

[54] MEANS AND METHOD OF WEB SLITTING
AND WINDING

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75.2

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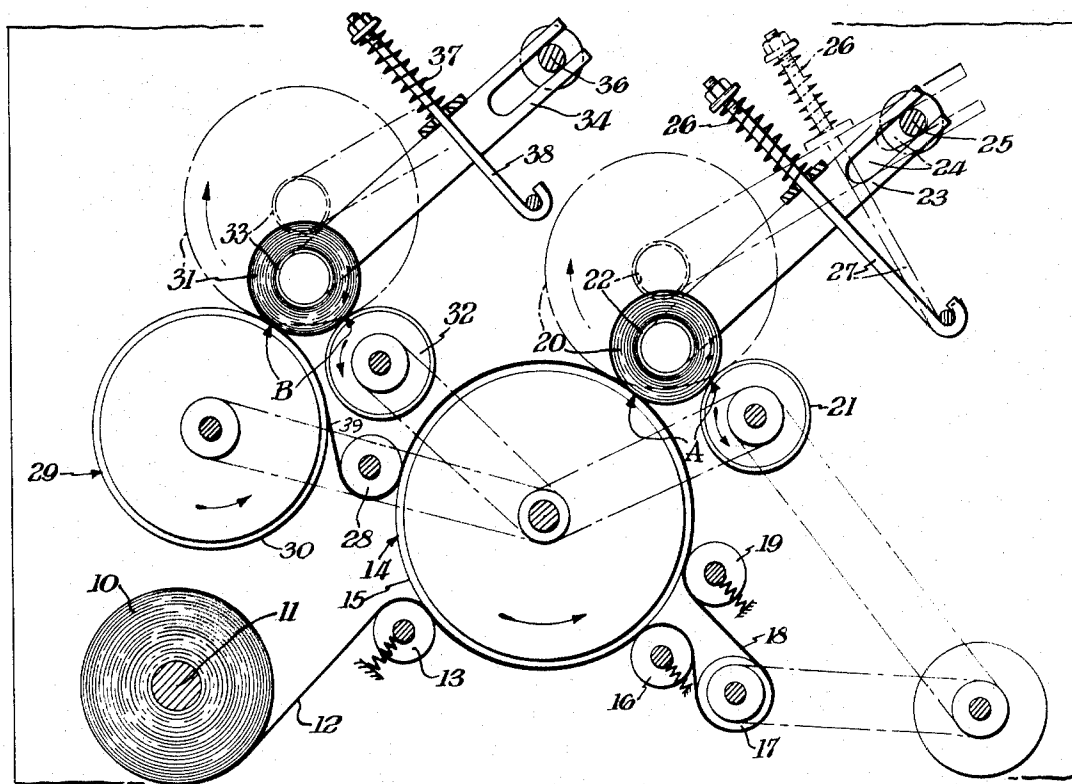
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ABSTRACT

A means and method for winding webs cut from sheet material into a compact and uniform rolls by constant contact with a pair of rotating members under a substantially uniform pressure. The roll during winding being associated with means for maintaining the roll in contact with the pair of rotating members and so that the roll axis of rotation elevates along a substantially straight line upon the accumulation of its convolutions. A tension is applied to the webs throughout travel from the slitting of the sheet material to the winding roll.

11 Claims, 2 Drawing Figures



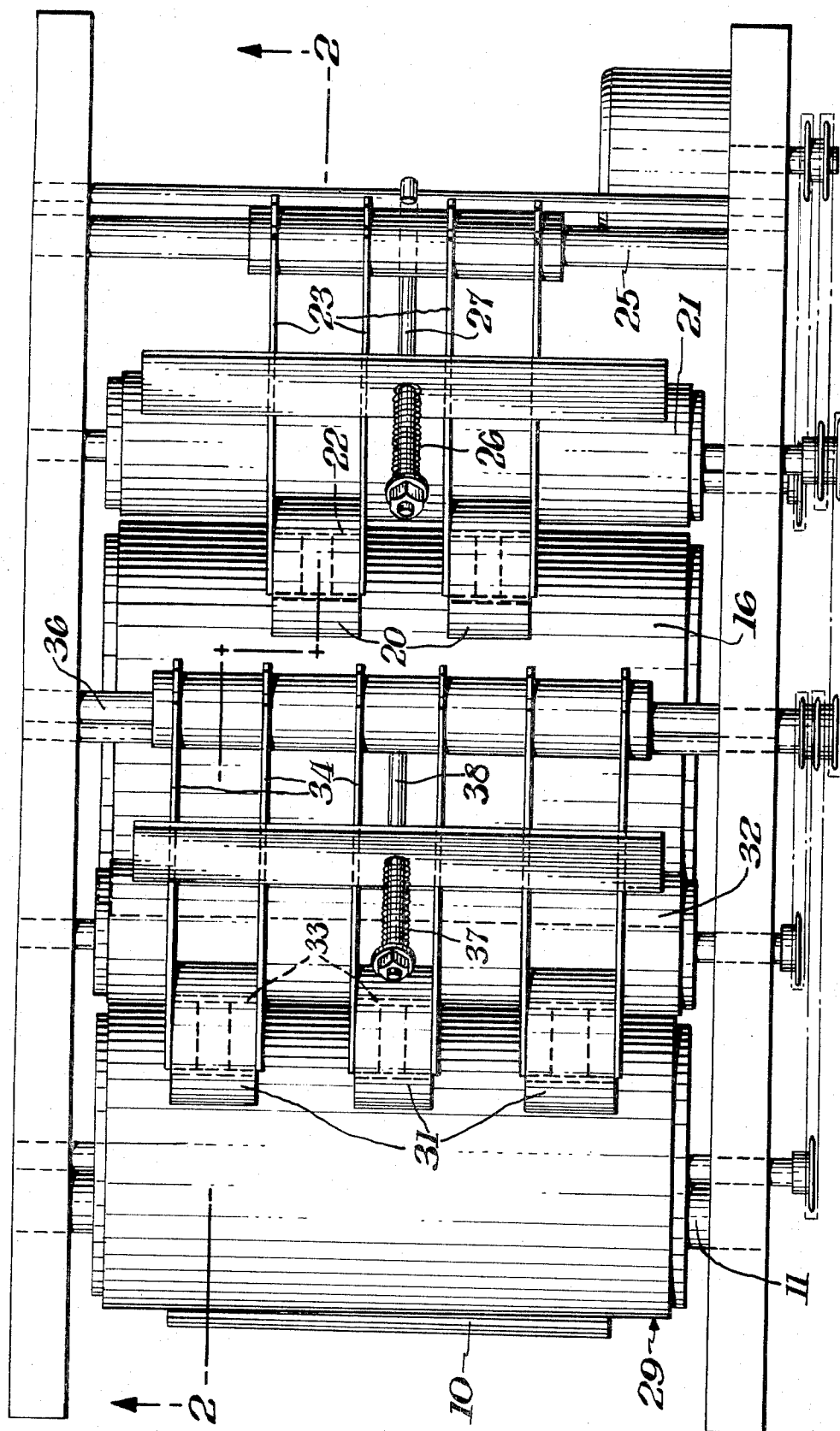
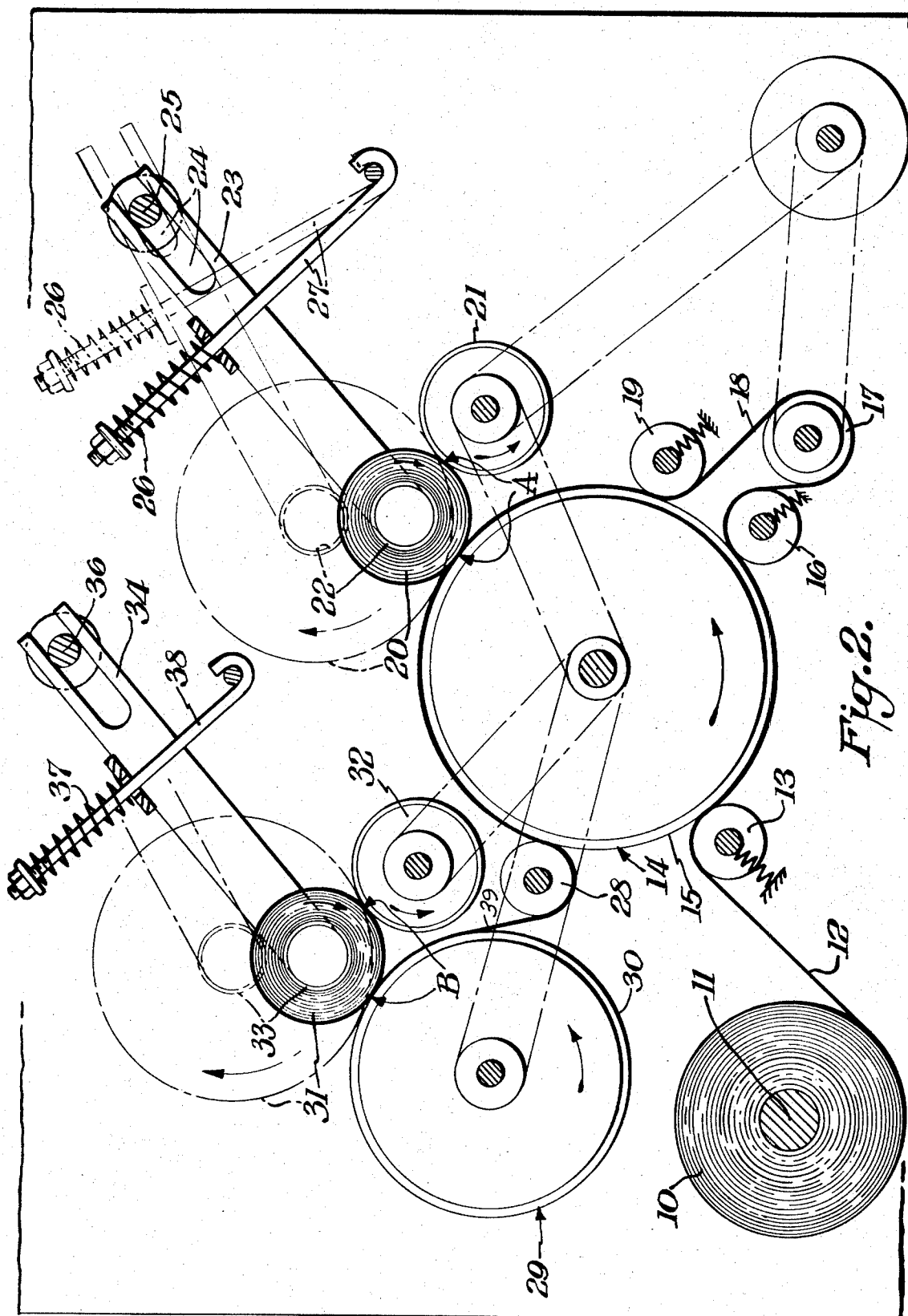


Fig. 1.



MEANS AND METHOD OF WEB SLITTING AND WINDING

BACKGROUND OF THE INVENTION

This invention relates to the winding of sheet material into rolls and more particularly to the winding of webs slit from sheet material into uniform, compact rolls. The invention provides a means and a method for uniform and compact rolling of the material with automatic adjustment to variations in the conditions of rolling and the characteristics and properties of the material.

In the rolling of material for capacitor construction, slight variations in the thickness of the material and in the tensions and pressures can result in irregularity in the quality of the rolled product and its usefulness, such as in manufacturing of capacitors. The rolling of a strip of this material has been previously performed on apparatus in which a stock material carried on a supply roll is drawn off as a continuous web of sheet material, drawn through cutting blades that slit the material into a desired width, the slit material is then pulled over a main driving roll and tension applied at the nip of the main driving roll and another roller. The main driving roll has a friction surface and the slit web is picked off this friction drum by a tension roller. In this prior technique the friction surface of the drum reduces the effect of tension of the winding roll. The nip roller where the slit material first contacts the driving roll tends to pucker-crease the material which is free to move and this affects the winding roll quality. The driven mechanism which picks the material off the driving roll is complicated and the means for driving is complex.

In the prior art techniques the changing of parts for winding various rolls is complex which decreases the flexibility of the machine. Further the pressure that the tension roller can apply to the driving roll is limited and this in turn limits the materials that can be wound.

It is an object of this invention to improve the application of tension to the wound material.

It is another object of this invention to position the core and the winding roll on the core in contact with two surfaces while the roll is being wound to apply tension to the strip being wound and maintain the roll uniformly in this position during winding.

It is a still further object of this invention to provide a uniformly compact roll of this material.

Still another object of this invention is to provide a means and method of winding a thin sheet of material on a core while maintaining a constant uniform contact of the core and a roll on the core with two rotating surfaces, and in which adjustment is automatically made to changing conditions so that the constant uniform contact is maintained.

These and other objects of this invention will be more fully understood upon consideration of the following description taken together with the accompanying drawings.

SUMMARY OF THE INVENTION

A winding machine for rolling a strip of material slit from a continuous web of sheet material which includes drums of large diameter having a polished surface and a friction roller of smaller diameters immediately adjacent to each other to support thereon between them a roll of the strip material on a core in the nip of the juxtaposed drum and roller. The smaller friction roller

which rotates in the opposite direction as the larger drum so as to increase the down pressure and a slightly higher peripheral speed thereby applying tension to the winding roll whereby the tension is effected on the strip back of the cutting medium.

The core and the roll on the core are held at the end of an arm which maintains them in a position in the nip of the drum and roller so that as the strip is wound into the roll on the core, the axis moves along a substantially straight line which is substantially vertical. The arm is bifurcated at the opposite end and rides on a stay rod slideably fitted in the fork. The arm has a combination of rotational and reciprocatory movements that allows the axis of rotation of the core to elevate along the vertical line as the diameter of the wound roll increases.

Further, the core may be mounted between a pair of bifurcated arms which being independent of each other allow the diametric ends of the core to move radially independently with a resultant tilt of the axis whereby differences in thickness of the roll may be accommodated during winding so that constant engagement of both drum and roller across the width of the roll is automatically maintained.

In addition, a down pressure may be exerted on the arm to apply pressure on the winding roll against the roller and drum. This can be adjusted to give increased drive ability and accommodate for stiffness of the base material as well as adjust the density of the building roll. It is a feature that this increased pressure increase the pressure on the package and the contact of the friction roller but does not increase the tension on the web by pulling on it.

BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 is a plan view of the winding apparatus of this invention, and

FIG. 2 is an elevation of the winding apparatus of this invention.

DESCRIPTION OF THE PREFERRED EMBODIMENT

FIG. 1 is a plan view of the winding apparatus. Referring to FIG. 2, a master roll 10 on a reel 11 provides a stack of thin sheet material which is drawn off the master roll in a continuous sheet 12. The unwound sheet 12 passes into the nip formed by a nip roller 13 and a speed setting drum 14 and then over the surface 15 of the drum 14 to another roller 16 and from roller 16 past driven knives, one of which is knife 17 (or cutting media) which slit the sheet material 12 into strips, one of which is web 18. The web 18 is drawn from the knife 17 under a drum roller 19 which is in contact only on the edges of the speed setting drum 14, not shown. The edge contact roller 19 is designed to provide tab slippage of the web 18 as by means of a recessed peripheral surface, not shown, contacting the surface 15 only at the separated regions while guiding the strip of web 18 back to the surface 15 and then over the surface 15 of the drum 14.

Referring to FIG. 1 it is seen that a plurality of webs 18 are produced on the illustrated winding apparatus of this invention. The multiple continuous webs 18 are of any of a broad range of widths and move on the surface 15 from the nip roller 19, shown in FIG. 2, under a tension described in greater detail below. Referring to FIG. 2, the drum 14 rotates in a counterclockwise direction and the web 18 moves in this counterclockwise

direction upward on the surface 15 from the edge contact roller 19. FIG. 1 shows that the plurality of the webs 18 are side-by-side and not spaced apart on the surface 15. In practice, a condition may arise wherein the webs 18 overlap at their adjacent edges.

The webs 18 are removed from the surface 15 by winding into rolls of the material while under the tension, mentioned above. In the FIG. 2 roll 20 illustrates one of a number of rolls wound at the right side of the drum 14 in the FIG. 2 from the web 18. The drum 14 has juxtaposed adjacent thereto a tension control roller 21. The tension control roller 21 is provided with a surface having a higher coefficient of friction than that of surface 15.

The roller 21 rotates in a counterclockwise direction also, and juxtaposed with drum 14, forms a nip A area between them. The nip A area extends axially between the drum 14 and roller 21 across the machine. Referring to FIG. 1, in the nip A area the alternate webs 18 are convolutely wound each into individual rolls. Roll 20 of FIG. 2 is representative of one such convolutely wound roll from the alternate webs. It will be understood that the description of roll 20 is illustrative of the rolls wound at nip A area according to this invention. However, it will be also understood that the roll 20 is rolled independently of the convolute winding of other rolls from the alternate webs 18 shown in FIG. 1.

Referring again to FIG. 2 the friction roller 21 has counterclockwise rotation, it moves at the nip A area where its peripheral surface is closest to surface 15 in a downward direction opposite to the upward direction of movement of surface 15 at the nip A area. This roller 21 peripheral surface also moves in a slightly higher velocity above the velocity of the peripheral surface 15.

A core 22 is positioned between the drum 14 and the roller 21 in the nip A area and is rotatable in clockwise direction under the driving force applied by the drum 14 and the friction roller 21. As pointed out above, web 18 is picked up from the surface 15 and is wound in convolutions on the core 22 with the roll 20. The winding roll 20 is built up on the core 22 in convolutions by the feed of the continuous web 18.

The web 18 is contacted by the friction surface of roller 21 where the winding roll 20 is in contact with the roller 21 in the nip A area. The rotating roller 21 thus grips the web 18 and by its peripheral speed which is slightly greater than the peripheral speed of winding roll 20 pulls the web 18 to apply a tension to web 18. This tension applied to the web 18 at the point of contact of the winding roll 20 and the roller 21 tenses the outer convolution of web 18 extending around roll 20 to the point where it is picked off the surface 15. The tension is applied to the web 18 on the relatively slippery smooth surface 15 and past the roller 19 to the cutting means 17. As pointed out above, the roller 19 permits web slippage and thus permits the tension to be applied to the web right through to the knives.

In addition to the tension pull applied to the web 18 at the point of contact between roll 20 and roller 21, the tension on the web 18 across the surface 15 to the cutting means is aided by the constant contact of the roll 20 at the drum 14. This contact, and particularly the pressure which may be applied, assists in avoiding undesirable reactions in the web 18 after being slit from the sheet material 12, as for example, puckering.

The contact of winding roll 20 and friction roller 21 and the contact of winding roll 20 and drum 14 associ-

ate with each other to produce the nip A area. The desired tension pull is applied to the web 18 in the nip A area and the resultant tension is present throughout the length of the web 18 from the point of its creation to and including its incorporation in the winding roll 20 as convolutions. Thus there is provided and insured the desired compactness in the resultant finished roll.

It is important to this invention and to the maintenance of the tension on the web 18 that the winding roll 20 be continually in contact with the drum 14 and roller 21. An arm 23 at its working end is attached to the core 22 by suitable bushings, not shown, so that the core 22 and the winding roll 20 on the core easily rotate on their common axis at the end of the arm 23. The arm 23 extends radially of the roll 20 to an idle end which is bifurcated by a slot 24 running into the idle end longitudinally. The slot 24 receives a stay rod 25. The slot 24 has sufficient length to permit substantial longitudinal movement of the arm 23 on the stay rod 25. The working end of the arm 23 and its attached roll 22 are positioned at the nip A area as shown in full lines in the FIG. 2.

The arm 23 is mounted so that the working end is movable in all directions independently of drum 14 and roller 21. This independent movement includes a generally rotational movement of the working end pivoting around the axis of the stay rod 25 and also a reciprocal movement in a longitudinal direction by sliding of the arm 23 on the rod 25 in the slot 24. In reciprocating the arm 23 can move forward or backward, toward the drum 14 and roller 21 and away from the drum 14 and the roller 21. In rotating around the rod 25, the arm 23 working end moves so that the associated core 22 and roll 20 tend to revolve with respect to the rod 25. It will be seen that the core 22 and the roll 20 on the arm 23 do not orbit in a circular path around the rod 25 axis. Instead, the track described by the winding roll 20 axis, as convolutions are accumulated on the roll 20, is a straight line and vertical rather than curvilinear.

The straight line elevation of the axis of the winding roll 20 occurs on the build-up of the roll 20 and is illustrated in the FIG. 2 by the showing of the arm 23, the core 22 and the roll 20 in two positions, each representing a stage in the winding. In the early stages of accumulation the position of the arm 23, core 22 and roll 20 is shown in solid lines. The broken line showing of the arm 23, the core 22 and the roll 20 represents a later stage after a substantial accumulation. The two illustrated positions at these two stages of winding show the roll 20 continually in position in the nip A area and constantly in contact with both the drum 14 and roller 21. As a result of the accumulation of convolution of web 18 on the roll 20, thin roll 20 has a greater diameter at the later stage in the winding operation. With the roll 20 continually positioned in the nip A area, the axis of the roll 20 must move upon the increase in diameter by the accumulation.

A fact of this invention is the movement of the roll 20 axis on a straight line. This straight line elevation results from the combined rotary and reciprocating movement of the arm 23. The arm 23 both turns on the rod 25 and slides on the rod 25 under the influence of the movement of its working end. Thus, the track of the moving axis winding roll 20 is concomitant with constant contact of winding roll 20 with both the drum 14 and the roller 21 according to this invention. The cons-

tant contact of the roll 20 with these two rotating bodies is assured.

It is important that a proper and adequate pressure of contact be maintained between the winding roll 20 and the drum 14 and roller 21. Adequate pressure is essential to application of the desired tension to the web 18. Adequacy of the pressure is determined by the characteristics of the web material, for example, the stiffer the web material the greater is the pressure needed to insure that the tension applied at the contact points will extend to the entire web 18 and will bring about the desired results in the web 18. Proper pressure is pressure that does not damage the material. To insure an adequate pressure of the roll 20 in the nip A area, a pressure-applying means may be applied to the arm 23 at a convenient location. As shown in the preferred embodiment of the FIG. 2, this pressure-applying means is in the form of a compression spring 26 mounted on an anchored rod 27 so as to apply the force of the compression spring 26 against the arm 23 in a downwardly direction pressing the winding roll 20 against the drum 14 and the roller 21 in the nip A area. This pressure both provides for the firm contact between the rotating parts needed for tension application and insures an increase in pressure as the diameter of the roll 20 increases. The compression of the spring 26 can cause a greater pressure in the later stages of winding than in the initial stages unless it is adjusted. It is possible to have a tension spring to overcome the weight of the arms if that is desirable.

As the arms connected to the core 22 and the winding roll 20 may move independently of one another, engagement of the material being wound into the individual winding roll 20 is maintained even when there are slight gauge differences in the material along its length. These gauge differences can cause the material to build up on one side of the core 22 at a slightly greater rate than the other side of a core 22 during winding. If the arms could not move independently this gauge difference would thus cause the smaller diameter end of the core 22 to be lifted out of engagement with the drum 14 and roller 21 by the large diameter end. This would lessen or interrupt the constant contact and pressure shown above to be of importance. With the independently movable arms 23, however, the build up on one side of the core merely moves the arm on the side of the greater build up a little more away from the nip A area while leaving the arm and the end of the roll with the smaller diameter closer to the nip A area. As a result the pressure contact of the roll 20 or drum 14 and roller 21 remains constant across the width of the web 18 as pulled under tension and wound.

In the FIG. 2 a single winding roll 20 is shown with its attached arm 23. However, this one illustrated roll 20 is merely representative of the several winding rolls which are wound simultaneously side by side on the parallel drum 14 and roller 21 as shown in FIG. 1. Each individual, independent roll is attached to its own individual arm or set of arms and turns on its own axis independent of all the other rolls simultaneously wound in the nip A area. As mentioned above the alternate webs are picked off the surface 15 at nip A area and each rolled on its individual winding roll in the manner shown for the illustrated roll 20 and supported on an arm as illustrated by the arm 23 of the FIG. 2.

As shown in FIG. 1 the core 22 is preferably supported by a pair of arms 23, one at each end of the cy-

lindrical core. The pair of arms extend parallel to each other to the stay rod 25 so that only one of the pair is seen in the elevation view of the FIG. 2. Each of the arms shown in FIG. 1 operates independently of the other connected solely by attachment to the common core and support at the common pivot line of stay rod 25. As mentioned above, each arm is independent of the other arms. As a result, any of the arms can move with both rotation and reciprocation that is different than any of the other arms. Consequently, variations in the winding rolls, such as differences arising from differences in thickness of the webs are easily accommodated without leading to loss of contact of any of the rolls with the friction roller 21 or the surface 15 of drum 14.

It will be understood that the arms are held at their sides to allow for only limited lateral motion. However, this lateral restraint does not impair the free movement described in detail above. Collars suitably positioned on the stay rod 25 adjacent the various arms are a means for providing the lateral restraint. Similarly the pairs of arms associated with a winding roll are spaced apart, as for example with a core mounted on the stay rod between the associated arms.

The alternate webs on the surface 15 not picked up at nip A are carried on by the counterclockwise rotation of drum 14 to a point where these remaining alternate webs are picked off the surface 15 by a roller 28 and passed to a second smooth surfaced drum 29. The drum 29 similar to drum 14 has a surface 30 providing low frictional resistance to the webs. This second set of alternate webs are wound into rolls in the same fashion as the first set of alternate webs at nip A described above. A roll 31 shown in the FIG. 2 is representative of the rolls wound from this second set of webs.

A nip B area is provided at the contact of the winding roll 31 with a friction roller 32 and the contact of the roll 31 with the drum 29. The roller 32 is comparable to roller 21, while roll 31 is comparable to roll 20 described above. The description above with respect to winding at the nip A area applies to winding at the nip B area. Web 39 is one of the second set of alternate webs and is wound on a core 33 to form the roll 31. The tension applied to this web 39 by friction roller 32 and by the contact of the winding roll 31 on the surface 30 extends back along this web 18 around the surface 30, the roller 28, the surface 15 to the cutting means.

Similarly, to the arm 23 for roll 20, an arm 34 is attached to the core 33 and roll 31. The idle end of arm 34 bifurcated by slot 35 rides on a stay rod 36. The description above of the action and movement of arm 23 equally applies to arm 34. A compression spring 37 on an anchored rod 38 is a means for controlling and insuring the pressure at the contacts of winding roll 31 on drum 29 and roller 32.

It will be understood that winding roll 31 is illustrative of similar rolls wound simultaneously at the nip B area. The same independence is present in the winding of these rolls as in the winding of the rolls at nip A area described above.

On prior art machines the tension is not applied to the slit web material throughout the travel from the cutting means to the winding roll. This improvement provided by the present invention overcomes the slackness and provides the tension throughout the winding from the point of slitting.

The cradle-type arrangement of the winding roll in the nip at the working end of the arm maintains engagement of the wound material despite differences in thickness from winding roll to winding roll and within a roll during a single winding operation. The process is economical to run. The arms are easily replaceable making for ease of setting up during production.

What is claimed is:

1. In an apparatus for winding a web of material by drawing the web under tension in which tension is applied to the web by a roller and the web is wound into a roll against a drum of larger diameter than the roller, the improvement comprising a friction roll, a tension means against which the web is drawn, said friction roll being juxtaposed adjacent to but spaced from said tension means, at least one arm having a working end positionable adjacent the spacing between the friction roll and the tension means, means at the working end for supporting a winding roll of the web and a flexible mount at the idle end of the arm comprised of a stationary member fixed on said apparatus and having an axis in alignment with the axis of the winding roll and means integral with the idle end of the arm in continuous sliding engagement with said stationary member and said idle end being rotatable around the axis of the fixed member, and means positioned adjacent the arm to restrict lateral movement of the arm in the direction of the axis of the stationary member but not restrict said rotatable and sliding capabilities of said arm on said stationary member.

2. In apparatus as claimed in claim 1, means for slitting sheet material into a plurality of webs adjacent to said tension means.

3. In apparatus as claimed in claim 2, a plurality of arms each having a working end positionable adjacent the spacing between the friction roll and the tension means, and means at said working ends for supporting a winding roll of one of said plurality of webs.

4. In apparatus as claimed in claim 1, a forked end formed in the arm at the idle end and the slot of the forked end slideably engaging the stationary member.

5. In apparatus as claimed in claim 1, a core connected to the working end of the arm, the winding roll being wound on the core.

6. In apparatus as claimed in claim 1, a pair of bifur-

cated arms, working ends of said arms connected to the winding roll, said stationary member being a stay rod received in the fork at the idle end of the arms, said arms being movable independently of each other.

7. In apparatus as claimed in claim 1, a surface on the tension means having a lower coefficient of friction than the surface on the friction roller.

8. Apparatus as claimed in claim 1, wherein a rotating drum having a low friction surface is the tension means and having means for rotating the drum at a slightly lower peripheral speed than the peripheral speed of the friction roller.

9. In apparatus as claimed in claim 1, means for applying pressure on the arm to control the pressure of the contacts between the winding roll and the tension means and the friction roller.

10. A method of winding a web of material into a compact roll in which the material is drawn under tension from a point where the web is free from previous restraint to a winding roll including the steps of contacting the web of material at a winding roll of the material by a friction surfaced roller to apply a tension to the web, drawing the web across the surface of a rotating drum by the applied tension, winding the tensed web into the winding roll between and in contact with the drum and the friction surfaced roller, the drum and the roller having the same type of motion of rotation, rotating the roller at a peripheral velocity slightly higher than the peripheral speed of the drum, rotating the winding roll at substantially the speed of the drum, positioning the winding roll in said contact with the drum and the friction surfaced roller on an elongated member, holding the winding roll in contact with both the drum and the friction surfaced roller by pressure on the elongated member rotating said elongated member around a fixed axis removed from the winding roll and simultaneously moving the elongated member longitudinally with respect to the fixed axis.

11. The method of winding as claimed in claim 10, in which the tension applied to the web at the contacting of the winding roll and friction roller extends along the web without restraint to the point of slitting a sheet of material into a plurality of webs which is the point of last restraint.

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