United States Patent

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Continuation-in-part of application Ser. No. 563,440, July 7, 1966, now Patent No. 3,412,949.

[54] COP WINDER WITH CONTROLLED YARN TENSION

8 Claims, 3 Drawing Figs.

[52] U.S. Cl. 242/45
[51] Int. Cl. B65h 59/38
[50] Field of Search 242/45, 75.5, 75.51

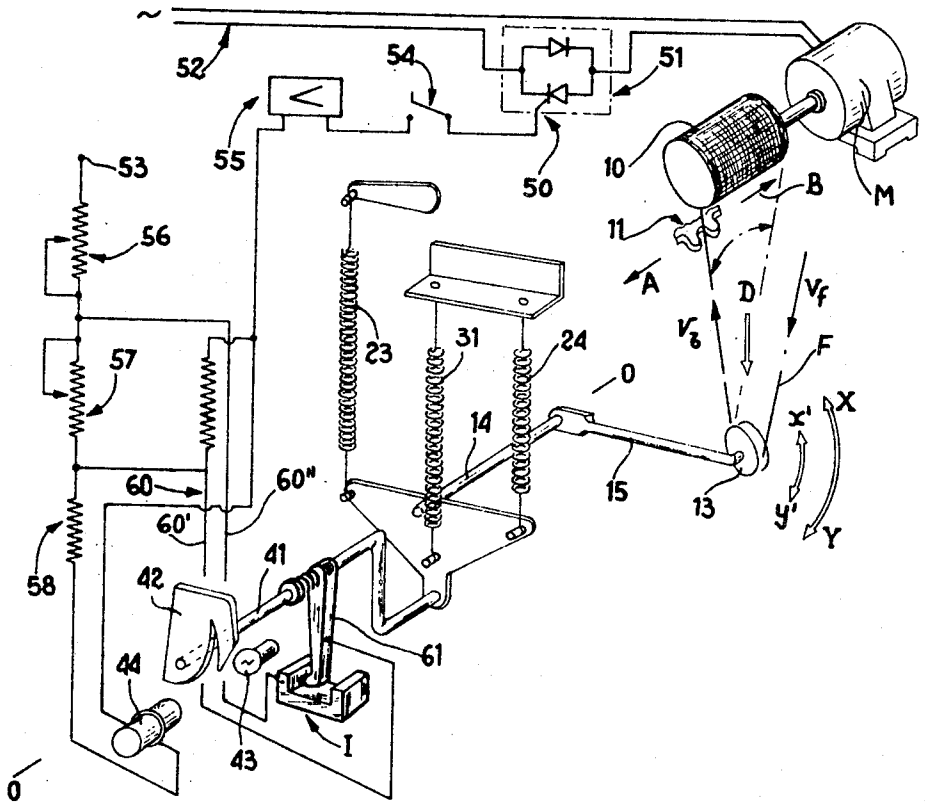
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ABSTRACT: A yarn feeler means for a yarn winder includes a dancer pulley carried by a pivotally supported arm pivotal about the axis of a mounting shaft, the dancer pulley being engaged in a loop of the yarn in advance of the yarn-winding means. Spring means are connected to the shaft to apply an essentially uniform torque thereto and tension to the looping arm. The yarn winder is driven from a variable speed motor supplied by a supply circuit including supply adjusting means operable responsive to the actual position of the dancer pulley and arm to provide a supply proportional to the actual position to compensate for differences between the yarn-feeding speed and the yarn-winding speed. An auxiliary supply control circuit is effective, when closed, to boost the adjustment of the supply, and includes a movable contact supported by an arm fixedly connected to the shaft and movable within an arc of small amplitude, the movable contact, upon movement of the dancer pulley and arm in one given direction, engaging a fixed contact to close the auxiliary control circuit to boost the motor supply, such as the motor voltage, to counteract any tendency to increasing the difference between the yarn-feeding and yarn-winding speeds.



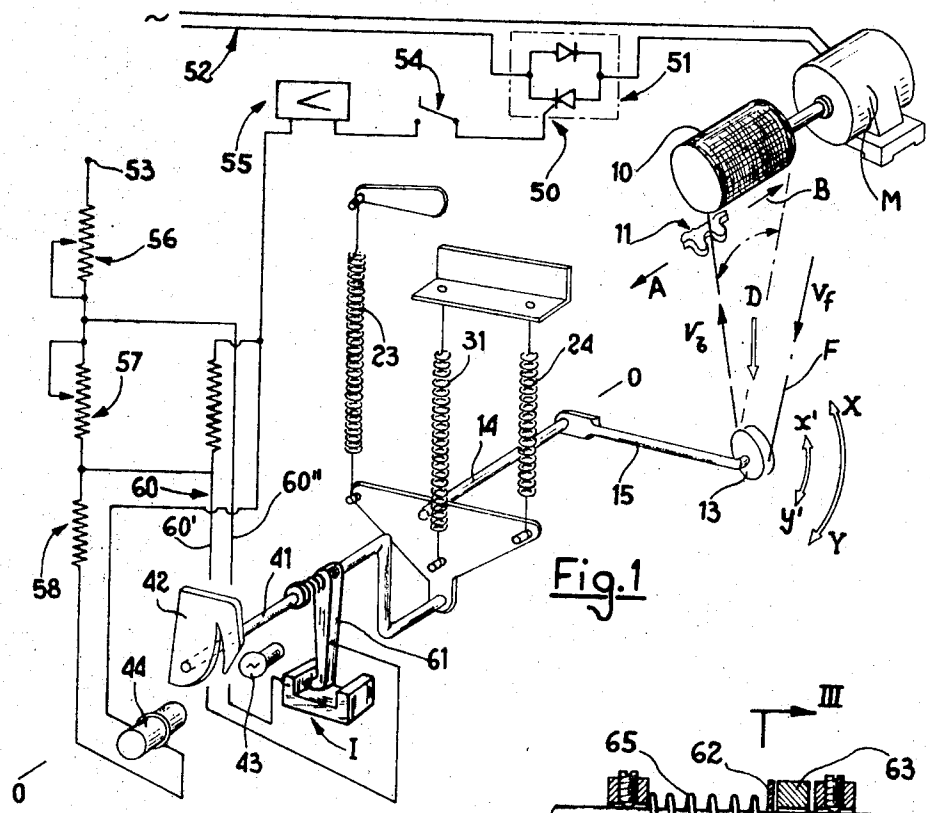


Fig.1

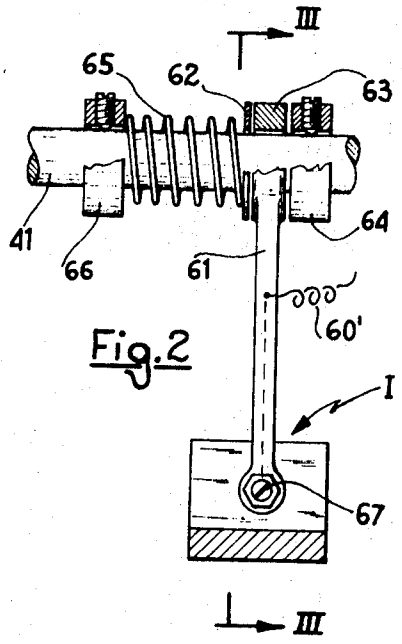


Fig.2

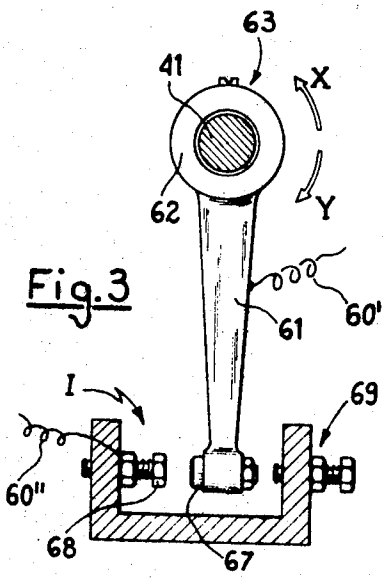


Fig.3

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COP WINDER WITH CONTROLLED YARN TENSION

This application is a continuation-in-part application based on my prior copending application Ser. No. 563,440 filed July 7, 1966 (now U.S. Pat. No. 3,412,949).

BACKGROUND OF THE INVENTION

This invention concerns an improvement in and to winders for yarn cops, and in particular in and to so-called "parallel winders," with a programmed and controlled yarn tension.

The invention finds a particular application in the field of devices that comprise a winding assembly consisting of a spindle, adapted to support and to impart a rotary motion to a cop whereon the yarn is to be wound, a controlled speed drive means, by which the spindle is driven, a distributing device, adapted to distribute the incoming yarn cyclically across the whole length (or axial dimension) of cop and a swingable arm, carrying a dancer idle pulley, around which the yarn is engaged in a loop in advance of the distributing device, whereby a preset tension, at which the winding is to be carried out, is imparted to the yarn.

As well known, the arm, biased by suitably calibrated spring means, that can be adjusted and controlled according to the progressively increasing diameter of the cop which is being wound, is shifted as a function of the possible differences between the linear feeding speed of the yarn to the winder and the cop-winding speed. The shiftings or swinging motions which the arm undergoes, as a consequence of the changes in the speed and/or in the tension of yarn, are utilized to control the output, and thus the speed, of the motor by which the spindle is driven. Such control may be carried out by different means and preferably—but not necessarily—by acting on an electric circuit that is interlocked with a photocell or preferably a photoresistor, excited by a light source, with the amount of light effective on the photocell or photoresistor being varied in accordance with oscillations of the arm, all as disclosed in my above U.S. patent.

As can be readily appreciated, the most favorable operating conditions, by which the smoothness and evenness of winding are influenced, can be theoretically attained when the arm is kept steadily in a preestablished position, and in particular in that position which corresponds to the middle point of its possible swinging amplitude. Obviously, such requirement cannot be strictly met, owing to the unforeseeable variations which may occur in the tension, feeding and winding conditions. On the other side, notwithstanding the fact that the counterspring means, by which the arm is biased against the yarn tension, are realized in such a manner as to ensure an approximate steadiness of the moment that is applied to the arm, when in a position other than the middle one, it is obviously far from being possible to have such steadiness strictly ensured. Thus, the most favorable conditions are obtained when the device allows, by its operation, to keep the arm within the most narrow possible range of positions surrounding the middle position.

Also further factors preferably are to be borne in mind, to ensure the highest efficiency of equipment. Thus, e.g., the device should return quickly back to its normal operating position, at the end of every possible perturbation. In addition, such theoretically preferable condition should be maintained through the whole winding time, i.e. independently from the progressive increase in the cop diameter. Moreover, the corrective interventions and the return of the arm back in its normal operating position should be sufficiently quick, but also damped, in order to prevent any further oscillation, in particular under resonance or unstability conditions.

To positively avoid any oscillation and perturbation phenomena under the action of small transient changes, it would be preferable to keep the extent of each intervention restricted to small values, thereby to impart a given smoothness to the intervention and to ensure a proportionality of the amount of intervention to the extent of perturbation. On the other side, to stabilize the action of winder and to keep the operating conditions thereof close to the theoretical ones, powerful and quick intervention would be required when any perturbation occurs.

SUMMARY OF THE INVENTION

The object of this invention is to provide a winder, and in particular parallel winders of the considered type, improved in such a manner as to prevent, or at least to strongly reduce, the drawbacks and limitations of heretofore known devices.

In particular, the object of this invention consists in the provision of improved parallel winders, comprising controls and intervention means adapted to meet the above-stated contrasting requirements.

Such purposes are essentially attained, according to the invention, by having a primary system, by which the motor input is controlled and adjusted in relation to the instantaneous position of the arm, associated with a second system, that operates independently from the arm position, and exclusively according to the direction in which the arm is moved under the action of perturbation.

In particular, the invention is carried into practice, by having a control system, preferably—but not necessarily—operating on the basis of changes in the excitation of a photoresistor, depending on the position taken by the arm, associated with a switching system interlocked with the swinging direction of the arm, independently from the position at which the arm starts to swing, and which switching system controls an auxiliary circuit by which an instantaneous and relatively large change in the motor input is ensured, each time the arm is shifted in a direction indicative of a difference, in a predetermined sense, between the linear feeding speed and the yarn-winding peripheral speed.

According to a further feature of the invention for the purpose of a full control of the operating conditions of the winder, advantage is taken of the relatively small cyclic motions which the arm undergoes as effects of the likewise cyclic changes in the distance between the guide pulley (fitted on the arm) and the yarn guide, and caused by the motion of the mechanism.

The switching system is realized in such a manner as to be adapted to intervene within the width or amplitude of the small motions, and thus with the correlated frequency (which, as well known, is reduced with the increase in the cop diameter) while the peripheral speed of winding remains unchanged. Thus, a condition of quick and cyclic interventions is established, which is automatically adapted to the progressive variation in the winding conditions, resulting from the progressive increase in the diameter.

The above and further purposes, objects and features of the invention will be hereinafter disclosed and pointed out, in the course of the following detailed description of a preferred but not restrictive embodiment of the invention, as shown in the accompanying drawing, wherein only the components and structural details which are essential for the invention are represented, while all other prior art components are omitted, or shown diagrammatically.

DRAWINGS

FIG. 1 is a diagrammatic perspective view of a winder of the considered type, improved according to the invention;

FIG. 2 is a fragmentary side view of the switching device, interlocked with the components by which the arm motions are followed, and

FIG. 3 is a view looking from the right of FIG. 2 and partly sectioned on the plane III–III of FIG. 2.

PREFERRED EMBODIMENT

As shown in FIG. 1, a parallel winder of the considered type comprises a cop 10, driven by a motor M, and whereon the yarn F is wound, the yarn being guided by a dancer pulley 13, carried by an arm 15 that can be swung round an axis 0–0 coinciding with the axis of a shaft 14. The yarn is distributed on the cop 10 by an already known distributing device, of which the yarn guide 11 only is diagrammatically shown, the

yarn guide being moved cyclically and alternately in the directions A and B. As a consequence thereof, the distance between the pulley **13** (that is assumed as stationary) and the yarn guide **11** undergoes cyclic changes, which depend on the width of the motion of guide **11** and having a frequency that depends on the angular velocity of the cop.

By means of a suitable spring set, that may comprise e.g. three springs **23**, **24** and **31**, a force D is applied to pulley **13**. Such force D is maintained nearly constant throughout the amplitude X—Y of the admissible oscillations of arm **15**, and the tension of the yarn being wound is determined by it. The device may be completed by already known safety means (not shown), such as e.g. limit switches, by which the operation thereof is discontinued when the end positions X and Y are attained by the swinging arm, by means for the calibration and adjustment of the elastic resistances, both initial and depending on the progressive increase in the diameter of cop **10**, and so on.

As well known, the swinging motions of arm **15** are caused by the possible differences between the speed V_f at, which the yarn F is fed, and the speed V_r, at which the yarn is wound on the cop **10**. Such differences result in a motion in either direction X or Y of the arm. Moreover, small cyclical oscillations x'—y' are imparted to the arm, due to the aforestated motion of yarn guide **11**, pertaining to the distributing mechanism.

The "basic" intervention on the input circuit of motor M, when differences occur between yarn-feeding speed V_f and yarn-winding speed V_r, is preferably performed by a change in the action exerted by a light source **43** on a photoresistor **44**, as a consequence of the motion of a light intercepting shield **42**, connected with an extension **41** of shaft **14**. Such intervention can be advantageously obtained by acting on the control **50** of an already known controlled diode feeder **51**, connected across the motor feeding circuit **52**.

The control voltage is applied, e.g. through a circuit starting from a terminal **53**, connected with a voltage source (not shown), and that comprises, in addition to photoresistor **44**, a main switch **54**, a possible amplifier **55** and a set of resistances **56**, **57** and **58**, some of which are of the variable type for the required calibrations and adjustments.

Thus, assuming that the winder is made up of the aforedescribed means and components only, it would operate similarly to prior art winders. The sensitivity, regularity and reliability of both the intervention and control obviously depend on the good operation of the counterspring system, and of different control means and circuits. However, as can be readily appreciated, such conditions cannot be better than the presently attained limits, and are inherently subject to all drawbacks and restrictions initially mentioned.

By the improvement according to this invention, the above described control system (or any other equivalent one) is associated with a second system that operates as a result of the direction of arm swinging motions, independently of the starting point of same motions. This system comprises a switching means I, by which wide variations are caused in the input of the motor, in particular by acting on the control voltage, which is applied to control means **50** of feeder **51**, when the arm **15** is swung in a given direction. Preferably, an auxiliary circuit **60** is closed by the switching means, whereby at least one of the resistances (in the example, the resistances **57** and **58** and the photoresistor **44**) are bypassed, each time the arm **15** is swung in the direction Y, thus increasing e.g. in an amount of 25 percent, the value of voltage that is applied to motor M, by a corresponding increased of the voltage to control means **50**.

Thus, each time the arm motion reveals a positive difference between the speeds V_f and V_r, independently from the absolute values thereof, a voltage increment is applied to the motor, and is maintained until a reversal in the swinging motion of arm **15** occurs, i.e. when the arm is swung in the X direction.

From a structural viewpoint, switching means I may advantageously comprise a short arm **61** (clearly shown in FIGS. **1** and **2**), carried by the extension **41** of shaft **14** to which the arm **15** is fastened, and connected with the extension by a mounting means comprising e.g. a spring washer **62** that presses upon the hub **63** of arm **61**, which is, in turn, pressed against a counter-ring **64** under the action of a spring **65**, that, in turn, reacts against a ring **66** fixed to extension **41**. Fast with the free end of arm **61**, is a movable contact **67** that is connected with a conductor **60'** of circuit **60**, with the conductor **60''** of circuit **60** being connected with a fixed contact **68**. The amplitude of oscillation that can be performed by the arm **61** is limited, e.g. by an adjustable abutting means **69**, and is restricted to a value smaller than that of cyclic oscillations x'—y', which are caused by cyclic motion of yarn guide **11** of the distributor, as previously stated with reference to FIG. **1**.

Thus, from what has been previously stated and from a perusal of accompanying drawings, it will be manifest that the input of motor M is made dependent on the dual control system, and more precisely on a basic system, with control means represented by the photoresistor **44**, by which the middle operating position of arm **15** is established, according to the light-shielding degree of shutter **42**, and on an intervention system, with control means comprising switching means I, and by which an increment of power is instantaneously and abruptly applied to Motor M every time the arm **15** is swung in the direction Y, this increment being also instantaneously and abruptly terminated every time the arm is swung in the opposite direction, and irrespective of the position of the arm at the start of such swinging motions.

According to another viewpoint, the second control system may be considered as an amplifier or booster of the intervention of the basic system, which means that the power which is fed to the motor is widely varied in conformity with the requirements, i.e. whether the bobbin is to be accelerated or decelerated to bring the arm back in its normal operating position, corresponding to the regular operation of the bobbin. Thus, a quick and powerful intervention is obtained, which is abruptly terminated when the arm-swinging motion is reversed.

According to a third viewpoint, the second control system, by taking advantage of cyclic oscillations x'—x', will exert a stabilizing action on the arm by intervening, when the winder is in operation, in moments and through times which are automatically adapted to the changing frequency of motions A—B of the distributor and that, as well known, is proportional to the gradually reduced rotary speed of the bobbin which is being wound.

The above advantageous effects have been confirmed by repeated practical experimentation, which has evidenced the practically absolute stability of the operating winder, the quick return of the arm back in its middle position even after strong perturbations, and the practical absence of oscillations i.e. the practically instantaneous damping of return motions on attaining the middle operating position.

Moreover, the recourse to the motor input control system and to circuits of the type diagrammatically shown in FIG. **1** has proved to be highly advantageous since the intensity of current that flows through the circuit **60**, controlled by the switch means I, can be limited to negligible values. Thus, no sparkings or other prejudicial actions occur between the contacts **67** and **68**, and the device can operate with the highest degree of safety, without deteriorations or other troubles.

I claim:

1. In a yarn winder of the type including rotatable yarn-winding means, a variable speed motor driving the yarn winding means to wind thereon yarn fed thereto at a substantially constant given feeding speed, yarn feeler means including pivotally supported 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, motor speed-adjusting means operable, responsive to swinging of the dancer pulley about the pivot axis of the arm means, to adjust

the motor speed to compensate for differences between the yarn-feeding speed and the yarn-winding speed, the adjusting means including a motor supply circuit comprising an electric signal controlled adjustable supply and a control circuit, sensitive to the actual position of said arm means, providing a control signal for adjusting the supply as a function of such swinging of the dancer pulley; the improvement comprising, in combination, movable contact means; means frictionally coupling said movable contact means to said arm means for frictional displacement by said arm means concurrently with said swinging of said dancer pulley; limiting means cooperable with said movable contact means and limiting the motion of said movable contact means within an amplitude less than that of said swinging of said dancer pulley; fixed contact means positioned for engagement by said movable contact means when said movable contact means is moved in one direction of the swinging of said dancer pulley and concurrently with said swinging; auxiliary adjusting circuit means connected to said control circuit and including said movable and fixed contact means; said auxiliary adjusting circuit being activated upon engagement between said movable and fixed contact means to modulate said control circuit to apply, to said adjustable supply, a control signal providing a sharp variation of the motor supply.

2. In a yarn winder, the improvement claimed in claim 1, including a shaft connected to said arm means at the pivot axis of said arm means; an arm supported at one end on said shaft for rotation about said shaft; and friction means connecting said shaft to said arm to cause said arm to follow rotation of said shaft within said amplitude; said movable contact means being mounted on the free end of said arm.

3. In a yarn winder, the improvement claimed in claim 2 including spring-biased friction means adjusted to admit swinging of said dancer pulley and arm means outside of said given amplitude.

4. In the improved yarn winder as claimed in claim 2, a stationary U-shaped member having opposite side parts defining a space therebetween, said fixed contact means being supported on one of said side parts, said arm having its free end moving within said space and the amplitude of motion thereof being defined by said side parts.

5. In the improved yarn winder as claimed in claim 4, adjustable abutment limiting means on one of said side parts for adjustment of the amplitude of motion of said movable contact supporting arm.

6. In a yarn winder, the improvement claimed in claim 1, in which said control circuit includes resistance means; said auxiliary circuit including said movable and fixed contact means being connected in shunt with said resistance means.

7. In a yarn winder, the improvement claimed in claim 6, in which engagement of said movable and fixed contact means closes said auxiliary circuit responsive to swinging of said arm means in a direction resulting from the yarn-winding speed being less than the yarn-feeding speed, to increase the motor supply by an amount greater than the increase effected responsive to operation of said control circuit.

8. In a yarn winder, the improvement claimed in claim 6, in which said control circuit comprises photosensitive means sensing the actual position of said swinging arm means and controlling the motor supply circuit as a function of said actual position; said resistance means including said photosensitive means.