March 5, 1963 C. E. HAUER 3,080,128

STRAND-REELING APPARATUS

Filed Oct. 6, 1960 5 Sheets-Sheet 1

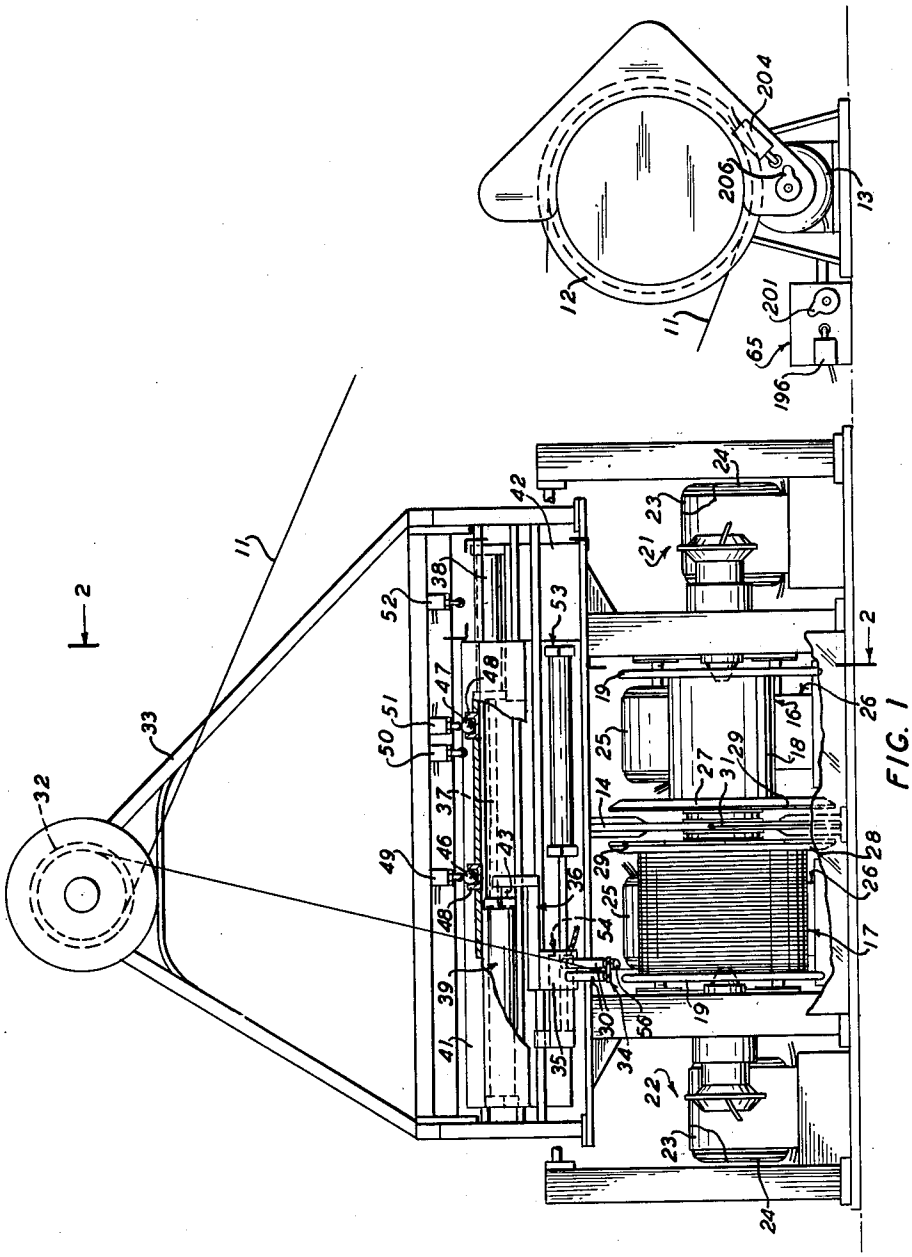


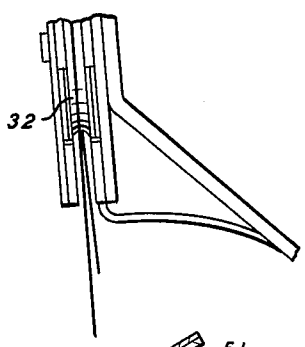
FIG. 1

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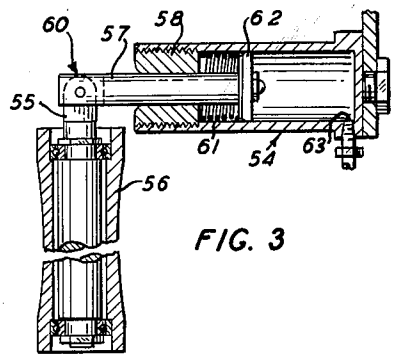


FIG. 3

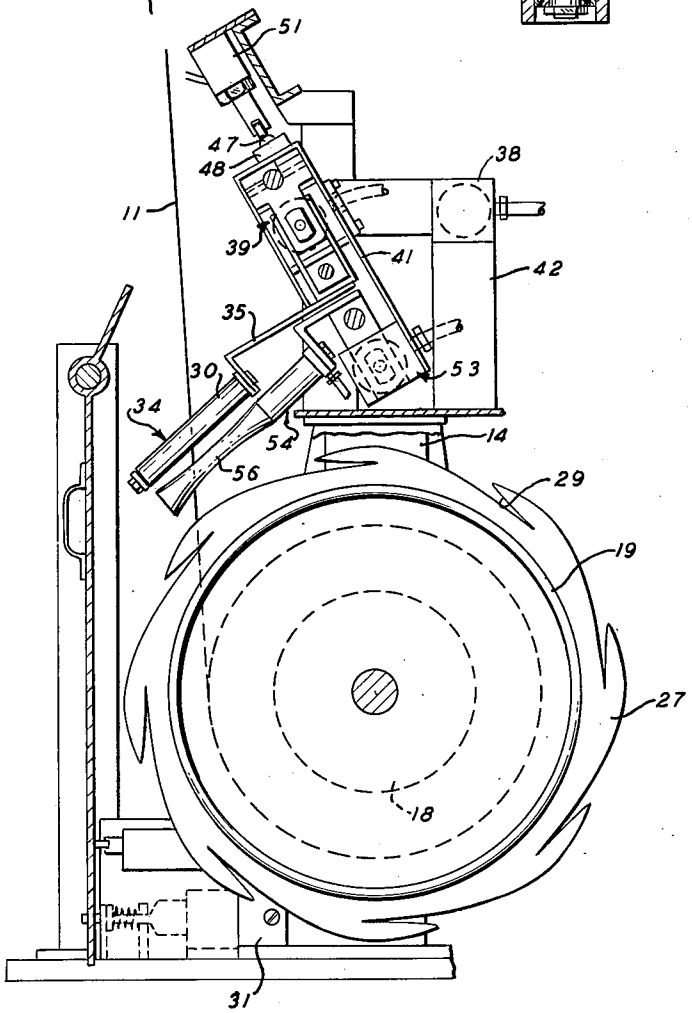


FIG. 2

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STRAND-REELING APPARATUS

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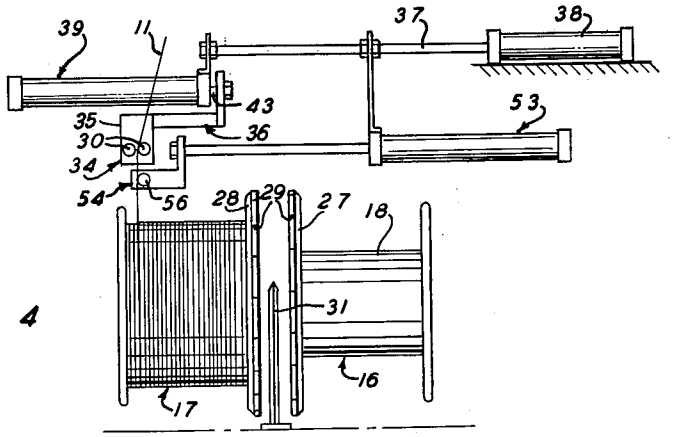


FIG. 4

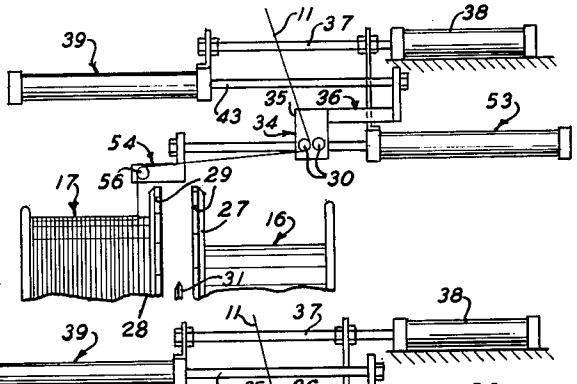


FIG. 5

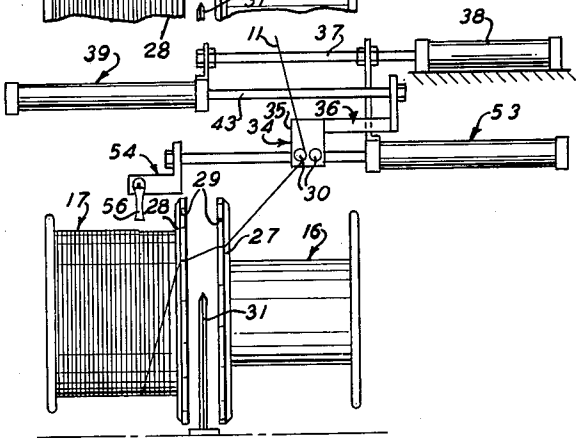


FIG. 6

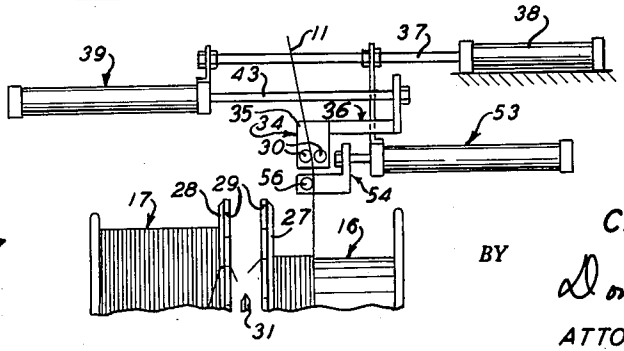


FIG. 7

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STRAND-REELING APPARATUS

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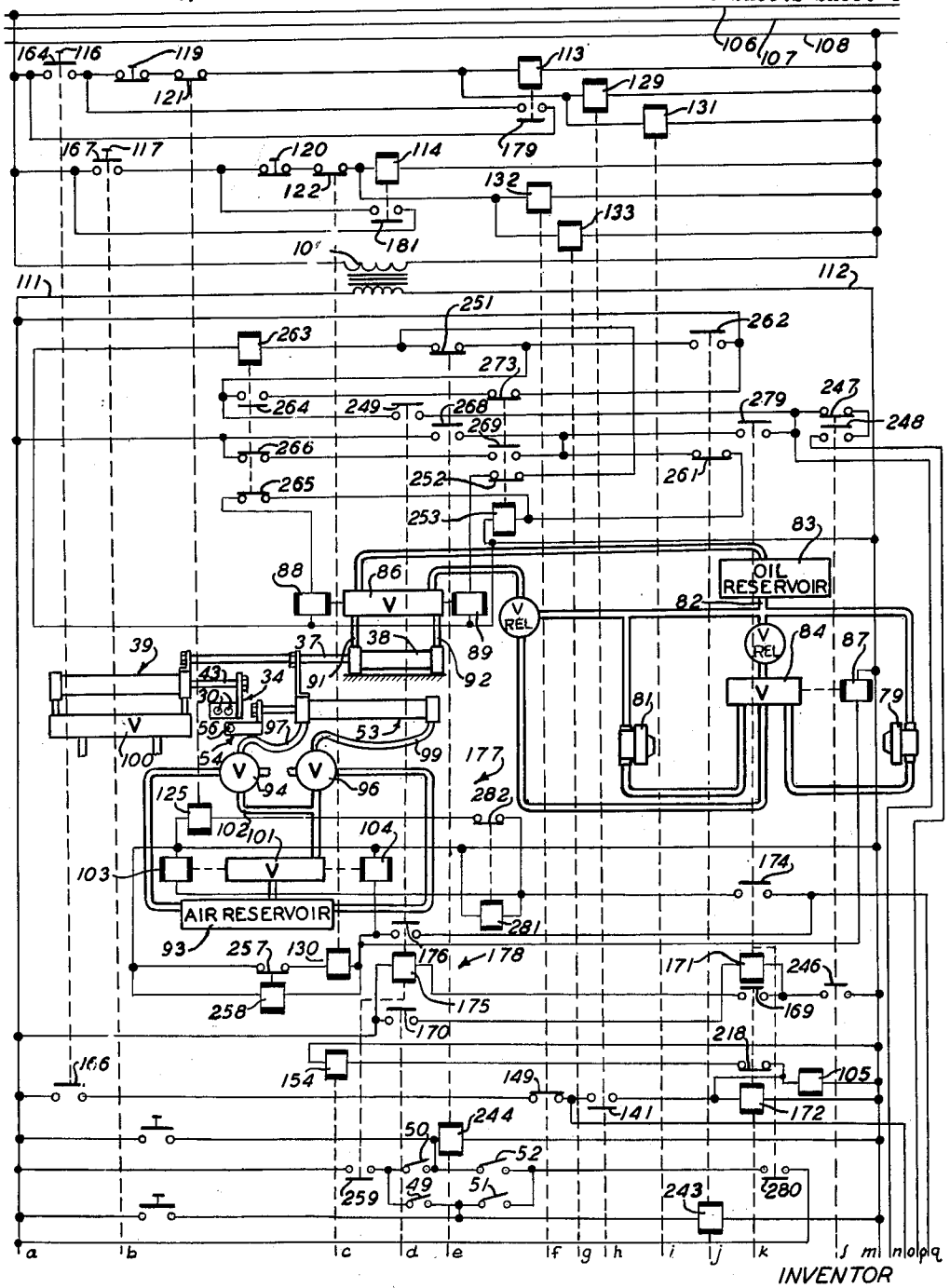


FIG. 8

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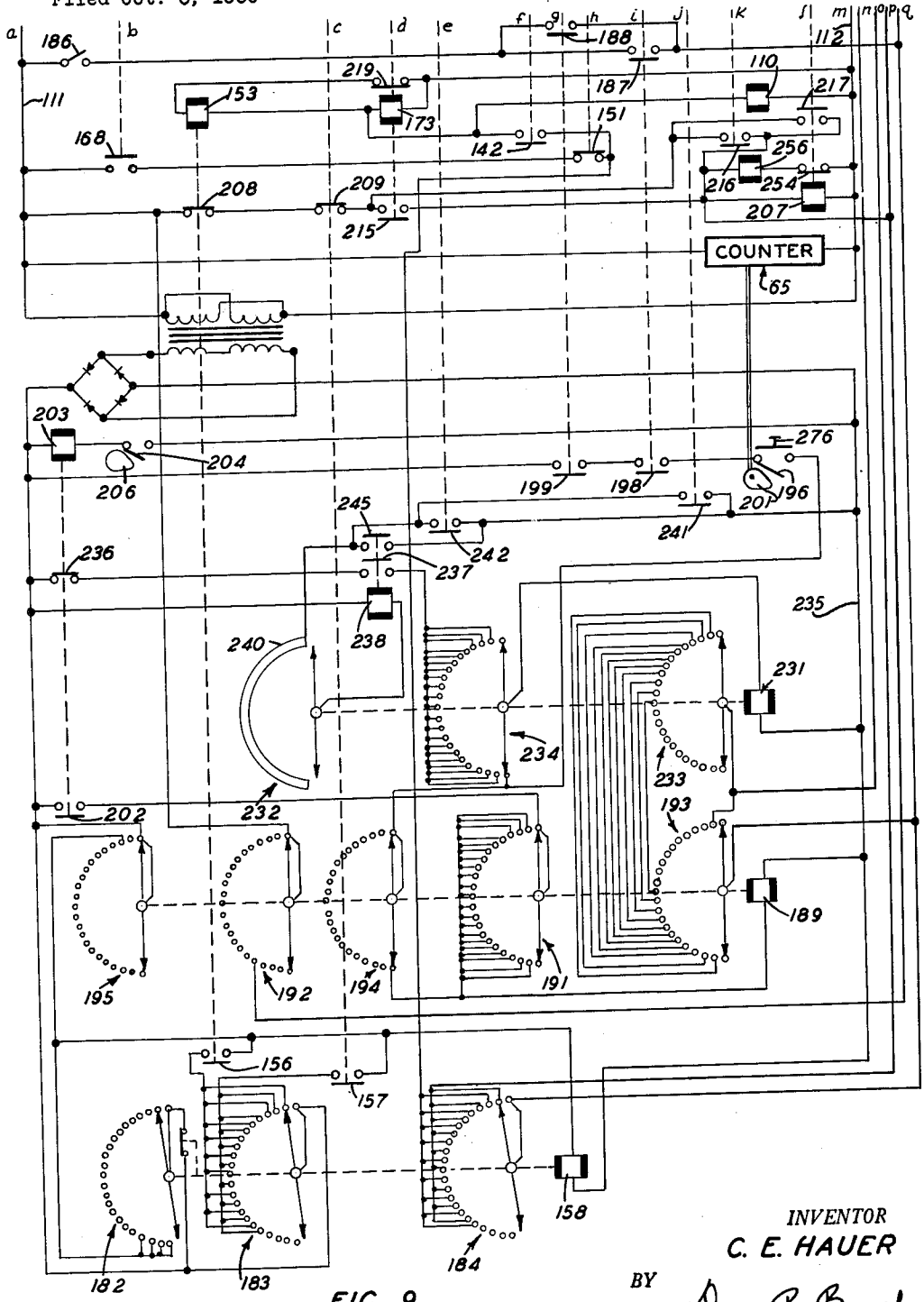


FIG. 9

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United States Patent Office 3,080,128 Patented Mar. 5, 1963

3,080,128

STRAND-REELING APPARATUS

Charles E. Hauer, Baltimore, Md., assignor to Western Electric Company, Incorporated, New York, N.Y., a corporation of New York

Filed Oct. 6, 1960, Ser. No. 60,965
9 Claims. (Cl. 242—25)

This invention relates to apparatus for reeling strand. The invention relates more particularly to strand-reeling apparatus for distributing and winding strand material on successive reels, which distributing and winding may continue uninterruptedly.

In general, insulated electrical conductors are manufactured by means of a substantially continuous process in which an elongated, conductive core or conductor is advanced continuously from a supply thereof to and through a series of manufacturing apparatus or processes, such as continuous extrusion apparatus, to produce a finished insulated conductor. In order that the extrusion operation may continue without interruption or disturbance, it is a common practice to employ take-up apparatus having two or more rotatable take-up reels onto which predetermined lengths of finished insulated conductors are wound successively.

When a predetermined length of insulated conductor has been wound upon one of the take-up reels, the advancing insulated conductor is transferred to an empty take-up reel without interrupting the advancement of the insulated conductor emerging from the extrusion apparatus. Snaggers are connected operatively to adjacent sides of each of the take-up reels for gripping portions of the insulated conductor extending between the reels, when the distribution of the insulated conductor is transferred from one reel to another. The portion of the insulated conductor extending between the reels is cut by a knife positioned between the reels. It is desirable that the strand be distributed uniformly to lay successive strand convolutions side by side throughout the width of a reel drum, and that the convolutions do not pile up on the take-up reel.

When conventional apparatus is used to transfer the distribution of a rapidly moving strand from one take-up reel to another take-up reel in a conventional manner, the strand is sometimes damaged by the distributing guide jerking the strand and thus placing excessive stresses in the strand. Therefore, it is highly desirable to provide new and improved apparatus for transferring the distribution of the strand from one reel to the other without causing the strand to pile up on the winding surface or placing excessive stresses on the strand. This may be accomplished in accordance with the present invention by providing apparatus, which will continue to distribute the strand on a substantially filled reel when a distributing guide is moved to an empty reel position, so that slow-moving distributing guides of simpler designs can be tolerated without sacrificing a very important object of effecting snagging of the strand at a preferred time.

An object of the present invention is to provide new and improved apparatus for reeling strand material.

Another object of the present invention is to provide new and improved strand-reeling apparatus for distributing and winding strand material on successive reels without stopping the distributing and winding of the strand material.

A further object of the present invention is to provide new and improved apparatus for controlling the distribution of the strand for a period just prior to and during the time in which the strand is transferred from the full reel to an empty reel.

Another object of the present invention is to provide new and improved distributing mechanisms for reeling

apparatus whereby the reeling apparatus can be operated with greater speed and better efficiency.

A still further object of the present invention is to provide new and improved apparatus for providing continued distribution of strand on a partially filled reel after the distributing guide has been moved to an empty reel position.

Apparatus for taking up an advancing strand upon rotatably driven take-up reels, which embodies certain principles of the present invention, may include a movable guide designed to hold the span of the strand outwardly from snagging means secured to the reels when the strand distributor is indexed from a partially filled reel to the empty reel so as to delay the gripping of the strand by the snagging means. Means are provided for moving the guide transversely of the partially filled reel during the delay to distribute an additional predetermined amount of the strand on the partially filled reel. Means are also provided for causing the span of the strand to become disengaged from the guide and to move into the paths of the snagging devices as soon as the additional predetermined amount of strand has been wound on the full reel to effect a cutover from the latter to the empty take-up reel.

Other objects and features of the invention will be more readily understood from the following detailed descriptions of specific embodiments thereof, when read in conjunction with the accompanying drawings, in which:

FIG. 1 is a fragmentary, front elevation of a strand-reeling apparatus embodying certain principles of the present invention, with portions thereof broken away for purposes of clarity;

FIG. 2 is an enlarged, fragmentary, sectional view of the apparatus of FIG. 1 taken along line 2—2 thereof;

FIG. 3 is an enlarged, fragmentary, sectional view of a guide roller of the apparatus of FIG. 1 in an operated or pendent position;

FIGS. 4 to 7, inclusive, are schematic views illustrating different operating positions for various elements of the apparatus of FIG. 1, and

FIGS. 8 and 9 combined, constitute a schematic representation of portions of the electrical control circuit and hydraulic and pneumatic systems forming a part of the reeling apparatus.

Referring now to the drawings, there is shown strand-reeling apparatus for taking up a strand **11** without interruption. The strand **11** may be, for example, an insulated wire, delivered at a substantially constant, relatively rapid rate from an insulating machine (not shown) by a conventional strand-advancing capstan **12** driven by a motor **13**.

The strand-reeling apparatus comprises a flat, rigid, support member **14** located centrally between a right take-up reel, designated generally by the numeral **16**, and a left take-up reel, designated generally by the numeral **17**. The take-up reels **16** and **17** are identical in construction and are positioned side by side as shown in FIG. 1 for axial rotation about a common axis. The take-up reels **16** and **17** are of a conventional design and each includes a cylindrical winding drum **18** and a pair of flange-like reels heads **19—19** secured fixedly at opposite ends of the winding drum. The reels **16** and **17** are driven rotatably by electric motor drive units, designated generally by the numerals **21** and **22**, respectively. The drive units **21** and **22** each include two direct-current machines **23** and **24** connected operatively to each other and to an alternating current motor **25** through a plurality of gears and shafts (not shown) in transmission units, designated generally by the numerals **26—26**.

Suitable electrical control means are illustrated on FIGS. 8 and 9 for stopping, starting and controlling the machines **23** and **24** and the motor **25** of the drive units

21 and 22, independently. The portions of the circuit controlling the drive units 21 and 22 which are not disclosed in the present application are substantially identical to those disclosed in a copending application, Serial No. 656,978, filed May 3, 1957, in the name of T. T. Bunch, now Patent 2,971,710. The structural features of the present take-up apparatus which are not disclosed in the present application are substantially identical to those disclosed in the above-identified application and a copending application, Serial No. 784,193, filed on December 31, 1958, in the name of C. E. Hauer, now Patent 2,971,711, of which the present apparatus are modifications.

Mounted between the central support member 14 and the adjacent reel heads 19—19 of the take-up reels 16 and 17, respectively, are a pair of snagger wheels 27 and 28. Each of the snagger wheels 27 and 28 is provided with a series of peripheral, tangentially projecting fingers 29—29, which function to catch the strand 11 when the latter is transferred from one of the take-up reels 16 and 17 to the other during a cutover operation. A stationary, vertically positioned cutter 31 is mounted on the front surface of the central support member 14 and is designed to sever the strand 11 when a portion thereof is engaged by and extends between the fingers 29—29 on the snagger wheels 27 and 28 during a cutover operation.

The strand 11, as it advances toward the take-up reels 16 or 17, advances from the capstan 12 to and around a freely rotatable guide sheave 32 which is positioned at the top of an inverted, V-shaped frame 33 and near the center of the take-up apparatus so that the longitudinal axis of the central support member 14 is tangent to the right-hand side of the guide sheave. From the guide sheave 32, the strand 11 is directed downwardly into a slot between a pair of forwardly projecting rollers 30—30 forming a slotted distributing guide, designated generally by the numeral 34, mounted at the lower end of a depending distributor arm 35. The distributing guide 34 normally directs the strand 11 to one or the other of the take-up reels 16 and 17.

The distributor arm 35 forms a portion of a movable distributor carriage, designated generally by the numeral 36. The distributor carriage 36 is shown connected operatively to the free end of a movable piston rod 37 of a hydraulic distributing cylinder 38 which is actuatable to reciprocate the distributor carriage 36 transversely with respect to the take-up reels 16 and 17 alternately so as to distribute the strand 11 across the winding drums 18—18 of alternate take-up reels. The free end of the piston rod 37 is secured rigidly to an indexing cylinder, designated generally by the numeral 39, at the right-hand end thereof as viewed in FIG. 1. The opposite end of the cylinder 39 is secured to a hood 41 by suitable means.

The distributing cylinder 38 is secured rigidly to the frame of the apparatus by means of a support member, designated generally by the numeral 42. The piston rod 37 of the cylinder 38 is secured to the hood 41 and the cylinder 39 so as to reciprocate the cylinder 39 and the hood 41. The distributor carriage 36 is secured fixedly to the free end of a movable piston rod 43 of the cylinder 39 which is designed to index the distributor carriage 36 alternately from a left-hand operating position adjacent to the left-hand reel 17 to a right-hand operating position adjacent to the right-hand reel 16 and vice versa.

The distributor carriage 36 is shown in FIGS. 1 and 4 in its left-hand operating position, in which operating position it operates to distribute the continuously advancing strand 11 upon the left take-up reel 17. The hood 41 is provided with ball members 46 and 47, which are secured fixedly in supports 48—48 on the hood 41. The hood 41 carries the ball members 46 and 47 so that the ball members 46 and 47 extend above the surface of the hood 41 a sufficient distance, to actuate spring-biased plungers of sensitive limit switches 49 to 52, inclusive.

An auxiliary, pneumatic cylinder, designated generally by the numeral 53, is secured to the piston rod 37 by being attached to the right side of the hood 41, as viewed in FIG. 1. A cylinder, designated generally by the numeral 54, is mounted transversely of the cylinders 38, 39 and 53 and is secured to the piston rod of the cylinder 53. An arm 55 (FIG. 3), which has a roller 56 mounted rotatably thereon, is mounted pivotably to the free end of the piston rod 57 of the cylinder 54. The cylinder 53 is designed to index the cylinder 54 alternately from a left-hand reel position to a right-hand reel position, and vice versa.

The piston rod 57 of the cylinder 54 is mounted slidably in a tapered bell-mouthed passage formed in a bearing 58 in one end of the cylinder 54. A compression spring 61 encompasses the piston rod 57 and abuts adjacent ends of the piston 62 of the cylinder 54 and the bearing 58 for normally urging the piston 62 away from the bearing 58 and pulling the pivotable connection, designated generally by the numeral 60, between the arm 55 and piston rod 57 into the bearing 58. When the connection 60, between the arm 55 and piston rod 57, is moved into and through the bell-mouthed passage in the bearing 8, the guide roller 56 is forced into axial alignment with the piston rod 57 to hold the roller 56 in a normal erect position.

As is illustrated in FIG. 5, the roller 56 cooperates with the strand-distributing guide 34 to hold a span of the strand, extending from the distributing guide 34 to a partially filled take-up reel 16 or 17, outwardly beyond substantially circular paths defined by the rotating movement of snagger wheels 27 and 28 as the distributing guide 34 indexes to an adjacent reel prior to a cutover operation from one of the take-up reels 16 or 17 to the other to delay the gripping of the strand 11 by the snaggers on both snagging wheels until a desired time. As is illustrated in FIGS. 5 and 8, the guide roller 56 is positioned normally below the roller 30 of the strand-distributing guide 34 nearest the inside flange 19 of the associated reel, and normally is moved in unison with the distributing guide 34 by the cylinder 38 in a path parallel to the axis of rotation of the take-up reels 16 and 17.

When a signal is received, from a counter, designated generally by the numeral 65, indicating that a predetermined length of the strand 11 remains to be taken up on the substantially full reel 16 or 17 prior to a cutover operation from a full reel to an empty reel, the distributing guide 34 is indexed to the empty reel by the indexing cylinder 39 connected thereto. However, as is illustrated in FIG. 5, the span of the strand 11, extending from the strand-distributing guide 34 to the partially filled reel, is moved into contact with the guide roller 56, which is positioned adjacent to the partially filled reel 16 or 17. The guide roller 56, which is connected operatively to the distributing guide 34 through the hood 41 and is moved in unison therewith by the cylinder 38, is then utilized to distribute the remaining amount of the strand 11 onto the partially filled reel.

The control circuit illustrated on FIGS. 8 and 9 causes a cutover of the distribution of the strand 11 from one of the take-up reels 16 or 17 to the other to take place by supplying fluid momentarily to an inlet 64 (FIG. 3) of the cylinder 54 to push the piston 62 toward the bearing 58 to move the connection 60, between the arm 55 and the piston rod 57, from a normal position best illustrated in FIG. 2. The connection 60 is moved out of the bearing 58 to permit the arm 55 and the roller 56 to drop downwardly to a pendent position illustrated best in FIGS. 3 and 6. When the guide roller 56 moves from a normal erect position downwardly into a pendent position, the span of the strand 11 extending thereover is permitted to become disengaged from the guide roller 56 and drop into the snaggers of both of the snagger wheels 27 and 28 simultaneously, as illustrated in FIG. 6. After a cutover operation has been completed, the

arm 55 and the associated guide roller 56 are retracted into an erect position and moved to the empty-reel position, as illustrated in FIG. 7, in preparation for another cutover operation. During substantially the entire operation, the cylinders 39, 53 and 54 are moved in unison by the strand-distributing cylinder 38.

Referring now to FIG. 8, there is shown in a portion thereof, a schematic representation of a combined hydraulic and pneumatic system forming a part of the strand-reeling apparatus. This system includes a pair of constant displacement, rotary, hydraulic pumps 79 and 81, which are driven by the drive units 21 and 22, respectively (FIG. 1), at speeds proportional to the rotational speeds of their respective take-up reels 16 and 17. The intake ports of both hydraulic pumps 79 and 81 are connected directly to a common supply line 82, which, in turn, communicates directly with a reservoir 83 containing a hydraulic fluid at atmospheric pressure.

A four-way, solenoid-operated, spring-return valve 84 is connected to the discharge ports of the hydraulic pumps 79 and 81 so that, normally the hydraulic fluid discharged from the hydraulic pump 81 is bypassed and returned to the reservoir 83 through the valve 84 and the supply line 82, while normally the valve 84 prevents the return of the hydraulic fluid discharged by the hydraulic pump 79 to the reservoir 83, and the hydraulic fluid from the latter pump 79 flows to a four-way, spring-centered, double solenoid-operated distributor reversing valve 86. However, when the solenoid 87 of the valve 84 is energized, the hydraulic fluid discharged from the pump 81 is directed to the distributor reversing valve 86, whereas the hydraulic fluid discharged by the hydraulic pump 79 is returned to the reservoir 83 through the valve 84.

The distributor reversing valve 86 normally is in its central position, and in this position directs fluid from the pump 79 or 81 back to the reservoir 83. The distributor reversing valve 86 is designed to control the direction of flow of the hydraulic fluid supplied by either of the hydraulic pumps 79 and 81 to the distributor cylinder 38 when actuated by a solenoid 88 or 89. One end of the distributor cylinder 38 is connected to a corresponding port of the distributor reversing valve 86 by means of a line 91 and, similarly, the opposite end of the cylinder 38 is connected to another port on the distributor reversing valve 86 by a line 92.

The distributor reversing valve 86 is controlled by the two solenoids 88 and 89 which are energized alternately. When the solenoid 89 is energized, the valve 86 is operated to supply hydraulic fluid under pressure from either the hydraulic pump 79 or the hydraulic pump 81 to the left-hand end of the distributor cylinder 38, as viewed in FIG. 1, to move the piston rod 37 and attached distributing guide 34 and guide roller 56 to the right. Conversely, when the solenoid 88 is energized, the distributing guide 34 and guide roller 56 are caused to move to the left.

The opposing ends of the guide-roller indexing cylinder 53 are supplied from an air reservoir 93 through pilot-operated, three-way valves 94 and 96. The valves 94 and 96 are connected to opposite ends of the guide-roller indexing cylinder 53 by means of flexible lines 97 and 99, respectively. If there is no pilot pressure supplied by a valve 101, the valve 94 connects the left-hand end of the cylinder 53 directly to the air reservoir 93 so that the piston rod of the cylinder 53 is in its retracted, right-hand position, and the valve 96 connects the opposite end of the cylinder 53 to exhaust at atmospheric pressure. However, when a pilot line 102 is connected to the air reservoir 93 through the threeway, double-solenoid operated valve 101, the valves 94 and 96 are actuated so that the left-hand end of the indexing cylinder 53 is connected to exhaust through the valve 94 and the opposite end of the indexing cylinder 53 is connected to the air reservoir 93 by the valve 96 so that the piston rod of the cylinder 53 is held in the left-hand, extended position, as shown in FIG. 1.

The valve 101 is provided with two solenoids 103 and 104 designed to be energized alternately. When the solenoid 103 is energized, the pilot line 102 is connected to exhaust through the valve 101 to hold the guide roller 56 in the right-hand position or index the guide roller 56 to the right-hand position if it is not already in the right-hand position. When the solenoid 104 is energized, the pilot line 102 is connected to the air reservoir 93 through the valve 101 to actuate the valves 94 and 96 to hold the guide roller 56 in the left-hand position or to index the guide roller 56 to the left-hand position if it is not already there.

The indexing cylinder 39 is controlled in a similar manner to that of the indexing cylinder 53. However, for the purpose of simplicity only, a single solenoid-operated valve 100 is illustrated in the drawings. The opposite ends of the cylinder 39 are supplied fluid from a suitable source (not shown) through the valve 100 which is controlled by two solenoids 105 (FIG. 8) and 110 (FIG. 9) which are energized alternately. When the solenoid 105 is energized, the valve 100 is operated to supply fluid under pressure to the right-hand side of the cylinder 39 to move the distributing guide 34 to a position adjacent to the lefthand reel 17 (FIGS. 1 and 4). Conversely, when the solenoid 110 is energized, the valve 100 is operated to supply fluid under pressure to the left-hand side of the cylinder 39 to move the distributing guide 34 to a position adjacent to the right-hand reel 16 (FIGS. 5, 6 and 7).

Referring now to combined FIGS. 8 and 9, there is shown an electrical circuit for controlling the operation of the apparatus. The electrical circuit includes three bus lines 106, 107 and 108 supplying electrical power from a suitable 440 volt, 3 phase, 60 cycle source of E.M.F. (not shown) to the primary of a transformer 109, the secondary of which is connected to bus bars 111 and 112. Connected across the bus lines 106 and 108 is a pair of motor-starting relays 113 and 114 (FIG. 8). Connected in series with the relays 113 and 114 are start butons 116 and 117, respectively. When one of the start buttons 116 or 117 is depressed, the associated relay 113 or 114 is energized resulting in the energization of the associated motor 25 of the drive units 22 or 21, respectively.

The motor-starting relay 113 or 114 is energized by depressing the start button 116 or 117, respectively, and is energized through a normally closed emergency stop button 119 or 120 and a normally closed, time-to-close contact 121 or 122 associated with a relay 125 or 130, respectively. If neither drive unit 22 nor 21 had been running previously, neither relays 129 and 131 nor relays 132 and 133, connected in parallel with the respective motor-starting relay 113 or 114, would be energized when the other relay 113 and associated relays 129 and 131, or relay 114 and associated relays 132 and 133, were energized. Therefore, when contact 141 or 142 is closed as a result of the energization of the associated relay 129 or 132, normally closed contacts 149 and 151 would be closed to complete a circuit to respective relays 154 and 153. The energization of the relay 153 or 154 will close a normally open contact 156 or 157, respectively, which tends to complete a circuit to the solenoid of a stepping relay 158.

Each of the start buttons 116 and 117 is provided with two contacts 164 and 166, and 167 and 168, respectively, and depending upon which of the buttons 116 or 117 is pressed first, the strand 11 will be taken up on the reel 17 or 16 associated with their respective drive units 22 or 21 if the strand 11 is properly connected thereto. If the distributing guide 34 is in the right-reel position when the left-start button 116 is depressed, the distributing guide 34 wil index to the left reel 17. If the distributing guide 34 is in the left-reel position at the time

the start button 116 is depressed, the distributing guide 34 will stay in that position.

If either of the drive units 21 or 22 associated with the reel 16 or 17, respectively, is energized already, the relay 132 or 129 will be energized and the normally closed contact 149 or 151, respectively, associated therewith will be open. If the contact 149 or 151 is open, it will prevent a relay 172 or 173 from being energized to close a contact 169 or 170 and thus prevent one of a pair of relays 175 or 171 from being energized to close a normally open, time-to-close contact 176 or 174 associated therewith and thus prevent an associated distributor indexing circuit, designated generally by the numeral 177 or 178, from being energized as a result of depressing the start button 116 or 117 and closing the contact 166 or 168, respectively. When either the start relay 113 or 114 is energized, it closes a contact 179 or 181, respectively, associated therewith in a respective holding circuit to hold the associated relay 113 or 114 energized and permit the operator to release the normally open start button 116 or 117 without causing the motor 25 in the associated drive unit 22 or 21 to stop.

The relay 158 may include three arcuate-shaped banks 182 to 184, inclusive, of contacts. The circuit to the solenoid of the relay 158 is completed if the contacts of bank 183 of relay 158 are in the proper position. If relay 158 does become energized and then deenergized, it steps to such a position as to create a circuit through bank 184 of relay 158 parallel to that which was established by the depressing of the start button 116 or 117. This parallel circuit then acts to hold the relays 172 or 173 energized. This is so because, a capstan relay (not shown) is energized to close a normally open contact 186 whenever the capstan 12 is running. Also, either relay 131 or 133 is energized and a normally open contact 187 or 188, respectively, is closed when one of the take-up drive units 22 or 21 is running.

When the relay 172 or 173 is energized, it closes the normally open contact 169 or 170 to pass a current to the solenoids 175 or 171, which, in turn, closes the normally open contact 176 or 174 to energize the solenoid 104 or 103, respectively, of the pneumatic valve 101 which causes the distributing guide 34 to be positioned at the reel 17 or 16, respectively, that is being driven by the drive unit 22 or 21 which is energized.

The coil of a stepping relay 189, which relay is similar to relay 158, except that it comprises five contact banks, designated generally by the numerals 191 to 195, inclusive, is energized when a circuit is completed through the brushes of bank 194 thereof. The circuit containing the brushes of bank 194 is closed initially from a switch 196 actuated by the counter 65 and through both normally open contacts 198 and 199, of the relays 131 and 133. The coils of the relays 131 and 133 are energized when their respective drive units 22 and 21 are running.

The switch 196 is closed by a cam 201 at the end of a predetermined count by the counter 65. The counter 65 is geared to the capstan 12 and actuated thereby to measure the length of the strand 11 fed to the take-up apparatus thereby. The counter 65 is a predetermined counter which has selector switches thereon to enable it to be set so that it will close the switch 196 after a preselected number of feet of the strand 11 has been fed to the take-up reel by the capstan 12. The closing and opening of the counter switch 196 therefore will cause the relay 189 to move off its normal position.

The coil of relay 189 also has a circuit connected through each of the rest of the contacts on bank 191 thereof, and through a normally open contact 202 of a relay 203. The delay 203 is energized through a normally open switch 204 which is closed by a cam 206 actuated by the capstan 12 once each time the capstan 12 feeds any desired predetermined length (e.g. ten feet) of strand 11 to the take-up apparatus. Therefore, when relay 189 is off its initial position, it advances one step for every ten feet of travel of the pitch surface of the capstan 12 until it returns to its initial position. The reason for choosing the specific ten foot length of strand 11 is that with the specific size of the reels 16 and 17, and the specific diameter of the strand, one layer of convolutions of the strand 11 on a substantially full reel contains approximately two hundred and twenty feet of the strand 11. Since the stepping relay 189 is stepped twenty-two times, it is desirable to have the relay step once for each ten feet so that the remaining length of strand 11 will have been wound on the reel when the relay 189 steps past its twenty-second contact.

It should be noted that the ratio between the frequency of actuation of the switch 204 by the cam 206 and the speed of revolution of the capstan 12 could be any desired value to insure that the desired length of strand 11 is fed to the take-up reel 16 or 17 during each period of time the relay 189 steps from one contact to another. The cam 206 could be connected to and driven by the capstan 12 by any well-known, variable type, positive connections.

The coil of a relay 207 is connected across the lines 111 and 112 through the eighteenth contact of the bank 192 of the relay 189, or, alternatively, through a pair of normally closed, instantaneous contacts 208 and 209 of the relays 153 and 154, respectively, and connected in series with a normally open, time-to-close contact 215 of relay 173, a normally open contact 216 of the relay 172, and its own normally open contact 217, which are connected in parallel.

When the brushes on bank 195 of relay 189 reach a position where the second contact of bank 195 is closed, the relay 158 will be energized. When relay 158 is deenergized, it will step to its next position, which, in turn, will cause either the relay 153 or the relay 154 to be energized through bank 184 of relay 158 and the normally closed contact 208 or 209, respectively, thereof will hold off reenergizing of the relay 207 until after the cutover from one reel 16 or 17 to the other has taken place.

The relays 172 and 173 are in parallel with the relays 154 and 153, respectively, and are energized simultaneously. After a time delay, the relay 172 or 173 closes the normally open, time-to-close contact 169 or 170 to deenergize the relay 175 or 171 and close the contact 176 or 174. The closure of the contact 176 or 174 results in the energization of solenoid 104 or 103 which actuates the cutover valve 101, which, in turn, results in the distributing guide 34 being indexed to the new reel position. The closure of the contact 174 or 176 causes the relay 125 or 130 to open the normally closed contact 121 or 122 to deenergize the drive units 22 or 21 driving the reel 17 or 16 which has been in use and allowing the reel 17 or 16 to drift to provide slack in the strand 11 to permit a cutover from one reel to the other to take place without introducing excessive stresses therein. The reel 16 or 17 coasts to a stop as a result of the inherent friction in the transmission 26 in the drive unit 21 or 22. Simultaneously, a normally closed, time-to-close contact 218 or 219 of relay 172 or 173 breaks the circuit energizing the coil of the relay 154 or 153.

The rate of movement of the distributing guide 34 and guide roller 56, transversely of the take-up reel 16 or 17, is responsive to the rotational speed of the reel 16 or 17 onto which the strand 11 is being distributed. Accordingly, if the machine is slowed down for some reason or other then the distributing guide 34 and guide roller 56 will slow down a proportional amount and thus the same number of feet (220 feet) of the strand 11 will be fed to the take-up reel 16 or 17 for each traverse of the distributing guide 34 or guide roller 56, assuming that the diameters of the strand and winding surface of the reel are the same in each case.

Means may be provided to insure that the distributing guide 34 and guide roller 56 are always in the desired

position wth respect to the full reel **16** or **17** when the distributing guide **34** and guide roller **56** are transferred to the empty take-up reel. This may be accomplished by adding a stepping relay, designated generally by the numeral **231** (FIG. 9), similar to stepping relays **158** and **189**, having three banks **232**, **233** and **234** of contacts.

The latter results may be accomplished by connecting the bank **234** of relay **231** between the brushes of bank **194** of relay **189** and the switch **196**, and at the same time connecting the solenoid of relay **231** between the brushes of bank **234** of relay **231** and a bus **235**. The first through twenty-first contact of bank **234** are connected together and in series with a normally closed contact **236** of relay **203** and a normally open contact **237** of a relay **238** which are connected in series with each other.

The solenoid of relay **238** is connected to the brushes of the bank **232** of the relay **231**. The first through twenty-first contact of bank **232** of relay **231** are made in the form of a solid conductive bar **240**, and are connected to the bus **235** through a normally open contact **241** of a relay **243**, a normally open contact **242** of a relay **244**, and a normally open contact **245** of the relay **238**, all of which are connected in parallel with each other.

Operation

After it has been decided which take-up reel **16** or **17** will be used first, the machine is started by energizing the direct-current machines **23** and **24** and the motor **25** associated with the drive unit **21** or **22** of that reel. Assuming that the distributing guide **34** is positioned over the right take-up reel **16**, as illustrated in FIG. 7, and it is desirable to use the left take-up reel **17** first, the start button **116** associated with the left reel **17** will be depressed by the operator which will cause the relays **113**, **129** and **131** to be energized.

The energization of the relay **113** will close the normally open contact **179** to form a holding circuit for the relays **113**, **129** and **131** across the contact **164** of the start button **116**, so that the start button **116** may be released subsequently. The energization of the relay **113** will also cause the machines **23** and **24** and the motor **25** of the drive unit **22** associated therewith to be energized. The energization of the relay **129** closes the normally open contact **141** and opens the nomally closed contact **151**. The opening of the contact **151** prevents the closure of the contact **168** from affecting the circuit at this time. At this time the start button **116** may be released.

Simultaneously, the closure of the contact **166** of the start button **116** closes a circuit through contact **149** and contact **141** to energize the solenoid **105** causing the distributing guide **34** to move to the left reel **17**. When the contact **166** of switch **116** was closed, relay **154** was energized to close the contact **157** and, in turn, energize the coil of the relay **158**. When the relay **154** is subsequently deenergized by the opening of the time-to-open contact **218** of the relay **172**, the brushes of the relay **158** will advance one step to odd numbered contacts on the banks **182**, **183** and **184** thereof to make a hold circuit for the relays **105**, **154** and **172**. The energization of the relay **153** or **154** causes the resistance and the current in the shunt field (not shown) of the direct current machine **23** of the drive unit **22** or **21** associated therewith to change to slow down the associated reel to the desired speed to produce the necessary slack in the strand **11** to permit a cutover to take place from one reel **17** or **16** to the other.

When relay **154** was first energized, the normally closed contact **209** thereof opened to deenergize the coil of relay **207**. When the relay **207** is deenergized, a normally open contact **246** thereof is opened. The coil of relay **172** remains energized, after the time-to-open contact **218** opens to deenergize the relay **154**. The time-to-close contact **169** closes to complete a circuit to the coil of the relay **175** and stays closed until after the longer time-to-close contact **216** of relay **172** closes to energize the coil of the relay **207**. The closure of the time-to-close contact **169** results in the energization of the solenoid **87** of the pump bypass valve **84** to cause the distributing assembly **38** to be driven by the pump **81** associated with the left reel **17**.

It should be noted that the relays **171** and **175** are latch-type relays in which the contacts thereof remain in their operated positions until unlatched by the energization of other relays **175** or **171**.

The solenoid **89** is energized through the contacts **208**, and **209**, the now closed contact **216**, a time-to-open contact **247** and instantaneously closing contact **248** of the relay **207**, a normally open contact **249** of the relay **175**, a normally closed contact **251** of the relay **244** and a normally closed contact **252** of a relay **253** to send the distributing guide **34** toward the inside edge of the left reel **17**. At the same time, a time-to-close contact **254** of the relay **207** is closed to energize a solenoid **256** to cause fluid to be directed momentarily to the inlet **63** of the cylinder **54** and, in turn, cause the guide roller **56** to drop to the pendent position thereof, as shown in FIG. 3, so that the span of the strand **11** becomes disengaged from the guide roller **56** and drops into the snaggers of both snagger wheels **27** and **28** simultaneously. The fluid pressure is then released automatically to allow the spring **61** to return the roller **56** to the normal, erect position thereof.

Since the contacts **246** and **169** are also closed at this time, the coil of the relay **175** is energized to close the contact **176** and energize the solenoid **104** of the valve **101** to cause guide roller **56** to index to a position below the right roller **30** of the distributing guide **34** and adjacent to the left reel **17**, as is illustrated in FIGS. 1 and 4. The closure of the contact **176** caused the relay **130** to become energized, which, in turn, opened the normally closed contact **122** in the circuit of the right-reel drive unit **21**. However, the opening of the contact **122** does not effect the right-reel drive unit **21** at this time since the right-reel drive unit is not running. A normally open, time-to-close contact **257** of a relay **258**, in series with the relay **130**, is then opened to open the circuit to coil of relay **130**, which, in turn, closes the contact **122**.

As the strand **11** advances continuously, the distributing guide **34** is reciprocated to distribute the convolutions of the strand **11** in uniform layers upon the winding drum **18** or winding surface of the left take-up reel **17**. At this time, the relay **175** is energized and a contact **259** thereof is closed so that the reciprocation of the piston rod **37** of the cylinder **38** is controlled by the ball **46** operating the limit switches **49** and **50** alternately.

When the limit switch **49** is operated by the ball **46**, the contact thereof closes to energize the relay **243** which opens a normally closed contact **261** to deenergize the solenoid **88** and closes a normally open contact **262** resulting in the energization of the solenoid **89** of the distributor reversing valve **86**, thereby reversing the direction of flow of the hydraulic fluid in the lines **91** and **92**. The hydraulic fluid now enters the left-hand end of the distributing cylinder **38** and causes other fluid to exit from the right-hand end thereof so that the distributor carriage **36** and guide roller **56** are moved to the right at a speed proportional to the rotational speed of the left-hand drive unit **22**. The closure of the contact **262** results in the energization of the relay **263** to close and hold closed a contact **264** to hold the relay **89** energizes until deenergized as a result of the closure of the limit switch **50**. The relay **263** also opens the contact **265** and a contact **266** in the circuit of the relay **88**.

The movement of the distributor carriage **36** is reversed again when the ball **46** operates the limit switch **50** since the operation of the latter results in the energization of the relay **244** to open the normally closed contact **251**

to deenergize the solenoid 89 and to close a normally open contact 263 to energize the solenoid 88 of the distributor reversing valve 86 to reverse the distributor 36. The closure of the contact 263 energizes the relay 253, thus in turn, closes and holds a holding contact 269 closed and also opens the contact 252 and a contact 273 in the circuit of the relay 89. In this manner, the distribution of the strand 11 continues throughout the normal reeling of the strand 11 upon the take-up reel 17.

With the left reel 17 taking up the strand 11, the right-reel drive unit 21 is then energized in a similar manner to that described above with respect to the left-reel drive unit 22. The start button 117 is depressed to complete the circuit to the relays 114, 132 and 133. Contacts 187 and 188 of the relays 131 and 133 are closed at this time and also contacts 198 and 199 of the relays 131 and 133 are closed at this time to prepare a circuit for the closure of the switch 196 of the counter 65 or the closure of a hand switch 276 to initiate cutover operation when the desired amount of the stand 11 is accumulated on the left reel 17.

When the switch 276 is closed and then opened or the switch 196 of the counter 65 is closed by the cam 201 and then opens the brushes of the relays 189 and 231 advance one step from the twenty-second contacts to the first contacts on the banks thereof. The bank 191 of the relay 189 has the first through twenty-first contacts thereof connected together and to the coil thereof and the brushes of the bank 191 are connected to the contact 202 of the relay 203. Therefore, since the relay 203 is energized once for each ten feet of the strand 11 moved by the capstan 12, the relay 189 will advance one step for each ten feet of the stand 11 passing over the capstan 12 until it reaches the twenty-second contact of the relay 189 to open the circuit to the coil of the relay 189.

When the brushes on bank 193 of the relay 189 step to the first contact thereof, a circuit is completed through the normally open contact 249 of the relay 175, through the normally closed contact 251 of the relay 244 and through the normally closed contact 252 of the relay 253 to the solenoid 89 to energize the solenoid 89 and cause the distributing guide 34 and guide roller 56 to be sent towards the inside flange 19 of the left reel 17 onto which the strand 11 is being distributed. Conversely, if the strand 11 is being taken up on the right reel when the brushes of bank 193 of the relay 189 stepped to the first contact thereof, a circuit is completed through a normally open contact 279 of the relay 171, through the normally closed contact 261 of the relay 243 and through the normally closed contact 265 of the relay 263 to the solenoid 88 to energize the solenoid 88 and cause the distributing guide 34 and guide roller 56 to be sent toward the inside flange 19 of the right reel 16 onto which the strand 11 is being distributed.

When the brushes on the bank 195 of the relay 189 are stepped off the first contact thereof, the relay 153 will be deenergized and advanced one step to move the brushes on bank 184 thereof to an even numbered contact position which will close the circuit through the normally open contact 142 to the solenoid 110 which, in turn, causes the assembly 39 to move the distributor guide 34 toward the right reel 16. At this time, the guide roller 56 will continue to distribute the strand 11 on the left reel 17. The relay 153 will be energized to open the normally closed contact 208 resulting in the relay 207 being deenergized. When the relay 207 is deenergized, the normally open contact 246 opens to deenergize the relay 175 and also the normally open instantaneous contact 248 of the relay 207 will open and the normally closed time-to-open contact 247 of the relay 207 will close. Also, the normally closed, time-to-open contact 254 of the relay 207 connected in series with the solenoid 256 will close; however, no action will take place until the coil of the relay 207 is energized by the brushes on bank 192 of the relay 189 moving to the eighteenth contact thereof.

The reason that the eighteenth contact is chosen instead of the twenty-first contact is because of the normal delay in the operation of the control circuit pneumatic and hydraulic circuit and mechanical elements. By the time the cutover has taken place, the desired amount of the strand 11 has been taken up on the then active take-up reel 16 or 17. The relay 153 is energized at this time so that the normally open contact 156 is closed to energize the coil of relay 158 in the event that the brush on bank 193 of relay 158 has not already stepped to an even numbered contact. Even though the relay 172 was energized, no action occurred when the time-to-close contact 169 thereof was closed in the circuit containing the relays 171 and 175 since, at this time, the contact 246 of the relay 207 is open.

When the brushes of bank 192 of the relay 189 reach the eighteenth contact thereof, the coil of the relay 207 is energized and will be held energized by closure of the normally open contact 217 thereof. Simultaneously, the solenoid 256 will be energized through the normally closed, time-to-open contact 254 so that the guide roller 56 is dropped and the strand 11 extending thereover becomes disengaged and drops into the snaggers of both snagger wheels 27 and 28, simultaneously. The normally open contact 246 of the relay 207 will close to energize the coils of the relay 171 and also the normally open contact 248 and normally closed time-to-open contact 247 of the relay 207 will operate to send the distributing guide 34 to the inside edge of the reel 16.

As the strand 11 advances continuously, the distributing guide 34 is reciprocated to distribute the convolutions of the strand 11 in uniform layers upon the winding drum 18 or winding surface of the right take-up reel 16. At this time, since the relay 171 is energized and a contact 280 thereof is closed, the reciprocation of the piston rod 37 of the cylinder 38 is controlled by the ball 47 operating the limit switches 51 and 52 alternately, which, in turn, cause the relays 89 and 88, respectively, to be energized in a manner described above with respect to the closure of switches 49 and 50.

The normally open contact 174 of the relay 171 will close causing the solenoid 103 of the valve 101 to be energized which will cause the cylinder 53 to move the guide roller 56 to the right reel 16. Simultaneously, the relay 125 will be energized to open the contact 121 in the circuit of the left-reel drive unit 22 to deenergize the left-reel drive unit 22 and cause the left reel 17 to coast to a stop. The closure of the contact 174 causes a relay 281 to be energized to open a normally closed, time-to-open contact 282 to cause the coil of the relay 125 to be deenergized and close the contact 121 in the circuit of the left-reel drive unit 22 allowing the left-reel drive unit 22 to be energized.

When a cutover from one reel 16 or 17 to the other is initiated by the closure of the switch 276 or by the counter 65, by the closure and subsequent opening of contact 196, the relay 189 is energized and is then deenergized so that the brushes of the relay 189 are stepped from the twenty-second position thereof to the first position thereof starting the stepping cycle of the relay 189. Simultaneously, the relay 231 is energized and then deenergized to move from position twenty-two to position one thereof, remaining there due to the fact that the contact 237 of the relay 238 is open. Since the contacts one through twenty-one of bank 232 of the relay 231 form a solid conductive bar, when the distributing guide 34 and guide roller 56 reach the inside flange 19 of the left or right reel 17 or 16, the limit switch 50 or 51 is closed to energize the relay 244 or 243 and the contact 242 or 241 of the relay 244 or 243 is closed, closing the circuit to the relay 238 which, in turn, closes the contact 237 thereof, holding the coil of the relay 238 energized until the brushes of the bank 232

of the relay 231 step to the twenty-second position thereof.

When the relay 238 was energized, the normally open contact 237 thereof was closed. Therefore, each time the normally closed contact 236 of the relay 203 is closed and opened, the relay 231 will advance one position. The brushes on both bank 233 of the relay 231 and bank 193 of the relay 189 are advanced to the left, as viewed in FIG. 9. Accordingly, when the brushes of banks 193 and 233 of relays 189 and 231, respectively, arrived on common contacts connected together, a circuit may be completed therethrough through the contact 249 of relay 175 through the contact 251 of the relay 244 and through the contact 252 of the relay 253 to the solenoid 89. Alternatively, a circuit may be completed through the contact 279 of the relay 171, through the contact 261 of the relay 243 and through the contact 265 to the solenoid 88. The energization of the relay 88 or 89 causes the distributing guide 34 and guide roller 56 to be directed towards the inside flange 19 of the right reel 16 or left reel 17 onto which the strand 11 is being taken up. When the brushes of the relay 189 reach the twenty-second position thereof, the distributor will be at the inside edge of the reel.

By setting the counter 65 to close the switch 196 when the desired number of feet of the strand remains to be taken up on the active take-up reel 16 or 17 and selecting the proper contact on bank 192 of the relay 189, the exact position which the distributing guide 34 and guide roller 56 occupy on the respective opposite reels at the time of cutover can be chosen. If the time required for the relay 189 to complete its cycle is made equivalent to the time needed to distribute two layers of convolutions of the strand 11 on the reel 16 or 17, any positions from the inside edge of the take-up reel to the center of the take-up reel can be chosen for the distributing guide 34 and guide roller 56 to occupy at the time of cutover. If it were desirable to have the distributing guide 34 and guide roller 56 positioned between the center of the reel to the outside edge of the reel at the time of cutover, the position of contacts 249 and 279 should be interchanged to cause the distributor to move initially toward the outside flange 19 of the reel instead of toward the inside flange 19 of the reel when a cutover from one take-up reel to the other is initiated.

It should be understood that both the distributing guide 34 and the guide roller 56 could be tilted downwardly to lower the strand 11 extending therebetween into the paths of travel of the snaggers of both snagger wheels 27 and 28 at the same time. Further, the guide roller 56 and strand-distributing guide 34 could be maintained in the same orientation and a hook or pusher, mounted on reciprocating or articulating linkages (not shown), could be used respectively to pull or push the strand off the guide roller 56. The guide roller 56 could also be mounted on an articulated linkage (not shown) so that the roller 56 is not only moved downwardly but so that the support for the roller is backed away from the strand 11. The guide roller 56 could be mounted on a vertically reciprocable and/or horizontally reciprocable support (not shown). Further, to facilitate distribution of the strand 11 by the guide roller 56, the guide roller 56 could be driven rotatably by a belt or by a small motor (not shown) mounted on the arm 55.

It is to be understood that the above-described arrangements are simply illustrative of the application of the principles of the invention. Other arrangements may be devised by those skilled in the art which will embody the principles of the invention and fall within the spirit and scope thereof.

What is claimed is:

1. In strand-reeling apparatus for taking up an advancing strand including a pair of rotatably driven take-up reels, strand-distributing means mounted for movement transversely of the winding surface of the take-up reels, means for indexing said strand-distributing means from a partially filled take-up reel to an adjacent empty take-up reel, and revolving snagging means connected operatively to each of said reels for gripping portions of the strand adjacent to each reel when the strand is transferred from one reel to another, the improvement which comprises movable guide means positioned adjacent to said snagging means and arranged to extend outwardly beyond substantially circular paths defined by the movement of the snagging means and across the direct transverse path of travel taken by a span of the strand extending from the distributing means to the partially filled take-up reel as the distributing means is indexed to an adjacent reel, said guide means being designed to hold said span outwardly from the snagging means as the strand-distributing means is so indexed to cause a desired delay of the gripping of the strand by said snagging means, means for moving said guide means transversely of the partially filled reel during said delay to distribute an additional predetermined amount of the strand on the partially filled reel, and means for causing the span of the strand extending from the distributing means to the reel onto which the strand is being wound to become disengaged from the guide and move into the paths of the snagging means as soon as the additional predetermined amount of the strand has been wound on the last-mentioned reel to effect a cutover from the take-up reel onto which the strand has been wound to the empty take-up reel.

2. An automatic, slow action, cutover device for a continuous strand take-up apparatus, which comprises a pair of rotatably driven take-up reels for taking up an advancing strand, revolving snagging means connected operatively to adjacent ends of said reels for gripping portions of the advancing strand adjacent to each reel when distribution of the strand is transferred from one of the reels to the other reel, strand-distributing means for guiding the strand on successive take-up reels, means for indexing the strand-distributing means from a position adjacent to one of the take-up reels on which substantially the desired amount of strand has been taken up to a position adjacent to an empty one of the take-up reels onto which it is desired to subsequently take up the strand, movable guide means mounted between the strand-distributing means and the snagging means and extending outwardly beyond substantially circular paths defined by the movement of the snagging means to hold the span of the strand extending between the strand-distributing means and a partially filled take-up reel away from the snagging means to delay the gripping of the strand by the snagging means during the indexing of the strand-distributing means, the indexing movement of the strand-distributing means causing the span of the strand to contact the guide means and be supported thereby, means for reciprocating the guide means during the delay to distribute an additional predetermined amount of the strand on the partially filled reel while the span of the strand is being held out of the path of the snagging means by the guide means, means for moving the guide means away from the span of the strand as soon as the additional predetermined amount of the strand has been wound on the last-mentioned reel to drop the span of the strand into the snagging means and effect a cutover from the reel onto which the strand has been wound to an empty take-up reel, and means for indexing the guide means to the empty reel position in preparation for another cutover operation from the last-mentioned reel to a subsequent empty take-up reel.

3. An automatic, slow-action, cutover device for a continuous strand take-up apparatus, which comprises a pair of rotatably driven take-up reels for taking up an advancing strand, revolving snagging means connected operatively to adjacent ends of said reels for gripping portions of the advancing strand adjacent to each reel when distribution of the strand is transferred from one of the reels to the other reel, a strand-distributing guide for guiding the strand on successive take-up reels, means for

indexing the strand-distributing guide from a position adjacent to one of the take-up reels on which substantially the desired amount of strand has been taken up to a position adjacent to an empty one of the take-up reels onto which it is desired to subsequently take up the strand, a movable guide roller mounted between the strand-distributing guide and the snagging means and extending outwardly beyond substantially circular paths defined by the movement of the snagging means to hold the span of the strand extending between the strand-distributing guide and a partially filled take-up reel away from the snagging means to delay the gripping of the strand by the snagging means during the indexing of the strand-distributing guide, the indexing movement of the strand-distributing guide causing the span of the strand to contact the guide roller and be supported thereby, means for reciprocating the guide roller during the delay to distribute an additional predetermined amount of the strand on the partially filled reel while the span of the strand is being held out of the path of the snagging means by the guide roller, means for movinng the guide roller away from the span of the strand as soon as the additional predetermined amount of the strand has been wound on the last-mentioned reel to drop the span of the strand into the snagging means and effect a cutover from the reel onto which the strand has been wound to an empty take-up reel, and means for indexing the guide roller to the empty reel position in preparation for another cutover operation from that reel to a subsequent empty take-up reel.

4. An automatic, slow action, cutover device for a continuous strand take-up apparatus, which comprises a pair of rotatably driven take-up reels for taking up an advancing strand, revolving snagging means connected operatively to adjacent ends of said reels for gripping portions of the advancing strand adjacent to each reel when distribution of the strand is transferred from one of the reels to the other reel, a strand-distributing guide for guiding the strand on successive take-up reels, means for indicating the length of the strand being taken up on the take-up reel, means responsive to the indicating means for indexing the strand-distributing guide from a position adjacent to one of the take-up reels on which substantially the desired amount of strand has been taken up to a position adjacent to an empty one of the take-up reels onto which it is desired to subsequently take up the strand, a movable guide roller mounted between the strand-distributing guide and the snagging means and extending outwardly beyond substantially circular paths defined by the movement of the snagging means to hold the span of the strand extending between the strand-distributing guide and the partially filled take-up reel away from the snagging means to delay the gripping of the strand by the snagging means during the indexing of the strand-distributing guide, the indexing movement of the strand-distributing guide causing the span of the strand to contact the guide roller and be supported thereby, means for reciprocating the guide roller during the delay to distribute an additional predetermined amount of the strand on the partially filled reel while the span of the strand is being held out of the path of the snagging means by the guide roller, means responsive to said indicating means for moving the guide roller away from the span of the strand as soon as the additional predetermined amount of the strand has been wound on the last-mentioned reel to drop the span of the strand into the snagging means and effect a cutover from the reel onto which strand has been wound to an empty take-up reel, and means responsive to said indicating means for indexing the guide roller to the empty reel position in preparation for another cutover operation from that reel to a subsequent empty take-up reel.

5. An automatic, slow action, cutover device for a continuous strand take-up apparatus, which comprises a pair of rotatably driven take-up reels for taking up an advancing strand, revolving snagging means connected operatively to adjacent ends of said reels for gripping portions of the advancing strand adjacent to each reel when distribution of the strand is transferred from one of the reels to the other reel, a strand-distributing guide for guiding the strand on successive take-up reels, means for indexing the strand-distributing guide from a position adjacent to one of the take-up reels on which substantially the desired amount of strand has been taken up to a position adjacent to an empty one of the take-up reels onto which it is desired to subsequently take up the strand, a movable guide roller mounted between the strand-distributing guide and the snagging means and extending outwardly beyond substantially circular paths defined by the movement of the snagging means to hold the span of strand extending between the strand-distributing guide and the partially filled take-up reel away from the snagging means to delay the gripping of the strand by the snagging means during the indexing of the strand-distributing guide, the indexing movement of the strand-distributing guide causing the span of the strand to contact the guide roller and be supported thereby, means for reciprocating the guide roller during the delay to distribute an additional predetermined amount of the strand on the partially filled reel while the span of the strand is being held out of the path of the snagging means by the guide roller, means for moving the guide roller away from the span of the strand as soon as the additional predetermined amount of the strand has been wound on the last-mentioned reel to drop the span of the strand into the snagging means and effect a cutover from the reel onto which the strand has been wound to an empty take-up reel, and means for indexing the guide roller to the empty reel position in preparation for another cutover operation, said means for reciprocating the guide roller causing the guide roller and said strand distributing guide to move transversely of the winding surface of the empty take-up reel in unison during the remaining period of time that the distributing guide distributes the strand on the empty reel.

6. In a strand-reeling apparatus for taking up an advancing strand including a pair of rotatably driven take-up reels mounted side by side about a common rotational axis, strand-distributing means mounted for movement transversely of the winding surfaces of the take-up reels, fluid-operated means for indexing said strand-distributing means from a partially filled take-up reel to an adjacent empty take-up reel, and revolving snagging means connected operatively to each of said reels for gripping portions of the strand adjacent to each reel when the strand is transferred from one of the reels to the other, the improvement which comprises a movable guide roller mounted pivotally adjacent to said snagging means, said guide roller having a portion extending outwardly beyond substantially circular paths defined by the revolving movement of the snagging means and positioned in the direct transverse path of travel of the span of the strand extending from the distributing means to the partially filled take-up reel as the distributing means is indexed to an adjacent reel, said guide means being designed to hold said span outwardly from the snagging means as the strand-distributing means is indexed from the partially filled reel to the empty reel so as to delay the gripping of the strand by said snagging means, fluid operated means connected operatively to said first-mentioned fluid operated means for moving said guide roller transversely of the partially filled reel during the delay to distribute an additional predetermined amount of strand on the partially filled reel, and fluid operated means for causing the guide roller to pivot downwardly to cause the span of the strand extending from the distributing means to the reel onto which the strand is being wound to become disengaged from the guide roller and move into the paths of the snagging means as soon as the additional predeter-

mined amount of strand has been wound on the last-mentioned reel to effect a cutover from the take-up reel onto which the strand has been wound to the empty take-up reel.

7. An automatic, slow action, cutover device for a continuous strand take-up apparatus, which comprises a pair of rotatably driven take-up reels mounted side by side on a common rotational axis, revolving snagging means connected operatively to adjacent sides of said reels for gripping portions of the advancing strand adjacent to each reel when distribution of the strand is transferred from one of the reels to the other reel, means for indicating the length of the strand being taken up on the take-up reels, a strand-distributing guide for guiding the strand on successive take-up reels, means responsive to said indicating means for indexing the strand-distributing guide from a position adjacent to one of the take-up reels on which substantially the desired amount of strand has been taken up to a position adjacent to an empty one of the take-up reels onto which it is desired subsequently to take up the strand, a fluid cylinder mounted substantially transversely of the rotational axis of the take-up reels, a movable guide roller secured pivotably to the piston rod of the cylinder, a bearing mounted in the end of the cylinder and having a tapered opening therein, the pivotable connection between said roller and the rod of said cylinder being movable through the tapered opening of said bearing and positioned normally in the cylinder for normally preventing the roller from pivoting with respect to the piston rod to which it is connected pivotably, said roller being positioned between the strand-distributing guide and the snagging means and extending outwardly beyond substantially circular paths defined by the rotational movement of the snagging means to hold the span of the strand extending between the strand-distributing guide and the partially filled take-up reel away from the snagging means to delay the gripping of the strand by the snagging means during the indexing of the strand-distributing guide, the indexing movement of the strand-distributing guide causing the span of the strand to contact the guide roller and be supported thereby, means for reciprocating the guide roller during the delay transversely of the winding surface of the partially filled reel to distribute an additional predetermined amount of the strand on the partially filled reel while the span of the strand is being held out of the path of the snagging means by the guide roller, means responsive to said indicating means to direct fluid to the cylinder for moving the pivotable connection between the guide roller and the associated piston rod out of the associated cylinder to permit the guide roller to pivot and move away from the span of the strand as soon as the additional predetermined amount of the strand has been wound on the last-mentioned reel to drop the span of the strand into the snagging means and effect a cutover from the reel onto which the strand has been wound to an empty take-up reel, and means for urging the piston rod into the cylinder and causing the pivotable connection to slide through the tapered opening of the bearing to move the guide roller upwardly to its normal position.

8. An automatic, slow action, cutover device for a continuous strand take-up apparatus, which comprises a pair of rotatably driven take-up reels mounted side by side on a common rotational axis, revolving snagging means connected operatively to adjacent sides of said reels for gripping portions of the advancing strand adjacent to each reel when distribution of the strand is transferred from one of the reels to the other reel, means for indicating the length of the strand being taken up on the take-up reels, a stationary frame, a first fluid cylinder mounted on said frame with the longitudinal axis of the cylinder being parallel to the axis of rotation of the reels, a second fluid cylinder mounted parallel to the first cylinder and having the cylinder secured fixedly to the piston rod of the first cylinder, a strand-distributing guide for guiding the strand on successive take-up reels, said guide being secured to the piston rod of the second cylinder, means responsive to said indicating means for directing fluid to the second cylinder for indexing the strand-distributing guide secured to the piston rod of the second cylinder from a position adjacent to one of the take-up reels on which substantially the desired amount of the strand has been taken up to a position adjacent to an empty one of the take-up reels onto which it is desired subsequently to take up the strand, a third fluid cylinder mounted parallel to the first and second cylinders and secured fixedly to the piston rod of said first cylinder and to the second cylinder, a fourth fluid cylinder mounted substantially transversely of said first, second and third cylinders and secured to the piston rod of the third-mentioned cylinder, a movable guide roller secured pivotably to the piston rod of the fourth cylinder, a bearing mounted in the end of the fourth cylinder and having a tapered passage therein, the pivotable connection between said roller and the rod of said fourth cylinder being movable into the tapered passage of said bearing and positioned normally in said fourth cylinder for normally preventing the roller from pivoting with respect to the piston rod to which it is connected pivotably, said roller being positioned between the strand-distributing guide and the snagging means and extending outwardly beyond substantially circular paths defined by the rotational movement of the snagging means to hold the span of the strand extending between the strand-distributing guide and the partially filled take-up reel away from the snagging means to delay the gripping of the strand by the snagging means during the indexing of the strand-distributing guide, the indexing movement of the strand-distributing guide by said second cylinder causing the span of the strand to contact the guide roller and be supported thereby, said first cylinder reciprocating the guide roller during the delay transversely of the winding surface of the partially filled reel to distribute an additional predetermined amount of the strand on the partially filled reel while the span of the strand is being held out of the path of the snagging means by the guide roller, means responsive to said indicating means to direct fluid to the fourth cylinder for moving the pivotable connection between the guide roller and associated piston rod out of the associated cylinder to permit the guide roller to pivot and move away from the span of the strand as soon as the additional predetermined amount of the strand has been wound on the last-mentioned reel to drop the span of the strand into the snagging means and effect a cutover from the reel onto which the strand has been wound to an empty take-up reel, and means for urging the piston rod of the fourth cylinder into the cylinder and causing the pivotable connection to slide through the tapered passage of the bearing to move the guide roller upwardly to its normal position.

9. An automatic, slow action, cutover device for a continuous strand take-up apparatus, which comprises a pair of rotatably driven take-up reels mounted side by side on a common rotational axis, revolving snagging means connected operatively to adjacent sides of said reels for gripping portions of the advancing strand adjacent to each reel when distribution of the strand is transferred from one of the reels to the other reel, means for indicating the length of the strand being taken up on the take-up reels, a stationary frame, a first fluid cylinder mounted on said frame with the longitudinal axis of the cylinder parallel to the axis of rotation of the reels, a second fluid cylinder mounted parallel to the first cylinder and secured fixedly to the piston rod of the first cylinder, a strand-distributing guide for guiding the strand on successive take-up reels, said guide being secured to the piston rod of the second cylinder, means responsive to said indicating means for directing fluid to the second cylinder for indexing the strand-distributing guide secured to the piston rod of the second cylinder from a position adjacent to one of the take-up reels on which substantially the

desired amount of the strand has been taken up to a position adjacent to an empty one of the take-up reels onto which it is desired subsequently to take up the strand, a third fluid cylinder mounted parallel to the first and second cylinders and secured fixedly to the piston rod of said first cylinder and the second cylinder, a fourth fluid cylinder mounted substantially transversely of said first, second and third cylinders and secured to the piston rod of the third-mentioned cylinder, a movable guide roller secured pivotably to the piston rod of the fourth cylinder, a bell-mouth bearing mounted in the end of the cylinder of said fourth cylinder, the pivotable connection between said roller and the rod of said fourth cylinder being movable into said bearing and positioned normally in said fourth cylinder for normally preventing the roller from pivoting with respect to the piston rod to which it is connected pivotably, said roller being positioned between the strand-distributing guide and the snagging means and extending outwardly beyond substantially circular paths defined by the rotational movement of the snagging means to hold the span of the strand extending between the strand-distributing guide and the partially filled take-up reel away from the snagging means to delay the gripping of the strand by the snagging means during the indexing of the strand-distributing guide, the indexing movement of the strand-distributing guide by said second cylinder causing the span of the strand to contact the guide roller and be supported thereby, said first cylinder reciprocating the guide roller during the delay transversely of the winding surface of the partially filled reel to distribute an additional predetermined amount of the strand on the partially filled reel while the span of the strand is being held out of the path of the snagging means by the guide roller, means responsive to said indicating means to direct fluid to the fourth cylinder for moving the pivotable connection between the guide roller and the associated piston rod out of the associated cylinder to permit the guide roller to pivot and move away from the span of the strand as soon as the additional predetermined amount of the strand has been wound on the last-mentioned reel to drop the span of the strand into the snagging means and effect a cutover from the reel onto which the strand has been wound to an empty take-up reel, resilient means for urging the piston rod of the fourth cylinder into the cylinder and causing the pivotable connection to slide into the bell-mouth bearing to move the guide roller upwardly to its normal position, and means responsive to said indicating means for directing fluid to said third cylinder for indexing the guide roller to the empty reel position in preparation for another cutover operation from that reel to a subsequent empty take-up reel.

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UNITED STATES PATENT OFFICE

CERTIFICATE OF CORRECTION

Patent No. 3,080,128 March 5, 1963

Charles E. Hauer

It is hereby certified that error appears in the above numbered patent requiring correction and that the said Letters Patent should read as corrected below.

Column 4, line 24, for "8" read -- 58 --; line 37, for "FIGS. 5 and 8" read -- FIGS. 1, 4 and 7 --; column 6, line 41, for "butons" read -- buttons --; line 74, for "wil" read -- will --; column 7, line 71, for "delay" read -- relay --; column 11, line 33, for "stand" read -- strand --; column 15, lines 21 and 22, for "movinng" read -- moving --.

Signed and sealed this 12th day of November 1963.

(SEAL)
Attest:

ERNEST W. SWIDER

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Acting Commissioner of Patents