Aug. 15, 1944. H. W. DOUGHTY, JR 2,355,634

YARN WINDING MACHINE

Filed Oct. 30, 1941 3 Sheets-Sheet 1

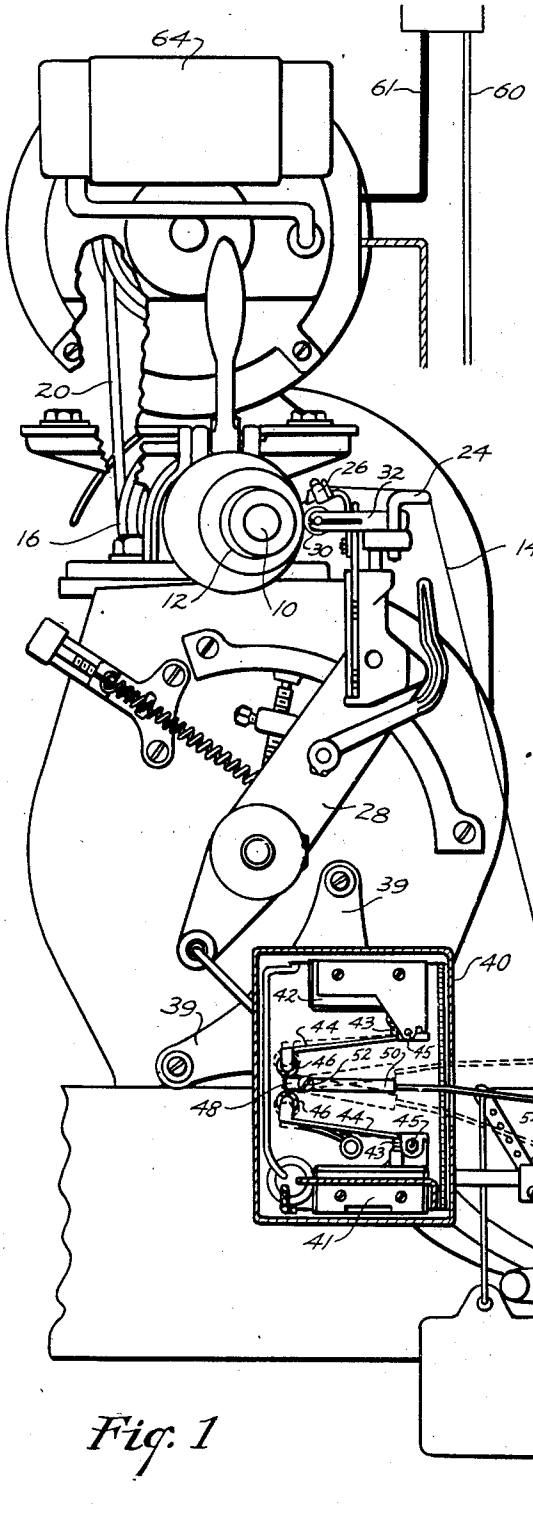


Fig. 1

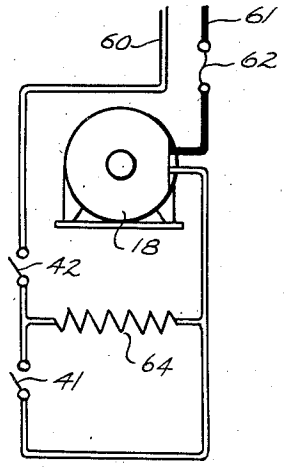


Fig. 2

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YARN WINDING MACHINE

Filed Oct. 30, 1941 3 Sheets-Sheet 2

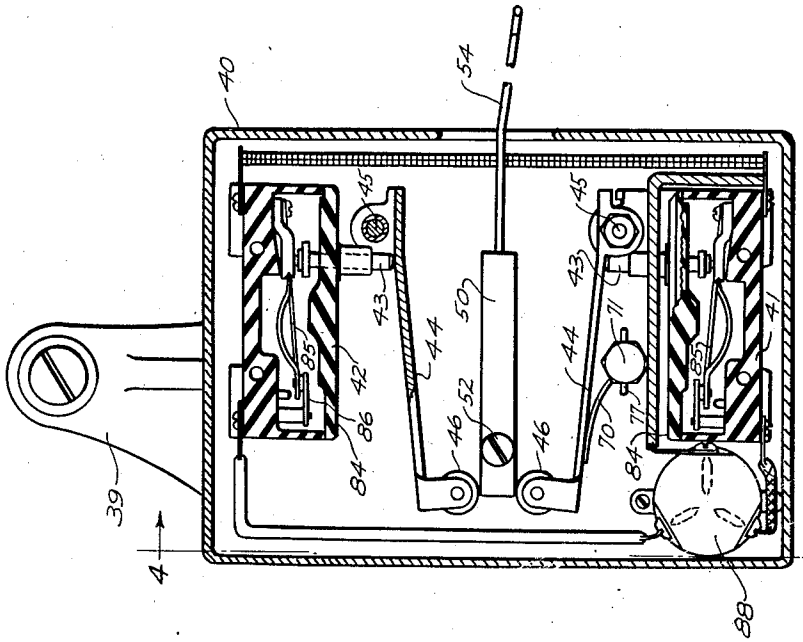


Fig. 3

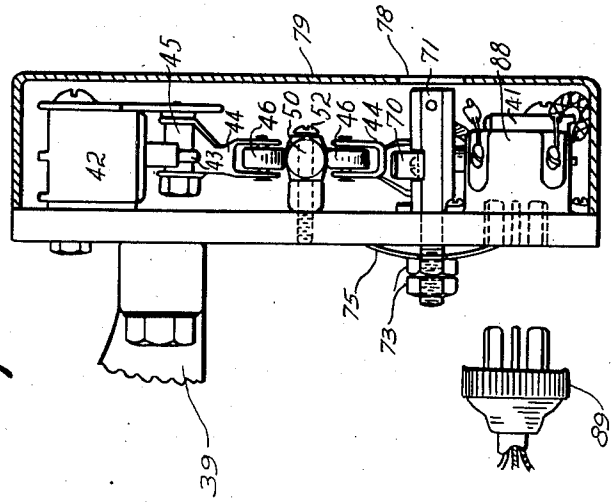


Fig. 4

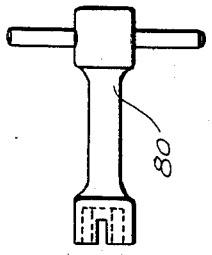


Fig. 6

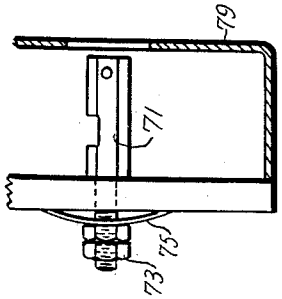


Fig. 5

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YARN WINDING MACHINE

Filed Oct. 30, 1941 3 Sheets-Sheet 3

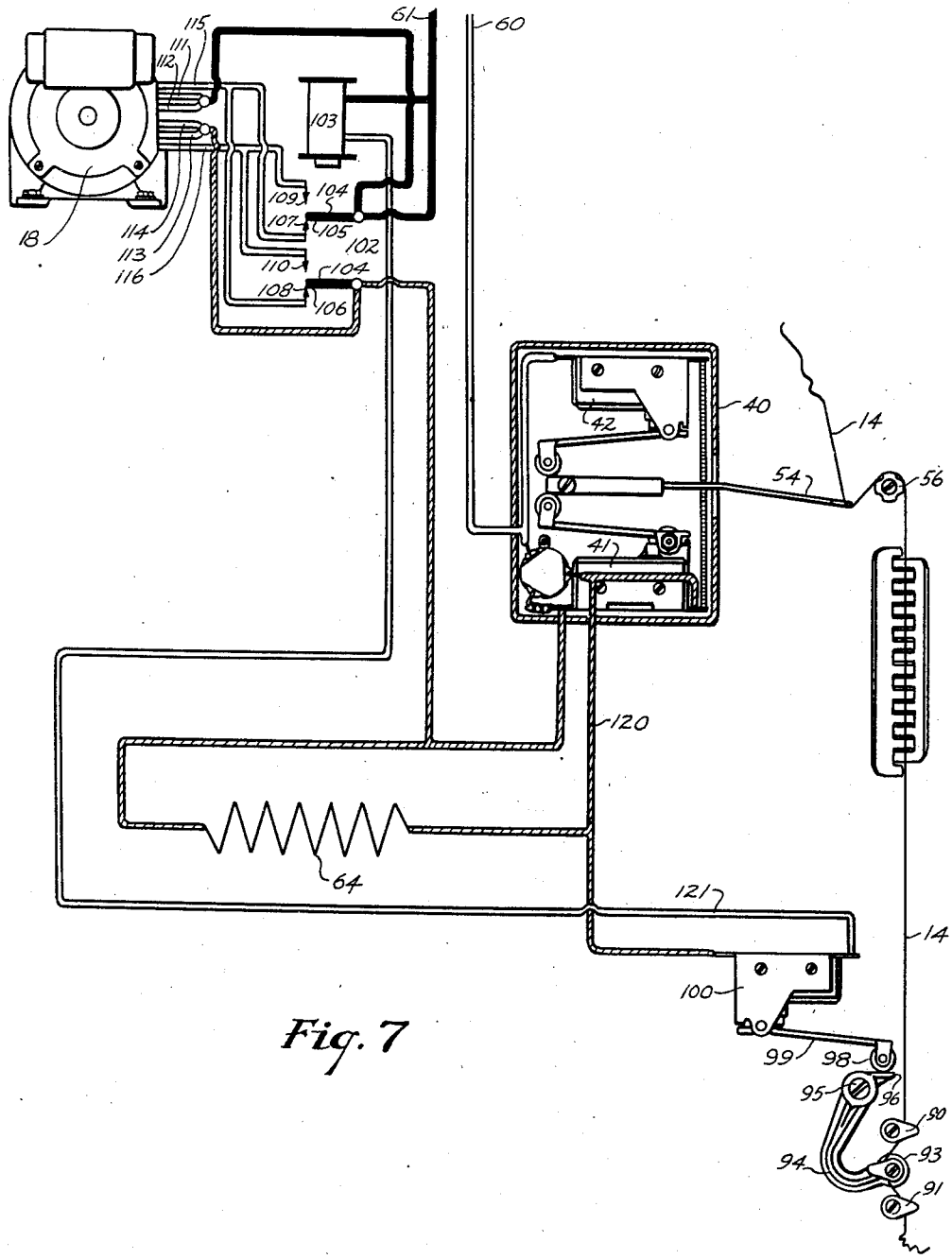


Fig. 7

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Patented Aug. 15, 1944 2,355,634

UNITED STATES PATENT OFFICE

2,355,634

YARN WINDING MACHINE

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Application October 30, 1941, Serial No. 417,104

31 Claims. (Cl. 242—45)

The present invention relates to a new and improved yarn winding machine and more particularly to a novel and improved high-speed winding machine for winding yarn on paper cores.

Objects and advantages of the invention will be set forth in part hereinafter and in part will be obvious herefrom, or may be learned by practice with the invention, the same being realized and attained by means of the instrumentalities and combinations pointed out in the appended claims.

The invention consists in the novel parts, constructions, arrangements, combinations and improvements herein shown and described.

The accompanying drawings, referred to herein and constituting a part hereof, illustrate one embodiment of the invention, and together with the description, serve to explain the principles of the invention.

Of the drawings:

Fig. 1 is a front elevation with certain parts omitted and other parts broken away of a typical and illustrative winding machine embodying the present invention;

Fig. 2 is a wiring diagram showing the electrical connections of the electrical parts of Fig. 1;

Fig. 3 is a detailed side elevation of the control box, with its cover removed, and with the switches broken away to show their internal construction;

Fig. 4 is a detailed sectional view taken on the line 4—4 of Fig. 3;

Fig. 5 is a fragmentary, detailed sectional view showing the tension adjusting means;

Fig. 6 is a detailed side elevation of a key member for moving the tension adjusting means; and

Fig. 7 is a fragmentary elevation showing a modified form of the invention, with wiring diagram.

The present invention has for its object the provision of an improved high-speed winding machine for winding yarn into packages at a relatively constant tension. A further object of the invention is the provision of a winding apparatus which will wind an improved package of yarn, without damaging the yarn by excessive tension during the winding process. The invention further provides a yarn winding machine in which the tension of the yarn being wound can be accurately controlled, and the speed of winding is determined by the tension of the yarn being wound. Still another object of the invention is the provision of an improved winding machine for yarn having means for quickly relieving the tension on the yarn being wound as a "pluck" occurs so that damage to the yarn is avoided.

In the winding of yarn, particularly synthetic yarns such as rayon, nylon, and other filaments, it is of great importance that the yarn be not subjected to any excessive tension during the various winding and other operations to which it is subjected prior to dyeing. Not only would excessive tension increase the breakage of the yarn, but lesser degrees of excessive tension permanently damage the yarn so as to change its absorption of dye, thereby producing "shiners" in the finished fabric and increasing the spoilage. Winding of the yarn at a constant tension, which can be accurately controlled, is also of great importance in the preparation of the yarn for knitting, and other operations, as the quality of the resultant product is improved by the free, uniform delivery of the yarn from the wound packages.

Heretofore, it has been customary to vary the drag on the yarn to maintain a constant winding tension, but these devices have not proved to be entirely satisfactory. It has also been proposed to vary the speed of the winding spindle to compensate for its increasing diameter, so that the yarn may be wound at a substantially constant linear speed, but these devices have proved to be unsatisfactory as they do not compensate for variations in tension caused by the thread or yarn itself, by the supply package from which the yarn is being wound, by the traverse of the yarn across the package of either a tube or a cone, or by the difference in diameter between the ends of a conical package.

In accordance with the present invention, the winding or packaging of textile yarns is controlled by the tension of the yarn being wound, and this control is exercised by varying the speed of winding in accordance with the tension of the yarn itself. As illustrated, the invention is shown as applied to a winding machine corresponding in general to a Foster Standard Winder for producing "precise" wound cones or tubes. The spindle of the winding machine is adapted to receive a paper core on which the package is to be wound, and this spindle is driven by an electric motor which can operate at widely different speeds. The yarn to be wound is led in the usual manner from the supply package through a tensioning device which subjects the yarn to a predetermined tension. Thereafter, the yarn passes through a feeler guide or drop wire which is raised by increases in tension and is lowered as the yarn tension decreases, after which the yarn passes

to the traversing thread guide which moves back and forth along the surface of the package being wound on the spindle.

The feeler guide or drop wire controls a quick acting snap switch which is adapted to be actuated on minute movement such as is caused by relatively small movements of the feeler guide corresponding to minor changes in the tension of the yarn. A resistance is in circuit with the motor, and is adapted to be shunted by the snap switch as the yarn tension decreases, thereby supplying more power to the motor so that its speed is increased to reattain the constant tension. A second switch is preferably provided in the motor circuit and is adapted to be opened on a further decrease in yarn tension corresponding to a breakage or exhaustion of the yarn, this switch serving to stop the motor when the thread supply is interrupted for any reason. Due to the variation in tension of the yarn being supplied to the package being wound, and to the constant variations in speed of yarn travel due to the movement of the yarn guide in supplying yarn to the "precise" wound package, the resistance-shunting switch is constantly opened and closed supplying the motor with current at full voltage for short periods and at lower voltage for the alternate intervening periods, the relative lengths of the high and low voltage periods determining the speed of running of the motor driving the winding spindle.

The inertia of the motor, rotor and spindle is relatively great compared with the length of the periods so that the motor runs and the yarn is wound at a speed which changes gradually and is normally neither the full voltage speed, nor the low voltage speed, of the motor, but is precisely suited to the tension of the yarn being wound.

The tension device which subjects the yarn to a predetermined drag is capable of accurate regulation so as to produce the desired normal tension on the yarn prior to winding, and other means are provided for varying the response of the feeler guide or drop wire to the changes in yarn tension, thereby providing accurate means for controlling the tension of the wound yarn. These other varying means are preferably formed so that they may be changed only by means of a special key, thereby preventing the individual machine operators from changing the adjustment of the winding machines without knowledge of the foreman.

As illustrated, the feeler guide or drop wire, the quick acting snap switches and their control means preferably comprise a removable unit, which can be quickly detached from the machine and may be replaced on the same or another machine, thereby facilitating and expediting replacement of the machine in service if adjustment or repair of the control unit is required, as well as permitting the control units to be accurately adjusted while they are removed from machines serving for production.

In accordance with a modified embodiment of the invention, means are provided for momentarily braking the motor or winding spindle whenever the yarn being supplied is subject to excessive tension, as for instance whenever a pluck occurs, thereby preventing excessive stretching of the yarn such as would result in the production of "shiners." These means, as illustrated, preferably comprise a second feeler, moved by changes in the tension of the yarn and operating a motor reversing switch and positioned between the yarn supply package and the normal tension creating or drag device. Thus, the normal tension of the yarn supplied for winding allows the motor to operate in its normal forward direction, but whenever the tension increases beyond a predetermined amount, the reversing switch momentarily supplies current to the motor to rotate it oppositely, thereby braking the motor, checking the winding operation and normally allowing the yarn to feed onward to the drag device, by its inertia and normal tension, so that the reversing switch is almost immediately returned to its normal position for forward movement of the motor.

It will be understood that the foregoing general description and the following detailed description as well are exemplary and explanatory of the invention but are not restrictive thereof.

Referring now in detail to the illustrative embodiment of the invention as shown in the accompanying drawings, the invention is applied to a Foster winding machine having a spindle **10** to receive the usual conical paper core **12** on which the yarn **14** is to be wound. Spindle **10** is mounted for rotation and is provided with a pulley **16** by which it is driven from the motor **18** through the belt **20**. The yarn **14** is supplied from a conventional supply package (not shown) and passes between the slotted tension plates **22** of conventional form. However, tensioning plates **22** are not, as some times, mounted on nor operatively connected with the swinging frame **28** and do not vary the friction exerted on the yarn in accordance with the position of the frame, but create a constant variable drag on the yarn, which then passes over a guide bar **24** to the traversing yarn guide **26** by which the yarn is traversed back and forth over the surface of the package to produce a "precise" wind conical package. The guide bar **24** and yarn guide **26** are mounted on a swinging frame **28** in the usual manner so that the guide **26** is and its driving parts are moved from the spindle **10** progressively as the package builds by the winding of yarn thereon. Preferably, the guide **26** is spaced from the package by means of a freely rotatable roller **30** mounted in a yoke **32** and supported on the frame **28** and bearing against the package, and the guide **26** is driven in its traversing movement by means of the usual traverse rod, cam, etc., (not shown) so that it makes one traverse to and fro along the surface of the package each several revolutions of the package.

Between the spindle **10** and the tension plates **22** is provided the control apparatus in accordance with the present invention which illustratively comprises a box **40** of generally rectangular form provided with mounting arms **39** by which it is bolted to the winding machine frame. Within this box is provided a pair of quick acting snap or toggle switches, preferably adapted to operate rapidly on slight movement and requiring only light pressure for their operation. As illustratively shown these switches are of the type more fully shown and described in the patent to McGall 1,960,020 and are known in the trade as "Micro switches." In the preferred form, these switches require only a few thousandths of an inch movement to operate them, and only a few ounces of pressure is required even for rapid operation, for instance as rapidly as several operations per second.

Within box **40** are provided the switches **41** and **42** with their operating plungers **43** projecting towards each other. Each switch is provided

with an operating lever 44 pivoted at 45 bearing against the operating plunger 43 so that by movement of the lever towards the switch, the switch is moved to open position from its normally closed position. At the end of each lever 44 is a roller 46 and the switches 41, 42 and their levers 44 are so mounted that their rollers 46 are closely adjacent to each other and bear against the short end 48 of a lever 50 pivotally mounted on pin 52 and carrying the feeler or drop wire 54. Normally, and with the drop wire 54 in its intermediate position both switches 41 and 42 are closed, but movement of the drop wire to its lower position by gravity causes the switch 42 to be opened, while movement of the drop wire to its upper position causes switch 41 to be opened.

Figure 2 of the drawings shows the wiring diagram of the present embodiment. In that figure, the motor 18 is shown as a capacitor-run, capacitor-start motor of fractional horsepower receiving its power from the conductors 60, 61 through fuse 62. Conductor 60 is connected to the motor through normally closed switches 41 and 42 which are connected in series, and switch 41 is shunted across a series resistance 64 in the motor circuit. With switch 42 closed, the motor is supplied with power through the resistance 64, which may be about 100 or 150 ohms resistance, and supplies sufficient power to the motor 18 to cause it to run at a relatively low speed, or alternatively, it may supply only enough power to delay stopping of the motor 18. When switch 41 is closed, motor 18 is supplied with power at the full voltage so that it operates at a relatively high speed. As the switch 41 is rapidly opened and closed, the motor 18 operates at an intermediate speed, dependent upon the proportion of time that the switch 41 is closed and the motor receives its full voltage.

The loop 55 at the end of the drop wire 54 is positioned to one side of the yarn path between fluted bar 56 above the tensioning plates 22 and the thread bar 24, so that the yarn 14 is looped under the loop 55 and deflects the yarn from its straight path. As the yarn tension increases in the length of the yarn between the plates 22 and the thread bar 24, loop 55 is lifted to the upper dotted line position, while a decrease in yarn tension allows the loop 55 to fall. In its high position, loop 55 keeps switch 42 closed and opens switch 41. In its central position, loop 55 causes both switches to be closed, while in its lowermost position, corresponding to a break in the yarn, the switch 42 is opened, stopping the motor 18 notwithstanding the fact that switch 41 may be closed.

The drop wire 54, the lever 50 and the switch operating levers 44 are of relatively small mass so that they can be operated with great rapidity and respond to even minute changes in the tension of the yarn being wound and it has been found practical to make these parts sensitive to even less than one-half gram change in tension.

Means are also provided for varying the operation of the switch 41 so that it is opened and closed at varying degrees of yarn tension, or so that the yarn may be wound at different speeds at the same tension. For this purpose a leaf spring 70 is mounted on a short shaft 71 rotatably journaled in the back of the box 40 and bearing with variable pressure against the under side of the lower lever 44, thereby varying the pressure required to move the switch 41 to its open position, corresponding with low voltage operation of the motor 18. Shaft 71 is shouldered and its portion of reduced diameter projects through the back of box 40 and is threaded to receive the locked nuts 73 which compress the friction spring washer 75 which holds the shaft 71 against turning to maintain the desired pressure of spring 70 against the lower lever 44. The forward end of the shaft 71 is preferably provided with a key fitting pin 77 which is accessible only through the aperture 78 in the box cover 79 and may be turned only by means of the special socket key 80, thereby preventing tampering by the workman or operator once the proper setting of the spring 70 has been established.

Figures 3 and 4 show the switch box 40 and its component parts more in detail, and each of the switches comprises an insulating switch housing 84 in which is slidable the switch operating plunger 43 contacting with the snap acting spring contact 85 near its fulcrum so that minute movement of the plunger 43 moves the contact spring 85 out of contact with the fixed switch contact 86 thereby quickly breaking the circuit.

A polarized female connector 88 is mounted in the box 40 and the switch terminals are connected to it so that all of the switch connections may be made or disconnected simultaneously by means of the male connector plug 89 which is connected to the motor 18, resistance 64 and main 60 and can only be plugged in when correctly alined.

Whenever it is desired to remove the switch box 40, for instance in case of a failure of either of the switches 41 or 42, it is merely necessary to disconnect the plug 89, remove the mounting screws for box 40 and replace it with another switch box 40 to which all connections may be made by insertion of the connector plug 89.

A conventional slub catcher 23 may be provided between the tensioning plates 22 and the fluted bar 56 to remove slubs, lint and other foreign matter from the yarn before it is wound.

In the operation of the described embodiment, yarn is supplied at a constant drag from a conventional supply package through the tensioning plates 22 and is looped under the drop wire loop 55 after passing over fluted bar 56. The yarn then passes to the guide bar 24, over it and through the traversing guide 26, thence over roller 30 and onto the surface of the package 12 being wound.

The tension of the yarn as it leaves the plates 22 is relatively constant most of the time being subject, however, to minor variations as the yarn is fed first from the top and then the bottom of the supply package, and also subject to greater variations in case of a "pluck" or snagging of the yarn in case it is turned over the bottom lip of the supply package. Another factor varying the tension of the yarn may be the presence and size of a fluff ball in the slub catcher 23, which in the past frequently built up sufficiently to overstretch the yarn or even break the yarn.

The tension of the yarn being wound, however, is normally subject to other variations, due to the increasing diameter of the package, to the conical shape of the package and to the traversing of the guide 26, the yarn having one acceleration on its linear movement as the guide moves from the smaller to the larger end of the conical package. In addition to this first acceleration of the linear movement of the yarn which occurs only with a conical package, the yarn being

wound on either a cyldindrical or conical package has an acceleration as the yarn guide moves towards either end of the package from its central position, and a corresponding deceleration as the yarn guide moves from either end of the package towards the central portion of the package. The wound yarn is also subject to other variations in tension due to differences in yarn, size, twist, humidity, moisture and oil content, slub formation, etc. All of these variable factors tend to create both rapid changes in the tension and gradual changes in tension of the yarn, but may be compensated for by the apparatus of the present invention so that the wound yarn is of substantially uniform tension from the beginning to the end of the package. In actual practice, the drop wire **54** causes switch **41** to be opened and then closed approximately twice during each traverse of the yarn guide **26**, and may also cause switch **42** to be opened and closed twice per traverse, depending on the setting of the tension controls, and other factors. That is, the switch **41** may be opened as the guide **26** moves from the package center towards an end, closed as the guide **26** returns to center, opened as the guide **26** travels towards the other end, and again closed as the guide returns to its starting point. Similarly, switch **42** may be opened once and closed once each time the guide passes along the package, assuming that no other major variation in tension occurs.

As the package diameter increases, the time during which switch **41** remains closed may shorten considerably for a single yarn traverse, as a single revolution of the spindle **10** will produce a greater draft of yarn, and motor **18** can drive the spindle **10** at a slower speed to give a constant yarn speed. Regardless of the spindle speed, however, the switch **41** opens and closes rapidly so that the speed of running of motor **18** is determined by the relative time the switch **41** is open and closed, by the relative time the switch **42** is open and by the torque required for drawing the yarn through the tension plates **22**, and is usually intermediate the full voltage and low voltage speeds of the motor.

In the event a fluff ball forms on the yarn at the slub catcher **23**, the yarn will increase very slightly in tension, thereby slowing or even stopping the winding and completely eliminating any danger of overstretching or breaking of the yarn.

The operation of the winding machine continues with frame **28** swinging away from the spindle **10** but with roller **30** bearing lightly against the surface of the wound package until the yarn is exhausted or breaks, thereby causing drop wire **54** to drop opening switch **42** to discontinue the supply of power to the motor **18**, gradually bringing the motor and spindle **10** to a stop. When the package has been removed and another core inserted on the spindle, the yarn may be threaded and the machine started by lifting the drop wire **54** thereby closing switch **42**, and switch **41** as well if desired.

With the drop wire **54** in its midway position vertically and the traversing guide **26** in its midway position horizontally, the circuit is closed and the motor **18** runs at full speed, as long as the switch **41** remains closed, but, as the traverse guide **26** reaches either extreme end of its travel, the yarn pulls the drop wire up, which breaks the circuit and the motor would stop and stay stopped as long as the circuit remains open. Since the guide **26** traverses rapidly back and forth, the conditions change, so that when the guide travels by or past its midway position, the electric circuit is momentarily closed and the motor **18** increases in speed. When the guide travels towards the extreme ends of its traverse, the electric circuit is momentarily opened and the motor and spindle **10** tend to decrease in speed, with the result that due to the large inertia of the motor **18** and spindle **10**, and the rapid movement of drop wire **56**, the motor and spindle never reach their maximum speed, neither does either stop, but maintain a varying spindle speed within close limits slightly less than full load speed.

In actual winding conditions sufficient tension in the winding strand is imposed to cause the drop wire **56** to lift as the yarn is traversed by the guide in either direction away from the midway position and this results in what appears as fluttering of the drop wire **56** which causes an interruption in the electric circuit and a response in the speed of the motor.

Also, as the speed of the motor **18**, spindle **10** and package decreases as the package increases in diameter, the motor shows a greater degree of response, due to the time element being progressively larger, the fluttering being slower. The spindle response is such that at the beginning of winding an empty core **12** the package speed normally is nearly full speed, while at the finish of winding a package of approximately five inches in diameter the speed is reduced to approximately two-thirds full speed. Thus, the fluttering of the drop wire, associated with the reciprocations of the guide **26**, result in electric motor responses, whereby the motor speed is controlled and varied while a constant tension on the winding strand is maintained. In addition, the yarn traverse, rapidly accelerating and decelerating the yarn speed causes a "take-up" action of a drop wire, which provides a small reserve of yarn so that the yarn is not alternately stretched and slackened even with a constant motor and spindle speed, thereby providing a mechanical means of "take-up" in conjunction with electric motor controls.

The winder of the present invention is capable of producing an increase in the linear speed of the strand without any increase in the tension, or stated conversely, this winder is provided with means to maintain a constant tension on the winding strand while the linear speed of the strand is being increased, as the package increases in diameter. Also, as the motor, spindle and package speed progressively decreases as the diameter of the package progressively increases, the motor shows a progressively greater degree of response due to the time element becoming progressively longer. The motor and spindle speed is the result of the ratio of the co-efficient of friction to the rate of the work being done. The tension then is the frictional co-efficient as to the rate of work being done, contingent on several variables such as condition of the strand, dry, moist, irregular in size, etc., as well as the variable conditions caused by the traversing movement of the strand.

Figure 7 illustrates a modified embodiment of the invention in which means are provided for momentarily reversing the motor field so as to suddenly but momentarily check the speed of the motor, thereby preventing damage to the yarn by excessive stretching.

As embodied, the winding spindle **10**, motor **18**, thread guide **26**, and swinging frame **28** may be of the same construction as in Figure 1, and for

that reason are not duplicated in the drawings. The control box 40, including the switches 41, 42 and drop wire 54 are likewise duplicates of those in Figure 1 and cooperate with the yarn 14 after it has been drawn over the guide 56.

Below the resiliently pressed-together tension plates 22 is mounted a tension dampener which comprises the stationary guides 90, 91 between which, and almost alined therewith is mounted a swinging guide bar 93 mounted at the lower end of a balanced lever 94 pivoted about screw 95 so that any slight change in the tension of thread 14 is it passes over guides 90, 91, 93 moves lever 94 about its pivot. The upper end of lever 94 is formed with a cam plate 96 bearing against a roller 98 at the outer end of micro-switch lever 99, serving to close the normally open micro-switch 100. Normally, switch 100 is open, but a very slight increase in tension of the yarn 14 moves balanced lever 94 to close the switch 100.

For momentarily reversing the field of motor 18 as switch 100 is closed by increases in the tension of the thread supplied to the pressure plates 22, a reversing relay 102 is provided in the motor circuit and is reversed when current is supplied through switch 100 to the relay magnet winding 103. Relay 102 includes the magnet winding 103, and armatures 104 carrying movable contacts 105, 106, which are normally in contact with contacts 107 and 108 but are moved on energization of the magnet 103 against contacts 109, 110, to reverse the motor field and thereby tend to stop the motor 18.

Contacts 107 and 110 are connected to the terminals 115 and 116 of the motor while motor terminals 111 and 112 are connected to main 61 and terminals 113 and 114 are connected to main 60 through switches 41 and 42 or through switch 42 and resistor 64.

Switch 100 connects mains 60 and 61 to the magnet winding 103 through branch conductors 120 and 121, so that closure of the switch 100 by an increase in yarn tension momentarily reverses the current supplied to terminals 115 and 116 thereby instantly checking the speed of motor 18 and stopping the pull on the yarn 14. If the excessive tension on the yarn continued, motor 18 would reverse, but the sudden slowing of the motor 18 and spindle 10 relieves this excess tension, so that the motor 18 almost immediately resumes its speed under control of the drop wire 54 and switch 41.

In other respects, the operations of the form shown in Figure 7 is similar to the previously described embodiment.

The invention in its broader aspects is not limited to the specific mechanisms shown and described but departures may be made therefrom within the scope of the accompanying claims without departing from the principles of the invention and without sacrificing its chief advantages.

What I claim is:

1. In a yarn winding machine driven by an electric motor, the combination of a pivoted lever having a yarn engaging member to be moved by changes in yarn tension, said member having an effective mass such that it may be oscillated at least several times a second by changes in said yarn tension, a pair of quick acting snap switches alternatively actuated by said member and controlling the supply of power to said motor and a variable biasing spring for varying the response of one of said switches to changes in yarn tension.

2. In a yarn winding machine driven by an electric motor, the combination of a pivoted lever having a yarn engaging member to be moved by changes in yarn tension, said member having an effective mass such that it may be oscillated at least several times a second by changes in said yarn tension, a quick acting snap switch controlling the supply of power to said motor actuated by said member on changes in yarn tension, a manually rotatable member having a leaf spring projecting therefrom and operating on said lever to vary the range of response of said switch to change in yarn tension.

3. In a yarn winding machine driven by an electric motor, the combination of a pivoted lever having a yarn engaging member to be moved by changes in yarn tension, said member having an effective mass such that it may be oscillated at least several times a second by changes in said yarn tension, a pair of quick acting snap switches controlling the supply of power to said motor alternately actuated by said lever and closed by movement of the lever to a central position and a variable biasing spring to vary the range of response of one of said switches to changes in yarn tension.

4. In a yarn winding machine driven by an electric motor, the combination of a pivoted lever having a yarn engaging member to be moved by changes in yarn tension of approximately one-half gram, and a pair of quick acting snap switches controlling the supply of power to said motor alternatively actuated by said lever and closed by movement of the lever to a central position.

5. In a winding machine for winding packages of yarn, the combination of an electric motor driven spindle on which the yarn is to be wound under tension, a member moved by small changes in yarn tension and having a high frequency of movement by the yarn, a quick acting snap switch operable on minute movement and actuated by said member, a resistance in the motor circuit and connected to be shunted by said switch when the yarn tension decreases.

6. In a winding machine for winding packages of yarn, the combination of an electric motor driven spindle on which the yarn is to be wound under tension, a member moved by small changes in yarn tension and having a high frequency of movement by the yarn, a pair of quick acting snap switches operable on minute movement and actuated by said member, one of said switches being opened by movement of the member upon an increase yarn tension and a resistance in the motor circuit shunted by one of said switches when the yarn tension decreases a predetermined amount and the other switch being opened by further movement of said member.

7. In a winding machine for winding packages of yarn, the combination of an electric motor driven spindle on which the yarn is to be wound under tension, a member moved by small changes in yarn tension and having a high frequency of movement by the yarn, a pair of quick acting snap switches operable on minute movement and alternatively actuated by said member, both of said switches being closed by movement of said member to an intermediate position, and a resistance in the motor circuit shunted by one of said switches and reducing the motor speed when the yarn tension exceeds a predetermined value, the other of said switches being opened to stop the supply of power to the motor when the yarn breaks or is exhausted.

8. In a winding machine for winding packages of yarn, the combination of an electric motor driven spindle on which the yarn is to be wound under tension, a member moved by small changes in yarn tension and having a high frequency of movement by the yarn, a pair of quick acting snap switches operable on minute movement and alternatively actuated by said member, both of said switches being closed by movement of said member to an intermediate position, a resistance in the motor circuit shunted by one of said switches and reducing the motor speed when the yarn tension exceeds a predetermined value, the other of said switches being opened to stop the supply of power to the motor when the yarn breaks or is exhausted and means for variably biasing said member to vary the tension of the yarn being wound.

9. In a yarn winding machine driven by an electric motor, the combination of a pivoted lever having a yarn-engaging member to be moved by changes in yarn tension of approximately one-half gram, a quick acting snap switch controlling the supply of power to said motor actuated by said member on changes in yarn tension, and a normally rotatable member having a leaf spring projecting therefrom and operating on said lever to vary the range of response of said switch to change in yarn tension.

10. In a yarn winding machine driven by an electric motor, the combination of a pivoted lever having a yarn-engaging member to be moved by changes in yarn tension of approximately one-half gram, a quick acting snap switch controlling the supply of power to said motor actuated by said member on changes in yarn tension, a normally rotatable member having a leaf spring projecting therefrom and operating on said lever to vary the range of response of said switch to changes in yarn tension and a connector plug through which all connections to said switches are made.

11. In a winding machine for winding packages of yarn, the combination of an electric motor driven spindle on which the yarn is to be wound under tension, a member moved by small changes in yarn tension and having a high frequency of movement by the yarn, a pair of quick acting snap switches operable on minute movement and actuated by said member, one of said switches being closed by movement of the member upon a decrease yarn tension and a resistance in the motor circuit shunted by one of said switches when the yarn tension decreases a predetermined amount and the other switch being opened by further movement of said member to discontinue the supply of power to the motor.

12. In a winding machine for winding packages of yarn, the combination of an electric motor-driven spindle on which the yarn is to be wound under tension, the inertia of the motor driven spindle being relatively great with respect to the torque required for winding, a member moved by small changes in yarn tension and having a high frequency of movement by the yarn and a switch in the motor circuit capable of being rapidly actuated and providing a plurality of speeds for the spindle, said switch being actuated by said member and the frequency of the switch actuation being sufficiently rapid that the spindle runs at a smooth speed other than said plurality of speeds.

13. In a winding machine for winding packages of yarn, the combination of an electric motor-driven spindle on which the yarn is to be wound under tension, the inertia of the motor driven spindle being relatively great with respect to the torque required for winding, yarn traversing means, a member moved by small changes in yarn tension and having a frequency of movement of the order of twice per yarn traverse, and a switch in the motor circuit capable of being rapidly actuated and providing a plurality of speeds for the spindle, said switch being actuated by said member.

14. In a winding machine for winding packages of yarn, the combination of an electric motor driven spindle on which the yarn is to be wound under tension, yarn traversing means, a member moved by small changes in yarn tension at a rate of approximately twice per yarn traverse, a quick acting snap switch operable on minute movement and actuated by said member, a resistance in the motor circuit and connected to be shunted by said switch when the yarn tension decreases.

15. In a winding machine for winding packages of yarn, the combination of an electric motor driven spindle on which the yarn is to be wound under tension, yarn traversing means, a member moved by small changes in yarn tension and having a frequency of movement by the yarn of approximately twice per yarn traverse, a pair of quick acting snap switches operable on minute movement and actuated by said member, one of said switches being opened by movement of the member upon an increase yarn tension and a resistance in the motor circuit shunted by one of said switches when the yarn tension decreases a predetermined amount and the other switch being opened by further movement of said member.

16. In a yarn winding apparatus the combination of a motor driven winding spindle to support a package core on which yarn is to be wound, a resistance in the motor circuit, a switch opened and closed by changes in yarn tension and shunting the resistance, and a reversing switch operated by other changes in yarn tension to check the motor speed suddenly as the tension increases.

17. In a yarn winding apparatus, the combination of a motor driven winding spindle to support a package core on which yarn is to be wound, yarn traversing means for traversing the yarn along said core, a resistance in the motor circuit, tension means for creating a normal tension on the yarn, a switch opened and closed by changes in yarn tension between the tension means and package, said switch shunting the resistance, and a motor reversing switch operated by increase in yarn tension between the yarn supply and tension means for suddenly checking the motor driven spindle when the yarn is supplied under appreciable tension.

18. In a yarn winding apparatus, the combination of a motor driven winding spindle to support a package core on which yarn is to be wound, yarn traversing means for traversing the yarn along said core, a resistance in the motor circuit, tension means for creating a normal tension on the yarn, a quick acting snap switch opened and closed by changes in yarn tension between the tension means and package, said switch shunting the resistance, and a balanced motor reversing switch operated by increase in yarn tension between the yarn supply and tension means for suddenly checking the motor driven spindle when the yarn is supplied under appreciable tension.

19. In a yarn winding apparatus, the combination of a motor driven winding spindle to sup-

port a package core on which yarn is to be wound, yarn traversing means for traversing the yarn along said core, a resistance in the motor circuit, tension means for creating a normal tension on the yarn, a switch opened and closed by changes in yarn tension between the tension means and package, said switch shunting the resistance, a second switch alternatively operated to intercept the current supplied to the motor when the yarn is exhausted, and a motor reversing switch operated by increase in yarn tension between the yarn supply and tension means for suddenly checking the motor driven spindle when the yarn is supplied under appreciable tension.

20. In a yarn winding apparatus, the combination of a motor driven winding spindle to support a package core on which yarn is to be wound, yarn traversing means for traversing the yarn along said core, a resistance in the motor circuit, a tension means for creating a normal tension on the yarn, means actuated by yarn tension between the package and tension means for controlling the spindle speed in accordance with said yarn tension and means actuated by yarn tension between a yarn supply and said tension means for suddenly checking the spindle speed to prevent sudden excessive tension on the yarn.

21. In a yarn winding apparatus, the combination of a motor driven winding spindle to support a package core on which yarn is to be wound, yarn traversing means for traversing the yarn along said core, a resistance in the motor circuit, a tension means creating a normal tension on the yarn supplied for winding, a pair of switches, one normally closed and shunting a resistance out of the motor circuit, the other normally closed controlling the supply of power to the motor, said switches being alternately actuated by changes in yarn tension by means of a lever supported by the yarn being wound, and a third switch normally open for reversing the motor field and reversed by increase in the tension of the yarn supplied for winding for checking the motor speed.

22. In a yarn winding apparatus, the combination of a motor driven winding spindle to support a package core on which yarn is to be wound, yarn traversing means for traversing the yarn along said core, a resistance in the motor circuit, a tension means creating a normal tension on the yarn supplied for winding, a pair of switches, one normally closed and shunting a resistance out of the motor circuit, the other normally closed controlling the supply of power to the motor, said switches being alternately actuated by changes in yarn tension by means of a lever supported by the yarn being wound, a third switch normally open for reversing the motor field and reversed by increase in the tension of the yarn supplied for winding for checking the motor speed, said tension creating means being positioned between the first two switches and the reversing switch actuating means.

23. In a yarn winding apparatus, the combination of a motor driven spindle, a traversing yarn guide, a yarn tension means cooperating to wind yarn under tension on a core on the spindle, a pair of quick acting snap switches, one normally closed and interrupting the supply of power to the motor when opened, the other normally closed and shunting a series resistance out of the motor circuit when closed, a lever supported by the yarn being wound and alternately actuating said switches on changes in yarn tension, variable spring means for varying the resistance of the lever to movement, a motor reversing relay to check the motor speed suddenly, a third switch to control the relay, said switch being actuated by changes in the tension of yarn supplied for winding, means for creating a normal yarn tension, said tension creating means operating on the yarn between the pair of switches and said third switch.

24. In a yarn winding apparatus, the combination of a motor driven spindle, a traversing yarn guide, a yarn tension means cooperating to wind yarn under tension on a core on the spindle, a pair of quick acting snap switches, one normally closed and interrupting the supply of power to the motor when opened, the other normally closed and shunting a series resistance out of the motor circuit when closed, a lever supported by the yarn being wound and alternately actuating said switches on changes in yarn tension, variable spring means for varying the resistance of the lever to movement, a motor reversing relay to check the motor speed suddenly, a third switch to control the relay, said switch being actuated by changes in the tension of yarn supplied for winding.

25. In a winding machine for winding packages of yarn, the combination of an electric motor driven spindle on which the yarn is to be wound under tension, a member moved by small changes in yarn tension and having a frequency of movement by the yarn approximately several times a second, a quick acting resistance controlling member operable on minute movement and actuated by said first member, a resistance in the motor circuit and connected to be varied by said controlling member when the yarn tension varies.

26. In a yarn winding machine, the combination of yarn traversing means, a pivoted lever of small mass having a yarn-engaging member to be rapidly moved by slight changes in yarn tension, a quick acting resistance controlling member actuated by minute movement of said member and a variable biasing spring for varying the range of response of said controlling member to changes in yarn tension.

27. In a winding machine for winding packages of yarn, the combination of an electric motor-driven spindle on which the yarn is to be wound under tension, the inertia of the motor driven spindle being relatively great with respect to the torque required for winding, a member moved by small changes in yarn tension and having a high frequency of movement by the yarn and a resistance in the motor circuit capable of being rapidly varied to provide a plurality of speeds for the spindle, said resistance being controlled by said member and the frequency of the control actuation approximating several times a second so that the spindle runs at a smooth speed other than said plurality of speeds.

28. In a winding machine for winding packages of yarn, the combination of an electric motor-driven spindle on which the yarn is to be wound under tension, the inertia of the motor driven spindle being relatively great with respect to the torque required for winding, yarn traversing means, a member moved by small changes in yarn tension and having a frequency of movement of the order of twice per yarn traverse, and a resistance in the motor circuit capable of being rapidly varied and providing a plurality of speeds

for the spindle, said resistance being varied by said member.

29. In a winding machine for winding packages of yarn, the combination of an electric motor driven spindle on which the yarn is to be wound under tension, yarn traversing means, a member moved by small changes in yarn tension at a rate of approximately twice per yarn traverse, a resistance in the motor circuit, a resistance controlling means operable on minute movement and actuated by said member whereby the speed of the motor is controlled by the winding of the yarn.

30. In a yarn winding apparatus the combination of a motor driven winding spindle to support a package core on which yarn is to be wound, a resistance in the motor circuit, means operated by changes in yarn tension for varying the resistance and a reversing switch operated by other changes in yarn tension to check the motor speed suddenly as the tension increases.

31. In a yarn winding machine, the combination of yarn traversing means, a pivoted lever having a yarn-engaging member to be moved by changes in yarn tension approximately twice per yarn traverse, a quick acting resistance controlling member actuated by said member and a variable biasing spring for varying the range of response of said controlling member to changes in yarn tension.

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