

Oct. 18, 1966

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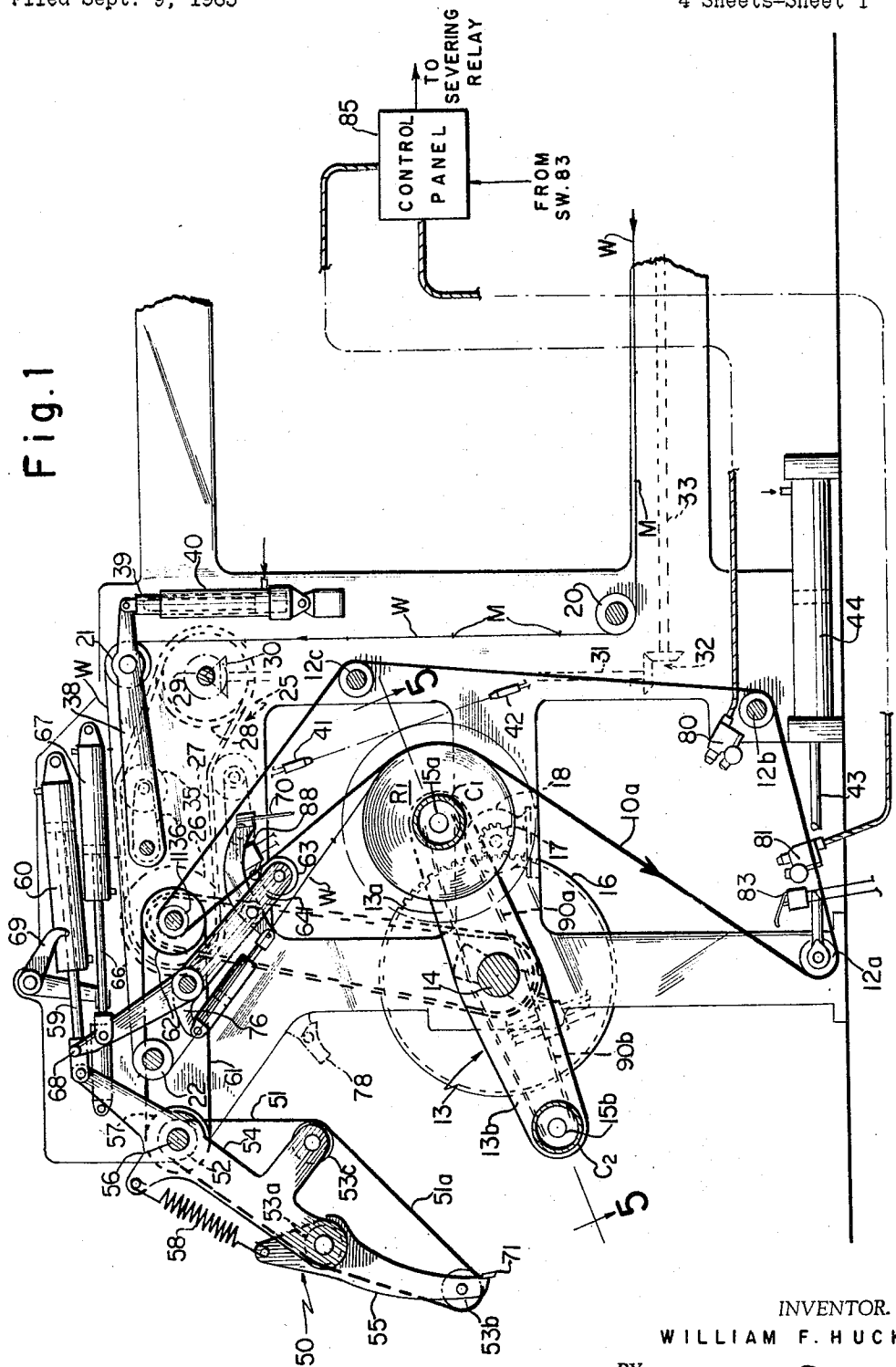
3,279,716

CONTINUOUS WEB WINDING ROLLSTAND

Filed Sept. 9, 1963

4 Sheets-Sheet 1

Fig. 1



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4 Sheets-Sheet 2

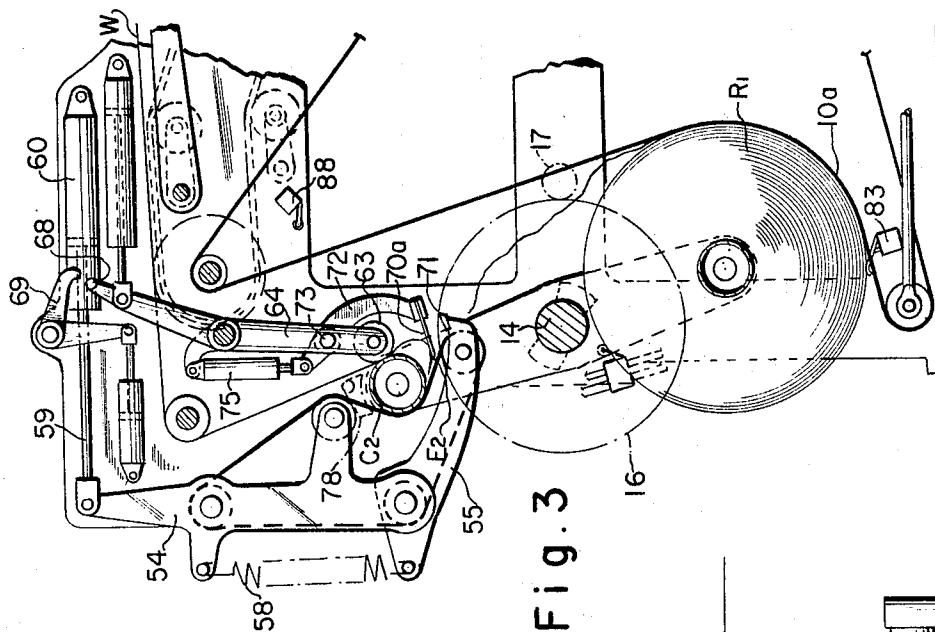


Fig. 3

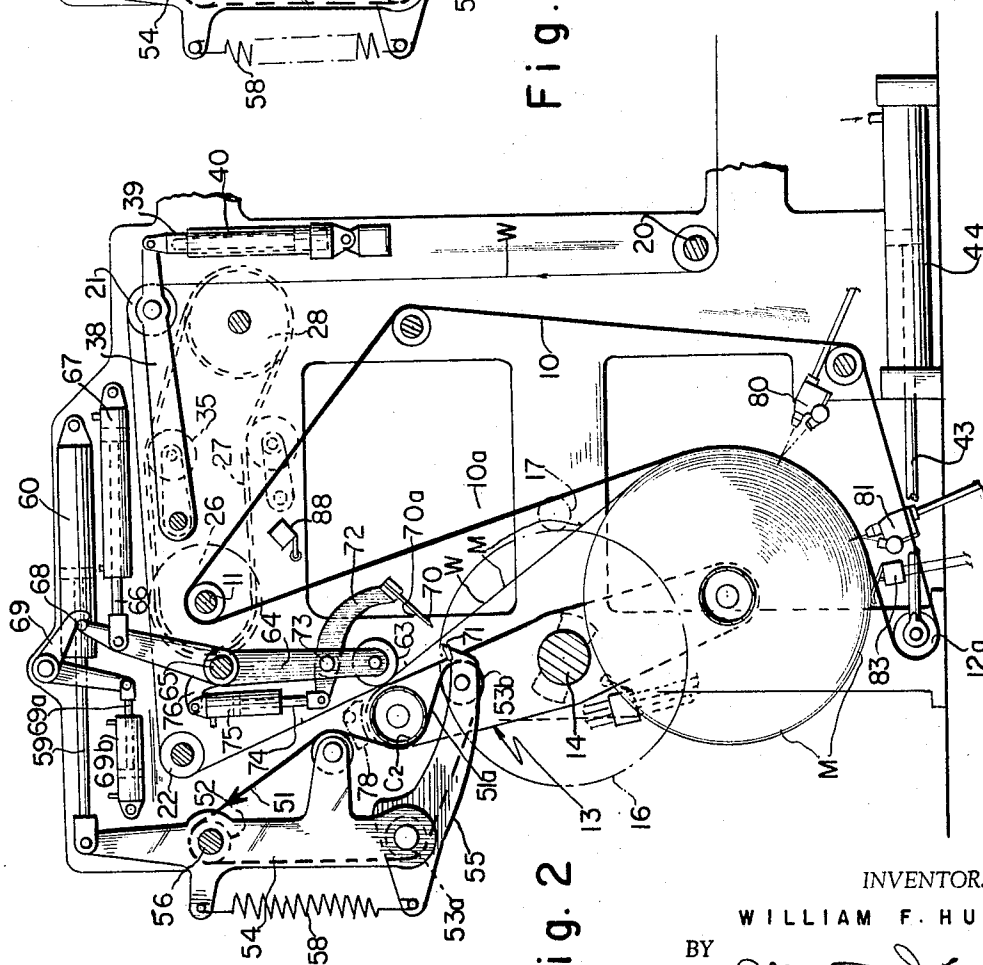


Fig. 2

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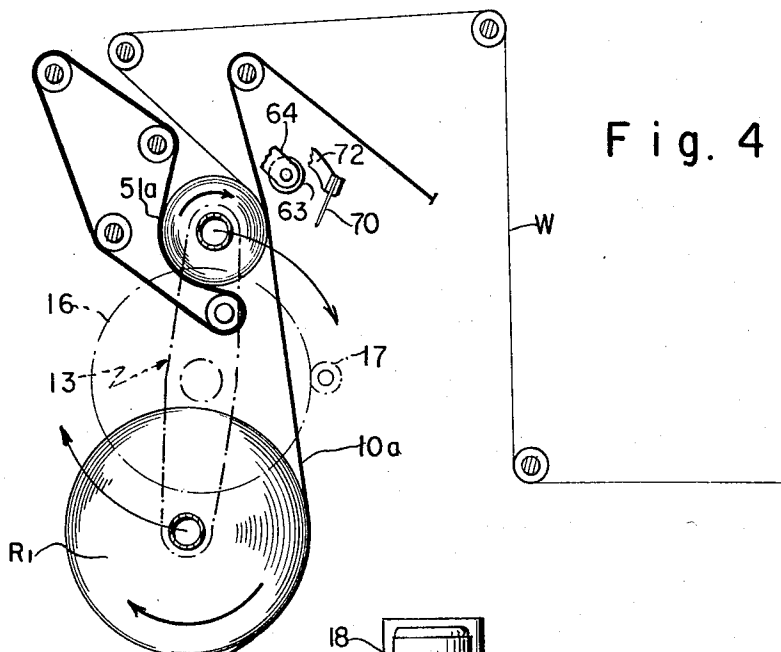


Fig. 4

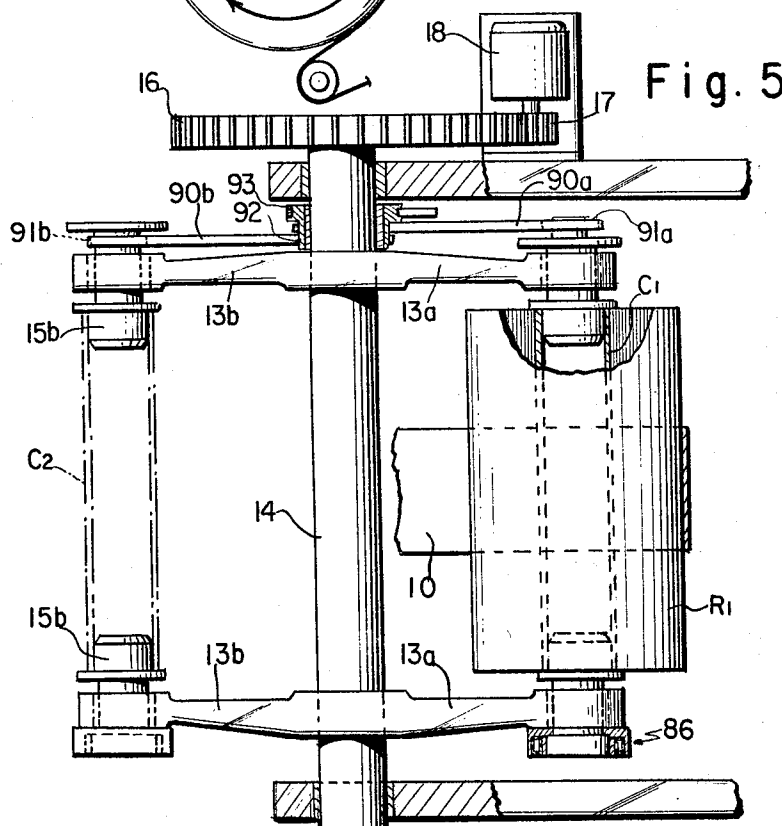


Fig. 5

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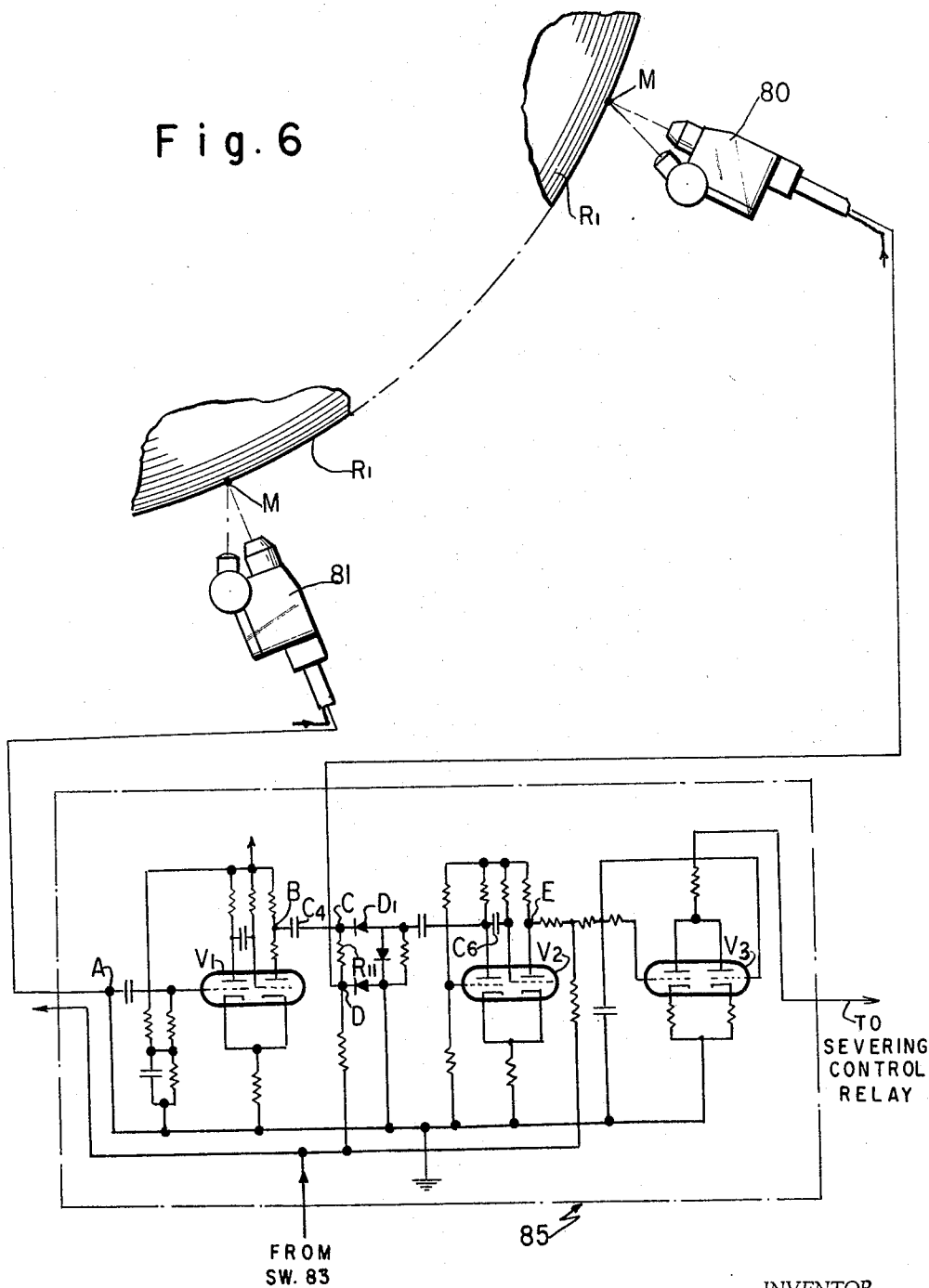
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Filed Sept. 9, 1963

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Fig. 6



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CONTINUOUS WEB WINDING ROLLSTAND

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Filed Sept. 9, 1963, Ser. No. 307,483

16 Claims. (Cl. 242—56)

This invention relates to apparatus for winding continuously running webs of flexible materials such as paper, cloth, metal or plastic foil, and the like, into the form of rolls which are to be used for further processing. More particularly, it relates to apparatus for automatically and continuously winding either blank webs or webs having repetitive patterns thereon into successions of rolls having precisely controlled qualities of size and layer tension, without interruption of the delivery of the webs to the apparatus.

In the use of continuous web processing machines such, for example, as high speed printing presses it is important to be able to deliver the processed web to a winding mechanism without interruption, for otherwise expenses and losses of production are suffered when the machines are stopped for the replacement of a wound web roll by an empty roll core on a winding spindle.

In current practices, semi-automatic apparatus is used to sever the web being rewound and lead its new leading end around an empty core without stopping the web processing machine. In the use of this apparatus, however, extensive wastes of the web occur, due partly to the tendency of operators, in order to avoid any interruption of the machine, to initiate the winding onto a new core when a considerable amount of the web could still be wound onto the winding roll. Accordingly, there has been a trend in the printing industry to reduce the number of transitions from roll to core by providing capacity for larger and larger rolls; but any relief available in this way tends to be offset by the fact that web speeds are also continually increasing as faster and more economical presses are designed.

The common winding apparatus has another important shortcoming in that it does not enable the circumference of a final layer of the web on each wound roll to be controlled accurately. The lack of this quality in the rolls may lead to difficulty and expense in the subsequent processing of the web when it is a printed web that must be brought into register with operations of the machine subsequently processing it.

Among the known forms of web winding apparatus are some in which each winding web roll is driven by one or more rotating drums continuously urged into positive line contact with its surface. This technique is not satisfactory for high speed operations, for when the roll size and the web speed are increased beyond rather narrow limits, a disproportionate increase in roll momentum results and the limited line contact between drum and roll is no longer able to control properly the surface conditions of the winding roll; so the wound rolls produced under these conditions are not acceptable.

Sometimes the winding roll rests by gravity upon the drum drive. In such cases, its pressure increases as it grows in size, causing an increase of tension from one layer to the next outer layer of the roll. So extensive is this tension increase that rolls wound in this manner have been known to develop radial cracks in their outer layers. The likelihood of such damage is aggravated when the rolls are to be stored for lengthy periods before they are used, with exposure to variations of humidity and temperature and possibly to rough handling in the course of storage.

Efforts to overcome these problems have included locating the axes of the driving drum and winding roll

in a horizontal plane, but this necessitates relatively large and heavy movable supports for the drum or the roll, as well as auxiliary equipment for maintaining a finely regulated but relatively high pressure between drum and roll.

Another remedy is to provide apparatus for measuring the size of the roll during winding and accordingly modifying the speed of the drum and/or the pressure between the drum and roll to provide an essentially constant tension in each web layer forming the roll. This involves complex measuring, computational and correction means, the cost of which can be justified only under special circumstances.

It is also known to wind webs into rolls by variable speed motors driving the roll cores, usually with the output speed of the motor varied in inverse proportion to the growth of the roll. The equipment required for this purpose is complex and expensive, and an intrinsic disadvantage is that as the winding roll grows in size the core drive places an ever increasing strain on the core and layers of the web near the core. Hence, it is typical of core wound rolls that the tension decreases from one layer to the next outer layer. The attendant increased strain on inner layers of the roll gives rise to serious register problems in the processing of printed webs core wound into rolls, for it tends to stretch the web permanently so that when a roll of it is unwound the length of a pattern printed on the web comes greater as the roll gets smaller. The wound web then can no longer be registered accurately to a machine processing it. Moreover, it is probably a greater disadvantage that there is no effective control over the web tension at the surface of the winding roll, as a result of which the tension in each roll varies greatly from layer to layer and the rolls end to be conically shaped or otherwise eccentric or to be dish-shaped by telescoping adjacent layers of the web, having too little tension in the layers near the core at the beginning of the winding and too much tension in these layers at the conclusion of the winding.

Further disadvantages arise in the apparatus currently employed for automatically severing the winding web and bringing its new leading end into winding relation to a new roll core, from the fact that the new core is brought up to the web speed by a drive, controlled separately from that of the nearly fully wound roll. Electrical controls usually are provided for first measuring the web speed and then adjusting correspondingly the speed of the core drive. It is difficult, however, to match the speed of the empty roll core to that of the winding web where the drives are separate. Further, in high speed web processing operations breakage of the web often occurs before the speeds of the two drives can be equalized; and when such breakage does not occur, the layer to layer tension in the roll often varies over such a wide range that the wound roll may be unusable.

It is accordingly a principal object of the present invention to provide a continuous web winding rollstand apparatus which effectively overcomes the above mentioned disadvantages of the apparatus currently used.

A further object of the invention is to provide apparatus by which a web printed or otherwise formed with patterns repeating at regular intervals therealong will be wound continuously into rolls having an accurately controlled size, each of which may be produced with an outer wind of the web containing a precise number of the patterns so that the wound web may be easily brought into register with operations of a machine subsequently processing it.

According to one feature of the invention the web running continuously to the winding rollstand from a machine processing the web is, upon being severed at the completion of the winding of one roll, moved into

winding engagement with a new roll core the periphery of which is kept moving exactly at the speed of the web when it takes up the new leading end thereof and while it is built up in diameter by the winding of the web into the new roll, until the new roll is fully wound.

Among other things, the invention provides in this connection an organization of means for driving the core for a new roll and means for severing the winding web and immediately tucking its new leading end into winding engagement with the new core and the drive thereof, whereby the transition of the web from a fully wound roll to a new core is effected quickly and reliably without causing harmful variations of the speed or the tension of the winding web.

According to another feature of the invention, while the speeds of both the winding web and the new core and roll are kept synchronized both before and after the transition of the web from a fully wound roll to the new core, the tension in the winding web is also maintained substantially constant throughout the winding of each roll, notwithstanding that each roll is given, and is displaced between, different positions as it is wound in order that its place may be taken automatically by a new core and roll to keep the web winding without interruption. In this way a substantially constant and equal web tension is provided in each layer of each wound roll, and the rolls are produced in true cylindrical forms which are eminently suited for a storage and eventual unwinding for further processing.

Other important features of the invention reside in the provision of means by which the final diameter of each wound roll is precisely controlled when the web being wound is a blank web or is to be wound without regard to the locations of marks or patterns carried upon it and, further, in the provision of means whereby in the winding of a web having repetitive patterns thereon each of the wound rolls is produced with an outer wind having a precisely determined circumference containing a predetermined desired number of the patterns. This outer wind when desired then may be covered by a predetermined number of protective layers of the web before the web is severed for removal of the roll from the winding rollstand.

The above mentioned and other objects, features and advantages of the invention and ways of putting it into practice will be apparent from the following detailed description and the accompanying drawings of illustrative embodiments of the invention.

In the drawings:

FIG. 1 is a partial side elevation of a web winding rollstand embodying the invention;

FIG. 2 is a side elevation thereof with the winding roll at final winding position;

FIG. 3 is a partial side elevation thereof at the moment of transition from a wound roll to a new roll core;

FIG. 4 shows diagrammatically relative positions of a fully wound roll, a new winding roll and the drives for these rolls as the winding roll is displaced from initial toward normal winding position;

FIG. 5 is a view of a portion of the rollstand as seen along line 5-5 of FIGURE 1; and

FIG. 6 is a diagram of an automatic triggering circuit useful for controlling the actuation of the web severing knife.

The web winding rollstand shown in the drawings functions during the greater period of its operations to wind a web W running continuously to it from a web processing machine; for example, a high speed printing press, into a winding roll R1 which is positioned in non-slipable peripheral engagement with an extended belt flight 10a of a roll drive comprising a belt 10, or group of laterally spaced belts, trained over a driving pulley 11 and over positioning pulleys 12a, 12b and 12c. The web W may be a printed web having repetitive patterns thereon at regular intervals the length of which may be repre-

sented by registers marks M printed or otherwise formed along one edge of the web.

The winding roll R1 is held in the position seen in FIG. 1, which may be considered its normal winding position, by means of an indexable roll support 13 which is mounted on a central shaft 14 for movement in steps through a complete revolution. The support 13 includes two parallel arms which hold between their ends 13a at one side of the shaft 14 spindles 15a on which are mounted the core C1 of a roll such as the winding roll R1, their ends 13b at the other side of the shaft carrying similar spindle 15b to receive the core C2 for a new roll to be wound by the apparatus.

By rotation of the roll support, each new roll core such as core C2 is displaceable from the position shown in FIG. 1, which corresponds to said normal winding position of the winding roll C2, to an initial winding position seen in FIGS. 2 and 3, which corresponds to a final winding position of winding roll R1. Then the new roll winding upon the core is displaceable stepwise to and through the said normal and final winding positions.

Thus, there are two principal working positions of the roll support. In one of them, that of FIG. 1, the main winding of each roll takes place while the preceding wound roll is brought to a stop, removed from the support and replaced by a core for a new roll; and in the other of them, that of FIG. 2, the winding of each roll is completed and the web is severed and transferred to the new roll core in initiation of the winding of the succeeding roll. Each roll thus is wound at and displaced between initial, normal and final winding positions, until it is fully wound.

The movements of the roll support 13 are effected by means of a gear 16 secured to shaft 14 and engaged by a pinion 17 mounted on the output shaft of an electric motor 18.

The web W enters the rollstand from the right-hand side as seen in the drawings, passing under guide roller 20, over floating roller 21, over guide roller 22, and then to and upon the winding roll R1 in the position seen in FIG. 1.

The roll driving belt flight 10a keeps the web W winding upon the roll R1 at precisely the speed at which the web is delivered to the rollstand and also keeps the winding web under substantially constant tension. It so functions by virtue of a drive transmission including a variable speed coupling 25 which connects the belt driving pulley 11 with the drive of the web processing machine and, upon any variation of the tension of the web W sensed by the floating roller 21, transiently varies the speed of the roll drive so as to eliminate the tension variation.

This drive transmission includes a variable diameter V-belt pulley 26 connected to the pulley 11, a V-belt 27 connecting pulley 26 with a pulley 28 on shaft 29, and gears and shafts 30, 31, 32 and 33 driving the shaft 29 and V-belt pulley 28 from and synchronously with the drive of the web processing machine. The variable diameter pulley 26 is preferably of the type disclosed in U.S. Patent 2,812,666. It changes its radius of contact with the V-belt in instantaneous response to variations of the tension of that belt and contains an internal spring arrangement always urging it toward its maximum belt contact radius in opposition to the tension of the V-belt 27.

The V-belt 27 is tensioned variably by a roller 35 which is carried on arms 36 and a shaft 37 for movement with arms 38 supporting the floating web-guiding roller 21. One of the arms 38 is connected with a piston 39 slidable freely in a cylinder 40 into which a fluid under regulated pressure is admitted constantly so as to press the floating roller 21 constantly against the web W in counteraction to the tension of the web and, at the same time, to press the belt tensioning roller 35 constantly against the V-belt 27 in counteraction to the spring force acting in the variable diameter pulley 26.

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Accordingly, whenever the tension of the winding web W decreases to an extent sensible by roller 21, the pressure in cylinder 40 displaces the rollers 21 and 35 incrementally to increase the relative speed of the driving pulley 26, belt driving pulley 11 and belt 10 and thereby increase the winding speed of the roll R1 and web W until the web tension is again at the predetermined value set by the pressure in the cylinder; and the converse actions occur whenever the tension of the winding web increases sensibly.

As indicated in FIG. 1, a photoelectric scanner including a light source 41 and a photoelectric cell 42 is provided adjacent to the normal winding position of each winding roll, so that when the winding roll, such as roll R1, grows to a certain diameter approaching its desired final diameter, the light beam to cell 42 will be interrupted and a signal generated to energize the motor 18 and index the roll support 13 through a quarter turn to the position it occupies in FIGS. 2-4.

In the course of this indexing movement, the winding roll R1 continues to be engaged non-slippably and to be driven at the web speed by the extended belt flight 10a, the position of which is adapted automatically to the increasing size and the displacement of the winding roll by the action of the belt positioning pulley 12a. That pulley is mounted on pistons 43 which are displaceable in fluid pressure cylinders 44, so that its position will be adjustable at any time by a displacement of the winding roll and yet, at all times, it will press the belt flight 10a against the winding roll with a constant force determined by the fluid pressure in the cylinders 44.

The indexing of the roll support swings the new roll core C2 clockwise to its initial winding position. After it reaches that position, a swingable drive mechanism 50 is brought into non-slipping peripheral engagement with it, to drive it to the speed of the winding web and then continuously at that speed while the web is transferred to it and as the web winds upon it during the initial winding period of the resulting new roll.

The drive mechanism 50 includes a driving belt 51 or group of laterally spaced belts, trained about a driving pulley 52 and about guide pulleys 53a, 53b and 53c which are carried in pairs of laterally spaced lever arms 54 and 55. The arms 54 are mounted for swinging movement about the axis of a shaft 56 which is concentric with driving pulley 52 and with a driven belt pulley 57 secured to pulley 52. The arms 55 are pivoted to the lower ends of the arms 54 for relative swinging movement about the axis of pulley 53a; and they have an extension connected by a tension spring 58 with an extension of arms 54.

The lever arms 54 have an upper end connected with the piston rod 59 of a double-acting fluid pressure cylinder 60 which, when under pressure at its outer end, swings and holds the drive mechanism 50 away from the path of the roll core. When cylinder 60 is under pressure at its inner end it swings the drive mechanism 50 counter-clockwise so as to bring the driving belt 51 into and hold it in firm driving engagement with the periphery of the core C2, with the core nested into a large wrap which it forms in the driving flight 51a of the belt, as indicated in FIG. 2.

The tension of the belt 51 against the core then is determined by the tension of spring 58. By reason of spring 58 and the pressure in cylinder 60, the drive 50 will continue to act with like tension upon the new winding roll started on the core C2, by adapting its position to the increasing size of this roll and further, as indicated in FIG. 5, by adapting its position to the change of position of this roll which occurs during a part of the travel of the new roll to normal winding position.

The pulleys 52, 57 driving the belt 51 are coupled positively with the driving pulley 11 of belt 10 through a transmission belt 61 and a pulley 62 rotated with the variable diameter V-belt pulley 26. The belt 51 driving the core and the new winding roll thus is driven always

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at precisely the same speed as the driving belt 10 for the winding roll disposed at the normal and final winding positions, hence always at precisely the same speed as the web W.

As indicated in FIG. 2, the new core C2 in initial winding position is in close proximity to the length of web W running to the winding roll R1 in final winding position. It also has associated with it a pinch roller 63 for pressing this web length into non-slipping engagement with its periphery and, further, a web severing mechanism which includes a knife 70 at one side of the web, at a location between the core and the winding roll, and a coacting cutting anvil 71 at the opposite or core side of the web.

The pinch roller 63 is carried between the lower ends of levers 64 which are fulcrumed on shaft 65 and have an upper arm connected to the piston 66 of a fluid pressure cylinder 67. The upper arm also carries a latch pin 68 coacting with a pivoted latch 69 which is positioned by the piston rod 69a of a fluid pressure cylinder 69b.

In the place of a roller as shown at 63 a brush may be used to press the web against the new roll core as the web is severed, when the core has pressure-sensitive adhesive applied to it for adhering the new web end to its surface.

The knife 70 for severing the web includes blades disposed laterally of the belt flight or flights 10a in well known manner. The blades are fixed to one end of levers 72 which are fulcrumed on a pin 73 mounted in the lower arms of the levers 64 and are connected at their other end to the piston rod 74 of a fluid pressure cylinder 75. This cylinder is pivotably connected to an arm 76 mounted on shaft 65, so that the knife levers 72 and knife 70 are positioned by the levers which position the pinch roller but will be moved clockwise relative to the latter to thrust the knife across the path of the winding web upon the admission of fluid pressure into the lower end of the cylinder 75.

The anvil 71 is mounted on the free ends of the lever arms 55 which carry the guide pulley 53b of the driving belt 51. As seen in FIG. 2, when the drive mechanism 50 is held by cylinder 60 in driving engagement with the core C2, the levers 64 are positioned by cylinder 67 with their latch pin 68 restrained by latch 69, with roller 63 engaging the web running next to the periphery of core C2, and with the knife 70 poised near to the web W. In that condition of the mechanisms the anvil 71 is held by the arms 55 in position to coact with the knife edge and ensure a clean cut through the web when the knife is swung by cylinder 75 across the web path and over the anvil.

As is also evident from FIGS. 2 and 3, the knife has an upper surface 70a extended laterally away from its cutting edge by a considerable distance and lying generally in the direction of its movement about pin 73. This extended surface serves as a guiding means for the new leading web end E2 produced by the cut of the knife. It engages that web end as the cut is made, and then, as it is swung farther clockwise as seen in FIG. 3, it guides the web end E2 into engagement with the periphery of the core C2 at a location where the web end will be tucked and gripped between the belt flight 51a and the core C2 to initiate the winding of a new roll.

A guide horn 78 may be positioned over the top side of the core C2 to confine the new web end E2 near to the surface of the core so that it will not be doubled up or crumpled as it passes from the belt flight 51a to a location beneath the second wind of the web on the new core.

Reverting now to conditions of the winding roll R1 indexed to its final winding position, the apparatus is provided with a control system for sensing the size of this roll and acting when it reaches a predetermined desired size to actuate the described mechanisms for severing

the winding web and guiding its new leading end onto the new roll core.

While a photoelectric sensing device of the type shown at 41-42 in FIG. 1 can be employed in this control system when the winding web is blank or when it is not to be wound to any precisely determined number of patterns in its circumference, an important feature of the invention consists in the provision of apparatus that will bring the winding roll to a precisely measured circumference containing a predetermined desired number of pattern lengths of the web and thereupon will trigger the transition to a new winding roll.

For this purpose, as seen in FIGS. 1 and 2, two photoelectric scanning heads 80 and 81 are arranged to direct light beams into the path of the register marks M on the outermost web layer winding onto the roll R1 in final winding position. These heads produce convergent light beams so spaced apart that at a certain diameter and circumference of the roll the distance between the points of impingement of the two beams upon its surface will correspond to the chordal dimension of a pattern length of the web in a wind of the web having the circumference that contain the desired number of pattern lengths.

Accordingly, when the roll R1 becomes wound to that certain diameter and circumference, two of the register marks M on its outermost wind intercept the two light beams simultaneously, and the photoelectric cells contained in the scanning heads then generate a control signal by which other electrical elements of the control system located at a control panel 85, are caused to activate the web severing and transfer mechanisms.

The scanners 80 and 81 may be activated automatically by the closing of a limit switch 83 engaging the surface of the winding roll, at a moment when the diameter of the roll is a little less than that required to give the desired number of pattern lengths in its circumference.

Soon thereafter the scanners will generate the said control signal, in response to which the mechanisms last mentioned are actuated to move rapidly from the ready-to-sever positions indicated in FIG. 2 to the web transferring positions indicated in FIG. 3. More specifically, the lever 64, then under clockwise pressure from cylinder 67, is released from the latch 69, thus moving roller 63 to press the web tightly against core C2, and pressure acting in the lower end of cylinder 75 thrusts the knife 70 quickly across the path of the web W, over the anvil 71 and toward the core to guide the new web end E2 to the surface of the core at a location between this surface and belt flight 51a.

By the introduction of a limited time delay into the response of the control elements to the signal from the scanners, the severing of the web will be caused to occur at a moment sufficiently later than that of the generation of the control signal to ensure that a desired number of protective layers of the web will be wound onto the roll R1 over the wind thereof having precisely the desired circumference.

When the web W has been severed and its trailing end E1 wound upon the roll R1, this roll in fully wound condition continues to be driven by belt flight 10a until the new roll winding on core C2 at initial winding position has acquired enough winds to be displaced securely to the normal winding position occupied by roll R1 as seen in FIG. 1. The new winding roll is so displaced by actuation of the motor 18 to index the roll support 13 another quarter turn. In the course of its movement away from initial winding position, as indicated in FIG. 4, it is followed and continues to be driven by belt flight 51a, due to the continuing pressure of cylinder 60 on the swingable lever arms 54, 55 supporting the belt 51, until it has been brought into secure peripheral driving engagement with belt flight 10a.

At the same time, the fully wound roll R1 is displaced away from final winding position to the position of core C2 as seen in FIG. 1, whereupon it moves free of the belt

flight 10 and its rotation is stopped by the actuation of suitable braking means, such as a conventional air brake 86 acting upon a spindle at one end of the roll core C1 (FIG. 5).

According to another feature of the apparatus here shown, the core of each winding roll is also provided with a mechanism which applies to the core an overspeed torque whereby a desired degree of tightness is maintained in web layers wound upon the core to keep them from slipping thereon as the roll grows in size. This mechanism is especially useful in the winding of relatively smooth web materials which may tend to telescope or slip at layers closest to the core even though the winding web and the roll driving belts are kept under substantially constant tension.

As shown in FIGS. 1 and 5, the overspeed torque is provided by belts 90a and 90b which run over pulleys 91a and 91b respectively on spindles of the cores C1 and C2 and are driven from a common pulley mounted for rotation on the roll support shaft 14. The pulley 92 is secured to a pulley 93 driven by a belt 94 which extends over a pulley 95 rotated with the drives for the roll driving belts 10 and 51. The drive transmission to each belt 90a or 90b causes the belt to move at a speed slightly greater than that of pulley 91a or 91b, and the tension of the belt is regulated so that it will slip continually on this pulley and yet will deliver through it to the related core a supplemental torque sufficient to keep the web layers wound closest to the core in a tight, non-slipping condition.

A typical sequence of operations of the described continuous web winding apparatus may now be described. It will be understood that the control system employed may make use of various electrical and/or pneumatic control elements of well known forms, including, for example, relays of the "latching" type, limit switches, pushbuttons, pneumatic fluid pressure cylinders, solenoid-operated air valves, and pressure regulating valves, in any of various suitable circuit arrangements. The particular control elements and control operations here mentioned are merely illustrative.

(1) With the parts in the condition seen in FIG. 1, the roll R1 increases to nearly its desired final size and then interrupts the light beam from source 41 to cell 42, whereupon a relay is deenergized to close a circuit to a motor control that energizes motor 18. The roll support 13 then is indexed clockwise to the position shown in full lines in FIG. 2. This operation may be effected by a pushbutton whenever desired.

(2) When the roll R1 reaches the final winding position, its periphery depresses limit switch 83 whereby:

(a) The motor control relay is reenergized to stop motor 18;

(b) The scanning heads 80 and 81 and panel 85 are activated;

(c) A relay is energized to shift a solenoid air valve connected with the backward end of cylinder 67 so that said end is vented and the severing lever system 64 is moved to the position seen in FIG. 2, where latch 69 restrains it against further movement; and

(d) Through the same relay, a relay is energized to shift a solenoid air valve connected with the air cylinder 60 of belt drive 50, thus admitting pressure to the backward end of this cylinder so that it swings the levers 54 and 55 counterclockwise to position belt flight 51a about the new roll core C2 as seen in FIG. 2.

The core C2 is now driven precisely at the speed of the web W and the apparatus is ready for the web severing and transfer operations.

(3) When the roll R1 is wound to the desired final size, a relay actuated in response to a signal generated by the scanning heads 80, 81, or one actuated by hand or by a scanner like that at 41, 42 in FIG. 1, is energized to move switches whereby:

(a) A solenoid air valve vents the forward end of the

latch cylinder 69b, causing pressure in its backward end to move latch 69 away from pin 68, whereupon cylinder 67 moves the levers 64 farther clockwise until roller 63 has pinched the web W into direct running contact with the periphery of core C2;

(b) A time delay relay is energized and acts, after a predetermined brief interval sufficient for a few protective layers of the web to be wound over a web layer of required circumference, to close a circuit to a solenoid air valve connected with the knife operating cylinder 75, whereupon the upper end of this cylinder is vented and pressure in its lower end thrusts the knife 70 rapidly across the path of the web W, over the anvil 71 and into the gap where belt flight 51a moves onto the core C2. The web thus is severed to form a new leading end E2 and a loose trailing end E1 of roll R1, the former being guided to the core and tucked between it and belt flight 51a and the latter being wound onto the finished roll by belt flight 10a.

(4) The timing-out action under 3(b) also energizes a second time delay relay which, after a predetermined time interval sufficient for the winding of initial layers of the web securely upon the core C2, closes a switch whereby:

(a) Motor 18 is again energized, to index the roll support 13 clockwise away from the position shown in FIG. 2; and

(b) The solenoid valve connected with cylinder 67 is deenergized to reverse the action of this cylinder, thus swinging levers 64 counterclockwise to their retracted position seen in FIG. 1.

(5) When the levers 64 reach their retracted position they depress a limit switch 88, whereby:

(a) The solenoid valve connected with knife operating cylinder 75 is deenergized to reverse the action of this cylinder and swing knife 70 counterclockwise to its retracted position;

(b) The solenoid valve connected with belt drive cylinder 60 is deenergized to reverse the action of this cylinder and swing the levers 54, 55 and belt drive 50 clockwise into their retracted position seen in FIG. 1; and

(c) A relay is energized to shift a solenoid air valve connected with the air brake 86, so that this brake is actuated to stop the rotation of the fully wound roll R1.

(6) As the roll support 13 reaches the position shown in FIG. 1, it moves a switch by which:

(a) The power supply to motor 18 is cut off;

(b) The action of the latch cylinder 69b is reversed to return latch 69 to the position seen in FIG. 1; and

(c) The relays in control circuits of the motor 18 and the air brake 86 are deenergized.

Thus the sequence of operations is completed. The apparatus with the new roll winding on core C2 at normal winding position becomes ready to enter into a repeating cycle upon replacement of the fully wound roll R1 by another new roll core.

Referring more particularly to the roll measuring action of the two photoelectric scanning heads 80 and 81, FIG. 6 of the drawings shows diagrammatically one form of a triggering circuit which may be provided at the control panel 85 to generate the required control signal in response to signals from those heads.

As indicated in FIG. 6, the scanner 81 casts a light beam upon the surface of roll R1 and by detecting light reflected from this surface emits pulses carried to point A of the first stage of a multiple-stage vibrator circuit. Point A normally is at negative potential, and the first half of twin triode tube V-1 in the first stage is biased so that it is normally non-conducting.

When a dark register mark M on the web of roll R1 intercepts the beam from head 81, the potential of point A increases and a positive pulse is applied to the first half of tube V-1, whereupon the first vibrator stage sends a positive pulse to point B of the triggering circuit.

The other scanner 80, by emitting a beam to the roll surface and detecting the reflected light, normally emits pulses holding point D of the second vibrator stage at a positive potential. The first half of twin triode tube V-2 in this stage is normally non-conducting and will conduct only when the second half of the same tube is driven to cut-off by a negative pulse passing through capacitor C6. Points C and D in this circuit being at essentially the same positive potential in static condition, a pulse coming from the first vibrator stage has no effect on the second vibrator stage unless, at the same instant, scanner 80 also detects a reduction in reflected light such as occurs when a register mark M on the wound web intercepts its light beam.

When scanner 80 is thus momentarily deprived of light, the points C and D lower to zero (ground) potential, and if a pulse is emanating at the same moment from point B in the first vibrator stage, this positive pulse, reversed in phase by the differentiating network of capacitor C4 and resistor R11, will pass through diode D1 to the second vibrator stage and cause it to generate a pulse of predetermined magnitude and direction at point E leading to the third vibrator stage.

When the second vibrator stage generates such a pulse, point E acquires a more positive potential, thus activating the third twin triode tube V-3. This tube then emits a pulse or control signal which, limit switch 83 then being closed, energizes the relay through which the latch cylinder 69b is actuated to commence the web severing operations above described.

The subject matter of this application is related to that of my copending application Serial No. 786,843, filed January 14, 1959, now United States Patent No. 3,103,320.

It will be understood that the invention herein set forth may be embodied in various arrangements and forms of apparatus other than those particularly described hereinabove and illustrated in the drawings and that the invention is not restricted to the illustrative embodiments except as may be required for fair construction of the appended claims.

What is claimed is:

1. Apparatus for winding a continuously running web into a succession of rolls, comprising:

means to rotatably support both a roll winding said web and a core for a new roll to be wound;

means for displacing said support means to displace the winding roll and said core respectively through initial, normal and final winding positions in succession, said core upon reaching said initial position being spaced from but in close proximity to said web running to the winding roll in said final position; a first drive to engage non-slipably and drive the periphery of said winding roll when it is in said normal and final positions;

a second drive to engage non-slipably and drive the periphery of said core when it is in said initial position;

means to drive both of said drives at the speed of said web;

means operative while said core is in said initial position and is being driven at said speed by said second drive to sever said web and to guide the newly created leading end thereof into non-slipping engagement with said core, thereby initiating the winding of a new roll;

and means for holding each winding roll non-slipably engaged constantly by at least one of said drives while the roll is in and while it is displaced between all of said positions, until it is fully wound.

2. Apparatus for winding a continuously running web into a succession of rolls, comprising:

means to rotatably support both a roll winding said web and a core for a new roll to be wound;

means for displacing said support means to displace the winding roll and said core respectively through

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initial, normal and final winding positions in succession, said core upon reaching said initial position being spaced from but in close proximity to said web running to the winding roll in said final position;

a first drive to engage non-slipably and drive the periphery of said winding roll when it is in said normal and final positions;

a second drive to engage non-slipably and drive the periphery of said core when it is in said initial position;

means to drive both of said drives at the speed of said web;

means operative while said core is in said initial position and is being driven at said speed by said second drive to pinch said web into non-slipping engagement with the periphery of said core, then to sever said web at a location between said core and the winding roll, and then to guide the newly created leading end of the web into non-slipping engagement with said core, thereby initiating the winding of a new roll;

and means for holding each winding roll non-slipably engaged constantly by at least one of said drives while the roll is in and while it is displaced between all of said positions, until it is fully wound.

3. Apparatus according to claim 1, said second drive comprising an endless belt to engage the periphery of said core, and said guiding means being operative to tuck said leading end into a position where it is gripped and driven between said core and said belt.

4. Apparatus according to claim 1, and means acting upon the core of each winding roll for applying thereto an overspeed torque whereby a desired degree of tightness is maintained in web layers wound thereupon.

5. Apparatus according to claim 1, and variable speed means instantaneously responsive to variations of the tension of said web to vary transiently the speed of said drives so as to eliminate the tension variations.

6. Apparatus according to claim 1, and means for actuating said displacing means to move the fully wound roll away from said final winding position while moving the new winding roll toward said normal winding position, and for then automatically braking the fully wound roll to a halt, after the operation of said severing and guiding means.

7. Apparatus according to claim 1, said severing and guiding means including:

a cutting anvil and a coacting cutting knife;

means for disposing said anvil and said knife respectively at opposite sides of said web in close proximity thereto prior to the severing operation, said knife having a cutting edge and a surface extended laterally away from said edge;

and means to displace said knife rapidly across the path of said web and over said anvil into lateral engagement with said core, whereby to sever the web and to guide the newly created web end to said core on said extended surface.

8. Apparatus for winding a continuously running web into a succession of rolls, comprising:

means to rotatably support both a roll winding said web and a core for a new roll to be wound;

means for displacing said support means to displace the winding roll and said core respectively through initial, normal and final winding positions in succession, said core upon reaching said initial position being spaced from but in close proximity to said web running to the winding roll in said final position;

a first endless belt to engage non-slipably and drive the periphery of the winding roll when it is in said normal and final positions;

a second endless belt to engage non-slipably and drive the periphery of said core when it is in said initial position;

means to drive both of said belts at the speed of said web;

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means operative while said core is in said initial position and is being driven at said speed by said second belt to sever said web and to guide the newly created leading end thereof into non-slipping engagement with said core, thereby initiating the winding of a new roll;

and means for holding each winding roll non-slipably engaged constantly by at least one of said belts while the roll is in and while it is displaced between all of said positions, until it is fully wound, said holding means including displaceable pulleys respectively positioning said first and second belts and separate yieldable means respectively acting through said pulleys to urge said belts against the winding roll and said core, respectively, with substantially constant predetermined forces.

9. Apparatus according to claim 8, further including means for pressing said web into non-slipping contact with the periphery of said core prior to the operation of said web severing means.

10. Apparatus for winding into a succession of rolls a continuously running web having repetitive patterns thereon, each occupying a given length of the web, comprising:

means to rotatably support both a roll winding said web and a core for a new roll to be wound;

means for displacing said support means to displace the winding roll and said core respectively through initial, normal and final winding positions in succession, said core upon reaching said initial position being spaced from but in close proximity to said web running to the winding roll in said final position;

a first drive to engage non-slipably and drive the periphery of said winding roll when it is in said normal and final positions;

a second drive to engage non-slipably and drive the periphery of said core when it is in said initial position;

means to drive both of said drives at the speed of said web;

means operative while said core is in said initial position and is being driven at said speed by said second drive to sever said web and to guide the newly created leading end thereof into non-slipping engagement with said core, thereby initiating the winding of a new roll;

means for holding said winding roll non-slipably engaged constantly by at least one of said drives while the roll is in and while it is displaced between all of said positions, until it is fully wound;

scanning means for sensing the circumferential size of said winding roll and generating a control signal at the moment when the outermost wind of said winding roll reaches a circumference containing a predetermined desired number of said pattern lengths;

and control means responsive to said signal for actuating said severing and guiding means.

11. Apparatus for winding into a succession of rolls a web having repetitive patterns thereon, each occupying a given length of the web, comprising:

means to support a roll winding said web;

drive means for continuously rotating said roll until it is fully wound;

means for severing said web at a location ahead of said roll and thereby creating a new leading end of the web to be fixed to a new roll core;

means for measuring an arc traversed by one of said pattern lengths in the outermost wind of said winding roll and for generating a control signal synchronized to the moment when the angle included by said arc reaches a predetermined magnitude corresponding to the presence of a predetermined desired number of said pattern lengths in said outermost wind;

and control means responsive to said signal for actuating said web severing means.

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12. Apparatus for winding into a succession of rolls a web having repetitive patterns thereon, each occupying a given length of the web, comprising:

means to support a roll winding said web;
drive means for continuously rotating said roll until it is fully wound;

means for severing said web at a location ahead of said roll and thereby creating a new leading end of the web to be fixed to a new roll core;

means for measuring an arc traversed by one of said pattern lengths in the outermost wind of said winding roll and for generating a control signal synchronized to the moment when the angle included by said arc reaches a predetermined magnitude corresponding to the presence of a predetermined desired number of said pattern lengths in said outermost wind;

and control means responsive to said signal for actuating said web severing means and causing the same to sever said web at a further moment when a predetermined number of protective layers of the web has been wound upon the wind containing said desired number of pattern lengths.

13. Apparatus according to claim 11, and for winding a web having marks regularly spaced apart thereon by a distance corresponding to the pattern length, said scanning means comprising means for directing into the path of said marks on the periphery of said roll light beams spaced apart by a distance corresponding to the chordal dimension of a pattern length of the web in a wind of the web having said circumference, and photoelectric means activated to generate said signal upon the simultaneous interception of said beams by said marks.

14. Apparatus for winding a continuously running web into a succession of rolls, comprising:

means to rotatably support both a roll winding said web and a core for a new roll to be wound;

means for displacing said support means to displace the winding roll and said core respectively through initial, normal and final winding positions in succession, said core upon reaching said initial position being spaced from but in close proximity to said web running to the winding roll in said final position; a first endless belt to engage non-slipably and drive the periphery of the winding roll when it is in said normal and final positions;

a second endless belt to engage non-slipably and drive the periphery of said core when it is in said initial position;

means for driving both of said belts at the speed of said web, including variable speed means instantaneously responsive to variations of the tension of said web to vary transiently the speed of said drives so as to eliminate the tension variations;

means acting upon the core of each winding roll for applying thereto an overspeed torque whereby a desired degree of tightness is maintained in web layers wound thereupon;

means operative while said core is in said initial position and is being driven at said speed by said second belt to press said web into non-slipping engagement

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with the periphery of said core, then to sever said web at a location between said core and the winding roll, and then to tuck the newly created leading end of the web into engagement with said core at a location between said core and said second belt, thereby initiating the winding of a new roll;

means for holding each winding roll non-slipably engaged constantly by at least one of said belts while the roll is in and while it is displaced between all of said positions, until it is fully wound, said holding means including displaceable pulleys respectively positioning said first and second belts and separate yieldable means respectively acting through said pulleys to urge said belts against the winding roll and said core, respectively, with substantially constant predetermined forces;

photoelectric means for generating a control signal when each winding roll reaches a desired size;

control means responsive to said signal for actuating said severing and tucking means;

and means for actuating said displacing means to move the fully wound roll away from said final winding position while moving the new winding roll toward said normal winding position, and for then automatically braking the fully wound roll to a halt, after the operation of said severing and tucking means.

15. Apparatus according to claim 14, and for winding a web having thereon repetitive patterns each occupying a given length of the web and marks regularly spaced apart by a distance corresponding to the pattern length, said scanning means comprising means for directing into the path of said marks on the periphery of said winding roll light beams spaced apart by a distance corresponding to the chordal dimension of a pattern length of the web in a wind of the web containing a predetermined desired number of said pattern lengths, and photoelectric means activated to generate said signal upon the simultaneous interruption of said beams by said marks.

16. Apparatus according to claim 7, said second drive comprising an endless belt and movable support means carrying pulleys having said belt trained thereover, said support means being swingable to dispose said belt in driving engagement with the periphery of said core in said initial position, and said anvil being mounted on an end of said support means.

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