

Aug. 4, 1959

W. R. SPILLER ET AL

2,897,754

WEB TENSION CONTROL FOR ROTARY PRINTING PRESS

Filed March 21, 1957

7 Sheets-Sheet 1

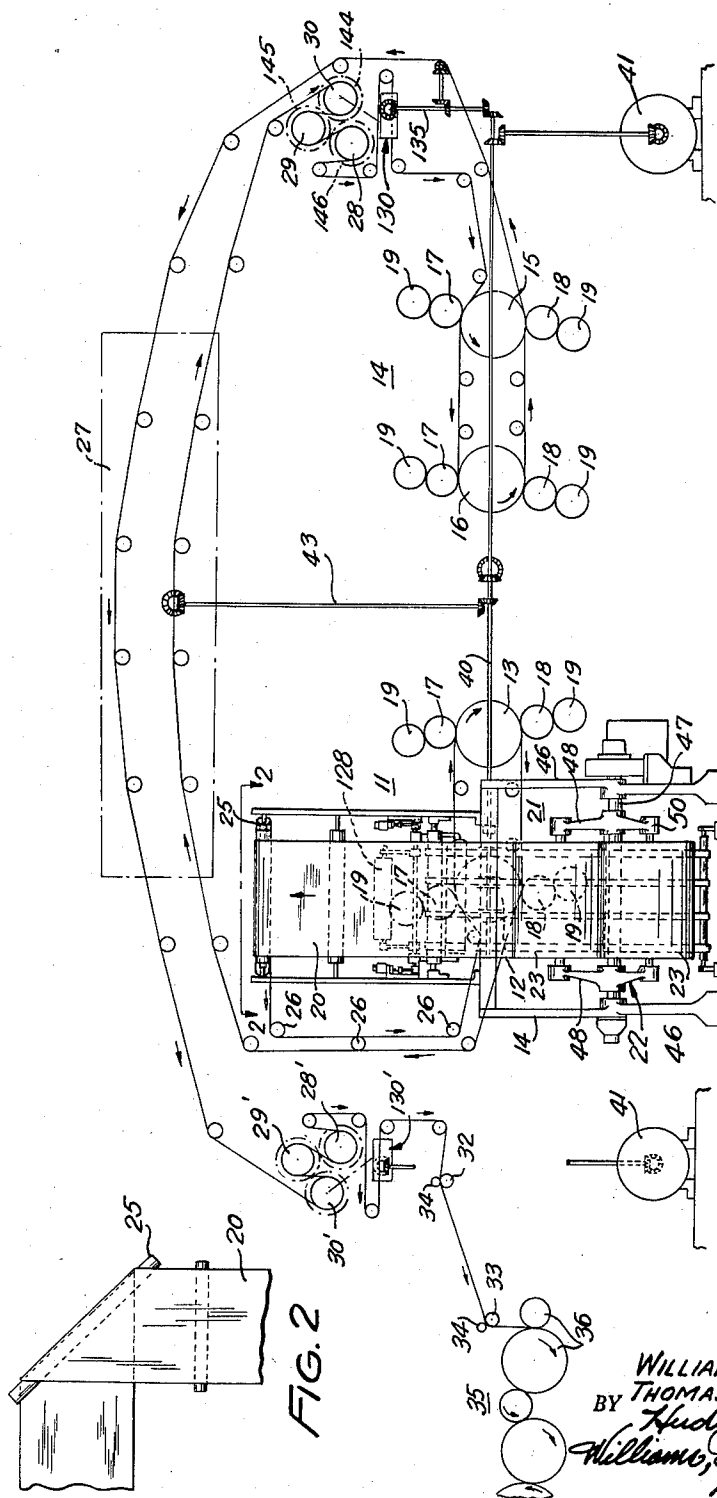


FIG. 1

FIG. 2

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7 Sheets-Sheet 2

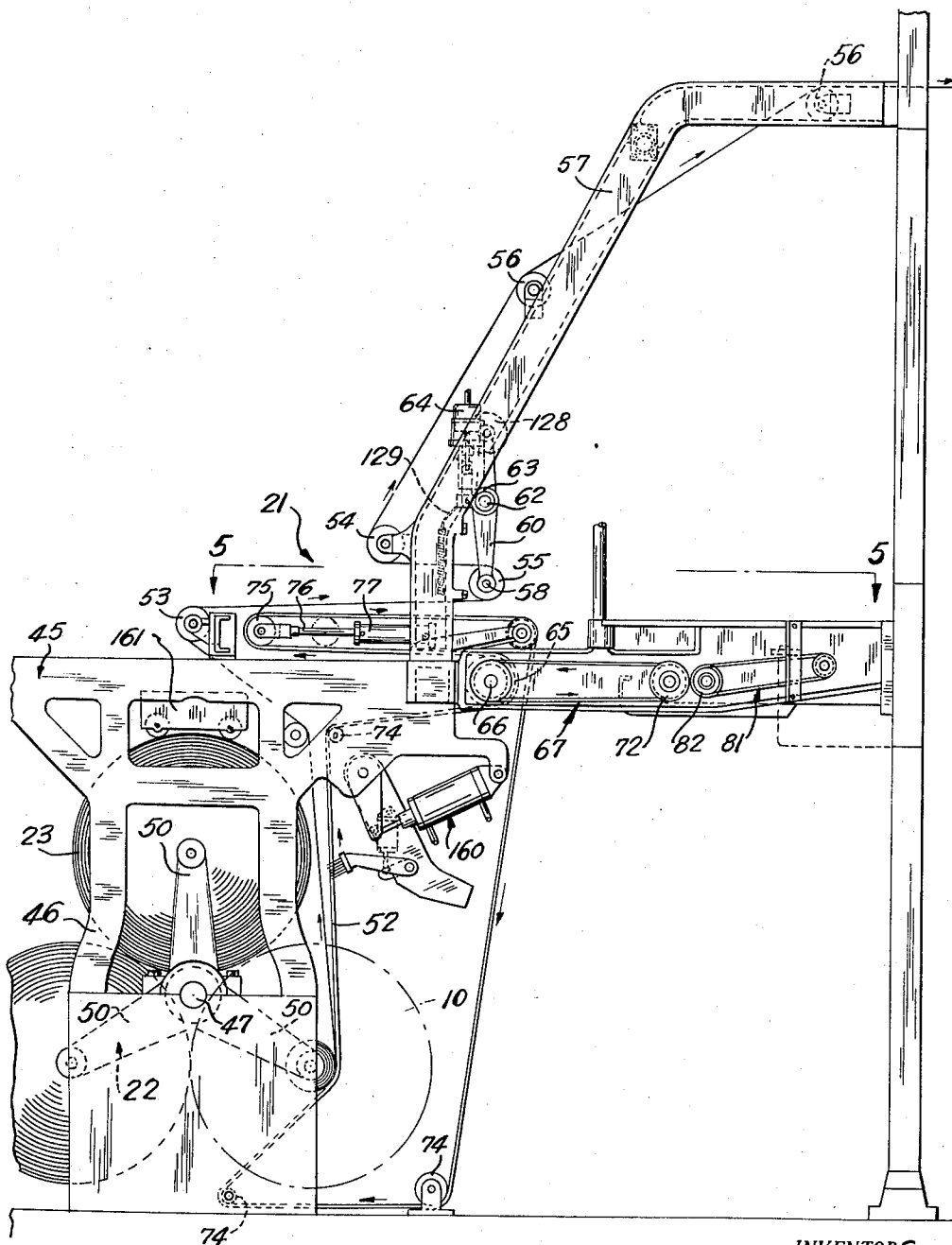


FIG. 3

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7 Sheets-Sheet 3

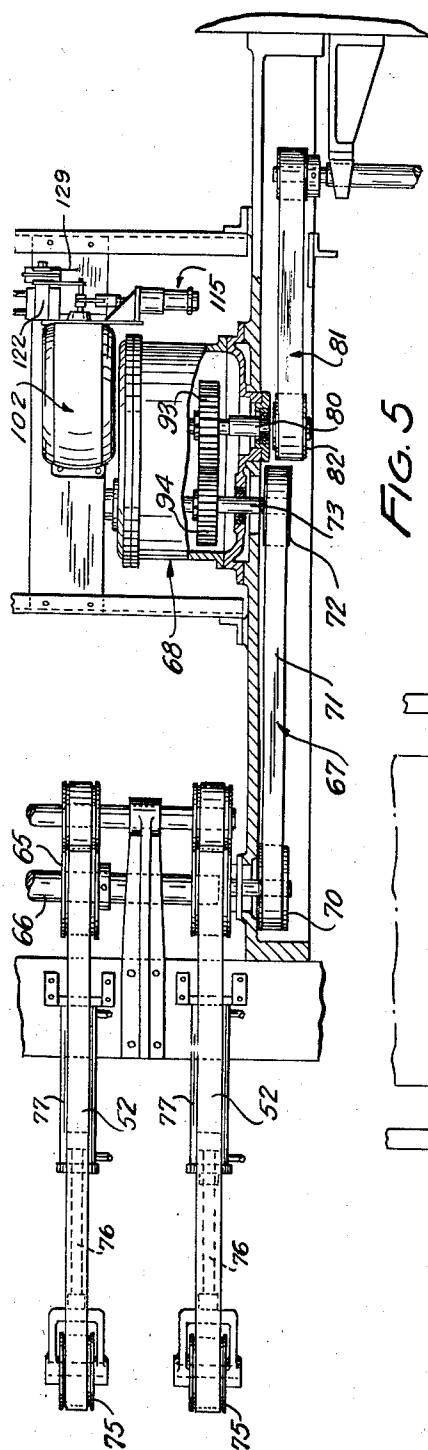


FIG. 5

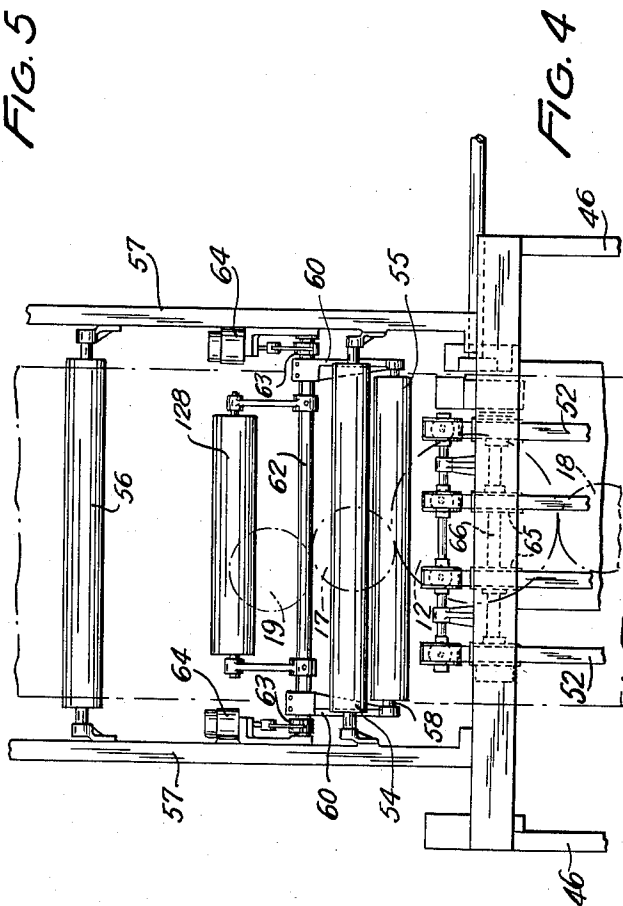


FIG. 4

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7 Sheets-Sheet 4

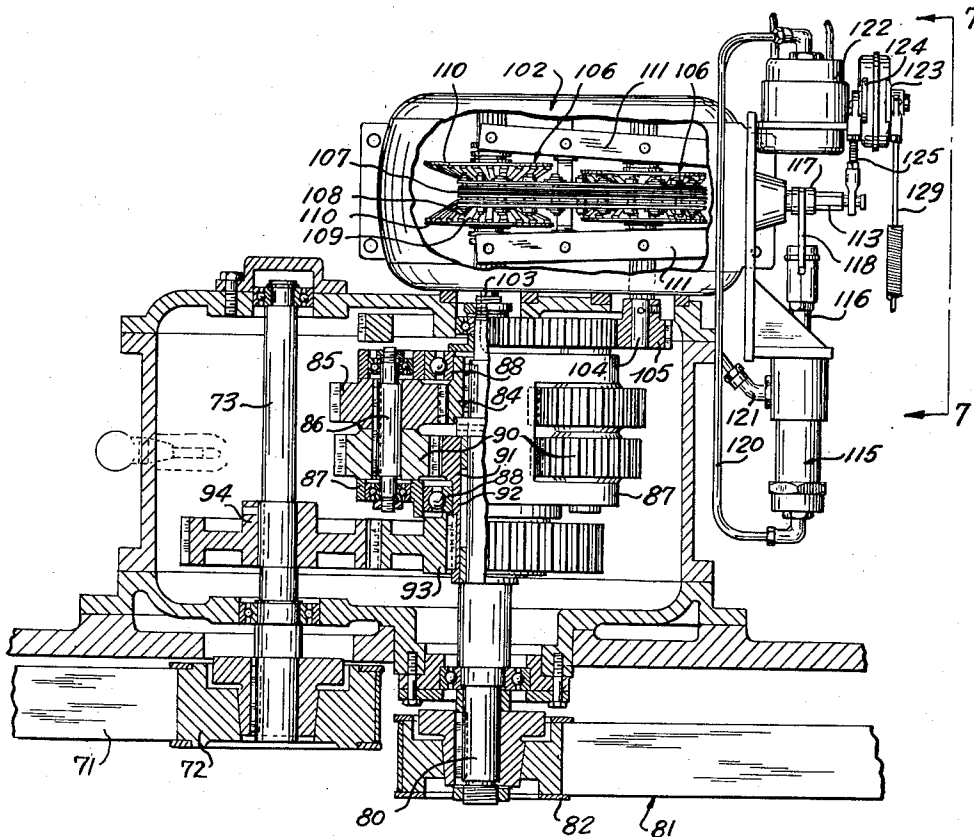


FIG. 6

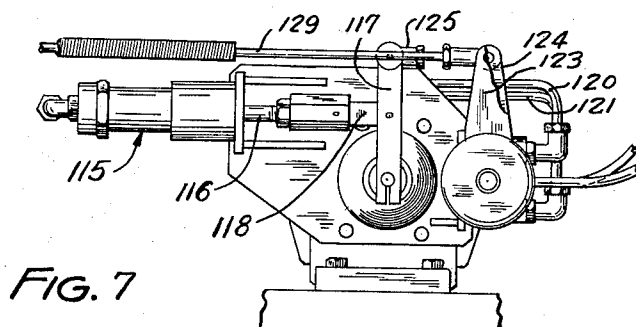


FIG. 7

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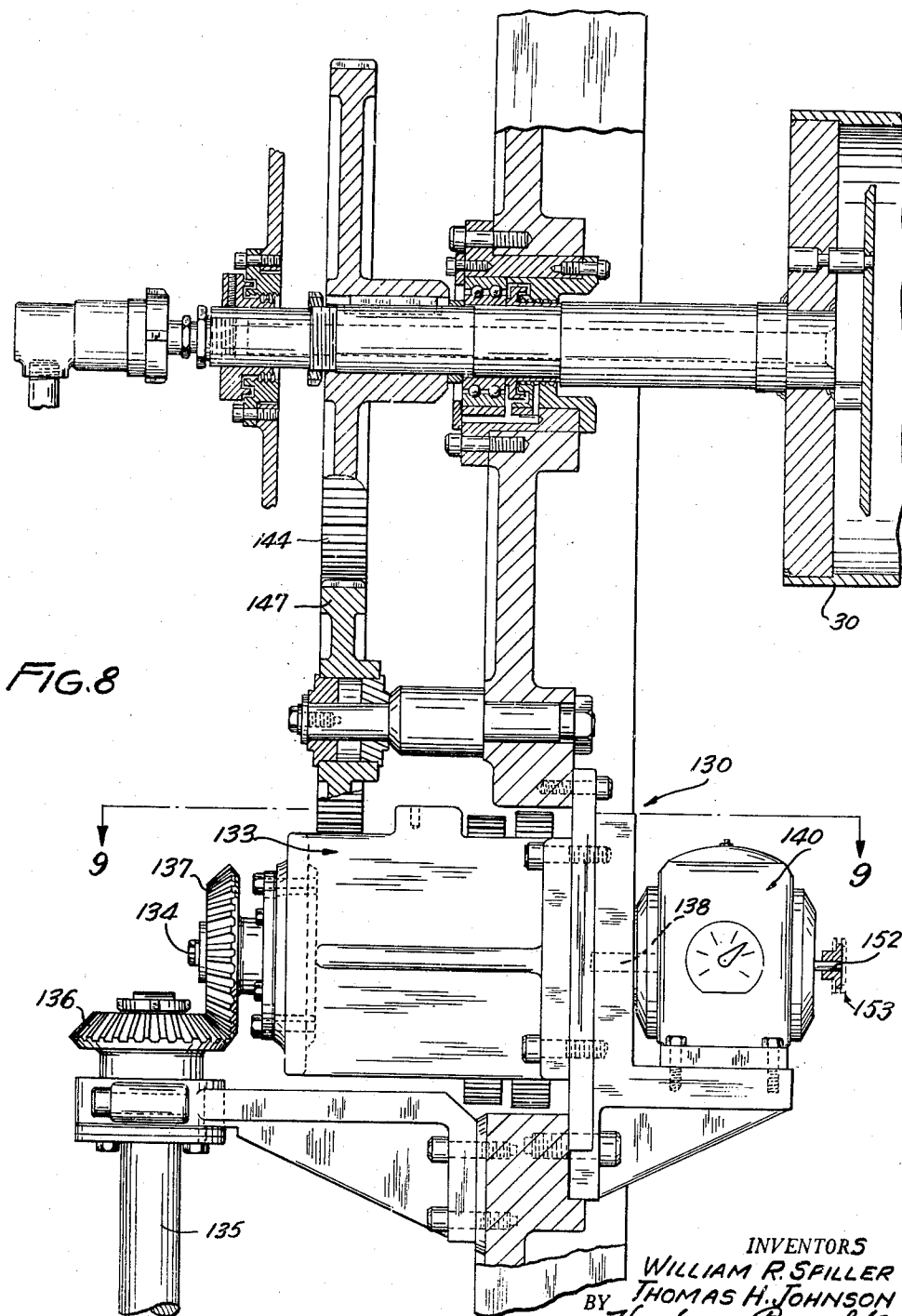
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7 Sheets-Sheet 6

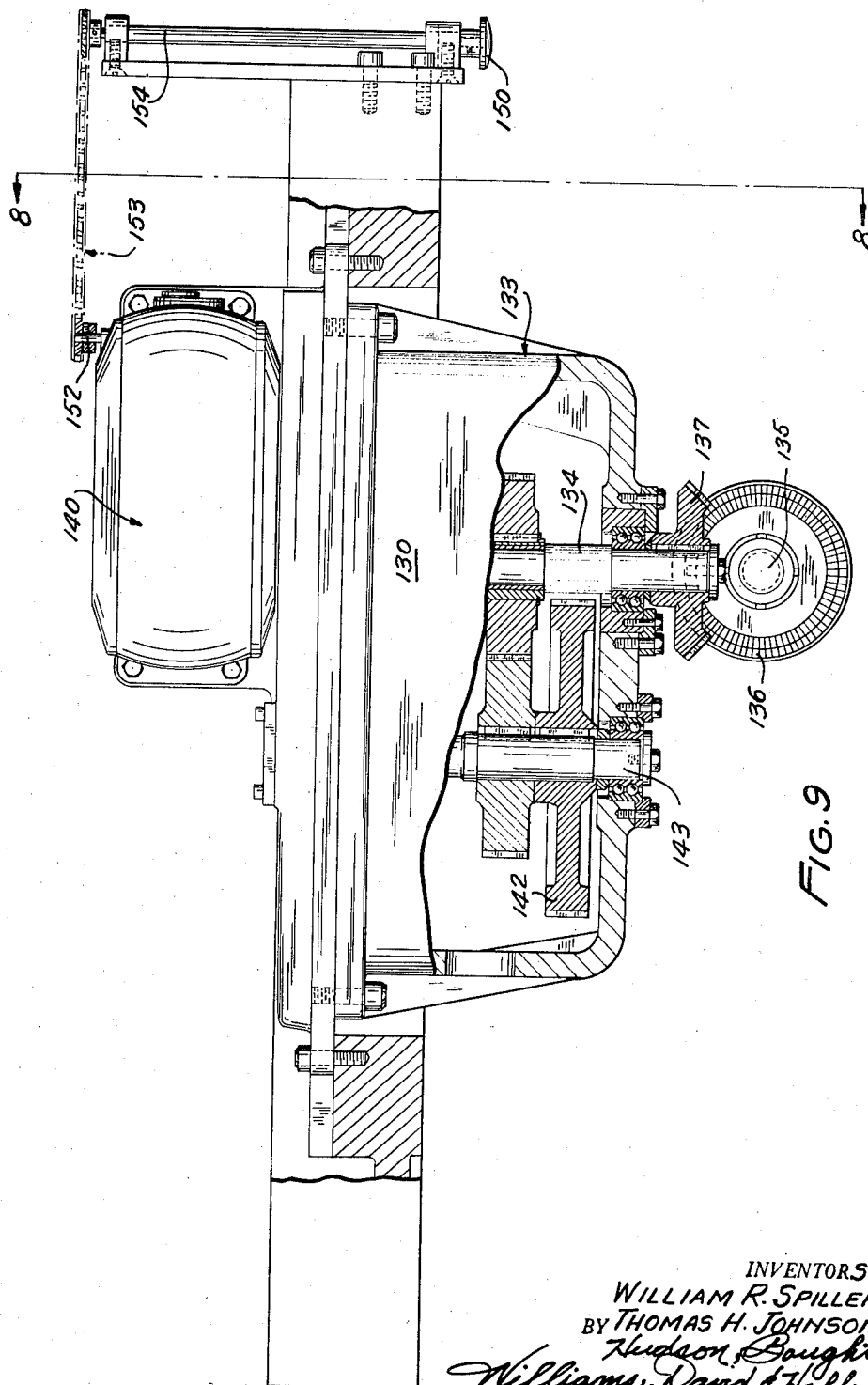


FIG. 9

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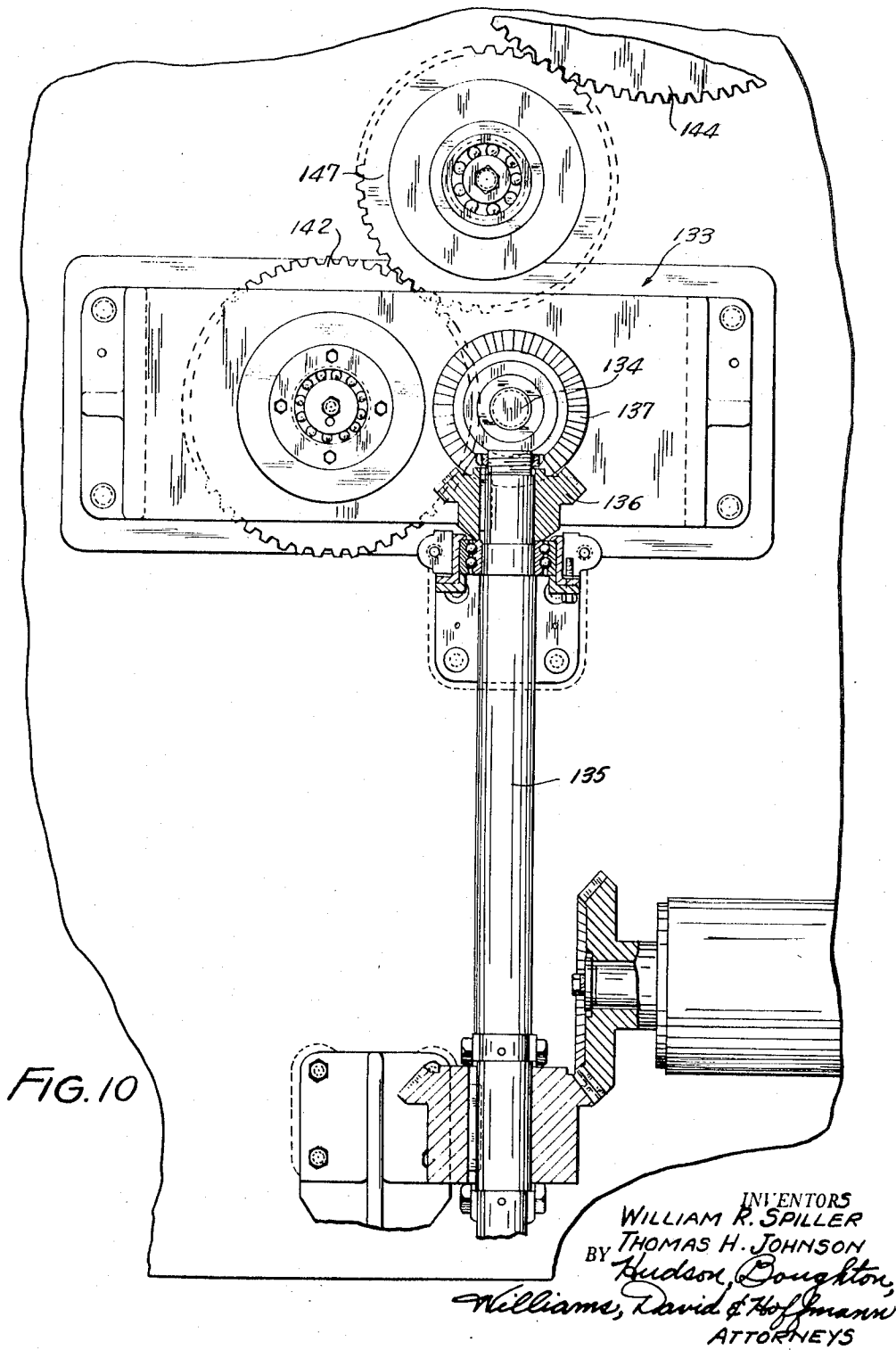
W. R. SPILLER ET AL

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WEB TENSION CONTROL FOR ROTARY PRINTING PRESS

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2,897,754

WEB TENSION CONTROL FOR ROTARY PRINTING PRESS

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Application March 21, 1957, Serial No. 647,641

12 Claims. (Cl. 101—180)

The present invention relates to printing presses and, more particularly, to web type printing presses having means for controlling the tension of the web being printed.

In offset color printing, the various colors are imprinted on paper or other material by passing a web of the material through a printing couple for each color to be printed. The web to be printed is fed from a supply roll through the successive printing couples and finally delivered to a sheeter, folder, wind-up roll, or other mechanism depending upon the desired final form of the material. The printing couples each exert a draw on the web passing therethrough and the supply roll for the web is driven so that the web is supplied at the speed required by the printing couples.

In order to obtain good registration of the printed colors, it is necessary that the tension in the web be maintained substantially constant. If the web tension varies, registration will be affected and poor registration results. To obtain constant tension, it is necessary to supply material to the printing couples from the supply roll at substantially the same speed that the web is being drawn by the couples.

Heretofore various tension control devices have been proposed and utilized. These devices have generally embodied a floating take-up or tensioning roll which is biased against the web and whose movements are utilized to actuate a brake or variable speed mechanism for controlling the speed of the supply roll to control the length of material between the supply roll and the first printing couple. These prior web tensioning mechanisms have not, however, controlled the web tension well enough to effect close registration of the colors.

It is, therefore, the principal object of the present invention to provide a new and improved printing press, and particularly a back-to-back perfecting press of the web type, in which the web tension is maintained substantially constant by an improved web tensioning mechanism, thus making it possible to obtain greatly improved registration of the printed colors.

It is another object of the present invention to provide a new and improved printing press having first and second printing units and web driving rolls positioned respectively between the printing units of the press and on the exit side of the second unit through which the web passes, which rolls are driven by infinitely variable speed transmissions to control web tension and wherein the supply roll for delivering web to the first printing unit is driven by an infinitely variable speed transmission actuated in response to movements of a take-up or tensioning roll for the web to maintain a generally constant length of material between the supply roll and the first printing couple.

Yet another object of the present invention is to provide in a printing press a positive, infinitely variable speed drive for rotating a supply roll for feeding web to a printing couple and in which the variable speed transmission is controlled in accordance with the movements

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of a tensioning or take-up roll which engages the web intermediate the first printing couple and the supply roll and in which the movements of the tensioning roll actuate a fluid pressure mechanism for operating a control member of the variable speed drive.

A further object of the present invention is the provision of an infinitely variable speed drive for driving the supply roll of a printing press in which the variable speed drive includes a differential unit having an output element connected to a driving member for engaging the peripheral surface of the supply roll to drive the latter and a first input element driven from the press drive and a second input element driven from the press drive through an infinitely variable speed transmission, preferably a positive variable speed transmission, having a control member movable to vary the relationship of the output speed to the input speed of the transmission and in which the control lever is actuated in response to movements of the take-up or tensioning roll for the web through a mechanism, preferably a fluid pressure actuated mechanism, to maintain the length of web between the supply roll and the first printing couple between predetermined limits.

A still further object of the present invention is to provide a printing press of the character set out above in which the web drive means intermediate the printing units and the web drive means on the exit side of the second printing unit each comprise a roll driven from the press drive through a variable speed transmission comprising a differential having an output element connected to the roll, a first input element driven by the press drive and a second input element driven by the output element of a positive, infinitely variable speed drive unit manually controllable to vary the speed relationship between its output and input shaft, and having its input shaft driven by the press drive.

The present invention also contemplates the provision of a new and improved printing press of the character described above having a web tensioning take-up roll which actuates a variable speed drive mechanism for driving the web supply roll through a fluid pressure actuated mechanism and which is biased into engagement with the web by means having low inertia and fast response and capable of providing a substantially constant biasing force.

Further objects and advantages of the present invention will be apparent from the following detailed description of the preferred embodiment made with reference to the accompanying drawings forming a part of this specification for all matter disclosed therein, whether or not expressly described, and in which:

Fig. 1 is a diagrammatic view of a back-to-back printing press embodying the present invention;

Fig. 2 is a fragmentary plan view taken approximately along line 2—2 of Fig. 1;

Fig. 3 is a side elevational view of the web feeding device of the press of Fig. 1;

Fig. 4 is a fragmentary elevational view of the web feeding device looking at the left-hand side of the device as the latter is viewed in Fig. 3;

Fig. 5 is a fragmentary view of the web feeding device taken approximately along line 5—5 of Fig. 3 with portions thereof cut away;

Fig. 6 is an enlarged fragmentary view of a portion of Fig. 5 with portions cut away;

Fig. 7 is a view looking at Fig. 6 from the line 7—7 in the direction of the arrows with portions cut away;

Fig. 8 is a vertical sectional view through an end column of the press of Fig. 1 showing the drive to the cooling drums at the right-hand end of the drier and taken approximately along line 8—8 of Fig. 9;

Fig. 9 is a sectional view taken approximately along line 9—9 of Fig. 8 with portions cut away; and

Fig. 10 is a view looking at the left-hand side of mechanism shown in Fig. 8.

While the present invention is susceptible of use in various machines where it is desirable to maintain a web being supplied to the machine from a web supply roll under substantially constant tension, the invention is herein embodied in a perfecting printing press for printing a plurality of colors on each side of the web and wherein quality printing is obtained only by maintaining proper web tension. The particular press illustrated is a back-to-back perfecting printing press comprised of two printing units in a line; one unit being adapted to print four colors on one side of the web, and the other unit being adapted to print four colors on the other side of the web.

Referring to the drawings, the printing press includes a first printing unit 11 having two parallel impression cylinders 12, 13 and a second printing unit 14 in line with the first unit and having two parallel impression cylinders 15, 16. Each of the impression cylinders 12, 13, 15, 16 cooperate with a blanket cylinder 17 disposed above the impression cylinder and a blanket cylinder 18 disposed below the impression cylinder to print a web passing therebetween. A cooperating plate cylinder 19 is provided for each blanket cylinder 17, 18. The plate cylinders 19, the blanket cylinders 17, 18 and the impression cylinders 12, 13, 15, 16 will not be described in detail since they may be of a conventional construction well known to those skilled in the art and since they do not, per se, form a part of this invention. The cylinders may be inked in any conventional manner.

The printing units 11, 14 operate upon a web 20 which is fed to the printing unit 11 from a feeding device 21 positioned adjacent the front side of the press as the latter is viewed in Fig. 1 so as to be laterally offset from the line of the press. The feeding device comprises a carrier 22 adapted to support three web supply rolls 23 with their axes horizontal and to move the rolls sequentially into position to be fed, one at a time, into the press. The axes of the supply rolls are parallel to the line of the press, i.e., perpendicular to the axes of the impression cylinders, and the web is fed from the supply roll in feeding position into the press along a path extending transversely of line of the press and parallel to the axes of the impression cylinders so that width of the web is parallel to the press line, as is best shown in Figs. 1 and 2. The web 20 enters the press at a point above the impression cylinder 12 of the first printing unit and is turned by an angle, or turning, bar 25 disposed above the cylinder 12 so that the width of the web traveling through the press extends parallel to the axes of the impression cylinders. The web is then guided by a plurality of rolls 26 from the angle bar 25 to the impression cylinder 12 and passes between the impression cylinder and its cooperating upper blanket cylinder 17. From the impression cylinder 12 the web travels to the impression cylinder 13 and first passes between the upper blanket cylinder 17 cooperating therewith, then wraps around the cylinder 13 and then passes between the impression cylinder and the lower blanket cylinder 18 cooperating therewith. From the impression cylinder 13 and lower blanket cylinder 18 the web returns to the impression cylinder 12, passes between the impression cylinder 12 and the cooperating lower blanket cylinder 18 and exits from the first printing unit. From the first printing unit the web is guided by rolls to and through the lower pass of an oven drier 27 positioned adjacent the top side of the press. As the press is viewed in Fig. 1, the web passes through the drier from left to right and exits from the right-hand end of the drier and passes around three cooling rolls 28, 29, 30. The three cooling drums 28, 29, 30 are preferably arranged so that the web wraps at least 180° of the periphery of each of the drums and after passing over the drums 28-30 the web is led into the second printing unit 14 and passes between the printing couple thereof in the following order: The impression cylinder 15 and the cooperating blanket cylinder

17; the impression cylinder 16 and the cooperating blanket cylinder 17; the impression cylinder 16 and the cooperating blanket cylinder 18; and, finally, the impression cylinder 15 and the cooperating blanket cylinder 18. The web then exits from the second printing unit at the right-hand end thereof, which is the end remote from the first printing unit, as viewed in Fig. 1, and is guided by rolls through an upper pass of the drier unit 27 and exits from the left-hand end thereof as viewed in Fig. 1. Upon exiting from the left-hand end of the drier unit 27, which is the end adjacent the first printing unit, the web 20 passes around and is driven by three cooling drums 28', 29', 30' arranged in the manner of the cooling drums 28, 29, 30. From the cooling drums 28'-30' the web is led over a series of rolls including driven rolls 32, 33 each having trolley rolls 34 cooperating with the upper periphery thereof. From the roll 33 the web passes into a sheeting mechanism 35 including severing rolls 36.

The impression cylinders 12, 13, 15, 16 are driven from a main press drive shaft 40 which, in turn, is driven by a pair of synchronous motors 41. The water cooled drums 28-30 and 28'-30' are driven from the press drive shaft through suitable variable speed mechanism to be described and certain of the rolls in the drier are also driven by a shaft 43 geared to the main drive shaft. The rolls 32, 33 are also driven from the main drive shaft by gearing not shown in the drawings, since it is not necessary for an understanding of the present invention.

When the press is operating, the action of the impression cylinders and the driven rolls or drums of the press is such as to tend to draw the web through the press at a certain speed. In the illustrated machine, the web supply roll is driven to supply the web to the press at a speed necessary to enable a constant tension to be maintained in the web. In addition to controlling the speed with which the web is fed into the press, the speeds of the water cooled drums 28-30 and 28'-30' are manually variable to respectively control the web tension at the exit side of the first printing unit and at the exit side of the second printing unit.

The feeding device 21 comprises a frame 45 including spaced side members 46 which stand on the floor and which support a shaft 47 upon which the carrier 22 is mounted. The carrier 22 includes spaced spiders 48 each formed with three radially extending arms 50. The web supply rolls are supported between corresponding radial arms of the spiders 48 and the latter are rotatable to move the rolls individually into engagement with a plurality of driving belts 52. The driving belts 52 engage the peripheral surface of the web supply roll to be fed and drive the roll to supply the web to the printing units. The web is fed from the supply roll which is being driven by the belts 52 upwardly over a plurality of rollers rotatably supported by the frame 45 including rollers 53, 54 disposed respectively below and above a floating take-up or tensioning roller 55. The rollers 53, 54 together with the floating, tensioning roller 55 are disposed so that the web forms a loop, a horizontally extending loop in the illustrated machine, with the bight of the loop being formed around the tensioning roller 55. The web 20 is guided from the roller 54 upwardly over rollers 56 to the turning bar 25 disposed above the printing unit 11. The rollers 54, 55, 56 are supported by the spaced frame members 57 extending upwardly from the side members 46 and connected to the press frame at their upper ends.

The tensioning roller 55 is rotatably mounted on a shaft 58 supported at its opposite ends by arms 60 of a rocker shaft 62. The shaft 62 is rockably supported between the frame members 57 above the tensioning roller 55 and the arms 60 extend downwardly from the shaft 62 to support the tensioning roller 55. A crank arm 63 is provided adjacent each end of the shaft 62 and the tensioning roller 55 is biased against the web 20 to apply a constant force thereto by a pair of

air cylinders 64 having their pistons connected to the crank arms 63. The cylinders 64 are supported by the frame members 57 adjacent the opposite ends of the shaft 62.

The air pressure in the cylinders 64 operate through the tensioning or take-up roller 55 to maintain a constant tension between the web supply roll and the first printing unit. If the first printing unit is drawing the web 20 faster than it is being supplied from the web supply roll, the loop about the tensioning roller 55 will shorten and the roller will move to the left, as the latter is viewed in Fig. 3. If the web is being supplied faster than it is being drawn into the first printing unit, the loop about the tensioning roller 55 lengthens and the roller will move to the right, as viewed in Fig. 3. The tension of the web 20 will remain constant as long as the take-up roller 55 has not reached its limit of movement in the direction of change.

The movements of the tensioning roller 55 are utilized to control the driving mechanism for the belts 52. The details of supporting the belts 52 and the manner in which they operate to drive the web roll are conventional and, therefore, will not be described in detail. The drive to the belts, however, will be fully described where it is necessary for an understanding of, or forms part of the present invention. Suffice it to say that the belts 52 pass around corresponding drive pulleys 65 fixed to a shaft 66 rotatably supported by the frame 45 and driven by a belt drive 67 from the output of a differential unit 68. The belt drive 67 comprises a drive pulley 70 fixed to one end of the shaft 66, a drive belt 71, and a pulley 72 fixed to an output shaft 73 of the differential unit 68 so as to be driven thereby.

The belts 52, in addition to the drive pulleys 65, also pass around a plurality of guide pulleys 74 disposed to cause the outer side of the belts 52 to engage a web supply roll supported by the carrier 22 and around take-up pulleys 75. The take-up pulleys 75 are supported at the outer ends of piston rods 76 of air cylinders 77 which function to take up the slack in the belts to maintain a tension therein as the diameter of the web supply roll diminishes.

In accordance with the present invention, the belt drive 67 is driven at a speed which varies in accordance with the movement of the tensioning roller 55. To this end the output speed of the differential unit 68 is determined by the relative speed of two input elements of the differential unit. One of the input elements of the differential unit 68 comprises a shaft 80 journaledly supported by the casing of the differential unit and driven from the main drive shaft 40 of the press through a belt drive 81. The shaft 80 extends transversely of the differential unit and has an end thereof extending outwardly of one side of the casing and on which a pulley 82 is fixed. The pulley 82 is the output pulley of the belt drive 81.

Adjacent the other end of the shaft 80 and within the casing of the differential unit 68, a gear 84 is keyed to the shaft 80 for rotation therewith. The gear 84 meshes with a plurality of pinion gears 85 keyed to corresponding shafts 86 extending parallel to the shaft 80. The shafts 86 are rotatably supported by a cage 87 which is, in turn, supported for rotation about the shaft 80 and with respect to the gear 84 by ball bearings 88. Each of the shafts 86 has, in addition to one of the gears 85, a gear 90 keyed thereto for rotation therewith. The gears 90 mesh with a gear 91 formed on a sleeve 92 supported coaxially with the shaft 80 and freely rotatable with respect thereto. The sleeve 91 also has a gear 93 keyed thereto which meshes with a gear 94 keyed to the output shaft 73 of the differential unit. The second input element of the differential unit is driven from the shaft 80 by an infinitely variable speed transmission 102 having an input shaft 103 connected to the end of the shaft 80 opposite the pulley 82 so as to be driven thereby and an output shaft 104 which drives the gear 96 75

on the cage through a pinion gear 105 fixed on the shaft 104 and in mesh with the gear 96. Input and output shafts 103, 104 are parallel shafts and the drive between the shafts is, in the illustrated embodiment, a positive drive with ratio of the input shaft speed to the output shaft speed being infinitely variable within the range of variation. The particular type of mechanism for interconnecting the shafts 103, 104 does not, per se, constitute a part of the present invention and any suitable drive meeting the requirements set for it may be utilized. The particular drive shown is a drive manufactured by The Link Belt Company and sold under the trade name, "P.I.V." As is best shown in Fig. 6, the illustrated drive between the shafts 103, 104 includes a variable diameter sheave 106 on each shaft 103, 104 and a chain belt 107 for driving one from the other. The chain has lugs or fingers 108 which are received in radial slots 109 in the inner sides of the sheaves. Each sheave 106 is formed by two cone members 110 engaged by the fingers 108 and movable toward and away from each other to vary the effective diameter of the sheave. The inner sides of the members 110 are cone shaped to provide the variable diameter effect upon relative axial movement of the members. The cone members are shifted to vary the diameter of the sheaves formed thereby by means of levers 111 disposed respectively on the opposite sides of the sheaves and pivotally supported intermediate the shafts 103, 104. The cone members 110 on the shaft 103 are respectively secured to one end of one of the levers 111 while the cone members on the shaft 104 are secured to the levers at points on the side of the pivots therefor remote from the ends of the levers to which the cone members on the shaft 103 are connected. The sheaves 106 are, therefore, adjusted in opposite directions upon movement of the levers 111 about their pivots. The other ends of the levers 111 are connected to an operating mechanism including a control arm 113 which extends outwardly of the casing of the variable speed transmission 102 to provide a rotatable adjustment for controlling the speed ratio of the output shaft 104 to the input shaft 103. When the control member 113 is rotated in one direction, the speed ratio is increased and when rotated in the other direction, the speed ratio is decreased.

The control member 113 is actuated to vary the output obtained of the variable speed mechanism by a double-acting fluid pressure motor 115. The fluid pressure motor includes a piston rod 116 connected to an arm 117 extending radially outwardly from the control member 113 by a link 118. The motor 115 has fluid pressure conduits 120, 121 connected thereto for supplying fluid pressure to one side of the motor and connecting the other side to drain to actuate the motor. The connection of the conduits 120, 121 to drain, or fluid pressure supply, is controlled by a servo valve 122 having a movable valve element operated by movement of a control lever 123 and a follow-up lever 124. The valve 122 is a conventional valve and will, therefore, not be described in detail. Suffice it to say that the valve is of the type which is in a position blocking the conduits 120, 121 when the movable valve element is in a neutral position and wherein fluid pressure is supplied to one side of the motor if the valve element is displaced in one direction and to the other side of the motor if displaced in the opposite direction. The control lever 123 is initially moved to displace the valve element. The follow-up lever 124 is connected to a crank arm on the control member 113 of the variable speed transmission by a rod 125, and, when the fluid pressure motor 115 is actuated in response to movement of the control lever 123, causes the follow-up element 124 to move in a direction to return the valve element to its predetermined position in which the valve is closed. In the particular servo valve shown in the drawings, the control levers are connected to a rotatable valve member through differential gearing where the movement im-

parted to the valve member is the differential of the movement of the control lever and the follow-up lever. A further description of the operation of the variable speed transmission 102, the fluid pressure motor 115, and the servo valve 122 is not deemed necessary inasmuch as the transmission 102, motor 115, and valve 122 are available commercially as a unit.

The control lever 123 of the servo valve 122 is connected to one of the cranks 63 on the rocker shaft 62 by a cable 129. Movement of the roller 55 is transmitted through the cable 129 to the control lever 123. If the speed of the belts 52 is too slow, the tension roller 55 will move to the left causing the control lever 123 to shift in a direction to supply fluid pressure to the motor 115 to operate the latter in the direction necessary to change the speed of the variable speed transmission in the direction to increase the speed of the output shaft 73 of the differential unit. If the speed of the web supply roll is too fast, the tensioning roll 55 will move in the opposite direction to cause the output shaft of the differential unit 68 to slow down. In the illustrated embodiment, the output of the positive, infinitely variable speed transmission is superimposed on the differential unit as an overriding component to provide an overriding speed transmission variable a given amount in either direction from a center speed.

In order to provide a tensioning roller which is fast in its response to changes in web tension and whose weight is a negligible factor, the tensioning roller is preferably counterbalanced by a bar 128 disposed on the opposite side of the shaft 62 to the tensioning roller 55 and secured to the shaft by support arms 129. If the tensioning roller is light enough, the counterbalance need not be provided.

Preferably, the full range of control of the variable speed transmission 102 effects, with a constant speed input to shaft 80 of the differential unit, a change of speed of the order of plus or minus 3% from a center speed at the output shaft 73 of the differential unit. The point of connection of the cable to the crank arm 63 is such that the distance the cable is moved by operation of the tensioning roller 55 through its full range of movement corresponds to the full range of movement of the control lever 123 of the valve 122. It can be seen, therefore, that preferably the full range of movement of the tensioning roller 55 will only effect a 6% maximum change in the speed of the driven belts 52, and, in turn, the speed at which the web is being supplied to the first printing unit. Such an arrangement provides an extremely fine control. It has been found that such fine control enables the tensioning roller to control the speed of the supply roll in a manner to maintain the web tension substantially constant.

After the press has been threaded, the tensioning roller will have a position corresponding to each position of the control member 113 which, in turn, corresponds to a given belt speed relative to press speed. The tensioning roller 55 will, therefore, tend to seek a certain position during operation of the machine wherein the belts 52 are operated at the speed necessary to supply the web at the proper rate.

While the tensioning roller 55 operates through the control mechanism actuated thereby to maintain an approximately constant length of web between the web supply roll and the first printing unit for a given web tension, the present invention also contemplates the provision of variable speed means for adjusting the rate of web feed to the second printing unit and the rate of web feed to the sheeter at the exit end of the second printing unit. To this end the water cooled drums 28-30 are driven by a variable speed mechanism 130 while the water cooled drums 28'-30' are driven by a variable speed mechanism 130'. The variable speed mechanisms 130, 130' may be of the same construction and, therefore, only the variable speed mechanism 130 will be described.

The variable speed mechanism 130 comprises a differential unit 133 having a first input comprising an input shaft 134 driven from the press drive by a vertical shaft 135 having a bevel gear 136 at its upper end which meshes with a bevel gear 137 fixed to the one end of the input shaft 134. The second input element of the differential unit 133 is driven from the output shaft of an infinitely variable speed transmission 140 whose input shaft is driven from the input shaft 134 of the differential unit 133. The differential unit 133 and the variable speed transmission 140 are of the same construction and operate in the same manner as the differential unit 68 and the variable speed transmission 102 with the exception that the variable speed unit 140 is manually controlled, and that the output element of the differential unit is a gear 142 secured to the output shaft 143 of the differential unit. The output shaft 143 corresponds to the shaft 73 of the differential unit 68. The output gear 142 is positioned within the casing of the differential unit, the latter being cut out to allow the output gear 142 to mesh with a gear 147 supported above the differential unit 133 and in mesh with a gear 144 fixed to one end of the drum 30. The gear 144 meshes with a gear 145 on the drum 29 which, in turn, meshes with a gear 146 on the drum 28. The speed at which the drums 28-30 are driven may be varied, in the illustrated embodiment, by operating a remote control member 150 for the variable speed transmission 140. In the embodiment shown, the control member 150 is fixed to one end of a shaft 151 connected to a control shaft 152 of the variable speed transmission 140 by a chain and sprocket drive 153. The control shaft 152 corresponds to the control member 113 of the transmission 102 and determines the ratio of the output speed to the input speed of transmission 140. By adjusting the remote control member 150, the speed of the water cooled drums 28-30 will be controlled to control the tension of the web being drawn into the second printing unit. It will be noted that the speed of the web supply roll of the feeding device does not control web tension as long as the tensioning roller 55 is operating between its limits of movement but in the case of the water cooled rolls, the speed of the rolls will determine the web tension between the rolls of the two printing units since no take-up or tensioning roller is provided. By the same token, the speed of the water cooled drums 28'-30' will determine the tension of the web being fed to the sheeter since the rolls 32, 33, and 34 draw the web to the sheeter at a certain speed and the tension between the rolls 32, 33, and 34 and the water cooled drums 28'-30' is determined by the rate at which the water cooled drums feed the web to the rolls 32, 33.

While a plurality of cooling drums have been driven in the illustrated machine through variable speed mechanisms so that the web tension to the second printing unit and to the sheeter may be controlled, it will be understood that drums need not necessarily be water cooled nor is it necessary to utilize three drums at each point.

The feeding device 21 has been illustrated as of the type capable of supporting three web supply rolls and sequentially bringing the web supply rolls into engagement with the belts 52 to maintain a constant feed to the press. The feeding mechanism 21 is preferably provided with a conventional web-pasting and cut-off mechanism 160 and a mechanism 161 for bringing a web supply roll up to speed before it is pasted to the web. The mechanisms 160, 161 will not be described in detail but suffice it to say that as the web roll from which the web is being supplied diminishes in diameter, the carrier 22 is rotated to bring the following web supply roll into engagement with the belts 52 and, prior to the engagement of the belt 52 therewith, the web supply roll 23 to be connected to the web is brought up to speed by the mechanism 161. When the connection is to be made, the pasteur and cut-off mechanism 160 brushes the web

against the roll to be connected to make a connection therewith and severs the web from the roll being exhausted.

In addition to the advantages set out above, the disclosed web tensioning mechanism includes the further advantage that the speed of the web supply roll closely follows the speed of the press through changes of press speed and it is not necessary to provide a special brake or other devices to prevent overrunning of the supply roll when the press is stopped quickly. The normal brake mechanism for the press cylinders and the press drive will furnish the necessary braking power through the drive for the web supply roll.

It can now be seen that the present invention provides a web type printing press capable of quality printing not heretofore possible with web presses of the prior art and in which the web tension is controlled in such a manner as to assure greatly improved registration of the colors.

While the present invention has been described in considerable detail, it is understood that the invention is not limited to the construction shown and that further modifications, constructions and arrangements may be made by those skilled in the art and it is hereby my intention to cover all such constructions, modifications and arrangements which fall within the scope of the appended claims.

Having thus described our invention, we claim:

1. In a web type printing press including press drive means, a device for feeding the web from a rotatably supported web roll to the printing cylinders of the press comprising a driving member engageable with the outer peripheral surface of the web roll to rotate the latter at the speed of the driving member, a floating roller, means connected to said floating roller and continuously urging the latter into engagement with the web with a constant force to tension the web, a differential gearing unit having an output member connected to said driving member to drive the latter and first and second input elements, the output member being driven at a speed dependent on the directions and speeds of rotations of said input elements, means for driving said first input element in timed relationship to the press drive means, an infinitely variable speed transmission having an output element and an input element and a control member for adjusting the ratio of the speed of the output element to the speed of the input element, means driving the input element of said transmission in timed relationship to the press drive means, means connecting the output element of said variable speed transmission to said second input element of the differential, and means connected to said control member and responsive in a continuous manner to the movements of said floating roller to vary the speed of said output element continuously in accordance with the movements of said floating roller and in a direction to oppose the movement of the floating roller.

2. In a web type printing press including press drive means, a device for feeding the web from a rotatable web roll to the printing cylinders of press comprising a floating roller, roll means guiding the web to form a loop around the floating roller with the floating roller engaging the bight of the loop, means connected to said floating roller and continuously urging the latter into engagement with the web with a substantially constant force to tension the web, means for driving the web roll comprising a differential gearing unit having an output member connected to drive said web roll means and first and second input elements, the output member being driven at a speed dependent on the directions and speeds of rotations of said input elements, means for driving said first input element in timed relationship to the press drive means, an infinitely variable speed transmission having an output element and an input element and a control member for adjusting the ratio of the speed of the output element to the speed of the input element thereof, means connected

to the input element of said transmission for driving the same in timed relation to the press drive means, means connecting the output element of said variable speed transmission to the second input element of the differential, and fluid pressure control means connected to said control member and responsive in a continuous manner to the movements of said floating roller to vary the speed of said output element continuously in accordance with the movements of said floating roller and in a direction to oppose movement of the floating roller.

3. In a web type printing press including press drive means, a device for feeding the web from a rotatable web roll to the printing cylinders of the press comprising a driving member engageable with the outer peripheral surface of the web roll to rotate the latter at the speed of the driving member, a floating roller, roll means guiding the web to form a loop around the floating roller with the floating roller engaging the bight of the loop, fluid pressure actuated biasing means connected to said floating roller and continuously urging the latter into engagement with the web with a substantially constant force to tension the web, a differential gearing unit having an output member connected to said driving member to drive the latter and first and second input elements, the output member being driven at a speed dependent on the directions and speeds of rotations of said input elements, means for driving said first input element in timed relationship to the press drive means, a positive infinitely variable speed transmission having an output element and an input element and a control member for adjusting the ratio of the speed of the output element to the speed of the input element, means for driving the input element of said transmission in timed relation to the press drive means, means connecting the output element of said variable speed transmission to said second input element, and control means connected to said control member and responsive in a continuous manner to the movements of said floating roller to vary the speed of said output element continuously in accordance with the movements of said floating roller and in a direction to oppose the movement of the floating roller.

4. In a web type printing press including press drive means, a device for feeding the web from a rotatable web roll to the printing cylinders of the press comprising a driving member engageable with the outer peripheral surface of web roll to rotate the latter at the speed of the driving member, a floating roller, roll means guiding the web to form a loop around the floating roller with the floating roller engaging the bight of the loop, fluid pressure actuated means connected to said floating roller and continuously urging the latter into engagement with the web with a constant force to tension the web, a differential gearing unit having an output member connected to said driving member to drive the latter and first and second input elements, the output member being driven at a speed dependent on the directions and speeds of rotations of said input elements, means for driving said first input element in timed relationship to the press drive means, an infinitely variable speed transmission having an output element and an input element and a control member for adjusting the ratio of the speed of the output element to the speed of the input element, means for connecting said first input element of said differential gearing unit in driving relationship with said input element of said transmission, means connecting the output element of said variable speed transmission to said second input element, and fluid pressure control means connected to said control member and responsive in a continuous manner to the movements of said floating roller to vary the speed of said output element continuously in accordance with the movements of said floating roller and in a direction to oppose the movement of the floating roller.

5. In a web type printing press including press drive means, a device for feeding the web from a rotatable web

roll to the printing cylinders of the press comprising a driving member engageable with the outer peripheral surface of web roll to rotate the latter at the speed of the driving member, a floating roller, roll means guiding the web to form a loop around the floating roller with the floating roller engaging the bight of the loop, means connected to said floating roller and continuously urging the latter into engagement with the web with a substantially constant force to tension the web, a differential gearing unit having an output member drivingly connected to said driving member and first and second input elements, the output member being driven at a speed dependent on the directions and speeds of rotations of said input elements, means for driving said first input element in timed relationship to the operation of the press drive means, an infinitely variable speed transmission having an output element and an input element and a control member for adjusting the ratio of the speed of the output element to the speed of the input element thereof, means for driving said input element of said transmission, means connecting the output element of said variable speed transmission to said second input element, and fluid pressure control means responsive in a continuous manner to the movements of said floating roller to vary the speed of said output element continuously in accordance with the movements of said floating roller and in a direction to oppose the movement of the floating roller comprising a double acting fluid pressure motor operatively connected to said control member and a servo valve for controlling the connection of said fluid pressure motor to a source of fluid pressure and to drain, said servo valve including a control element connected to said floating roller and a follow-up element connected to said control member.

6. In a web type printing press including press drive means, a device for feeding the web from a rotatable web roll to the printing cylinders of the press comprising a driving member engageable with the outer peripheral surface of web roll to rotate the latter at the speed of the driving member, a floating roller, roll means guiding the web to form a loop around the floating roller with the floating roller engaging the bight of the loop, fluid pressure actuated means connected to said floating roller and continuously urging the latter into engagement with the web with a constant force to tension the web, a differential gearing unit having an output member drivingly connected to said driving member and first and second input elements, the output member being driven at a speed dependent on the directions and speeds of rotations of said input elements, means for driving said first input element in timed relationship to the operation of the press drive means, an infinitely variable speed transmission having an output element and an input element and a control member for adjusting the ratio of the speed of the output element to the speed of the input element thereof, means for driving said input element of said transmission from the first input element of said differential unit, means connecting the output element of said variable speed transmission to said second input element, and fluid pressure control means responsive in a continuous manner to the movements of said floating roller to vary the speed of said output element continuously in accordance with the movements of said floating roller and in a direction to oppose the movement of the floating roller comprising a double acting fluid pressure motor operatively connected to said control member and a servo valve for controlling the connection of said fluid pressure motor to a source of fluid pressure and to drain, said servo valve including a control element connected to said floating roller and a follow-up element connected to said control member.

7. In a web printing press having at least one printing unit, web driving means on the exit side of said printing unit, delivery means to which the web is fed from said unit and with which it is to be precisely registered,

said web being driven by said driving means at a predetermined speed sufficient to maintain a constant tension in the web between the printing unit and the delivery means, a feeding mechanism including means for rotatably supporting a web supply roll and roll driving means engageable with the outer peripheral surface of the supply roll for rotating the same to feed the web to said printing unit, motor means for driving said printing unit and delivery means, an infinitely variable speed drive connecting said web driving means to the motor means, a second infinitely variable speed drive for driving said roll driving means and including a control member to vary the relationship of the output speed to the input speed of the second variable speed drive, a floating tension control roller engaging the web intermediate said feeding device and the printing unit, and means responsive in a continuous manner to the movement of said floating roller for actuating said control member to control the rate of feed from the supply roll to the printing unit, said infinitely variable speed drives each comprising a differential gearing unit having a first input element driven from said motor means and a second input element and an output member connected to the driving means driven by the drive and an infinitely variable speed transmission having an input element driven in timed relationship to the input element of said gearing unit and an output element connected to drive said second input element.

8. In a printing press having first and second printing units, first and second web driving means on the exit sides of said first and second printing units respectively, the portions of said web at said web driving means being driven at a speed determined by the speed of the web driving means, a feeding mechanism including means for rotatably supporting a web supply roll and a driving member engageable with the outer peripheral surface of the supply roll for rotating the same to feed the web to said first printing unit, motor means for driving said printing units, first and second infinitely variable speed drive means respectively connecting said first and second web driving means to said motor means, third infinitely variable speed drive means for driving said driving member and including a control member movable to vary the relationship of the output speed and the input speed of the third infinitely variable drive means, a floating tension control roller disposed to engage the web intermediate said feeding device and the first printing unit, and fluid pressure actuated means responsive in a continuous manner to the movement of said floating tension control roller for actuating said control member to control the rate of feed from the supply roll and the length of web between the supply roll and the first printing unit.

9. In a printing press having first and second printing units, first and second web driving means on the exit sides of said first and second printing units respectively, the portions of said web at each of said web driving means being driven at a speed determined by the speed of the respective web driving means, a feeding mechanism including means for rotatably supporting a web supply roll and a driving member engageable with the outer peripheral surface of the supply roll for rotating the same to feed the web to said first printing unit, motor means for driving said printing units, first and second infinitely variable speed drive means respectively connecting said first and second web driving means to said motor means, third infinitely variable speed drive means for driving said driving member and including a control member movable to vary the relationship of the output speed to the input speed of the third variable speed drive means, a floating tension control roller engaging the web intermediate said feeding device and the first printing unit, and fluid pressure actuated means responsive in a continuous manner to movement of said floating tension control roller for actuating said control member to control the rate of feed from the supply roll and the length of web between

the supply roll and the first printing unit and comprising a double acting fluid pressure motor connected to said control member, a valve for controlling the flow of pressure fluid to said motor, and a follow-up connection actuated in response to movement of said control member to move said valve toward a closed position.

10. In a printing press having first and second printing units, first and second web driving means on the exit sides of said first and second printing units respectively, the portions of said web at said web driving means being driven at a speed determined by the speed of the adjacent web driving means, a feeding mechanism including means for rotatably supporting a web supply roll and a driving member engageable with the outer peripheral surface of the supply roll for rotating the same to feed the web to said first printing unit, motor means for driving said printing units, first and second positive infinitely variable speed drive means driven by said motor means and having output members respectively connected to drive said first and second web driving means and settable to a preselected speed, third positive, infinitely variable speed drive means driven by said motor means and having an output member connected to drive said driving member and including a control member movable to vary the relationship of the output speed to the input speed of the third variable speed drive means, a floating tension control roller engaging the web intermediate said feeding device and the first printing unit, and means responsive in a continuous manner to movement of said floating tension control roller for actuating said control member to control the rate of feed from the supply roll and the length of web between the supply roll and the first printing unit, said infinitely variable speed drive means each comprising a differential gearing unit having a first input element driven from said motor means and a second input element and a positive infinitely variable speed transmission having an input element driven in timed relationship to the first input element of said gearing unit and an output element connected to drive the second input element.

11. In a printing press having first and second printing units, first and second web driving means on the exit sides of said first and second printing units respectively, the portions of said web at said web driving means being driven at a speed determined by the speed of the adjacent web driving means, a feeding mechanism including

means for rotatably supporting a web supply roll and a driving member engageable with the outer peripheral surface of the supply roll for rotating the same to feed the web to said first printing unit, motor means for driving said printing units, first and second positive, infinitely variable speed drive means respectively connecting said first and second web driving means to said motor means, third positive, infinitely variable speed drive means for driving said driving member and including a control member movable to vary the relationship of the output speed to the input speed of the third variable speed drive means, a floating tension control roller engaging the web intermediate said feeding device and the first printing unit, and fluid pressure actuated means responsive to movement of said floating tension control roller for actuating said control member to control the rate of feed from the supply roll and the length of web between the supply roll and the first printing unit and comprising a double acting fluid pressure motor connected to said control member, a valve for controlling the flow of pressure fluid to said motor, means interconnecting said valve and said floating roller to operate said valve in accordance with the movements of said roller to supply pressure fluid to said motor, and a follow-up connection actuated in response to movement of said control member to move said valve toward a closed position, said positive, infinitely variable speed drive means each comprising a differential gearing unit having a first input element driven from said motor means and a second input element and an output member, and a positive, infinitely variable speed transmission having an input element driven from said first input element of said gearing unit and an output element connected to drive said second input element.

12. In a press or similar machine as defined in claim 11 wherein said feeding mechanism includes means for supporting a plurality of web supply rolls to be fed one at a time to the press and means for connecting the next supply roll to the web from the supply roll being exhausted.

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