Nov. 26, 1968 G. POLESE 3,412,949

COP WINDER WITH CONTROLLED OR PROGRAMMED YARN TENSION

Filed July 7, 1966 2 Sheets-Sheet 1

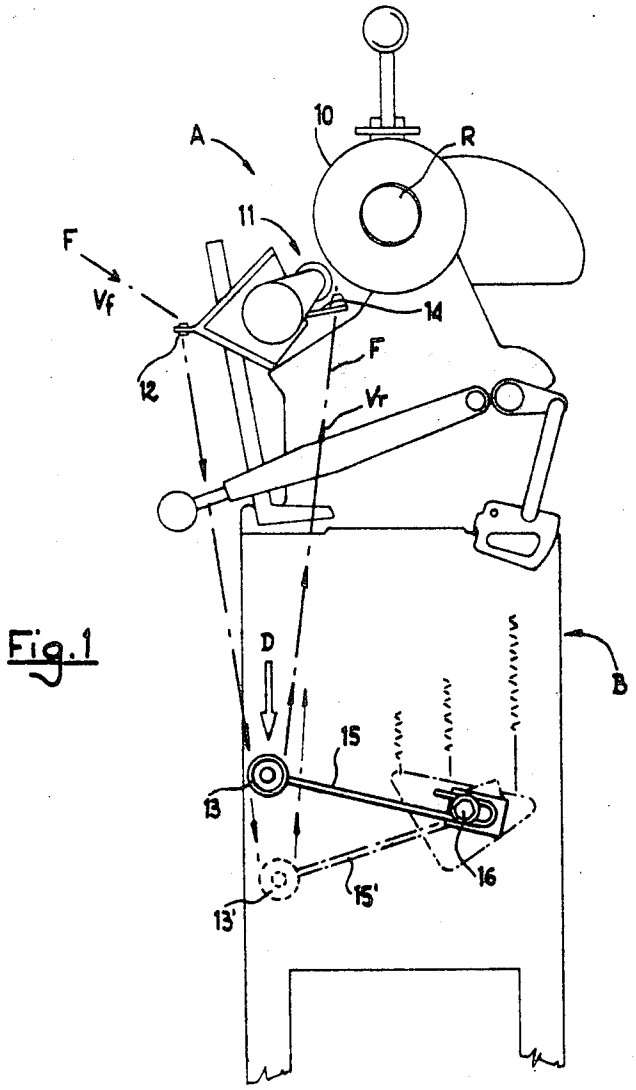



Fig. 1

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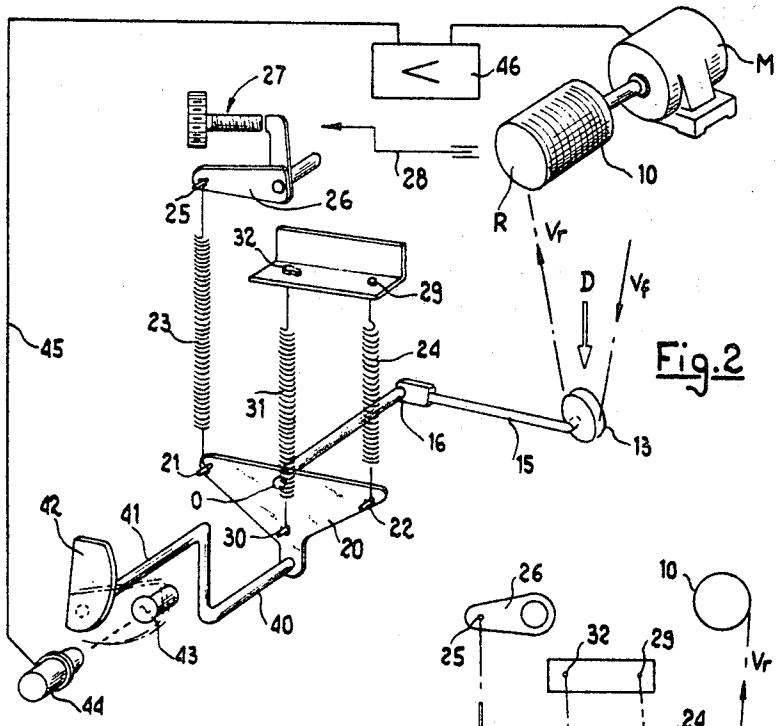



Fig.2

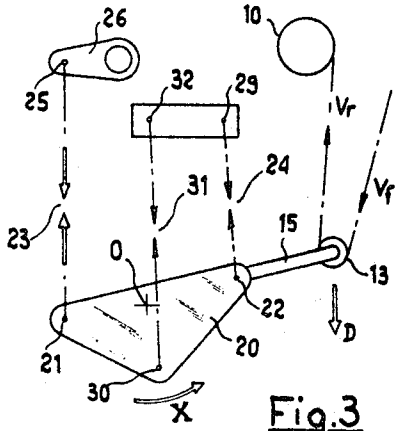



Fig.3

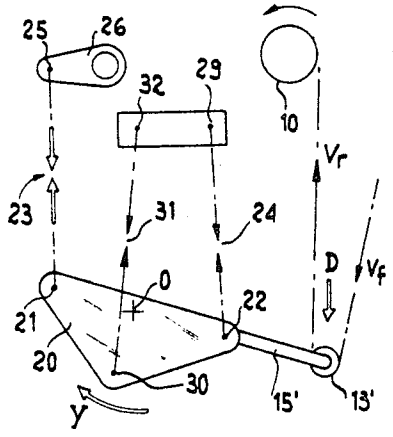



Fig.4

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United States Patent Office 3,412,949 Patented Nov. 26, 1968



3,412,949

# COP WINDER WITH CONTROLLED OR PROGRAMMED YARN TENSION

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Filed July 7, 1966, Ser. No. 563,440
Claims priority, application Italy, July 13, 1965, 6,839/65
12 Claims. (Cl. 242—45)


## ABSTRACT OF THE DISCLOSURE

A yarn feeler means, for a yarn winder, includes a dancer pulley carried rotatably by a pivotally supported arm pivotal about the axis of a mounting shaft, the dancer pulley being engaged in a loop of the yarn in advance of the yarn winding means. A lever is secured to the shaft to pivot with the arm, and first and second springs extend between fixed points and points on the lever on opposite sides of the pivot axis of the shaft. The first spring biases the arm in a direction to extend the loop, and the second spring opposes the bias of the first spring. A third spring is connected between a fixed point and a point on the lever which, in the mean position of the arm means, is on a line intersecting the pivot axis and the fixed point connection of the third spring, the pivot axis lying between the fixed point connection of the third spring and the connection of the third spring to the lever. As the lever swings from the mean position in one or the other direction, one or the other of the first and second springs has its force increased and the other thereof has its force decreased. Due to the particular connection of the third spring to the lever, this connection is moved to one side of the mentioned line and the third spring augments the force of that one of the first and second springs whose force has been decreased. Thereby, a substantially constant force is maintained on the dancer pulley and the loop.

The yarn winder is driven by a variable speed motor, and the speed of this motor is controlled in response to movement of the feeler means. For this purpose, a shutter is connected to pivot with the mentioned shaft and intersects more or less of the light passing from a light source to a photocell, this photocell providing a signal to an amplifier which controls the speed of operation of the variable speed motor.


This invention relates to a device or equipment for winding cops, bobbins or the like, and in particular to wind textile yarns on cops, bobbins or the like, under pre-established and controlled conditions of yarn tension. The device according to the invention is particularly, but not exclusively, designed for the winding of man-made and synthetic yarns, or at any rate of yarns which, due to their inherent nature and/or to special requirements to be fulfilled in the application thereof, are to be wound under rather exacting, pre-established conditions of yarn tension.

More specifically, the object of this invention consists in the provision of a device for the purpose as stated above, and which is usually called "cop winder" or "winder" in the art, such being device designed to operate at high speeds, and to wind the yarn, which is fed thereto, at a pre-established speed.

As already well known, such devices are to be equipped with particularly sensitive and complex mechanisms, if the required steadiness in the tension of yarn which is being wound is to be attained. Moreover, the r.p.m. of the prime mover, by which the winding equipment is powered, has to be controlled in such a manner as to compensate all changes in the two determining operational factors—i.e. the speed at which the yarn is fed, and the winding speed, or momentary tangential speed, of the winding which is being formed—in such a manner as to keep them in a pre-established ratio, that may be equal to, or different from the unitary.



In most cases, the above variations are detected and controlled by means of a loose pulley or guide roller, that is usually fitted at the end of a swinging arm, and where motions are utilized, for the control of said speed, through suitable follow-up systems. The tension of the yarn attaining the bobbin is also determined by the same mechanism, since a given force is applied to said loose pulley, or more specifically to the swinging arm by which this pulley is supported, all as described in more detail later on.

Since said guide or "jockey" pulley is unavoidably swung while the device is in operation, remarkable difficulties have been encountered in ensuring that the opposing force, which is applied to swinging the arm in order to maintain the yarn under the required tension, be strictly constant, or be caused to follow all changes of a pre-set program, whatever the momentary position of the pulley and related arm may be.

Thus, e.g. in some already known types of cop winders, recourse is had to complex electromechanic devices for detecting the different positions taken by the jockey pulley. As an example, changes in electromagnetic induction conditions, and changes in elastic means by which the swinging motions of the pulley carrying arm are counteracted, are utilized in such devices. In other cases, recourse is had to counteracting means based on the force of gravity—e.g. a weight that is connected under geometrically constant conditions with the pulley carrying arm—in order to eliminate the changes in elastic resistance which are unavoidably associated with the elastic deformation of the above counteracting system. However, said gravity systems are subjected in turn to heavy limitations; thus, e.g. they do not allow a programmed change in the counteracting force.

Considering the foregoing, the object of this invention resides in a special winder which is not subject to the abovestated operational limitations, and that therefore possesses a number of prominent technical advantages from the viewpoint both of the application and of the reliability of operation at the high working speeds required by modern techniques.

In more detail, the object of this invention consists in the provision of a device of the mentioned type, and for the above stated or equivalent purposes, which is characterized in that it comprises elastic means for counteracting the tension applied to yarn, and is such as to show practically no variation in the counteracting force, whatever the momentary position taken by the jockey pulley may be within a pre-set useful range of positions, or within given limits of motion.

The invention covers also a device of the mentioned type and for the above stated purposes, characterized in that it comprises means for detecting all changes in the position of the jockey pulley, thereby to control the motor r.p.m., and which does not oppose any frictional or other resistance to the motion of the pulley, whereby no prejudicial variation is caused in the counteracting force by which the tension of yarn being wound is determined.

According to the invention, the mentioned advantageous technical advantages are obtained by a mechanical assembly embodying a structure, such as a pivotally supported arm which is swung as a function of the position

taken by the jockey pulley as well as of a function of a set of springs that are, in part, designed to exert a counteracting force on the arm. These springs also in part are for the purpose of partly compensating for the applied elastic counteracting force. The assembly includes at least one spring that is so connected with the pivotally supported structure that it will, under certain conditions, reverse the direction of application of its bias to the structure, to compensate for the oppositely directed variations and the elastic resistances as exerted by respective compensating and counteracting springs, and in depedence on swinging motions of the pivotally supported structure.

The device embodying the invention also comprises a photoelectric system serving as a control element for the prime mover or driving means for the winder. This photoelectric system includes a light source and a photosensitive means, such as, for example, a photocell or a photoresistor, serving to produce a change in an electric signal upon variation of the light incident thereupon. This photoelectric system further includes a shielding means mechanically connected with the pivotally supported structure and adapted to intercept a variable amount of the light from the light source directed onto the photosensitive means. Thereby any variation in the position of the pivotally supported structure, and thus of the jockey pulley, will result in a change in the excitation of the photosensitive means and the corresponding variation in the output electric signal thereof. Their latter variations are utilized, after suitable amplification, for correspondingly varying, as either a direct or reverse function, the speed of the prime mover driving the winder.

The above and further advantageous features of the device according to the invention will be better understood from the following description of a typical embodiment thereof as illustrated in the accompanying drawings, and which description and drawings are given by way of example and not by way of restriction.

In the drawings:

FIG. 1 is a front elevation view of the cop winder illustrating, in simplified form, all parts thereof with which the invention is not concerned, while those parts by which differences between the yarn feeding speed and the yarn winding speed are determined have been graphically emphasized;

FIG. 2 is a somewhat diagrammatic perspective and exploded view of a device embodying the invention, illustrating schematically the interconnection of the several parts thereof; and

FIGS. 3 and 4 show, in a wholly diagrammatic form, the operation of the device by which a compensated, elastic counteracting force is applied.

The cop winder may be advantageously realized e.g. as shown in the FIG. 1, wherein it comprises a base B, whereon an operating head A is supported, this head being fitted with a winding spindle R on which the bobbin **10** is wound with yarn suitably and cyclically distributed by means of an appropriate distributing device **11**, to which the yarn F is fed at a preestablished speed V*f*, and then wound at a speed V*r* corresponding to the momentary tangential speed of the bobbin which is being wound.

The incoming yarn F is first passed through a suitable thread guide **12**, then over a guide pulley **13** to thread guide **14** of distributor **11**. Guide pulley **13** is rotatably supported e.g. at the outer end of an arm **15**, which is pivotally supported by a shaft **16**. Spindle R is driven, directly or through a suitable transmission, by an electric motor M, as diagrammatically shown in the FIG. 2.

A force acting in the direction D is applied to guide pulley **13** through the means which will be hereinafter described, thereby determining the tension under which the yarn is wound on the bobbin **10**. Such force, which as a rule is very small (depending on the count of yarn and on further already known factors), is to be kept practically constant, or is to be changed according to gradual changes in the bobbin diameter. At any rate, this force is to be kept under strict control and no variations should occur, at least theoretically, in it, whatever the positions which can be taken by pulley **13** during the course of winding operation.

Such changes in the position of pulley **13**, i.e. the swinging motions of arm **15**, are in turn utilized for controlling the speed of motor M, and thus also the rotary speed of bobbin **10**, whenever the proper ratio of feeding speed V*f* to winding speed V*r* is not maintained, owing to momentary trouble, as well as owing to the gradual increase in the diameter of the wound bobbin. By assuming, e.g., that the winding speed V*r* is, at a given moment, lower than the speed V*f* at which the yarn is fed, then the pulley **13** will be moved downwardly under the action of force D, thus taking a new position **13'**, whereby the arm **15** is swung down to position **15'**. A reversed motion occurs when the winding speed V*r* is higher than the yarn feeding speed V*f*. As can be readily appreciated, in such cases the r.p.m. of motor R should respectively be increased and decreased to restore the proper speed ratio.

Two conditions are therefore to be fulfilled if the above effects and interventions are to be obtained, i.e.:

(a) In order to keep the yarn under the required tension, the force D shall not be influenced by the swinging motions of arm **15**.

(b) The feeding of motor M shall be coordinated with the swinging motions of arm **15**, without however inducing additional resistances, or at any rate changes in force D, by the action of coordinating means.

The technical solutions provided by the invention in order to obtain this combination of effects, as well as the fulfillment of both of the above conditions, are shown in FIG. 2.

Connected with shaft **16** is a rigid structure **20**. Such structure may advantageously consist of a shaped arm, oscillatable about an axis (**0** in FIGS. 3 and 4) represented by the axis of shaft **16**. A counter spring **23** and compensating spring **24** are connected with respective ends **21** and **22** of arm **20**, and one of these springs **23** and **24** (and preferably, but not necessarily the counter spring **23**) is anchored as at **25** to a device **26** that can be manually or automatically adjusted when the need arises to change the calibration of the spring. A device, that may take any form suitable for the manual adjustment of such calibration, is illustrated at **27** in FIG. 2. Other means, forming no part of the claimed invention, may be used to adjust the spring calibration, as schematically illustrated by the arrow **28**.

The opposite end of the other spring (compensating spring **24** in the example) is anchored as at **29** at a fixed point, although suitable means may be provided for adjusting the bias of the second spring.

Secured to a point **30** of said structure **20**, such point **30** being located, in the considered example, below the axis **0** of shaft **16**, is one end of a third spring **31**, whose opposite end is connected to a fixed point **32**, preferably with the interposition of means designed for changing the calibration of spring **31**. Spring **31** extends in a direction such that, when said structure **20** is in its middle position (as shown approximately in FIG. 2) points **30** and **32** are aligned with the pivotal center **0** of structure **20**. Therefore, when such condition exists, no force, tending to swing structure **20** in either direction, is exerted by the spring **31**.

Thus, under the above conditions, the force D, as applied to guide pulley **13**, is determined not only by the length of arm **15**, or at any rate by the geometric and dimensional parameters of the pivotally fitted assembly, but also by the difference between the forces that are exerted by the counter spring **23** and compensating spring **24**, as well as by the adjustment of the counterspring. On the other hand, it is well known that the bias of a spring unavoidably changes as a function of its loading. In the considered case, wherein use is made of tension springs,

the bias thereof increases as a function of the elongation thereof.

By assuming, as an example and as shown in FIG. 3, that the arm **15** is swung upwardly due to a positive change in the winding speed V*r* relative to the feeding speed V*f*, then the counter spring **23** is elongated, while the compensating spring **24** is compressed. In such a case, an increase in the force D, as applied to guide pulley **13**, would occur. However, under the above conditions, a change takes place in the position of third spring **31** in respect to pivot axis **0**, since the application point **30** of its force to the structure **20** is shifted to a new position, wherein structure **20** is acted upon by a new force, tending to swing it in the direction X, thereby compensating both the increase in the force applied by the counter spring **23** and the decrease in the force applied by the compensating spring **24**. A reverse action would occur when the guide pulley is swung downward, as shown in FIG. 4, since the line by which the anchoring points **30** and **32** of third spring **31** are joined with each other is shifted to the opposite side of pivot point **0**, thereby inducing an added force in the structure **20**, which is thus urged to swing in a direction Y opposite to the previous swinging direction. As a consequence thereof, the reversed changes in the forces of both springs **23** and **24** are again compensated.

By suitably dimensioning the different fixed, movable and elastic components, and by an accurate geometric predetermination of the points **21**, **22** and **30** wherein the force of the springs is applied to structure **20**, relative to pivot axis **0** thereof, the required effect of a substantial uniformity of the force D can be attained, irrespective of the momentary position taken by the guide pulley **13**, within the limits of the arc across which this pulley can be moved in the practical operation of the winder.

The force D, in turn, should not suffer any change, due e.g. to frictional resistances or the like, in the means by which the swinging motions of arm **13** are utilized to control the r.p.m. of motor M. The solution of such a problem is also shown, again as an example, in FIG. 2. By means of a suitable connection **40**, the shaft **16** is extended as at **41**, and is connected with a darkening means, as e.g. a suitably shaped shield **42**, that can be gradually brought between a light source **43** and a photosensitve means **44**, e.g. a photoresistor due to rotary motion of the shaft, and thus of the arm **15**. Thus, according to the momentary position of darkening means **42**, the excitation degree of photosensitive means **44** will be more or less changed, no frictional resistance being encountered in the course of the motions of the darkening means.

The signal obtained at the output of photosensitive element **44** is applied, through a suitable circuit diagrammatically indicated by numeral **45**, to an amplifying system **46**, and then utilized in the already known manner to act upon the motor feding, e.g. on the excitation circuit of motor M in order to control the r.p.m. thereof, and to obtain the above stated effects of restoring the required ratio of yarn feed rate V*f* to yarn winding speed V*r*.

As it can be readily appreciated, the abovedescribed device may be augmented by many other means and mechanisms. For example, recourse may be had to balancing masses or to other suitable means, to ensure that the assembly, which can be swung around the axis **0**, is always kept in all of its positions, in the required conditions of stable equilibrium. While a specific embodiment of the invention has been shown and described in detail to illustrate the application of the principles of the invention, it will be understood that the invention may be embodied otherwise without departing from such principles.

What I claim is:

**1.** In a yarn winder including rotatable yarn winding means, a variable speed motor driving the yarn winding means to wind thereon yarn which is fed thereto at a substantially constant feeding speed, yarn feeler means including pivotally suported arm means and a spring biased dancer pulley carried rotatably by the arm means and engaged in a loop of the yarn in advance of the yarn winding means, and means responsive to swinging of the dancer pulley about the pivot axis of the arm means, from a mean position of the arm means, to adjust the motor speed to compensate for differences between the yarn feeding speed and the yarn winding speed: improved yarn feeler means comprising, in combination, first spring means connected between a fixed point and a point on said arm means spaced from said pivot axis, and biasing said arm means in a direction to extend said loop; second spring means connected between a fixed point and a point on said arm means spaced from said pivot axis and opposing the bias of said first spring means; and third spring means connected between a fixed point and a point on said arm means which is spaced from said pivot axis and which, when said arm means is in said mean position, is on a line intersecting said pivot axis and the fixed point connection of said third spring means; whereby, when said arm means is swung in one direction or the other about its axis, as the result of difference between the yarn feeding speed and the yarn winding speed, with corresponding reduction in the effective force of one of said first and second spring means and corresponding increase in the effective force of the other of said first and second spring means, the point of connection between said third spring means and said arm means moves to one side or the other of said line so that said third spring means augments the effective force of the one of said first and second spring means whose effective force has been diminished by swinging of said arm means, thereby maintaining the effective force of said dancer pulley on said loop substantially constant.

**2.** In a yarn winder, improved yarn feeler means, as claimed in claim **1**, in which, when said arm means is in said mean position, said pivot axis is disposed between the respective connection points of said third spring means.

**3.** In a yarn winder, improved yarn feeler means, as claimed in claim **1**, in which said motor speed adjusting means comprises a photo-responsive device and a light source arranged in aligned spaced relation, circuit means connecting said photo-responsive device in speed controlling relation with said motor, and shutter means pivotal with said arm means about said pivot axis and positioned for movement in the gap between said photo-responsive device and said light source.

**4.** In a yarn winder, improved yarn feeler means, as claimed in claim **1**, in which said arm means comprises an arm rotatably carrying said dancer pulley at one end thereof, a shaft to which the other end of said arm is secured and which is coaxial with said pivot axis, and a lever secured to said shaft for conjoint movement with said arm; said spring means being connected to said lever.

**5.** In a yarn winder, improved yarn feeler means, as claimed in claim **4**, in which said first and second spring means are connected to said lever on opposite sides of said pivot axis.

**6.** In a yarn winder, improved yarn feeler means, as claimed in claim **5**, in which said lever is a plate form lever; said third spring means being connected to said lever at a point thereof intermediate the connections of said first and second spring means to said lever; said pivot axis being disposed between the two points of connection of said third spring means.

**7.** In a yarn winder, improved yarn feeler means, as claimed in claim **6**, in which said first, second and third spring means comprise tension springs each having one end secured to a respective fixed point.

**8.** In a yarn winder, improved yarn feeler means, as claimed in claim **7**, in which the connection of each spring means to a fixed point includes means operable to adjust the effective bias of the associated spring means.

9. In a yarn winder, improved yarn feeler means, as claimed in claim 4, in which said motor speed adjusting means includes a photo-responsive device and a light source arranged in aligned spaced relation, circuit means connecting said device to said motor and operable to adjust the motor speed in accordance with the output signal of said device, a shutter mounted for swinging about said pivot axis relative to the gap between said device and said light source to control the amount of light effective on said device in accordance with swinging of said arm, and means interconnecting said lever and said shutter and effective to swing said shutter in accordance with swinging of said lever and said arm.

10. In a yarn winder, improved yarn feeler means, as claimed in claim 9, in which said circuit means includes an amplifier having its output connected in speed controlling relation with said motor and its input connected to said photo-responsive device.



11. In a yarn winder, improved yarn feeler means, as claimed in claim 10, in which said photo-responsive device is a photoelectric cell.

12. In a yarn winder, improved yarn feeler means, as claimed in claim 10, in which said photo-responsive device is a photo resistor.

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