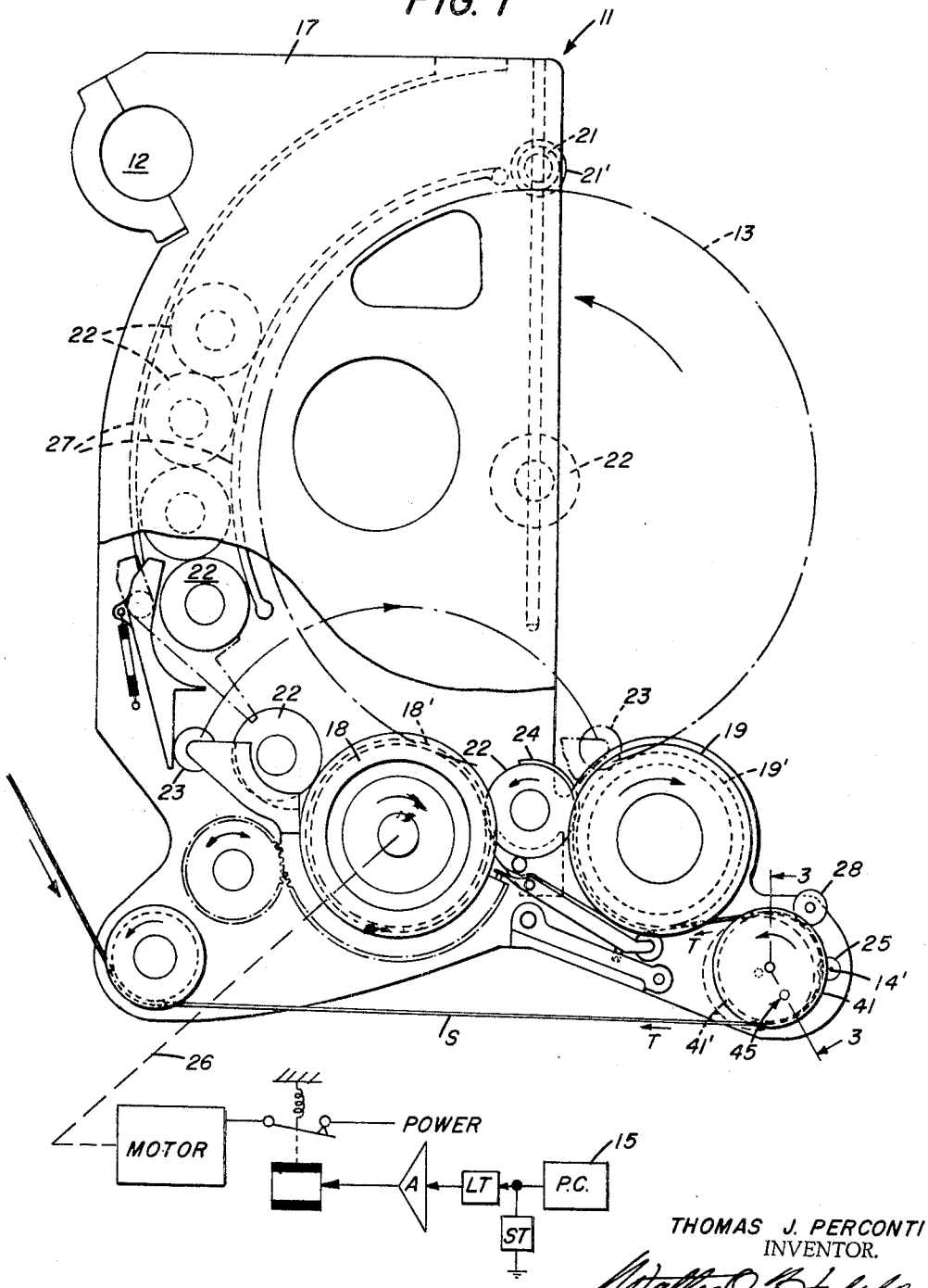
March 17, 1970 T. J. PERCONTI 3,501,105

TENSION SENSING DEVICE

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FIG. 1



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FIG. 2

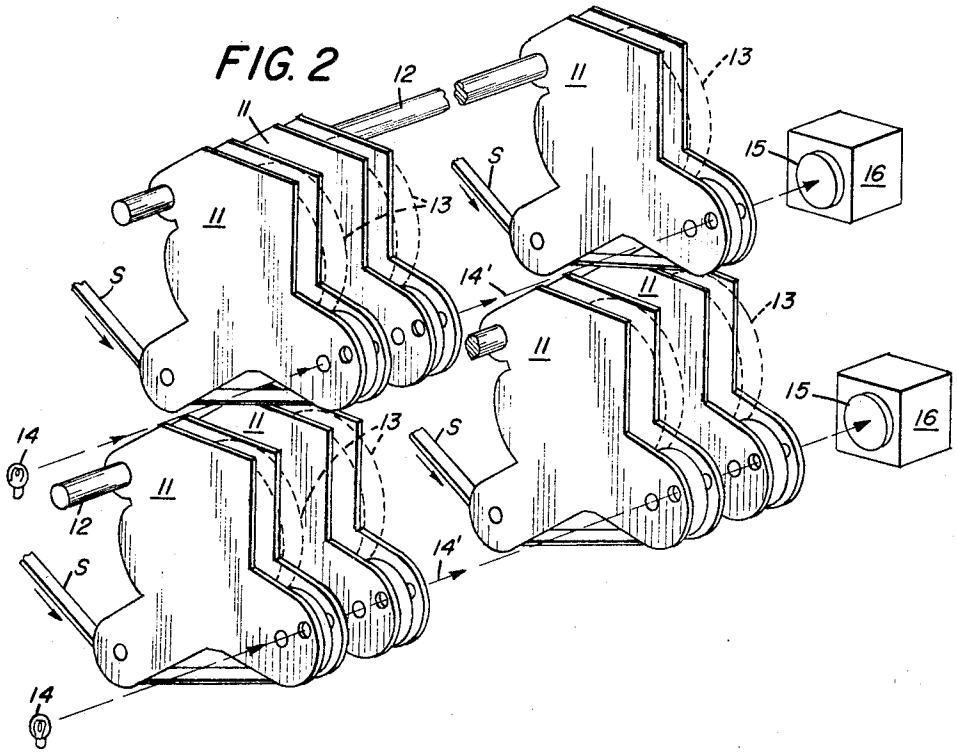
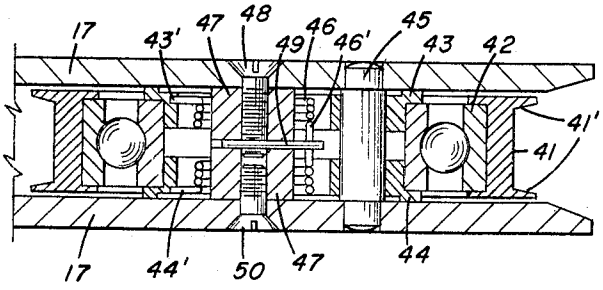


FIG. 3



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3,501,105

TENSION SENSING DEVICE

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Int. Cl. B65h 19/28, 25/10, 25/52
U.S. Cl. 242—56.9 8 Claims

ABSTRACT OF THE DISCLOSURE

An automatic apparatus for winding a first plurality of webs simultaneously and for subsequently winding a second plurality of webs simultaneously. The automatic winding apparatus has a photoelectric means for detecting when the tension in any one of the plurality of webs is absent or is below a predetermined minimum level. The apparatus is stopped if either of these tension conditions are present because they are indicative of malfunctions in the automatic apparatus.

The present invention relates to a winding apparatus for a plurality of elongated flexible elements and, more particularly, to an apparatus for sensing tension variations in webs caused by malfunctions of the winding apparatus.

While the automatic winding apparatus, described in copending U.S. application Ser. No. 766,187, filed Oct. 9, 1968 entitled Automatic Winding Apparatus and Methods, is highly reliable in its operation, it has been found that it would be desirable to detect malfunctions in the equipment as soon as possible so that they may be corrected. Also, it has been found that it would be desirable to smooth out, or dampen, slight tension fluctuations during winding. In the aforementioned application, a plurality of webs are supplied from a slitting machine and simultaneously wound into rolls by a plurality of unitized windup devices. Each of the unitized windup devices includes means for automatically introducing successive cores within the nest of the winding drums, for cinching the leading end of a successive web around the core, and for winding the web onto the core to form a roll. The core introduction and web cinching occur during a start-up phase of operation. The roll is formed during the winding phase.

It has been found that there may be various malfunctions introduced during the startup phase of operation. As disclosed in said aforementioned application, a plurality of cores are contained in each of said windup devices. This arrangement may cause malfunctions if a core is oversized and jams in the winding device, or if there are an unequal number of cores in each one of the plurality of windup devices which are operated simultaneously. Also, malfunctions may occur during the startup phase if the leading end of the web is improperly guided around a nested core during cinching. The absence of tension on a web indicates that one of the above malfunctions has occurred during the startup phase of operation.

During the winding phase, malfunctions may result from several sources. For example, the webs may become tangled or broken between the slitting machine and the unitized windup devices. An individual windup device may malfunction such as when the bearings therein are insufficiently lubricated. Also, malfunctions may be introduced by webs which are slit to an improper width which causes binding between the roll being wound and the flanges which support the roll during winding. Since the webs are normally wound at a predetermined minimum level of tension, it has been found that a gradual as well as substantially instantaneous decrease below

this level indicates that one of the above malfunctions has occurred.

While the above malfunctions infrequently occur in the automatic winding apparatus described in the aforementioned application, it should be apparent that it would be desirable to detect any of these malfunctions as soon as possible.

Accordingly, an object of the present invention is to avoid or minimize product waste or damage, damage to machine elements, and down time caused by various malfunctions in an apparatus for winding a first plurality of webs simultaneously and for subsequently winding a second plurality of webs simultaneously.

Another object of the present invention is to smooth, or dampen, slight tension flucuations in each web during winding.

Other objects and advantages of the present invention will be apparent to those skilled in the art by description of a preferred embodiment of the invention which follows.

The objects of the present invention are accomplished by providing an automatic winding apparatus, e.g. described in the aforementioned application, with means for sensing when the tension in at least one web is below a predetermined minimum tension. A preferred tension sensing means includes a movable guide roll for each unitized windup device. Each giude roll is mounted for rotation about its axis and for movement of its axis from a first to a second position. When the tension in the associated web is absent, or drops below a predetermined minimum level, the guide roll assumes the second position where the guide roll causes the activation of a photoelectric detecting means.

Reference is now made to the accompanying drawing wherein like reference numerals and characters designate like parts and wherein:

FIG. 1 is a side view, with portions broken away, of an individual unitized windup device and a schematic representation of a photoelectric detecting means according to one embodiment of the present invention.

FIG. 2 is a schematic representation of a plurality of adjacent unitized windup devices and a representation of the arrangement of the photoelectric detecting means according to one embodiment of the present invention.

FIG. 3, an enlarged cross-sectional view taken along line 3—3 in FIG. 1, shows some of the details of the tension sensing means according to one embodiment of the present invention.

FIG. 2 of the drawings is a schematic view of the upper and lower banks of a plurality of unitized windup devices **11**. The windup devices are mounted on means such as rods **12** and are arranged to receive a plurality of webs S which are wound to form rolls **13**. As described in the aforementioned copending application, the plurality of webs S may be supplied from a slitting device. As will be described in more detail in a further paragraph, the housing of each unitized windup device **11** has aligned holes **25**. The plurality of unitized windup devices shown in FIGURE 2 are arranged so that a collimated light beam **14'**, supplied from light source **14**, passes through the aligned holes **25** and illuminates a photocell **15** which is associated with means **16** for detecting the presence or absence of illumination. As will be described in a further paragraph, a malfunction in any of the unitized windup devices **11** causes the interruption of light beam **14'**.

FIGURE 1 is a more detailed view of one of the unitized windup devices shown schematically in FIGURE 2. Only the portions of these devices which are needed for understanding the present invention will be described here. However, for further details of the construction and the operation of the windup device, reference may be made to the specification of the aforemen-

tioned copending U.S. application and to copending U.S. application Ser. No. 766,241 filed Oct. 9, 1968, entitled Surface Winding Device. I intend that the description in these applications be incorporated into the present description.

Each unitized windup device **11** includes a drive drum **18** and an idler drum **19** which form a nest for core **22** which is automatically inserted to initiate the winding phase. Drums **18** and **19** have flanges **18'** and **19'** respectively which partially embrace the sides of a web roll **13** during winding. Further, roll **21**, having flanges **21'**, contacts the top of a web roll **13** as it winds when it has reached approximately 6 inches in diameter. The flanged drums and follower roll help to support the web roll **13** as it is being wound. Guide roll **41** is also mounted between side plates **17** of the housing. Guide roll **41**, having flanges **41'**, is mounted so that it can move to cover aligned holes **25** in the housing in a manner which will be described in more detail in a later paragraph.

During the startup phase of operation of each unitized windup device, top guide **23** rotates in a clockwise direction to introduce a core **22** into the nest between drums **18** and **19**. Successive cores **22** are supplied from core chute **27**. When the top guide **23** is in the extreme clockwise position, as seen in dotted lines in FIGURE 1, the automatic cinching of the leading end **24** of web S is accomplished. FIGURE 1 illustrates the point in the automatic cinching cycle where leading end **24** of web S is being guided by top guide **23** around the nested core **22**. Once the leading end **24** is cinched completely around the core **22**, top guide **23** is rotated to its extreme counterclockwise position, as shown in full lines in FIGURE 1, and winding of the web roll commences.

FIGURE 1 illustrates, in schematic form, circuitry which may be used to stop the winding apparatus if a malfunction is detected in any of the plurality of unitized windup device **11**. Photocell (P.C.) **15** is normally illuminated by a beam of light **14'**. If light beam **14'** is interrupted by a guide roll **41** due to a malfunction in any of the unitized windup devices, then the photocell produces a signal, the long term components of which are filtered out at LT and amplified at A to operate a relay to disconnect the drive motor; the drive motor being mechanically coupled through drive means **26** to the unitized windup devices. Short term components of the photocell signal, as will occur as a result of intermittent (but not faulty) interruption of light beam **14'**, are filtered to ground at ST so as not to cause operation of the relay. Long term signal components are produced in the apparatus described in the aforementioned applications when more than approximately 10 feet of web S passes around a guide roll **41** which is interrupting the beam **14'**. It should be understood that the schematic illustrated in FIGURE 1 is only by way of example and that persons of ordinary skill in the art may use other means to stop the driving of the unitized windup devices or to provide alarms, or the like, in case of a malfunction of any one device.

FIGURE 3 shows the various details for mounting the flanged guide roll **41** so that it will perform its function of interrupting light beam **14'** if tension T is either absent or below the minimum predetermined winding tension for the unitized windup device. As seen in FIGURE 3, flanged guide roll **41** is mounted on the outer race of ball bearing **42**. The inner race of ball bearing **42** is mounted on hubs **43** and **44**. During winding, the flanged roll **41** is rotated on bearing **42** while defining a path for the moving web S which is partially wrapped about and engaged by the flanged guide roll **41**. Hubs **43** and **44** are pivoted to the housing formed by plates **17** on pivot pin **45** which is off center from the center of the guide roll **41**. Torsion spring **46** urges hubs **43** and **44**, and the bearings **42** and guide roll **41** mounted thereon, toward a second position as shown in full lines on FIGURE 1 wherein guide roll **41** interrupts light beam **14'**. Torsion spring **46** acts to absorb slight tension fluctuations

introduced into the webs during winding. The guide roll **41** pivots clockwise around pin **45** when tension T decreases. The pinch roller **28** shown in FIG. 1 has an associated ratchet and can only rotate in the clockwise direction. Thus, when a web S is pinched between roller **28** and guide roll **41**, when the latter pivots in the clockwise direction, the web S will be held in the clockwise unitized windup device. This has been found to be advantageous when only the leading end of a web S lies under the flanged idler drum **19**, such as during the cleaning cycle described in the aforementioned copending U.S. application entitled Automatic Winding Apparatus and Methods. The ends of torsion spring **46** are connected to hubs **43** and **44** at holes **43'** and **44'**, respectively. Torsion spring **46** has a U-shaped loop **46'** which is engaged by an adjusting pin **49** which is rigidly attached to adjusting screw **48** and rotatable spacer **47**. Adjusting screw **48** and spacer **47** are locked in the desired position by locking screw **50**. Normally, after the leading end **24** of web S is cinched onto core **22**, tension T, as seen in FIG. 1, is developed in web S and the tensioned web S provides a force pulling the flanged guide roll **41** to the left to a first position as seen in dotted lines in FIGURE 1. During assembly of the windup device, the adjusting screw **48** in FIGURE 3 is turned and the torsion spring **46** is adjusted so that the guide roll **41** will remain in its first position under the influence of the force from the tensioned web during winding.

In one installation embodying the present invention, 85 webs of 16 mm. photographic film were simultaneously wound to form successive rolls of 18 inches in diameter. The winding was accomplished in a darkened room and a collimated infrared light beam was utilized to detect when the tension in any of the webs dropped below a predetermined minimum of about 12 oz. per web during winding, or failed to develop during startup. When tension was below the predetermined minimum for a time indicative of a malfunction, the winding apparatus was automatically stopped to avoid damage to the apparatus or waste of the photographic product.

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 winding simultaneously at least a first plurality of webs and for subsequently winding simultaneously at least a second plurality of webs, said apparatus including:

means for winding said webs under a predetermined minimum tension when forming respective convolutely wound rolls therefrom; and

means for sensing when the tension in at least one of said webs is below said predetermined minimum tension, said sensing means comprising:

a plurality of rotable guide rolls for engaging respective webs of said first plurality and defining paths for such webs during winding, and subsequently, for engaging respective webs of said second plurality and defining paths for such webs during winding, the respective axes of rotation of said guide rolls being supported in respective first positions by the respective forces exerted on said guide rolls by said webs under said predetermined minimum tension;

means mounting said guide rolls for rotation about said axes and for movement of said axes from said first position to respective second positions when the tension of said respective webs is less than said predetermined minimum;

means operatively associated with said mounting means for urging said axes toward said second positions; and

means for detecting when the axis of at least one guide roll moves to its second position.

2. The invention of claim 1 wherein said means for winding said webs includes means for supporting respective rolls during forming by partially embracing the sides thereof.

3. The invention of claim 1 wherein said means for winding said webs includes means for supplying respective cores onto which said rolls are formed.

4. The invention of claim 3 wherein said means for winding said webs includes means for guiding the respective leading ends of said webs onto said cores to initiate winding of said webs.

5. The invention of claim 1, 2, 3, or 4, wherein said detecting means includes a photoelectric cell which is illuminated by a light beam from a source when all of the guide rolls' axes are in their first positions, and which receives no illumination from said source when at least one guide rolls' axis is in its second position wherein said guide roll interrupts the light beam.

6. The invention of claim 1, 2, 3, or 4 further including means, responsive to said detecting means for stopping the winding apparatus when the axis of at least one guide roll moves to its second position.

7. The invention of claim 1, 2, 3, or 4, wherein said detecting means includes a photoelectric cell which is illuminated by a light beam from a source when all of the guide rolls' axes are in their first positions and which receives no illumination from said source when at least one guide roll's axis is in its second position wherein said guide roll interrupts the light beam, and; means, responsive to said photoelectric cell, for stopping the winding apparatus when said last-named guide roll interrupts said light beam.

8. An apparatus for winding simultaneously at least a first plurality of elongated flexible elements during a winding phase and for subsequently winding simultaneously at least a second plurality of elongated flexible elements during another winding phase which follows an automatic start-up phase of operation, said apparatus including:

means for winding every one of said flexible elements individually under a predetermined minimum tension when forming respective convolutely wound rolls therefrom, and;

means for sensing when the tension in at least one of said elongated flexible elements is below said predetermined minimum tension, said sensing means comprising:

a plurality of rotatable guide rolls for engaging respective elongated flexible elements of said first plurality and defining paths for such elements during winding, and subsequently, for engaging respective elongated flexible elements of said second plurality and defining paths for such elements during winding, the respective axes of rotation of said guide rolls being supported in respective first positions by the respective forces exerted on said guide rolls by said elements under said predetermined minimum tension;

means mounting said guide rolls for rotation about said axes and for movement of said axes from said first positions to respective second positions when the tension of said respective elements is less than said predetermined minimum;

means operatively associated with said mounting means for urging said axes toward said second positions; and

means for detecting when the axis of at least one guide roll moves to said second position during either the winding or start-up phases of operation of said apparatus.

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U.S. Cl. X.R.

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