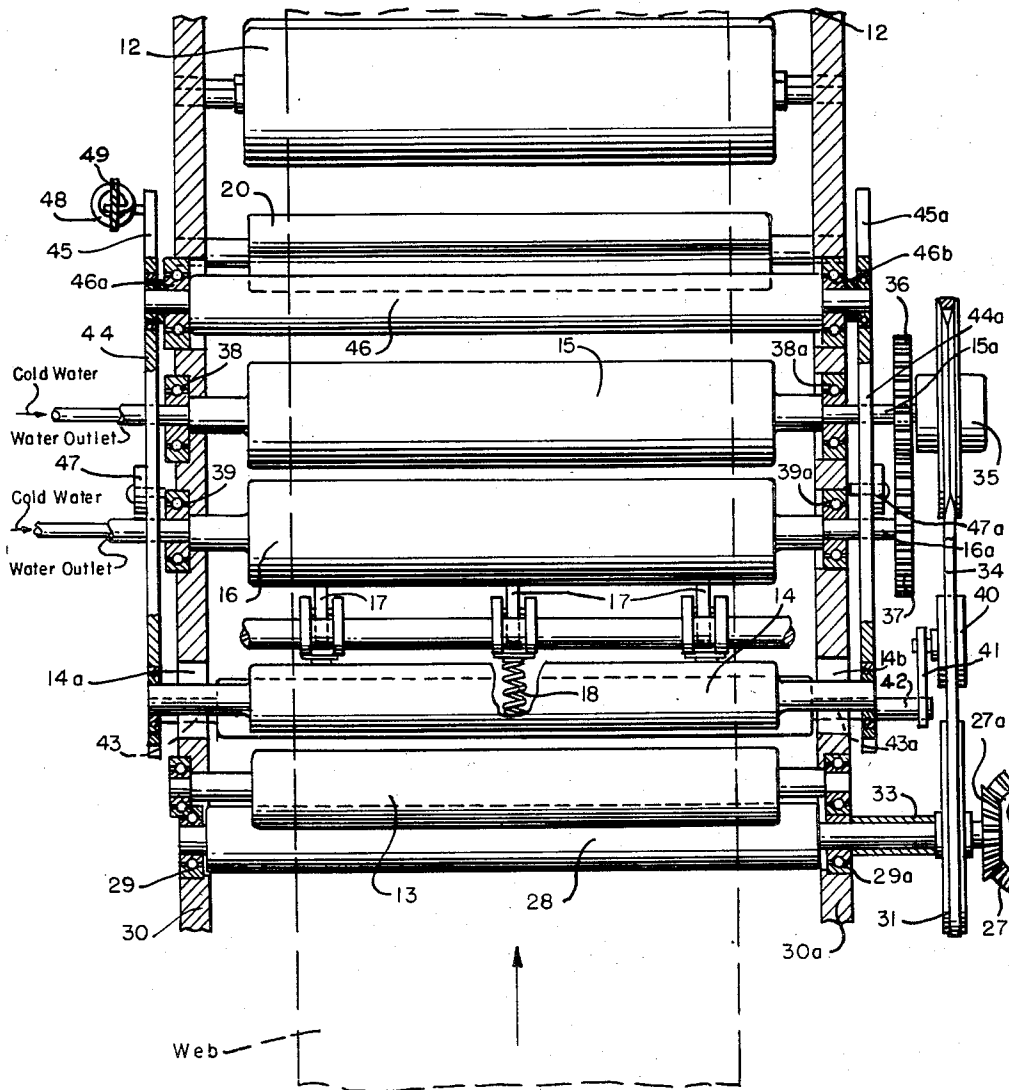


FIG. 2.

INVENTOR

William F. Huck

BY

Horner R. Montague

ATTORNEY

Aug. 16, 1960

W. F. HUCK

2,949,295

WEB TENSION CONTROL MECHANISM

Filed Aug. 8, 1957

3 Sheets-Sheet 3

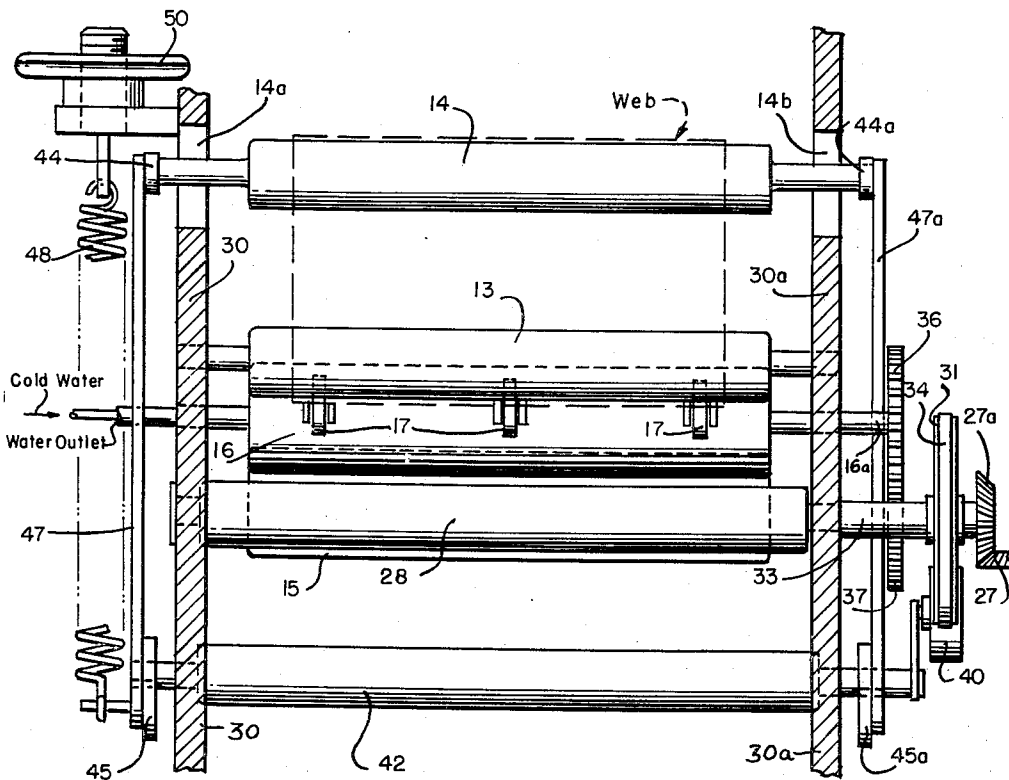


FIG. 3.

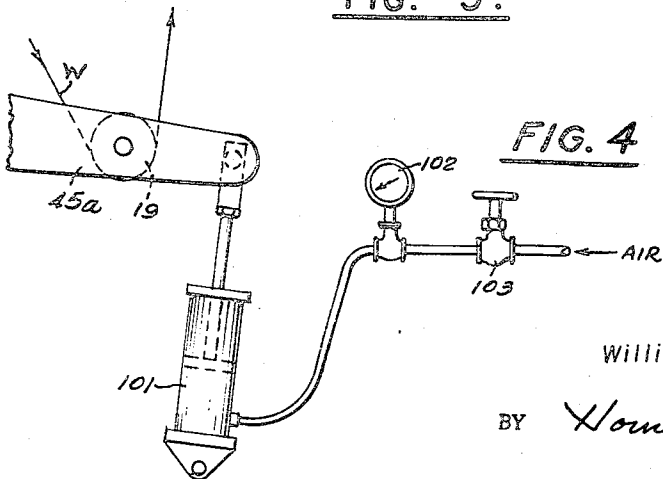


FIG. 4

INVENTOR

William F. Huck

BY

Homer Q. Montague

ATTORNEY

1

2,949,295

WEB TENSION CONTROL MECHANISM

William F. Huck, Forest Hills, N.Y., assignor to Huck Co., New York, N.Y., a partnership

Filed Aug. 8, 1957, Ser. No. 677,143

10 Claims. (Cl. 271—2.3)

This invention relates to a device for controlling the tension of a moving web, and more particularly to a mechanism which automatically senses variation of web tension on opposite sides of a variable speed drive for the web, and which adjusts the speed of the drive to compensate for such variation, whereby the web tension on opposite sides of the drive may be equalized or adjusted to any desired relative value.

The present invention, while having more general application, is particularly suitable for use in printing presses in which it is necessary to dry the ink on a web by heating the web after each printing operation, and subsequently to cool the web. In such presses the web first passes through an oven or other suitable heaters and is then cooled by contact with rollers through which cooling water is circulated. Prior to the present invention the cooling rollers have been driven at a selected fixed speed, normally providing a minute overspeed to their surfaces to provide the desired web tension, or through variable speed drives which must be manually adjusted frequently to maintain constant web tension. Web tension is especially difficult to maintain during starting and stopping periods or at any time that the web speed is changing. Such speed variations cause varying drying and shrinking effects in the web, and seriously detract from the final printed product.

Accordingly it is a primary object of the invention to provide a unique mechanism for controlling, regulating, and maintaining the tension of a moving web substantially automatically.

Another object of the invention is to provide a mechanism of the foregoing type which overcomes the deficiencies of prior mechanisms.

A further object of the invention is to provide a mechanism of the aforesaid type which incorporates cooling rollers driven by a variable speed drive that is controlled automatically in accordance with the tension of the web, so as to maintain the desired web tension before and after the driven cooling rollers regardless of the numerical value of the tension, which may be changed from time to time.

An additional object of the invention is to provide a device of the aforesaid type which incorporates unique means for sensing the tension in accordance with sensed web tension variations.

Still another object of the invention is to provide apparatus for maintaining the desired web tension on opposite sides of a variable speed drive located intermediate a pair of printing couples, without varying the effective web length between the couples.

These and other objects of the invention will become more readily apparent upon consideration of the following detailed description of exemplary embodiments of the invention when taken in conjunction with the accompanying drawings illustrating such embodiments and wherein:

Figure 1 is a partially diagrammatic side elevation view of a preferred form of the invention.

2

Figure 2 is a top plan view, partly in section, taken along line 2—2 of Figure 1 in the direction of the arrows.

Figure 3 is an end elevation view, partly in section, taken along line 3—3 of Figure 1 in the direction of the arrows.

Figure 4 is a fragmentary side view of a modified form of the invention.

Briefly stated, the mechanism of the invention, as applied to a printing press of the type referred to above, maintains constant the web tension on opposite sides of cooling rollers located between a pair of printing couples. The cooling rollers are driven by a variable speed drive that is controlled by web tension sensing means responsive to the tension of the web on opposite sides of the rollers. This means automatically adjusts the speed of the variable speed drive to equalize or otherwise regulate the tension of the web on opposite sides of the cooling rollers, without substantially changing the length of web between the printing couples.

Referring to the drawings and particularly to Figure 1 thereof, the web W is arranged to travel between two consecutive printing couples (which constitute reference points for the operation of the system) including pairs of drive rollers 11 and 12, respectively. In Figure 1 the web passes to the right through the heaters shown, travels upwardly around an idler roller 13, then around a first floating roller 14, downwardly to a first cooling cylinder 15, around cooling cylinder 15 and a companion cooling cylinder 16 in an S curve, downwardly around a second floating roller 19, upwardly to an idler roller 20 and then through the second printing couple 12. Rollers 17, urged against cooling cylinder 16 by spring 18, hold the web against the surface of the cylinder. Cylinders 15 and 16 may be cooled by cold water circulated through the cylinders as indicated by the coaxial inlet and outlet pipes in Figures 2 and 3.

The printing couple 11, driven from a suitable source of motive power (not shown) drives a gear train including miter gears 21, 21a, shaft 22, miter gears 23, 23a, shaft 24, miter gears 25, 25a, shaft 26, and miter gears 27, 27a. Gear 27a is fixed to the end of a shaft 28 (better seen in Figures 2 and 3). Shaft 28 revolves in bearings 29, 29a mounted on side frames 30, 30a, which support the moving parts of the invention. A pulley 31, spaced from side frame 30a by a sleeve 33, is connected to one end of shaft 28 by a key 32 (Figure 1). Pulley 31 drives a belt 34, which in turn drives a variable diameter pulley 35 mounted on a shaft 15a rotatable with the cooling cylinder 15. The variable diameter pulley may be of the conventional type comprising a pair of conical disks that are spring biased toward each other into engagement with the belt 34, which may be of the conventional trapezoidal cross-section type. Any tendency toward an increase in belt tension will be opposed by a decrease in pulley diameter, and vice versa.

Cooling cylinder 16 is driven by mating gears 36 and 37 respectively fixed to shafts 15a and 16a that are rotatable with the cooling cylinders 15, 16. The cooling cylinders revolve in bearings 38, 38a, and 39, 39a, respectively, which are mounted in the side frames 30, 30a. An idler pulley 40 engages the belt 34 as shown in Figure 1 and is rotatably mounted on an arm 41 securely fixed to a round crossbar 42. The crossbar 42 is rotatably mounted on the side frames 30, 30a in ball bearings 43, 43a indicated generally in Figure 2. Rotation of the crossbar varies the amount of deflection of the belt 34 by pulley 40.

Idler rollers 14 and 19 are rotatably mounted on arms 44, 44a and 45, 45a, respectively, the elements of each pair of arms being arranged on opposite sides of the side frames 30, 30a as indicated in Figure 3. Arms 45

and 45a are fixed to and rotate with crossbar 42 previously described, and arms 44, 44a are similarly fixed to and rotate with a crossbar 46 rotatably mounted in bearings 46a, 46b on side frames 30, 30a. Arms 44 and 45 are connected by means of a bridge piece or link 47 pivotally connected to the respective arms at points intermediate their length. Arms 44a and 45a are similarly connected by a link 47a. The arms and their connecting links constitute a pair of floating H-frame linkages arranged adjacent the respective side frames 30, 30a. Arm 45 is connected to side frame 30 by means of a tension spring 48. A spring tension adjustment is provided in the form of a screw 49, which is attached to one end of the spring 48 and which passes through a part of side frame 30 and is threaded into an adjusting knob 50 abutting the side frame.

In the operation of the mechanism of the invention, the web follows the path previously described, and variations in web tension are sensed by control rollers 14 and 19. For example, when there is an increase in web tension between printing couple 11 and cooling rollers 15 and 16, idler cylinder 14 moves downwardly about the axis of crossbar 46, clearing the side frames 30, 30a by virtue of slots 14a, 14b (Figures 2 and 3). This motion is transmitted by arms 44, 44a which support roller 14, to links 47, 47a, and in turn to arms 45, 45a, causing the latter arms to pivot downwardly about the axis of crossbar 42. As crossbar 42 rotates with the arms 45, 45a, pulley 40 is rotated downwardly away from belt 34 about the axis of crossbar 42. This tends to reduce the deflection of the belt by the pulley and relax the belt 34. The variable diameter pulley 35 contracts under its spring bias to force the belt 34 outwardly on the pulley to a new position of equilibrium between the belt tension and pulley spring bias, thereby effectively to increase the diameter of the pulley. This action changes the drive ratio between shaft 28 and cooling cylinder 15 and decreases the rotational speed of the cooling cylinders with respect to the relatively constant speed of the printing couples 11, 12. The speed reduction decreases the web tension between printing couple 11 and the cooling rollers just enough to compensate for the assumed initial increase in web tension.

It will be observed that the downward motion of floating cylinder 14 in the example assumed is accompanied by a downward motion of floating cylinder 19. The latter motion tends to increase the tension of the web between the cooling cylinders and printing couple 12. This tendency is further augmented by the decrease in the drive speed of cooling rollers 15 and 16 relative to the speed of printing couple 12. The resulting reaction on roller 19 tends to reduce the effect produced by the motion of roller 14, but finally a point of equilibrium will be reached in which the tension on opposite sides of the cooling rollers will be equalized or adjusted in accordance with the desired ratio. Taking shaft 42 as the reference point, the force of the web "W" acting on roller 14 will tend to rotate shaft 46 counter-clockwise and, by virtue of the H frame linkage, will also tend to rotate shaft 42 clockwise. The force exerted by belt 34 against idler roller 40 also tends to rotate shaft 42 clockwise. The tension of the web leaving roller 19, and the force of spring 48, tend to rotate shaft 42 counter-clockwise. Whenever these forces are not in balance, shaft 42 rotates slightly to find such balance and thereby shorten or lengthen belt 34 with respect to variable diameter pulley 35. This action causes slight increase or decrease in the effective diameter of said pulley, and correspondingly increases or decreases the relative speed of the web around the cooling rollers until the balance of all these forces is restored.

This automatic balancing of the forces in the incoming web before roller 14 with that of the outgoing web behind roller 19, or to have the tension in one branch ex-

ceed that of the other branch as may be desired, is accomplished by the adjustment of spring 48.

A decrease in the web tension between the printing couple 11 and the cooling rollers will be compensated in exactly the opposite manner, and increases or decreases in the web tension between the cooling rollers and the printing couple 12 will be similarly compensated. Thus, the desired web tension will be maintained.

Since the web tension in the entire system does not depend on this device as shown, the overall tension between printing couple 11 and printing couple 12 may increase or decrease as a result of adjustments or conditions beyond the sphere of the mechanism shown in Figure 1. Thus, for example, the tension between printing couples 11 and cooling rollers 15 and 16 may be set to some quantity X units higher than that existing between the latter and printing couple 12. This differential setting will be maintained even if the overall tension between printing couple 11 and printing couple 12 should increase or decrease.

It is important to note that the web tension regulation is substantially independent of the speed of the web and is, therefore, effective during variations in web speed, wherein the web tension adjustment mechanisms of the prior art are particularly deficient. It is also important to note that at no time during the web tension adjustment does the web length between the printing couples 11 and 12 change appreciably. Increases in the length of the web path between the printing couple 11 and the cooling rollers are compensated by decreases in the length of the web path between the cooling rollers and the printing couple 12 and vice versa, through the reciprocal action of rollers 14 and 19.

This latter feature is important in connection with the printing of different colors by successive applications, such as printing the first color by printing cylinder 11 and a second color by printing cylinder 12. It will be readily understood that serious changes in the total length of the web between these two points would disturb the accurate location of the two impressions with respect to each other.

In an alternative form of the invention, the printing couple 11 may be located so that the web travels directly to floating cylinder 14 without passing around an idler cylinder 13. This arrangement is indicated in Figure 1 by the showing of printing couple 11' and web W' in phantom lines and has the advantage of not allowing the printed and heated surfaces of the web to come in contact with any surface except the surface of cylinder 14 before contacting the cooling cylinders and then succeeding rollers.

Spring 48, screw 49, and handwheel 50 may be replaced by the equivalent pneumatic (fluid pressure) cylinder 101, pressure gage 102, and regulating valve 103 shown in Figure 4. This fluid pressure arrangement has the advantage of built-in air lubrication which overcomes the inertia and friction characteristics of the spring arrangement. Hence, the fluid pressure arrangement can be more sensitive than the spring arrangement, but it is also more expensive.

While preferred forms of the invention have been shown and described, it will be apparent to those skilled in the art that changes may be made in these forms of the invention without departing from the principles and spirit of the invention, the scope of which is defined in the appended claims. Accordingly, the foregoing embodiments are to be taken as illustrative, rather than restrictive of the invention, and those modifications which come within the meaning and range of equivalency of the claims are to be included therein.

What is claimed is:

1. A device for regulating the tension of a moving web on opposite sides of a location between reference points along said web, comprising a drive roller at said location for driving said web, a first control roller engaging

5

said web on one side of said location, a second control roller engaging said web on the other side of said location, an H-frame having a pair of arms and a bridge piece pivotally connected at opposite ends to said arms, respectively, said control rollers being mounted on said H-frame near diagonally opposite extremities of the respective arms, the arms being pivoted on a framework near their other ends whereby said control rollers may be moved toward and away from said web reciprocally, a variable speed drive for said drive roller, and means responsive to the motion of said control rollers for changing the speed of said drive roller, whereby variations of the web tension on either side of said location are transmitted to said control rollers to move said H-frame to vary the speed of said drive roller and adjust the tension of said web to compensate for said variations.

2. A device for regulating the tension of a moving web on opposite sides of a location between sets of printing rolls or the like, comprising an intermediate set of rollers at said location for driving said web, a first control roller engaging said web on one side of said location, a second control roller engaging said web on the other side of said location, an H-frame having a pair of arms and a bridge piece pivotally connected at opposite ends to said arms, respectively, said control rollers being mounted on said H-frame near diagonally opposite extremities of the respective arms, the arms being pivoted on a support near their other ends for reciprocal motion of said control rollers toward and away from said web, a belt drive for said intermediate set of rollers including a pulley whose effective diameter varies to oppose changes in the belt tension, an idler roller engaging said belt and connected to one of the arms of said H-frame to move therewith and tend to vary the tension of said belt, thereby to change the drive speed of said intermediate set of rollers, whereby variations of the web tension on either side of said location are transmitted to said control rollers to move said H-frame and affect said belt so as to vary the drive speed of said intermediate set of rollers and adjust the tension of said web to compensate for said variations.

3. The device of claim 2, further comprising a spring connected between said support and said H-frame to bias the position of the H-frame.

4. A device for regulating the tension in a moving web which passes successively in cooperation with a first printing couple, a heater, a cooling roller, and a second printing couple, comprising a first control roller engaging said web on one side of said cooling roller, a second control roller engaging said web on the other side of said cooling roller, an H-frame having a pair of arms and a bridge piece pivotally connected at opposite ends to said arms, respectively, said control rollers being mounted on said H-frame near diagonally opposite extremities of the respective arms, the arms being pivoted on a support near their other ends for reciprocal motion of said control rollers toward and away from said web, a belt drive for said cooling roller including a pulley whose effective diameter varies to oppose changes in the belt tension, an idler roller engaging said belt and connected to one of the arms of said H-frame to move therewith and tend to vary the tension of said belt, thereby to change the drive speed of said cooling roller, and an adjustable tension spring connected to a support and said H-frame to bias the position of said H-frame, whereby variations of the web tension on either side of said cooling roller are transmitted to said control rollers to move said H-frame

6

and affect said belt so as to vary the drive speed of said cooling roller and adjust the tension of said web to compensate for said variations.

5. In a device for processing a web, at least one roller carrying said web wrapped around its circumference, variable speed means for driving said roller, individual web tension sensitive means located in the path of the web before and after said roller, the sensitive means being inter-connected so that motion thereof will not disturb the length of the web between two given points beyond said respective sensitive means, continuously operating means connected to said tension sensitive means to vary the speed of said roller smoothly in response to web tension variations, and resilient means for relatively adjusting said sensitive means to vary the setting of tension before and after said driven rollers, whereby to automatically maintain the difference of such tension setting regardless of variation of the tension between said points.

6. A device for regulating the relative values of the tension in a moving web at locations before and after said device in the sense of the web travel direction, without altering the web path length between such locations, comprising a driven roller engaging the web between said locations, a pair of movable web-engaging tension sensing elements mounted aside from the web travel path and arranged to move with respect to the web travel path in response to a change in web tension, said elements being located to engage the web at positions respectively before and after said roller, means inter-connecting said sensing elements for opposite movements with respect to the web travel path to neutralize any changes in effective path length between said locations, and continuously operating means responsive to movement of said sensing elements for varying the speed of said driven roller to compensate for variations in the said relative values of web tension.

7. The device of claim 6, including a belt and variable diameter pulley drive for said roller, and in which said continuously operating means includes mechanism connected to said sensing elements for deflecting said belt to vary the effective diameter of said pulley.

8. The device of claim 6, wherein said sensing elements are supported by a floating linkage.

9. The device of claim 6, wherein said sensing elements comprise other rollers engaging said web, said other rollers being mounted on arms pivotable toward and away from said web, and wherein said inter-connecting means comprises a link pivotally connected to said arms.

10. Apparatus for regulating the tension of a web between a location along the web and a pair of reference points on opposite sides of said location, comprising a variable speed drive for said web at said location, individual biased roller means for sensing the tension of said web at opposite sides of said location, means inter-connecting said tension sensing means for reciprocal movement thereof transversely to the web travel path at opposite sides of said location without appreciably varying the length of web between said reference points, and continuously operating means instantaneously and minutely responsive to said sensing means for proportionally varying the speed of said drive to maintain a predetermined ratio of the web tensions on opposite sides of said location.

References Cited in the file of this patent

UNITED STATES PATENTS

1,265,328 Henderson ----- May 7, 1918