Nov. 15, 1955 W. F. HUCK 2,723,620

ROTARY WEB PRINTING MACHINE WITH TENSION CONTROLS

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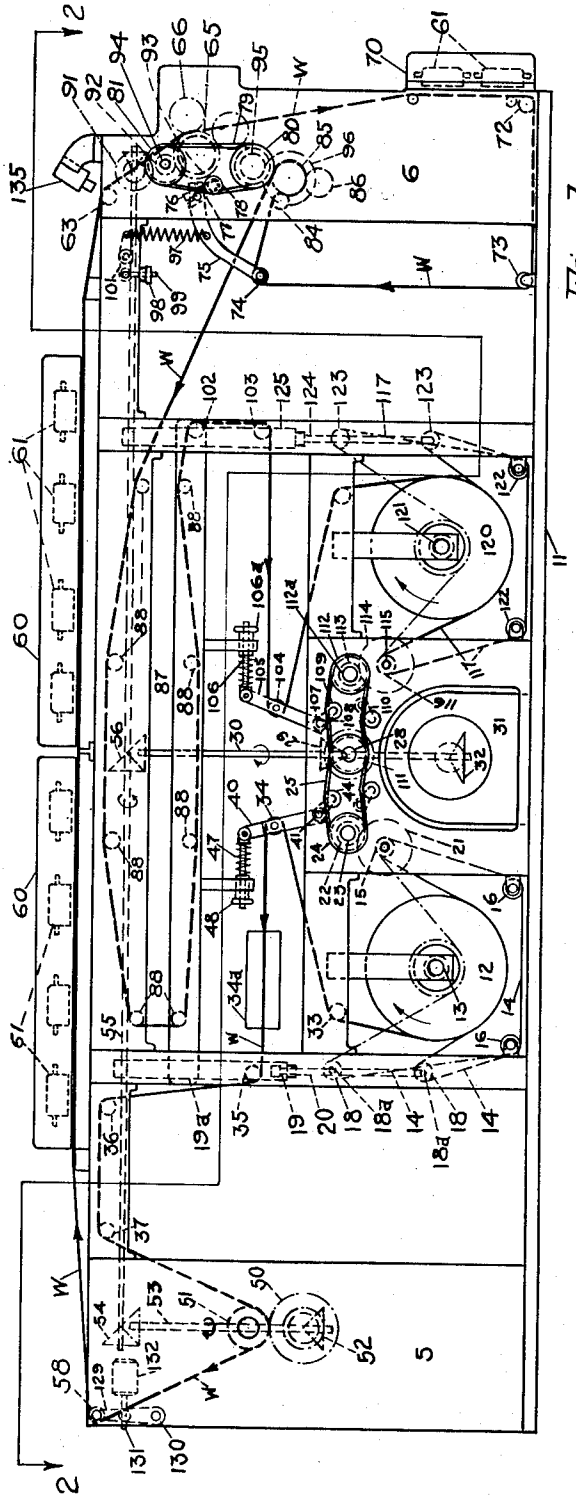

Fig. 1

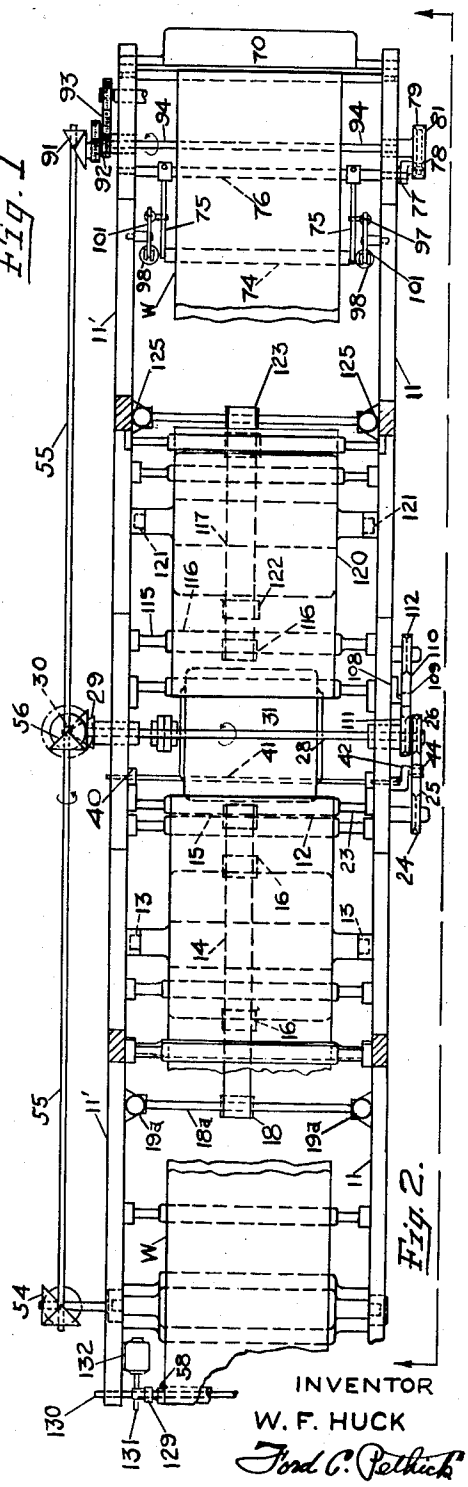

Fig. 2.

INVENTOR

W. F. HUCK

Ford C. Pettrick

ATTORNEY

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ROTARY WEB PRINTING MACHINE WITH TENSION CONTROLS

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

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5 Claims. (Cl. 101—181)

This invention relates to web printing machines and more particularly to multi-couple web printing machines in which the tension of the web is controlled and/or regulated at a plurality of locations as the web passes through the printing machine.

In printing machines, heretofore used, tension control of the web has been provided at only one location usually at or near the point of origin of the web. For example, web printing machines, now in general use, often employ tension controls which act on the unrolling paper supply roll. These tension controls have in the past been in the form of friction brakes acting either on the spindle of the unwinding supply roll or on the surface of the paper roll. In some cases driven belts which contact the surface of the supply roll have been used, these belts being driven at a speed that is slightly less than the speed of the printing machine cylinders. In these prior printing machines it has been necessary to rely on variations in the diameters of the various cylinders around which the paper passes to control the tension as the web passes from one impression location to another impression location or to a delivery mechanism of one kind or another. Experience has shown that a web of paper or other material often undergoes changes in length during its passage through a multi-couple printing machine. These changes in length vary with the variations in the printing process, the pressure applied to the printing couples, the speed of operation and to other factors such as humidity, temperature, etc. At present it is the practice to change the diameter of the cylinders by "packing" the various cylinders to the best suited diameter or by the use of printing plates of various thicknesses. This procedure is time consuming and even if the cylinders are properly packed at the beginning of a run, the conditions may and do vary so that the exact requirements of the printing couples cannot be maintained by such efforts. Therefore, one important object of the present invention is to provide a new and improved printing machine in which means is provided for automatically adjusting the tension of the web at a plurality of locations along the length of the web run.

Another object of the invention is to provide an improved printing machine having incorporated as part thereof a means for rewinding a web under controlled tension.

Another object of the invention is to provide an improved printing machine having an accurately controlled means for rewinding a web under controlled tension by the use of paper roll surface contacting belts which are directly connected to the press drive through a variable speed device so that the tension is maintained on the rewinding roll at all press speeds and during acceleration and deceleration periods

Another object of the invention is to provide a means for passing a web through a printing machine in such a manner that it will respond readily to both automatic longitudinal and cross-ways web or register control.

A practical embodiment of one form of the invention

is represented in the accompanying drawings, which form a part of this specification and in which:

Figure 1 is an elevational side view of a printing machine showing one form of the invention;

Figure 2 is a plan view, partly in section, of the printing machine, as seen along the irregular line 2—2 of Figure 1.

In Figures 1 and 2, this invention has been shown as including a pair of individual printing units 5 and 6 supported by a pair of spaced frame members 11—11'. These frames are designed to properly support not only the units 5 and 6 but all other mechanisms which make up the printing machine. A web (indicated by a heavy line having direction arrows) of paper or other material on which the printing machine operates, originates from a roll 12, which will be termed the supply or unwinding roll. The roll 12 is supported on a pair of bearings 13—13 suitably supported by the frames 11—11'. The roll 12 is driven, in a manner hereinafter set forth, by a flat driving belt 14 which passes over a driven pulley 15, thence over two idler pulleys 16—16 and over a movably adjustable tension pulley 18, which is carried by a shaft 18*a*. Opposite ends of the shaft 18*a* are movably supported by a pair of piston rods 20—20 connected to fluid pistons 19—19 operating within cylinders 19*a*—19*a*. The pulley 15, which drives the belt 14, is secured to the same shaft to which a gear 21 is secured. The gear 21 meshes with a pinion 22, which is secured to a shaft 23, which shaft also carries a variable diameter speed changing V-belt pulley 24. The V-belt pulley 24 is driven by a V-belt 25, which in turn is driven by a driving pulley 26, the latter being mounted on one end of a shaft 28 of which the other end is driven by a pair of bevel gears 29, of which one is secured to a vertical shaft 30. The lower end of the shaft 30 is driven by an electric motor 31 through a pair of bevel gears 32. As will hereinafter be shown, the motor 31 is the same motor that drives the printing couples of the printing machine, and thus, if the printing machine is started, stopped, accelerated, or decelerated, the shaft 28 and the pulley 26 are likewise actuated.

As the web W unwinds from the supply roll 12, it passes over an idler roller 33, thence over a movably mounted floating or tension roller 34, through a moistening device 34*a* then consecutively over fixed rollers 35, 36 and 37. From the roller 37 the web W enters and is acted upon by the printing unit 5, in a manner presently to be discussed. The floating tension roller 34 is mounted at a location intermediate to the ends of a pair of spaced arms 40—40, of which the lower ends are keyed to opposite ends of a cross shaft 41. One end of the shaft 41 passes through the frame member 11 and at this location has an arm 42 which rotatably supports an idler pulley 44 which engages the inner surface of the aforementioned V-belt 25. Variations in tension in the web W will, in a manner fully set forth in a co-pending patent application, Serial No. 770,440, filed Aug. 25, 1947, now Patent No. 2,670,907, cause slight oscillations of the shaft 41. This causes the idler pulley 44 to change the tension of the V-belt 25 with the result that the V-belt 25 will run on either a larger or a smaller diameter of the variable diameter V-belt pulley 24. In this connection it should be noted that a spring 47, the tension of which may be adjusted by a member 48, biases the arms 40—40 in a clockwise direction to counter-act and balance the pull of the web W.

The printing unit 5 may be more or less conventional and, as shown, comprises a plate cylinder 50 and impression roll 51, the latter acting to force one side of the web W into printing contact with printing plates (not shown) on the cylinder 50. Cylinder 50 is driven by a pair of bevel gears 52 through a vertical shaft 53 which, in turn is driven by a pair of bevel gears 54 from a main

horizon press drive shaft 55, which in turn is driven by a third pair of bevel gears 56, of which one is mounted on and driven by the hereinbefore mentioned vertical shaft 30.

The portion of the complete printing machine which has been described, supra, functions in the following manner. As the web W is printed, it is pulled by the printing couple 50—51 so that the web W, as it unwinds from the roll 12, travels along the path marked by heavy lines in the direction indicated by the arrows. The flat belt 14 firmly engages the surface of the paper supply roll 12, the belt 14 being driven by the flat pulley 15 through gear 21, pinion 22, and the V-belt 25. The printing couple 50—51, and the supply paper roll 12 will start, and rotate simultaneously and always with the correct paper tension when the printing machine is started and rotated. When a new or full roll of paper 12 is supported from the bearings 13—13', the belt 14 will be in the lower position indicated by a solid line, but, as the size of the roll 12 diminishes, the belt 14 moves to the position indicated by the dash-dot line, the slack in the belt 14 being taken up by the fluid pressure pistons 19—19.

Since the diameter of the V-belt pulley 24 varies in response to variations in the tension of V-belt 25, it will be understood (as fully set forth in co-pending patent application, Serial No. 770,440, supra) that, should the tension in the web W become excessive it would force the roller 34 to rock the shaft 41 in a counterclockwise direction as seen in Fig. 1. Then the idler pulley 44 will lift up on the upper reach of the V-belt 25. This, of course, increases the tension in the V-belt 25, and the V-belt pulley 24 in effect becomes slightly smaller in diameter and thereby slightly increases the speed of the driving belt 14. As a result of this, the unwinding paper roll 12 will feed the web W slightly faster than the speed of the cylinder 50. This, of course, causes the arms 40—40 to regain their original position.

Conversely, should the tension in the web W decrease below the desired tension, the spring 47 will over balance the pull of the web W and cause the lever arms 40—40 to move clockwise, thereby loosening the V-belt 25 with the result that the V-belt 25 contacts the V-belt pulley 24 at a larger diameter thus causing the belt 14 to decrease slightly the speed of the roll 12. This results in less paper feed, thereby again restoring the rollers 34 and 44 as well as arms 40—40 and 42 to their original positions.

It is well known that the application of moisture to a web of paper will cause the paper to expand. By use of the corrective effects of the mechanisms provided in the herein described printing machine, the paper web may be moistened or left dry depending upon the requirements of the printer. Therefore, the mechanism of the present invention will, regardless of any elongation or shortening of the web between the unwinding roll 12 and the printing couple 50—51, maintain a constant web tension despite firm contact of the belt 14 with the roll 12.

After the web W has been printed by the printing unit 5, it passes over a register adjusting roller 58, later to be described, and then passes through a pair of heaters 60—60 where the web is exposed to heating elements 61—61—61, etc. Thence the web passes over a roller 63, from whence it is led over a second impression cylinder 65. At this location the web W receives a second printing from a plate cylinder 66. Then the web W continues through a second heater 70 where it is exposed to additional heating units 61—61, and consecutively passes over rollers 72 and 73 after which it passes over a floating roller 74. The roller 74 is mounted on the distal ends of a pair of spaced arms 75—75, keyed to a shaft 76 which extends between the frames 11—11'. The shaft 76, at a location in front of the frame 11, has secured thereto an arm 77, of which the distal end rotatably supports a pulley 78. The face of the pulley 78 contacts the inner face of a V-belt 79 which drivingly connects a driven variable diameter V-belt speed changing pulley 80 with a driving pulley 81. After the web W leaves the roller 74 it is threaded around an idler roller 84, is wrapped around an impression roller 85 where a roller 86 applies a gum substance to the web in a known manner, the rollers 85 and 86 constituting a gum applying couple. After the gum has been applied, the web is dried as it passes through a heater 87 wherein the web is supported on rollers 88—88, etc.

The printing cylinders or couple 65—66 are driven from the main press drive shaft 55 through a train of driving members, including a pair of bevel gears 91 and gears 92 and 93. Thus the cylinders, which form the couple 65—66, are rotated in synchronism with the plate cylinder 50, but due to the size of these cylinders and the gear ratios of the parts, the cylinder 66 preferably makes two revolutions for each revolution of the cylinder 50.

The hereinbefore mentioned gear 92 is mounted on one end of a shaft 94 and at its other end the shaft 94 carries the belt pulley 81. Also the previously mentioned V-belt 79, by way of the driven V-belt pulley 80 and a common shaft for the pulley 80 and a gear 95, drives the gear 95 which is in mesh with a gear 96, the latter gear being secured to the same shaft that carries the impression roller 85.

The previously mentioned arms 75—75, which carry the roller 74, are urged in a clockwise direction about the center of the shaft 76 by a spring 97 which may be adjusted by a hand wheel 98 through a screw 99 and a lever 101. Preferably, the printing type on the cylinder 66 will contact the web of paper W with an intermittent pressure against the impression cylinder 65 which has only a slight wrap of the web W. This permits the web W to have a small increment motion relative to the cylinder 65.

It will be appreciated that the web W, which may be wet at the point of entrance into the heater 60, begins to shrink as it is subjected to heat radiated from heaters 61 in the heater 60. This changes the length of the strand of the web W between the cylinders 50 and 66. However, the floating roller 74 on the arms 75—75 will maintain the portion of the web W between the plate cylinder 50 and the roller 85 in constant tension. Should the tension in the web W become less than required, the floating roller 74 on the arms 75 will respond to the action of the spring 97 which would over balance the web tension to move in a clockwise direction, thereby causing the pulley 78 on the arm 77 to increase the tension in the V-belt 79, so that the variable diameter V-belt speed changing pulley 80 will be contacted by the V-belt 79 on a smaller diameter end to increase the speed of rotation of the impression roller 85. This increase of speed will correct the tension in the web and quickly restore the arms 75—75 to their original position. Conversely, if tension in the web W exceeds the desired amount, the floating roller 74 on arms 75—75 will move counterclockwise as seen in Fig. 1. Then the idler pulley 78 on the arm 77, will cause the V-belt 79 to become looser and to ride on a larger diameter of the variable diameter speed changing pulley 80. This reduces the speed of the impression roller 85 and less web W is pulled so that the roller 74 will again be restored to its desired position.

After the web W leaves the heater 87 it passes over rollers 102 and 103 and then passes over a floating roller 104 supported (in a manner similar to that described for roller 34) on a pair of arms 105—105. A spring 106 urges the arms 105—105 in a counterclockwise direction as seen in Fig. 1, the arms 105—105 are keyed to a shaft 107, which on its end in front of the frame 11 carries a lever 108 of which the distal ends carry a pulley 109 which contacts a V-belt 110. A pulley 111 is secured to the hereinbefore mentioned shaft 28 and at a location alongside the hereinbefore mentioned pulley 26. The

V-belt 110 drivingly connects the drive pulley 111 with a variable diameter V-belt speed changing pulley 112, the latter being mounted on a shaft 112A which is drivingly connected through a pair of gears 113 and 114 to drive a shaft 115 which, in turn, drives a flat pulley 116 over which a belt 117 passes to contact the peripheral surface of a rewinding roll of paper 120. The rewinding roll of paper is supported on a pair of bearings 121 supported from the frame structure 11—11'. The belt 117 passes over idler pulleys 122—122 and around a tension pulley 123, which is mounted in a manner similar to that described for pulley 18 associated with the supply roll 12. The pulley 123 is urged upwardly by a piston rod 124 through the action of a piston 125, thus to maintain the belt 117 under proper and constant tension and thus to hold the belt 117 in firm contact with the surface of the rewinding roll 120.

Since the belt 117 is drivingly connected to the press drive, as hereinbefore described, it will be understood that the rewinding roll 120 will start, rotate, and stop simultaneously with the complete printing machine. In the event that the tension in the web W just before it is wound on the rewinding roll 120 becomes too loose, the roller 104 on arms 105 will be overbalanced and will be pushed by the spring 106 adjustable in tension by handwheel 106A, in a counterclockwise direction, so that the idler pulley 109 will tighten the V-belt 110 thereby causing the variable diameter speed changing pulley 112 to assume a smaller diameter. By this action the speed of the rewinding roll 120 will be increased and thus the pulley 104 on the arms 105—105 will be restored to its original position. Conversely, if the web W becomes too tight, it will over balance the spring 106 and cause the roller 104 on the arms 105—105 to move clockwise, as seen in Fig. 1. By this action pulley 109 will loosen the V-belt 110 so that the variable diameter pulley 112 will increase in effective diameter and thus drive the rewinding roll 120 at a slower speed. The arms 105—105, which carry the roller 104, will now move counterclockwise until the roller is restored to its original position.

From the foregoing it will be understood that the web W will be maintained under constant tension between the impression roller 85 and the rewinding roll 120, this control being accomplished by means of floating roller 104 and the equipment associated therewith.

Any one of several standard register control devices, for example the device shown in U. S. Patent 2,497,909, may be used to control register between the printing couples 50—51 and 65—66. However, for the present disclosure the hereinbefore mentioned register adjusting roller 58 will be understood to provide a means for automatically controlling the register of the web W as the second printing is made by the plate cylinder 66. The roller 58 is supported on the distal ends of a pair of arms 129—129 which, in turn, are supported on a shaft 130. The movement of the arms 129—129 and thus the roller 58 are controlled by a screw 131 which is turned by a small motor 132, the latter being under the influence of an electric eye 135 and connected thereto by electric circuits, not shown, but well known. As the roller 58 moves from left to the right, as seen in Fig. 1, it shortens the length of the portion of the web W between the plate cylinder 50 and the plate cylinder 66. This action will cause a displacement of a portion of the web W printed upon by the cylinder 50 as it arrives at the cylinder 66 of the printing unit 6. This, of course, will disturb the web tension but in the mechanism hereindescribed the response of the floating roller 74 will quickly restore the web tension to normal. Conversely, motion of the roller 58 to the left, in Fig. 1 would tend to lengthen the web, but again the action of the floating roller 74 restores the web tension to normal before an appreciable variation has occurred.

Since the rewinding roll 120 has its own tension control mechanism, it will maintain constant tension in the web W as it is wound on the roll 120. This control will be independent of the tension as controlled by the preceeding controls through the floating roller 74. This arrangement is very important, because otherwise the preceeding tension in the web may be disturbed.

The herein described plurality of tension control devices thus function in combination with one another at any web speed and during both acceleration and deceleration periods. Such control is absolutely required for the maintenance of accurate register between the first printing at the plate cylinder 50 and the second printing at the cylinder 66. It will be noted that the tension in the web sections between the various control points may, by means of hand wheels be adjusted independently for different tensions and thus tension will be maintained regardless of variations in the web due to moisture and/or other causes.

I claim as my invention:

1. A machine for effecting plural modifying operations on a web, comprising a supply reel, a plurality of treating stations each operative to alter the relative length of portions of the web, a take-up reel, means for guiding said web from said supply reel successively through said treating stations to said take-up reel, a motor, positive drive means connected to said motor to drive said web at certain of said stations, a pair of variable speed transmission drives directly connected to be driven from said motor and to drive said supply and take-up reels respectively at varying speeds to control web tension at said reels, an additional variable speed transmission drive connected to be driven directly from said motor and to control the tension of said web at a particular one of said treating stations independently of its tension at said reels, and means for controlling the last named variable speed transmission in accordance with the tension of said web as it leaves a preceding one of said treating stations.

2. A machine for effecting plural modifying operations on a web, comprising a supply reel, a plurality of treating stations each operative to alter the moisture content of said web, a take-up reel, means for guiding said web from said supply reel successively through said treating stations to said take-up reel, a motor, a pair of variable speed transmission drives directly connected to be driven from said motor and to drive said supply and take-up reels respectively at varying speeds to control web tension at said reels, an additional variable speed transmission drive connected to be driven directly from said motor and to control the tension of said web at a particular one of said treating stations independently of its tension at said reels, and means for controlling the last named variable speed transmission in accordance with the tension of said web as it leaves one of said treating stations.

3. A machine for effecting plural printing and other modifying operations on a web, comprising a supply reel, a plurality of printing couples, a plurality of other treating stations each operative to alter the moisture content of said web, a take-up reel, means for guiding said web from said supply reel successively through said printing couples and said treating stations to said take-up reel, a motor, a pair of variable speed transmission drives directly connected to be driven from said motor and to drive said supply and take-up reels respectively at varying speeds to control web tension at said reels, an additional variable speed transmission drive connected to be driven directly from said motor and to control the tension of said web at a particular one of said treating stations following said printing couples and independently of its tension at said reels, and means for controlling the last named variable speed transmission in accordance with the tension of said web as it leaves a preceding one of said treating stations.

4. A printing machine for printing a plurality of impressions on a web, comprising a supply reel, a plurality of printing couples, a plurality of treating stations opera-

tive to alter the moisture content of said web, certain of said treating stations being disposed to either side of the respective printing couples, a take-up reel, means for guiding said web from said supply reel successively through said printing couples and said treating stations to said take-up reel, a motor, means connecting said motor directly to said printing couples, variable speed transmission drives directly connected to be driven from said motor and to drive said supply and take-up reels at varying speeds to control web tension at said reels, at least one variable speed transmission drive connected to be driven directly from said motor and to control the tension of said web at one of said treating stations, and means for controlling the last named variable speed transmission in accordance with the tension of said web as it leaves a preceding one of said treating stations.

5. A printing machine in accordance with claim 4, in which said treating stations include a drying station following one of said printing couples, a gumming station following said drying station, and a second drying station following said gumming station, and in which the last-named variable speed transmission drive controls the tension of the web at said gumming station in accordance with the tension of the web leaving said first named drying station.

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