

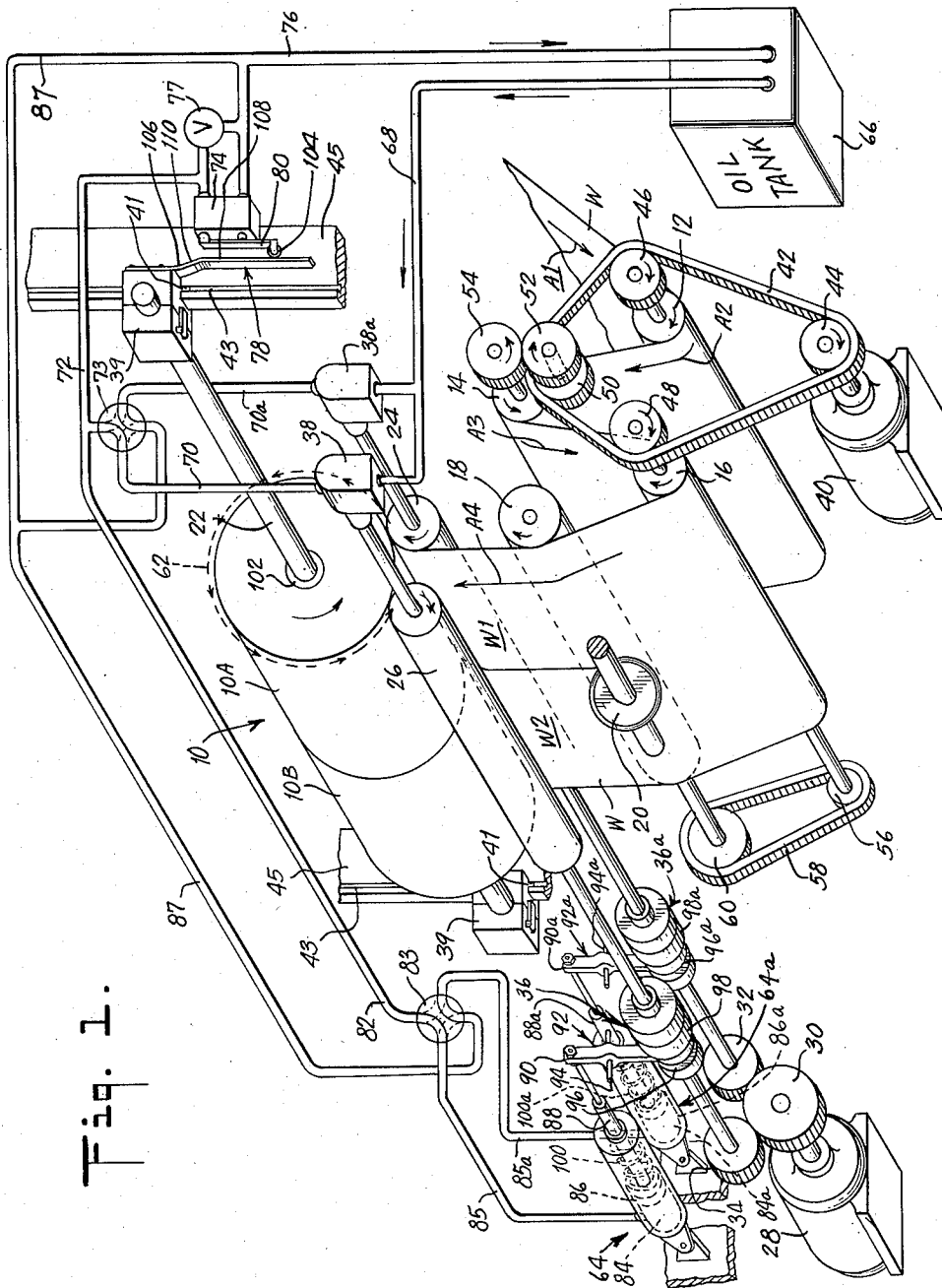
Nov. 4, 1958

L. ROCKSTROM
WINDING MACHINE

2,858,997

Filed July 11, 1956

3 Sheets-Sheet 1



INVENTOR:
LEONARD ROCKSTROM
BY Robert Henderson
ATTORNEY

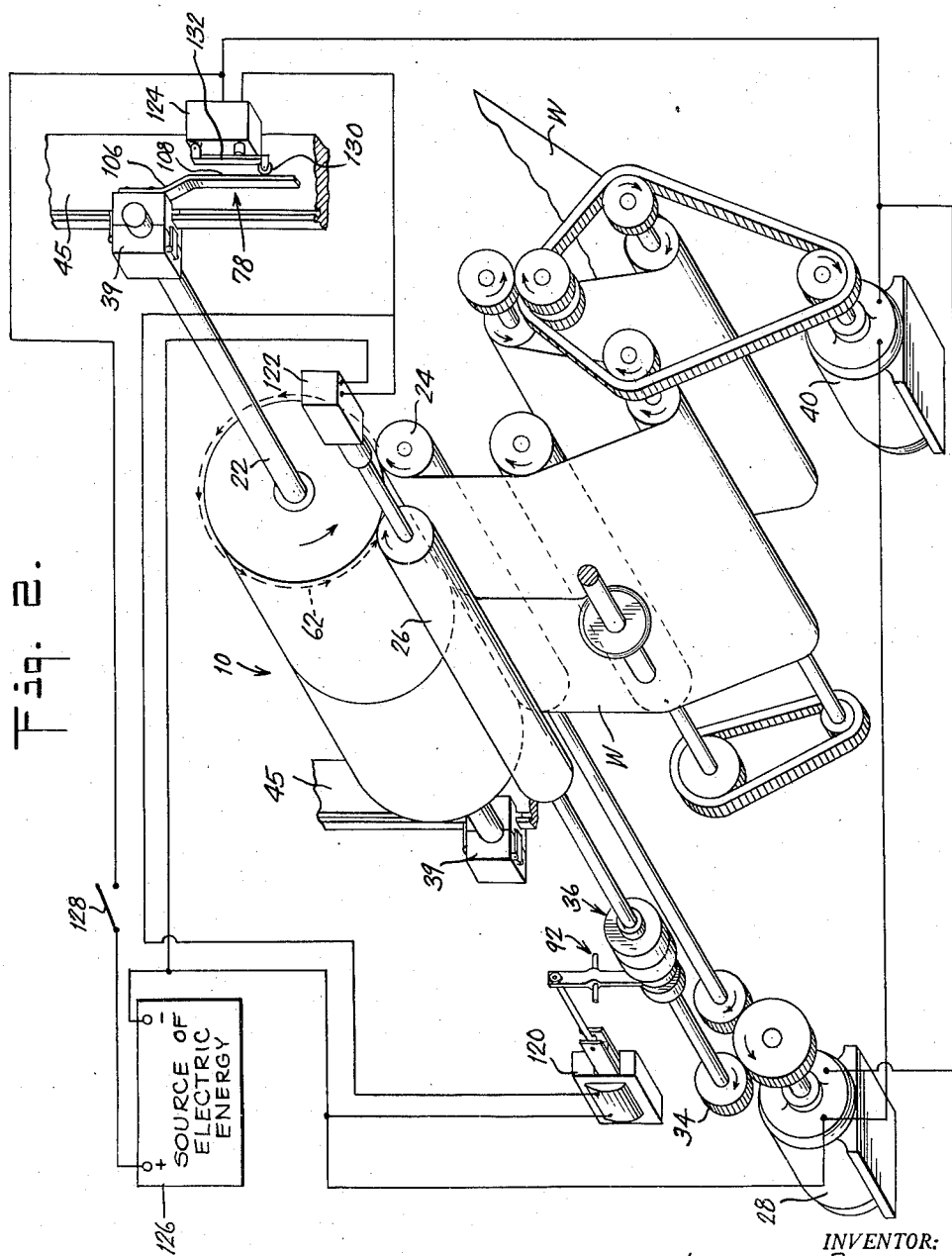
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Fig. 3.

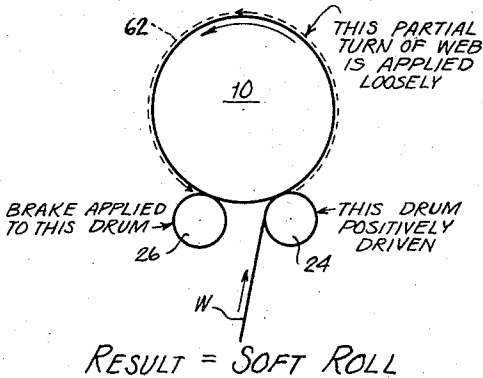


Fig. 4.

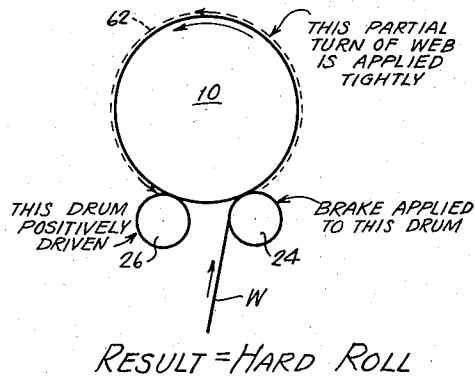


Fig. 5.

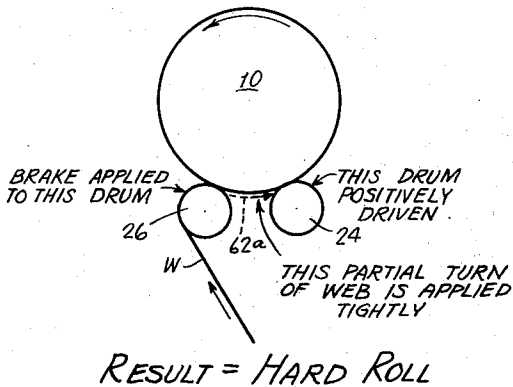
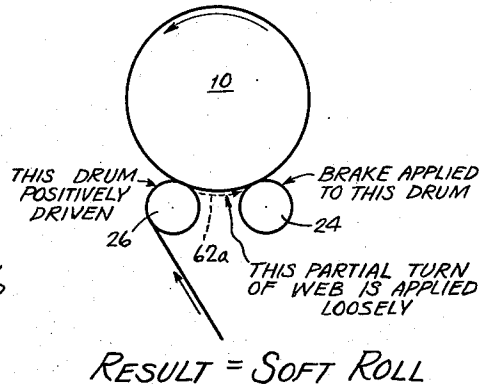


Fig. 6.



INVENTOR.
LEONARD ROCKSTROM
BY *Robert Henderson*
ATTORNEY

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2,858,997

WINDING MACHINE

Leonard Rockstrom, Madison, N. J., assignor to Cameron Machine Company, Brooklyn, N. Y., a corporation of New York

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10 Claims. (Cl. 242-66)

This invention relates generally to machines for wind-web material into the form of a roll; such machines being used, for example, when it is desired to unroll such web material from one roll to subject the material to converting, printing or some other form of processing and then, in a continuous operation, to rewind the processed material into the form of another roll.

More particularly, the invention relates to improved means for thus rewinding such web material either into a so-called "soft" roll which is more or less loosely wound or into a hard or tightly wound roll. The need for deriving a condition of either softness or hardness usually depends upon the nature of the web material and/or the nature of the processing to which it has been subjected. In rewinding web material into a soft roll, it is necessary to provide fine control of the application of the web to the rewind roll to substantially minimize or obviate tension in each turn of the web as it is applied to the latter roll. In rewinding web material into a hard roll, on the other hand, tension must be maintained in the web as it is applied to the rewind roll.

The principal object of this invention, therefore, is the provision of improved means, in or associated with a winding machine, for minimizing or nullifying tension in each turn of the web as it is applied to the rewind roll to derive soft-roll winding or for maintaining tension in the web to derive hard-roll winding. These and other more or less obvious objects are accomplished by the present invention of which two preferred embodiments are shown, for illustrative purposes, in the accompanying drawings without, however, limiting the invention to the two disclosed embodiments.

In the drawings:

Figure 1 is an isometric, more or less diagrammatic view of an embodiment of this invention in which certain hydraulic means are employed.

Fig. 2 is an isometric view of another embodiment of the invention which differs from that of Fig. 1 chiefly in that electrical rather than hydraulic means are employed therein.

Figs. 3-6, inclusive, are diagrams, applicable to either of the machines of the embodiments of Fig. 1 or Fig. 2, showing several possible variations in the use of said machines and the results of such variations in use.

Referring to Fig. 1, it should first be understood that, while all necessary operational parts are included, said figure includes little or nothing of a frame of a machine or of supports for the various operating parts. Those skilled in the related art will readily understand the manner in which the operating parts are supported in a suitable frame.

As shown in Fig. 1, a web W of flexible material, such as, for example, paper, is drawn continuously from a supply roll (not shown) and pursues an undulating course indicated by arrows A1, A2, A3 and A4 to a rewind roll 10. In pursuing said course, the web passes first around the underside of a roller 12, thence upward

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to a roller 14 and around the top side of the latter, thence downwardly and around the underside of another roller 16. From the latter the web passes upwardly in contact with a cutting roller or mandrel 18, disposed at one side of the web, and between said mandrel and a rotary, circular knife 20 which cooperates with the mandrel 18 to slit the web longitudinally into parts W1 and W2.

The web parts W1 and W2 pass in unison from knife 20 partially about a rewind roller or drum 24 in a clockwise direction as viewed in the drawings, thence counterclockwise about shaft 22 and the previously accumulated portion of roll 10. In winding onto roll 10, the outer layer of web material passes between roll 10 and another rewind roller or drum 26. Thus, after the mentioned cutting or slitting, the web accumulates on shaft 22 as rewind rolls 10A and 10B of processed web material. The shaft or roller 22 is not directly driven but it and web material accumulating thereon derive an indirect, frictional drive from either or both of the two rewind rollers or drums 24 and 26 by reason of the fact that the roll or rolls 10A and 10B of web material accumulating on the roller 22 are supported only upon said rollers 24 and 26 and that either or both of the rollers 24, 26 are driven by means hereinafter described.

Roller or drum 26 is driven by a motor 28 through gears 30 and 34 and a clutch 36 which, by means hereinafter described, is controlled to operate in coordination with braking means shown diagrammatically as a hydraulic brake 38. It should be noted that the brake 38 may be in the form of a gear pump adapted, if driven, to pump liquid and to derive a braking effect from pumped liquid which is throttled against movement. Roller or drum 24 is similarly driven by the motor 28 through gears 30 and 32 and a similar clutch 36a which, like clutch 36, is controlled to operate in coordination with braking means 38a which are substantially similar to braking means 38. The brakes 38, 38a are connected to the ends of shafts or drums 26, 24, respectively, to apply their braking effect to said drums separately and at different times.

The ends of the shaft or roller 22 are journaled in bearings 39 which are formed with tongues 41 slidably retained in vertical grooves 43 in opposite, similar, side-frame uprights 45 of the frame (not shown) of the machine. Thus, the bearings 39, by their stated sliding cooperation with uprights 45, guide the shaft 22 and roll 10 vertically while said roll rests upon and is frictionally driven by either or both of rollers 24 and 26. The frictional engagement, affording said driving action, may be enhanced, if desired, by using a vertically guided, so-called "riding-roll" (not shown) which rests upon the roll 10; and such a riding-roll may be power-driven, to aid in driving roll 10, if so desired.

As illustrated, rollers 12, 14 and 16 are advantageously driven, in the directions shown by arrows thereon, by a motor 40 through the medium of a chain 42 which is in driving association with a driving sprocket 44 of said motor and driven sprockets 46 and 48 rigidly associated respectively with rollers 12 and 16 and with a sprocket 50 which is rigidly coupled to and drives a pinion 52 which, in turn, drives a pinion 54 rigidly associated with roller 14.

The chief function of the rollers 12, 14 and 16 is to draw the web material from a supply roll (not shown) and move the web at controlled speed toward the rewind rolls 10A and 10B. The operation of rollers 24 and 26 is so coordinated to the operation of driven rollers 12, 14 and 16 as to tension the portion of the web moving between rollers 16 and 24 to the proper extent to enable slitting of the web to be accomplished by the knife 20 as already described. The cutting roller or mandrel 18 may

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advantageously be driven in any suitable way as by a separate motor (not shown) or directly by motor 40 or indirectly by the latter through a power take-off sprocket 56 rigidly associated with roller 16, which take-off sprocket, through a chain 58, drives a sprocket 60 rigidly associated with said cutting mandrel. The knife 20 also may be driven, if desired, by any suitable means.

It will be readily understood, by those familiar with the art under discussion, that, if the rollers 24 and 26 are the same in circumference, if gears 32 and 34 are the same in circumference, if both clutches 36 and 36a remain engaged, and if brakes 38 and 38a were omitted or rendered inoperative, the rollers 24 and 26, by turning roll 10, would cause the latter to draw web material thereonto without any particular emphasis on the softness or hardness of the accumulating roll 10. Under such conditions, the density of roll 10 would depend largely upon the nature of the material being rewound.

It is considered desirable to have certain types of web material, as, for example, glazed or smooth papers, wound rather loosely into what are commonly known as soft rolls, while it may be desired to wind various other types of web material into relatively hard or tightly wound rolls. The need or desire for either hard-roll or soft-roll winding might also be dictated by the nature of the processing to which the web material is subjected.

According to the present invention as illustrated in Fig. 1, soft-roll winding is achieved by means which control the operation of roller 26 in such manner that it is given a tendency to oppose the movement of the web material past it as the latter becomes incorporated into the rolls 10A and 10B; and to achieve hard-roll winding, such an opposing tendency is given to the roller 24 instead of to roller 26. This is done, for soft-roll winding, by controlled operation of the clutch 36 and brake 38, and, for hard-roll winding, by similarly controlled operation of the clutch 36a and the brake 38a.

The means for controlling the operation of the clutches 36 and 36a and brakes 38 and 38a include a servomotor 64 for operating clutch 36, a servomotor 64a for operating clutch 36a, an oil tank 66, a pipe 68 with two branches arranged to pass oil from said tank to the brakes 38 and 38a, pipes 70 and 70a for passing oil from said brakes to a suitable selector valve 73, a pipe 72 for conducting oil from valve 73 to a suitable throttle valve 74, and a pipe 76 for passing oil from valve 74 back to the tank 66. A by-pass valve 77 is suitably connected between pipes 72 and 76, in parallel with the throttle valve 74. Said control means also include a cam member 78 rigidly fixed upon one of the bearings 39 to rise with the latter as web material accumulates upon the roll 10 and thereby actuate a throttle-control lever 80 of the valve 74 to cause throttling of the flow of oil in its course thus far described.

The means for controlling the density of the rewound roll of web material also include a pipe 82 connecting pipe 72 with a selector valve 83 by means of which pipe 82 may be connected selectively by pipes 85 and 85a, respectively, to similar pressure chambers 84, 84a defined at the ends of the servomotors 64, 64a by pistons 86, 86a having piston rods 88, 88a which extend from the servomotors and are pivoted to the upper ends 90, 90a of operating levers 92, 92a. These levers are rockable about fixed fulcrums 94, 94a and have yokes 96, 96a at their lower ends for shifting shiftable members 98, 98a of clutches 36, 36a to disengage one or the other of the later in a generally well-understood manner. Within each servomotor and bearing against one end wall of each servomotor and against the pistons 86, 86a, are compressed coil springs 100, 100a which maintain the clutches 36, 36a normally in engaged or driving condition. A pipe 87 connects valve 83 to tank 66 through pipe 76.

To understand the operation of the described apparatus for soft-roll winding, it should be assumed that the leading end of the web material is threaded past the rollers

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12, 14, 16, 18 and 24 and that, by manual or jog rotation of the shaft 22, a few starting turns of the web are formed upon said shaft or upon a roll core 102 disposed upon said shaft. It should also be assumed that valve 77 is closed, that valve 73 is in condition (as shown in full lines) to connect brake 38 to valve 74 and brake 38a to the tank; and that valve 83 is in condition (as shown in full lines) to connect servomotor 64 to pump 38 and to valve 74 and to connect servomotor 64a to the tank. At the commencement of operation, the shaft 22, having very little web material thereon, is much lower than shown in the drawings or, i. e., at a level only slightly higher than rolls 24 and 26. In consequence, the cam member 78 is at such a low level that roller 104 of throttling-control lever 80 rests upon low area 106 of cam member 78, in which condition valve 74 is adapted to pass oil freely to tank 66.

In the just-stated condition, starting of machine operation by starting the motors 28 and 40 will have the effect of positively driving roller 22 and its core 102 through both of the rollers 24 and 26, the latter two rollers being positively driven because, when valve 74 is thus freely passing oil, springs 100, 100a maintain the clutches 36 and 36a engaged to cause such driving of the rollers 24 and 26. Operation in this fashion will cause a relatively small quantity of the web material to accumulate on core 102.

As the web material begins to build up, however, the roller 104 of valve arm 80 rides onto the high area 108 of cam member 78 and remains on that area throughout the remainder of the winding of the web material onto roller 22 to form the roll or rolls 10 or 10A and 10B. It should be understood that the cam member 78, like some other parts of the mechanism, is shown diagrammatically and that the intermediate cam area 110 of said member may give either a more or a less abrupt transition than shown, between the cam areas 106 and 108; also, that the cam surface 108 may be shaped to yield either a gradual increase or a gradual decrease in the throttling action of valve 74 throughout the winding of the web material upon the roller 22.

As, with early accumulation of the web on roller 22, the roller 104 rides upon cam area 110 toward cam area 108, throttling becomes initiated and progressively increases in valve 74, whereupon pressure of the liquid in pipes 82, 85 and pressure chamber 84 increases, gradually overcoming the force of spring 100 and gradually disengaging clutch 36 until, when roller 104 closely approaches and reaches cam surface 108, the throttling effect in valve 74 establishes sufficient pressure in chamber 84 to bring about complete disengagement of clutch 36.

At that point, accumulating roll 10 derives no driving effect from roller 26; on the contrary, the latter is driven frictionally by roll 10 subject, however, to a braking effect operative in brake 38 by reason of the fact that the throttled valve 74 has caused back pressure in the liquid against which the brake 38 is attempting to pump.

In the presence of the described braking effect, the roller 26 frictionally opposes movement past it of the outermost partial turn of web being wound upon roll 10 (or rolls 10A, 10B), said partial turn being indicated by the broken-line arrow 62; and this opposition has the effect of causing the web, in said partial turn, to become incorporated somewhat loosely into the roll 10. The ultimate effect of the continuance of such loose winding throughout the greater part of the accumulation of web as roll 10 is formed is that said roll is formed as the desired "soft roll."

It may be noted that the bearings 39 are shown as split or separable bearings, enabling them to be readily opened up to permit removal of a rewound roll 10 and insertion of another roller 22 in place.

To achieve hard-roll winding, the selector valves 73

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and 83 are set as indicated in broken lines to establish pipe interconnections which render clutch 36a and brake 38a (rather than clutch 36 and brake 38) subject to the described throttling effect in valve 74. Under this revision of the machine, the establishing of throttling action in the valve 74, by the ascent of the cam 108 with shaft 22, causes clutch 36a to be disengaged and the already described braking effect to be established in roller 24 while roller 26 continues to be driven positively by motor 28. In that condition, roller 26 is pulling on the outer, partial turn 62 of the web being applied to the roll 10 while roller 24 is working against that pull with the result that the web is applied tightly to roll 10, causing the latter to be a hard roll.

If the user of the machine desires to rewind web material without either hard-roll or soft-roll emphasis, he merely opens by-pass valve 77, thereby preventing any fluid-pressure operation of either of the servomotors 64, 64a. In that arrangement, the two rollers or drums 24 and 26 are both continuously driven in what may be termed a "straight through" drive by motor 28, so that the density of the rewound roll would depend largely upon the composition of the web and the manner in which the web runs onto the roll 10.

The second embodiment, illustrated in Fig. 2, differs from that of Fig. 1 chiefly in including braking means associated only with roller or drum 26 and in having electric rather than hydraulic means for imparting such a braking effect. A machine as and used according to Fig. 2 yields soft-roll winding. Thus, a solenoid 120 takes the place of servomotor 64, an electric brake which may advantageously be an eddy-current brake, diagrammatically indicated at 122, takes the place of hydraulic brake 38, a switch 124 takes the place of valve 74, and an electric circuit including wires, as shown, interconnecting the mentioned electrical instrumentalities through a suitable source of electric energy 126 takes the place of the oil tank 66 and the various pipes shown in Fig. 1. The second embodiment does not require any instrumentalities to take the places of valves 73, 83 and 77.

A spring (not shown) in solenoid 120, or a separate spring if desired, operates through lever 92, when said solenoid is in de-energized condition, to maintain the clutch 36 normally engaged or in condition to enable motor 28 to drive roller 26. When said solenoid is energized, it operates magnetically, in opposition to the force of said spring, to disengage the clutch.

The electric brake is in non-braking condition when de-energized and in braking condition when energized; and the switch 124 is normally open as when its roller 130 is at cam area 106 and is closed when said roller is at cam area 108.

The apparatus of Fig. 2 operates very much like the described soft-roll arrangement of the apparatus of Fig. 1. After the web W has been threaded and started on roller 22 as already explained, switch 128 is closed manually, thereby closing circuits through motors 28 and 40. This starts the mechanism into operation, the clutch 36 being engaged and the roller 26 being driven by the motor 28.

The accumulation of an initial amount of web upon the roll 10 causes the roll 22 and its bearings 39 as well as cam member 78 to rise, causing roller 130 to roll toward and onto cam area 108 to operate arm 132 of switch 124 to close, through the latter, circuits through solenoid 120 and brake 122. This has the effect of disengaging the clutch 36 and of setting up braking eddy currents in brake 122 or of otherwise imparting a braking effect to said brake to cause the latter to offer opposition to the movement past it of the outermost partial turn (indicated by broken-line arrow 62) of web being wound upon roll 10, causing a loose or soft wind of the web material on roll 10 as already explained with reference to Fig. 1.

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It should be understood that, in the disclosed second embodiment, the roller 26 need not necessarily be driven at any time by the motor 28; hence, the invention could be practiced in its broader aspects even if gear 34, clutch 36 and solenoid 120 were omitted. In such an arrangement, the roller 26 would function essentially as a braking roller and, if disposed as shown in the drawings, would function also to contribute to the support of roller 22 and the web material thereon.

Those familiar with this art will perceive that, within this invention, one may substitute more or less equivalent electrical instrumentalities for the hydraulic instrumentalities of Fig. 1 to derive an electrically controlled machine which will wind either hard or soft rolls. It will also be realized that electrical controls as shown in Fig. 2 could be provided for roller or drum 24 but not for drum 26; also, that hydraulic rather than electrical controls could be provided for either but not for both of drums 24, 26.

It is also possible, in any machine embodying the principles of this invention and wherein only one or the other of drums 24, 26 has braking means associated therewith, to omit completely any driving connection, either straight through or clutch-controlled, between any direct driving means such as motor 28 and the drum 24 or 26 with which the braking means is associated. In such an arrangement, the braking drum will never function as a driving drum.

The foregoing description is based entirely upon machines in which the web W is threaded therethrough as shown in Figs. 1 and 2. To those familiar with this art, it will be understood that with different web-threading arrangements and with the described braking effect applied in different ways, the user of a given machine within this invention may derive either soft-roll or hard-roll winding. This may be better understood by reference to Figs. 3-6, inclusive.

Figs. 3 and 4 show diagrammatically the effect of applying the braking effect on one or the other of drums 24, 26 when the threading of the web is as shown in Figs. 1 and 2. Where the braking effect is at drum 26 as in Fig. 3, the latter drum exerts a drag upon the oncoming web while drum 24 is pushing or advancing the web, whereby each new partial turn 62 of the web is loosely applied and a soft roll is derived. On the other hand, where the braking effect is at drum 24 as in Fig. 4, the latter drum exerts a drag upon the oncoming web while drum 26 is pulling the advancing web against such drag, whereby each new partial turn 62 of the web is tightly applied and a hard roll is derived.

As shown in Figs. 5 and 6, the web W may be threaded upwardly about the left side and top of drum 26 (as viewed in said figures), between drum 26 and roll 10, thence between the latter and roll 24 and onto roll 10. This leaves a partial outer turn 62a of the web which is considerably smaller than partial turn 62 but the looseness or tightness of the partial turn 62a has the same effect as with partial turn 62 upon the density of the resultant rewound roll. Thus, where, as in Fig. 5, the braking effect is applied to drum 26, the partial turn 62a is applied tightly, resulting in a hard rewound roll. However, if the braking effect is applied to drum 24, as in Fig. 6, the partial turn 62a is applied loosely, resulting in a soft rewound roll.

One advantage of a machine having dual brakes, as in Fig. 1, over a machine with only a single brake, as in Fig. 2, is that, without changing the web-threading scheme, the user of a dual-brake machine may quickly change over from soft to hard roll winding, or vice versa, merely by manually reversing the setting of valves 73 and 83. With a single-brake machine, the web-threading arrangement must be changed to change over from soft-roll winding to hard-roll winding, or vice versa.

It should be noted that for simplicity of diagramming,

the valves 73 and 83 are shown as separate valves. As a practical matter, said valves may be combined, at least operationally, so that they are operable in unison by means of a single handle. Also, although a separate motor 28 has been shown for driving either or both of drums 24, 26, the latter may be driven by the same motor 40 which drives other illustrated drums or rollers.

It should be apparent that this invention achieves the stated objects very simply and effectively; also, that winding mechanisms including the disclosed inventive concepts may be considerably varied without departing from the invention as set forth in the following claims.

I claim:

1. In a winding mechanism, the combination comprising a rotatable winding roller adapted to have web material wound thereon, a pair of rotatable drums upon which said winding roller rests with said drums in frictional engagement with web material on said winding roller at spaced circumferential points of the latter, said winding roller being free to ascend as web material accumulates thereon, driving means adapted to drive one of said drums, means for driving the other of said drums, means for braking said other drum, a circuit interconnecting said two latter means and control means in said circuit coacting with said winding roller during the latter's ascent, and through said circuit terminating the driving of said other drum by said latter driving means and initiating the braking of said other drum by said braking means.

2. The combination according to claim 1, wherein said circuit and said control means are hydraulic.

3. The combination according to claim 1, wherein said circuit and said control means are electrical.

4. The combination according to claim 1, further including a cam member, constrained to move with said winding roller during the latter's ascent and arranged to operate said control means to derive such termination of driving and initiation of braking of said other drum.

5. The combination according to claim 1, including, for said mentioned one drum, means for braking it, a cir-

cuit interconnecting its said driving and braking means, and control means in said last-mentioned circuit coacting with said winding roller during the latter's ascent, and through said circuit terminating the driving of said one drum by its said driving means and initiating the braking of said one drum by its said braking means.

6. The combination according to claim 5, further including selection means for conditioning said driving means of either one of said drums to discontinue its driving of its related drum during the ascent of said winding roller.

7. The combination according to claim 5, further including selection means for incapacitating the braking means, of either one of said drums, whereby to render said incapacitated braking means incapable of braking its related drum during the ascent of said winding roller.

8. The combination according to claim 1, said latter driving means including a motor for driving said other drum, and a clutch operable between said motor and said other drum and responsive to said control means to terminate such driving of said other drum.

9. The combination according to claim 8, said braking means comprising a hydraulic brake and the combination further including hydraulic operating means, hydraulically interconnected with said brake, for operating said clutch.

10. The combination according to claim 8, said braking means including an electric brake and the combination further including electrical operating means, electrically interconnected with said brake, for operating said clutch.

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