

Sept. 20, 1955

R. P. PIPEROUX ET AL

2,718,362

WEB-WINDING MACHINE

Filed Aug. 17, 1950

7 Sheets-Sheet 1

FIG. 1.

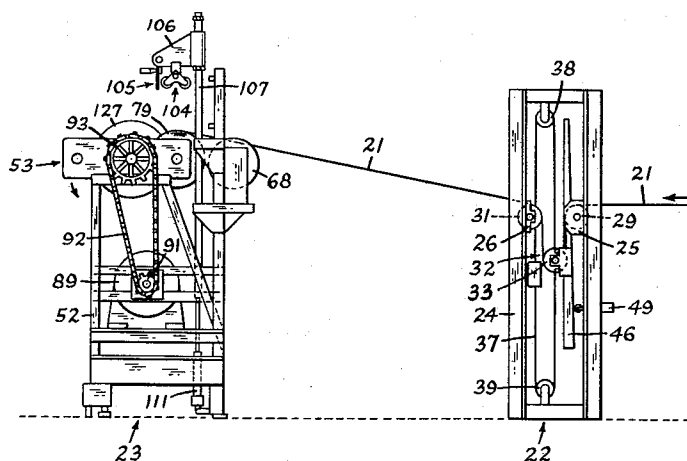
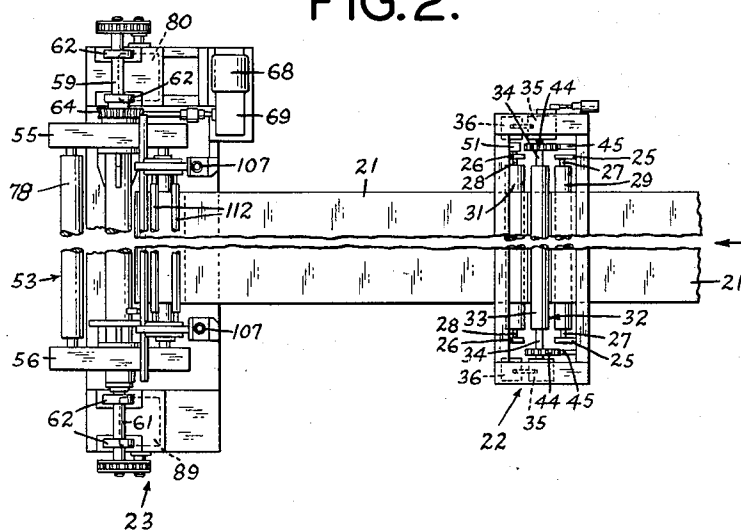


FIG. 2.



INVENTORS.
RENE P. PIPEROUX
JOHN N. BIRMINGHAM

BY *J. M. Lewis*
ATTORNEYS.

Sept. 20, 1955

R. P. PIPEROUX ET AL

2,718,362

WEB-WINDING MACHINE

Filed Aug. 17, 1950

7 Sheets-Sheet 3

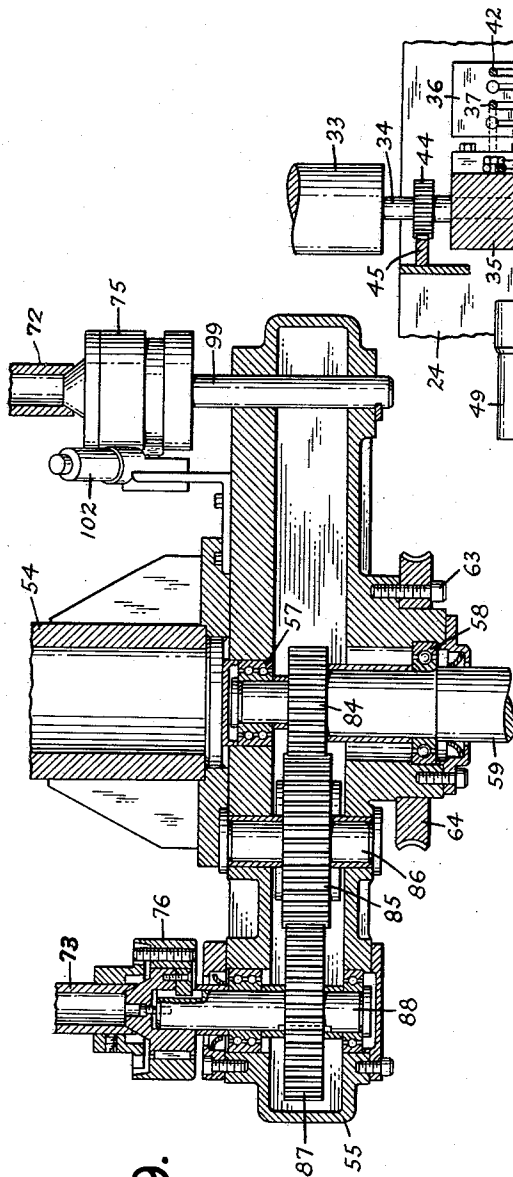


FIG. 9.

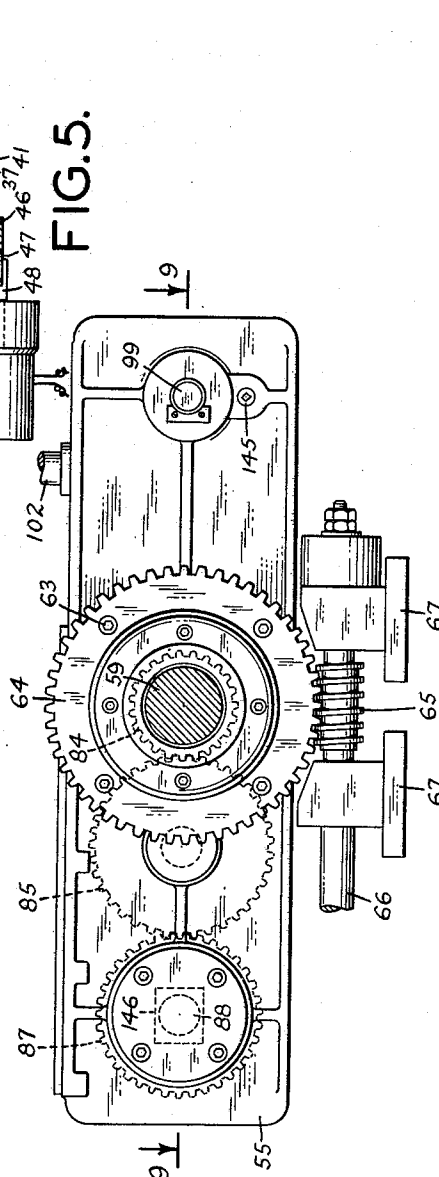


FIG. 8.

INVENTORS.
RENE P. PIPEROUX
JOHN N. BIRMINGHAM

BY *P. Seligman & Co.*
ATTORNEYS.

Sept. 20, 1955

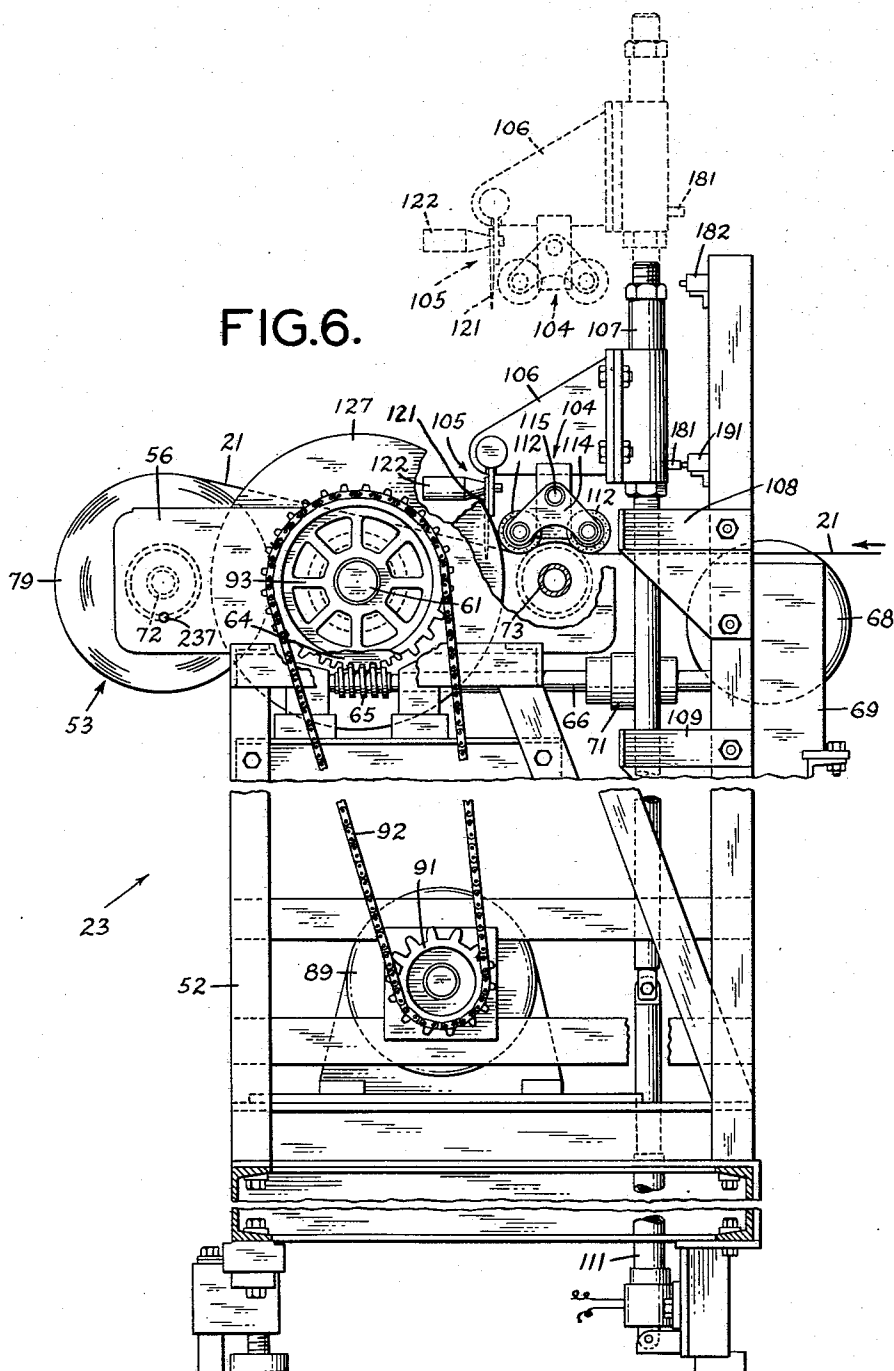
R. P. PIPEROUX ET AL

2,718,362

WEB-WINDING MACHINE

Filed Aug. 17, 1950

7 Sheets-Sheet 4



INVENTORS.
RENE P. PIPEROUX
JOHN N. BIRMINGHAM

BY
J. Helgeson & C. L. Swanson
ATTORNEYS.

Sept. 20, 1955

R. P. PIPEROUX ET AL
WEB-WINDING MACHINE

2,718,362

Filed Aug. 17, 1950

7 Sheets-Sheet 6

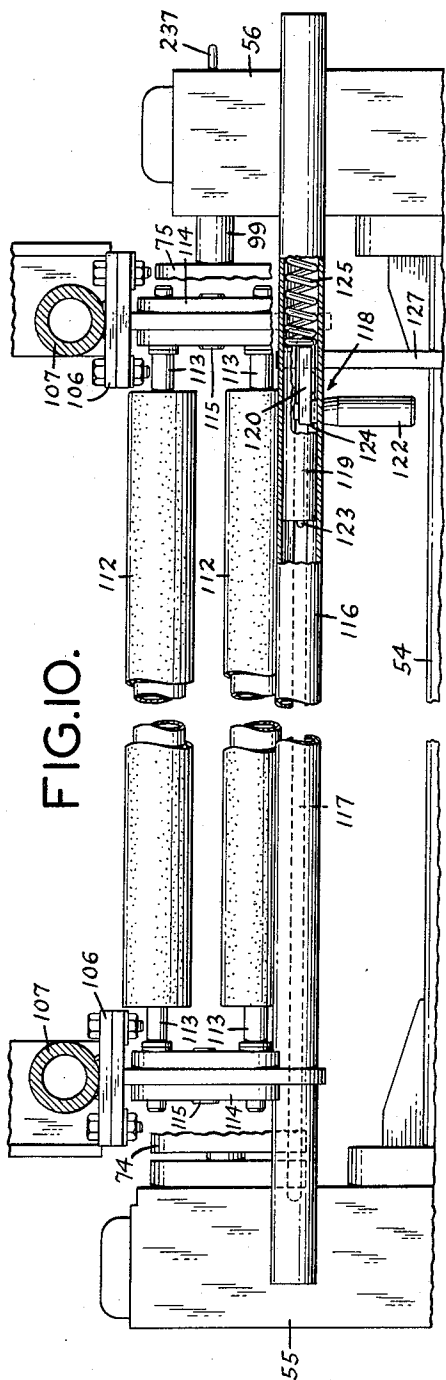


FIG. 10.

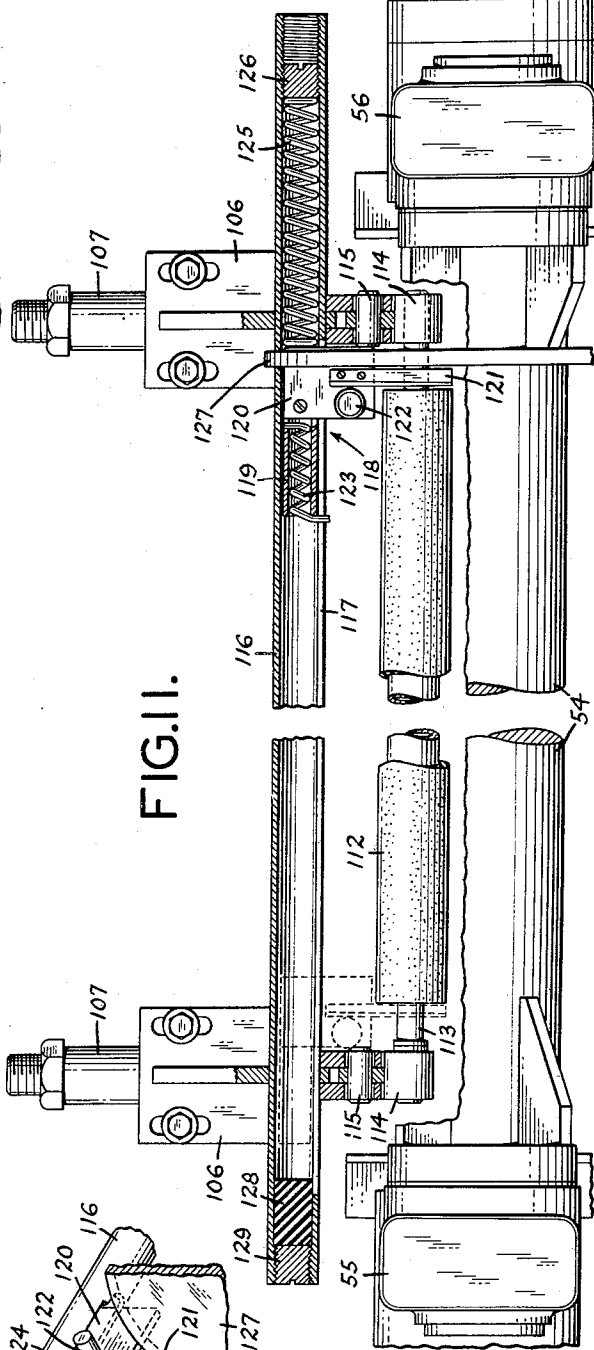
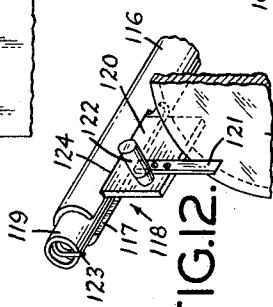


FIG. 11.



Sept. 20, 1955

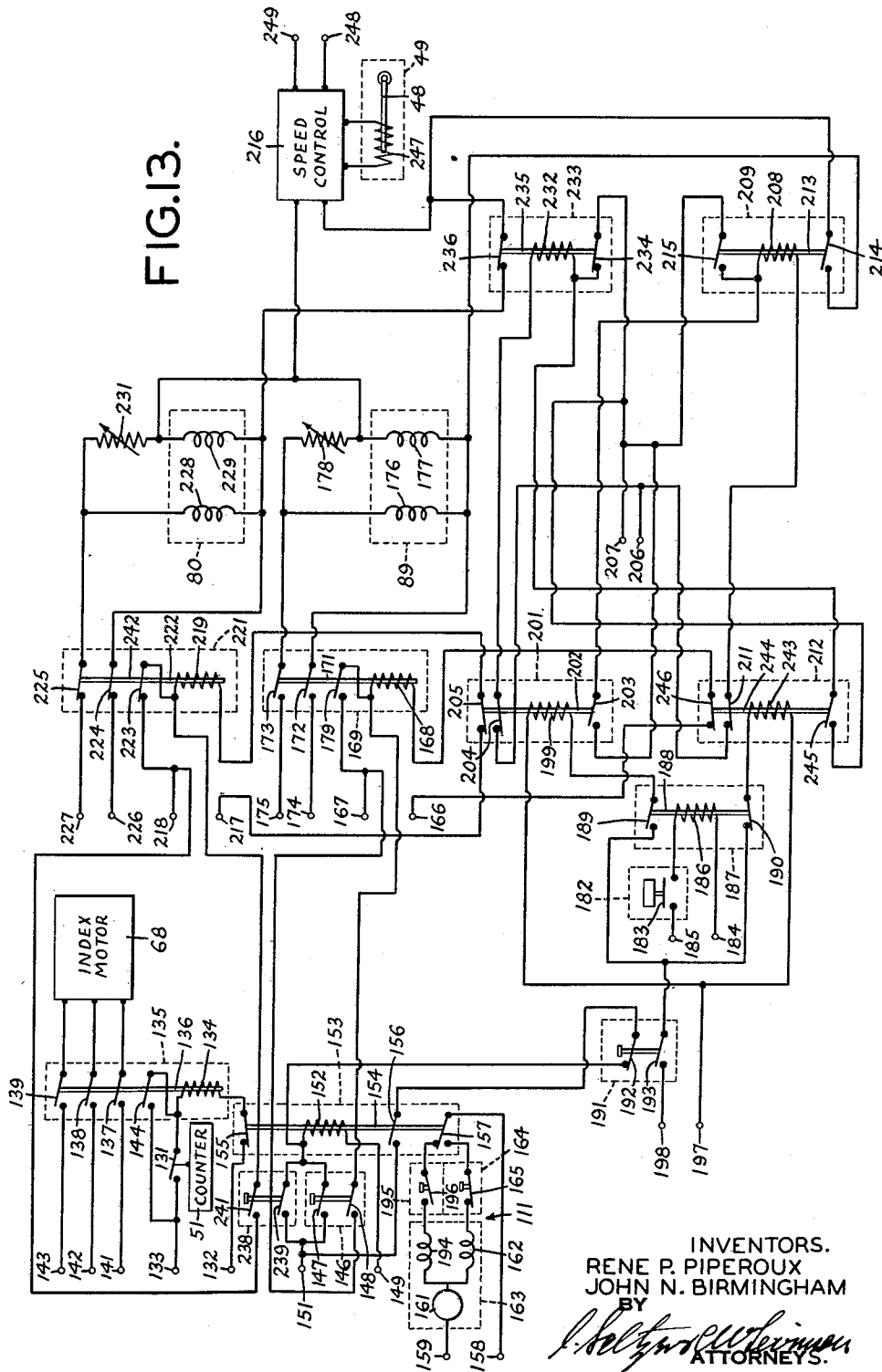
R. P. PIPEROUX ET AL

2,718,362

WEB-WINDING MACHINE

Filed Aug. 17, 1950

7 Sheets-Sheet 7



1

2,718,362

WEB-WINDING MACHINE

Rene P. Piperoux, Radburn, and John N. Birmingham, Nutley, N. J., assignors to Celanese Corporation of America, New York, N. Y., a corporation of Delaware

Application August 17, 1950, Serial No. 180,018

20 Claims. (Cl. 242—56)

This invention relates to web-winding or spooling machines for winding a web of indeterminate length into rolls of commercial size.

When film, foil and the like are produced from thermoplastic materials, such as cellulose acetate or other organic derivative of cellulose, in the form of a web of indeterminate length, it is common to wind said web into rolls directly as it leaves the web-producing apparatus to assist in handling, storing and shipping the same. In the web-winding or spooling machine, hereinafter referred to as a spooling machine, wherein the winding of the web into rolls takes place, it is desirable to maintain a uniform tension on the web to avoid the production of rolls containing soft spots, hard spots or other defects therein, and to avoid imposing excessive tensions on the web which would impair the physical properties of or distort the same. Since the web is produced at a constant linear speed and is wound into a roll of constantly increasing radius, the maintenance of a uniform tension on the web requires that the angular speed of the roll be reduced in inverse proportion to its increase in radius. After a full roll has been wound, the web must be severed and the winding of said web into a new roll must begin. Advantageously, the spooling machine should perform these operations automatically on a web moving at high speeds, without permitting the tension on said web to vary appreciably and without wastage of the material of the web.

It is an important object of this invention to provide a spooling machine for winding a web of indeterminate length into rolls which will fulfill the foregoing requirements and which will be especially simple in construction and efficient in operation.

A further object of this invention is to provide a spooling machine for winding a web of indeterminate length into rolls which will maintain a uniform tension on the web during the winding operation.

Another object of this invention is to provide a spooling machine for winding a web of indeterminate length into rolls which will automatically sever the web and start the winding of a new roll after a full roll has been wound.

Other objects of this invention, together with certain details of construction and combinations of parts, will be apparent from the following detailed description and claims.

According to the present invention, there is provided a spooling machine for winding a web of indeterminate length into rolls of commercial size, comprising a tension control assembly and a take-up assembly. In the tension control assembly, the web is formed into a loop in which is suspended a dangle roll assembly which is free to move as the size of loop is increased or decreased. The position of the dangle roll assembly controls the speed of the motor driving the roll into which the web is being wound in such fashion that the peripheral speed of said roll will remain substantially constant and equal to the linear speed of the web. Under these conditions, the tension in the web will, at all times, remain substantially uniform

2

and will equal one half of that portion of the weight of the dangle roll assembly which is supported by the loop.

After passing through the tension control assembly, the web enters the take-up assembly to be wound into a roll. The take-up assembly comprises a rotatably mounted index frame having means for engaging at least two mandrels, each of which is adapted to support a core onto which the web is wound to form a roll and each of which is provided with means, such as an electric motor, for driving the same at the desired speed. There are also provided means for severing the web and for pressing the web against an empty core supported on one of said mandrels to start the winding of a new roll, after a roll on a core supported on another of said mandrels has been wound to the desired extent.

To operate the spooling machine of this invention, the winding of the web onto a core positioned on one of the mandrels is started and the motor driving said mandrel is connected to the tension control assembly, which is designed to control the speed of said motor so as to maintain the peripheral speed of said roll substantially equal to the linear speed of the web. An empty core is positioned on another mandrel and is coated over at least a portion of its periphery with an adhesive material. After a predetermined footage of the web, as determined by any suitable means such as a counter or the like, is wound into a roll, the index frame is rotated to bring the mandrel carrying the empty core adjacent to the web and the motor driving this mandrel is started. The base speed of the motor is adjusted so that the peripheral speed of the empty core is somewhat less than the linear speed of the web. Then, the web is severed and simultaneously the web is pressed into contact with the rotating empty core to which it adheres to begin the winding of a new roll. At the same time, the motor driving the mandrel carrying the full roll is stopped and the tension control disconnected from said motor and connected to the motor driving the mandrel carrying the new roll. The full roll is now removed from its mandrel and an empty core is placed thereon and coated over at least a portion of its periphery with an adhesive material so that it will be ready for the winding of another roll thereon.

A preferred embodiment of this invention is shown in the accompanying drawings wherein

Fig. 1 is a side elevational view of the spooling machine of this invention,

Fig. 2 is a top plan view thereof,

Fig. 3 is a side elevational view of the tension control assembly,

Fig. 4 is a front elevational view of the tension control assembly with certain parts broken away,

Fig. 5 is a cross-sectional view taken on the line 5—5 in Fig. 3 in the direction of the arrows,

Fig. 6 is a side elevational view of the take-up assembly,

Fig. 7 is a top plan view of the take-up assembly,

Fig. 8 is a side elevational view of the mandrel drive, taken on the line 8—8 in Fig. 7 in the direction of the arrows,

Fig. 9 is a cross-sectional view of the mandrel drive taken on the line 9—9 in Fig. 8 in the direction of the arrows,

Fig. 10 is a top plan view of the squeeze roll assembly and cutting mechanism, partly in section,

Fig. 11 is a front elevational view of the squeeze roll assembly and cutting mechanism, partly in section,

Fig. 12 is a detail view, in perspective, of the tripping device for the cutting mechanism, and

Fig. 13 is a circuit diagram of the spooling machine control.

Referring now to the drawings, the reference numeral 21 designates a web that is drawn from a film-produc-

ing apparatus (not shown) and, after passing through a tension control assembly indicated generally by reference numeral 22, is entered into a take-up assembly, indicated generally by reference numeral 23. The tension control assembly 22 comprises a supporting framework 24 to which are fastened bearing blocks 25 and 26 in which stub shafts 27 and 28 carrying rollers 29 and 31 are journaled for free rotation. Positioned between the rollers 29 and 31 is a dangle roll assembly, indicated generally by reference numeral 32, which comprises a dangle roller 33 rotatably mounted on a shaft 34 journaled for free rotation in bearing blocks 35. The dangle roll assembly 32 is free to move vertically and is counter-balanced by means of weights 36 that are carried by cables 37, which cables 37 are trained around pulleys 38 and 39 and are fastened to the bearing blocks 35 at each end of the dangle roller 33 by means of bolts 41. The weights 36 are freely slidable on and are guided vertically by means of cables 42 that extend therethrough, and are fastened at their ends to clamps 43 mounted on the framework 24. Pinions 44 fixedly mounted on the shaft 34 mesh with racks 45 fastened to the framework 24 to hold the dangle roller 33 in horizontal position as the dangle roll assembly 32 moves vertically. One of the bearing blocks 35 has fastened thereto an elongated bar cam 46 against the cam surface 47 of which bears plunger 48 of a variable reactor 49 whose function will be set forth more fully hereinafter. The web 21 going through the tension control assembly 22 passes over the roller 29, under the dangle roller 33 and over the roller 31, and its footage is measured by means of a suitable counter 51 fastened to the stub shaft 28 of the roller 31.

After passing through the tension control assembly 22, the web 21 is entered into the take-up assembly 23 which comprises a supporting framework 52 on which is carried an index frame, indicated generally by reference numeral 53. The index frame 53 comprises a tubular arbor 54 to the opposite ends of which are fastened, as by welding or the like, spiders 55 and 56, which are rotatably mounted by means of ball bearings 57 and 58 on shafts 59 and 61 journaled in pillow blocks 62 carried by the framework 52. Fastened to the spider 55 by means of bolts 63 is a worm wheel 64 that meshes with a worm 65 mounted on a shaft 66 journaled in bearing blocks 67. The shaft 66 is driven from an index motor 68, through a gear reducer 69 and a coupling 71, to rotate the index frame 53 as will be set forth more fully hereinafter.

Supported on the index frame 53 to either side of the arbor 54 are a pair of mandrels 72 and 73, the mandrel 72 being engaged between a driven center 74 on the spider 55 and a free wheeling center 75 on the spider 56, and the mandrel 73 being similarly engaged between a driven center 76 on the spider 56 and a free wheeling center 77 on the spider 55. Each of the mandrels 72 and 73 is adapted to support a tubular core 78 upon which the web 21 may be wound to form a roll 79. The mandrel 72 is driven by means of a motor 80 through a sprocket wheel 81, a chain 82, a sprocket wheel 83 fastened to the shaft 59, and a gear train positioned in the spider 55 and comprising a gear 84 fastened to the shaft 59, an idler gear 85 mounted on a stub shaft 86 journaled in the spider 55, and a gear 87 fastened to a shaft 88 to which the driven center 74 is secured. The mandrel 73 is driven in a similar manner by means of a motor 89 through a sprocket wheel 91, a chain 92, a sprocket wheel 93 fastened to the shaft 61 and a gear train positioned in the spider 56 and comprising a gear 94 fastened to the shaft 61, an idler gear 95 mounted on a stub shaft 96 journaled in the spider 56, and a gear 97 fastened to shaft 98 to which the driven center 76 is secured. The free wheeling centers 75 and 77 are fastened to shafts 99 and 101 which are mounted for reciprocation in the spiders 56 and 55, respectively, and said centers are provided with handles 102 and 103 whereby they may be

moved into engagement with the mandrels 72 and 73 during the winding operation and out of engagement with said mandrels when the winding operation is complete to permit the mandrel on which the core 78 carrying the roll 79 is mounted to be removed from the index frame 53.

The take-up assembly 23 includes a squeeze roll assembly, indicated generally by reference numeral 104, and a web cutting mechanism, indicated generally by reference numeral 105, which are mounted between brackets 106 fastened to the upper ends of standards 107 that are supported for vertical reciprocation by bearings 108 and 109. At their lower ends, the standards 107 are fastened to linear actuators 111 of well known type which serve to move the standards 107 vertically between the positions shown in dotted and full lines in Fig. 6 of the drawings as will be set forth more fully hereinafter.

The squeeze roll assembly 104 comprises a pair of rubber covered rollers 112 carried by stub shafts 113 that are rotatably mounted in rockers 114 pivotally fastened to the brackets 106 by means of pins 115. The squeeze roll assembly 104 is positioned on the brackets 106 so that when the linear actuators 11 draw the standards 107 downwardly, the rollers 112 will bring the web 21 into contact with the tubular core 78, the pivotal mounting of the rocker 114 permitting said rollers to center themselves properly on said core.

The web cutting mechanism 105 comprises a tubular guide 116 that is supported by the brackets 106 and is provided with a slot 117 extending longitudinally thereof. Positioned in the tubular guide 116 is a cutter assembly, indicated generally by reference numeral 118 and comprising a tubular slider 119 to which is fastened a rectangular holder 120 that protrudes through the slot 117 and carries a knife 121 and a handle 122. Positioned in the tubular slider 119 is a torsion spring 123 one end of which is fastened to the tubular slider 119 and the other end of which projects into the slot 117. The torsion spring 123 tends to rotate the tubular slider 119 in the tubular guide 116 so that when the cutter assembly 118 is moved to the right (Figs. 10 and 11) by means of the handle 122, the rectangular holder 120 will enter offset slot 124 opening from the slot 117 thereby to latch said cutter assembly in place. Also positioned in the tubular guide 116 is a helical spring 125 that is compressed between the tubular slider 118 and a plug 126 in threaded engagement with one end of the tubular guide 116 when the cutter assembly 118 is moved to the right and latched in place. To unlatch the cutter assembly 118, there is provided a disk 127 carried by the arbor 54. When the linear actuators 111 move the standards 107 to the position shown in full lines in Fig. 6 of the drawings, the rectangular holder 120 will strike the disk 127 as shown in Fig. 12 of the drawings, rotating the rectangular holder 120 out of the offset slot 124 against the torsion of the spring 123 and permitting the spring 125 to project the cutter assembly 118 to the left through the tubular guide 116 so that the knife 121 will sever the web 21. After the cutter assembly 118 has traversed the full width of the web 21, it is brought to rest by means of a cylinder 128 of soft rubber or the like which is positioned in the tubular guide 116 and is held in place by means of a plug 129 in threaded engagement with said tubular guide. After the linear actuators 111 have moved the standards 107 up to the position shown in dotted lines in Fig. 6 of the drawings, the handle 122 is drawn to the right manually, compressing the spring 125 and again latching the cutter assembly 118 in the offset slot 124.

During operation, the web 21 is spooled to form a roll 79 on the tubular core 78 mounted on the mandrel closest to the tension control assembly 22, which may be the mandrel 72 as shown in Figs. 1, 2 and 7 of the drawings. After a predetermined footage of the web 21 has been spooled onto the roll 79, the counter 51 causes the closing of contact 131, as shown in Fig. 13

of the drawings, completing the circuit from terminals 132 and 133 through coil 134 of relay 135. When the coil 134 is energized, it draws plunger 136 downwardly, closing contacts 137, 138 and 139 to connect the index motor 68 to power supply terminals 141, 142, and 143, thereby to start said index motor and rotate the index frame 53 in the direction shown by the arrow in Fig. 1. The downward movement of the plunger 136 also closes holding contact 144 which is connected in parallel with the contact 131 so that the coil 134 will remain energized and the index motor 68 will continue to run after the counter 51 has opened contact 131.

When the index frame 53 has been rotated through an angle of slightly less than 180°, pin 145 on the spider 55 will strike limit switch 146 closing contacts 147 and 148 therein. The closing of contact 147 will complete the circuit from terminals 149 and 151 through coil 152 of relay 153, whereby the plunger 154 is caused to move downwardly to open contact 155, breaking the circuit through coil 134 of relay 135 and thereby opening the holding contact 144 and the contacts 137, 138 and 139 to stop the index motor 68. Due to inertia, the index frame 53 and the index motor 68 will continue to rotate for a limited period of time after the contacts 137, 138 and 139 are opened, moving the index frame 53 to a horizontal position as shown in Fig. 6 of the drawings and carrying the pin 145 past and out of contact with limit switch 146 thereby to permit the contacts 147 and 148 to return to their normally open position. The downward movement of the plunger 154 also causes the closing of holding contact 156 which is connected in parallel with the contact 147 so that the coil 152 will remain energized after the continued rotation of the index frame 53 has permitted the contact 147 to open. In addition to operating the contacts 155 and 156, the downward movement of the plunger 154 swings contact 157 to the down position completing the circuit from power supply terminals 158 and 159 through armature 161 and field winding 162 of reversible motor 163 of linear actuator 111, causing said linear actuator to move the standards 107 downwardly. At the end of its downward movement, the linear actuator 111 will operate built-in limit switch 164 to open contact 165 connected in series with the field winding 162 to stop the motor 163. Although there are two linear actuators 111 employed, one for each of the standards 107, only one has been shown in the circuit diagram in the interest of clarity since both are connected in identical fashion.

The closing of the contact 148 in the limit switch 146 by the pin 145 on the spider 55 will complete the circuit from terminals 166 and 167 through coil 168 of relay 169, causing plunger 171 to move downwardly and close contacts 172 and 173 to complete the circuit from power supply terminals 174 and 175 to motor 89, thereby to start said motor and rotate the mandrel 73 on which has been positioned an empty tubular core 78 that has been coated over at least a portion of its periphery with an adhesive material. The motor 89 comprises armature 176 and field winding 177 and has rheostat 178 connected in series with said field winding whereby the base speed of said motor may be adjusted so that the peripheral speed of the empty tubular core 78 on the mandrel 73 will be slightly less than the linear speed of the web 21. The downward movement of the plunger 171 also causes the closing of holding contact 179 which is connected in parallel with the contact 148 so that the coil 168 will remain energized and the motor 89 will continue to run after the rotation of the index frame 53 has permitted the contact 148 to open.

As the standards 107 move downwardly, pin 181 on bracket 106 will operate limit switch 182, which is of the alternate make-and-break type, to close contact 183 completing the circuit from terminals 184 and 185 through coil 186 of relay 187. When the coil 186 is energized it will move plunger 188 downwardly closing

contact 189 and opening contact 190. Then, when the standards 107 reach the lower limit of their downward movement, the pin 181 will operate limit switch 191 to open contact 192 and close contact 193. The opening of the contact 192 will break the circuit from terminals 149 and 151 through coil 152 of relay 153, permitting plunger 154 to move upwardly, opening holding contact 156 and closing contact 155 whereby the index motor 68 may again be started when the contact 131 is closed by the counter 51. The upward movement of the plunger 154 swings contact 157 to the up position completing the circuit from power supply terminals 158 and 159 through armature 161 and field winding 194 of motor 163 of linear actuator 111. The field winding 194 is wound in a direction opposite to field winding 162 so that it will cause motor 163 to rotate in a reverse direction to move the standards 107 upwardly, permitting limit switch 191 to return to its normal position with contact 192 closed, whereby the coil 152 of relay 153 may again be energized, and with contact 193 open. The relay 153 is equipped with time delay means to retard its upward motion so that the linear actuator 111 will not be energized to move the standards 107 upwardly for a short interval after limit switch 191 is operated. At the end of its upward movement, the linear actuator 111 will operate built-in limit switch 195 to open contact 196 connected in series with the field winding 194 to stop the motor 163.

The contact 193, upon being closed by operation of the limit switch 191, completes the circuit from terminals 197 and 198 through the contact 189 to coil 199 of relay 201, moving plunger 202 downwardly to close contact 203 and open contacts 204 and 205. The closing of contact 203 completes the circuit from terminals 206 and 207 to coil 208 of relay 209 through contact 211 of relay 212. When the coil 208 is energized, it moves plunger 213 downwardly, closing contact 214 and closing holding contact 215, which holding contact is connected in parallel with contact 203 so that the coil 208 will remain energized after contact 193 of limit switch 191 opens and the coil 199 of relay 201 is deenergized. Contact 214, when closed, completes the circuit from speed control 216 to field 177 of motor 89 properly to regulate the speed of said motor as will be set forth fully hereinafter. Opening of contact 205 breaks the circuit from terminals 217 and 218 through coil 219 of relay 221, permitting plunger 222 to move upwardly to open holding contact 223 and contacts 224 and 225, breaking the circuit from power terminals 226 and 227 to armature 228 and field winding 229 of motor 80, thereby to stop said motor. The field winding 229 of motor 80 has a rheostat 231 connected in series therewith whereby the base speed of said motor may be adjusted so that the peripheral speed of an empty tubular core 78 on the mandrel 72 will be slightly less than the linear speed of the web 21. Opening of contact 204 breaks the circuit from terminals 206 and 207 to coil 232 of relay 233 through holding contact 234 of said relay, permitting plunger 235 to move upwardly to open holding contact 234, so that coil 232 will not again be energized when the contact 204 is closed, and to open contact 236 thereby to disconnect the field winding 229 of motor 80 from speed control 216.

When the standards 107 reach the lower limit of their downward motion as shown in full lines in Fig. 6 of the drawings and operate the limit switch 191 to stop the motor 80 and connect the speed control 216 to the motor 89, they will also bring the rectangular holder 120 of the web cutting mechanism 105 into contact with the disk 127 to unlatch the cutter assembly 118 and permit the spring 125 to project said cutter assembly through the tubular guide 116 so that the knife 121 will sever the web 21. Simultaneously, the rollers 112 of the squeeze roll assembly 104 will bring the web 21 into contact with the rotating empty tubular core 78 on the mandrel 73,

whereupon the web 21 will adhere to the adhesive material on the tubular core 78 and the winding of a roll 79 on said tubular core will begin. Following this the standards 107 will, after a short interval, move upwardly until they reach the position shown in dotted lines in Fig. 6 of the drawings. The full roll 79 on the mandrel 72 is then removed and an empty tubular core 78 is mounted on said mandrel and coated, over at least a portion of its periphery, with an adhesive material.

After a predetermined footage of the web 21 has been spooled onto the roll 79 mounted on the mandrel 73, the counter 51 will again close contact 131 to start the index motor 68 to rotate the index frame 53. When the index frame 53 has been rotated through an angle of slightly less than 180°, pin 237 on the spider 56 will strike limit switch 238 closing contacts 239 and 241 therein. The closing of the contact 239 will complete the circuit from terminals 149 and 151 through coil 152 of relay 153 to stop the index motor 68 and to start the standards 107 moving downwardly as previously pointed out. The closing of contact 241 will complete the circuit from terminals 217 and 218 through coil 219 of relay 221, moving plunger 242 downwardly to close contacts 224 and 225 to complete the circuit from power supply terminals 226 and 227 to motor 80, thereby to start said motor and rotate the mandrel 72. The downward movement of the plunger 242 will also close holding contact 223 which is connected in parallel with contact 241 so that the coil 219 will remain energized and motor 80 will continue to run after the inertia of the index frame 53 and the index motor 68 have carried the pin 237 past limit switch 238 and permitted contact 241 to open.

As the standards move downwardly, pin 181 on bracket 106 will operate limit switch 182, this time to open contact 183 and break the circuit from terminals 184 and 185 through coil 186 of relay 187, permitting plunger 188 to move upwardly and open the contact 189 and close the contact 190. Then, when the standards 107 reach the lower limit of their downward movement, the pin 181 will operate limit switch 191 to open contact 192 and close contact 193. The opening of contact 192 will, as previously pointed out, break the circuit from terminals 149 and 151 through coil 152 of relay 153, starting the actuator 111 to move the standards 107 upwardly. The closing of contact 193 completes the circuit from terminals 197 and 198 through the contact 190 to coil 243 of relay 212, moving plunger 244 downwardly to close contact 245 and open contacts 211 and 246. The closing of contact 245 completes the circuit from terminals 206 and 207 to coil 232 of relay 233 through contact 204 of relay 201. When the coil 232 is energized, it moves plunger 235 downwardly closing contact 236 and closing holding contact 234, which holding contact 234 is connected in parallel with contact 245 so that the coil 232 will remain energized after contact 193 of limit switch 191 opens and the coil 243 of relay 212 is deenergized. Contact 236, when closed, completes the circuit from speed control 216 to field winding 229 of motor 80 properly to regulate the speed of said motor as will be set out more fully hereinafter. Opening of contact 246 breaks the circuit from terminals 166 and 167 through coils 168 of relay 169, permitting plunger 171 to move upwardly thereto to stop motor 89. Opening of contact 211 breaks the circuit from terminals 206 and 207 to coil 208 of relay 209 through holding contact 215 of said relay, permitting plunger 213 to move upwardly to open holding contact 215, so that coil 208 will not again be energized when the contact 211 is closed, and to open contact 214 thereby to disconnect the field winding 177 of motor 89 from speed control 216.

Simultaneously with the stopping of motor 89 and the transfer of the speed control 216 to the motor 80, the cutting mechanism 105 will sever the web 21 and the squeeze roll assembly 104 will bring said web into con-

tact with an empty tubular core 78 on the mandrel 72 so that the winding of a roll 79 on said tubular core will begin. The full roll 79 on the mandrel 73 is then removed and an empty tubular core 78 is mounted on said mandrel and coated, over at least a portion of its periphery, with an adhesive material.

The speed of the motors 80 and 89 is controlled by the position of the dangle roller 33 in the tension control assembly 22. For example, when the web 21 is first adhered to the tubular core 78 mounted on the mandrel 72 driven by the motor 80, the peripheral speed of said tubular core 78 is less than the linear speed of the web 21. Owing to this difference in speeds, slack will accumulate in the web 21, permitting the dangle roller 33 to drop to the position shown in dotted lines in Fig. 4 of the drawings, carrying with it the elongated bar cam 46. The downward movement of the elongated bar cam 47 will permit the plunger 48 to move outwardly from the coil 247 of the variable reactor 49, causing the speed control 216, which is of well known type and which is powered from terminals 248 and 249, to decrease the voltage applied to field winding 229 causing the speed of motor 80 to increase until the peripheral speed of the roll 79 on the mandrel 72 is equal to the linear speed of said web. As the diameter of the roll 79 on the mandrel 72 increases, the peripheral speed of said roll will tend to increase, pulling the slack out of the web 21 and raising the dangle roller 33. The upward movement of the dangle roller 33 will raise the elongated bar cam 46 to force the plunger 48 into the coil 247, thereby to increase the voltage applied to field winding 229 from the speed control 216 and decrease the speed of the motor 80. In this way, the speed of the motor 80 will be adjusted continuously during the spooling of a roll 79 so that the peripheral speed of said roll will at all times be equal to the linear speed of the web 21, and the tension on said web will always be equal to one-half the unbalanced weight of the dangle roll assembly 32.

The spooling machine control circuit is shown in Fig. 13 of the accompanying drawings with the motor 80 running under the control of the speed control 216 and with the standards 107 in their uppermost position, as shown in dotted lines in Fig. 6 of the drawings, with contact 196 of limit switch 195 open.

Although the foil spooling machine of this invention has been described in connection with the winding of a web of film or foil produced from thermoplastic material, to which it is specially adapted, it may also be employed for the winding of webs of other materials such as paper, fabric and the like.

It is to be understood that the foregoing detailed description is given merely by way of illustration and that many variations may be made therein without departing from the spirit of our invention.

Having described our invention, what we desire to secure by Letters Patent is:

1. In a spooling machine for winding a moving web of indeterminate length into rolls, an index frame, means carried by said index frame for engaging at least two mandrels adapted alternately to support the roll into which the web is being wound, and independent means for driving each of said mandrels during the winding operation whereby the mandrels may be driven simultaneously at different speeds.

2. In a spooling machine for winding a moving web of indeterminate length into rolls, an index frame, means carried by said index frame for engaging at least two mandrels adapted alternately to support the roll into which the web is being wound, independent means for driving each of said mandrels during the winding operation whereby the mandrels may be driven simultaneously at different speeds, means for controlling said mandrel driving means so that the peripheral speed of the roll is substantially equal to the linear speed of the web, and means for alternately connecting said controlling means

to the mandrel driving means driving the mandrel supporting the roll into which the web is being wound.

3. In a spooling machine for winding a moving web of indeterminate length into rolls, an index frame, means carried by said index frame for engaging at least two mandrels adapted alternately to support the roll into which the web is being wound, independent means for driving each of said mandrels during the winding operation whereby the mandrels may be driven simultaneously at different speeds, means for controlling the mandrel driving means driving the mandrel supporting the roll into which the web is being wound so that the peripheral speed of the roll is substantially equal to the linear speed of the web, and means for setting the speed of the mandrel driving means driving another mandrel so that the peripheral speed of a roll-supporting core on said other mandrel is less than the linear speed of the web.

4. In a spooling machine for winding a moving web of indeterminate length into rolls, an index frame, means carried by said index frame for engaging at least two mandrels adapted alternately to support the roll into which the web is being wound, independent means for driving each of said mandrels during the winding operation whereby the mandrels may be driven simultaneously at different speeds, means for controlling said mandrel driving means so that the peripheral speed of the roll is substantially equal to the linear speed of the web, means for alternately connecting said controlling means to the mandrel driving means driving the mandrel supporting the roll into which the web is being wound, and means for setting the speed of the mandrel driving means driving another mandrel so that the peripheral speed of a roll-supporting core on said other mandrel is less than the linear speed of the web.

5. In a spooling machine for winding a moving web of indeterminate length into rolls, an index frame, means carried by said index frame for engaging at least two mandrels adapted alternately to support the roll into which the web is being wound, means for driving each of said mandrels during the winding operation, means for rotating said index frame to bring one of said mandrels adjacent the moving web, and means for setting the speed of the mandrel driving means driving said mandrel so that the peripheral speed of a roll-supporting core on said mandrel is less than the linear speed of the web.

6. In a spooling machine for winding a moving web of indeterminate length into rolls, an index frame, means carried by said index frame for engaging at least two mandrels adapted alternately to support the roll into which the web is being wound, means for driving each of said mandrels during the winding operation, means for rotating said index frame to bring one of said mandrels adjacent the moving web, means for setting the speed of the mandrel driving means driving said mandrel so that the peripheral speed of a roll-supporting core on said mandrel is less than the linear speed of the web, means for severing the web, and means for bringing the web into contact with the roll-supporting core to start the winding of the web into a roll on said core.

7. In a spooling machine for winding a moving web of indeterminate length into rolls, an index frame, means carried by said index frame for engaging at least two mandrels adapted alternately to support the roll into which the web is being wound, means for driving each of said mandrels during the winding operation, means for controlling the mandrel driving means driving the mandrel supporting the roll into which the web is being wound so that the peripheral speed of the roll is substantially equal to the linear speed of the web, means for setting the speed of the mandrel driving means driving another mandrel so that the peripheral speed of a roll-supporting core on said other mandrel is less than the linear speed of the web, means for rotating said index frame to bring said other mandrel adjacent the moving web, means for severing the web, means for bringing the moving web into contact with the roll-supporting core on

said other mandrel to start the winding of the web into a roll on said core, and means for connecting the mandrel driving means driving said other mandrel to the first-mentioned control means so that the peripheral speed of the roll on said other mandrel will be substantially equal to the linear speed of the web.

8. In a spooling machine for winding a moving web of indeterminate length into rolls, an index frame, means carried by said index frame for engaging at least two mandrels adapted alternately to support the roll into which the web is being wound, independent means for driving each of said mandrels during the winding operation whereby the mandrels may be driven simultaneously at different speeds, means for rotating said index frame to bring one of said mandrels adjacent the moving web, and means operable by the movement of said index frame for starting the driving means driving said mandrel.

9. In a spooling machine for winding a moving web of indeterminate length into rolls, an index frame, means carried by said index frame for engaging at least two mandrels adapted alternately to support the roll into which the web is being wound, means for driving each of said mandrels during the winding operation, means for controlling the mandrel driving means driving the mandrel supporting the roll into which the web is being wound so that the peripheral speed of the roll is substantially equal to the linear speed of the web, means for setting the speed of the mandrel driving means driving another mandrel so that the peripheral speed of a roll-supporting core on said other mandrel is less than the linear speed of the web, means for rotating said index frame to bring said other mandrel adjacent the moving web, means operable by the movement of said index frame for starting the driving means driving said other mandrel, means for severing the web, means for bringing the moving web into contact with the roll-supporting core on said other mandrel to start the winding of the web into a roll on said core, and means operable by the web-contacting means for connecting the mandrel driving means driving said other mandrel to the first-mentioned control means so that the peripheral speed of the roll on said other mandrel will be substantially equal to the linear speed of the web and for stopping the mandrel driving means to which the first-mentioned control means was originally connected.

10. In a spooling machine for winding a moving web of indeterminate length into rolls, an index frame, means carried by said index frame for engaging at least two mandrels adapted alternately to support the roll into which the web is being wound, independent means for driving each of said mandrels during the winding operation whereby the mandrels may be driven simultaneously at different speeds, and a tension control assembly for maintaining a substantially uniform tension on the web during the winding operation, comprising means for guiding the web to form a loop, a dangle roll assembly positioned in said loop and free to move as the size of the loop changes, and means operable by the movement of the dangle roll assembly for controlling the mandrel driving means driving the mandrel supporting the roll into which the web is being wound so that the peripheral speed of the roll is substantially equal to the linear speed of the web.

11. In a spooling machine for winding a web of indeterminate length into rolls, an index frame, means carried by said index frame for engaging at least two mandrels adapted alternately to support the roll into which the web is being wound, separate means for driving each of said mandrels during the winding operation, a tension control assembly for maintaining a substantially uniform tension on the web during the winding operation, comprising means for guiding the web to form a loop, a dangle roll assembly positioned in said loop and free to move as the size of the loop changes, and means operable by the movement of the dangle roll assembly for controlling the mandrel driving means driving the

mandrel supporting the roll into which the web is being wound so that the peripheral speed of the roll is substantially equal to the linear speed of the web, said controlling means being designed so that the dangle roll assembly rises as the diameter of the roll into which the material is being wound increases and the rotational speed of the roll is decreased, means for rotating said index frame to bring another mandrel into roll-winding position, means for severing the web and starting the winding of the web into a roll on a core supported by said other mandrel, means for setting the speed of the driving means driving said other mandrel so that the peripheral speed of the core on said mandrel is less than the linear speed of the web whereby the dangle roll will drop when the web is first wound on the core supported on said other mandrel, and means for connecting the mandrel driving means driving said other mandrel to the tension control assembly so as to bring the peripheral speed of the roll on said other mandrel to the linear speed of the web.

12. In a spooling machine for winding a moving web of indeterminate length into rolls, an index frame, means carried by said index frame for engaging at least two mandrels adapted alternately to support the roll into which the web is being wound, means for driving each of said mandrels during the winding operation, a tension control assembly for maintaining a substantially uniform tension on the web during the winding operation, comprising means for guiding the web to form a loop, a dangle roll assembly positioned in said loop and free to move as the size of the loop changes, a cam movable by said dangle roll assembly, a variable reactor operable by said cam, and means operable by said variable reactor for controlling the mandrel driving means driving the mandrel supporting the roll into which the web is being wound so that the peripheral speed of the roll is substantially equal to the linear speed of the web, means for setting the speed of the mandrel driving means driving another mandrel so that the peripheral speed of a roll-supporting core on said other mandrel is less than the linear speed of the web, means for rotating said index frame to bring said other mandrel adjacent the moving web, means for severing the web, means for bringing the moving web into contact with the roll-supporting core on said other mandrel to start the winding of the web into a roll on said core, and means for connecting the mandrel driving means driving said other mandrel to the tension control assembly so that the peripheral speed of the roll on said other mandrel will be substantially equal to the linear speed of the web and for stopping the mandrel driving means to which the tension control means was originally connected.

13. In a spooling machine for winding a web of indeterminate length into rolls, an index frame, shafts rotatably supporting said index frame, a drive for rotating said index frame, centers carried by said index frame for engaging at least two mandrels adapted alternately to support the roll into which the web is being wound, a separate motor for driving each of said mandrels mounted in fixed position separate from said index frame, and means for connecting each motor to the mandrel it drives including a member mounted on the shaft supporting the index frame whereby the rotation of the index frame will not interrupt the drive of the mandrels.

14. In a spooling machine for winding a web of indeterminate length into rolls, an index frame, shafts rotatably supporting said index frame, a drive for rotating said index frame, centers carried by said index frame for engaging at least two mandrels adapted alternately to support the roll into which the web is being wound, a separate motor for driving each of said mandrels mounted in fixed position separate from said index frame, and a gear train for connecting each motor to the mandrel it drives including a gear mounted on the shaft supporting the index frame whereby the rotation of the index frame will not interrupt the drive of the mandrels.

15. In a spooling machine for winding a web of indeterminate length into rolls, an index frame, shafts rotatably supporting said index frame, a drive for rotating said index frame, centers carried by said index frame for engaging at least two mandrels adapted alternately to support the roll into which the web is being wound, a motor for driving each of said mandrels, standards adjacent said index frame, a web cutting mechanism carried by said standards, a squeeze roll assembly carried by said standards, and actuators fastened to said standards for moving said standards to bring the web cutting mechanism into contact with said web to sever the web and to bring the squeeze roll assembly into contact with the web to move the web into contact with a roll-supporting core on one of said mandrels to start the winding of the web into a roll on said core.

16. In a spooling machine for winding a web of indeterminate length into rolls, an index frame, shafts rotatably supporting said index frame, a drive for rotating said index frame, centers carried by said index frame for engaging at least two mandrels adapted alternately to support the roll into which the web is being wound, a motor for driving each of said mandrels, standards adjacent said index frame, a web cutting mechanism carried by said standards and comprising a knife, means urging said knife transversely of said web to sever the web, and latching means for holding the knife against movement, and actuators fastened to said standards for moving said standards to bring the web cutting mechanism into contact with said web and release said latching means whereby the knife will move transversely of the web and sever the same, said standards being so positioned, relative to said index frame as to bring the web cutting mechanism into position to cut the web at a point between the mandrels.

17. In a spooling machine for winding a web of indeterminate length into rolls, an index frame, shafts rotatably supporting said index frame, a drive for rotating said index frame, centers carried by said index frame for engaging at least two mandrels adapted alternately to support the roll into which the web is being wound, a motor for driving each of said mandrels, standards adjacent said index frame, a web cutting mechanism carried by said standards and comprising a tubular guide positioned transversely of the web and having a slot extending longitudinally thereof, a knife assembly slidably mounted in said tubular guide and having a knife projecting through said slot, an offset slot opening from one end of said longitudinal slot for latching said knife assembly, a torsion spring urging said knife assembly into said offset slot, and a compression spring urging said knife assembly through said tubular guide transversely of the web, and actuators fastened to said standards for moving said standards to bring the web cutting mechanism into contact with said web and move said knife assembly out of the offset slot to permit the compression spring to move the knife assembly through the tubular guide whereby the knife will move transversely of the web and sever the same, said standards being so positioned relative to said index frame as to bring the web cutting mechanism into position to cut the web at a point between the mandrels.

18. In a spooling machine for winding a moving web of indeterminate length into rolls, a web cutting mechanism for severing the web comprising a tubular guide positioned transversely of the web and having a slot extending longitudinally thereof, a knife assembly slidably mounted in said tubular guide and having a knife projecting through said slot, an offset slot opening from one end of said longitudinal slot for latching said knife assembly, a torsion spring operatively connected to said knife assembly for urging said knife assembly into said offset slot, and a compression spring operatively connected to said knife assembly for urging said knife assembly through said tubular guide transversely of the web.

19. A web cutting mechanism for severing a web comprising a guide positioned transversely of the web, a knife assembly mounted on said guide, a stop, a spring adapted to be compressed between the knife assembly and the stop for urging said knife assembly along said guide transversely of the web, latching means for preventing movement of said knife assembly, and means for releasing said latching means, the construction and arrangement being such that when the latching means is released the spring will project the knife assembly along said guide to cut said web but will not move with said knife assembly.

20. A web cutting mechanism for severing a web comprising a tubular guide positioned transversely of the web and having a slot extending longitudinally thereof, a knife assembly slidably mounted in said tubular guide and having a knife projecting through said slot, a stop, a spring adapted to be compressed between the knife assembly and the stop for urging said knife assembly through said tubular guide transversely of the web, latching means for preventing movement of said knife assembly, and means for releasing said latching means, the construction and arrangement being such that when the latching means is released the spring will project

the knife assembly along said guide to cut said web but will not move with said knife assembly.

References Cited in the file of this patent

UNITED STATES PATENTS

303,472	Tylee	Aug. 12, 1884
866,277	Heinen et al.	Sept. 17, 1907
883,795	Engberg	Apr. 7, 1908
1,000,631	Sola	Aug. 15, 1911
1,046,783	Hardy	Dec. 10, 1912
1,343,910	Evans	June 22, 1920
1,446,404	Tackaberry	Feb. 20, 1923
1,609,093	Miller	Nov. 30, 1926
1,706,164	Hull	Mar. 19, 1929
1,750,487	Okuura	Mar. 11, 1930
1,838,011	St. Peter	Dec. 22, 1931
1,966,525	Schultz et al.	July 17, 1934
1,973,363	Wood	Sept. 11, 1934
1,976,641	Vernon et al.	Oct. 9, 1934
2,032,176	Kovalsky	Feb. 25, 1936
2,272,940	Gerard	Feb. 10, 1942
2,357,976	Roesen	Sept. 12, 1944
2,403,147	Westergaard	July 2, 1946
2,509,250	Roberts	May 30, 1950