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ROLLSTAND DRIVE

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FIG. 1

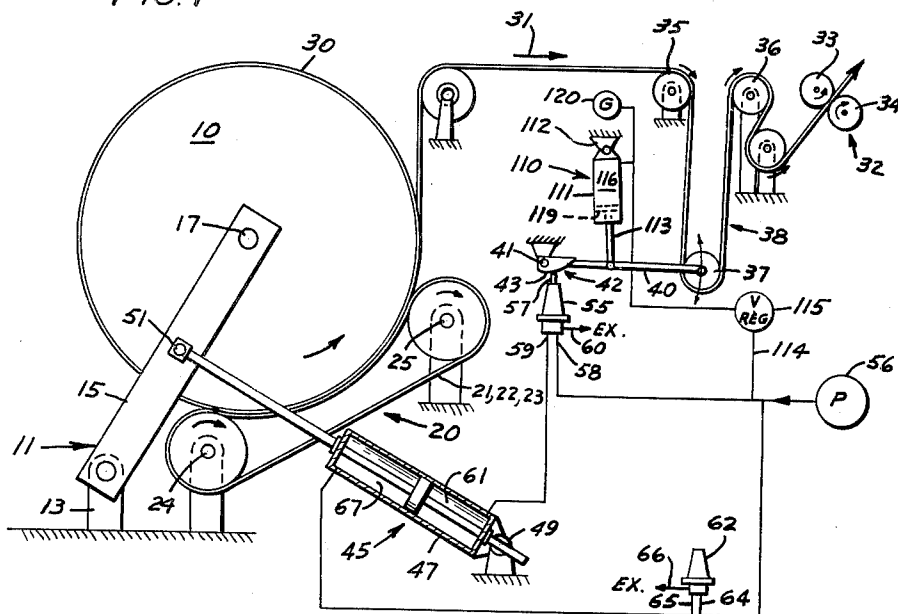


FIG. 2

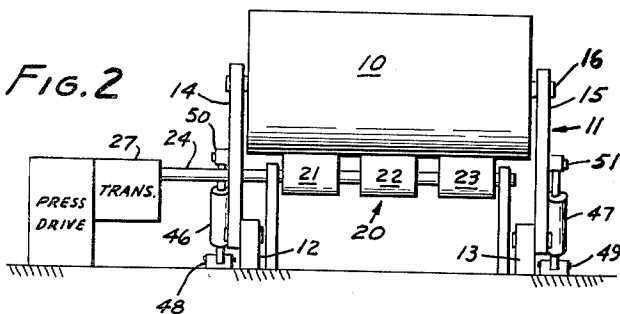


FIG. 3

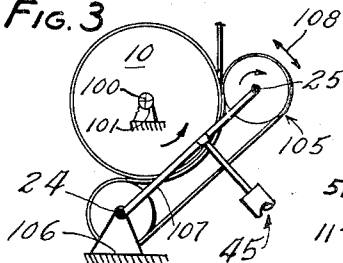


FIG. 4

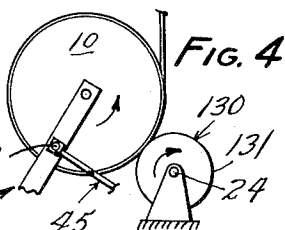
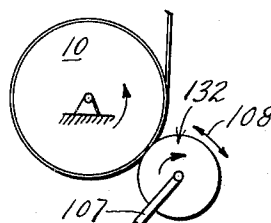


FIG. 5



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ROLLSTAND DRIVE

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This invention relates to a rollstand drive and control for rotating a roll of web material to feed the material at a controlled rate of speed, and at a proper tension.

Particularly in the printing industries, where rolls of paper are fed into a printing press, it is necessary to keep the tension of the material close to a constant value, as well as to feed the material at the rate demanded by the press. Substantial deviations in tension will result in portions of the printed material being out of register which is particularly undesirable in color work, and failure to feed at press speed can cause tearing or wrinkling of the web.

Maintaining close speed and tension control over a heavy roll of decreasing weight and increasing angular velocity is inherently difficult. When a roll is nearly exhausted, it is light and tends to overspeed and otherwise behave erratically. When the roll is new and heavy, its inertia tends to keep it turning at a rate which might be either too fast or too slow. Both of these conditions can lead to variations in rate and tension. Numerous rollstand drives and controls have been provided which have as their desired objective the close control over feed rate and tension of paper, foil, and like web material. In general they exert control by exerting a braking force on the core of the material. These and other types of controls require constant care, attention, and adjustment.

It is an object of this invention to provide a rollstand drive and control which is inherently self-correcting, and which operates as a running brake control at the surface of the roll, thereby avoiding the variations and corrections which arise from change in angular velocity of the roll when control is exerted at the core.

It is a further and optional object of this invention to provide a device wherein the roll is stable and rotates under close control, even when paying out the last portion of the material which it carries.

A device according to this invention includes an outfeed drive which engages the material at a location spaced from the roll, which outfeed drive exerts the demand for material from the roll. The outfeed drive is usually driven by the press itself. Support means at least partially supports the roll. Drive means contacts the roll, and preferably derives power from the press through a transmission which can be set to drive the roll so that the linear speed of the periphery is just a bit slower than that demanded by the outfeed drive. The support means and drive means are so disposed and arranged that one of them is movable relative to the other so as to vary the normal force with which the roll and drive means are brought together, whereby the amount of slippage between them is variably adjustable. Adjustment means is adapted variably to adjust the force exerted between the roll and the drive means by moving the movable one of the support and drive means. The web is drawn from the roll and moved toward the outfeed drive through a loop formed over a pair of fixed parallel rollers and a movable sensing roller.

A control means responsive to the position of the sensing roller is provided for variably adjusting the adjustment means whereby an increase or decrease in the loop length caused by a differential between the rate of demand and that of supply causes the sensing

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roller to lower or to raise, and the adjustment means to adjustably vary the force between the roll and the drive means, thereby permitting less or more slippage between the roll and drive means, with the objective of permitting the outfeed drive to pull off the web at the desired rate and tension.

According to a preferred but optional feature of this invention, the drive means comprises belts which engage and support at least portion of the periphery of the roll, and the adjustment means comprises a piston-cylinder assembly responsive to a fluid pressure determined by the position of the sensing roller.

The above and other features of this invention will be fully understood from the following detailed description and the accompanying drawings in which:

FIG. 1 is a side elevation, partly in cutaway cross-section and partly in schematic notation, showing the presently preferred embodiment of the invention;

FIG. 2 is a partial left-hand end view of FIG. 1; and

FIGS. 3-5 are fragmentary side elevations of alternate embodiments of the invention.

In FIG. 1, a roll 10 of web material, such as a paper web for a printing press, is at least in part supported by support means 11. In this embodiment, the support means comprises a pair of base journals 12, 13, and a pair of swing arms 14, 15 pin-jointed thereto. The central shaft 16 of the roll is held in bearing 17 in the swing arms, spaced from the journals. The roll axis normally stands to one side of a perpendicular line drawn up from the base journals, so that the roll's tendency is to move downwardly toward the ground, and more particularly to bear against friction drive means 20.

The presently preferred embodiment of drive means 20 comprises three drive belts 21, 22, 23, looped around shafts 24 and 25. Shaft 24 is driven by the press drive through a manually adjustable transmission 27, whose output speed relative to motor input speed is adjustable. At least a portion of the periphery of the roll is engaged by the drive belts, and the drive means supports a portion of the weight of the roll.

Web material 30 is withdrawn from the roll in the direction indicated by arrow 31. The demand for the web material is exerted by an outfeed drive 32, which comprises two driven rolls 33, 34 which engage opposite sides of the paper. The rolls are ordinarily driven by the press or whatever device receives the web for processing.

Between roll 10 and the outfeed drive, two fixed parallel rollers 35, 36 are mounted to the frame. A sensing roller 37 is located so that the web forms a loop 38 between the two fixed rollers, the length of which is determined at least in part by the relative linear velocities of the material at roll 10 and at the outfeed drive 32. All rollers in the device are parallel to the axis of the roll.

Preferably, but not necessarily, the sensing roller is supported so that its weight tends to move it downwardly. It could, of course, instead be supported and biased sidewise or even upwardly by springs or by fluid-actuated cylinders to change the direction of the loop. In the illustrated embodiment of the invention, the sensing roller is supported near the free ends of two pivot arms 40, which are joined by pins 41 to the frame of the machine. Alternatively, the sensing roller could be mounted in upwardly extending slots or brackets in the side frame. It is merely important that the sensing roller be movable in response to web tension.

One of the pivot arms carries a cam 42 with an actuating surface 43 thereon. The sensing roller is supported by the loop in the illustrated embodiment and the tension at the loop is at least in part determined by the weight of the sensing roller.

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An adjustment means 45 comprising two piston-cylinder assemblies 46, 47 is mounted to support means 11. Two brackets 48, 49 hinge-joint the cylinders to the base. The piston rods are held at joints 50, 51 to the swing arms at points spaced from brackets 48, 49.

Control means for controlling the position of the adjustment means includes a first bleed-type pressure regulator 55 mounted to the machine frame beneath the cam. It receives pressure from a pump or compressor 56. The regulator includes a stem 57, an inlet port 58, an outlet port 59, and an exhaust port 60. Regulators of this type are well known. They receive pressure from a pressure source and are capable of maintaining a regulated pressure at the outlet port in the range between ambient atmospheric pressure and the maximum pressure of the supply. No detailed disclosure of the construction of such a regulator is necessary here, because such details form no part of this invention. Suffice it to say that the farther down the sensing roller moves, the farther down is the stem 57 of the regulator moved, and the lower is the pressure produced by the regulator and supplied from the outlet port to region 61 of both of the piston-cylinder assemblies. The pressure produced may approach atmospheric. Bleeding off of pressure from regions 61 to lower the same is accomplished by passing some fluid from these regions through the exhaust port. As the sensing roller and the stem move upwardly, the pressure produced by regulator 55, and provided to regions 61 increases.

A second bleed-type pressure regulator 62 receives fluid under pressure from the same source as the first regulator, and also includes an inlet port 64, outlet port 65, and exhaust port 66. The outlet port 66 is connected to region 67 of both piston-cylinder assemblies. The second regulator is adjustable, but not as a function of the sensing roller pressure. Its purpose is similar to that of an accumulator in that it provides and maintains a constant pressure in regions 67. It will thereby be seen that the pressure maintained in regions 67 is a constant force tending to press the roll downwardly toward the drive means, while the force produced by regulator 55 variably offsets this force and the weight of the roll, the adjustment means thereby partially assuming a burden of the roll which otherwise would be assumed by the drive means. The arrangement could, of course, be reversed by applying a higher static pressure to regions 61, and varying the pressure in regions 67 with regulator 55, instead of vice versa as shown, by reversing the cam operation.

Bias means 110 forces the sensing roller against the loop with a regulable, constant force. The bias means comprises two piston-cylinder assemblies 111 mounted to pivot plate 112 on the side frames of the machine. The piston rods 113 are pinned to the pivot arms.

A fluid conducting line 114 conducts fluid under pressure from source 56 to a bleed type pressure regulator 115. This regulator has the property of keeping its downstream side at a constant adjusted pressure, so long as the adjusted pressure lies between atmospheric pressure and pressure from supply 56.

Valve 115 discharges into regions 116 on the opposite sides of pistons 119 from the pivot arms, there being one of these assemblies for each pivot arm. A gauge 120 is teed into the line from valve 115. This gauge may be calibrated to read in units of force load on the loop. The force is, of course, directly proportional to pressure from valve 116, taking into account the constant weight of the sensing roller and pivot arms. Valve 115 provides a simple means for finely adjusting the web tension.

FIGS. 3-5 illustrate alternate means of accomplishing the objectives of the device of FIG. 1. In FIG. 1, the force exerted between the roll and the friction drive means is determined by the adjustment means which shifts the roll toward and away from the drive means,

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reducing the normal force between them by assuming more of the weight of the roll itself. FIG. 3 illustrates a device in which the same objective is accomplished, but in which the roll (and its support means) is unmovably mounted, while the drive means is relatively movable, instead of vice versa.

FIGS. 4 and 5 illustrate a different type of friction drive means. In the system of FIGS. 1 and 3, the drive means is a belt system. In FIGS 4 and 5 it is a drive wheel.

In FIGS 3-5, the numerals of components of the system of FIG. 1 are used so far as the components are common, it being understood that the components of FIGS. 3-5 are adapted for direct replacement of the functionally similar parts in FIG. 1.

FIG. 3 illustrates roll 10 mounted to a fixed journal bearing 100. The roll rotates around its axis 101, but the axis is not laterally shiftable, as it is in FIG. 1. Friction drive means 105 includes a pair of base journals 106 at opposite sides of the rollstand and a drive support arm 107 pin-jointed to each of the journals. The drive support arms swing in the directions indicated by arrow 108. Shafts 24, 25, and belts 21-23 are mounted to arms 107 so that the belts can be moved with varying force against the roll by moving them toward and away from the roll by means of swinging arms 107.

Adjustment means 45 moves arms 107 instead of the support means. In this system, greater force between roll and drive means is obtained by increasing the pressure in region 61, instead of decreasing it. This reversal of pressure direction can be secured either by reversing the cam, or by reversing the output of the valves with respect to stem movement, or by reversing line connections to regions 61 and 67. Such rearrangements of fluid flow are well within the skill of any person likely to use this device.

Drive means 105 friction drives the belts from the transmission as in FIG. 1, the only major difference residing in the mounting of shaft 25.

In FIG. 4, the rollstand construction is identical to that of FIG. 1, except that in place of drive means 20, which includes drive belts, different friction drive means 130 is provided which utilizes a roller 131. The roller is mounted to shaft 24, and may either be a long cylinder, or one or more individual driven wheels carrying tires, keyed to the shaft.

FIG. 5 illustrates friction drive means 132 comprising a cylinder or wheels as in FIG. 4 mounted to drive support arms 107, and otherwise adapted to drive the roll as in FIG. 3.

Slippage between cylinders or wheels can be controlled as with belts, as illustrated by FIGS. 4 and 5.

In the operation of the device of FIG. 1, the press is started, which starts the outfeed drive and transmission 27. The transmission is set to drive the roll periphery at a speed somewhat slower than the outfeed drive demands. The roll drive will then operate as a running brake, and the outfeed drive will obtain the web it demands by pulling it off the roll, thereby slipping the roll on the belts. This pull on the web places the web under tension, and the tension is a function of the force it takes to secure the necessary slippage.

The second pressure regulator is manually set at a higher-than-atmospheric level, and the first pressure regulator, which is controlled by the cam, is set relative to the cam and sensing roller so that, when the loop is of the precisely correct length and tension for operation, the pressure passed by it counterbalances sufficient of the pressure in region 67 and thereby supports enough of the roll weight, that the slippage rate between the roll and the drive means will enable the outfeed drive to obtain the web it demands at the proper speed.

At the outset, when the roll is heavy, it turns quite stably on the belts and without substantial bouncing, so that roll stabilization is not a great problem. However,

the inertia is then at its maximum value, and the system must be protected from the over-running by coasting of the roll in case the press demand rate diminishes, or in case the press should suddenly be shut down. This device does inherently provide this protection. Because the device is a running brake, and moves at a speed quite close to that of the roll, in contrast to core brakes which are stationary, it maintains a closer control.

Should the roll be turning at a speed faster than that demanded by the outfeed drive, the loop will slacken, and the sensing roller will move downwardly. It is necessary then to slow down the roll. To do this, the cam will depress the stem of the first pressure regulator. This will lower the pressure in region 61, which will cause the support means to move clockwise in FIG. 1, thereby reducing the portion of the weight of the roll which the adjustment means carries and which formerly was borne by the support means. That is to say, normal force exerted by the roll on the drive means is increased. This is accomplished by permitting the roll to bear more heavily on the drive means. The increased frictional engagement between the belts and the roll causes the drive belts to brake the roll to bring its rate closer to that of the drive means, because less slippage is possible. This causes the loop to tighten up and shorten, and the sensing roller to rise. As the sensing roller rises, the cam backs away from the stem, thereby raising the pressure emanating from the first regulator, and the pressure in regions 61 increases. More of the weight of the roll is then carried by the support means as the swing arms move counter-clockwise, and move the roll, so that it bears less firmly on the drive belts, which is to say that the normal force between them decreases. Greater slippage can therefore occur. Obviously, in this arrangement, there is a stable position of the sensing roller at which tension and rate are properly set, and this system hunts for it and then stably remains there, subject to adjusting itself for varying conditions during a run. The functions are under control of the sensing roller. Varying the sensing roller weight, or varying the pressure from valve 115, changes the tension of the web, and the system automatically adjusts itself to the new force conditions.

Toward the end of the roll, its radius is smaller, so that there will be less peripheral contact between the belt and the roller, and also less weight thereon. Excessive slippage between the drive means and the roll might then occur. Also, there is inherently a greater tendency for the roll to bounce around when it is light and supported on belts as shown. Excessive slippage is equivalent to a substantial speeding up of the supply rate, or lessening of the tension, both of which will cause the loop to lengthen, and the pressure from the first regulator to drop, ultimately to a value less than that supplied by the second regulator, thereby reversing the direction of bias of the adjustment means and causing the roll to be pressed more firmly against the belts by the adjustment means. This not only decreases the slippage, but stabilizes the roll against bouncing by forcing it against the drive belts. The device is thereby capable of reversing its counterbalancing action to forcibly cause contact between the roll and the belts, as well as to maintain the proper slippage rate for correct tension, thereby to stabilize the roll, maintain a proper rate of rotation, and maintain the tension at a desired value.

The transmission output rate is usually not changed during a run, and is not under control of the sensing roller. The drive belts act as brakes, and the variability is achieved by varying the slippage rate. However, the transmission can readily be "fine-tuned" in operation by manual adjustment.

The device of FIG. 3 operates in the same manner as that of FIG. 1, except that the support means does not move, and the drive means does. In this embodiment, weight of the roll is not transferred to the adjustment

means in the same sense as in FIG. 1, but the normal force between the roll and the drive means is varied in precisely the same manner. The drive means is driven by the transmission. The direction of force in the adjustment means is reversed as aforesaid, because to increase the force on the roll in FIG. 1 called for a decrease of pressure in regions 61, while in FIG. 3, it calls for an increase.

The devices of FIGS. 4 and 5 operate the same as those of FIGS. 1 and 3, respectively, except that their single shafts carry wheels or cylinders instead of belts, but the slippage situation is the same. The belts for both embodiments which use them will ordinarily be of leather. The wheels will ordinarily carry non-marking rubber tires.

All drive means shown are disposed beneath the roll. However, they could also be located at any other portion or portions of the periphery of the roll, including atop the same, with only small and obvious rearrangements of parts, and proper selection of pressure direction on the adjustment means.

The device is inherently very simple, utilizing only conventional construction elements which are easily manufactured and easily repaired or replaced. It eliminates any need for close care and attention to core speeds, such as is required in conventional core brake type rollstands, is simple to set up, and automatic in operation.

This invention is not to be limited by the embodiments shown in the drawings and described in the description which are given by way of example and not of limitation, but only in accordance with the scope of the appended claims.

We claim:

1. A rollstand drive and control for turning a roll of web material to feed the material at a controlled rate and tension, comprising: an outfeed drive engaging the material at a location spaced from the roll, which outfeed drive exerts a demand for material from the roll; support means at least in part supporting the roll, the roll being rotatably supported; friction drive means adapted to contact and turn the roll, said drive means operating at a constant speed; adjustment means adapted to variably adjust the normal force between the roll and the drive means; a pair of laterally spaced-apart, fixed parallel rollers, a movable sensing roller; material withdrawn from the roll passing over both of said fixed rollers, and over said sensing roller to form a loop between the fixed rollers, and thence to the outfeed drive, whereby a difference in linear speed of material at the point of departure from the roll and at the outfeed drive changes the length of the loop, and thereby the position of said sensing roller; and control means responsive to the position of the sensing roller for variably adjusting the output of the adjustment means, whereby variation in loop length permits the sensing roller position to change, causing the control means to adjust the adjustment means and thereby the said normal force between the drive means and the roll, thereby to adjust the slippage rate therebetween, and cause the roll speed to change to restore the loop to a desired length indicative of correct tension and linear speed.

2. Apparatus according to claim 1 in which the adjustment means comprises a pressure-actuated piston-cylinder assembly, and in which the control means comprises a valve responsive to the position of said sensing roller for adjusting pressure supplied to said assembly which tends to move the roll away from said drive means.

3. Apparatus according to claim 1 in which the support means and roll are movable toward and away from the drive means, the adjustment means moving the support means.

4. Apparatus according to claim 3 in which the drive means comprises belts engaging a portion of the periphery of the roll.

5. Apparatus according to claim 3 in which the drive means comprises cylindrical structure engaging a portion of the periphery of the roll.

6. Apparatus according to claim 1 in which the drive means is movable toward and away from the support means and roll, the adjustment means moving the drive means.

7. Apparatus according to claim 6 in which the drive means comprises belts engaging a portion of the periphery of the roll.

8. Apparatus according to claim 6 in which the drive means comprises cylindrical structure engaging a portion of the periphery of the roll.

9. A rollstand drive and control for turning a roll of web material to feed the material at a controlled rate and tension, comprising: an outfeed drive engaging the material at a location spaced from the roll, which outfeed drive exerts a demand for material from the roll; support means at least in part supporting the roll, the roll being rotatably supported, friction drive means adapted to contact the roll, bear at least a part of the weight of said roll, and turn the roll, said drive means operating at a constant speed; adjustment means adapted to variably adjust the proportion of the weight of the roll which is carried by the drive means by assuming some of the weight which otherwise would be carried by the drive means and thereby to adjust the normal force between them; a pair of laterally spaced-apart, fixed parallel rollers, a movable sensing roller; material withdrawal from the roll passing over both of said fixed rollers; and over said sensing roller to form a loop between the fixed rollers, and thence to the outfeed drive, whereby a difference in linear speed of the material at the point of departure from the roll and at the outfeed drive changes the length of the loop, and thereby the position of said sensing roller; and control means responsive to the position of the sensing roller for variably adjusting the adjustment means, whereby increase or decrease in loop length permits the sensing roller to lower or raise, and the adjustment means to assume a lesser or greater proportion of the roll weight, thereby permitting less or more slippage between the roll and the drive means as a function of the said normal force, thereby enabling the roll to slow down and shorten the loop or to speed up and lengthen the loop, all respectively.

10. Apparatus according to claim 9 in which the adjustment means comprises a pressure-actuated piston-cylinder assembly, and in which the control means comprises a valve responsive to the position of the sensing roller for adjusting pressure supplied to said assembly which tends to move the roll away from said drive means.

11. Apparatus according to claim 10 in which said valve is a bleed-type pressure regulator valve, and in which the other side of the said assembly is adapted to receive fluid under constant pressure, whereby lowering of the pressure from the regulator below that of the said constant pressure enables the roll to be pressed against the drive means.

12. Apparatus according to claim 11 in which the drive means comprises driven belts which embrace a portion of the roll's periphery.

13. A rollstand drive and control for turning a roll of web material to feed the material at a controlled rate and tension, comprising: an outfeed drive engaging the material at a location spaced from the roll, which outfeed drive exerts a demand for material from the roll; support means at least in part supporting the roll, the roll being rotatably supported; friction drive means adapted to contact the roll, bear at least a part of the weight of said roll, and turn the roll, said drive means operating at a constant speed; adjustment means adapted to variably adjust the proportion of the weight of the roll which is carried by the drive means by assuming some of the weight which otherwise would be carried by the drive means and thereby to adjust the normal force between them; a pair of laterally spaced-apart, fixed parallel rollers; a sensing roller, material withdrawn from the roll passing over one of said fixed rollers, under said sensing

roller, over the other of said fixed rollers to form a loop, and thence to the outfeed drive, whereby a difference in linear speed of the material at the point of departure from the roll and at the outfeed drive changes the length of the loop, and thereby the position of said sensing roller; and control means responsive to the position of the sensing roller for variably adjusting the adjustment means, whereby increase or decrease in loop length permits the sensing roller to lower or raise, and the adjustment means to assume a lesser or greater proportion of the roll weight, thereby permitting less or more slippage between the roll and the drive means as a function of the said normal force, thereby enabling the roll to slow down and shorten the loop or to speed up and lengthen the loop, all respectively.

14. Apparatus according to claim 13 in which the adjustment means comprises a pressure-actuated piston-cylinder assembly, and in which the control means comprises a valve responsive to the position of the sensing roller for adjusting pressure supplied to said assembly which tends to move the roll away from said drive means.

15. Apparatus according to claim 14 in which said valve is a bleed-type pressure regulator valve, and in which the other side of the said assembly is adapted to receive fluid under constant pressure, whereby lowering of the pressure from the regulator below that of the said constant pressure enables the roll to be pressed against the drive means.

16. Apparatus according to claim 15 in which the drive means comprises driven belts which embrace a portion of the roll's periphery.

17. Apparatus according to claim 15 in which the drive means comprises cylindrical structure which engages a portion of the periphery of the roll.

18. A rollstand drive and control for turning a roll of web material to feed the material at a controlled rate and tension, comprising: an outfeed drive engaging the material at a location spaced from the roll, which outfeed drive exerts a demand for material from the roll; support means at least in part supporting the roll, the roll being rotatably supported; friction drive means adapted to contact the roll, bear at least a part of the weight of said roll, and turn the roll, said drive means operating at a constant speed; adjustment means adapted to variably adjust the proportion of the weight of the roll which is carried by the drive means by assuming some of the weight which otherwise would be carried by the drive means and thereby to adjust the normal force between them; a pair of laterally spaced-apart, fixed parallel rollers; a sensing roller; a pivot arm rotatably and swingably supporting said sensing roller, material withdrawn from the roll passing over one of said fixed rollers, under said sensing roller, over the other of said fixed rollers to form a loop, and thence to the outfeed drive, whereby a difference in linear speed of the material at the point of departure from the roll and at the outfeed drive changes the length of the loop, and thereby the position of the pivot arm; and control means operatively connected to the pivot arm and controlled by said pivot arm for variably adjusting the adjustment means, whereby increase or decrease in loop length permits the sensing roller to lower or raise and the adjustment means to assume a lesser or greater proportion of the roll weight, thereby permitting less or more slippage between the roll and the drive means as a function of the said normal force, thereby enabling the roll to slow down and shorten the loop or to speed up and lengthen the loop, all respectively.

19. Apparatus according to claim 18 in which the adjustment means comprises a pressure-actuated piston-cylinder assembly, and in which the control means comprises a valve responsive to the position of the sensing roller for adjusting pressure supplied to said assembly which tends to move the roll away from said drive means.

20. Apparatus according to claim 19 in which said valve is a bleed-type pressure regulator valve, and in which the other side of the said assembly is adapted to receive fluid

under constant pressure, whereby lowering of the pressure from the regulator below that of the said constant pressure enables the roll to be pressed against the drive means.

21. Apparatus according to claim 18 in which the drive means comprises driven belts which embrace a portion 5 of the roll's periphery.

22. Apparatus according to claim 21 in which the adjustment means comprises a double-ended piston-cylinder assembly and in which the control means includes a first pressure regulator feeding one side of the assembly and 10 whose output pressure is governed by the position of the sensing roller, and a second pressure regulator which maintains the pressure on the other side of the piston at a constant above-atmospheric value.

23. Apparatus according to claim 22 in which a cam 15 is regulated by the position of the sensing roller to set the first pressure regulator.

24. Apparatus according to claim 23 in which the sensing roller is mounted to a pivot arm, said pivot arm carrying the cam.

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