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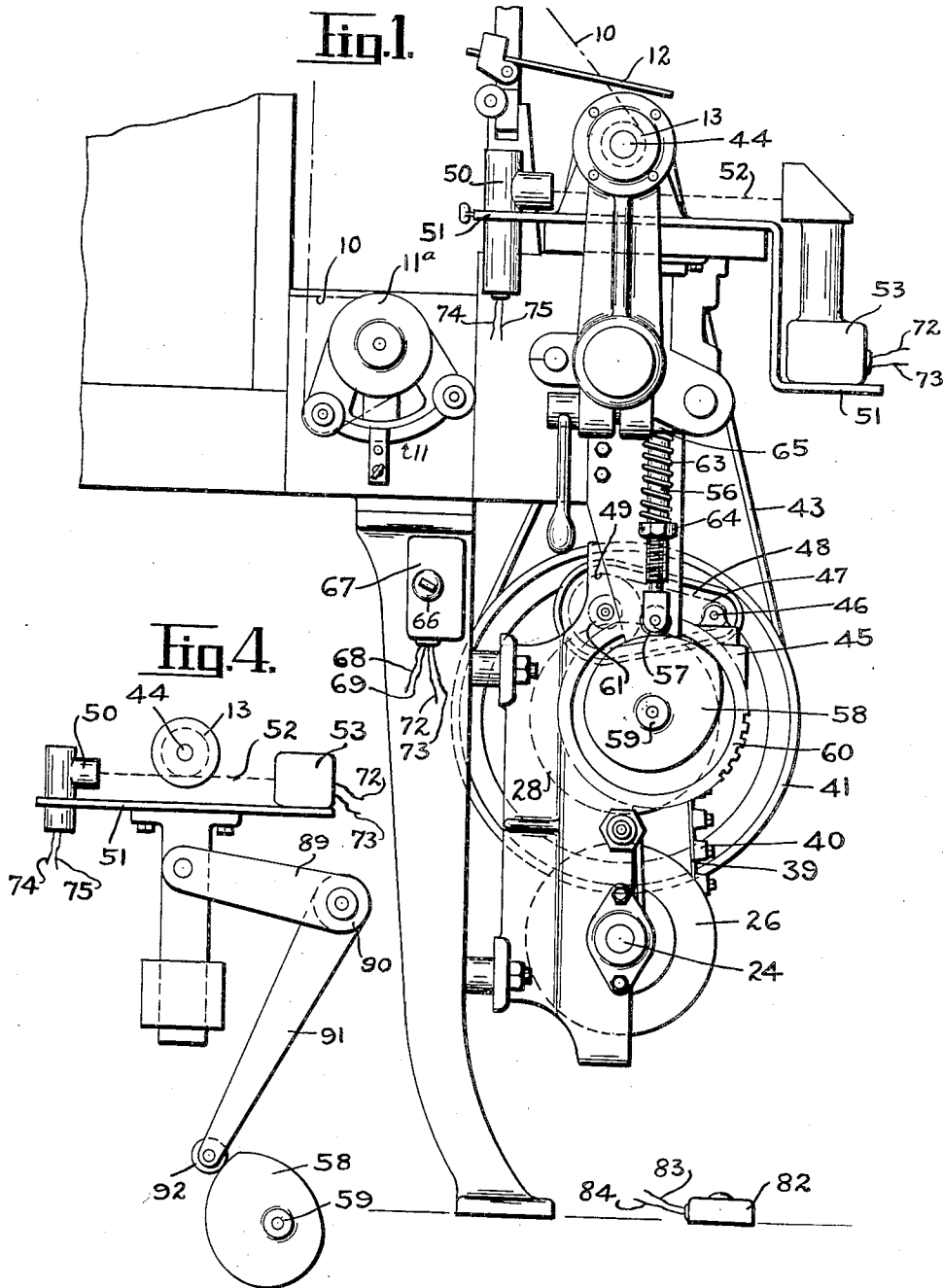
R. E. WALSH ET AL

2,214,333

APPARATUS FOR AND METHOD OF WINDING WIRE

Filed Oct. 5, 1937

3 Sheets-Sheet 1



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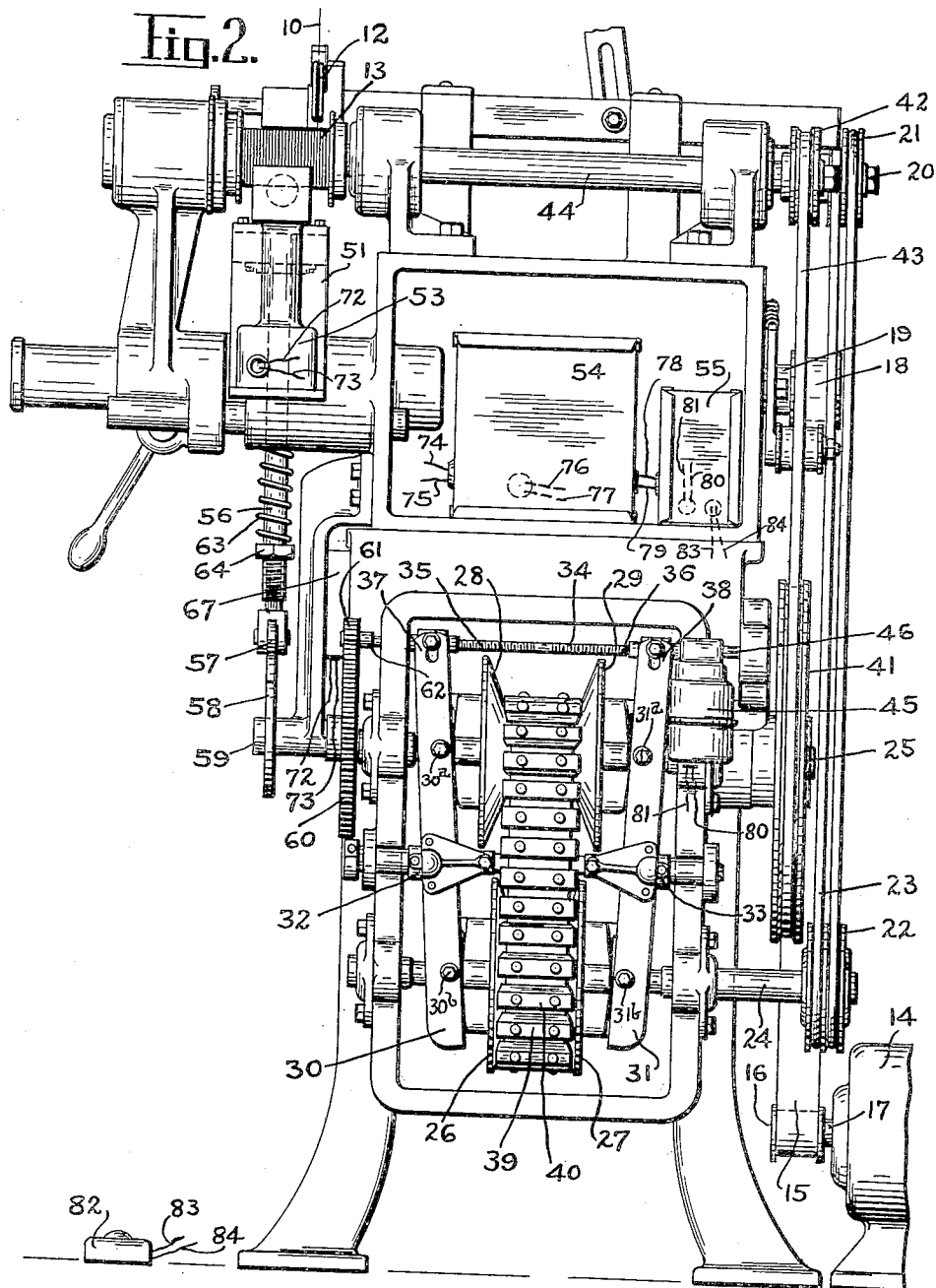
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3 Sheets-Sheet 3

Fig. 3.

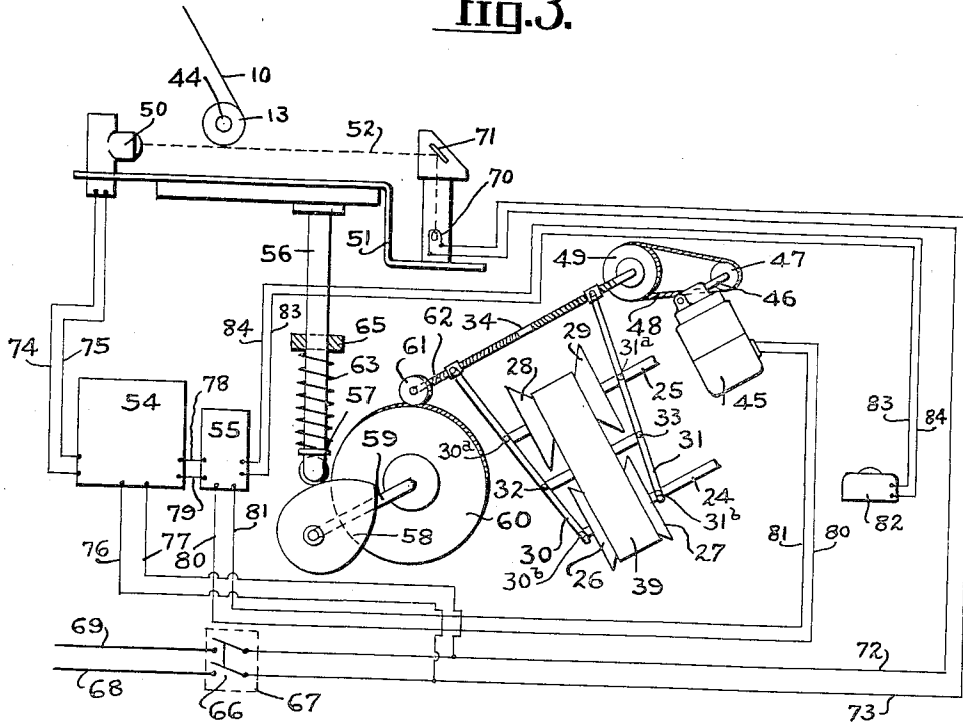
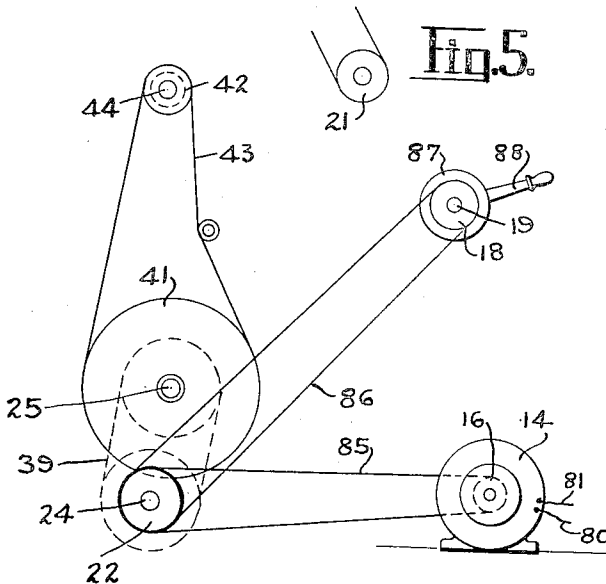


Fig. 5.



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2,214,333

APPARATUS FOR AND METHOD OF WINDING WIRE

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Application October 5, 1937, Serial No. 167,366

29 Claims. (Cl. 242—45)

This invention relates to wire spooling mechanisms, and more particularly to an improved spooler for use with a high speed wiredrawing machine.

In the spooling of wire from a wiredrawing machine, it is desirable that the receiving spool be run at a constant circumferential speed from the start to the finish of the spooling operation in order to obtain a uniform wire tension and tightness of winding. Many spoolers have been provided with devices for gradually reducing the rotative speed of the spool as the spool fills up with wire, but most of these devices were controlled by parts having mechanical contact with the wire, which resulted in the soiling, discoloration, scratching or roughening of the wire surface, and lack of uniformity in winding.

By means of the present invention, the above and other disadvantages have been avoided. This has been accomplished by means of an "electric eye" controlled mechanism whereby the wire will be uniformly wound at the desired tension and tightness upon the spool without requiring any mechanical contact with the wire.

One object of this invention is to provide a spooler of the above nature having electrical means responsive to the electric eye for retarding the rotative speed of the spool in correspondence with the diameter of the wire being wound upon the spool.

A further object is to provide a device of the above nature in which the electrical means is adapted to intermittently adjust a variable speed control mechanism drivingly connected to the spool.

A still further object is to provide an improved spooling mechanism of the above type which will be relatively simple in construction, inexpensive to manufacture, readily manipulated, compact, ornamental in appearance, and very efficient and durable in use.

With these and other objects in view there have been illustrated on the accompanying drawings three forms in which the invention may be conveniently embodied in practice.

In the drawings:

Fig. 1 is a side view of a spooling mechanism embodying the invention.

Fig. 2 is a front view of the same.

Fig. 3 is a diagrammatic view of the invention.

Fig. 4 is a side view showing a modified form of supporting bracket adjusting means.

Fig. 5 shows a modified form of drive arrangement.

Referring now to the drawings in which like

reference characters denote corresponding parts throughout the several views, the numeral 10 indicates a wire received from a wiredrawing machine and delivered to a variable wire tensioning mechanism 11 including a capstan drum or final drawing roll 11a for drawing the wire through the last die of the wiredrawing machine at a substantially constant speed, as fully described in Patent No. 1,935,726, issued November 21, 1933, to William D. Pierson, for a Variable wire tensioning device. The wire then passes upwardly over a resilient device, not shown, and then downwardly through a pair of transversely reciprocating wire guiding fingers 12 to a spool 13.

In order to supply driving power to the spooler mechanism, provision is made of an electric motor 14 (see Fig. 2), preferably the same motor which operates the wiredrawing mechanism. A belt 15 leads from a pulley 16 on the shaft 17 of the motor 14, and runs over a pulley 18 on a horizontal shaft 19, which is connected by interior mechanism, not shown, to an elevated shaft 20 extending out of the machine. Mounted on the shaft 20 is a pulley 21 which is connected to a pulley 22 by a belt 23 to drive said pulley in synchronism with the wiredrawing mechanism of the machine.

The driven pulley 22 is connected to a driving shaft 24 of a well known form of variable speed mechanism, such as the "Reeves," wherein another shaft 25 is arranged to be driven from the shaft 24 by what is termed "infinite speed regulation," as distinguished from speed regulation by successive steps, such as by cone pulleys, etc. This mechanism includes a pair of oppositely facing conical-faced discs 26 and 27, which are rotatively secured to the shaft 24 and also axially slidable thereon, and a pair of similar opposed conical-faced discs 28 and 29 mounted on the shaft 25. The discs 26 and 27 are respectively secured to the lower ends 30b and 31b of a pair of shift levers 30 and 31, which levers are pivoted at 32 and 33, respectively, to stationary parts of the mechanism. The upper ends of the shift levers 30 and 31 are secured to the discs 28 and 29 at 30a and 31a. By this construction, rocking of the levers 30 and 31 upon their pivots 32 and 33 in one direction will draw together the discs 26 and 27 and separate the discs 28 and 29 simultaneously, and reversely actuate these discs when the levers 30 and 31 are rocked in the other direction.

The levers 30 and 31 are adapted to be rocked by means of a rotatable threaded rod 34 having a pair of reversely threaded portions 35 and 36, 55

to which the upper lever ends 37 and 38 are threadedly secured. By means of this construction, the rotation of the rod 34 will rock the levers 30 and 31 simultaneously in opposite directions to actuate the discs 26, 27 and 28, 29, which are drivingly connected by a belt 39 having a plurality of bevel ended cross-bars 40 secured thereon, said cross-bars being adapted to engage the inclined faces of the oppositely facing discs in driving contact therewith, thereby producing an infinite, smooth and gradual variation in relative speed between the shafts 24 and 25.

The shaft 25 has a large pulley 41 connected to one of its ends and is drivingly connected to a pulley 42 by a belt 43. The pulley 42 is secured upon a spool spindle 44, by which the spool 13 may be rotated to wind wire thereon at the speed the wire is being delivered thereto from the wire-drawing machine. By means of the above described spool driving mechanism the speed of the spool 13 may be infinitely varied by rotation of the threaded rod 34 to maintain the circumferential speed of the wire on the spool in correspondence with the speed of the wire being fed thereto.

In order to automatically rotate the threaded rod 34, an electric motor 45 is provided, which is of the well known reversible type, having built-in reduction gears which are connected by a shaft 46 to a sprocket wheel 47. A chain 48 drivingly connects the sprocket wheel 47 to another sprocket wheel 49, secured upon an extending end of the rod 34. By this arrangement, actuation of the motor 45 will rotate the rod 34, as desired, to vary the speed of the spool 13.

To intermittently control the actuation of the motor 45 in accordance with the amount of wire wound upon the spool, provision is made of an electric eye device now to be described. This device includes a photo-electric cell 50 mounted upon a bracket 51 and arranged in the path of a beam of light 52 from a source of light in a box 53, also mounted on the bracket 51. The bracket 51 is vertically adjustable to position the beam of light 52 tangent to the circumference of the wire on the spool 13. Through suitable cooperating electrical controls disposed in casings 54 and 55, the photo-electric cell 50 will cause energization of the motor 45 to vary the rotative speed of the spool 13 when the beam of light 52 is interrupted by the wire on the spool as the diameter of the layers of wire on the spool increases. The electrical control apparatus in the casings 54 and 55 are similar to the control and amplifier units 73 and 119 described in the Patent 2,108,410 to W. R. Perry, for "Speed control mechanism," dated February 15, 1938. Reference should be had to this patent for a more complete disclosure thereof. After a short operation of the motor 45, the bracket 51 will be lowered slightly, again establishing an uninterrupted beam of light 52 and stopping the motor 45, the screw 34 being adjusted during this interval sufficiently to produce the proper variation in the speed of the spool 13. The bracket 51 is carried upon the upper end of a plunger 56 which is provided at its lower end with a roller 57 adapted to ride upon the peripheral camming edge of a plate cam 58. The cam 58 is secured upon a stud shaft 59 having a gear 60 secured thereto adapted to mesh with, and be driven by, a pinion 61 secured upon an extending end 62 of the rod 34. A spring 63 coiled about the plunger 56 reacts against an adjusting nut 64 threaded upon the plunger and a

stationary supporting bracket 65 to maintain the roller 57 against the cam 58, the nut being manually operable to vary the tension of the spring 63. The edge of the cam 58 is shaped to permit the bracket 51 to be slowly lowered to re-position the light beam 52 into controlling position and to compensate for the additional layers of wire upon the spool 13 and re-establish the beam 52. Such re-establishment of the light beam 52 stops the motor 45 after an adjustment in speed has been made.

Operation

In operation, assuming that the machine has been initially adjusted with the light beam 52 tangent to the periphery of the spindle 44 of the empty spool 13, and that the wire 10 has been passed through the guiding fingers 12 and frictionally or otherwise connected to said spool, the motor 14 will be started in the usual manner to operate the wire-drawing machine. At the same time a switch 66, preferably disposed in a box 67, will be manually closed to connect the electric circuits of the control devices to the main line conductors 68 and 69. The closing of the switch 66 will cause a lamp filament 70 in the box 53 to become incandescent and the beam of light 52 therefrom will be reflected by a mirror 71 past the lower peripheral edge of the spool 13 to the photo-electric cell 50. The impinging of the beam of light 52 upon the cell 50 will cause it to actuate the controls in the casings 54 and 55 to maintain the circuit, including the motor 45, in open condition.

The lamp filament 70 is connected to the switch 66 by a pair of conductors 72 and 73, and the photo-electric cell 50 is connected to the controls in the casing 54 by conductors 74 and 75. The controls in the casing 54 are connected to conductors 72 and 73 by conductors 76 and 77, and to the controls in the casing 55 by conductors 78 and 79. Provision is also made of a pair of conductors 80 and 81 which connect the motor 45 with the controls in the casing 55. A motor reversing switch 82 is also provided and is connected to the motor controls in the casing 55 by conductors 83 and 84.

During the operation of the wire-drawing machine, the spool 13 will be continuously driven to wind up the wire received from the drawing machine. When a sufficient number of layers of wire have been wound upon the spool 13 so that the diameter has increased enough to interrupt the beam of light 52, the circuit of the motor 45 will be closed by the cooperating action of the controls in the casings 54 and 55, and the motor 45 will then momentarily operate to rotate the threaded rod 34.

The rotation of the rod 34 will actuate the variable speed mechanism, as above described, to slightly decrease the rotative speed of the spool spindle 44 and at the same time will slightly rotate the cam 58 by means of the intermeshing pinion 61 and the gear 60. The rotation of the cam 58 will permit the bracket 51 to move downwardly by the action of gravity, and this action will continue until the beam of light 52 passes below the outer layer of wire on the spool 13, and again impinges upon the electric eye 50, whereupon the motor 45 will again be stopped by the actuation of the electrical controls in the casings 54 and 55. It has been found in practice in one instance that an increase of diameter of the layers of wire on the spool 13 of .005 of an inch will be sufficient to cause the above mentioned in-

interruption of the light beam 52. After the spool 13 has been filled, the mechanism will be brought back to its initial position for the filling of a second empty spool merely by reversing the motor 45 by actuation of the foot-operated switch 32, and allowing said motor to operate until the cam 58, the light beam 52, and the variable speed mechanism are again in their initial positions, as shown in Fig. 3.

In the modified form of the invention shown in Fig. 5, the pulley 16 of the driving motor 14 is directly connected by a belt 85 to the pulley 22 of the driving shaft 24 of the variable speed mechanism. Another belt 86 connects the pulley 22 to the pulley 18 which, in this instance, is arranged to be connected to the shaft 19 extending into the wiredrawing machine by a suitable clutch 87 operable by a handle 88. By the use of the arrangement shown in Fig. 5, the variable speed mechanism together with the electric eye control may be reset to its initial starting position without operating the wiredrawing machine, the shaft 19 being disconnected from its driving pulley 18 by a releasing actuation of the clutch 87.

In accordance with the modification shown in Fig. 4, the bracket 51 which supports the electric eye apparatus is carried by the upper arm 89 of a bell-crank lever 90, the lower arm 91 of said lever being actuated by the cam 58 through a roller 92 resting thereon and carried by said arm 91. It will be understood that the rotation of the cam 58 will permit the lever 90 to be swung by gravity in a counter-clockwise direction to lower the bracket 51, and with it, the photo-electric cell 50 and the light box 53. Preferably, the box 53 may be mounted on the bracket 51 in such a manner that the beam of light 52 from the filament 70 will shine directly upon the cell 50 without the use of a mirror 71.

It will be understood that, within the scope of this invention, the term "photo-electric cell" employed herein includes devices employing selenium or other suitable substances, as the light sensitive element.

It will also be understood that while the interruption and reestablishment of the beam of light 52 has been herein described as causing the motor 45 to start and stop respectively, it is within the scope of this invention to allow the motor 45 to operate continuously throughout the spooling and to merely have its speed increased and decreased momentarily by the interruption of the beam and the reestablishment thereof. In other words, the control motor will be continuously energized and the energization varied by being altered periodically by controlling current from the photocell controlled circuit to cause the variable speed drive to be regulated in accordance with the changing diameter of the package. This will permit a somewhat more uniform control of the operation which is especially advantageous for small wire, which is operated at high speed. This construction will lessen the possibility of breakage of wire by the stresses due to jerks and impulses incident to the starting and stopping of the motor.

While there have been disclosed in this specification several forms in which the invention may be embodied, it is to be understood that these forms are shown for the purpose of illustration only, and that the invention is not to be limited to the specific disclosures but may be modified and embodied in various other forms without departing from its spirit. In short, the invention includes all the modifications and embodi-

ments coming within the scope of the following claims.

Having thus fully described the invention, what is claimed as new, and for which it is desired to secure Letters Patent, is:

1. In a wire spooling mechanism, mechanism to rotate a wire receiving spool at variable speed including electrically operated means to adjust said variable speed mechanism, and photo-electrical controlling means responsive to the thickness of the layer of wire wound on said spool to intermittently actuate said electrically operated means as the wire builds up on said spool.

2. In a wire spooling mechanism, mechanism to rotate a wire receiving spool at variable speed including electrically operated means to adjust said variable speed mechanism, and photo-electrical controlling means responsive to the thickness of the layer of wire being received on the spool to intermittently actuate said electrical adjusting means and decrease the speed of the spool in accordance with the increased diameter of said wire.

3. In a wire spooling mechanism, mechanism to rotate a wire receiving spool at variable speed including electrically operated means to adjust said variable speed mechanism, a photo-electric cell, a lamp for throwing a beam of light on said cell adjacent the periphery of the layer of wire wound on said spool for controlling said electrical adjusting means, and means to slow down the speed of said mechanism responsive to the successive interruptions of said beam as the wire builds up on said spool.

4. In a wire spooling mechanism, mechanism to rotate a wire receiving spool at variable speed including electrical means to adjust said variable speed mechanism, a photo-electric cell, means to cause a beam of light to pass in proximity to the wire wound on said spool and impinge upon said cell, and means responsive to the interruption of said beam of light to actuate said electrical adjusting means, and means to move said cell and light producing apparatus so that the path of said beam will again strike said cell to stop the operation of said speed adjusting means.

5. In a wire spooling mechanism, mechanism to rotate a wire receiving spool including a variable speed mechanism having a rotatable adjusting member, an electric motor to rotate said member, electrical controls for said motor, and means including photo-electric means responsive to the intermittent interruption of a beam of light by the wire wound on said spool to actuate said controls.

6. In a wire spooling mechanism, mechanism to rotate a wire receiving spool including a variable speed mechanism having a rotatable adjusting member, an electric motor to rotate said member, electrical controls for said motor, a source producing a light beam, means responsive to the interruption of a beam of light by wire wound on said spool to actuate said controls, and means actuated by the operation of said member to reestablish the interrupted beam of light after a predetermined amount of wire has been wound on said spool.

7. In a wire spooling mechanism, mechanism to rotate a wire receiving spool including a variable speed mechanism having a rotatable adjusting member, an electric motor to rotate said member, electrical controls for said motor, a photo-electric cell, a source of light arranged to direct a beam of light across the axis of the spool adjacent its periphery and upon said cell, said cell being responsive to the interruption of said

beam of light by wire wound on the spool to actuate said controls and cause said motor to temporarily operate said speed adjusting member.

8. In a wire spooling mechanism, mechanism to rotate a wire receiving spool including a variable speed mechanism having a rotatable adjusting member, an electric motor to rotate said member, electrical controls for said motor, a photo-electric cell, a source of light arranged to direct a beam of light across the axis of the spool adjacent its periphery and upon said cell, said cell being arranged to actuate said controls when the beam of light is interrupted by wire wound on the spool to cause operation of said motor, and means responsive to the operation of said speed adjusting member to move said cell and said source of light as a unit to re-establish the beam therebetween.

9. In combination, a rotatable spool adapted to have wire wound thereon, means to rotate said spool including a variable speed mechanism, and photo-electrical control means responsive to the added wire on the periphery of said spool to actuate said variable speed mechanism to decrease the speed of said spool in accordance with the increased diameter of the wire wound on said spool.

10. In combination, a rotatable spool adapted to have wire wound thereon, means to rotate said spool including a variable speed mechanism, a rotatable member to adjust said variable speed mechanism, means to rotate said member, and photo-electrical control means responsive to the addition of wire to said spool to actuate said adjusting member rotating means to decrease the spool speed in accordance with the increase in diameter of the wire wound on said spool.

11. In combination, a rotatable spool adapted to have wire wound thereon, means to rotate said spool including a variable speed mechanism, a rotatable member to adjust said variable speed mechanism, a motor to rotate said member, and photo-electric means responsive to the addition of wire to said spool to cause a temporary actuation of said motor to reduce the speed of said spool to produce a substantially constant peripheral speed of winding.

12. In combination, a rotatable spool adapted to have wire wound thereon, means to rotate said spool including a variable speed mechanism, a rotatable member to adjust said variable speed mechanism, means to rotate said member, photo-electrical control means responsive to the added wire to said spool to actuate said adjusting member rotating means, adjustable means to support said control means, and means rotatably connected to said rotatable member to adjust said supporting means.

13. In combination, a rotatable spool adapted to have wire wound thereon, means to rotate said spool including a variable speed mechanism, a rotatable member to adjust said variable speed mechanism, a motor to rotate said member, an electric eye device responsive to the addition of wire on said spool to cause actuation of said motor, an adjustable support for said electric eye device, and means rotatably driven by said rotatable member to automatically adjust said support.

14. In combination, a rotatable spool adapted to have wire wound thereon, means to rotate said spool including a variable speed mechanism, means to adjust said variable speed mechanism including a rotatable threaded member, a motor for rotating said member, an electric eye for

controlling said motor, a source of light for throwing a beam of light upon said electric eye, means to support said light source with its beam of light in position to be interrupted by the addition of wire on said spool for starting said motor and operating said threaded member to adjust said variable speed mechanism, and means actuated by the operation of said motor to cause said beam of light to be moved beyond said added wire and automatically stop said motor.

15. In a wire spooling mechanism, means to rotate a spool to wind wire thereon, means to vary the speed of said spool-rotating means including an electric eye device having a beam of light arranged to be successively interrupted and re-established by the wire built up on said spool, the interruptions of said beam causing temporary operations of said speed-varying means.

16. In a wire spooling mechanism, means to rotate a spool to wind wire thereon, means to vary the speed of said spool rotating means including a motor and an electric eye device having a beam of light arranged to be interrupted by the wire added to said spool, and means operated by said motor to re-establish said beam of light and stop the speed varying means until the beam has been again interrupted by the further addition of layers of wire to said spool.

17. In a wire spooling mechanism, means to wind wire upon a spool, means to vary the speed of said winding means including an electric eye device and a beam of light adapted to impinge on said electric eye, said beam of light being intermittently varied by the passage thereto of the wire wound on said spool, the variations in said beam causing temporary fluctuations in said speed varying means.

18. In a wire spooling mechanism, means to rotate a wire receiving spool, means to vary the speed of rotation of said spool including a motor, photo-electric means for controlling the speed of said motor, means to cause a beam of light to impinge on said photo-electric means, and means to intermittently vary the amount of said beam to vary the effect on said motor of said photo-electric means.

19. In a device of the character described, means for winding material under tension into a package; means for supplying a continuous windable material to the winding means; and photo-electric means controlled by the variation of the radial dimension of the packages on the winding means for controlling the tension in the material, said control means being free of physical contact with the material.

20. In a device of the character described, means for feeding a continuous windable material; means for winding the material into a package; and means controlled by variation in radial thickness of the wound package for controlling the ratio between the rate of feeding the material to the winding means and the rate of winding the material, said last-named means being adjacent but spaced from the winding means and free of physical contact therewith.

21. In a device of the character described, means for winding material under tension into a package; means for supplying a continuous windable material to the winding means; and photo-electric means including a beam of light for directly impinging upon the package itself controlled by the variation of the radial dimension of the package on the winding means for controlling the tension in the material, said control

means being free of physical contact with the material.

22. In a device of the character described, means for feeding a continuous windable material, means for winding the material into a package; and means responsive to the interruption of a beam of light by said package controlled by variation in radial thickness of the wound package for controlling the ratio between the rate of feeding the material to the winding means and the rate of winding the material, said means being adjacent but spaced from the winding means and free of physical contact therewith.

23. For controlling a material-reeling mechanism, torque-applying means for driving a reel, means for varying the torque-developed by said means, a source of radiant energy adapted to emit radiations across said reel, photo-responsive means associated with said source of radiant energy and said reel sensitive to change in radius of material on said reel, and means controlled by said photo-responsive means for actuating said torque-varying means.

24. In a control system for material-reeling mechanisms, a reel, torque-applying means connected to drive said reel, means for varying the torque developed by said means, controlling means for said torque-varying means, a light source adapted to emit light across said reel, photoelectric means sensitive to changing interception of light impinging thereon caused by change in radius of material on the reel, and means connecting said photoelectric means and said controlling means adapted to actuate said controlling means in response to impulses from said photoelectric means.

25. In a control system for a material-rewinding mechanism and drive, means for varying the torque of the rewind drive, driving means for said torque-varying means, controlling means for said driving means, a light source adapted to direct rays of light through a space to be occupied by material build-up on the rewind mechanism, photoelectric means sensitive to changing interception of the rays of light impinging thereon caused by change in radius of material on the rewind mechanism, and electrical means connecting said photoelectric means and said controlling means, said photoelectric means and electrical connecting means adapted to actuate said controlling means in response to change in radius of the material.

26. In a device of the character described, means for winding material into a package; means for positively feeding a continuous windable material to the winding means; and photoelectric means cooperable with the changing winding surface of the package for controlling the ratio between the rate of feeding and the rate of winding of the windable material, whereby the tension of the material in the package is controlled so as to form a package in which the tension is maintained uniform.

27. In a device of the character described, means for winding material into a package; means for feeding a continuous windable material to the winding means; and electric means positioned adjacent the bobbin but spaced therefrom and controlled directly by the changing position of the surface of the package in accordance with the changing radial thickness of the package during the winding for controlling the ratio between the rate of feeding and the rate of winding of the material, whereby physical contact of the control means with the material is avoided.

28. In the method of producing a package having a predetermined tension in the material, the steps of positively feeding the material toward a take-up means, taking it up to form a package, and controlling by photo-electric means throughout the formation of the package the ratio between the rate of feed and the rate of take up in a predetermined manner directly in accordance with the thickness of the package and without physical contact between the material and the control means.

29. In a wiredrawing machine, a capstan drum driven at substantially constant speed for pulling wire through a wiredrawing die, a spool for winding said wire as it is received from said capstan, and means for automatically varying the angular velocity of said spool to maintain a constant peripheral winding speed of said wire, including a source of radiant energy adapted to emit radiations across said periphery of the wire on said spool photo-responsive means sensitive to the interruption of said radiations by the periphery of the spool as the spool fills up, and means controlled by said photo-responsive means for actuating said angular spool velocity varying means.

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