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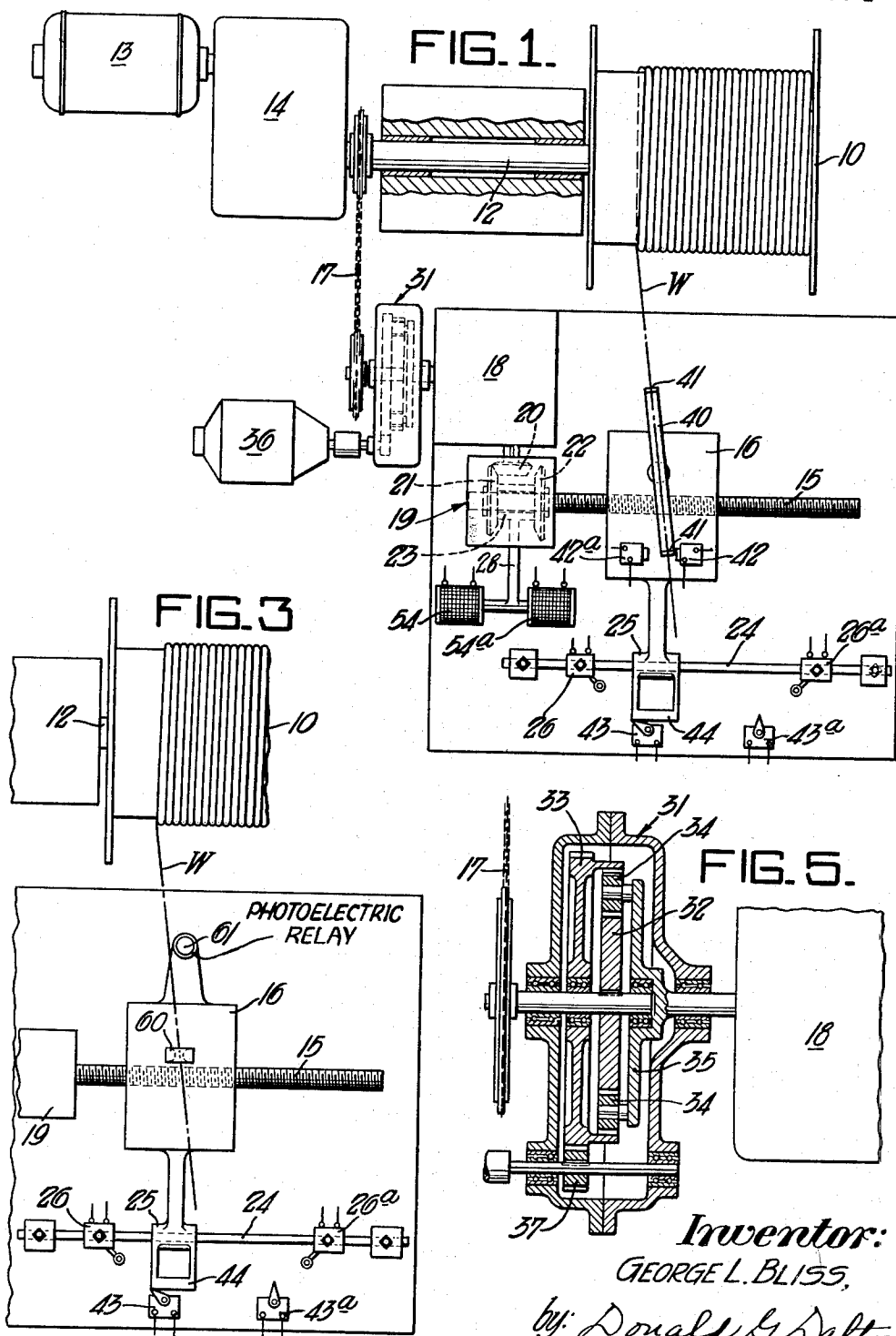
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METHOD AND APPARATUS FOR SPOOLING WIRE

Filed April 19, 1957

2 Sheets-Sheet 1



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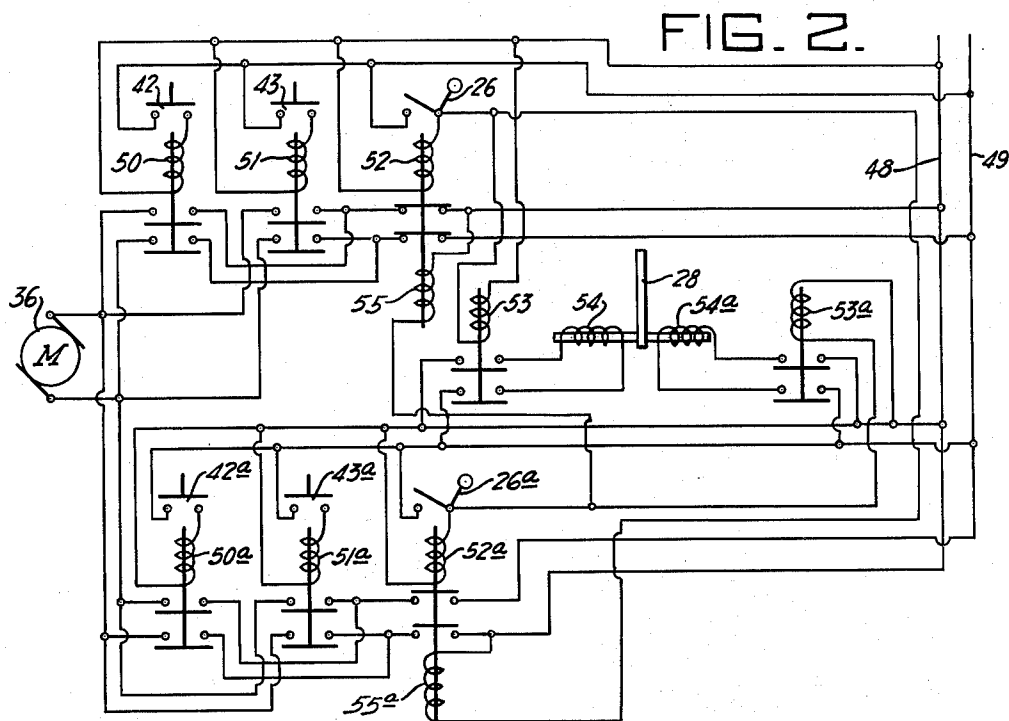
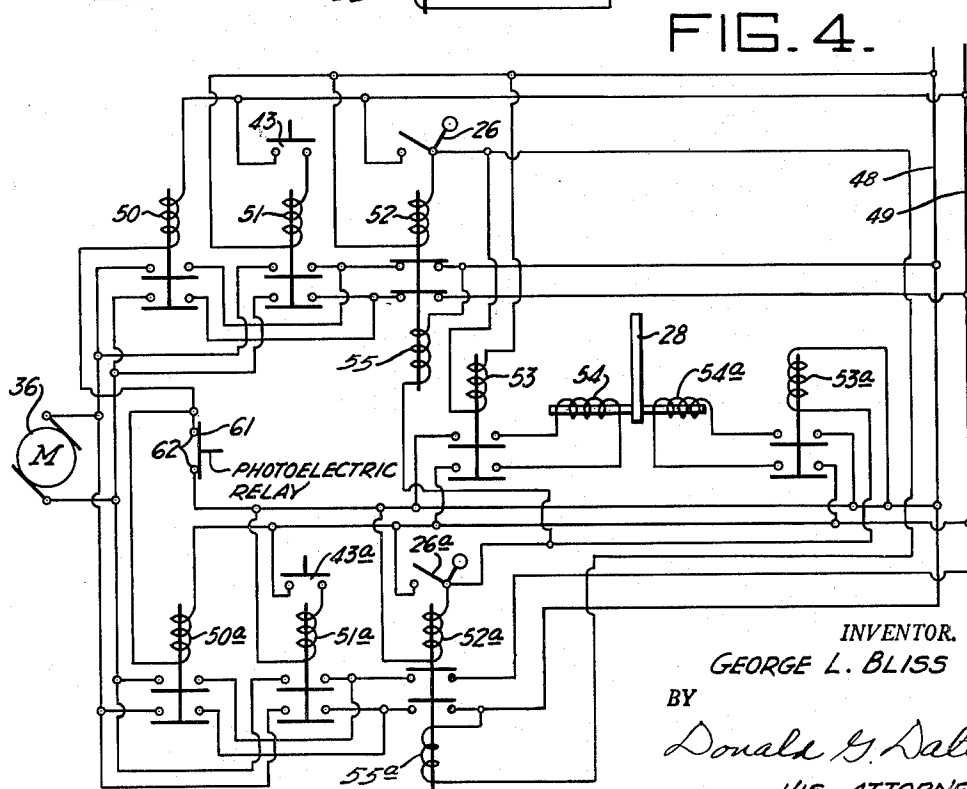
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METHOD AND APPARATUS FOR SPOOLING WIRE

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4 Claims. (Cl. 242—25)

This invention relates to methods and apparatus for spooling wire, and more particularly to improvements over the method and apparatus shown and claimed in my earlier co-pending application Serial No. 434,298, filed June 3, 1954 (now Patent No. 2,845,229).

Conventional wire spooling machines are equipped with traversing means for winding the wire evenly on the spool. The usual traversing means includes a carriage which travels back and forth along the length of the spool and guides the wire in its approach. Most traversing carriages travel at a preset rate which at any given setting remains constant with respect to that of the spool. Because of variations in the wire diameter, they are incapable of winding perfect coils, that is, coils in which the wire has an accurate thread lay and whose reversals are located precisely at the ends of the wire-receiving portion of the spool unaccompanied by any piling up. If there are gaps between successive convolutions, wire from an overlying layer can enter and impede subsequent unwinding. Any winding irregularities tend to be cumulative. Imperfect coils can cause operating difficulties in various automatic machines, such as balers and automatic welding machines. If wire snarls as it pays off, such machines cannot operate.

My aforesaid application shows and claims a spooling machine and method wherein, to assure a tight coil, the traversing means lags the point at which incoming wire meets the spool while the greater part of each layer is winding. As the wire approaches its reversal at the end of each layer, the traversing means accelerates and tends to overtake the point at which the wire meets the spool. Although this machine operates satisfactorily, it includes no means for limiting the distance by which the traversing means lags nor for accurately controlling movement of the traversing means during an actual reversal. The machine is set arbitrarily to maintain the traversing means even with wire of minimum diameter in the tolerance range of diameters encountered in any particular wire. The traversing means travels at a constant base rate relative to the spool until the reversal approaches, and lags only because portions of the wire exceed minimum diameter. If too much is oversize, the lag may become excessive and cause a convolution of wire to override convolutions already wound on the same layer. For an ideal reversal the wire contacts the end flange of the spool and starts winding back before the traversing means reverses and while it still lags slightly in the original direction. Ideally the traversing means continues at an accelerated rate past the wire reversal point, whereby on reversing it immediately lags in the other direction. Furthermore the traversing means should not fully overtake the wire until the wire actually has reversed, since a perpendicular relation between wire and spool at the moment of reversal tends to cause the wire to climb the flange and thus pile up.

An object of the present invention is to provide an improved wire spooling method and apparatus similar in most respects to that shown in my aforesaid application, but in which the distance of lag is accurately limited.

A further object is to provide spooling apparatus which has an improved electric circuit over that shown in my aforesaid application enabling the traversing means to accelerate over its constant base rate anywhere along the

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length of a layer to maintain a predetermined maximum lag, as well as at the approach of a reversal.

A further object is to provide an improved spooling method and apparatus which afford better control of the traversing means during the actual reversal steps, that is, in which the wire reverses ahead of the traversing means and the traversing means travels at its accelerated rate up to the moment of its own reversal and thus very quickly assumes a lag in the new direction.

In accomplishing these and other objects of the invention, I have provided improved details of structure, preferred form of which are shown in the accompanying drawings, in which:

FIGURE 1 is a schematic top plan view of a spooling apparatus constructed in accordance with my invention; FIGURE 2 is a wiring diagram of the apparatus shown in FIGURE 1;

FIGURE 3 is a schematic top plan view of a modification;

FIGURE 4 is a wiring diagram of the apparatus shown in FIGURE 3; and

FIGURE 5 is a sectional view of the epicyclic gear train embodied in both forms of the apparatus.

FIGURE 1 shows somewhat diagrammatically a typical spooling apparatus which, apart from the electric circuit, is similar structurally to that shown in my aforesaid application and comprises a spool 10, a shaft 12 supporting the spool, and a motor 13 and speed reducer 14 for driving the shaft and spool. Wire W from a preceding piece of equipment winds on the spool and is guided thereon by a traversing means. The latter includes a screw 15 and a carriage 16 mounted thereon. The screw 15 is journaled in spaced parallel relation with the spool shaft 12 and is driven therefrom via a chain and sprocket connection 17, a variable speed transmission 18, and a reversing mechanism 19. The reversing mechanism includes a drive pinion 20 connected with the transmission 18, a cooperating gear 21 on the screw 15 for rotating the latter to move the carriage 16 to the left, another cooperating gear 22 on the screw for rotating it the other way, and a spline clutch 23 for selectively establishing a driving connection between the drive pinion and either of said gears.

A shift mechanism automatically operates the clutch 23 whenever the carriage 16 reaches one of its reversal points, which are situated short distances outside the reversal points of the wire W. The shift mechanism includes a control rod 24 supported in spaced parallel relation with the traversing screw 15 and a sleeve 25 which is fixed to the carriage 16 and rides on said rod. Left and right normally open limit switches 26 and 26a are fixed to opposite end portions of the rod. A solenoid operated shifter arm 28 is connected with the clutch 23. Whenever the sleeve 25 abuts the left limit switch 26, it completes a circuit, hereinafter described, to shift the clutch 23 from a position in which the pinion 20 drives the gear 21 to a position in which it drives the gear 22. Consequently the direction of rotation of the screw is reversed. Whenever the sleeve abuts the right limit switch 26a, the opposite reversal takes place. The parts thus far mentioned and their operation are conventional and therefore they are not shown nor described in greater detail. They represent one form of machine to which my invention is applicable, although obviously it can be applied to other spooling machines and other forms of traversing means.

In common with the invention claimed in my aforesaid application, an epicyclic gear train 31 is interposed between the spool shaft 12 and the traversing screw 15. As shown in FIGURE 5, this gear train includes a sun gear 32 driven from the chain and sprocket means 17, a normally stationary ring gear 33, planetary gears 34,

and a yoke 35, which is connected to the transmission 18 and on which said planetary gears are journaled. The ring gear 33 has external gear teeth as well as internal. An electric motor 36 is connected to a pinion 37 which meshes with the external gear teeth on the ring gear. Normally the motor 36 does not operate and is held against rotating to hold the ring gear stationary. Consequently the traversing screw is driven in the usual way at a constant base rate relative to that of the spooling shaft 12. However, the motor can be operated to drive the ring gear 33 in the appropriate direction to turn the screw 15 faster than its base rate and thus accelerate the carriage 16.

In practice the actual diameter of the wire W varies within prescribed limits from its nominal diameter. The transmission 18 is set so that the carriage 16 would stay even with or slightly lag a wire of minimum diameter within the prescribed range, as long as the motor 36 does not operate. Since the greater part of the wire is of somewhat larger diameter, the carriage tends to lag the point at which incoming wire meets the spool and thus assure a tightly wound coil with each convolution bearing against the one preceding. The present invention provides means for automatically operating the motor 36 both at the approach of each reversal so that the carriage 16 overtakes the wire and acquires a lag in the opposite direction and otherwise whenever the lag exceeds a predetermined maximum.

In the form of my invention shown in FIGURE 1, a guide arm 40 is pivoted to the top of carriage 16 and carries eyelets 41 through which the wire passes on its way to the spool 10. The rear portion of the carriage carries spaced apart normally open electric switches 42 and 42a on opposite sides of the guide arm. If the carriage is moving to the left, as illustrated, and lagging the wire, the arm swings counterclockwise from its mid-position, but not far enough to close switch 42 as long as the lag is not excessive. If the lag becomes excessive, the arm closes switch 42 to complete a circuit to motor 36 and drive the traversing screw faster. Similarly, if the carriage is moving to the right, the arm may close switch 42a and complete a circuit to motor 36. As soon as the lag returns to normal, the arm swings clear of the switch and thus opens the motor circuit. Additional normally open electric switches 43 and 43a are situated a short distance ahead of the left and right reversal points respectively. The sleeve 25 of the carriage has an actuator 44 for these last named switches. When the carriage is moving toward the left and the actuator closes switch 43, or else when the carriage is moving toward the right and the actuator closes switch 43a, motor 36 also commences to operate, thus accelerating the carriage. Engagement of sleeve 25 with either limit switch 26 or 26a to reverse the carriage also automatically opens the circuit to motor 36 as hereinafter explained.

FIGURE 2 shows a wiring diagram of a preferred novel operating circuit for the embodiment of FIGURE 1. This circuit includes lines 48 and 49 connected to an outside power source. Switch 42 is connected across these lines in series with the coil of a relay 50, which has two sets of normally open contacts. Similarly switch 43 is connected across these lines in series with the coil of a relay 51, which also has two sets of normally open contacts. The left reversing limit switch 26 is connected across these lines in series with one coil of a latch-type relay 52, whose two sets of contacts remain closed during travel of the carriage toward the left as long as switch 26 remains open. The terminals of motor 36 are connected to one side of the normally open contacts of relay 50 and also to one side of those of relay 51, the contacts of the respective relays being in parallel. The other sides of the normally open contacts of both relays 50 and 51 are connected to the contacts of relay 52 (closed during travel toward the left) which in turn are connected to lines 48 and 49.

Whenever the guide arm 40 closes the switch 42, relay 50 picks up and its contacts remain closed as long as the switch remains closed. When the traversing carriage advances sufficiently that the arm clears the switch, relay 50 drops out and its contacts open. When the actuator 44 closes the switch 43, relay 51 picks up and its contacts close. Whenever the contacts of either relay 50 or 51 close, motor 36 is energized and thus accelerates carriage 16, provided the contacts of relay 52 also are closed. When sleeve 25 closes the limit switch 26, the coil of relay 52 controlled by this switch picks up and its previously closed contacts open, whereupon the motor is de-energized even though switch 43 remains closed temporarily until the carriage backs away. As already explained, switch 26 closes only after the wire has reversed and started to wind in the other direction. Consequently the carriage travels at its accelerated rate up to the actual moment of its reversal and quickly assumes a position of lag in the other direction.

The coil of a relay 53 is connected across the lines 48 and 49 in series with the limit switch 26. This relay has two sets of normally open contacts. A solenoid 54 for operating the clutch shifter 28 of the reversing mechanism 19 is connected across these lines in series with the respective contacts of relay 53. When sleeve 25 closes the limit switch 26, relay 53 also picks up and closes its contacts, whereupon solenoid 54 is energized. This solenoid moves the shifter arm 28 to a position in which clutch 23 connects gear 22 to drive the traversing screw 15. Consequently the direction of carriage moment is reversed.

The circuit also has a duplicate set of switches 26a, 42a and 43a, duplicate relays 50a, 51a, 52a and 53a, and a duplicate solenoid 54a for effecting acceleration and reversal of carriage 16 when it is traveling toward the right. These parts are connected in the same manner as the corresponding parts already described and the description is not repeated.

Since relay 52 is of the latch-type, its contacts remain open after sleeve 25 moves away from switch 26 and allows this switch to open. Consequently motor 36 cannot be energized accidentally through switch 42 or 43 as long as carriage 16 is traveling toward the right, but only through the proper switches 42a or 43a. Relay 52 has a second coil 55 connected in series with the contacts of switch 26a across lines 48 and 49. When switch 26a closes as the carriage reverses direction at the right, coil 55 is energized to close the contacts of relay 52. Relay 52a similarly is of the latch-type and has a second coil 55a connected in series with the contacts of switch 26.

FIGURES 3 and 4 show a modification in which a light sensitive relay replaces the mechanically movable guide arm 40 and switches 42 and 42a. Since the various drive means are similar to those already described, their showing is not repeated in FIGURE 3. In this modification the upper face of carriage 16 has an eyelet 60 for guiding the wire W. The front part of the carriage carries a photoelectric relay 61. When the carriage is even with the wire or not lagging excessively, the latter is over the light sensitive element of said relay, and thus darkens it. When the carriage lags the wire excessively, the latter passes to one side of the light sensitive element of the photoelectric relay and thus exposes it to light. This modification embodies the same switches 26, 26a, 43 and 43a as the form already described.

FIGURE 4 shows a wiring diagram of this modification. The photoelectric relay 61 controls a set of contacts 62 which open when the wire W darkens the light sensitive element and close when this element is exposed to light. When these contacts close, they complete current paths to the coils of either relay 50 or 50a, which are connected in series with these contacts. The remainder of the circuit and its operation are the same as already described, and hence the description is not repeated.

From the foregoing description it is seen that the present invention affords a simple method and apparatus for assuring accuracy in spooling wire. The invention affords a means for winding the wire tightly and yet assures an accurate relation between the carriage and wire at their reversal points.

While two embodiments of my invention have been shown and described, it will be apparent that other adaptations and modifications may be made without departing from the scope of the following claims.

I claim:

1. In a wire spooling apparatus which includes a spool adapted to have wire wound therearound in layers, drive means for rotating said spool, a traversing carriage adapted to travel back and forth along the length of said spool and guide the wire in its approach, a drive for said carriage normally moving it at a preset constant rate relative to the rate of rotation of said spool, at which rate said carriage lags behind the point at which the incoming wire meets the spool, and electrically operated reversing means in the drive for said carriage, the combination therewith of an accelerating drive for said carriage comprising electrically operated motive means adapted when energized to drive said carriage at a rate faster than said preset rate, first electric circuit means which include contacts operated by the wire for energizing said motive means when said carriage lags excessively, second electric circuit means which include contacts operated by said carriage for energizing said motive means whenever the wire reaches a position a short distance ahead of the end of a layer to enable the carriage to overtake and pass the wire and quickly assume a lag in the other direction, the contacts of said second circuit means being connected in parallel with the contacts of said first circuit means enabling the second circuit means to operate independently of the first circuit means, additional contacts operated by said carriage for operating said reversing means when said carriage reaches a position a short distance outside the end of a layer, and means operated by said additional contacts for interrupting said first and second circuit means when the direction of movement of said carriage is reversed.

2. In a wire spooling apparatus which includes a spool adapted to have wire wound therearound in layers, drive means for rotating said spool, a traversing carriage adapted to travel back and forth along the length of said spool and guide the wire in its approach, a drive for said carriage normally moving it at a preset constant rate relative to the rate of rotation of said spool, at which rate the carriage lags behind the point at which the incoming wire meets the spool, and electrically operated reversing means in the drive for said carriage, the combination

therewith of an accelerating drive for said carriage comprising electrically operated motive means adapted when energized to drive said carriage at a rate faster than said preset rate, a first pair of duplicate electric circuits which include contacts operated by the wire for respectively energizing said motive means when said carriage lags excessively as it moves in one direction or the other, a second pair of duplicate electric circuits which include contacts operated by said carriage for energizing said motive means whenever the wire reaches a position a short distance ahead of a layer to enable the carriage to overtake and pass the wire and quickly assume a lag in the other direction, the contacts of the second circuits being connected in parallel with the contacts of the respective first circuits enabling either second circuit to operate independently of the corresponding first circuit, additional contacts operated by said carriage for operating said reversing means when said carriage reaches a position a short distance outside the end of a layer, and means operated by said additional contacts for interrupting said first and second circuits when the direction of movement of said carriage is reversed.

3. A drive as defined in claim 2 in which said last named means includes latch-type relays which lock out one of said first circuits and the corresponding second circuit while the carriage is moving in either direction to prevent unintended energization of said motive means.

4. A method of winding wire in layers on a spool comprising rotating the spool, guiding the wire in its approach to the spool on a traversing means, driving said traversing means through the major portion of the length of the spool at a preset constant base rate relative to the rate of rotation of the spool, at which rate the traversing means lags behind the point at which the incoming wire meets the spool to assure that the wire winds tightly, accelerating said traversing means as the wire nears the end of each layer on the spool, reversing the direction of winding when the wire reaches the end of a layer, continuing to drive said traversing means in the original direction and at its accelerated rate until after the direction of winding is reversed, and reversing the direction of movement of said traversing means after it has moved far enough in the original direction to assume an immediate lag in the other direction.

References Cited in the file of this patent

UNITED STATES PATENTS

1,140,924	Underhill	May 25, 1915
2,626,765	Biddison	Jan. 27, 1953
2,757,884	Bryant	Aug. 7, 1956
2,845,229	Bliss	July 29, 1958