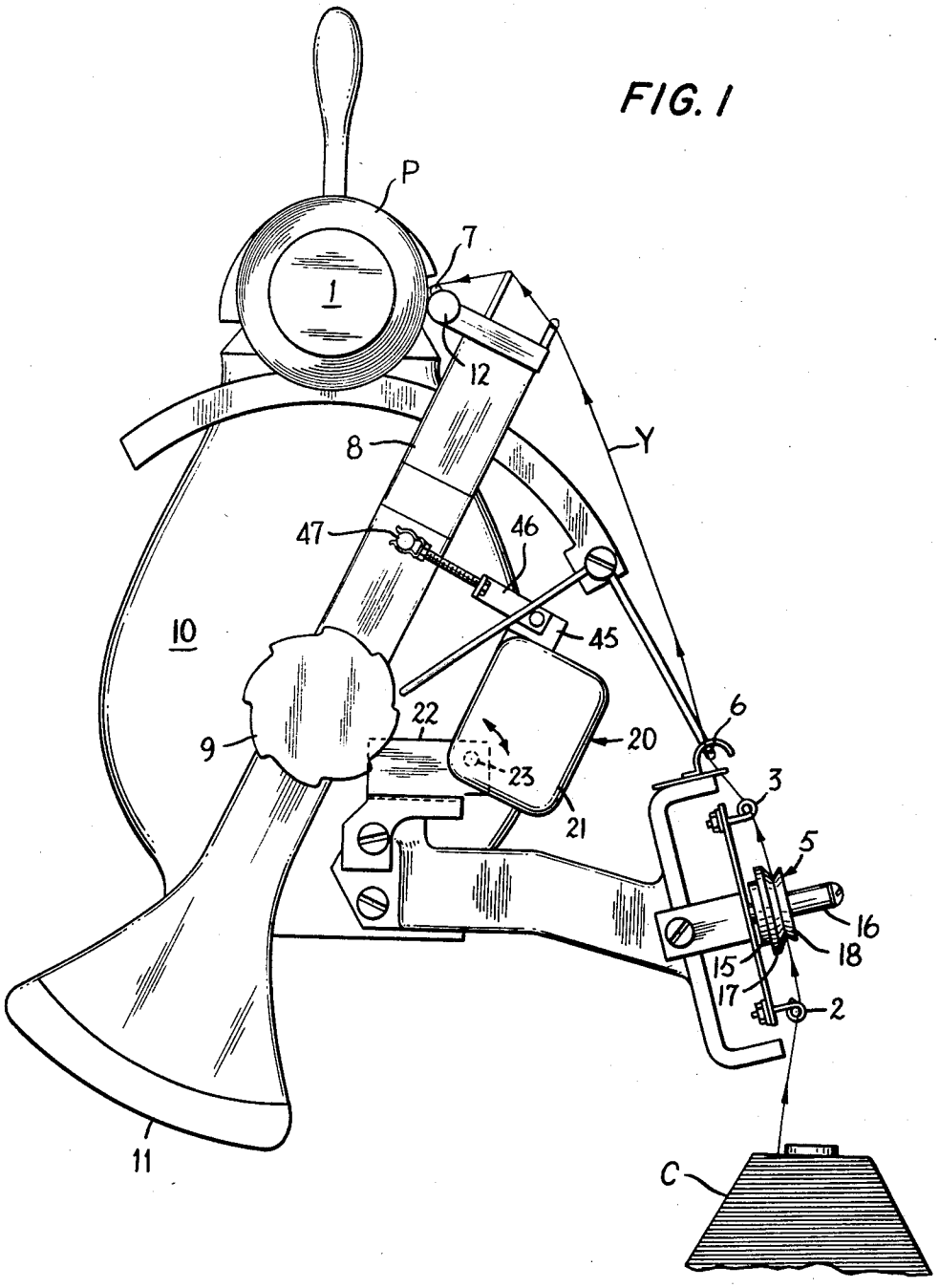
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VARIABLE CONTROL MEANS

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FIG. 1



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FIG. 2

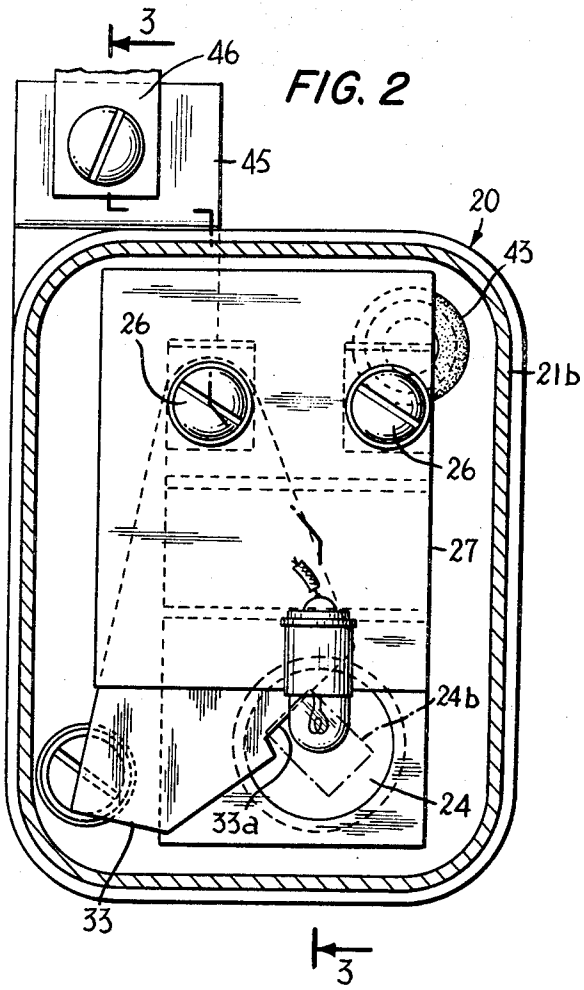


FIG. 3

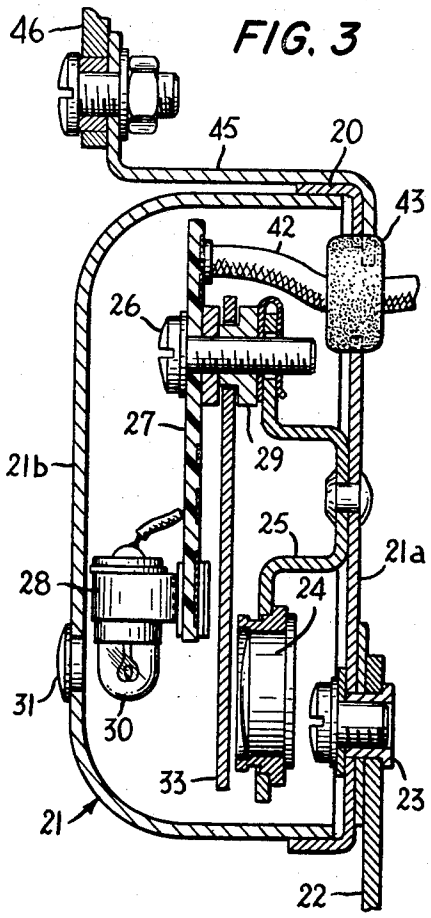


FIG. 5

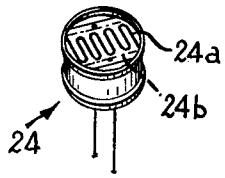
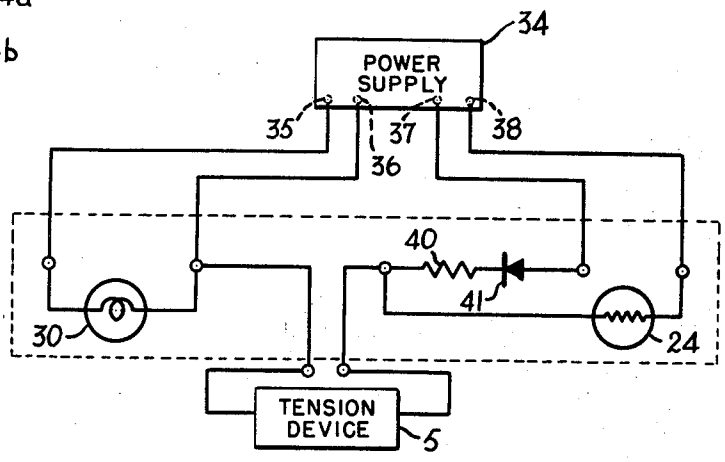


FIG. 4



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VARIABLE CONTROL MEANS

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Int. Cl. B65h 54/34, 59/00
U.S. Cl. 242—45 9 Claims

ABSTRACT OF THE DISCLOSURE

Means for variably controlling the tension on yarn as it is wound to form a package comprises electrically controlled tension means engaging and applying tension to said yarn, means for supplying power to the tension means and an electrical circuit including the tension means, the power supply and a control unit. The control unit comprises a casing mounted for tilting movement about an approximately horizontal axis, a photoresistive cell mounted in the casing, a light mounted in the casing in position to illuminate the photoresistive cell and a light shield which is freely suspended in the casing in position to hang partially between the light and the photoresistive cell and thereby partially intercept light rays from the light to the photoresistive cell to control the illumination and hence the resistance of the cell. The casing is mechanically connected to means for sensing the size of the package so that as yarn is progressively wound on the package, the resulting increase in size causes tilting of the casing so as to vary the position of the light source and photoresistive cell relative to the freely hanging light shield thereby varying the illumination and hence the resistance of the cell. The photoresistive cell is connected in circuit with the tension means so as to control the actuation of the tension means and thereby regulate the tension of the yarn as the size of the yarn package increases. The light shield is preferably shaped so as to vary the resistance of the photoresistive cell and thereby vary the tension applied to the yarn in accordance with a selected function of package size for example, a straight line fuinction.

The present invention relates to means for controlling yarn tension and to a control unit for regulating a variable yarn tension unit or other device.

In textile machines having yarn feeding means, it is necessary to control the tension at which the yarn is fed. In some instances, it is satisfactory to use fixed or manually adjustable tension means for this purpose. However, in many cases, it is desirable to provide automatically controlled tension means to maintain uniform tension despite variation of factors affecting the tension of the yarn or to provide for variation of yarn tension in accordance with the variation of a selected factor in the operation of the machine.

For example, in the textile industry when yarn is wound onto a "package" of selected configuration on a spindle rotating at constant rotational speed, the tension of yarn as it is wound on the package will increase in proportion to the size of the package. If this increase in yarn tension is not compensated, the result will be a poorly formed package which is harder on the outside than in the interior portions. The package may bulge or even collapse due to the non-uniform yarn tension.

In accordance with the present invention, there is provided an automatically compensating tension device for maintaining uniform yarn tension throughout the winding of a selected package. While the tension device in accordance with the invention is particularly useful on winding, coning, up-twisting, down-twisting and similar types of textile machinery, it is also useful in other applications where automatic control of yarn tension is desired.

In accordance with the invention, an electrically controlled tension means engaging and applying tension to the yarn is controlled by an automatic control unit comprising a casing, a photoresistive unit mounted in the casing, a light source in the casing in position to illuminate the photoresistive unit and a light shield movably mounted in the casing between the light means and the photoresistive unit and movable to intercept a variable amount of light passing from the light source to the photoresistive unit so as to control the illumination and hence the resistance of the photoresistive unit. The photoresistive unit is connected in circuit with the tension means and a power source so as to control the power supplied to the tension means. The position of the light shield is controlled by means for sensing a selected variable factor for example, the size of the package or the tension of the yarn so as to vary the position of the shield and thus the illumination of the photoresistive unit in accordance with the factor selected.

While the control unit in accordance with the invention is particularly useful in the textile industry for automatically controlling yarn tension, it may also be used in other applications.

The invention is illustrated by way of example in the accompanying drawings as applied to winding equipment for winding a yarn to form a package. In the drawings:

FIG. 1 is a somewhat schematic front view of winding equipment incorporating automatic tension control means in accordance with the invention,

FIG. 2 is a vertical section of the control unit shown in FIG. 1,

FIG. 3 is a section taken approximately on the line 3—3 in FIG. 2,

FIG. 4 is a circuit diagram illustrating a portion of the tension control circuit, and

FIG. 5 is an illustration of a photoresistive unit.

In the drawings, automatic tension control means in accordance with the invention is shown by way of example incorporated in a winding machine for winding yarn Y from a cone C onto a rotating spindle **1** to form a package P of selected size and shape. Yarn from the cone C is directed by yarn guides **2** and **3** through an electrically controlled tension device **5** through a suitable stop motion device **6** for detecting yarn breakage and thence through a yarn feeding guide **7** carried by an arm **8** pivotally mounted at **9** on the machine frame or casing **10**. The arm **8** is suitable biased, for example by a weight **11**, to swing in a counter-clockwise direction as seen in FIG. 1 so as to maintain a smooth bearing surface or roller **12** associated with the feed guide **7** in light contact with the surface of the package P. It will be seen that roller **12** follows the surface of the package P and hence as the size of the package increases, the arm **8** is progressively swung in a clockwise direction about its pivot **9**.

The yarn tension device **5** is shown as comprising an electromagnet **15**, a central post **16** of ceramic or other abrasive resistant material projecting from the electromagnet and yarn engaging tensions disks **17** and **18** surrounding the post **16** and overlying the electromagnet. The disk **17** nearest the electromagnet is preferably formed at least in part of non-magnetic material while the tension disk **18** farthest from the electromagnet is formed at least in part of magnetic material so as to be attracted toward the electromagnet when the magnet is energized. The tension disk **18** and preferably also disk **17** are rotatable about the central post **16**. The yarn Y is guided by the yarn guides **2** and **3** so as to pass between disks **17** and **18** of tension unit and preferably make a partial turn around the central post **16**. When the electromagnet **15** is energized, the outer tension disk **18** is attracted toward the magnet so as to press against the yarn passing between the disks and thereby apply tension to the yarn.

The amount of tension applied may be varied by varying the power supplied to the electromagnet **15**. The tension unit may be constructed essentially in accordance with Mindheim et al. Patent No. 2,907,535.

The power supplied to the tension unit **5** and hence the tension applied to the yarn Y is variably controlled in accordance with the invention by a control unit **20**. As illustrated in FIGS. 2 and 3, the control unit comprises a casing **21** having a base portion **21***a* and a removable cover **21***b*. The casing **21** is pivotally mounted on a supporting bracket **22** by a pivot bearing **23**. As photoresistive cell **24** is mounted in the casing by one end of a supporting bracket **25** adjustably fixed to the case **21***a*. Posts **26** carried by the other end of the supporting bracket **25** support a circuit board **27** carrying selected circuit elements and a socket **28** for an incandescent lamp **30**. The lamp **30** is positioned so as to illuminate the sensitive surface of the photoresistive cell **24**. A window **31** of material having suitable light filtering properties permits inspection to determine whether the lamp **30** is on while excluding ambient light that would affect the photoresistive cell **24**.

A light shield **33** which is at least partially opaque to light rays is freely suspended between the lamp **30** and photoresistive cell **24** by a bearing **29** on one of the posts **26**. Depending on the position to which the casing **21** is tilted about its pivot **23**, the light shield **33** partially intercepts light rays passing from the lamp **30** to the photoresistive unit **24** so as to control the amount of light reaching the photoresistive cell and thereby control its resistance. An edge portion **33***a* of the light shield **33** is contoured so as to vary the resistance of the photoresistive unit as a selected function of the angular position of the casing **21**.

The photoresistive cell **24** has the characteristic that its resistance varies in accordance with the illumination of the sensitive surface of the cell. A photoresistive cell that has been found satisfactory for this purpose is a cadmium sulfide or cadmium selenide having its active element **24***a* arranged in a sinuous path in a rectangular area **24***b* as illustrated by way of example in FIG. 5 in order to provide a greater effective length in a compact area. As the shield moves between the lamp and the photoresistive cell, light is progressively cut off from an increasing portion of the sensitive material thereby materially increasing the resistance of the cell. The current capacity of the cell is preferably sufficiently great that the cell can be used directly in circuit with the tension device **5** so that no amplification of the current is required.

A suitable electric circuit is shown by way of example in FIG. 4. A power supply **34** is provided with terminals **35**, **37** and **38** supplying regulated direct current voltage of selected values and a common ground return terminal **36**. The lamp **30** is connected across terminals **35** and **36**. One terminal of the tension device **5** is connected to the common return terminal **36** of the power supply while the second terminal is connected through the photoresistive unit **24** to terminal **38** and through a resistance **40** and crystal diode **41** to terminal **37** of the power supply. Hence current may be supplied to the tension device **5** through the photoresistive cell **24** and also through the resistance **40** of selected value. The diode **41** prevents reverse flow of current when the resistance value of the photoresistive cell **24** is low. The power supply **34** preferably includes suitable means for adjusting the values of voltage supplied at terminals **37** and **38** and thereby adjusting the tension of the tension device **5** under selected conditions. The voltage at terminals **35** for supplying current to the lamp **30** may also be adjustable if desired although this is ordinarily not necessary once the correct voltage value has been established.

Leads from the lamp socket **28** and from the photoresistive unit **24** preferably extend to the circuit board **27** on which the resistance **40** and diode **41** may conveniently by mounted. Connections from the circuit board to the power supply and to the tension device **5** are made by a flexible cable **42** which extends out through a grommet **43** in the base **21***a* of the casing. The grommet **43** fits tightly on the cable and the cover **21***b* fits tightly on the base **21***a* of the casing so that when the cover is closed, the casing is sealed so as to prevent entry of light, dirt, lint or other foreign particles into the casing.

A bracket or arm **45** fixed on the casing **21** is connected by an adjustable link **46** to a pivot post **47** on the arm **8** carrying the feed guide **7** of the winder. It will be seen that with the connections shown, rotary movement of the arm **8** about its pivot **9** causes the casing **21** of the control unit **20** to tilt about its pivot **23**. The length of the connecting link **46** is adjusted so that when the spindle of the winder is empty and the arm **8** is hence in its most counter-clockwise position, the casing **21** is in such position that the edge **33***a* of the freely suspended light shield **33** is in selected relation with respect to the photoresistive cell **24**, for example at the edge of the rectangular sensitive area **24***b* as illustrated FIG. 2. As yarn is wound onto the spindle, the arm **8** is progressively moved about its pivot **9** in a clockwise direction thereby tilting the casing **21** in a clockwise direction about its pivot **23** and causing the shield **33** to move progressively between the lamp and photosensitive cell thereby progressively shading a larger portion of the sensitive area of the cell. As the winding continues, movement of the shield **33** progresses until substantially the entire sensitive area of the cell is obscured when the winding of a package is completed.

When substantially the entire sensitive area of the photoresistive cell **24** is illuminated at the start of winding of a package, the resistance of the cell is at its minimum value and current is supplied through the cell to the tension device **5** so as to provide a selected initial value of tension applied to the yarn by the device. The initial tension is selected by adjustment of the voltage supplied at terminal **38** of the power supply **34**. As an increasing portion of the sensitive area of the cell **24** is shaded as winding of the package continues, the resistance of the photoresistive cell **24** increases. When it reaches a selected value, current is also supplied to the tension device **5** through the diode **41** and resistance **40**. During final stages of the winding of the package, the resistance of the photoresistive cell **24** is increased to a value substantially greater than that of resistance **40** so that a major portion of current for the tension device **5** is supplied through the resistance. By selection of a suitable value of the resistance **40** and adjustment of voltages supplied respectively at terminals **37** and **38** of the power supply, the starting tension, finishing tension and characteristics of the tension curve in relation to yarn package diameter can be selected. The tension curve is also affected by the characteristics of the photocell **24** and the shape of the edge **33***a* of the shield **33**.

While the control device **20** is particularly useful for controlling the tension of yarn winding mechanism as illustrated in the drawings, it may also be used for controlling other devices and has the advantage of being completely sealed so as to exclude light, dirt or other foreign particles from the interior of the casing thereby assuring long and reliable operation.

While a preferred embodiment of the invention has been shown and described, it will be understood that modifications may be made within the scope of the appended claims.

What we claim is:

1. Means for variably controlling the tension on yarn as it is wound to form a package comprising electrically controlled tension means engaging and applying tension to said yarn, means for supplying power to said tension means, and a control unit regulating the supply of power to said tension means, said control unit comprising a casing pivotally mounted to tilt about an approximately horizontal axis, a photoresistive unit mounted in said

casing, light means in position to illuminate said photoresistive unit, a light shield freely suspended in said casing between said light means and said photoresistive unit and movable relative to said photoresistive unit to intercept a variable amount of light passing from said light means to said photoresistive unit, means for sensing an increase in the size of said package as yarn is progressively wound thereon, means operatively connecting said sensing means with said casing to tilt said casing and thereby vary the position of said light shield relative to said photoresistive unit and hence the resistance of said photoresistive unit in accordance with increase in the size of said package, and an electric control circuit including said tension means, power supply and photoresistive unit to control the tension applied to the yarn by said tension means as the size of said package increases.

2. Control means according to claim 1, in which said photoresistive unit is connected in series with said tension means to reduce the current flowing through said tension means as the resistance of said photosensistive unit is increased.

3. Control means according to claim 1, in which said tension means comprises two tension members between which said yarn runs and an electromagnet which when energized exerts a force urging said tension members toward one another frictionally to engage said yarn.

4. Control means according to claim 3, in which said tension members comprise friction discs at least one of which is rotatable.

5. Control means according to claim 1, in which said sensing means comprises means for feeding yarn to said package.

6. Control means according to claim 5, in which said yarn feeding means comprises a pivoted arm, yarn guiding means carried by said arm and means for positioning said yarn guiding means close to said package as said yarn is being wound on it.

7. Control means comprising a casing, means for movably mounting said casing on a support for tilting movement about an approximately horizontal axis, a photoresistive unit mounted in said casing, light means mounted in said casing in position to illuminate said photoresistive unit, a light shield freely suspended in said casing in position to hang partially between said light means and photoresistive unit and partially intercept light from said light means to said photoresistive unit, and means for variably tilting said casing about said axis to vary the position of said light means and said photoresistive unit relative to said freely hanging light shield and thereby vary the light intercepted by said shield to vary the illumination and hence the resistance of said photoresistive unit.

8. In combination with textile machinery having a yarn feed, means for regulating the tension of the yarn in accordance with a selected variable factor, said means comprising electrically controlled tension means engaging and variably applying tension to said yarn, means for supplying power to said tension means and a control unit regulating the supply of power to said tension means, said control unit comprising a casing tiltable about an approximately horizontal axis, a photoresistive unit mounted in said casing, light means in position to illuminate said photoresistive unit, a light shield freely suspended in said casing between said light means and said photoresistive unit and movable to intercept a variable amount of light passing from said light means to said photoresistive unit and thereby control the illumination and hence the resistance of said photoresistive unit, means for sensing variation of said selected factor, means connecting said sensing means with said casing to tilt said casing and thereby vary the position of said light shield relative to said photoresistive unit and hence the resistance of said photoresistive unit in accordance with variation of said factor, and an electric control circuit including said tension means, power supply and photoresistive unit to control the tension applied to the yarn by said tension means in accordance with the resistance of said photoresistive unit.

9. Control means according to claim 8, in which said light shield has an edge contoured to vary the illumination and hence the resistance of said photoresistive unit in accordance with a selected function as said casing is tilted about said axis.

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STANLEY N. GILREATH, Primary Examiner

U.S. Cl. X.R.

242—150; 250—237