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Lorenzini et al.

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[45] **Jan. 23, 1973**

[54] **APPARATUS FOR WINDING A PLURALITY OF WEB ROLLS OF VARIOUS WIDTHS AND RADII AT A SINGLE WINDING STATION**

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[52] **U.S. Cl.**.....**242/56.2,** 242/56.9, 242/67.1 R

[51] **Int. Cl.** **B65h 35/02**

[58] **Field of Search**.....242/56.2, 65, 56.9, 75, 75.1, 242/67.1, 67.3, 156.2

[56] **References Cited**

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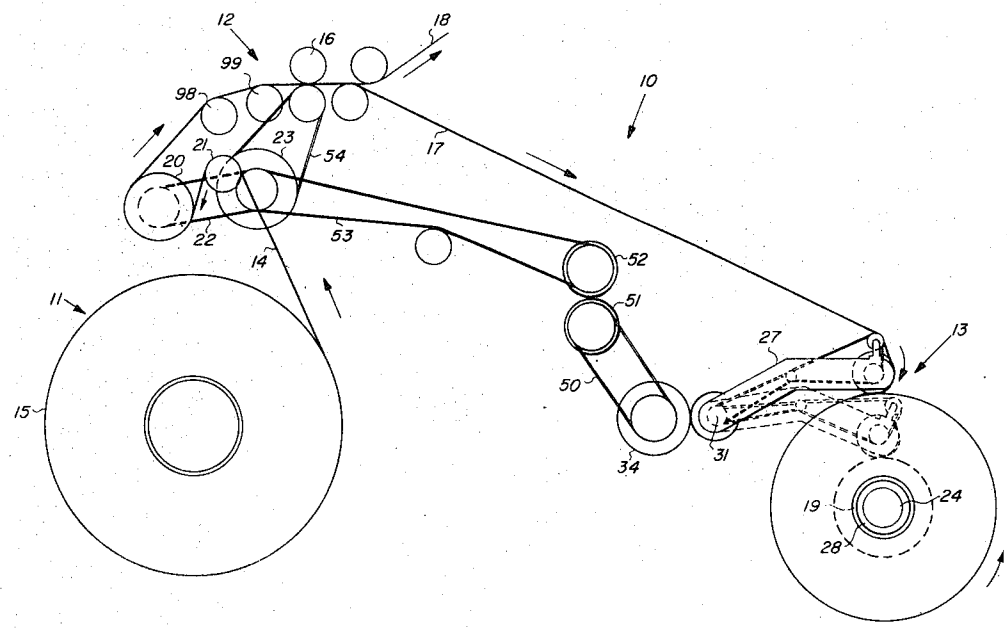
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[57] **ABSTRACT**

In combination with a slitting apparatus for slitting a stock web into a plurality of narrow strips, there is provided an apparatus for winding the strips into rolls of respective widths and respective radii at a single winding station. The apparatus includes a plurality of wind arms each having a builder roller for driving a core upon which a web is to be wound, and for maintaining web tension to facilitate the web slitting operation. The drive for the builder roller overdrives the builder roller, and includes a slip clutch which, by slipping, enables the builder roller to assume a peripheral speed which is the same as the speed of the web. The overdrive and the degree of coupling in the clutch are utilized to determine web tension. To provide improved tension control, the builder roller is driven from the same source that controls the speed of the web so that the speed profile of the builder roller is similar to that of the web. A driven air roller is mounted on the arm for positively guiding the web toward the builder roller.

6 Claims, 2 Drawing Figures



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SHEET 1 OF 2

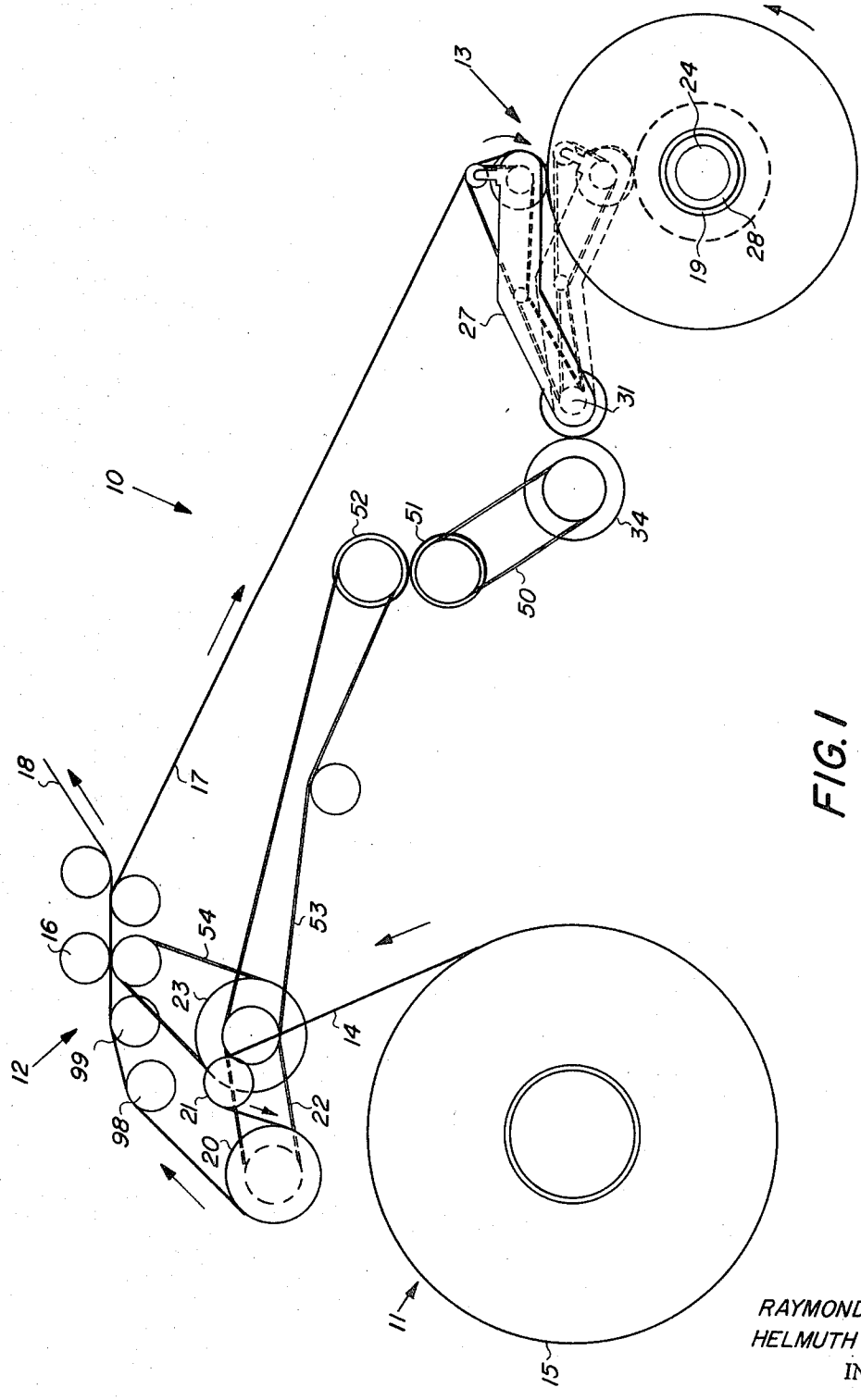


FIG. 1

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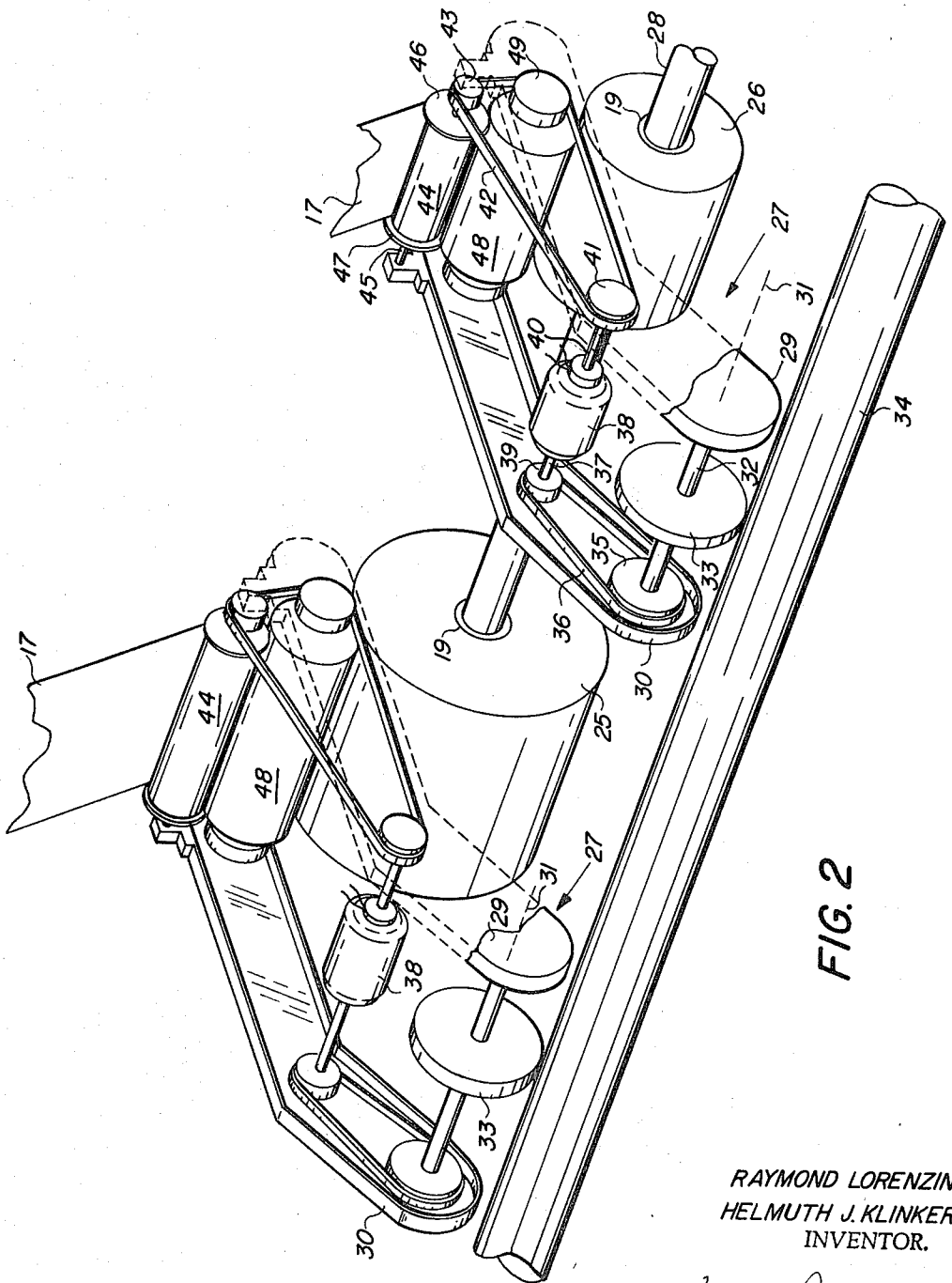


FIG. 2

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APPARATUS FOR WINDING A PLURALITY OF WEB ROLLS OF VARIOUS WIDTHS AND RADII AT A SINGLE WINDING STATION

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates to an apparatus for winding webs onto cores. More particularly, the invention provides apparatus for winding rolls of various widths and various radii at the same winding station. This invention further relates to a web winding apparatus having improved web tension control.

2. Description Relative to the Prior Art

In the production of, say, photographic film, there is a need to slit a stock roll of film into a plurality of narrower films of respective widths. As the stock roll is slit, an apparatus is required to rewind the narrower width films onto respective cores. One apparatus particularly useful for winding webs onto cores is disclosed in U.S. Pat. No. 3,387,798. In the apparatus of U.S. Pat. No. 3,387,798, a rewind arm is employed that has a contact or builder roller for removing entrapped air between adjacent convolutions of the web as it is wound on a core. At a particular winding station, a number of arms are provided to cooperate with a respective number of cores. The arms are mounted for pivotal movement about a common axis. As each wound roll grows in diameter, its respective arm is forced to pivot to maintain contact between the builder roller and the web roll. U.S. Pat. No. 3,387,798 indicates that the cores are mounted for rotation on a common mandrel, in such manner that each core can slip on the mandrel independently of the other cores to an extent corresponding to the tension of the strip of material being wound. This is accomplished by inserting spacer rings onto the mandrel between each core. Such spacer rings are individually keyed to the mandrel between each core, and the assembly of cores and spacer rings is clamped, axially, by means carried at each end of the mandrel. Because winding a wider web roll requires a substantially greater torque than when a narrower web is wound, the winding apparatus of U.S. Pat. No. 3,387,798 would have to be modified a bit in order to accommodate webs of different widths: For example, a lock ring could be provided on the mandrel **50** as to segregate wider web rolls from narrower ones. With the different width rolls so segregated, it would then be possible to apply one loading force to the assembly of wide rolls, and a smaller loading force to the assembly of narrow rolls. While this may provide satisfactory results, it requires that the slitting operation be set up so that all the wide webs are wound on one part of the mandrel while all the narrower webs are wound on another part of the mandrel.

There is at times a need to wind webs of as many as three, or four or more, different widths, and to use this lock ring technique described above in such instances may be quite burdensome.

In the course of rewinding webs, there may be a need for stopping the rewind apparatus so that a large sample may be removed, say, from one of the rolls for quality control purposes When the machine is restarted, the roll, from which the sample had been removed, will be substantially smaller in diameter. Because the tension, F, in each web is governed by the relationship $F = T/R$, where T is the torque delivered by the drive mandrel and R is the radius of the roll, it can be seen that where adjacent rolls receive the same torque — as would be the case with the above-described modified apparatus — large differences in their radii could result in large tension variations across the web as it is being slit. These large tension variations across the web may cause the web to be slit unevenly, thereby possibly resulting in unsatisfactory product.

In another prior development, a relatively thick narrow width web has been split longitudinally in half by driving the web through a web splitter. Thereafter, each web half was wound onto a core placed at a separate winding station: Each winding station consists of one rewind arm having a driven builder roller for rotating the core. The builder roller was so coupled to a DC torque motor that the builder roller was overdriven relative to the web coming from the web splitter. The motor was allowed to slip to maintain web tension.

SUMMARY OF THE INVENTION

In accordance with the invention, there is provided an apparatus for winding a plurality of strips onto respective cores at a single winding station which includes means for concentrically supporting a plurality of such cores; a plurality of pivotal arms, each arm being associated with a respective core and having (1) an overdriven builder roller for contacting a respective strip, and (2) means for driving the builder roller, the driving means including a primary drive and a secondary drive that may be slipped relative to the primary drive, whereby the overdrive which exists between the strip in question and the periphery of the builder roller is accommodated by slippage between the drives and is utilized to impart a desired tension to the web.

The invention further provides an apparatus for winding a web onto a core, which apparatus includes a pivotal arm, a builder roller, a drive means for overdriving the builder roller, such drive means including a primary drive and a secondary drive that is adapted to slip relative to the primary drive, and the improvement which comprises: Coupling means in communication with the web upstream of the builder roller and with the builder roller drive means for imparting similar speed profiles to both the builder roller and the web, thereby to provide inherent compensation for web speed changes.

It is therefore an object of this invention to provide apparatus that is capable of winding a plurality of webs of respective width within a single winding station.

It is another object of this invention to provide a web winding apparatus that allows web rolls being wound at a particular winding station to have substantial differences in their radii during the winding operation.

It is a further object of this invention to provide a web winding apparatus that has improved tension control of the web being wound.

It is a still further object of this invention to provide a winding apparatus particularly suited for the winding of very thin, but relatively wide, webs.

The invention and its objects and advantages will be more fully understood from the following description when it is read with reference to the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a side elevational view of a slitting and rewinding apparatus made in accordance with the invention, and

FIG. 2 is a perspective view of a part of the rewind apparatus shown in FIG. 1.

With reference to FIG. 1, a slitting and rewinding apparatus 10 includes an unwind station 11, a slitting station 12, and a rewind station 13. The apparatus of FIG. 1 is disposed to remove web material 14 from a stock roll 15 and to drive the stock material through a plurality of slitter knife pairs 16 that are spaced widthwise from each other across the stock web so as to cut the stock web into a number of narrower webs or strips 17,18. Even numbered webs are directed to a rewind station 13 where the webs are rewound onto cores 19. Odd numbered webs are directed to a similar rewind station, not shown.

To remove the stock web from the stock roll 15, which is mounted on a conventional unwinder, there is provided a conventional driven vacuum roller 20. The vacuum serves to urge the web 14 against the surface of the roller 20, thereby to peel positively the web from the stock roll 15. Because of the adherence of the web 14 to the vacuum roller 20, the web is driven at a speed equal to that of the linear speed of the periphery of the roller 20. An idler roller 21 is positioned between the vacuum roller 20 and the stock roll 15 to increase the angle of wrap of the web 14 about the roller 20. The vacuum roller 20 is driven by means of a belt drive 22 which couples the roller 20 to a driven roller 23; the roller 23 in turn being driven in a manner to be described below.

From the vacuum roller 20 the stock web passes over successive idler rollers 98,99 which serve to introduce the web into the nip of conventional slitter knives 16. The slitter knives are of the rotary type and are driven by the roller 23 through a belt 54. In the slitting operation, provision is made for ensuring that adjacent strips are cut with no substantial tension variations between them. As is known in the art, however, a slight tension variation between adjacent strips is desirable where the strips are of different widths — the wider strips having slightly higher tension than narrower ones. Apparatus according to the invention is particularly suited to meet these requirements.

After the slitting operation, the strips are guided toward the rewind station 13.

With reference to FIGS. 1 and 2, and with particular reference to the rewind station 13, there is provided a fixed non-rotatable mandrel 24 upon which a plurality of cores 19 are mounted. The cores are rotationally mounted on the mandrel 24 by means of conventional bearings 28. As shown in FIG. 2, web rolls 25,26 (whether adjacent or not) may be of different widths and diameters. (It should be appreciated that, while only two rolls are indicated in FIG. 2, additional rolls may be wound on the mandrel.) To wind strips 17 onto respective cores, respective rewind arms 27 are provided. Each rewind arm is lightweight and comprises a pair of spaced parallel panels 29,30 that are mounted by conventional means (not shown) for pivotal movement about an axis 31 that is parallel to mandrel 24. The panels 29 and 30 support a rotatable shaft 32 which is coaxial with the axis 31. A drive roller 33 is keyed to the shaft 32, and the roller 33 is in driving contact with a main drive shaft 34. The drive shaft 34 is connected to a conventional variable speed motor. Upon rotation of the main drive shaft 34, the roller 33 is driven and in turn drives the shaft 32. Mounted near one end of the shaft 32 is a belt wheel 35 that is keyed to the shaft 32. The wheel 35 is coupled via a belt 36 to a second belt wheel 39 that is keyed to a shaft 37. The shaft 37, which is supported for rotation by the panel 30, drives the input of a conventional hysteresis clutch 38. The output of the hysteresis clutch drives a shaft 40 which is supported for rotation by the panel 29. A belt wheel 41 is keyed to the shaft 40 and is coupled by means of a belt 42 to a belt wheel 43. The wheel 43 is keyed to a shaft 45 which is supported for rotation by the panels 29 and 30. An air roller 44 over which the web 17 is adapted to pass is also keyed to shaft 45, the air roller 44 having end flanges 46,47 which serve to prevent the web 17 from riding off the roller. The air roller, which is formed of porous material, cooperates with an air pressure source for providing a cushion of air on which the web rides.

A builder roller 48 is supported for rotation by the panels 29 and 30, the builder roller 48 having a belt wheel 49 associated with it. The wheel 49 is adapted to be driven by the belt 42. A highly frictional layer, such as of polyurethane, constitutes the web-contacting periphery of the roller 48 so as to prevent slippage between roller and web.

The radius of the builder roller is so selected that, were the builder roller to be clutch-driven without contact with the web, its periphery would attain a linear speed of about 15 percent above that of the web speed, which is determined by the speed of the vacuum roller. This difference in speed is known as "over-drive".

By coupling the main drive roller 34 to both the builder roller 48 and the vacuum roller 20, improved web tension controls obtains . . . with variations in the speed of the web drawn from the stock roll 15 being automatically compensated for by a corresponding change in the rate at which web is laid on the roll being wound. The drive coupling to the vacuum roller 20 comprises a belt 50 which drives a drive roller 51. The roller 51 is in driving contact with a drive roller 52; and the drive roller 52, in turn, drives, via a belt 53, the drive roller 23. The roller 23 drives the vacuum roller 20 through belt 22. Thus, any change in the speed of the main drive roller 34 will also be reflected in the speeds of both the web and the builder roller 48. This coordination of the web drive and the builder roller drive helps to maintain constant tension in the strips 17, thereby substantially eliminating web flutter problems.

OPERATION

Before the start of the winding operation, the cores 19 upon which the strips are to be wound are mounted on the mandrel 24. The slitting knife pairs are spaced transversely across the web so as to cut the stock web as desired and, as noted above, narrow-width strips may be cut adjacent wide-width strips. The rewind arms, each of which will be of a width corresponding to the width of strip material that it is handling, are pivotally mounted (about axis 31) into position by conventional means. Respective coupling currents are ap-

plied to the rewind arm hysteresis clutches, depending on the width of the strips that are to be handled. Since rotation of wider rolls requires greater torque than narrower ones, the current to the clutches on the wider rewind arms will be greater than the current to the clutches on the narrower rewind arms. The cut strips are affixed on the cores **19** by adhesive tape. The drive to the main drive roller **34** is then started. The vacuum roller **20** pulls the stock web **14** off the roll **15** and establishes the web speed. The stock web is then slit by the slitter knives into strips **17,18**. The strips are guided by air rollers **44** toward the builder rollers **48**. As the strips pass over the air rollers, they float on a cushion of air; and sidewise deviation of the strips is corrected by the strips being gently bounced off the air roller flanges. This is especially useful in guiding wide strips of very thin web materials. The rotation of the main drive roller **34** drives rollers **33** which in turn drive, via belts **36**, the input shafts **37** of the clutches **38**. The output shaft **40** of each clutch is driven in response to the driving of the clutch input, but the clutch output is free to slip relative to the clutch input. Since there is overdrive between the web speed and the peripheral speed of the builder roller **48**, and since the web is prevented from slipping relative to the builder roller **48**, the clutch output slips relative to its input, by action of the strip against the builder roller. In other words, a force is imparted, acting through the radius of the roller **48**, from the strip to the roller **48**, thereby providing tension in the web. The tension so formed will be a function of the amount of overdrive which is built into the rewind arm and the magnitude of clutch current. Since the operator may vary the current to each clutch, the desired tension in each strip is easily produceable. It should be appreciated that for the handling of strips of photographic material or other sensitized material, it is very important that the periphery of the air roller **44** be driven at the same linear speed as that of the strip. The reason for this is that the strip, in the course of the winding operation, will at times contact the surface of the roller and any relative movement between them could cause the web to be scuffed. The driving of the roller **44** at web speed is accomplished by having the ratio of the radii of the rollers **44** and **48** the same as the ratio of the radii of their respective belt wheels **43** and **49**.

The invention has been described in detail with particular reference to preferred embodiments thereof, but it will be understood that variations and modifications can be effected within the spirit and scope of the invention.

What is claimed is:

1. An apparatus for slitting a web into strips and for winding at least some of the strips into rolls at a single winding station, the apparatus comprising:

means for driving the web;

means for slitting the web into a plurality of strips;

means for concentrically supporting the rolls at the winding station for rotation about their axis;

a plurality of independently-pivotable rewind arms at said winding station, each of said rewind arms being associated with a respective strip;

means for supporting each of said pivot arms so that they may pivot independently of one another about a common axis generally parallel to said roll axis;

a builder roller mounted on each of said arms for pivotable movement therewith and for rotation about an axis spaced from and generally parallel to said roll axis and said common axis;

means for overdriving each of said builder rollers relative to the strips, said overdriving means comprising a plurality of slip clutches, at least one of each being coupled to and pivotable with a respective builder roller and adapted to transmit torque to drive said respective builder roller, each slip clutch including a torque input member, and a torque output member adapted to slip relative to the input member and means for coupling the input member to the output member so that said output member may slip relative to the input member, whereby the overdrive between a respective builder roller and its respective strip may be accommodated by slipping of the torque output member relative to the torque input member; and

means for coupling said web drive means to said torque input members to impart to said builder rollers speed profiles similar to that of said web drive means.

2. The invention according to claim **1** wherein each of said slip clutches is of the type wherein said coupling between said torque input member and said torque output member is a function of the electrical current applied to said clutch.

3. The invention according to claim **1** wherein said means for coupling said web driving means to said torque input members comprises a series of drive rollers and a belt drivingly coupling at least one of said drive rollers to another of said drive rollers.

4. The invention according to claim **1** wherein there is mounted on the roll supporting means a plurality of cores, at least some of which are of different widths.

5. The invention according to claim **1** wherein there is further mounted on at least some of the arms an air bearing that is positioned upstream of its respective builder roller, said air bearings having flanges at their respective ends for guiding the strip.

6. The invention according to claim **5** wherein at least some of said air bearings are rollers rotatively mounted on their respective arms, and wherein there is provided means for driving at least some of said air rollers so that the linear speeds of their peripheral surfaces are equal to the speeds of their respective strips.

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