Jan. 31, 1956 C. D. NITCHIE 2,733,018

WEB WINDER

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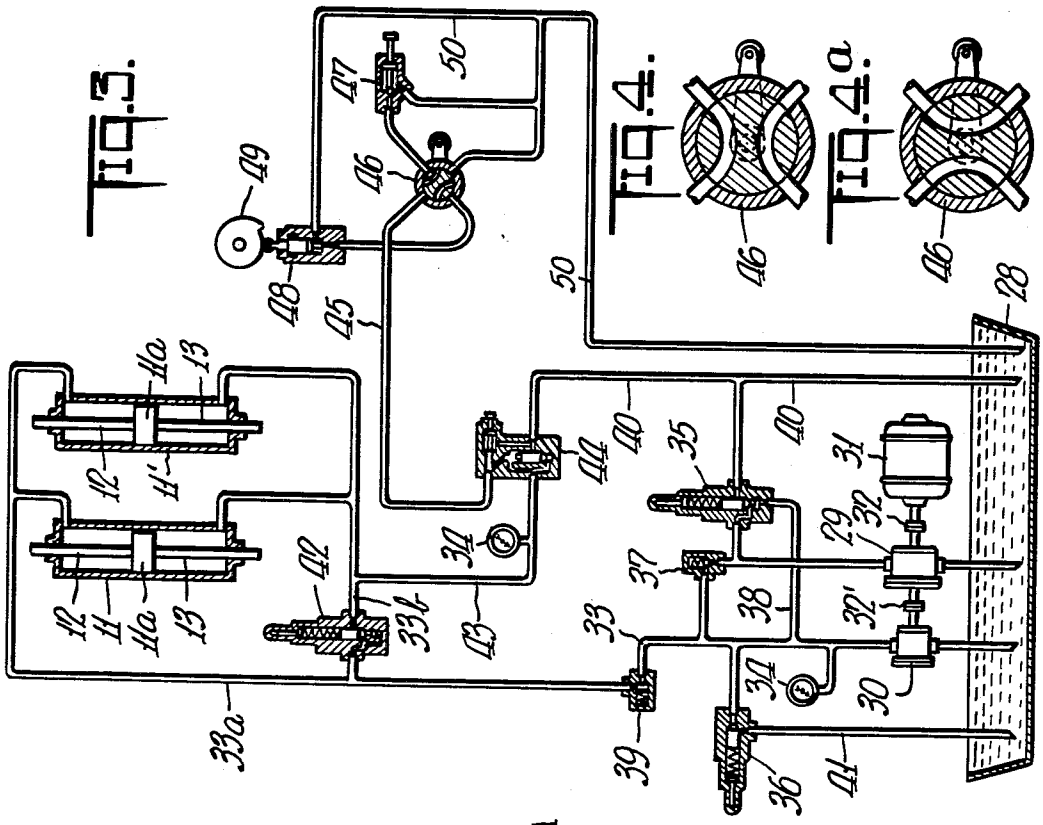

Fig. 3.

Fig. 4.

Fig. 4a.

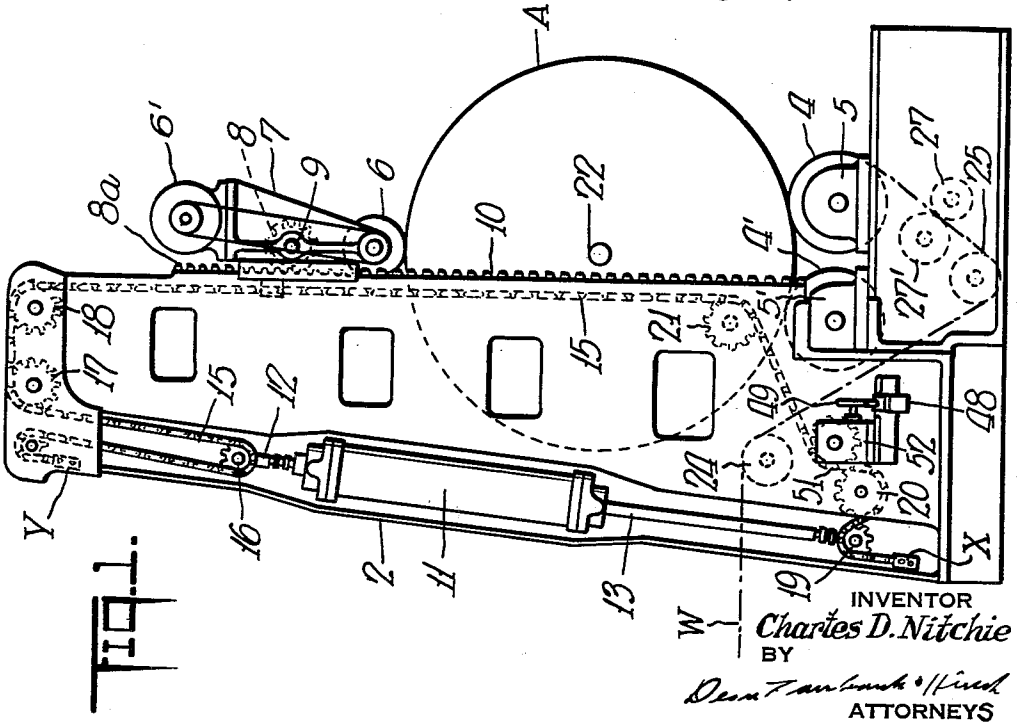

Fig. 1.

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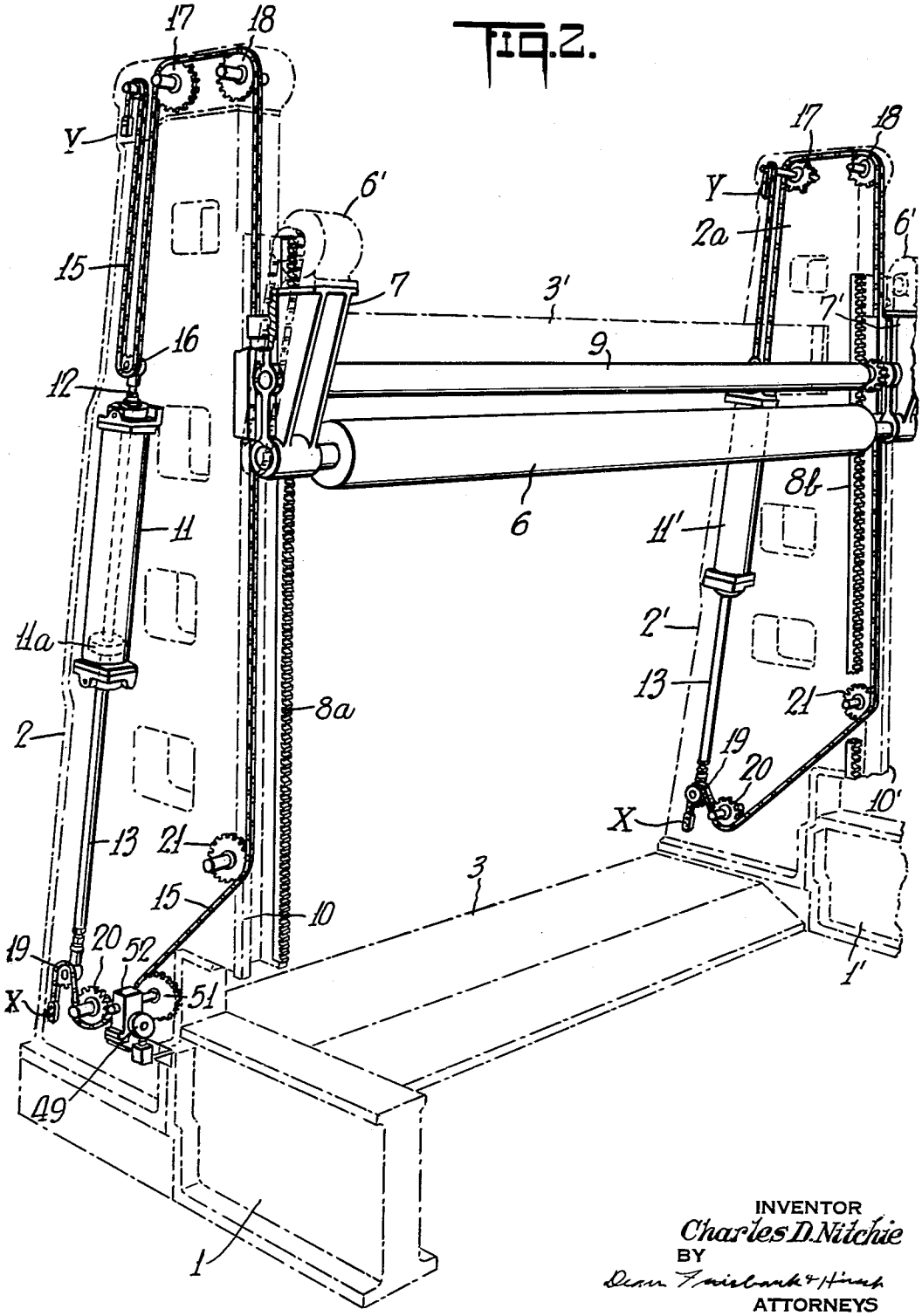
Fig. 2.



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2,733,018

WEB WINDER

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This invention relates to web winders of the 3-roll type, such as shown in the Langston et al. Patent 1,488,126 and the Sieg Patents 1,827,802, 1,831,201 and 1,888,810, and in which the rewind roll is supported on and between a pair of parallel drums which are rotated in the same direction from a suitable source of power, and a pressure roller which may or may not be driven, rests on the rewind roll and is forced upwardly as said rewind roll increases in diameter. In connection therewith there may be provided the customary slitters for trimming the edges of the sheet, and if desired, slitting the web into narrower widths as it passes from the supply roll to the rewind roll.

The present invention provides a pressure fluid system for (1) lowering the upper pressure roller onto a small roll at the start of winding operation; (2) automatically controlling and yieldingly resisting the vertical movement of the upper pressure or rider roller so that the roll is pressed down onto the driven supporting drums and a hard, dense roll is formed, and slipping of the roll on the supporting rollers is prevented; (3) automatically controlling the downward pressure exerted by the pressure roller to compensate for the increasing weight of the roll; and (4) lifting said pressure roller above the rewind roll when the latter has reached the desired size and is to be discharged.

Heretofore the means for applying the pressure on the upper roller has been heavy weights; and a motor, or a large hand wheel and gearing has been provided for lifting the pressure roller when the rewind roll reaches the desired size and is to be removed. A friction brake has also been provided on the upper floating roller to resist its lifting and increase the tension on the web. Under the old brake system of pressurizing the rewind roll the amount of pressure applied and the rate of reduction were left entirely to the operator's discretion, and inattention often resulted in poorly wound rolls.

The main objects of the present invention are to overcome these and other objection to such prior constructions, and particularly to reduce to the minimum the physical effort required by the operator when removing a rewound roll and starting a new one, and to eliminate the use of counter-balancing weights and friction brakes.

A further object is to provide simple and effective means for controlling the application of fluid pressure to the pressure roller, whereby the amount of pressure exerted by the upper roller on the rewind roll may be varied, and the fluid under pressure may be utilized to lift the roller or to force it down.

One of the primary reasons for the hydraulic means of manipulating the pressure roll is that on large winders the roller and bearings must of necessity be heavy to withstand the pressure and speed. This great weight makes it almost impossible to manipulate them manually.

As an important feature of the invention the bearings for the upper roller are secured to chains or tension members intermediate of their ends, the ends of the chains or tension members are anchored, loops are formed

adjacent to each end, and means are provided for shortening one loop and lengthening the other to raise or lower the pressure roller.

As another feature of the present invention hydraulic means are employed, and act on the chains to raise, lower, counterbalance and load the pressure roller, whereby any desired amount of pressure may be exerted, and in either direction.

In the accompanying drawings there is shown only one embodiment of the invention, but it will be understood that various changes may be made within the scope of my invention. In the drawings:

Fig. 1 is an end view of a machine embodying the invention.

Fig. 2 is a perspective view of only those parts of the machine which embody the novel features, certain parts of the conventional frame being shown in dot and dash lines.

Fig. 3 is a somewhat diagrammatic showing of a hydraulic control system, and

Figs. 4 and 4*a* are sections through a control valve in the positions for hand and for automatic operation.

The machine illustrated has lower side frame members 1 and 1', upright side frames 2 and 2', a base 3, and an upper rear cross-tie 3'. The roll A being wound is supported on and between winding drums 4 and 4' mounted in bearings 5 and 5' on the side frames 1 and 1'. The pressure or rider roller 6 is mounted in carriages 7 and 7' which may move up and down along gibs 10 and 10' on the front edges of the frames 2 and 2'. It is driven by a pair of motors 6' mounted one on each of the carriages 7 and 7', and by V-belt drives, as shown in Fig. 1. The carriages have journals carrying a shaft 9 having gears 8 meshing with racks 8*a* and 8*b* on the end frames so as to maintain the pressure roller 6 parallel to the roll supporting drums 4 and 4' at all times. The web W of paper to be wound passes around idlers 24 and 25, and then if desired between slitters 27, 27' which trim the edges. The web then passes up and around the front drum 4 to the rewind roll A.

All of the parts hereinbefore specifically referred to may be of the same general type employed in machines for the same purpose.

In my improved construction there are provided a pair of double acting hydraulic cylinders 11 and 11' mounted in substantially vertical positions on the end frames 2 and 2'. In each cylinder there is a piston 11*a* with a piston rod 12 extending through the upper cylinder head and a piston rod 13 extending through the lower cylinder head.

An important feature of the invention relates to the means for controlling the delivery of pressure fluid to the lower ends of the cylinders 11, 11' to lower the pressure roller 6 onto the small roll at the start of the winding operation; to press the roller down on the roll so that it will not slip on the drums 4 and 4'; to maintain the pressure on the roll as it increases in size; and to lift the pressure roller above the roll when the roll has reached the desired size; so that the roll may be removed.

As shown in Fig. 3, each of the upper piston rods 12 is of larger diameter than the connected lower piston rod 13, so that the effective area of the upper side of each piston is substantially less than the effective area of the underside. Thus, if the same pressure per square inch be applied simultaneously to both surfaces of the piston, the piston will travel upwardly or will exert an upward pressure equal to the pressure per square inch times the difference in area of the ends of the piston measured in square inches.

As shown in Figs. 1 and 2, each rod 12 carries a sprocket 16 at its upper end, and each rod 13 carries a sprocket 19 at its lower end. One end of each of the chains 15 is

anchored at the lower part of the frames, as at X on the base of the machine, and the other end is anchored at the upper part of the frame, as at the point Y. From the anchorage X the chain extends over the idler sprocket 19 on the piston rod 13, then beneath an idler 20, then into engagement with a sprocket 51, the function of which will be explained hereinafter, then to a sprocket 21 on the lower part of the main frame, and then up the frame to the carriage 7 to which it is secured. It then extends over sprockets 18 and 17, then down and beneath the sprocket 16 on the upper end of the piston rod 12, and up to the anchorage Y.

To start the winding of a roll the end of the web is passed over the idler 24 and beneath the idler 25 and wound a few times around the spindle or rewind shaft 22. This is then placed on and between the winding drums 4 and 4', and pressure fluid is delivered to the lower end of each cylinder 11, 11' to lower the top or pressure roller 6 onto this small roll. At this time the pistons 11*a* are in the upper position in the cylinders, the loop around the sprocket 19 is long, and the loop around the sprocket 16 is short. As the roll increasees in size the pressure roller 6 is forced upwardly, the upper loop increases in length, and the lower loop decreases in length. When the roll reaches the desired size the pressure roller 6 is lifted, and the roll is removed.

After the shaft 22, with a few turns of web wound thereon, has been placed on the drums 4 and 4' the selector valve 46 is moved to "hand" position, shown in Fig. 4, and the pilot valve 47 is adjusted to lower the pressure roller into contact with the small roll on the rewind shaft. The selector valve 46 is then moved to "automatic" position shown in Fig. 4*a*, and the pilot valve 48 is fully closed by cam 49 and full pressure is exerted on the roll.

The sprocket 51 hereinbefore referred to and driven by the chain 15, drives a cam 49 through a worm gear speed reducer 52 which causes the cam 49 to make one complete revolution during the full travel of the pressure roller 6 from its lowermost position on a small roll to highest position on a large roll. The cam controls a pilot valve 48, as shown at the upper right hand side of Fig. 3, and thus the range of pressures in the line 43 from a maximum down to that at which the weight of the pressure roller 6 is completely counterbalanced. At the discharge side of the valve 48 a line 50 drains liquid to the reservoir 28.

As the diameter of the roll increases the cam 49 opens pilot valve 48, thus automatically compensating in reduced pressure on the pressure roller for the weight gained by the roll as it increases in size, thus keeping the tractive pressure on the drums constant.

The amount of pressure applied and rate of reduction is varied by changing the spacing between the valve 48 and the cam 49, or by substituting a cam of different contour.

As shown in Fig. 3, pumps 29 and 30, driven by a motor 31 through a common shaft 32—32', draw oil from reservoir 28 and deliver it to pipe 33 under pressure indicated by the gauge 34. Pump 29 is a large volume low pressure pump, and pump 30 is a low volume high pressure pump. When the roll A reaches the desired size, or under conditions when it is desirable to raise or lower the roller 6 rapidly, the pump 29 delivers a large volume of oil at moderate pressure, but where high pressure is required for pressing a small roll down onto the drums 4, 4', the pump 29 is unloaded and a smaller volume of oil under higher pressure is delivered by the pump 30. This switchover is controlled by a pilot operated relief valve 35. When the pressure in line 33 is that produced by the pump 29 the oil pressure in pilot line 38 is insufficient to open the spring pressed relief valve 35, and all of the oil from both pumps flows into line 33 past check valve 39, and out to the system through line 33*a*. When the pressure in line 33 exceeds the rating of pump 29, the pressure of the oil in line 38 lifts the spool in valve 35 and opens it against

the action of a spring to the drain line 40, thus rendering the pump 29 ineffective and leaving only pump 30 to supply high pressure oil to the system. Check valve 37 prevents reverse flow from line 33. Relief valve 36 prevents the pump 30 from producing excessive pressure, as it permits bypassing of some of the oil to the reservoir 28 through drain line 41.

Bypass valve 42 is spring pressed, and the spring is adjusted to maintain a predetermined pressure in line 33*a*. This predetermined pressure which is applied to the top of cylinders 11 and 11' is set sufficiently high so that when line 43 opens to drain line 40 through valve 44, the pressure roller will be lifted. The effective piston area in the upper ends of cylinders 11 and 11' is approximately one-half of that in the lower ends, due to the upper rods 12, 12 being larger than the lower rods 13, 13. Thus, if an equal pressure is applied to opposite ends of the cylinder simultaneously, the piston will move up or exert an upward pressure equal to the pressure in pounds multiplied by the difference in square inches of the areas of the two ends.

Valve 44 is a pilot operated relief valve which may be controlled by either of two pilot valves 47 or 48, depending upon the position of selector valve 46. Valve 44 controls the pressure in line 43, and in the bottom chambers of cylinders 11 and 11'. When the valve is in the position shown in Fig. 4 for hand operation, the pipe 45 is connected to the valve 47. When it is in the position shown in Fig. 4*a* for automatic operation, the pipe 45 is connected to the valve 48, and the valve 47 is out of circuit.

With either pilot valve 47 or 48 open, the main spool of valve 44 will shift to the open position, thus reducing the pressure in line 43 to zero. Under this condition, the pressure in line 33 will act only on the upper side of the pistons 11*a* in cylinders 11 and 11', and will move them down to raise the pressure roller 6. If pilot valves 47 or 48 are closed slightly, valve 44 will close proportionately, and raise the pressure in line 43 to a value which, acting upon the large piston area in the bottom of cylinder 11, will counteract the thrust from the top of the cylinder, and the pistons will come to rest.

If pilot valve 47 is closed further, the pressure in the bottom of the cylinder will overbalance that in the top, and the pistons will move upward to lower the pressure roller or exert a higher pressure on the roll of material being wound.

Closing pilot valves 47 or 48 will cause valve 44 to tightly close, and full line pressure from the pump will be applied to both ends of the cylinders, with the result that downward pressure will be applied on the winding roll, and equal to the weight of the pressure roll assembly plus the product of the pressure in line 33*a* and the difference in area of the two ends of the cylinders.

Fig. 4 shows the oil passages in selector valve 46 in the "hand" position, and Fig. 4*a* shows them in "automatic" position. In the "hand" position the pilot line 45 is connected to manual pilot valve 47, and the pressure roller may be raised or lowered manually by adjusting the control knob on valve 47. In this position valve 48 is connected to drain line 50. In the "automatic" position of selector valve 46, shown in Fig. 4*a*, the pilot valve 48 is connected to pilot line 45, and valve 47 is connected to drain line 50.

Pilot valve 48 is controlled by a cam 49 mounted on the low speed shaft of a worm gear speed reducer 52 which is driven by sprocket 51 from chain 15. The ratio of the worm gear box is such that the full travel of the chain 15 is reduced to one revolution of the cam 49.

The difference in the low and high radii of the cam 49 is equal to that amount of travel of pilot valve 48 which will cover the range of pressures in line 43 from maximum down to that at which the weight of the pressure roller is completely counterbalanced.

In operation, the operator threads the web W around the rewind shaft 22 and places it in the crotch between drums 4 and 4', then with selector valve 46 in the "hand" position shown in Fig. 4, he adjusts pilot valve 47 to bring the pressure roller down into contact with the small roll on the rewind shaft 22. He then moves the selector valve 46 to the "automatic" position shown in Fig. 4a. In this position of the pressure roller, cam 49 holds pilot valve 48 fully closed so that full pressure is exerted on the roll being wound.

As winding begins and the diameter of roll A increases, the cam 49 starts slow rotation and gradually opens pilot valve 48, thus automatically compensating in reduced pressure on the pressure roll for weight gained by roll A as it increases in size, and keeps the tractive pressure on the drums 4 and 4' constant.

It is obvious that the amount of pressure applied and the rate of reduction may be varied by changing the spacing between valve 48 and cam 49, or by altering the contour of cam 49.

Having thus described my invention what I claim as new and desire to secure by Letters Patent is:

1. A web winder of the type in which the rewind roll rests on and is rotated by a pair of parallel driven rollers and a pressure roller rests on the roll and is moved upwardly along the frame members as the rewind roll increases in size, said web winder being characterized by having a cylinder, a piston therein, a piston rod having opposite end sections projecting respectively through the end walls of said cylinder, a chain having its ends anchored on said frame and its intermediate portion connected to the pressure roller, and having a pair of loops at opposite sides respectively of said intermediate portion, an idler sprocket in each of said loops, said sprockets being mounted on and carried by the respective opposite ends of said piston rod, and means for applying fluid pressure to said cylinder.

2. Mechanism for raising, lowering and resisting upward movement of the upper roll of a three-roll web winding machine, said mechanism including a freely flexible member having its ends anchored, its intermediate portion secured to the bearings of said upper roll, and provided with loops in the opposite end portions, a cylinder having a piston and piston rod sections extending from opposite ends of said cylinder, the ends of said sections having idler sprockets in said loops, and means for applying fluid pressure to said cylinder.

3. A web winding machine of the type having a pair of driven rollers for supporting thereon and therebetween a rewind roll, a vertically movable pressure roller for engaging the upper side of said rewind roll, and having vertically movable bearings, whereby said roller rises as the roll increases in diameter, said machine being characterized by means for controlling the effective pressure exerted by said pressure roller on said roll, said means including a freely flexible member having its ends anchored and having a pair of loops adjacent to said ends and its intermediate portion secured to the bearing of the pressure roller, a piston in said cylinder and having piston rods projecting from opposite ends of the latter, and idlers carried by said piston rod and engaging loops in said chain, and fluid pressure means for regulating the forces applied to said bearing by said piston.

4. A web winding machine of the type having a pair of driven rollers for supporting thereon and therebetween a rewind roll, a vertically movable pressure roller for engaging the upper side of said rewind roll and having vertically movable bearings, whereby said roller rises as the roll increases in diameter, said machine being characterized by means for controlling the effective pressure exerted by said pressure roller on said roll, said means including a freely flexible member having its ends anchored and having a pair of loops adjacent to said ends and its intermediate portion secured to the bearing of a pressure roller,

and means engaging said loops to extend one and shorten the other and thereby change the elevation of said pressure roller.

5. A web winding machine of the type having a pair of lower driven roll supporting rollers and an upper pressure roller having vertically movable bearings, a freely flexible non-extensible member having its ends anchored and its intermediate portion secured to a bearing of said upper pressure roller, a pressure cylinder having a piston, and a pair of idlers connected respectively to opposite sides of said piston and engaging said member adjacent to its ends, whereby upon delivering fluid to one or the other ends of said cylinder said pressure roller is raised or lowered.

6. A web winding machine of the type having a pair of frame members, a pair of roll supporting and rotating rollers journaled therein and an upper pressure roller having bearings vertically movable on said frame, each end frame member being characterized by having a substantially vertical cylinder mounted thereon, a piston therein, and a piston rod projecting through both ends of the cylinder and having sprockets at opposite ends thereof, a chain having its ends anchored on said frame member, an intermediate portion secured to the bearing of said pressure roller and a pair of loops, one adjacent to each end, one engaging one of said sprocket wheels and the other adjacent to the other end and engaging the other sprocket wheel, whereby as said roll increases in size said pressure roller moves upwardly, and hydraulic means operatively associated with said piston for exerting pressure through the latter tending to extend one loop and shorten the other to selectively lift, lower, and resist upward movement of said pressure roller.

7. A web winder of the type having a pair of roll supporting rollers simultaneously rotated in the same direction and a vertically movable idler pressure roller, bearings for said pressure roller, said winder having a pair of cylinders each having a piston, flexible members connected to said pistons and to the bearings of said pressure roller for raising, lowering and pressing downwardly said pressure roller, and means for delivering a fluid under pressure to both ends of each cylinder.

8. A web winder of the type having a pair of drum roll supporting rollers and an upper vertically movable pressure roller, said winder having a pair of cylinders each having a piston therein and piston rods projecting from opposite ends thereof, a pair of chains each having its opposite ends anchored and an intermediate portion connected to said pressure roller, and means operated by said piston rods and engaging said chains to move said intermediate portion and thereby raise or lower said pressure roller.

9. A web winder having a pair of rollers for supporting thereon and therebetween a web rewind roll, means for rotating said rollers thereby to rotate said roll, an upper pressure roller having vertically movable bearings, a pair of chains each having its ends anchored and an intermediate portion secured to one of said bearings, a pair of cylinders each having a piston and oppositely extending piston rods, a sprocket wheel carried by each end of each piston rod and engaging said chain adjacent to but spaced from the ends thereof to move the intermediate part endwise and raise or lower said pressure roller.

10. A web winder as defined in claim 9, and in which the oppositely extending piston rods are of different diameter, whereby the rate of movement in one direction is greater than the rate of movement in the opposite direction.

11. A web winder of the type in which the rewind roll rests on and is rotated by a pair of parallel driven rollers and a pressure roller rests on the roll and is moved upwardly along the frame members as the rewind roll increases in size, said web winder being characterized by having journal structures for the opposite ends of said pressure roller guided on said frame members, and a drive motor for said pressure roller mounted on each of

said journal structures and operatively connected to the proximate end of said roller.

12. A web winder of the type in which the rewind roll rests on and is rotated by a pair of parallel driven rollers and a pressure roller rests on the roll and is moved upwardly along the frame members as the rewind roll increases in size, said web winder being characterized by having a motor vertically movable with said pressure roller and operatively connected to the latter for driving it.

13. A web winder of the type having a pair of parallel juxtaposed lower roll supporting rollers and a pressure roller movable upwardly as said roll increases in diameter, said winder having hydraulic means responsive to said increase in diameter for automatically regulating the downward pressure exerted by said last mentioned roller.

14. A web winder according to claim 13 including manually actuated means for operating the hydraulic means independently of said automatic means for selectively elevating and lowering the pressure roller.

15. A web winder according to claim 14 wherein the hydraulic means includes a cylinder, a piston, said cylinder operatively connected to the pressure roller, said piston having opposite ends of differing effective areas exposed respectively to hydraulic pressure in the opposite ends of the cylinder, means for admitting an hydraulic pressure medium from a common pressure source to both ends of the cylinder simultaneously, and means for varying the pressure of said medium in one of the said ends of the cylinder.

16. A web winder according to claim 15 wherein the pressure varying means comprises a by-pass for the hydraulic medium at the one end of the cylinder and an element responsive to the movement of the piston for controlling said by-pass.

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