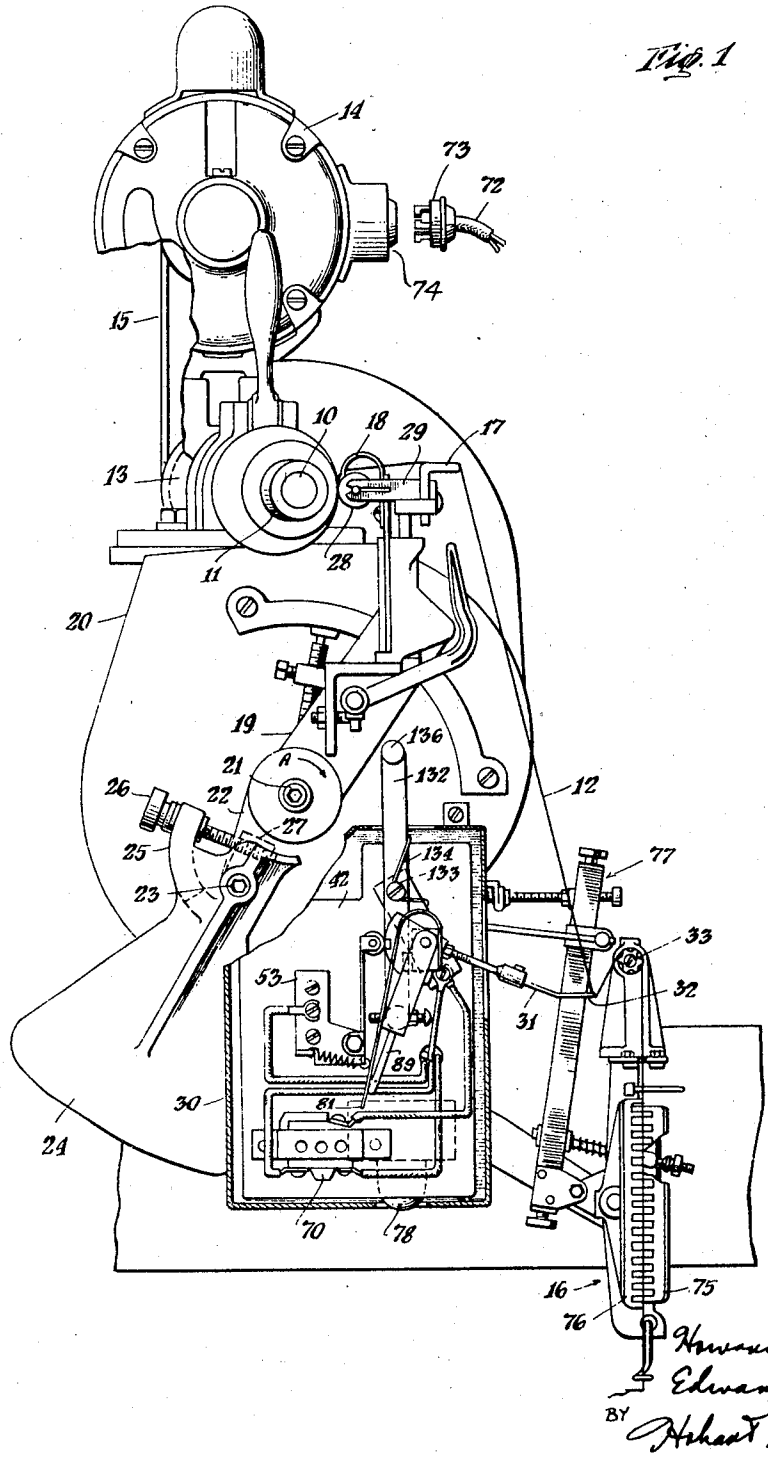
Feb. 24, 1948. E. R. DAVIS ET AL 2,436,557

YARN WINDING MACHINE

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Fig. 1



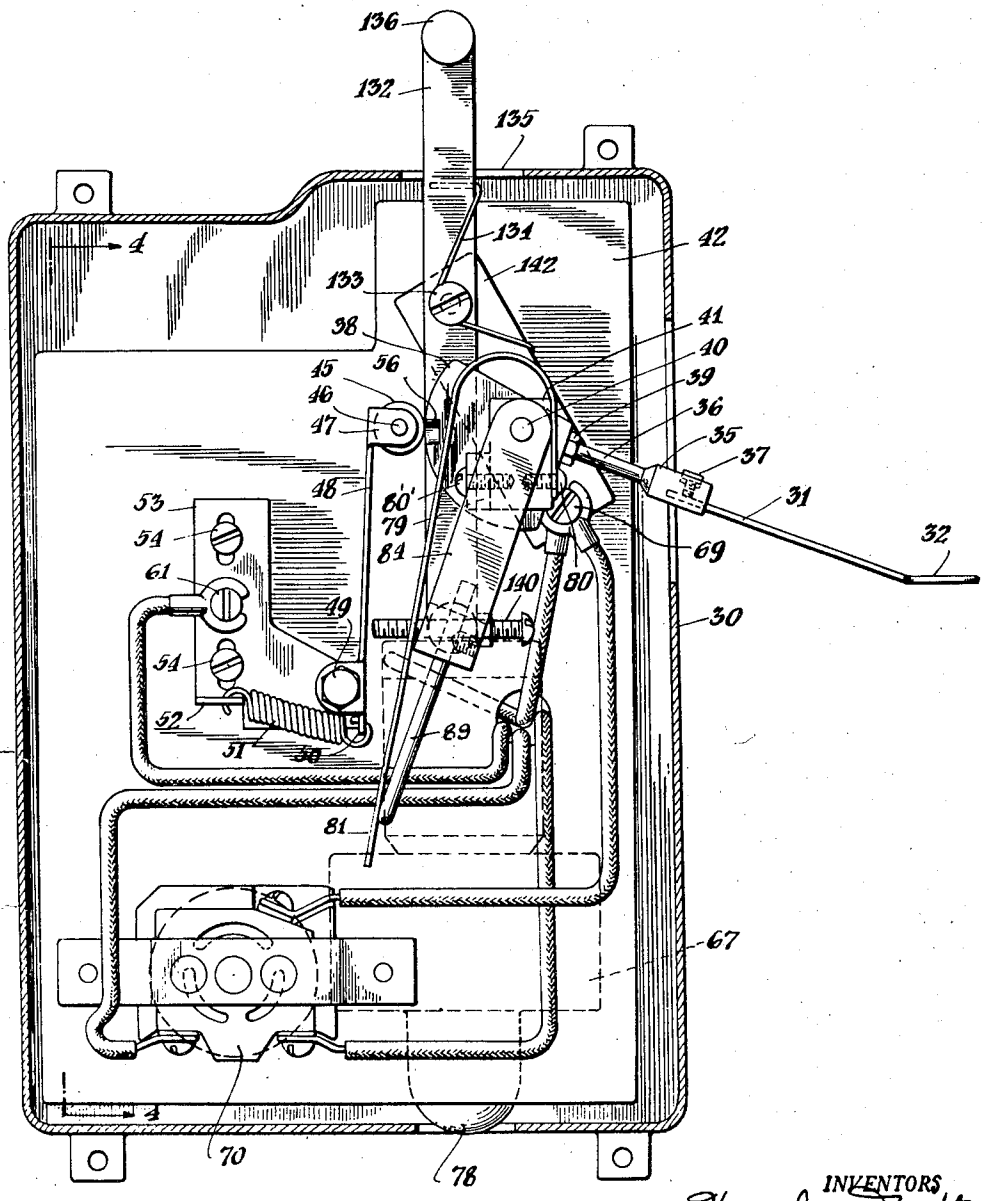

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YARN WINDING MACHINE

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Fig. 2



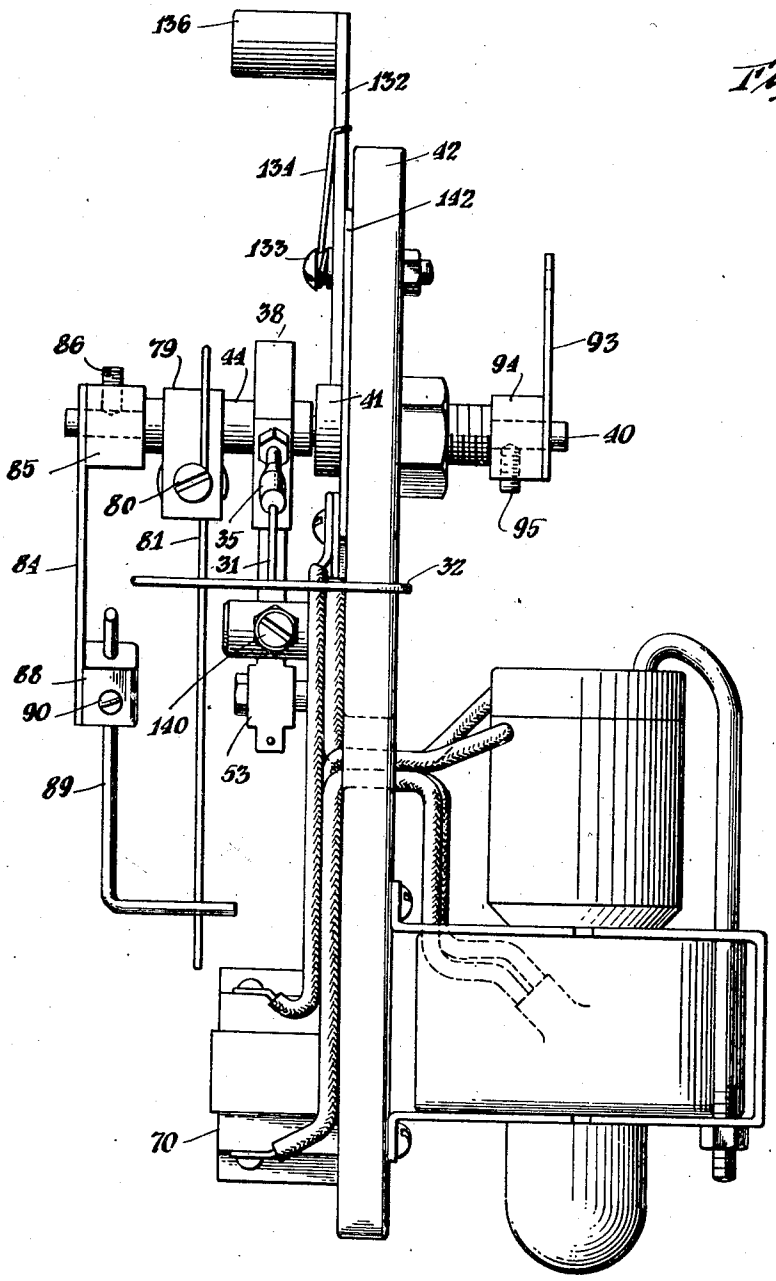

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YARN WINDING MACHINE

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Fig. 3



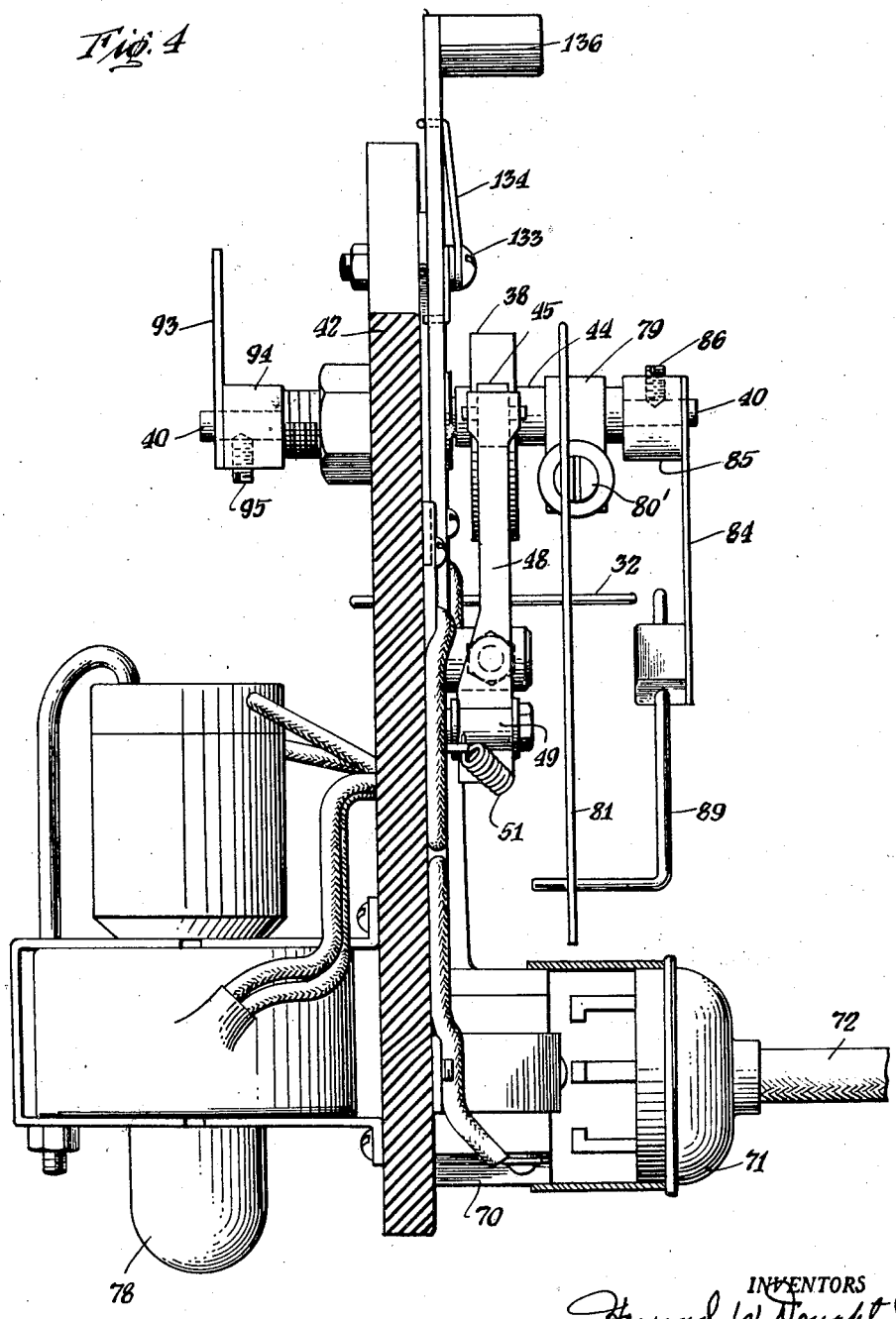

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YARN WINDING MACHINE

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Fig. 4



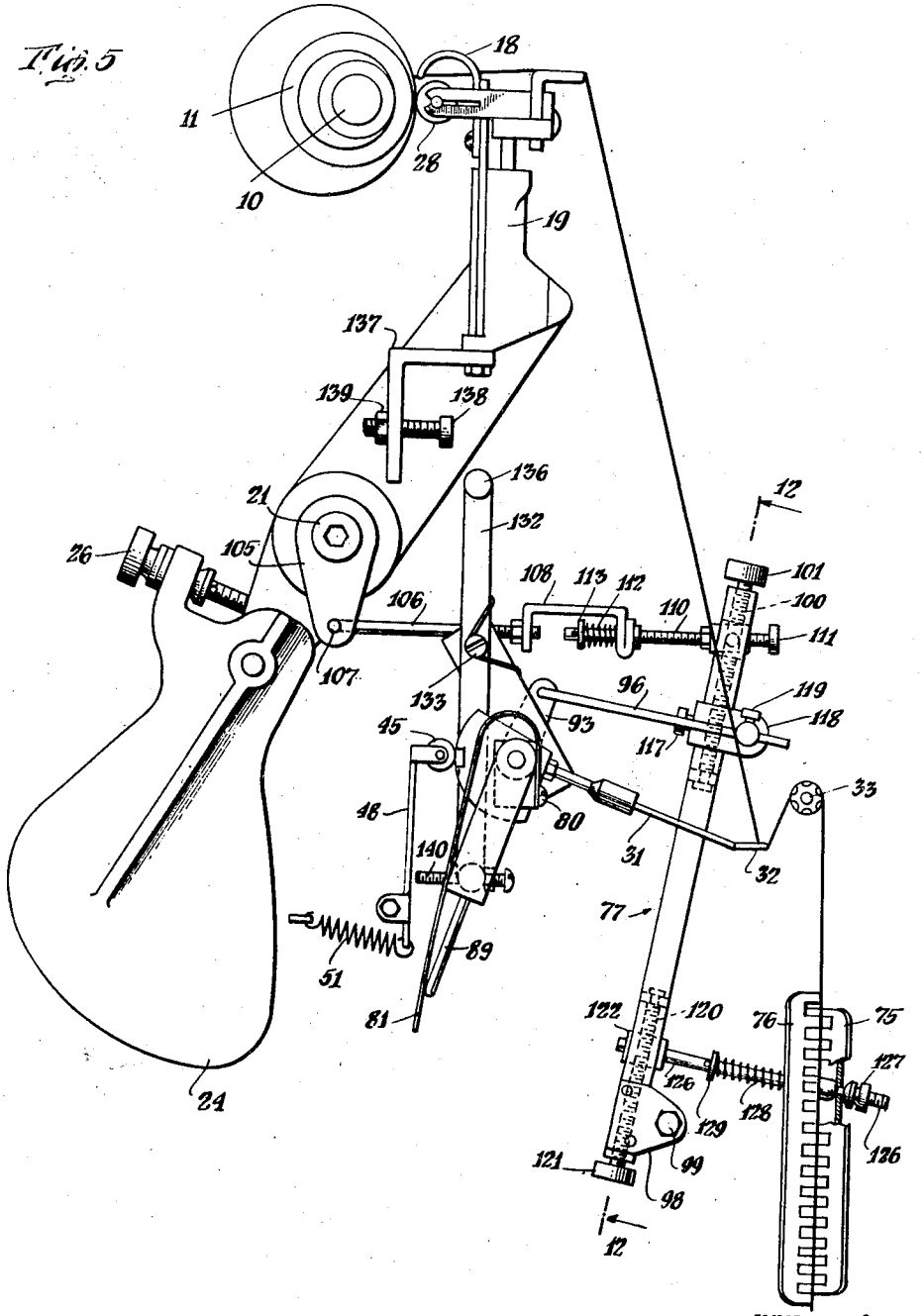

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YARN WINDING MACHINE

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Fig. 5




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YARN WINDING MACHINE

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Fig. 10

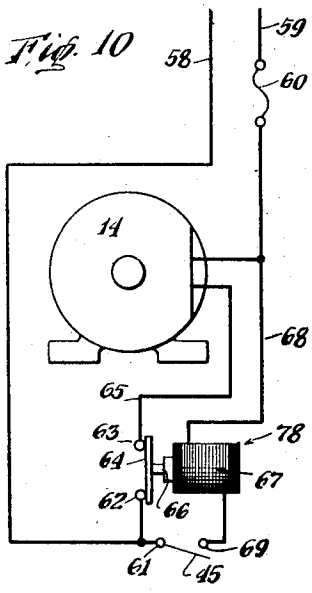



Fig. 11

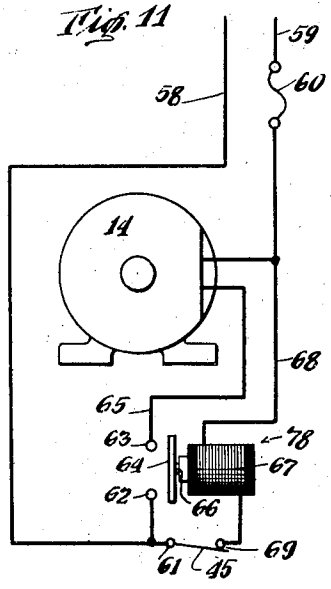



Fig. 12

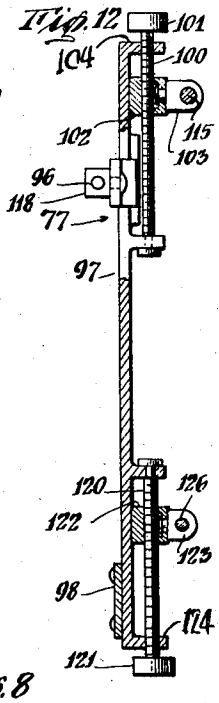



Fig. 6

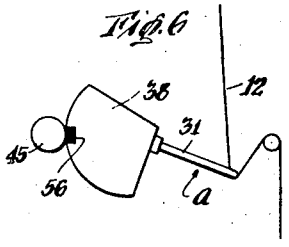



Fig. 7

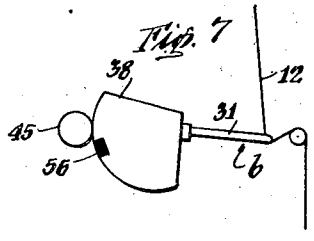



Fig. 8

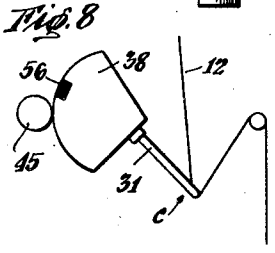



Fig. 13

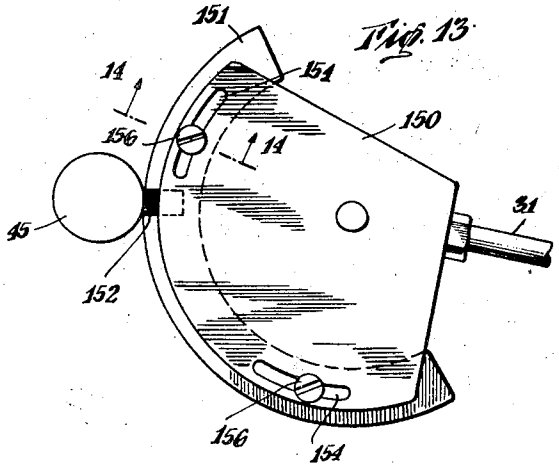
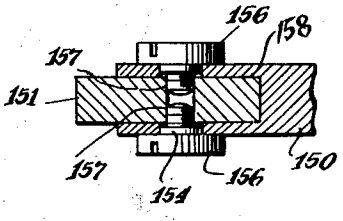



Fig. 14




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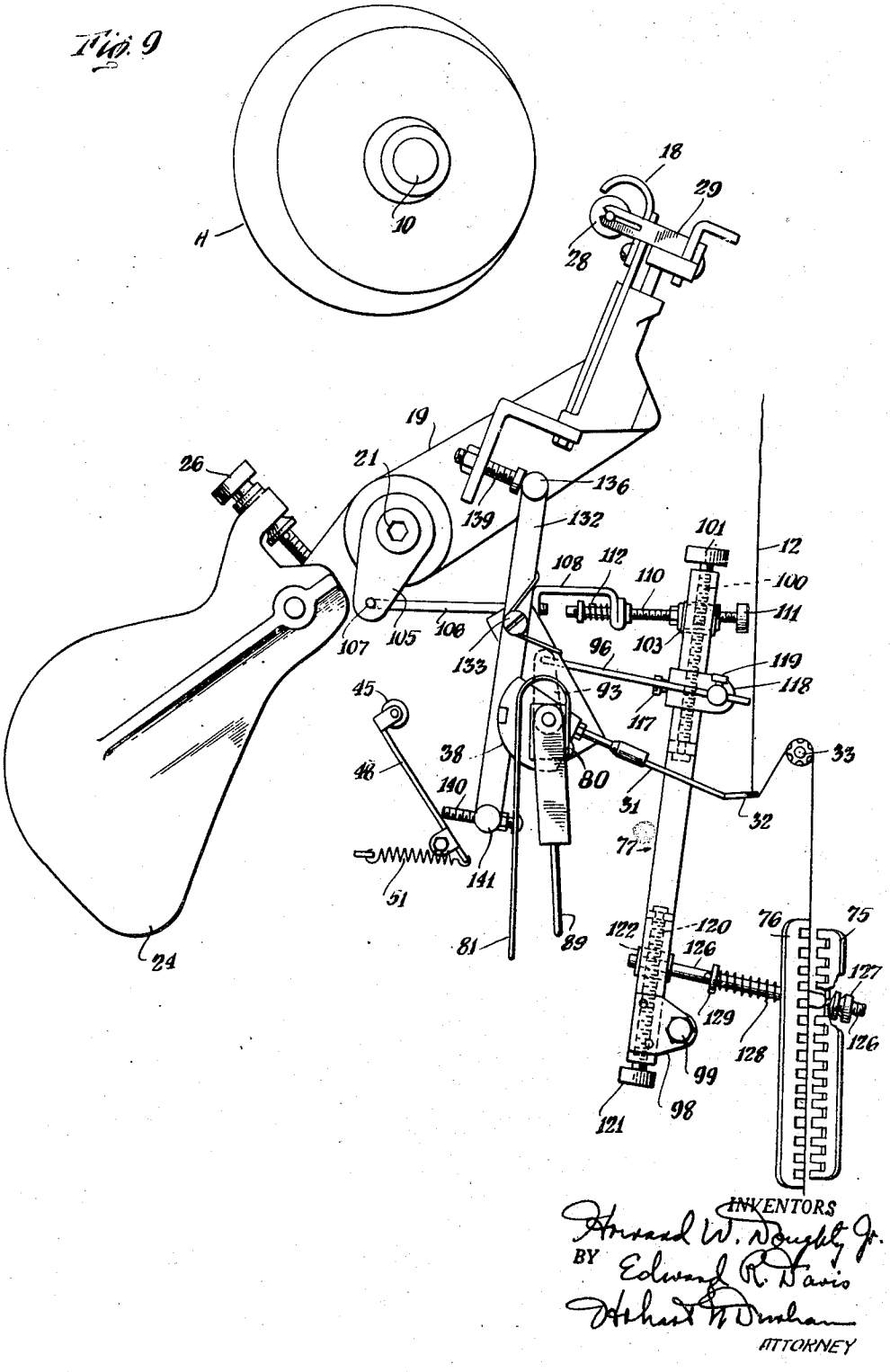
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YARN WINDING MACHINE

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Fig. 9




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YARN WINDING MACHINE

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Fig. 16

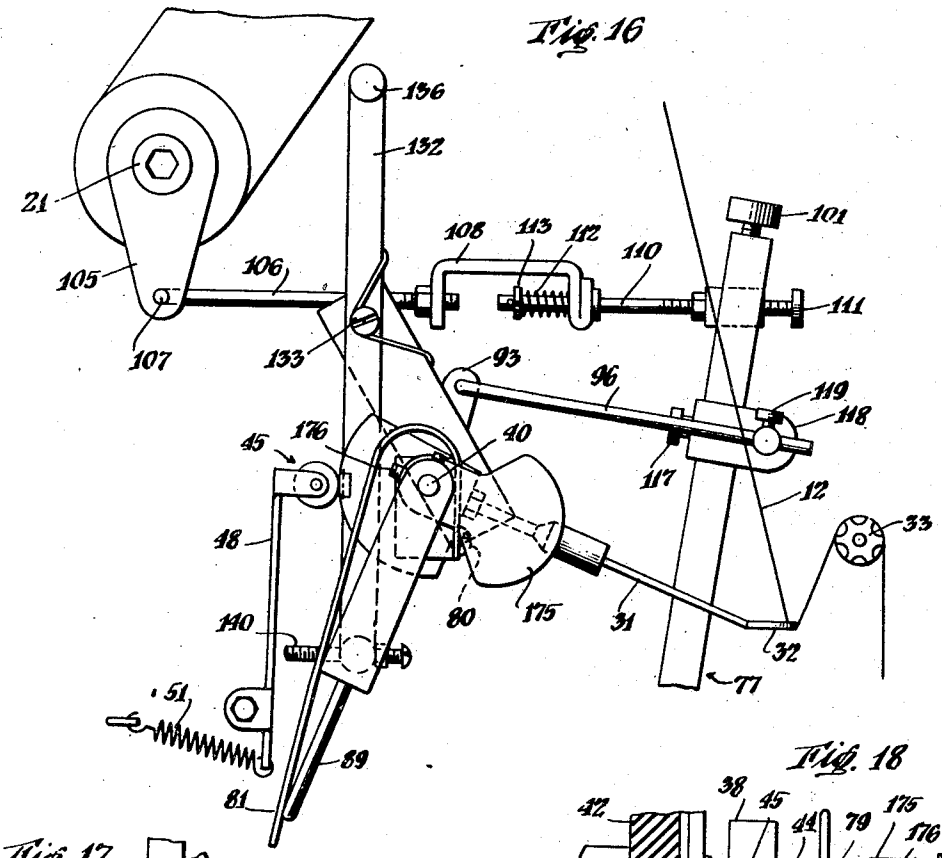



Fig. 17

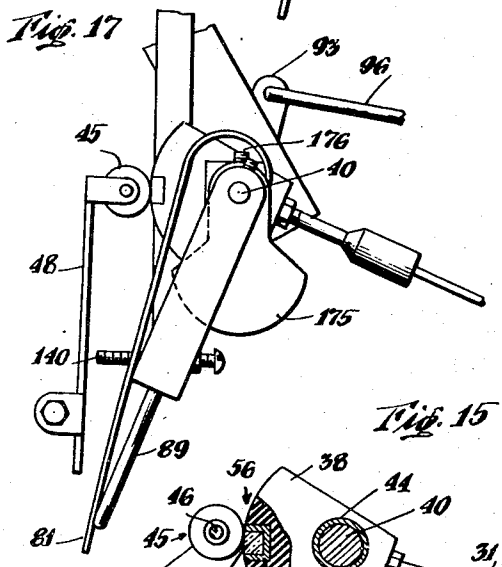



Fig. 15

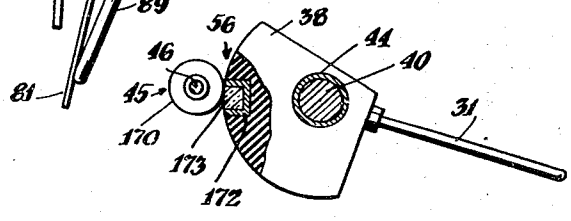
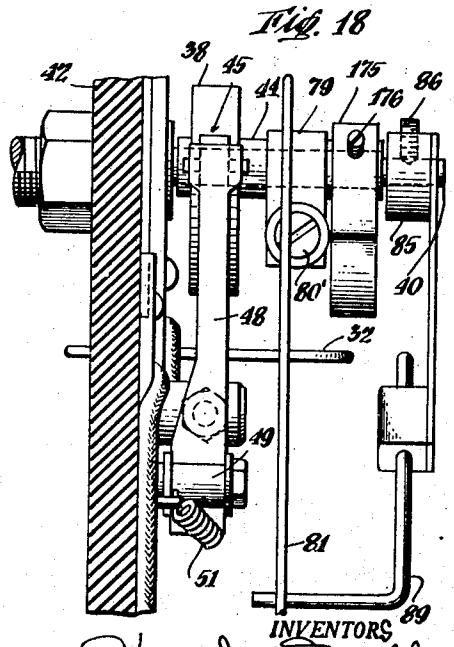



Fig. 18




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Patented Feb. 24, 1948

2,436,557

# UNITED STATES PATENT OFFICE

2,436,557

## YARN WINDING MACHINE

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Application February 5, 1945, Serial No. 576,284

24 Claims. (Cl. 242—45)

1

This invention relates to new and improved yarn winding machines and more particularly to improvements in high-speed winding machines of the general type disclosed in Patent No. 2,355,634, for winding yarns on paper cores or the like.

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 embodiments of the invention, and together with the description, serve to explain the principles of the invention.

Of the drawings:

Figure 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;

Figure 2 is a front elevation, with parts in section, of the control apparatus in accordance with the present invention, as embodied in the winding machine of Figure 1;

Figure 3 is a side elevation of the control apparatus of Figure 2, but with the outside casing removed;

Figure 4 is a cross section of the apparatus of Figure 2, as taken on the lines 4—4 of Figure 2;

Figure 5 is a detailed view of certain of the operating parts of the control apparatus in accordance with the present invention, showing these in normal winding positions;

Figures 6, 7 and 8 are detailed views of the dropwire switch of the control apparatus of Figure 2, shown in three different operative positions to illustrate the manner of control thereby;

Figure 9 is a view of the control apparatus similar in substance to the illustrative form of Figure 5, but showing the parts in a position permitting doffing of a built-up package from the winding spindle;

Figures 10 and 11 are wiring diagrams of part of the control apparatus of the present invention, showing the operating switches in power-supplying position and power-cut-off position respectively with regard to the electric driving means for causing winding of the yarn in the form of a package;

Figure 12 is a detailed view partly in section of

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one element of the control apparatus of Figure 5, as taken on the lines 12—12 of Figure 5;

Figure 13 is a detailed view of a modified form of the dropwire switch of Figures 6, 7 and 8;

Figure 14 is a section of the dropwire switch of Figure 13, taken on the lines 14—14;

Figure 15 is a detailed view of a modified form of dropwire switch of the control apparatus of Figure 2, in accordance with another embodiment of the present invention;

Figure 16 is a detailed view similar to Figure 5 of certain of the operative parts of the control apparatus but showing a modified form of dropwire switch in accordance with another embodiment of the present invention;

Figure 17 is a detailed view of the embodiment of Figure 16 but with some parts in a different position; and,

Figure 18 is a cross-section of the apparatus, similar to Figure 4 but showing the modification of Figures 16 and 17.

In winding machines of the type with which this invention is concerned, it has been a desirable feature to incorporate means whereby the actual speed of rotation of the winding spindle upon which the package being built up is carried, is varied in accordance with the tension on the yarn being wound on this package, bearing in mind that this tension varies due to many causes. This is particularly desirable in the winding of such yarns as synthetic filaments of which rayon and nylon may be specified, and it is of great importance that the yarn be wound under a suitable and regulated tension, which tension will vary with the particular yarn.

Furthermore, it is a most desirable feature for such winding machines to avoid subjecting the yarn to excessive tensions as it is being wound, and particularly to avoid irregular tension, because this increases the liability of breakage of the yarn and also in many instances renders it unsuitable for use in a finished fabric. Accordingly, winding of the yarn at a tension suitable for that particular yarn under accurate control is of great importance in the preparation of a package of yarn in order that the resultant product made from this yarn may have uniform desirable qualities. Several proposals have been made heretofore for controlling the speed of winding of the yarn in accordance with the yarn tension and more particularly in accordance with variability of tension caused by snags and similar usual irregularities in the normal flow of the yarn from the supply bobbin to the package being wound, but such prior proposals have fallen

short of complete efficiency of winding together with maximum speed of winding.

It has been customary to vary the drag on the yarn as it passes from the supply bobbin to the package, with the object of decreasing the winding tension but such devices as specifically designed for this purpose have not proved satisfactory. It has also been proposed to vary the speed of winding of the yarn on the package, to compensate for the increase in diameter of the package whereby to decrease the actual tension applied to the yarn as the diameter increases but such devices do not completely take into consideration compensations for variations of tension caused by the yarn itself, by the supply package from which the yarn is being wound, by the actual travel of the yarn in its yarn guide along the length of the package, and like tension varying factors.

It has also been proposed to compensate for these various tension varying factors by providing means to simultaneously control the speed of winding of the yarn upon the package by the tension on the yarn itself, and to compensate for the increasing diameter of the package by reducing the actual drag on the yarn as the diameter of the package increases, thus, in general, satisfactorily combining the advantages of all the prior proposals and resulting in a uniform and satisfactorily wound package from the point of view of tension. However, in such devices, one of the problems which always arises is that a certain amount of force is required to move the tension responsive lever such as a dropwire, to operate the various switching means for controlling the motor speed and therefore a certain minimum tension must be applied to the yarn and thus to the dropwire before the device can operate, while also partly due to this necessity of an initial tension on the yarn there is a time and inertia delay in the switching operations and small variations of tension may be overlooked.

It is, accordingly, the general object of the present invention to provide a new and improved high-speed winding machine for winding yarn into packages at a tension best suited for that particular yarn with the winding action completely controlled by the tension fluctuations of the yarn being wound, even when these fluctuations are extremely small.

It is a further object of the invention to provide a new and improved winding apparatus which will wind an improved package of any size and of yarn of any kind without difficulties causing the formation of an irregular package or of damage to the yarn by excessive or irregular tension or both during the winding operation.

A still further object of the invention is to provide an improved yarn winding machine in which the drag imposed on the yarn being wound can be accurately preset, and can be adjusted during running if desired, and the operating tension on the yarn can be automatically controlled, while the speed of winding is automatically regulated by the operating tension on the yarn being wound, with a minimum amount of tension only being necessary on the yarn for operation of the automatic control devices.

A still further object of the invention is to provide means for imposing and maintaining tension on the yarn being wound and for reducing the effective tension on the yarn being wound from start to finish of winding of the package so as to enable a maximum speed of winding action to be carried out with a minimum of tension on the yarn in order to suit the characteristics of that particular yarn.



A still further object of the invention is to provide novel electrical means for driving a winding spindle of a winding machine to accurately control and vary the speed of winding in accordance with the tension on the yarn being wound on the package, the control means being operatively sensitive to even minute changes of tension in the yarn.

In accordance with the present invention, the winding of a package of yarn is carried out at a maximum possible speed for that particular yarn under accurate and automatic control of the tension of the yarn being wound and this control is exercised first by varying the tension on the yarn as the package builds up and simultaneously by varying the speed of winding in accordance with changes in tension on the yarn, even though these may be extremely small.

As illustrated, the invention as shown is 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 suitable core, which may be paper, on which the package is to be wound and this spindle is driven by an electric motor which can operate effectively at widely different speeds. The yarn to be wound is led in the usual manner from the supply bobbin to the package through a tension device which subjects the yarn to a predetermined drag which can be adjusted to suit the particular yarn being wound. Thereafter the yarn passes through a feeler guide or dropwire which is adapted to be biased in a variable amount against the action of the yarn passing through it, this dropwire being set at a predetermined level and being raised by increases in tension during winding and lowered by decreases in tension. From the dropwire the yarn passes to the usual traversing thread guide which applies the thread to the core on the spindle and moves back and forth longitudinally of the package being wound, to lay the yarn correctly thereon.

As embodied in the present invention, the dropwire is lightly balanced and is operatively connected to operate a switch which is adapted to control the supply of power to the electric motor driving the spindle and determine whether such power shall be supplied to the motor or shall be cut off.

The dropwire operated switch is composed of two parts in anti-frictional and wiping engagement with each other whereby the amount of energy necessary to move the dropwire and operate the part of the switch connected thereto is very small indeed so that the tension applied to the yarn need not be of a high value, this being desirable in some particular yarns. Due to the anti-frictional engagement of the two parts of the switch no force other than that required to move the lightly balanced dropwire is required to cause the various switching operations, while the resistance of the parts of the switch to movements of the dropwire under tension changes will be the same, whatever the relative position of the parts of the switch.

Preferably, the moving selector of the switch is connected directly to the dropwire to share movements therewith, and move relative to a fixed conductor, the selector and conductor of the switch being wired in series with the motor circuit and being adapted in some positions to sup-

ply electric power to the motor and in at least one other position to disconnect the power to the motor and allow same to run down to a stop unless the power is reconnected by such supply positions of the selector.

The selector and conductor of the dropwire operated switch are adapted to operate with the two parts in continuous engagement during winding to minimize the arcing over usually present in dropwire operated switches for tension control and the selector thereof is provided with a nonconducting portion and one or more conducting portions which are adapted to sequentially make contact with the conductor of the switch under control of movements of the dropwire whereby with the dropwire at normal tension position the nonconducting portion of the selector of the switch will be in contact with the conductor, to present an open circuit position.

In this open circuit switch position, the dropwire switch is adapted to maintain a closed circuit condition of a solenoid operated cut-out relay in the motor circuit of the spindle motor, whereby the motor will continue to run at its full speed while the conductor of the switch is in contact with the nonconducting portion of the selector of the dropwire switch. Upon increase of tension of the yarn the dropwire is raised and places one of the conducting portions of the selector in contact with the conductor to complete the circuit through the solenoid coil of the relay and cause this to electromagnetically open the relay circuit to disconnect supply of power to the spindle motor. The motor for the spindle is of the type to permit coasting or running under inertia under such conditions whereby the spindle will continue to rotate but at a decreasing speed, thereby reducing the tension on the dropwire and lowering this. As the dropwire reaches its normal tension position the nonconducting portion of the selector will be in contact with the conductor of the switch, whereby the motor circuit will again be completed by opening of the relay to once more apply power to the motor and commence speeding up the motor and spindle.

Accordingly, under fluctuations of tension applied to the dropwire by the yarn, even in very small increments, the sensitive, lightly-balanced dropwire will operate to cause a cut-in and cut-out of the power to the spindle motor. In actual practice variations of tension of the yarn will be such that the dropwire will fluctuate in short strokes at a relatively high speed, cutting the motor power on and off rapidly, but without undue wear upon the switch parts due to their anti-friction characteristics and with a minimum of arcing due to the relatively continuous contact of the switch conductor and selector this resulting in the spindle motor running normally at a speed less than the full speed of the motor but as high a speed as can be attained with the particular yarn being wound. Inasmuch as the dropwire switch parts only control electric power to the solenoid of the motor cut-out relay, and inasmuch as the actual breaking of the motor power circuit is controlled by the solenoid cut-out relay, the amount of possible wear, erosion of contact points, and like difficulties usually found with high-speed make and break switches is eliminated substantially, since the relay solenoid coil circuit is only a few milliamperes while the motor circuit will be normally several amperes.

The other conducting portion of the selector of the dropwire switch will be placed in contact with the conductor of the switch when the dropwire



falls under decreased pressure, and since this decreased pressure can only be the result of a breakage or an equivalent detrimental factor such as slack in the yarn which must be corrected before winding is resumed, when the dropwire is thus lowered the conductor of the switch will be again in contact with a conducting part of the selector and thus the relay will be actuated to open the motor circuit, and allow the motor to run down to a stop. This can be observed by an operator who can repair the necessary error and the machine can again be started up in its normal winding sequence.

Accordingly, the invention provides a switch mechanism directly operated under tension fluctuations of the dropwire to compensate for increases in tension by slowing down the motor until normal tension is obtained and to stop this motor should breakage or like damage occur which would reduce the tension. Preferably, dropwire with the switch parts control thereby can be adjusted into any predetermined position so that the normal tension will be such that only an abnormal condition can result in the lowering of the dropwire to cut out the motor entirely and cause stoppage and in all other conditions the dropwire will fluctuate carrying the switch parts rapidly between power-on and power-off positions with respect to the circuit of the driving motor for the spindle.

Means are also provided cooperating with the dropwire switch described above for progressively varying the tension or drag applied to the yarn as the diameter of the package being wound increases.

To this end a compensator is pivotally mounted on the frame of the winding machine and is adapted to be swung around its pivot by suitable linkage as the frame carrying the thread guide is progressively moved outwardly radially from the package during its building up in size. This compensator is drivingly connected with dropwire switch mechanism so that as the compensator is swung by the radial movements of the thread guide frame the dropwire level being maintained because of the reduction of the tension applied thereby in the yarn passing therethrough as the package builds up in size.

Also suitably connected to this compensator is the moving part of the tension device which applied a drag upon the yarn prior to its passing through the dropwire so that simultaneously with the proportional reduction of the amount of drag on the yarn, caused by the swinging of the compensator, the dropwire level will be maintained. The attachment of the various linkage to the compensator for these actuations are all adjustable whereby a complete variability can be obtained of the various functions each independently of the other.

Means are also provided for stopping the rotation of the spindle motor when the package has reached a predetermined size and is thus ready for doffing, to which end the thread guide frame carries an adjustable stop which is positioned so that it will contact an abutment on a lever at some point in the swinging movement of the frame radially from the package as this builds up. Upon contact of the stop with the abutment, the lever is swung against resilient means to short circuit the parts of the dropwire switch and thus close the solenoid circuit of the relay to disconnect the power to the motor as hereinbefore described. This condition will continue until the finished package has been removed,

permitting the abutment on the lever to be separated from the stop operating it and thus returning the parts of the dropwire switch to normal operative position. As a further feature, in this part of the mechanism, there is provided an overthrow device whereby the contact on the lever can force the conductor of the dropwire switch from the selector when the frame is manually swung away from the finished package to allow this package to be removed from the spindle, this resulting in the motor driving the spindle being completely cut out during doffing of the finished package.

By this mechanism there is provided a complete control of motor speed with respect to variability of tension and, simultaneously, with respect to the size of the package being wound, which control mechanism has many advantageous features.

By correct proportioning of the size of the non-conducting portion and the conducting portions of the selector of the dropwire switch, it is possible to eliminate time and inertia dwell between the on and off periods of motor power operation, thus minimizing the necessary travel required of the dropwire as it passes from the cut-in and cut-out positions and return, of the motor circuit, giving a complete, rapid, and efficient response to even small tension changes. Furthermore, due to the anti-friction characteristics of the dropwire operated switch parts there is no force exerted by the switch on the dropwire itself nor is there any material energy needed to deflect the parts of the switch, so that the control mechanism can be operated through extremely low tension ranges even as low as 1 gram, although higher tension ranges can be equally well operably used, while obtaining all of the advantages hereinbefore mentioned. All of the parts of the mechanism are independently adjustable to permit complete variability of any factor involved in utilizing the mechanism whereby to obtain an optimum result of the fastest possible winding conditions with correct and efficient tension of winding on the finished package.

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 paper core 11 on which the yarn 12 is wound from a supply bobbin (not shown). Spindle 10 is conventionally mounted for rotation and is provided with a pulley 13 which is driven by a belt 15 from an electric motor 14. This motor 14 will be of a suitable type to give the desired rotation to spindle 10, and is preferably a capacitator-run, capacitator-start motor of fractional horsepower.

The yarn 12 passes from its supply through a tension device 16 having means to apply a variable tension on the yarn as hereinafter described. From the tension device 16, the yarn 12 extends to, and passes over a fluted bar 33, then under the dropwire 31 through its eye 32 up to a guide bar 17, to the traversing yarn guide 18 by which the yarn is traversed back and forth over the surface of the package to be wound on core 11, to produce a "precise" wind conical package.

Guide bar 17 and yarn guide 18 are mounted on a swinging frame 19 pivoted to the machine frame 20 at 21 and having a tail end 22 projecting beyond the pivot 21. Tail end 22 has pivotally connected thereto at 23 a counterweight 24. Thus, by rotating adjusting member 26, the counterweight 24 will move inwardly or outwardly with respect to tail end 22 and vary the balance about pivot 21 of frame 19, so as to give control of pressure to the package being wound on spindle 10.

Preferably, the guide 18 is spaced from the package being wound by a freely rotating roller 28 mounted in a yoke 29 and supported on frame 19.

The guide 16 will be driven in its traversing movements by means of, for instance, the usual traverse rod, cam and the like (not shown) so that it makes one traverse to and fro longitudinally of the package on spindle 10 each several revolutions of the package.

As the package on spindle 10 builds up and thus increases in diameter, the frame 19 moves about its pivot 21 in the direction of the arrow A, the counterweight 24 permitting retaining of pressure of roller 28 on package and the adjustment means 25, 26 and 27 permitting a correct balancing of this swinging out to suit the type of yarn being wound.

In accordance with the present invention, means are provided operating between the spindle 10 and the tension device 16 to control the tension applied to the yarn 12 being wound on the package on spindle 10 at a tension best suited to the kind of yarn being wound while maintaining the maximum speed and efficiency of winding. To this end, electrical control apparatus is employed having its operating parts enclosed in a box or casing 30 which is adapted to detachably mount in any desired manner on the frame 20 of the winding machine.

In Figure 1, dropwire 31 is shown in a normal or running position and should the tension of the yarn 12 alter as by a sudden increase in tension due to a snarl or the like, or suddenly decrease as by a break in the yarn 12 or a slack in yarn 12, the dropwire 31 will move accordingly being pivotally connected to swing downwardly on breakage or decreased tension and upwardly on increased tension.

In one feature of the present invention, the dropwire 31 acts upon the electrical parts in casing 30 to cause stoppage of the motor 14 on breakage of yarn and a decreasing of speed of rotation of motor 14 upon increased tension to equalize the tension. To this end, dropwire 31 is held in a socket 35 at the end of an arm 36 by a set screw 37. Arm 36 is screw-threadedly attached at its other end to a straight side of a member 38 formed as a segment of a circle, as for instance a quadrant, arm 36 being held fixedly in place by a nut 39. Segment 38 is formed of a thick piece of metal of any desired type such as stainless steel or brass and may be, for instance, one-half inch wide. It is pivoted on a pivot pin 40 in a bearing 41 which is mounted on a panel 42 of insulating material, arranged within the casing 30. Thus dropwire 31 swings with the arm 36 around and relative to the pivot pin 40 carrying segment 38 with it, swinging the curved face of the segment through an arcuate path relative to any fixed point. Segment 38 is preferably mounted on the pivot pin 40 by an anti-friction bearing 44.

Cooperating with the curved face of the segment 38 at a fixed point is a roller 45 mounted for free rotation by a pin 46 extending between the flanges 47 terminating a lever 48 which is pivotally supported at 49 near its lower end. In order to constantly urge the roller 45 into rolling contact with the curved face of segment 38, the

lever 48 has a tail end 50 to which is linked a spring 51, the other end of the spring being held by a lug 52 on a bracket 53 attached to panel 42 by screws 54. Bearing 49 for lever 48 is also carried by bracket 53.

Inserted in the arcuate face of segment 38 is a nonconducting strip 56 this insert 56 being formed of any suitable insulating material, such as fibre or mica, and being of a size to fulfill the desired purpose hereinafter brought out. The insert 56 continues the contour of the arcuate face of segment 38 so that, as the segment moves under tension changes effecting dropwire 31, the roller 45 will either be in contact with the metal conducting parts of the arcuate face of the segment or with the nonconducting surface of insert 56. While the roller 45 is in contact with insert 56, any electric current between roller 45 and segment 38 will be interrupted, and as soon as the movements of the dropwire 31 cause the segment 38 to move the insert out of contact, circuit continuity between roller 45 and metal parts of segment 38 will be established. Thus, anti-friction rotary switch formed of segment 38 and roller 45 is a normally open switch with the roller in contact normally with the nonconducting insert 56, and, upon tension variations of yarn 12, the switch will be closed.

Upon such closing of the rotary switch 38—45, a circuit is established to discontinue supply of electric energy to motor 14 through the medium of a normally closed relay 78. Figures 10 and 11 show the electric circuits involved, Figure 10 having the motor 14 running under full supply of current and Figure 11 showing discontinuance of current. Referring to these two figures, power is supplied to the motor through leads 58 and 59, through a series fuse 60, one lead going to a terminal 61 on bracket 53 (Figure 2) to make contact with the roller 45 which is metal as is arm 48 on which it is mounted. From terminal 61 the circuit is continued to a pair of switch points 62, 63 of relay 78 which are normally bridged, as shown in Figure 10, by an arm 64 to complete the circuit for normally operating the motor 14 through a lead 65 connected to one side of the motor and to switch point 63. Main lead 59 of the electric supply connects directly to the motor, so that, when arm 64 is in contact with switch points 62, 63 the motor will continue to run under full supply of current.

Arm 64 is solenoid operated by a plunger 66 through a coil 67 which is controlled entirely by the opening or closing of a rotary switch 38—45. To this end, lead 59 is also connected by a line 68 to the coil 67 and other side of the coil 67 is connected to the segment 38 by a terminal 69 (Figure 2).

While the roller 45 is in nonconducting contact with insulating insert 56 of segment 38 the switch 38—45 will be open as in Figure 10, coil 67 of relay 78 will not be actuated and plunger 66 will be extended keeping the arm 64 in contact with switch points 62, 63, so that the motor 14 will continue to run under full power. When the roller 45 makes conducting contact with the metal parts of the face of segment 38, circuit will be completed through coil 67 as shown in Figure 11, and the plunger 66 will be withdrawn to disconnect arm 64 from switch points 62, 63 to break the circuit of the motor 14.

The motor 14 has its power supply interrupted therefore by relay 78 whenever the roller 45 is in contact with the metal parts of segment 38 on either side of insert 56, and thus, if the yarn 12 breaks or becomes slack, the dropwire 31 will fall to disconnect the motor 14, or if the tension on the yarn increases greatly the dropwire 31 will rise to discontinue the supply to the motor.

The three positions of roller 45 and segment 38 are progressively shown in Figures 6, 7 and 8. In Figure 6, the roller 45 is in contact with nonconducting insert 56 and under these conditions which will continue when the correct tension is on the yarn 12 with the dropwire in position *a*, the motor 14 will receive continued supply of power. In Figure 7, the tension has increased raising dropwire 31 to position *b* and the motor 14 will have its power supply cut off through relay 78 with the result that the motor will run down, thus decreasing the tension on the yarn 12 until the dropwire is again at position *a* of Figure 6 when the power to the motor will be renewed by cutting out of rotary switch 38—45. This condition of repeated cutting out and cutting in of power to the motor 14 will continue at a relatively high speed of change so that the actual speed of the motor 14 will be less than its full speed and at a maximum for the particular yarn being wound, the motor speed being directly controlled by the tension on the yarn itself, which acts through dropwire 31 to operate segment 38 in a high speed fluctuating or fluttering reciprocation to adjust for even small increments of increase and decrease in yarn tension.

In Figure 8 the condition is shown where the yarn 12 has broken and no longer holds up the dropwire 31 which has fallen to position c, thus cutting out the motor power through relay 78 and allowing the motor 14 to come to a stop, for repair of the break in the yarn by an operative upon discovery as by a visual signal or the like, of the stoppage of winding.

It will be noted that no force, other than that to lift the lightly balanced dropwire, is required to cause the switching operations by means of segment 38 and roller 45, whereby the switch can be efficiently operable by minimum tension ranges as low as 1 gram, for example, while the smooth acting constant contact between roller 45 and the arcuate surface of segment 38 results in a long life of the parts of an anti-friction relatively nonarcing switch.

Preferably, the relay 78 is a mercury relay switch for example of the type described and illustrated in Figures 8 and 9 of application for patent Ser. No. 506,481, filed October 16, 1943, now Patent No. 2,402,739. By utilizing a mercury relay switch for the means whereby the actual motor power is cut-in and cut-out, only a minimum of energy is expended between the contact surfaces of roller 45 and segment 38, affording greater life to the rotary switch formed by these two elements, while a maximum of efficiency is obtained, including a no-lag low inertia system of operating the motor 14 with respect to the tension requirements of yarn 12.

As a convenient method of supply the electric power through the various switching parts of the motor 14 the wiring leads from the coil 67, and the switch points 62, 63 are connected to a polarized socket 70 and polarized plug 71 is adapted to be inserted therein (Figure 5). The leads therefrom are connected to another polarized plug 73 (Figure 1), which is adapted to be inserted in a socket 74 mounted conveniently on the casing of motor 14. Thereby, the electrical controlling unit in casing 30 can be readily disconnected from electric contact for removal of the unit for repair, adjustment or replacement.

It is a further feature of the present invention to provide means to adjust the operating position of dropwire 31 and specifically the angularity of position a of the dropwire to give the desired initial setting of the roller 45 with respect to insert 56, under a resiliently effective means, to thereby obtain the most advantageous winding of the material forming the yarn.

Accordingly, there is fixed upon the bearing 44 surrounding pin 40 and carrying segment 38, a shackle 79 which is held in predetermined position relative to the segment 38 by a tightening screw 80 and supported in the shackle and held also by screw 80 is a spring wire 81 which projects downwardly and beyond the lowest level of dropwire 31. Spring wire 81 is adapted to be fixed by screw 80 to share the movements of the bearing 44 and thus of the dropwire 31.

The pivot pin 40 extends beyond bearing 44 and is adapted to receive a lever 84 having a flange 85 in which a set screw 86 is threaded, to secure lever 84 in a predetermined position on pivot pin 40 so that it can move therewith, and relative to segment 38 and spring wire 81. Lever 84 has at its extremity a block 88 into a bore of which an L-shaped arm 89 is adjustably mounted by a set screw 90, the one branch of the L of arm 89 crossing and making contact with spring wire 81 in various degrees of pressure. By raising or lowering arm 89 within the block 88 the spring wire 81 has greater or lesser distortion from its normal unstressed position, so that a spring tension of varying amounts can be applied by this means to the dropwire 31 relative to pivot pin 40. Accordingly, with the dropwire 31 in running or operative position, the L-shaped arm 89 is adjusted within block 88 to give the desired amount of spring tension for the yarn which is being used, by spring biassing dropwire 31 against the yarn passing through eye 32.

In the winding of yarns with machines of the type referred to hereinbefore, it is desirable that the actual tension applied to the yarn, with respect to the predetermined drag applied to the yarn by the tension device 16, should be reduced as the size of the package builds up, and according to another feature of the present invention means are provided for effecting such a reduction of tension under control of the increase in size of the package being wound on spindle 10. To this end, at the opposite extremity of pivot pin 40 there is mounted a lever 93, being attached to the pivot pin 40 to move therewith by a flanged portion 94 and a set screw 95.

At its free end, lever 93 is connected to a link 96 the other end of which is connected intermediate the ends of a tension compensator 77 in the form of a long bar or lever 97 which compensator is adapted to be moved in proportion to increased size of the package, as hereinafter described. Lever 97 is pivotally attached at its lowermost end to the main frame 20 of the winding machine by a bracket 98 attached to the main frame 20 and a pivot 99. Carried by a lug 104 on one end of lever 97 is a screw threaded rod 100 which is suitably supported by the lug 104 for rotational movements and projects downwardly part of the length of the lever 97. An operating head 101 is attached to rod 100 and projects beyond the upper end of the lever 97. Threadedly carried by rod 100 to move relative to lever 97 is a rider 102 which is adapted to move up and down on rod 100 by rotation thereof by head 101, the rider 102 having an extension in the form of a pivoted block 103 which extends beyond lever 97, as shown in Figure 12.

Block 103 is suitably linked to an operating lever 105 fast upon pivot 21 of frame 19, whereby the movements of frame 19 about its pivot 21, as the package on spindle 10 increases in size are transmitted to lever 97 swinging this angularly about its pivot 99, for the purpose to be described.

The linkage between operating lever 105 moving with frame 19 and block 103 is preferably adjustable whereby the angularity of compensator 77 about its pivot can be initially preselected with respect to any package to be wound. To this end, as shown in Figure 5, a link 106 is pivotally connected at 107 to the extremity of lever 105 and is attached to a coupling 108 at 109, the other end of the coupling being attached to the block 103 by a screw threaded rod 110 having a knurled operating head 111 and being spring biased by a spring 112 between stop 113 on the other end of rod 110 and the coupling 108.

Block 103 has a threaded bore 115 which permits the rod 110 to be screwed in or out relative to the compensator 77 carrying coupling 108 with it, whereby the initial angular position of compensator 77, namely the lever 97 can be preselected, and thereafter as the package on spindle 10 increases in size, the compensator 77 will progressively swing about pivot 99 in a clockwise direction from this initial position.

Attached to the lever 97 is a link 96, previously described as attached to lever 93 which in turn is fixed on pivot pin 40, whereby the angular movements of the lever 97, under influence of the adjustment of rod 110 in block 103 as well as the increasing diameter of the package on spindle 10 will be transmitted to the lever 93 attached to pin 40 and effect spring pressure of spring 81 by moving arm 89 attached to the other end of pin 40 by lever 84, thus adjusting the spring pressure on the dropwire 31, as the package builds up.

Link 96 is adjustably carried in a shackle 118, being held in place therein by a set screw 119, shackle 118 being fixed upon the lever 97 by a lock screw and nut 117, to cause it to move therewith.

In utilizing the apparatus of the present invention, conventionally an initial pressure is applied on the yarn 12 in the tension device 16, this being calculated to give the desired tension on the yarn as it is wound, and to this end, the tension device 16 is provided with an adjustable gate 75 and a fixed gate 76, the adjustable gate being moved relative to the fixed gate to vary the drag applied to the yarn.

In order that the drag or tension applied to the yarn by the tension device 16 may be varied automatically as the package on spindle increases in size, compensator 77 is also associated with the movable gate 75 to modify its position relative to fixed gate 76.

To this end, at the lower end of lever 97, there is a lug 124 in which is located another screw threaded rod 120 operated by a head 121 to move the rider 122 upwardly or downwardly relative to the lever 97, in exactly the same manner as rider 102 is operated at the upper end, by head 101.

Pivotally connected to an extension 123 of rider 122 is a lever 126 which is suitably connected at its other end to the movable gate 75 whereby the angular movements already defined of compensator 77 about its pivot 99 will cause gate 75 to be moved progressively away from gate

76 during the increasing of diameter of the package on spindle 10 to relieve the drag caused by the cooperation of gates 75 and 76, as the package builds up.

The actual throw or amount of variation of movable gate 75 relative to fixed gate 76 can be preselected by an adjusting nut 127 operating on a screw threaded end of lever 126 against the action of a spring 128 and a stop 129 to apply a variable spring bias to the gate 75 which is in part relieved when the lever 97 swings clockwise about its pivot.

Also by raising or lowering rider 122 by turning head 121, the angularity of the lever 126 is altered, whereby the amount of release of drag or tension caused by the cooperation of gates 75 and 76 can be preselected.

Means are also provided in accordance with the present invention for causing positive stopping of the motor 14 when the package on the spindle has reached its predetermined full size, as well as means to permit an overthrow of all the mechanism of the control system while the package is being doffed.

To this end, as shown particularly in Figs. 2, 3, 4 and 5, a double ended lever 132 is pivotally mounted intermediate its ends on panel 42 as at 133 and is spring urged by a spring 134 into a normal upright position as shown in the figures mentioned. One extremity of lever extends above the panel 42 and externally of the casing 30 through a gap 135 and terminates in a knock-off abutment 136. Mounted upon an angle bracket 137 carried by frame 19 is an adjustable stop 138, being screw threaded into a leaf of bracket 137 and variably positioned with respect thereto by a nut 139. The position of bracket 137 is such that upon extreme outward swinging of the yarn feeding elements 18, 28, 29 on their supporting frame 19, the stop 138 will strike knock-off abutment 136 and swing lever 132 clockwise.

At the other extremity of lever 132, there is a pin 140 in the form of a threaded rod or screw carried by a threaded bore in a flange 141 in the lever so as to be adjustable in its operating length jutting beyond the lever.

Pin 140 is directed toward lever 48 mounting roller 45 and, as clearly seen by comparing Figures 5 and 9, as the lever 132 swings clockwise, will make contact with the body of lever 48. Lever 132 is in electrical contact at all times with the side of the circuit formed by the segment 38, by virtue of a conducting plate 142 in contact with lever 132 and with bearing 41 for segment 38. Accordingly, whatever the position of the insert 56 and roller 45 may be at the time of contact of pin 140 with lever 48, the circuit between terminals 69 and 61 will be completed to stop rotation of the motor 14 and keep this in a nonrunning condition while pin 140 is in contact with lever 48. Since the length of protrusion of pin 140 can be varied, as aforesaid, the exact time when this cut-out of power supply is made can be predetermined with respect to the size of package to be wound.

When it is desired to doff the full package, the mechanism of the control apparatus can be thrown manually into the position of Figure 9 with the pin 140 still in contact with the lever 48 to prevent starting of the motor 14, the lever 48 moving into the position shown, against the action of its spring 51. In the positions assumed by the apparatus as in Figure 9 the gate 75 will be free of gate 76 so that the yarn will be free of drag for adjusting readily to a new core and the dropwire 31 is relieved of its tension from spring 81 so that the overthrow position shown is ideally suited for replenishing the core supply on spindle 10, with easy withdrawal of the full package A from the spindle. Replacement of the parts to the position in Figure 5, will automatically start the next winding operation under the same drag of tension device 16, the same spring pressure on dropwire 31 and the same cut-out 140 for the fully built package, or any of these can be changed to suit new conditions.

In operation, a core 11 is placed on spindle 10 with the parts in the position of Figure 9. The yarn 12 is then threaded through the tension gate 16, the eye 32 of dropwire 31 and thence to the yarn guide 18 and around the core a few wraps. The apparatus is then generally placed in the positions shown in Figure 5 except that the dropwire will be lowered to a position similar to that of Figure 8. If no alterations to the tension and size of the package are to be made prior to winding, the dropwire will be manually raised to the position shown in Figure 6, and thereafter the motor 14 will continue to be rotated by interrupted power supply under the tension fluctuations as hereinbefore described, until the predetermined size of package is attained when the motor will be cut out by the cut-out switch 140.

When a relatively stronger strand is being wound, and a greater amount of tension is applied to the strand, a greater amount of resistance is put on the lifting action or movement of the dropwire to maintain the predetermined running position of the eye or strand engaging end of the dropwire. A definite amount of resistance best suited to most effectively hold up the dropwire is decided upon.

This running position can be changed, to give more or less angularity to the running strand, such as more resistance for stronger strands and less resistance for weaker strands, as may be determined to give the best winding conditions and produce the best shape and quality to the wound package, all variables being taken into consideration.

Means for controlling the position of the dropwire and determining the angularity of the strand are provided by the slots in the bracket 53, Figure 2 and screws 54, by which the roller 45 in the upper end of lever 48, is adjustably set in a higher position which necessitates the insulated insert 56 to be correspondingly raised and the strand engaging end of the dropwire to be lowered and/or the roller 45 and lever 48, is set in a lower position, the insulated insert to be correspondingly lowered and the strand engaging end of the dropwire to be raised. These settings are made in conjunction with the adjustments made by the bent lever 89 pressing against the long spring wire 81 which operates jointly with the dropwire 31.

In the event that an abnormal greater amount of tension than the initial tension is present in the running strand, the lifting of the dropwire tends to lessen the initial amount of angularity but never to such an extent that the strand becomes straight, thereby, preventing undue strain on the strand or possible breakage; conversely, in the event that an abnormal lesser amount of tension than the initial tension is present in the running strand, the dropping of the dropwire tends to increase the initial amount of angularity but never to such an extent that the strand becomes slack, thereby preventing undue looseness of the strand or possible absence of tension. Both

abnormal conditions affecting the control of the electric motor speed.

Adjustments can be made either prior to or during running to compensate for tension changes desired. For instance, turning head 101 in a clockwise direction will lower the rider 102 and move the compensator 77 counter-clockwise to relieve the pressure of spring 81 against arm 89 and thus reduce the ratio of spring pressure on the dropwire, while turning head 101 in a counter-clockwise direction will increase this ratio.

Also, by turning head 121 clockwise, rider 122 is lowered, shortening the throw of link 126 and causing less tension slacking under influence of increased diameter of the package, while a counter-clockwise turning of head 121 lengthens the throw and increases the increment of release of drag per unit change in diameter. Altering the position of stop 138 on frame 19 will change the size of package automatically obtained.

Furthermore, turning head 111 counter-clockwise will shorten the operative length of levers 106 and 110 to swing compensator 77 counter-clockwise and thus reduce the pressure of bar 89 against the spring 81 to attain a slightly higher level of the dropwire eye 32, this simultaneously lessening the pressure of gate 75 against gate 76 to reduce the drag on the yarn, whereby tension adjusting in a small increment can be effected.

With the apparatus hereinbefore described, complete adjustments to satisfy any desired condition can be effected before or during winding.

However, while it is possible to adjust the segment 38 and particularly the insert 56 with respect to the fixed conductor 45 as hereinbefore brought out, with the mechanism described, the angularity of the dropwire 31 cannot be adjusted with respect to the non-conducting contact position of conductor 45 and insert 56.

Accordingly, it is a further feature of this invention to modify the construction of the dropwire switch 38 whereby to permit the non-conducting or normal tension position of insert 56 and conductor 45 to be maintained with any desired initial level on the dropwire 31.

To this end, as shown in Figures 13 and 14, the dropwire switch is formed of a segment 150 which may be in this instance of insulating material, and adjustably attached to the curved face of quadrant 150 is a shoe 151 made of conducting material and having an insulating insert 152 equivalent in size and purpose to the insert 56 of segment 38, as shown in Figures 6, 7 and 8, for example. Shoe 151 is adjustable on the curved face of segment 150 by means of set screws 156 which pass through arcuate slots 154 in the side faces of segment 150, this segment being grooved as at 158 to embrace and hold shoe 151. Shoe 151 has threaded bores 157 to receive screws 156 and by loosening the screws 156 the shoe 151 may be moved in groove 158 an amount only limited by the extent of slots 154. By this means, the relative position of insert 152 and conductor 45 can be maintained for normal tension, and the resistance of dropwire 31 can be made to suit the desired running position. When the shoe 151 has been adjusted into desired position to suit conditions of winding, screws 156 are tightened by screwing into bores 157 and the shoe 151 is thereby clamped against the side walls of groove 158 and held in position.

By this modification there is effected a further adjustment of the apparatus to suit conditions of winding which may arise. Furthermore, the shoe 151 is readily removed and replaced with the construction shown in Figures 13 and 14, for either replacement, repair or alteration. Finally, the shoe 151 may be made of good conducting and hard wearing metal such as copper or stainless steel, while the body 150 to which it is attached may be of a different metal or of insulating material for either a desired lightness of weight, durability or similar result.

Hereinbefore, the insert 56 has been generally indicated as an insulating block made for example of fiber or mica with the roller 45 of suitable material such as metal.

In Figure 15 there is shown a specific form for the insert 56 and the roller 45 wherein the maximum smooth and continuous contact is obtained between the roller and the segment 38 with the reduction to a minimum of arcing on make and break of the circuit as segment 38 moves under control of dropwire 31. Roller 45 comprises a carbon cylinder 170 mounted upon a metal core 171, this core being mounted to rotate in the bracket 47 (Figure 2) as previously described by means of pivot pin 46.

Insert 56 comprises a U-shaped metallic seat 172, preferably of silver or like self cleaning conductor which is held in place in the stainless steel body of segment in any convenient manner and which embraces a mica insulating block 173. With this construction the contact roller 45 of carbon or graphite brush material contacts the insulation block of mica or the like 173 and there is an immediate contact edge of coil silver or the like formed by the arms of seat 172, thus providing a relatively non-sparking self-cleaning and long wearing switching means according to this invention.

The manner of constructing the dropwire switch formed of segment 38 and roller 45 according to the present invention is such that there is the greatest possible sensitivity to yarn tension changes of the dropwire switch, as hereinbefore brought out, and when dealing with very low winding tensions as required or as desired for some yarns rapid fluctuations of the dropwire 31 and thus the changes of speed controlled thereby through the rotor switch 45—38 will result. In some such instances, it may be desirable to be able to dampen the fluctuations of the dropwire 31. Furthermore, while the tension of the yarn on the dropwire 31 can be decreased or increased, as hereinbefore described by turning head 111 (Figure 5) to move the lever 77 about its pivot, it may be desirable to obtain more control of this increase or decrease than can be given by such means since the changes made are limited by the length of threaded portion 110, while also it may be preferable to avoid changing the tension of the yarn on the dropwire 31 by alteration of the position of head 111.

Accordingly, means are provided as illustrated in Figures 16, 17 and 18, for accomplishing these desired functions.

To this end, in the modification shown in these figures, a counterweight 175 is adjustably mounted on bearing 44, the counterweight thus moving with shackle 79 carrying spring wire 81 when the counterweight is fixed to the bearing by a tightening screw 176. The counterweight 175 is suitably shaped, for instance kidney shaped as illustrated, to give a definite bias of the spring 81 and its cooperating arm 89, variable from a maximum amount, when in the position of Figure 16 to a negligible amount when in the position of Figure 17, so that, by varying the position of counterweight 175 around bearing 44 by use of

the screw 176 greater or lesser tension of the yarn on the dropwire 31 can be attained, the counterweight acting to actually load the dropwire 31 with a positive force which is constant for that position of the counterweight.

Thus, this can be utilized for loading the dropwire 31 to adjust for tension as previously described irrespective of the adjustments made by means of head 111, or it may be used to dampen the lightly balanced dropwire 31.

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 is claimed is:

1. In a winding machine, the combination of a spindle on which the package is to be wound, a motor for driving the spindle, and a switch in the motor circuit controlling the supply of power to the motor, said switch having a yarn tension actuated selector, in contact with, and movable relative to a conductor in increments directly proportional to changes in yarn tension, and having its resistance to movement to such yarn tension changes of the same predetermined value at all positions of the selector relative to the conductor.

2. In a yarn winding machine, the combination of a motor driven spindle on which the package to be wound is mounted, a motor for driving the spindle, a relay in the motor circuit for controlling power to the motor to vary the spindle speed, and a switch for controlling the operation of the relay, said switch comprising a selector having a plurality of separate segments each controlling a different function, the selector moving under influence of changes in tension on the yarn, and a conductor in continuous contact sequentially with the segments and forming with each one a different form of control of the relay.

3. In a yarn winding machine, the combination of a motor driven spindle on which a package to be wound is mounted, a motor for driving the spindle, a relay in the motor circuit for controlling power to the motor to vary the spindle speed, and a switch for controlling the operation of the relay, said switch comprising a selector moving under influence of changes in tension on the yarn, and a conductor in continuous contact with the selector and operating the relay thereby in either an on or off position of supply of power to the motor, to vary the spindle speed relative to the change in yarn tension.

4. In a winding machine the combination of a motor driven spindle on which the package is to be wound, a motor for driving the spindle, and a switch in the motor circuit controlling the supply of power to the motor said switch having a yarn tension actuated selector, in contact with, and movable relative to a fixed conductor in increments directly proportional to changes in yarn tension, and having its resistance to such yarn tension changes of the same predetermined value at all positions of the selector relative to the conductor, said selector being lightly balanced to respond to yarn tension changes of a small magnitude relative to the tension on the yarn during winding.

5. In a yarn winding machine, the combination of a spindle on which the package is to be wound, a motor driving the spindle, a selector progressively moved by changes in tension in the yarn to two operative positions and a conductor in fixed position relative thereto and said selector and conductor having relative movement while in continuous contact for controlling the supply of power to the motor whereby the speed of driving of the spindle is governed by the tension of the yarn.

6. In a yarn winding machine, the combination of a spindle on which the package to be wound is carried, a motor driving the spindle, and control apparatus for varying the speed of the motor in accordance with the tension on the yarn being wound including a switch having a movable selector and a stationary conductor in continuous contact therewith, said selector having conducting and non-conducting segments which are moved into position with respect to the conductor selectively by means governed by the tension of the yarn being wound, to either cause supply of power to the motor or to discontinue such supply.

7. In a yarn winding machine, the combination of a spindle on which the package to be wound is carried, a motor driving the spindle, and control apparatus for varying the speed of the motor in accordance with the tension on the yarn being wound including a switch having a curved selector conducting member pivotally moving under variations of tension of the yarn, an insulating segment on the curved contact face of the selector, an anti-friction conductor in continuous contact at all times with the curved contact face, means operated by the open circuit between the insulated segment of the selector and the conductor for supplying power to the motor, and means operated by the closed circuit between the contact face of the selector and the conductor for disconnecting the power supply to the motor.

8. In a yarn winding machine, the combination of a spindle on which the package to be wound is carried, a motor driving the spindle, and control apparatus for varying the speed of the motor in accordance with the tension on the yarn being wound including a switch having a curved selector conducting member pivotally moving under variations of tension of the yarn, an insulating segment on the curved contact face of the selector, an anti-friction conductor in continuous contact at all times with the curved contact face, means operated by the open circuit between the insulated segment of the selector and the conductor for supplying power to the motor, and means operated by the closed circuit between the contact face of the selector and the conductor for disconnecting the power supply to the motor said means including a normally closed relay in series with the motor supply lines which is operated to open the motor circuit at all times that the conductor of the switch is in contact with the conducting curved surface of the selector.

9. In a yarn winding machine, the combination of a spindle on which the package to be wound is carried, a motor driving the spindle, and control apparatus for varying the speed of the motor in accordance with the tension on the yarn being wound including a switch having a selector with a curved surface one part of which is of conducting material and another part of non-conducting material, a conductor in continuous contact at all times with said surface, means to initially adjust the relative position of the non-conducting part of the surface with respect to the conductor, a connection between the selector

and a dropwire responsive to tension changes in the yarn, and a relay in the motor circuit normally closed by the open circuit between the non-conducting part of the selector surface and the conductor which represents a normal tension position, the relay being actuated to open the motor circuit whenever the dropwire is raised under increased tension by contact between the conducting part surface of the selector and the conductor to slow the spindle speed until the normal tension position is reached, when the power to the motor will be cut-in again.

10. In a yarn winding machine, the combination of a spindle on which the package to be wound is carried, a motor driving the spindle, and control apparatus for varying the speed of the motor in accordance with the tension on the yarn being wound including a switch having a selector with a curved surface two parts of which are of conducting material and another part of non-conducting material, a conductor in continuous contact at all times with said surface, a connection between the selector and a dropwire responsive to tension changes in the yarn, and a relay in the motor circuit normally closed by the open circuit between the non-conducting part of the selector surface and the conductor which represents a normal tension position, the relay being actuated to open the motor circuit whenever the dropwire is raised under increased tension by contact between one of the conducting parts surface of the selector and the conductor to slow the spindle speed until the normal tension position is reached, when the power to the motor will be cut-in again and to also open the motor circuit for complete stoppage of the spindle motor whenever the dropwire is lowered due to breakage of the yarn, by contact between the other conducting part of the surface of the selector and the conductor.

11. In a yarn winding machine, the combination of a spindle on which the package to be wound is carried, a motor driving the spindle, and control apparatus for varying the speed of the motor in accordance with the tension on the yarn being wound including a switch having a movable selector and a stationary conductor in continuous contact therewith, said selector having conducting and non-conducting segments which are moved into position with respect to the conductor selectively by means governed by the tension of the yarn being wound, to either cause supply of power to the motor or to discontinue such supply and a compensator operatively linked to the selector to alter the relative position of the non-conducting segment thereof with respect to the conductor, progressively as the package builds up in size.

12. In a yarn winding machine, the combination of a spindle on which the package to be wound is carried, a motor driving the spindle, and control apparatus for varying the speed of the motor in accordance with the tension on the yarn being wound including a switch having a movable selector and a stationary conductor in continuous contact therewith, said selector having conducting and non-conducting segments which are moved into position with respect to the conductor selectively by means governed by the tension of the yarn being wound, to either cause supply of power to the motor or to discontinue such supply, means being provided for varying the initial position of said segments relative to said selector and also relative to said conductor, to preselect the normal level position with the non-conducting segment in normal contact with the conductor.

13. In a yarn winding machine, the combination of a spindle upon which the package is to be wound, a motor driving the spindle, a thread guide mounted on a pivotally supported frame for guiding the yarn onto the package and control apparatus for varying the speed of the motor with respect to the tension on the yarn and to the progressively increasing size of the package including a normally open switch having a movable selector and a fixed conductor in continuous contact therewith, a plurality of segments of differing conducting characteristics on the contact surface of the selector, a normally closed relay operatively connected to the motor circuit and, governed by the switch to be opened or closed thereby by contact between the segments of the selector and the conductor, and levers connecting the thread guide frame and the selector to progressively alter the position of the segments with respect to the conductor.

14. In a yarn winding machine, the combination of a spindle upon which the package is to be wound, a motor driving the spindle, a thread guide mounted on a pivotally supported frame for guiding the yarn onto the package, a tension device for applying a drag to the yarn as it is fed to the thread guide, and control apparatus for varying the speed of the motor with respect to the tension on the yarn and to the progressively increasing size of the package including a normally open switch having a movable selector and a fixed conductor in continuous contact therewith, a plurality of segments of differing conducting characteristics on the contact surface of the selector, a normally closed relay operatively connected to the motor circuit and governed by the switch to be opened or closed thereby by contact between the segments of the selector and the conductor, and levers connecting the thread guide frame and the selector to progressively alter the position of the segments with respect to the conductor, and connections between said levers and the tension device for applying a drag to said yarn for reducing the drag as the package size increases.

15. In a winding machine the combination of a motor driven spindle on which the package is to be wound, a motor driving the spindle, and a switch in the motor circuit adapted to open the circuit in one position to stop supply of power to the motor, and close the circuit at least in one other position to supply power to the motor, said switch comprising a selector moved by small changes of tension in the yarn in contact relative to a fixed conductor to either close or open the motor circuit, said selector and conductor having relative movement while in contact, and having the resistance of the selector to such changes of substantially the same value in any relative position of the selector and conductor.

16. In a winding machine the combination of a motor driven spindle on which the package is to be wound, a motor driving the spindle, and a switch in the motor circuit adapted to open the circuit in one position to stop supply of power to the motor, and close the circuit at least in one other position to supply power to the motor, said switch comprising a selector moved by small changes of tension in the yarn in continuous contact relative to a fixed conductor to either close or open the motor circuit, the force required to move the selector to either closed or open circuit positions being of substantially equal magnitude.

17. In a winding machine the combination of a motor driven spindle on which the package is to be wound, a motor driving the spindle, and a switch in the motor circuit adapted to open the circuit in one position to stop supply of power to the motor, and close the circuit at least in one other position to supply power to the motor, said switch comprising a selector moved by small changes of tension in the yarn in contact relative to a fixed conductor to either close or open the motor circuit said selector and conductor having relative movement while in contact, the force required to move the selector to either closed or open circuit positions being of equal magnitude, and being a small part only of the force applied to the yarn in the form of tension.

18. In a winding machine, the combination of a spindle on which the package is to be wound, a motor for driving the spindle, and a switch in the motor circuit controlling the supply of power to the motor, said switch having a yarn tension actuated selector, in contact with, and movable relative to a conductor in increments directly proportional to changes in yarn tension, and having its resistance to movement to such yarn tension changes of the same predetermined value at all positions of the selector relative to the conductor, said selector being variably spring biased against the tension of the yarn moving same.

19. In a winding machine, the combination of a spindle on which the package is to be wound, a motor for driving the spindle, and a switch in the motor circuit controlling the supply of power to the motor, said switch having a yarn tension actuated selector, in contact with, and movable relative to a conductor in increments directly proportional to changes in yarn tension, and having its resistance to movement to such yarn tension changes of the same predetermined value at all positions of the selector relative to the conductor, said selector being variably gravity loaded against the tension of the yarn moving same.

20. In a winding machine, the combination of a spindle on which the package is to be wound, a motor for driving the spindle, and a switch in the motor circuit controlling the supply of power to the motor, said switch having a yarn tension actuated selector, in contact with, and movable relative to a conductor in increments directly proportional to changes in yarn tension, and having its resistance to movement to such yarn tension changes of the same predetermined value at all positions of the selector relative to the conductor, adjustable means being provided for applying a resilient force upon said selector and separate means being provided for applying a gravity bias in opposition to said resilient force in an adjustable amount.

21. In a yarn winding machine, the combination of a spindle on which the package to be wound is carried, a motor driving the spindle, and control apparatus for varying the speed of the motor in accordance with the tension on the yarn being wound including a switch having a selector with a curved surface one part of which is of conducting material and another part of non-conducting material, a conductor in continuous contact at all times with said surface, means to initially adjust the relative position of the non-conducting part of the surface with respect to the conductor, a connection between the selector and a dropwire responsive to tension changes in the yarn an adjustable weight adapted to alter the gravitational load of said dropwire, and a relay in the motor circuit normally closed by the open circuit between the non-conducting part of the selector surface and the conductor which represents a normal tension position, the relay being actuated to open the motor circuit whenever the dropwire is raised under increased tension by contact between the conducting part surface of the selector and the conductor to slow the spindle speed until the normal tension position is reached, when the power to the motor will be cut-in again.



22. In a winding machine, the combination of a spindle on which the package is to be wound, a motor for driving the spindle, and a switch in the motor circuit controlling the supply of power to the motor, said switch having a yarn tension actuated selector, in contact with, and movable relative to a conductor in increments directly proportional to changes in yarn tension, and having its resistance to movement to such yarn tension changes of the same predetermined value at all positions of the selector relative to the conductor and means acting on said selector to alter the gravitational load applied thereby against the yarn tension, in an adjustable amount.

23. In a winding machine, the combination of a spindle on which the package is to be wound, a motor for driving the spindle, and a switch in the motor circuit controlling the supply of power to the motor, said switch having a yarn tension actuated selector, in contact with, and movable relative to a conductor in increments directly proportional to changes in yarn tension, and having its resistance to movement to such yarn tension changes of the same predetermined value at all positions of the selector relative to the conductor and resilient means acting on the selector to oppose the movements imparted to the selector by changes in yarn tension, adjustable means for preselecting the resilient force applied by said resilient means to the selector.

24. In a winding machine, the combination of a spindle on which the package is to be wound, a motor for driving the spindle, and a switch in the motor circuit controlling the supply of power to the motor, said switch having a yarn tension actuated selector, in contact with, and movable relative to a conductor in increments directly proportional to changes in yarn tension, and having its resistance to movement to such yarn tension changes of the same predetermined value at all positions of the selector relative to the conductor, resilient means acting on the selector to oppose the movements imparted to the selector by changes in yarn tension, adjustable means for preselecting the resilient force applied by said resilient means to the selector, and a variable gravity load adapted to be applied to the selector in a preselected amount opposing the resilient force applied thereto.

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