

March 26, 1963

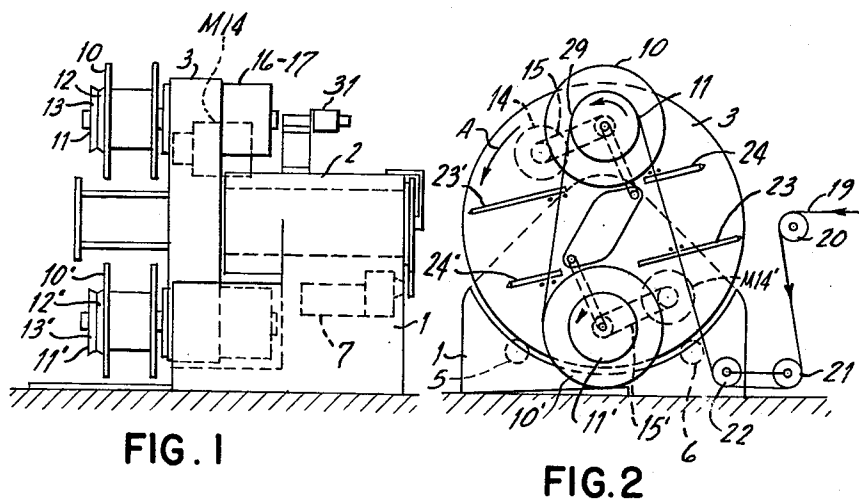
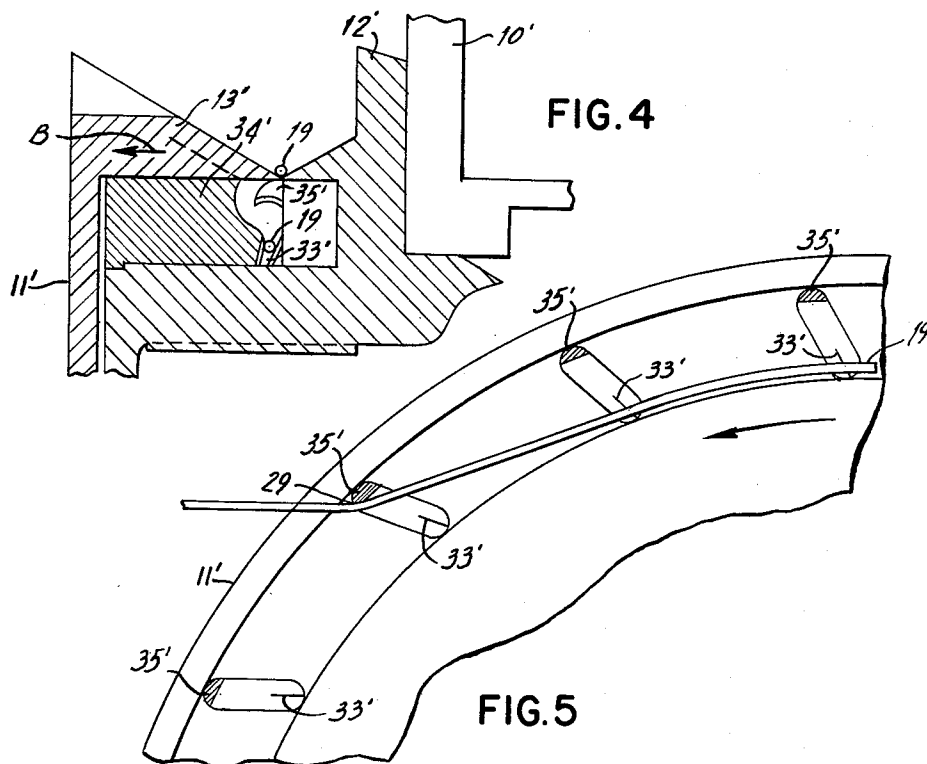
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APPARATUS FOR CONTINUOUS WINDING OF STRAND MATERIAL

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FIG. 3

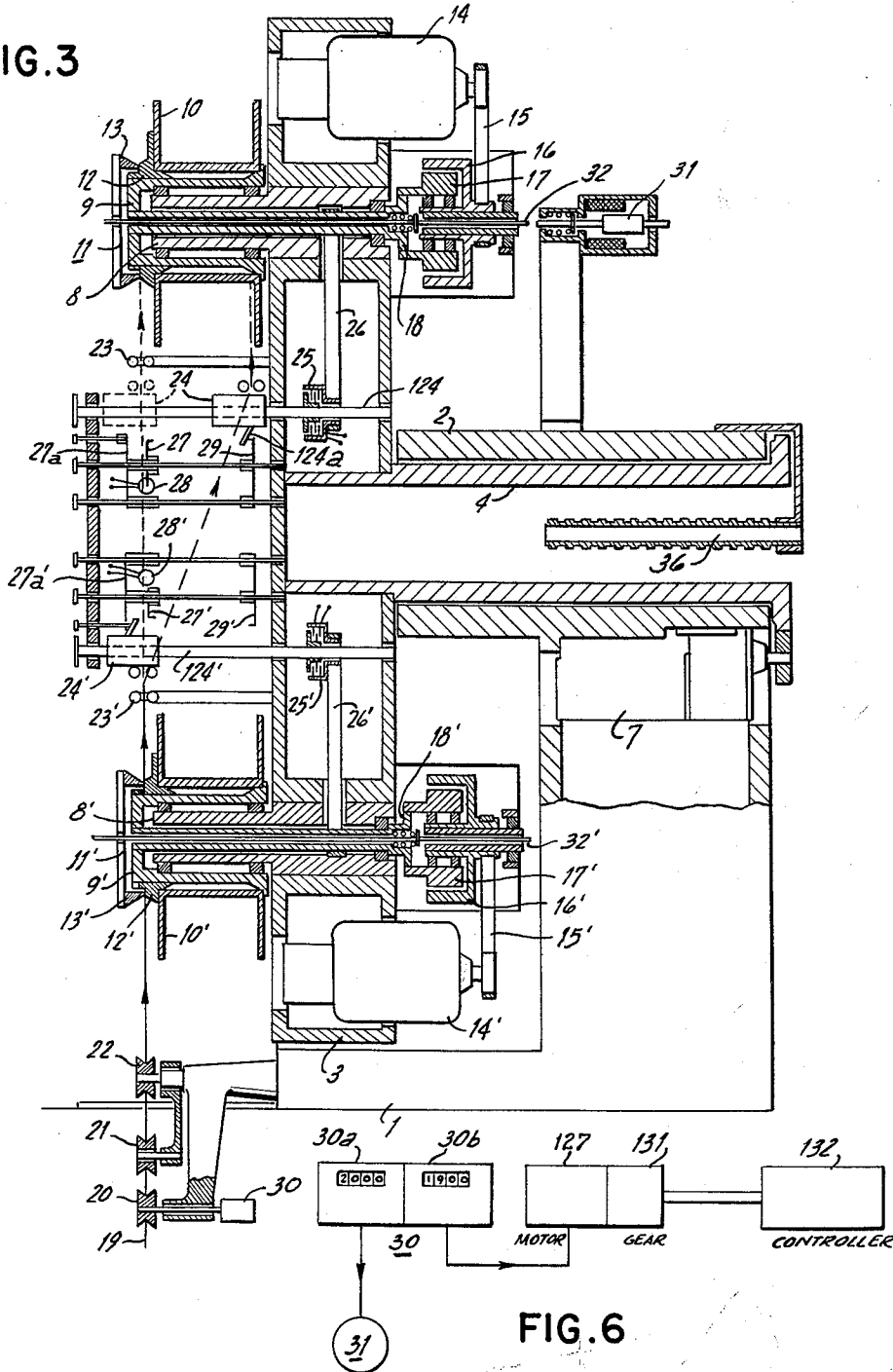


FIG. 6

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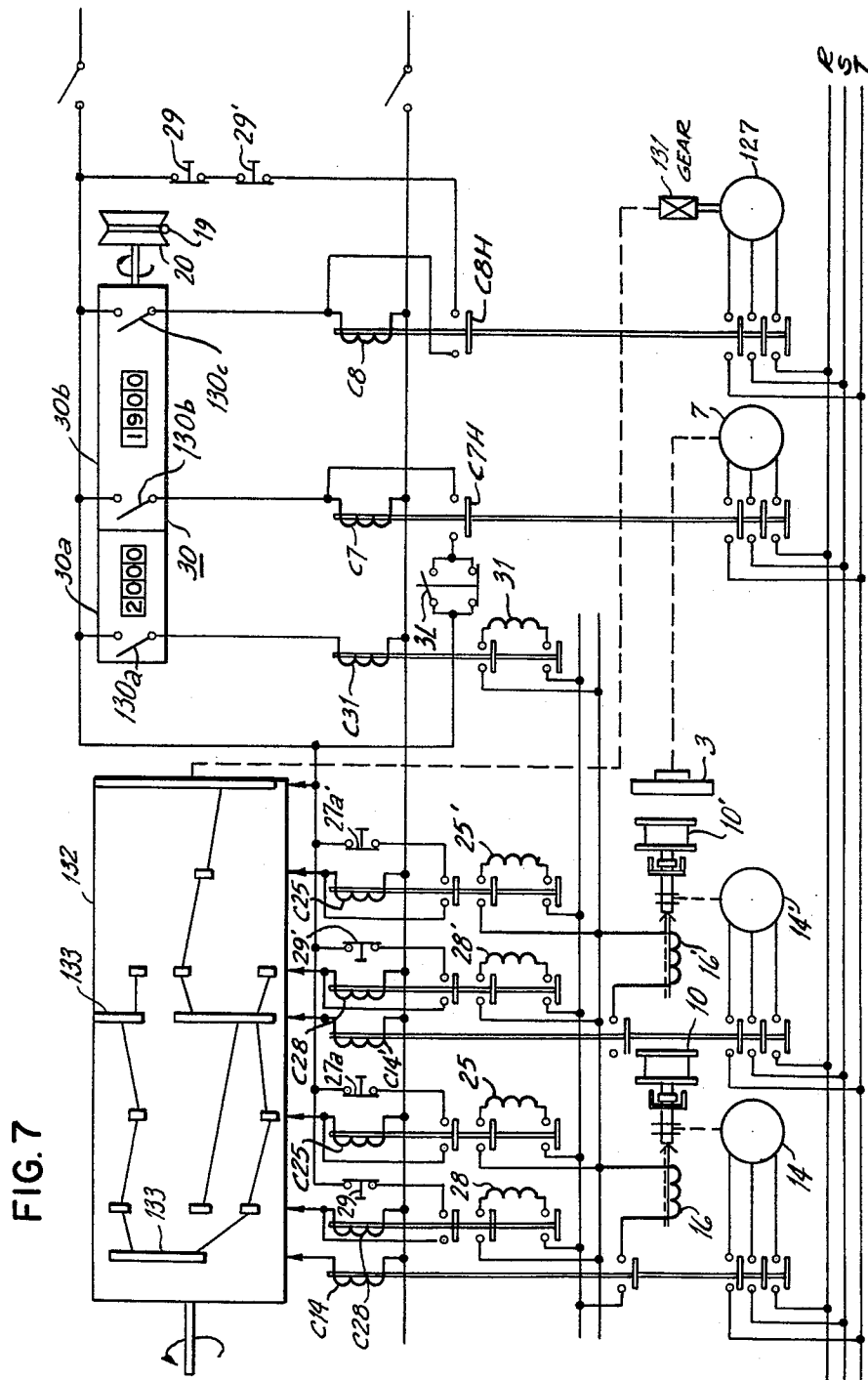
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APPARATUS FOR CONTINUOUS WINDING OF STRAND MATERIAL

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9 Claims. (Cl. 242-25)

Our invention relates to machinery for producing wound packages of wires, litz wires, insulated wires, cords or other strand materials.

The processing or fabrication of strand material, for example the coating of electric wires with insulation with the aid of extrusion presses of the feed-screw type, involves a continuous operation. This makes it necessary to also supply and withdraw the strand material in a continuous manner. To this end, the material must be wound upon a spool core or drum in such a manner that the starting length of the winding material, this being the inner end portion first wound about the spool core, remains accessible after the entire spool is filled with material. The starting end of the winding material must always extend out of the spool on the same side thereof. This makes it possible to solder, weld or otherwise join the starting end, while the spool in stationary condition is being unwound by pulling the strand material over the head of the spool, with the top end of the material coming from a still full spool without interrupting the unwinding operation. Such winding of spools or wire packages in the manner that the inner end of the winding material remains accessible is not particularly difficult with winding machines that can be stopped for the purpose of splicing the material of an expiring spool to the outer or top end of the material from a new spool. However, when a continuous performance is required, for example when the spools of material are to be unwound in cooperation with a wire-drawing machine cooperating with a continuously operating annealing device, the stopping of the machinery is infeasible and there occurs the above-described problem which so far has not found a satisfactory solution.

It is an object of our invention, therefore, to afford and facilitate a continuous winding of wire and other strand material into spools or coils of material in which the inner end, that is, the starting length of the winding material, is always extending toward the outside on one and the same side of the spools so as to remain readily accessible and to always require the same sense of rotation for subsequently unwinding the material over the head of the coil.

To this end, and in accordance with a feature of our invention, we provide the winding apparatus with an auxiliary reel or spool which temporarily receives the strand material being wound at the beginning of the winding operation and during an interval of time in which the material is transferred from a previously wound, filled spool to a new, empty spool. The transfer from the auxiliary reel to the main spool is effected after a predetermined length of material is wound onto the reel so that automatically a starting length of winding material remains laterally extended from the subsequently completed main spool towards the outside.

While the essential features of our invention are set forth with particularity in the claims annexed hereto, the invention will be more readily understood from the following description of the embodiment illustrated by way of example on the accompanying drawings in which:

FIG. 1 shows schematically a side elevation of a winding apparatus according to the invention;

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FIG. 2 is a schematic front view from the left of FIG. 1;

FIG. 3 is a sectional view comparable to FIG. 1;

FIG. 4 shows in section a detail of one of the auxiliary reel devices that form part of the apparatus;

FIG. 5 is a partial front view onto a component of the same reel device;

FIG. 6 is a schematic block diagram relating to the operation of gage-responsive control means for controlling the apparatus of FIGS. 1 to 5; and

FIG. 7 is a schematic circuit diagram of the entire electric control system in conjunction with a schematic illustration of the electrically operated mechanical components of the apparatus.

The supporting frame structure 1 of the illustrated winding apparatus comprises a bearing 2 in which the hollow shaft 4 of a circular turntable 3 is journaled (FIGS. 1, 2, 3). The turntable 3 is also supported by auxiliary rollers 5 and 6 likewise journaled in the frame structure 1 (FIG. 2). The turntable 3 is driven from an electric motor 7 (FIGS. 1, 3, 7) and, during each individual operation, is turned 180° in the counterclockwise direction indicated by an arrow A in FIG. 2.

Rigidly mounted in respective bores of the turntable 3 are two tubular carrier shafts 8 and 8' (FIG. 3) 180° displaced from each other. Rotatably journaled on these fixed shafts are sleeves 9 and 9' respectively which carry the main spools or drums 10 and 10'. Also arranged on the sleeves 9 and 9' are respective auxiliary spools or reels 11 and 11'. The auxiliary reel 11 comprises two conical disc members 12 and 13. The disc member 12 is firmly joined with the sleeve 9, for example by having an internal screw thread in engagement with an external thread of the sleeve 9. The disc member 12 thus also secures the spool 10 on the bushing 9. The disc member 13 is separable from member 12 and serves as a winder cone. By removing the two disc members 13 and 12, the spool 10 with the strand material wound thereupon can be removed from the turntable to be substituted by an empty spool core.

The drums 10 and 10' may be driven electrically, hydraulically or pneumatically. In the illustrated embodiment, the drum 10 and the appertaining reel 11 are driven by an electric motor 14 which is mounted on the turntable 3 and drives through an endless belt 15 the driving portion 16 of an electromagnetic or induction coupling at constant speed. The driven member 17 of the coupling is rigidly secured on a tubular shaft 18 which extends centrally through the fixed tubular carrier shaft 8 and is joined with the sleeve 9. Consequently when the coupling 16, 17 is energized, an adjustable torque is transmitted from motor 14 through tubular shaft 18 and sleeve 9 to drum 10 and the appertaining auxiliary reel 11.

The second drum 10' and the appertaining auxiliary reel device composed of conical disc members 12' and 13' are analogously driven from a motor 14' through a belt drive 15 and a controllable inductive coupling 16', 17' with the aid of a hollow shaft 18' acting upon a sleeve 9' on which the drum 10 and the reel members are mounted.

During operation of the winding apparatus the wire or other strand material 19 to be wound enters over guide rollers 20, 21 and 22 (FIGS. 2, 3) of which the roller 21 is designed as a dancer roller. The roller 20 drives a metering gage or counter 30 (FIGS. 3, 6, 7). Before commencing the winding operation both spools 10 and 10' are empty and the spool 10 is first to be filled with material. When starting the apparatus, the material passes from roller 22 through a fixed guiding arm 23 (FIGS. 2, 3) and over a reciprocating guide 24 onto the auxiliary reel 11 where it is wound onto the winder cone 13. As apparent from FIG. 3, the guiding arms

23 are fixedly mounted on the turntable 3, their guiding eye being located in the plane of the conical disc member 12. The reciprocating strand guide 24 (24') is axially displaceable on a shaft 124 (124') from which it is driven by a conventional roller-ring mechanism (not shown) to travel in one or the other direction depending upon the angular position of a control arm 124a which is turned one or the other way when abutting against a stop 27, 27a or 29. The mechanism has a ring seated on shaft 124 with four ball bearings. The ring has a bore of larger diameter than the shaft 124 and can assume a tilted position. Depending upon whether the ring is pressed against the shaft in one or the other tilting direction under control by the arm 124a, the guide 24 runs toward the right or left. The guide 24 is first located in the position shown by a broken line. After a given length of material, measured for example in yards, is wound onto the winder cone 13, the strand guide 24, under control by the devices described below, moves toward the right and places the winding material 19 onto the main drum 10. This operation is initiated by closing of the magnetic coupling 25 (FIGS. 3, 7) which is driven from shaft 18 by an endless belt 26. At this time, a stop 27 (FIG. 3) is moved by a magnet 28 (FIGS. 3, 7) out of the path of control arm 124, so that the guide 24 can travel toward the right (FIG. 3) until it reaches a stop 29 which turns the arm 124 and thus causes the guide 24 to reverse its travel. In the meantime the stop 27 is again turned into the path of the arm 124 by operation of the magnet 28 so that when the guide 24 arrives at the left-hand limit of its travel (FIG. 3) it is controlled by the stop 27 to reverse its travel, and so forth. The strand guide 24, thus reciprocating along the drum 10, causes the winding material 19 to be properly wound upon the drum in order to produce the desired coil or package of wire.

Shortly before the desired length of the winding material 19 on the drum 10 is reached, the length-metering gage 30, such as a digital counter, starts the motor 7 which commences rotating the turntable 3 counterclockwise (according to arrow A in FIG. 2). This rotation is limited to an angle of 180° by limit control means of the drive described further below. During table rotation, the winding of material onto the drum 10 and the reciprocating operation of the strand guide 24 are not interrupted.

During the rotary motion of the turntable 3, the drive motor 14' for the still empty drum 10' is switched on. By a properly timed excitation of the induction coupling 16', 17' (FIGS. 3, 7) the conical disc member 12' as well as the empty drum 10' are accelerated up to the speed corresponding to that of the winding material 19. Also during rotation of the turntable 3 in the direction of the arrow A (FIG. 2) the auxiliary reel device 11', comprising the conical members 12' and 13', comes into engagement with the winding material 19. With the reel device 11' thus engaging the winding material, this reel device as well as the still empty spool 10' will move to the upper position previously occupied by the drum 10. Due to the turning of the table 3, there occurs an additional speed of the winding material 19 which is compensated by the induction coupling 16', 17' and also by the compensating displacement of the dancer roller 21. Now, the eye of strand guide 24' is located in the plane of the reel device 11' or, more accurately, in the plane of the conical member 12' which now operates only as a guide roller because the winding material is still being wound upon the spool 10 now located in the lower position previously occupied by the empty spool.

However, when the material 19 being wound upon the drum 10, now located in lower position, has reached the full length, the counting gage 30 issues a signal or pulse to the relay C31 of a striker magnet 31 (FIGS. 1, 3, 7) which acts upon a pusher rod 32 to separate the

winder cone 13' from the member 12' of the reel device. The winder cone 13' is thus forced outwardly in the direction of the arrow B shown in FIG. 4. This causes the winding material 19 to be pulled into a clamping groove 33' (FIGS. 4, 5) formed between a clamping insert 34' and a cutter blade 35'. The clamping insert 34' and the cutter blade 35' are fixedly mounted on the conical disc member 12' of the reel. As apparent from FIG. 5, the winding material 19 then extends from the clamping slot 33' at a slant upwardly so that it enters into the range of the cutter blades 35' and is severed by one of the cutters. When the winding material 19, thus held fast at the reel by the clamping slot 33' has attained a desired length, it is laterally shifted to the main spool or drum 10'. During this operation the pendulous dancer roller 21 (FIGS. 2, 3) provides the necessary compensation.

When the striker magnet 31 is being energized, the control magnet 28 becomes also excited and the stop 27 is turned away from the path of the strand guide 24 so that the strand guide travels up to another stop 27a (FIG. 3) where it effects a reversing control. As a result, the coupling 25 is switched off by actuation of the stop 27a and the strand guide 24 is stopped.

After the drive motor 14 is stopped, the winder cone 13 and the conical disc member 12 of the reel device can be removed from the apparatus so that the spool 10, now located in the lower position, can be taken off and substituted by an empty spool core.

The supply of electric current to the drive motors, electric clutches as well as to the turning and pusher magnets is effected by means of a set of slip rings located in the hollow shaft 4 (FIG. 3).

The above-described cycle of operations is automatically controlled by a program controller under the action of the length-measuring gage 30. As mentioned, this gage is essentially a yard metering device driven from the roller 20 (FIG. 3). The gage 30 comprises two counters 30a and 30b (FIGS. 6, 7) each having a digital set of counting wheels. The counters are separately set or adjustable to close respective electric contact means when a predetermined number of yards is reached. The starting and transfer operations of the winding apparatus are initiated under control by the counter 30b which in the embodiment shown in FIGS. 6 and 7 is assumed to close contacts 130b and 130c when it reaches the count of 1900 yards. The contact 130b then energizes a relay C7 which applies power to the table drive motor 7 so that the turntable 3 commences its rotary angular travel. At the same time, the contact 130c energizes a contactor C8 which applies power to a motor controller drive 127. This motor drives through a gear 131 a program controller 132 here shown for convenience to be of the rotary switch type. The contacts 130b and 130c open when the counter 30b passes several yard values beyond the "1900" value. Then, however, the contactors C7 and C8 remain energized through respective self-holding contacts C7H and C8H so that the motors 7 and 127 keep running until the circuits of the holding contacts are opened by limit switches 29, 29' or 3L. The limit switch 3L in series with the holding contact C7H opens temporarily each time the turntable reaches the end of its 180° travel, being actuated, for example, by a cam boss on the table. This deenergizes the contactor C7 and stops the table drive motor because the counter contact 130b is open at that time.

The contact segments of the controller 132, such as those denoted by 133, control the operation of the drum drive motors 14 and 14' through respective contactors C14 and C14'. The controller also energizes the above-mentioned control magnet 28 through a contactor C28 thus turning the stop 27 (FIG. 3) out of the path of the strand guide. When the desired number of yards are wound onto the auxiliary reel device 11, the controller 132 energizes a contactor C25 which causes the magnet

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winding 25 to become excited and which, while the motor 14' is switched off, effects operation of the strand guide 24. The guide 24 then runs against the stop 29 (FIG. 3) which opens the limit switch also denoted by 29 (FIG. 7), thus disconnecting the control magnet 28. As a result, the stop 27 returns into the path of the strand guide 24, and this guide now travels between the stops 27 and 29.

These switching operations occur between 1900 and 2000 yards of material in accordance with the numerical data entered in the illustration of the gage 30 according to FIGS. 6 and 7. The counters 30a and 30b, of course, can be set to any other desired length values. When in the illustrated embodiment the total length of strand material wound onto the main spool has reached the pre-set value of 2000 yards, the counter 30a closes its contact 130a which causes a contactor C31 to energize the striker magnet 31 (FIGS. 6, 7, 3). As described above, the magnet 31 then effects clamping and cutting of the strand material 19 in the auxiliary reel device. At this time, the controller 132 energizes, through contactor C28, the control magnet 28, and the stop 27 is turned out of the path of the guide 24 (FIG. 3). Now the guide 24 runs up to the stop 27a and opens the limit switch also denoted by 27a in FIG. 7. This deenergizes the contactor C25 and hence the magnetic coupling 25. Thereafter the drum drive motor 14 is disconnected by its contactor C14 under control by the controller 132. Thereafter the full drum 10 can be removed and substituted by an empty drum in the manner described above.

When the desired length of material pre-set by the metering gage is reached, the above-described cycle of operations is repeated for the newly wound spool 10', and so forth.

Upon study of this disclosure it will be obvious to those skilled in the art that with respect to mechanical components and details as well as with respect to electrical circuitry and components my invention affords of various modifications and hence can be given embodiments other than particularly illustrated and described herein, without departing from the essential features of my invention and within the scope of the claims annexed hereto.

We claim:

1. Apparatus for winding of strand material, comprising a turntable, turntable drive means for turning said turntable a given angular amount, winder drums journaled about respective axes parallel to the table axis and spaced from each other said angular amount, auxiliary reels coaxially adjacent to said respective drums, drum drive means on said table connected with said respective drums for rotating each drum and adjacent reel, guide means engageable by the material to be wound for passing it onto one of said drums depending upon the angular position of said turntable, controllable clamping means for each of said reels engageable with the material for temporarily holding it on said reel, a length-metering gage engageable with the material, and control means connecting said gage with said respective table and drum drive means and with said guide means and clamping means for sequentially controlling said respective means to transfer the material after gage-initiated rotation of said turntable from a filled drum to the reel of an empty drum before commencing the winding of material on the latter drum, whereby the starting end of material extends laterally out of each full drum.

2. Apparatus for winding of strand material, comprising a turntable, turntable drive means for moving said turntable a given angle of rotation, two winder drums having respective shafts on said table in a diametrical plane and in equally spaced relation to the axis of turntable rotation, two drum drive means on said table for rotating said respective drums, an auxiliary reel mounted on said respective shafts coaxially adjacent to said respective drums, controllable means on each reel for holding and cutting the strand material, guide means for guiding

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the material onto said drums and reel devices, a length-measuring gage responsive to the length of material being wound, and control means connecting said gage with said respective drive means and guide means and with said holding and cutting means for sequentially controlling said respective means under control by said gage means, whereby said gage, when responding to a given length of wound-up material, causes the strand material, after filling one drum, to be transferred to the other drum by rotation of said turntable while said guide means first pass a further length of material over the reel device of the still empty drum until the empty drum reaches the wind-up position, whereafter an additional length of material is wound onto said latter reel device until said cutting means sever the material from that of the drum previously filled.

3. Apparatus for winding of strand material, comprising a turntable, turntable drive means for moving said turntable a given angle of rotation, two winder drums having respective shafts on said table in a diametrical plane and in equally spaced relation to the axis of table rotation, two drum drive means on said table for rotating said respective drums, a reel device on each of said shafts, each of said reel devices comprising two disc members coaxially adjacent to each other, one of said members being joined with said drum and the other member being axially displaceable on said shaft, each of said reel devices having means for holding and cutting the strand material actuatable by axial displacement of said other member, guide means for guiding the material onto said drums and reel devices, a length-measuring gage responsive to the length of material being wound, and control means connecting said gage with said respective drive means and guide means and with said holding and cutting means for sequentially controlling said respective means under control by said gage means, whereby said gage, when responding to a given length of wound-up material, causes the strand material, after filling one drum, to be transferred to the other drum by rotation of said turntable while said guide means first pass a further length of material over the reel device of the still empty drum until the empty drum reaches the winding-up position, whereafter an additional length of material is wound onto said latter reel device until said cutting means sever the material from that of the drum previously filled.

4. In winding apparatus according to claim 3, each of said drum shafts having a central bore, a pusher rod axially displaceable in said bore and engageable with said displaceable disc member of said reel device, and electric actuating means connected with said control means for actuating said rod under control by said gage to cause clamping and cutting of the material in said reel device.

5. In winding apparatus according to claim 3, each of said drum shafts comprising a tubular carrier shaft fixedly mounted on said turntable and protruding over the table top surface, an inner shaft revolvably traversing said fixed carrier shaft, an outer sleeve journaled on the protruding portion of said fixed carrier shaft and fixedly joined with said inner shaft to revolve together therewith; said drum and said adjacent reel device being coaxially mounted and removably secured to said sleeve in angularly fixed relation thereto so as to be rotatable by means of said inner shaft; and said drum drive means being connected to said inner shaft at the table side facing away from said sleeve.

6. In winding apparatus according to claim 5, said drum drive means comprising an electrically controllable clutch mounted on said turntable and mechanically connected with said inner shaft at the shaft end remote from said sleeve, said clutch being electrically connected with said gage-responsive control means.

7. In winding apparatus according to claim 3, said guide means comprising for each drum and reel device a reciprocating guide member having a path of reciprocating

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motion parallel to the turntable axis and located between the drum and the turntable axis, and actuating means for moving said guide means, said actuating means being connected with said drum drive means to be driven therefrom.

8. In winding apparatus according to claim 3, said guide means comprising for each drum and reel device a reciprocating guide member having a path of reciprocating motion parallel to the turntable axis and located between the drum and the turntable axis, and transmission means connecting said guide means with said drum drive means for actuating said guide means during winding operation of said drum, said transmission comprising an electrically operable clutch electrically connected to said gage-responsive control means.

9. In winding apparatus according to claim 1, said

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length-metering gage having two portions adjustable to different length values, the first-responsive portion having electric means for initiating the operation of said control means and starting said table drive, and the last-responsive portion of said gage being connected with said control means for stopping the previously wound drum and actuating said clamping means.

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