May 24, 1960 C. O. KIRCHNER 2,937,688

HELICAL SPRING WINDING MACHINE WITH TERMINAL EYE FORMING MEANS

Filed Sept. 4, 1956 6 Sheets-Sheet 1

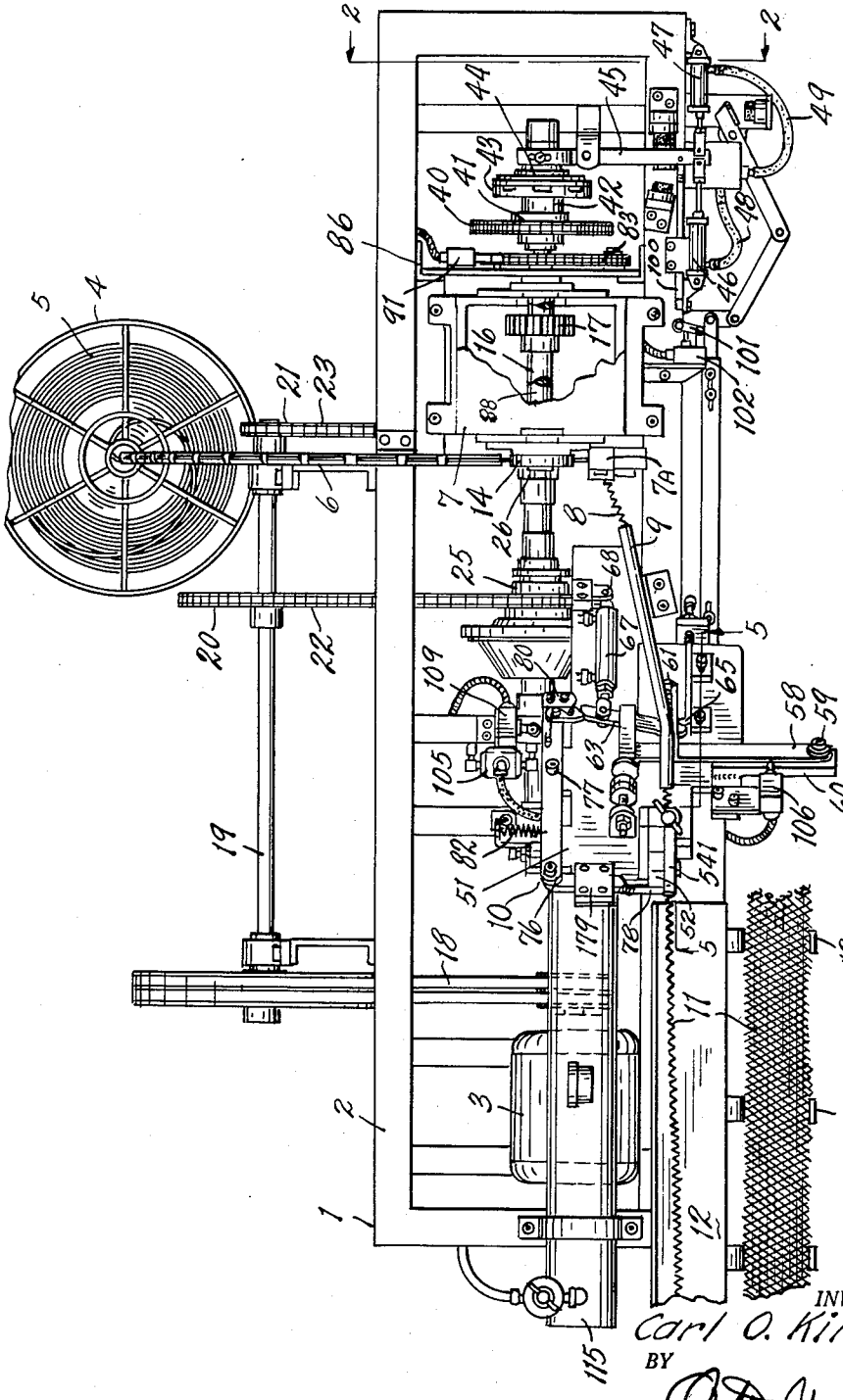


FIG. 1

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HELICAL SPRING WINDING MACHINE WITH TERMINAL EYE FORMING MEANS

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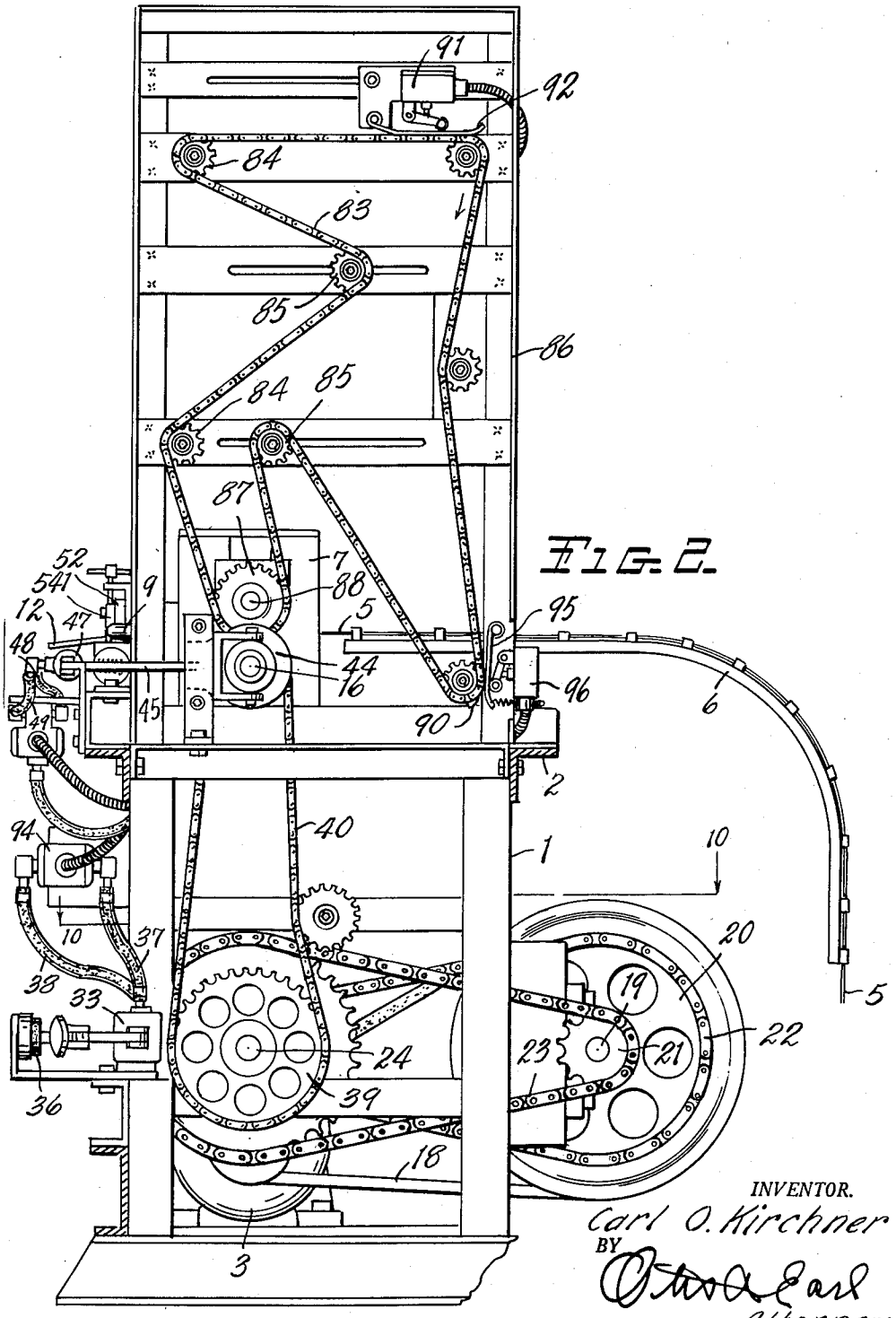


FIG. 2.

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HELICAL SPRING WINDING MACHINE WITH TERMINAL EYE FORMING MEANS

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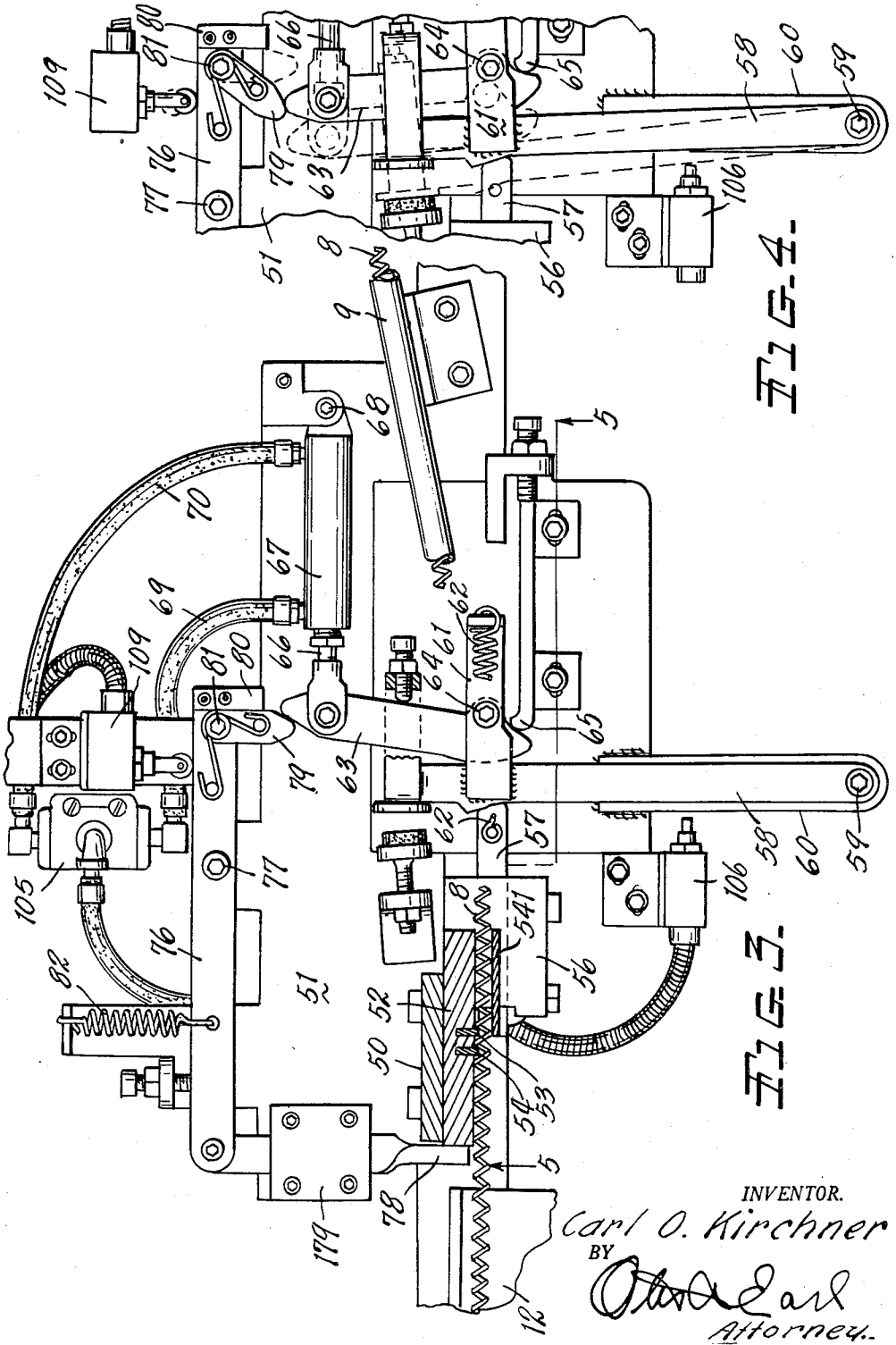


FIG. 4.

FIG. 3.

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HELICAL SPRING WINDING MACHINE WITH TERMINAL EYE FORMING MEANS

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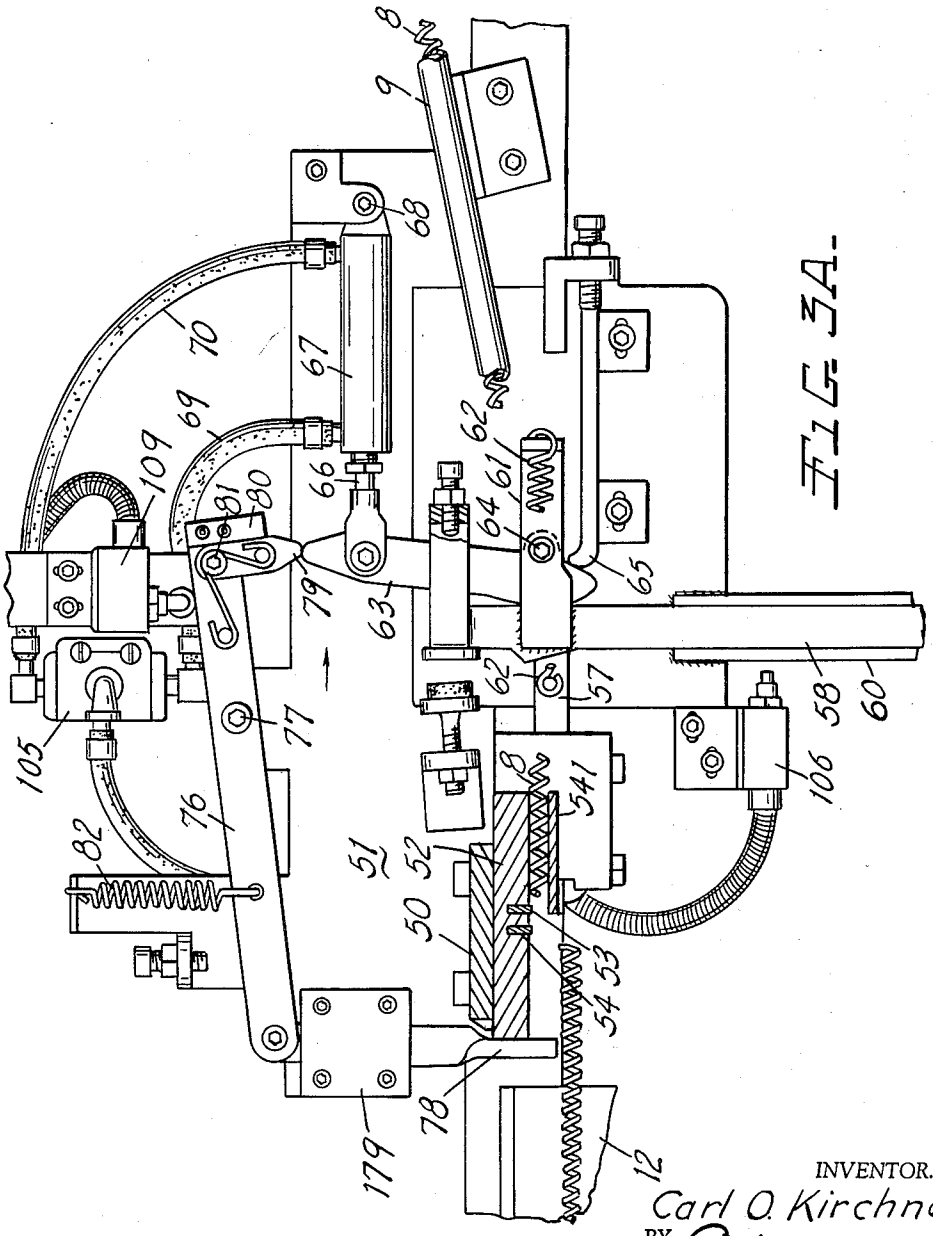


FIG 3A.

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HELICAL SPRING WINDING MACHINE WITH TERMINAL EYE FORMING MEANS

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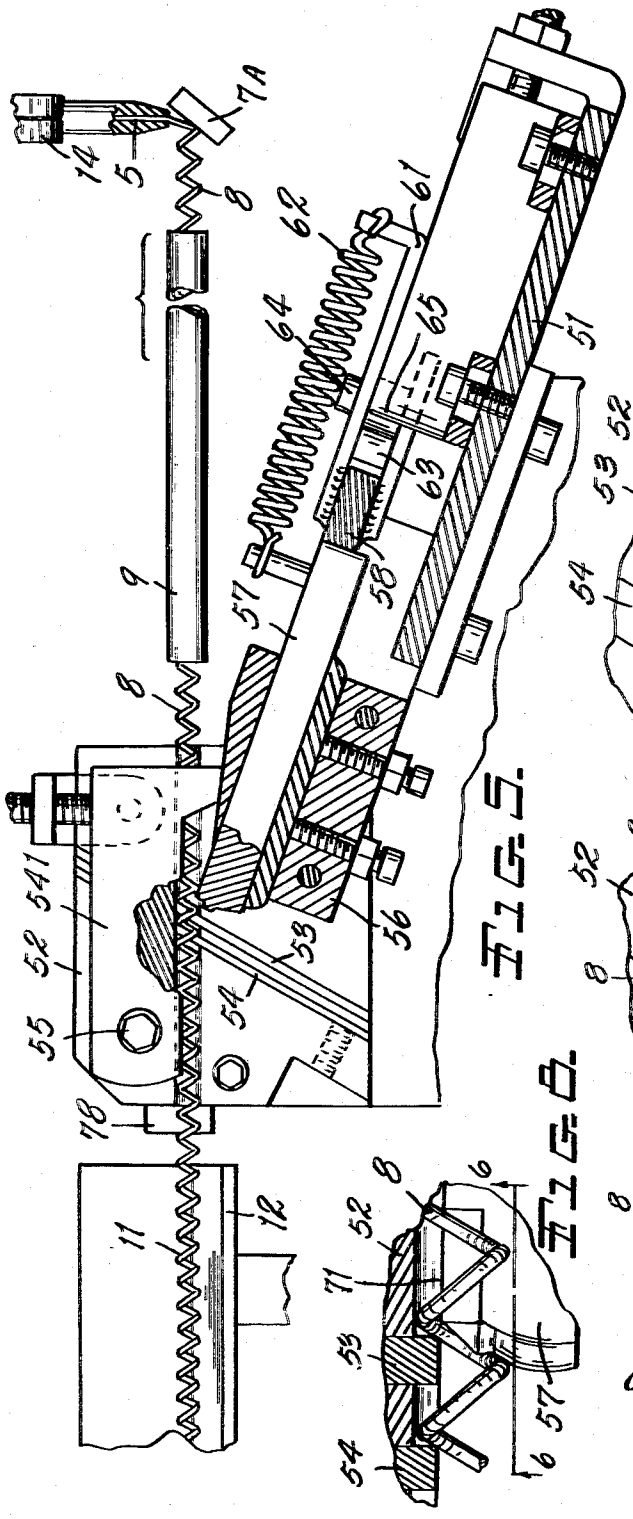


FIG. 5.

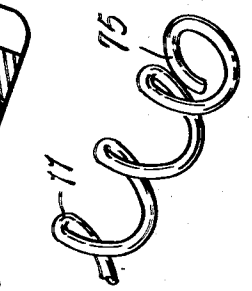


FIG. 9.

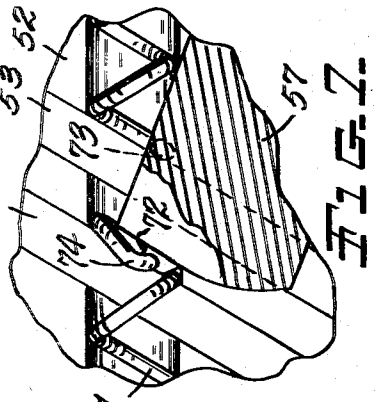


FIG. 7.

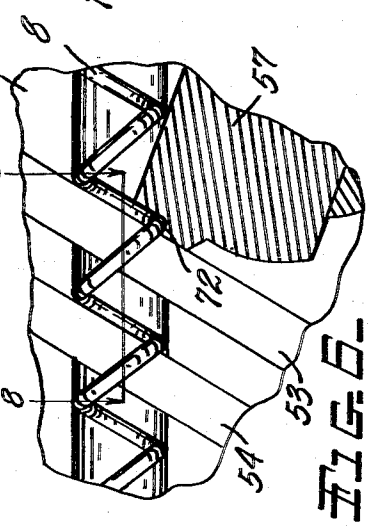


FIG. 6.

FIG. 8.

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HELICAL SPRING WINDING MACHINE WITH TERMINAL EYE FORMING MEANS

Filed Sept. 4, 1956 6 Sheets-Sheet 6

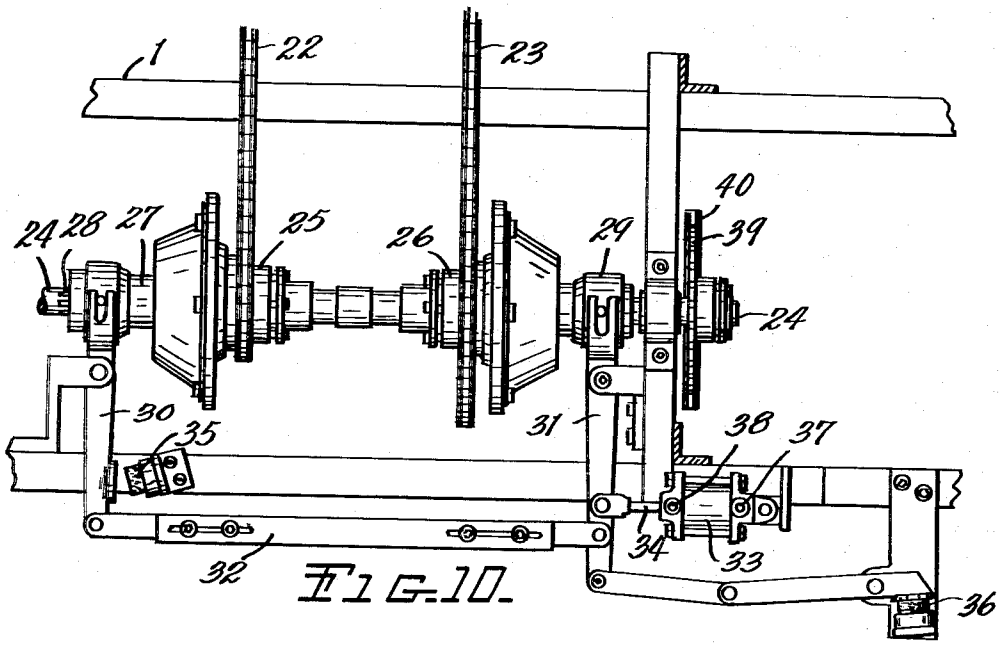


FIG. 10.

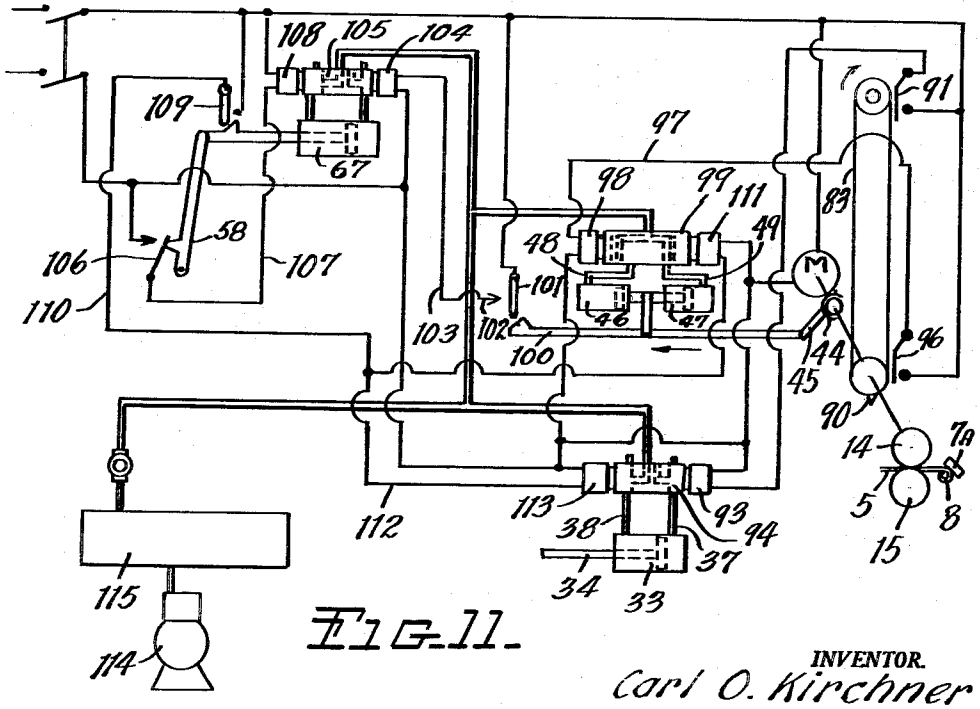


FIG. 11.

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HELICAL SPRING WINDING MACHINE WITH TERMINAL EYE FORMING MEANS

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Filed Sept. 4, 1956, Ser. No. 607,721

14 Claims. (Cl. 153—65)

This invention relates to improvements in helical spring winding machine with terminal eye forming means. The principal objects of this invention are:

First, to provide a machine that will automatically wind a series of separate helical coil springs of any desired length and form a closed eye on the trailing end of each spring as it is completed and ejected from the machine.

Second, to provide an automatic spring winding machine in which the length of the spring is accurately controlled.

Third, to provide an automatic spring winding machine in which the feed rollers that feed the wire stock into the machine are constantly engaged with the wire so there is no slippage and resultant inaccuracy in the length of the springs resulting from the starting and stopping of the feed between the forming of successive springs.

Fourth, to provide a machine having the foregoing advantages which is readily adjustable for forming springs of different lengths and of different diameters.

Fifth, to provide a novel form of cut-off mechanism for severing lengths of springs from a continuously formed helical coil of wire and bending the severed end of the coil into a substantially closed eye.

Sixth, to provide cut-off and ejecting apparatus for a helical coil spring machine that quickly severs a length of spring and forms it into an eye and ejects the severed spring to clear the machine for the formation of a succeeding length of spring.

Seventh, to provide a novel form of drive for a helical coil spring machine that reduces to a minimum the time lag between the formation of successive lengths of spring.

Other objects and advantages of the invention will be apparent from a consideration of the following description and claims. The drawings, of which there are six sheets, illustrate a highly practical form of the machine.

Fig. 1 is a plan view of the machine with a portion of the helical winding mechanism broken away to illustrate internal driving connections.

Fig. 2 is an end elevational view of the machine illustrating the driving and cycle control apparatus of the machine.

Fig. 3 is a fragmentary enlarged top plan view of the wire severing and coil ejecting mechanism of the machine with a portion of the coil guiding structure broken away to illustrate the position of the coil being formed.

Fig. 3A illustrates the parts shown in Fig. 3 in actuated position to eject a finished coil.

Fig. 4 is a fragmentary plan view similar to Fig. 3 but illustrating the coil severing linkage and control mechanism in partially actuated positions.

Fig. 5 is an enlarged fragmentary cross sectional view taken along the plane of the line 5—5 in Fig. 3 and illustrating the details of the coil severing and eye forming positions of the machine.

Fig. 6 is a further enlarged fragmentary view illustrating the coil severing elements at the beginning of the severing operation, the view is taken along the plane corresponding to the plane of the line 6—6 in Fig. 8.

Fig. 7 is a fragmentary enlarged view illustrating the coil severing and crimping element at the end of the crimping operation.

Fig. 8 is an enlarged fragmentary cross sectional view at 90° to the view if Fig. 6 and taken along the plane of the line 8—8 in Fig. 6.

Fig. 9 is a fragmentary perspective view of the end of a coil spring formed by the apparatus.

Fig. 10 is a fragmentary plan view of the drive connections to the coil forming apparatus, the view being taken along the plane of the broken line 10—10 in Fig. 2.

Fig. 11 is a diagrammatic conventional view illustrating the control connections to the several mechanical elements of the machine.

The machine consists generally of a bench like framework 1 having a top frame 2 on which the coil forming mechanism is mounted. Driving structure including the motor 3 is mounted on the lower portion of the framework. A support 4 for a coil of wire stock from which the spiral springs are to be formed is mounted behind the machine and the wire stock indicated at 5 is directed upwardly and forwardly through a suitable guide 6 to the helix forming apparatus generally indicated at 7 on top of the frame 2. The helix forming apparatus 7 functions in a well known manner to continuously form the incoming stock 5 into a continuous helical coil which is delivered at 8 to a tubular guide 9 that directs and conducts the helix to cut-off and crimping mechanism indicated generally at 10 and also supported on the top frame 2. The individual coils 11 of the desired length severed by the cut-off mechanism are ejected onto an inclined receiving platform 12 from where they roll by gravity into collecting arms 13.

Helix forming apparatus

The helix forming apparatus indicated generally at 7 is a conventional structure and so is not disclosed in great detail. The incoming stock 5 is pulled in by a pair of feed rolls 14 and 15 that are constantly engaged under pressure with opposite sides of the incoming stock. A main shaft 16 of the forming apparatus drives the lower feed roll 15 and is connected externally of the apparatus to a drive mechanism to be described. A gear 17 on the shaft 16 is connected to concurrently drive the upper feed roll 14 which is mounted on a shaft 88 described later in the description. The feed rolls project the wire against a coiler block 7A shown in Fig. 5 that bends and directs the wire in a spiral in a well known manner.

The motor 3 is connected as at 18 to drive a shaft 19 mounted on the rear of the framework. A first sprocket 20 of relatively large size and a second sprocket 21 of relatively small size are mounted on the drive shaft to provide two speed operation of the coil winding apparatus 7. Chains 22 and 23 are trained over the sprockets 20 and 21 respectively and extend to speed change mechanism mounted on the lower portion of the framework as illustrated in Fig. 10. A transmission shaft 24 supported on the framework rotatably supports a high speed driving clutch part 25 and a low speed driving clutch part 26. The chain 22 drives the clutch part 25 while the chain 23 drives the low speed part 26. A driven high speed clutch part 27 is axially slidably mounted on the shaft 24 in coacting relationship with the driving part 25 and has a splined driving connection to the shaft 24 as indicated at 28. A low speed drive clutch part 29 is axially slidably and drivingly mounted on the shaft 24 in coacting relationship with the low speed clutch part 26. The clutch parts 25, 26, 27 and 29 may obviously have various forms and in the example illustrated are actually automotive clutch parts. The high speed clutch 25, 27 is engaged and disengaged by a lever 30 while the low speed clutch 26, 29 is engaged and disengaged by a lever

31. The levers 30 and 31 are interconnected by a link 32 for simultaneous operation so that one clutch is engaged when the other is disengaged. A double acting pneumatic cylinder 33 is mounted on the lower portion of the framework and has its piston rod 34 connected to the lever 31 for reversely actuating the two clutches. Bumper stops 35 and 36 limit and cushion the movement of the clutch operating linkage. Air is delivered to opposite ends of the cylinder 33 through conduits 37 and 38 under the control of valve apparatus which will be described presently.

Mounted on the end of the transmission shaft 24 which is driven as described at high and low speeds by the two clutches is a sprocket 39 connected by the chain 40 to a sprocket 41 adjacent the end of the coil winding apparatus 7. As is best illustrated in Fig. 1 the sprocket 41 is mounted on a sleeve 42 rotatably journaled on the lower main shaft 16 of the coil winding apparatus 7. The sleeve 42 carries a driving clutch part 43 that coacts with a driven clutch part 44 mounted in axially shiftable and splined driving engagement on the shaft 16. The clutch part 44 is movable between engaged and disengaged positions by the lever 45. The coil winding apparatus 7 and its main shaft 16 can thus be engaged with or disengaged from the transmission shaft 24 and the transmission shaft may be driven at either high or low speeds.

The engagement and disengagement of the clutch 43, 44 is accomplished by a pair of opposed single acting pneumatic cylinders 46 and 47 mounted on the front rail of the top frame 2 and having their piston rods connected to the lever 45. Air is admitted to the cylinder 46 thru the conduit 48 and air is admitted to the cylinder 47 through the conduit 49 under the control of valve mechanism which will be described presently.

Coil severing, crimping and ejecting mechanism

As was previously pointed out the continuous helix formed by the winding apparatus 7 is directed through the guide 9 to the coil severing and crimping apparatus 10 which is illustrated more clearly in Figs. 3 to 9. The helix 8 passes from the end of the guide 9 along the side of an upright guide block 50 mounted on a support plate 51 on the top of the machine. The guide block 50 carries a removable guide plate 52 having a pair of inclined bars 53 and 54 set into and projecting from its exposed surface. As is best illustrated in Figs. 6 and 7 the inclined bars 53 and 54 have their rear faces spaced by a distance equal to the pitch of the spiral 8 and inclined on the guide plate to lap against the sides of adjacent turns of the helix. The guide plate 52 and inclined bars 53 and 54 are removable from the machine to permit the installation of guide plates and bars sized to coact with helix of different size and pitch. A gate 541 is pivoted to the guide plate at 55 (see Fig. 5) and falls over the outer side of the helix to retain the helix in engagement with the bars 53 and 54.

Projecting forwardly from the guide plate 52 and underneath the helix 8 is an inclined support 56 having a cut-off and crimp bar 57 slidably mounted therein. The lower end of the cut-off bar 57 abuts against a cut-off lever 58 that is pivotally supported at 59 on a forwardly inclined extension 60 of the support plate 51. The lever 58 carries a laterally extending arm 61. A spring 62 connected between the arm and the cut-off bar holds the bar in engagement with the lever.

The lever 58 and the cut-off bar 57 are actuated to advance the cut-off bar by means of a cam link 63 that is pivotally connected at 64 to the arm 61 on the lever. The lower end of the cam link 63 abuts against a fixed stop 65 and the upper end of the cam link 63 is connected to the piston rod 66 of a double acting air cylinder 67. The cylinder 67 is anchored to the plate 51 at 68 and supplied with air through the conduits 69 and 70 as will be described. The first increment of advancing motion of the piston rod 66 swings the cam lever 63 about the abutment 65 and so moves the connection 64 and cut-off lever 58 forwardly to advance the cut-off bar 57 under high mechanical advantage and pressure. This initial advancing motion shears off a coil from the continuous helix as will be described in greater detail. Further advancing motion of the piston rod 66 brings the cam lever 63 into lapped side by side engagement with the upper end of the cut-off lever 58 as appears in full lines in Fig. 4 so that the cam lever and the cut-off lever advance as a unit about the pivot 59 at decreased mechanical advantage but at greater speed. The final advancing motion of the cut-off lever and bar function to crimp the end of the severed coil as will be described.

Figs. 6 to 9 illustrate in detail the action of the cut-off bar 57 with respect to the inclined bars 53 and 54 and the helix 8. The inner edge 71 of the cut-off bar 57 is arranged to slide in shearing relation along the face of the first inclined bar 53 as shown in Fig. 8. The leading end of the cut-off bar 57 has an upwardly facing seat or shoulder 72 that supports the underside of the helix so that the helix is severed against the first inclined bar 53 as indicated at 73 in Fig. 7. The seat 72 and the forward end of the cut-off bar 57 then advance past the inclined bar 53 carrying the severed end 74 of the coil cut from the helix into the plane of the end turn of the coil thus forming a substantially closed eye 75 on the end of the severed coil. The second inclined bar 54 acts as an abutment against which the eye clamping pressure is exerted.

Severed coil ejector

The ejector lever 76 is pivotally mounted on the upper rear edge of the support plate 51 at 77 above the cutter bar mechanism. The left end of the lever as viewed in the drawings is connected to a pusher bar 78 that is retained by a cover plate 179 in sliding engagement with the left end of the guide plate 52. The right end of the lever 76 carries a spring pressed pawl 79 that is biased against a stop 80 opposite the upper end of the cam lever 63. When the piston rod 66 and cam lever 63 advance to cut-off and crimp the end of a coil as previously explained, the pawl 79 is swung about its pivot 81 by the cam lever 63 without imparting any motion to the ejector lever. However, when the cam lever 63 retracts after cutting off and crimping the end of the coil the end of the cam lever engages the pawl 79 which is restrained against rearward tilting by the stop 80 and the right end of the ejector lever is cammed upwardly to cause the pusher bar 78 to eject the newly severed coil from the guide plate 51. It is pointed out that the inclined position of the receiving table 12 causes the leading end of each coil to sag downwardly as the coil is advanced so that the entire coil is quickly cleared from the cutting and crimping mechanism as the pusher bar 78 ejects the trailing end of the coil. A spring 82 returns the ejector lever to retracted position.

Controlling apparatus and connections

The coil forming apparatus thus far described is controlled by a timing or cycle chain 83 trained in an irregular loop over a plurality of fixed sprockets 84 and adjustable sprockets 85 mounted on an upright frame 86 that projects above the right end of the coil forming apparatus 7. (See Figs. 1 and 2.) The chain is trained around a sprocket 87 on the upper shaft 88 of the coil winding apparatus so as to operate in timed relationship with the coil forming apparatus. The adjustable sprockets 85 are adjustable along slots in the cross members 89 so that the length of the chain can be varied for forming coils of different lengths. The chain 83 carries a single projecting lug 90 that travels around the circuit of the chain and a complete rotation of the lug about the circuit determines the complete cycle of the coil forming apparatus.

Positioned above the upper reach of the chain 83 on the framework 86 is an electrical switch 91 having an actuating member engaged with a pivoted shoe 92 located in the path of the lug 90. As is best illustrated in the circuit diagram, Fig. 11, the switch 91 is connected to energize a solenoid 93 mechanically connected to a two way valve 94. The system is shown at the point in the cycle of the machine where the controls are moving to stop the coil forming operation and start the eye forming and cut-off operation. The valve 94 is positioned at the front of the machine and connected to the previously mentioned conduits 38 and 37 for reversely actuating the pneumatic cylinder 33 that controls the high and low speed clutches. Energization of the solenoid 93 conditions the valve 94 to actuate the piston rod 34 to engage the low speed clutch 26, 29. The speed of the drive connections to the coil forming apparatus 7 and the speed at which the helix is formed is therefore reduced toward the end of the cycle of the machine.

The lug 90 continues in its circuit to engage the pivoted shoe 95 near the lower rear corner of the framework (see Fig. 2) that actuates a switch 96. Closing of the switch 96 energizes a circuit 97 to a solenoid 98 mechanically connected to one end of a two way valve 99. Energization of the solenoid 98 conditions the valve 99 to deliver air to the previously mentioned conduit 49 and the cylinder 47 to actuate the clutch lever 45 and disengage the clutch 44. The drive to the coil forming apparatus 7 being interrupted, the formation of the helix is stopped and the rotation of the timing chain 83 is stopped after a short overrun which clears the lug 90 from the shoe 95 as it appears in Figs. 2 and 11. Movement of the clutch actuating lever 45 moves a control bar 100 extending along the top of the top frame 2 adjacent to the cylinder 46 to engage a tappet 101 and close a switch 102. The switch 102 is connected through a conductor 103 to a solenoid 104 associated with the valve 105. The valve 105 is mounted on the support plate 51 and connected to control the pneumatic cylinder 67 that actuates the cut-off levers 58 and 63. Energization of the solenoid 104 conditions the valve 105 and cylinder 67 to advance the cut-off bar and cut off a coil from the now stationary helix. Fig. 11 shows the mechanism conditioned to move control bar 100 to the left but prior to the closing of the switch 101—102 by the control bar.

When the cut-off lever 58 reaches the end of its advancing motion it engages and closes a switch 106 that is connected through the conductor 107 to a solenoid 108 at the opposite end of the valve 105. Energization of the solenoid 108 conditions the valve to reverse the air supply to the cylinder 67 so that the cylinder 67 automatically reverses itself and retracts the cut-off bar 57 at the end of the cutting and crimping operation.

Retracting motion of the cutting mechanism actuates the ejector lever 76 as previously described and ejecting motion of the lever 76 engages and closes a switch 109 positioned above the ejector lever. A switch 109 is connected through a conductor 110 to a solenoid 111 associated with the valve 99 that controls the clutch 44. Energization of the solenoid 111 conditions the valve to admit air to the cylinder 46 to engage the clutch 44 and resume the drive to the coil forming apparatus. Energization of the conductor 110 through the switch 109 also energizes a conductor 112 connected to a solenoid 113 associated with the valve 94. Energization of the solenoid 113 conditions the valve to reverse the air supply to the cylinder 33 to actuate the piston rod 34 and reengage the high speed clutch 25, 27. The machine therefore automatically resumes its initial high speed operation and delivery of the continuous helix until the the lug 90 again strikes the shoe and switch 91 to slow down the machine for a succeeding cutting and crimping operation. Fig. 11 conventionally illustrates a compressor 114 and supply conduit and tank 115 for delivering air under pressure to the three cylinders.

The cycle of operation of the machine, starting with the helix forming apparatus operating at high speed is as follows:

Switch 91 closes when the timing chain approaches the end of its circuit. Solenoid 93 and valve 94 cause cylinder 33 to engage the low speed clutch and the apparatus continues at low speed until switch 96 is closed. This energizes solenoid 98 to shift valve 99 and cylinders 46 and 47 to stop position. Cylinder 47 disengages clutch 44 and then closes switch 102. Switch 102 energizes solenoid 104 to condition valve 105 to advance the piston of cylinder 67 and cut off and crimp the end of a coil. At the end of the crimping operation switch 106 is closed and energizes solenoid 108 and valve 105 to retract the crimping slide. At the end of the retracting motion of the crimping slide switch 109 closes to energize solenoids 113 and 111 that reengage clutch 44 and the high speed clutch so the machine starts out at high speed on a new cycle. The entire cycle is automatic and no slippage of the clutches will affect the product. If any clutch slips the timing chain is retarded to the same degree as the forming apparatus and thus requires full completion of the forming cycle after the clutch slippage has stopped. The cylinders 33, 46, 47 and 67 may be termed power shift elements for actuating their associated parts.

Having thus described the invention, what is claimed as new and is desired to be secured by Letters Patent is:

1. In combination with a spiral coil winding apparatus including a pair of coacting feed rolls arranged to feed wire into the apparatus, control and drive means for actuating said apparatus to form and eject a predetermined length of coil and form a substantially closed eye on the end of each coil comprising a constantly operated drive shaft, a pair of rotatably supported driving clutch parts connected to be driven at relatively high and low speeds from said drive shaft, a transmission shaft alined with and rotatably supporting said driving clutch parts, a pair of driven clutch parts slidably mounted on said transmission shaft in driving engagement therewith and in coacting relation to said driving clutch parts, lever means connected to alternatively connect said transmission shaft to said drive shaft for high and slow speed operation by engaging said driven clutch parts, a driven shaft in said apparatus arranged to drive the apparatus and said rolls, a third driving clutch part rotatable on said driven shaft and connected to said transmission shaft, a third driven clutch drivingly engaged with said driven shaft and slidable thereon into coacting relation with said third driving clutch part, second lever means connected to engage and disengage said third clutch parts, a pair of spaced bars positioned to lap against the sides of adjacent turns of a coil discharged by said apparatus, a gate swingable into spaced relation to said bars to retain said coil in threading engagement with the bars, a slide having a hardened nose movable in shearing relation across the turn of a coil engaged with the rearmost of said bars and having a seat in its end face arranged to press the severed turn in axial collapsing and closing relation toward the next forward turn seated against the foremost of said bars, a first lever having a fixed pivot and arranged in transverse relation to said slide, a second lever pivoted on a swinging portion of said first lever and having a face portion adjacent its pivot in abutting relation to said slide, a fixed abutment engageable with an end of said second lever, a first air cylinder connected to swing said second lever about said abutment to advance said slide in shearing action on said coil, said first and second levers having abutting parts engageable after said shearing action is complete to move both levers and said slide to collapse the end turn and eject the severed coil from said bars, a pusher bar positioned to move severed coils transversely of their length, a third lever connected

to actuate said pusher bar, a pawl swingable on said third lever and positioned in the path of said second lever to tilt thereover on the advancing stroke of the second lever, a stop on said third lever limiting retracting motion of said pawl whereby retracting motion of said second lever actuates said third lever and said pusher bar, a second air cylinder having a piston rod connected to actuate said first lever means to operate said first and second clutch parts, third air cylinders having piston rods connected to said second lever means which engage and disengage said third clutch, valves connected to reversely actuate said cylinders, pairs of solenoids connected to reversely actuate said valves, a timing chain driven in a closed circuit by said driven shaft and having a timing lug projecting therefrom, a low speed switch positioned to be closed momentarily by said lug at one position of the chain, a stop switch positioned to be closed momentarily by said lug after said low speed switch, a first circuit closed by said stop switch connected to the solenoid for moving the valve associated with the solenoid associated with said third cylinders to actuate the cylinders to disengage said third clutch parts, a cut-off switch positioned to be closed momentarily by means operated by movement of said second lever means to clutch disengaging position, a second circuit closed by said cut-off switch and connected to condition the valve associated with said first cylinder to actuate the cylinder to cut off a coil, a cutter return switch positioned to be closed by means operated by movement of said first lever to coil cutting position and connected to actuate a solenoid associated with said first cylinder to actuate the cylinder to retract said first lever and eject the severed coil, a start switch positioned to be closed by means operated by actuation of said third lever and connected to the solenoids for actuating said second and third cylinders to engage the high speed clutch and engage the third clutch, and a low speed circuit controlled by said low speed switch connected to a solenoid for actuating said second cylinder to engage said slow speed clutch.

2. In combination with a spiral coil winding apparatus including a pair of coacting feed rolls arranged to feed wire into the apparatus, control and drive means for actuating said apparatus to form and eject a predetermined length of coil and form a substantially closed eye on the end of each coil comprising a constantly operated drive shaft, a pair of rotatably supported driving clutch parts connected to be driven at relatively high and low speeds from said drive shaft, a transmission shaft alined with and rotatably supporting said driving clutch parts, a pair of driven clutch parts slidably mounted on said transmission shaft in driving engagement therewith and in coacting relation to said driving clutch parts, lever means connected to alternatively connect said transmission shaft to said drive shaft for high and low speed operation by engaging said driven clutch parts, a driven shaft in said apparatus arranged to drive the apparatus and said rolls, a third driving clutch part connected to said transmission shaft, a third driven clutch drivingly engaged with said driven shaft and coacting with said third driving clutch part, second lever means connected to engage and disengage said third clutch parts, a pair of spaced bars positioned to lap against the sides of adjacent turns of a coil discharged by said apparatus, means to retain said coil in threading engagement with the bars, a slide having a hardened nose movable in shearing relation across the turn of a coil engaged with the rearmost of said bars and having its end face arranged to press the severed turn in axial collapsing and closing relation toward the next forward turn seated against the foremost of said bars, a first lever having a fixed pivot and arranged in transverse relation to said slide, a second lever pivoted on a swinging portion of said first lever and having a face portion adjacent its pivot in abutting relation to said slide, a fixed abutment engageable with an end of said second lever, a first air cylinder connected to swing said second lever about said abutment to advance said slide in shearing action on said coil, said first and second levers having abutting parts engageable after said shearing action is complete to move both levers and said slide to collapse the end turn and eject the severed coil from said bars, a pusher bar positioned to move severed coils transversely of their length, a third lever connected to actuate said pusher bar, a pawl swingable on said third lever and positioned in the path of said second lever to tilt thereover on the advancing stroke of the second lever, a stop on said third lever limiting retracting motion of said pawl whereby retracting motion of said second lever actuates said third lever and said pusher bar, a second air cylinder having a piston rod connected to actuate said first lever means to operate said first and second clutch parts, third air cylinders having piston rods connected to said second lever means which engage and disengage said third clutch, valves connected to reversely actuate said cylinders, pairs of solenoids connected to reversely actuate said valves, a timing chain driven in a closed circuit by said driven shaft and having a timing lug projecting therefrom, a low speed switch positioned to be closed momentarily by said lug at one position of the chain, a stop switch positioned to be closed momentarily by said lug after said low speed switch, a first circuit closed by said stop switch connected to the solenoid for moving the valve associated with the solenoid associated with said third cylinders to actuate the cylinders to disengage said third clutch parts, a cut-off switch positioned to be closed momentarily by means operated by movement of said second lever means to clutch disengaging position, a second circuit closed by said cut-off switch and connected to condition the valve associated with said first cylinder to actuate the cylinder to cut off a coil, a cutter return switch positioned to be closed by means operated by movement of said first lever to coil cutting position and connected to actuate a solenoid associated with said first cylinder to actuate the cylinder to retract said first lever and eject the severed coil, a start switch positioned to be closed by means operated by actuation of said third lever and connected to the solenoids for actuating said second and third cylinders to engage the high speed clutch and engage the third clutch, and a low speed circuit controlled by said low speed switch connected to a solenoid for actuating said second cylinder to engage said slow speed clutch.

3. In combination with a spiral coil winding apparatus including a pair of coacting feed rolls arranged to feed wire into the apparatus, control and drive means for actuating said apparatus to form and eject a predetermined length of coil comprising a constantly operated drive shaft, a pair of driving clutch parts connected to be driven at relatively high and low speeds from said drive shaft, a pair of driven clutch parts mounted in coacting relation to said driving clutch parts, lever means connected to alternatively connect said clutch parts for high and low speed operation, a driven shaft in said apparatus arranged to drive the apparatus and said rolls, a third driving clutch part connected to be driven by said high and low speed clutches, a third driven clutch drivingly engaged with said driven shaft and in coacting relation with said third driving clutch part, second lever means connected to engage and disengage said third clutch parts, a bar positioned to lap against the side of a turn of a coil discharged by said apparatus, means to retain said coil in threading engagement with the bar, a slide movable in shearing relation across the turn of a coil engaged with said bar, a lever arranged in transverse relation to said slide and having a face portion in abutting relation to said slide, a first air cylinder connected to swing said lever about its pivot to advance said slide in shearing action on said coil, a pusher bar positioned to move severed coils transversely of their length, a second lever connected to actuate said pusher bar, a pawl swingable in one direction on said second lever and positioned

in the path of said first lever to tilt thereover on the advancing stroke of the first lever, means limiting retracting motion of said pawl whereby retracting motion of said first lever actuates said second lever and said pusher bar, a second air cylinder having a piston rod connected to actuate said first lever means to operate said first and second clutch parts, third air cylinders having piston rods connected to said second lever means which engage and disengage said third clutch, valves connected to reversely actuate said cylinders, pairs of solenoids connected to reversely actuate said valves, a timing chain driven in a closed circuit by said driven shaft and having a timing lug projecting therefrom, a low speed switch positioned to be closed momentarily by said lug at one position of the chain, a stop switch positioned to be closed momentarily by said lug after said low speed switch, a first circuit closed by said stop switch connected to the solenoid for moving the valve associated with said third cylinders to actuate the cylinders to disengage said third clutch parts, a cut-off switch positioned to be closed momentarily by means operated by movement of said second lever means to clutch disengaging position, a second circuit connected to condition the valve associated with said first cylinder to actuate the cylinder to cut off a coil, a cutter return switch position to be closed by means operated by movement of said first lever to coil cutting position and connected to actuate a solenoid associated with said first cylinder to actuate the cylinder to retract said first lever and eject the severed coil, a start switch positioned to be closed by means operated by actuation of said second lever and connected to the solenoid for actuating said second and third cylinders to engage the high speed clutch and engage the third clutch, and a low speed circuit controlled by said low speed switch connected to a solenoid for actuating said second cylinder to engage said low speed clutch.

4. In combination with a spiral coil winding apparatus including a pair of coacting feed rolls arranged to feed wire into the apparatus, control and drive means for actuating said apparatus to form and eject a predetermined length of coil comprising a constantly operated drive shaft, a pair of driving clutch parts connected to be driven at relatively high and low speeds from said drive shaft, a pair of driven clutch parts mounted in coacting relation to said driving clutch parts, lever means connected to alternatively connect said clutch parts for high and low speed operation, a driven shaft in said apparatus arranged to drive the apparatus and said rolls, a third driving clutch part connected to be driven by said high and low speed clutches, a third driven clutch drivingly engaged with said driven shaft and in coacting relation with said third driving clutch part, second lever means connected to engage and disengage said third clutch parts, a bar positioned to lap against the side of a turn of a coil discharged by said apparatus, means to retain said coil in threading engagement with the bar, a slide movable in shearing relation across the turn of a coil engaged with said bar, a lever arranged in transverse relation to said slide and having a face portion in abutting relation to said slide, a first air cylinder connected to swing said lever about its pivot to advance said slide in shearing action on said coil, a second air cylinder having a piston rod connected to actuate said first lever means to operate said first and second clutch parts, third air cylinders having piston rods connected to said second lever means which engage and disengage said third clutch, valves connected to reversely actuate said cylinders, pairs of solenoids connected to reversely actuate said valves, a timing element driven in a closed circuit by said driven shaft and having a timing lug projecting therefrom, a low speed switch positioned to be closed momentarily by said lug at one position of the element, a stop switch positioned to be closed momentarily by said lug after said low speed switch, a first circuit closed by said stop switch connected to the solenoid for moving the valve associated with said third cylinders to actuate the cylinders to disengage said third clutch parts, a cut-off switch positioned to be closed momentarily by means operated by movement of said second lever means to clutch disengaging position, a second circuit connected to condition the valve associated with said first cylinder to actuate the cylinder to cut off a coil, a cutter return switch positioned to be closed by means operated by movement of said first lever to advanced position and connected to actuate a solenoid associated with said first cylinder to actuate the cylinder to retract said first lever, a start switch positioned to be closed by means operated by retracting motion of said slide and connected to the solenoids for actuating said second and third cylinders to engage the high speed clutch and engage the third clutch, and a low speed circuit controlled by said low speed switch connected to a solenoid for actuating said second cylinder to engage said low speed clutch.

5. In combination with a spiral coil winding apparatus including a pair of coacting feed rolls arranged to constantly drivingly engage wire being fed into the apparatus, control and drive means for actuating said apparatus to form and cut off a predetermined length of coil comprising a constantly operated drive shaft, a pair of relatively high and low speed clutches driven from said drive shaft, a transmission shaft arranged to be driven by said pair of clutches, lever means connected to alternatively connect said high and low speed clutches, a driven shaft in said apparatus arranged to drive the apparatus and said rolls, a third clutch connected to drive said driven shaft from said transmission shaft, a second lever means connected to engage and disengage said third clutch, a shear bar positioned to lap against the side of a turn of a coil discharged by said apparatus, a gate swingable into spaced relation to retain said coil in threading engagement with the bar, a slide movable in shearing relation across the turn of a coil engaged with said bar and having a seat in its end face arranged to press the severed turn in ejecting motion from said bar, a first lever having a fixed pivot and arranged in transverse relation to said slide, a second lever pivoted on a swinging portion of said first lever and having a face portion adjacent its pivot in abutting relation to said slide, a fixed abutment engageable with an end of said second lever, a first air cylinder connected to swing said second lever about said abutment to advance said slide in shearing action on said coil, said first and second levers having abutting parts engageable after said shearing action is complete to move both levers and said slide to displace the severed coil from said bar, a second air cylinder having a piston rod connected to actuate said first lever means to operate said high and low speed clutches, a third air cylinder means having a piston rod connected to said second lever means which engage and disengage said third clutch, valves connected to reversely actuate each of said cylinders, pairs of solenoids connected to reversely actuate said valves, a timing element driven in a closed circuit by said driven shaft and having a timing lug projecting thereon, a low speed switch positioned to be closed momentarily by said lug at one position of the element, a stop switch positioned to be closed momentarily by said lug after said low speed switch, a first circuit closed by said stop switch connected to the solenoid for moving the valve associated with said third cylinder means to actuate the cylinder to disengage said third clutch, a cut-off switch positioned to be closed momentarily by means operated by movement of said second lever means to clutch disengaging position, a second circuit energized by said cut-off switch and connected to condition a valve associated with said first cylinder to actuate the cylinder to cut off and displace a coil, a cutter return switch positioned to be closed by means operated by movement of said first lever to advanced position and connected to actuate a solenoid associated with said first cylinder to actuate the cylinder to retract said first lever, a start

switch positioned to be closed by means operated by actuation of said slide to retracted position and connected to the solenoids for actuating said second and third cylinders to engage the high speed clutch and engage the third clutch, and a low speed circuit controlled by said low speed switch connected to a solenoid for actuating said second cylinder means to engage said slow speed clutch.

6. In combination with a spiral coil winding apparatus including a pair of coacting feed rolls arranged to constantly drivingly engage wire being fed into the apparatus, control and drive means for actuating said apparatus to form and cut off a predetermined length of coil comprising a constantly operated drive shaft, a pair of relatively high and low speed clutches driven from said drive shaft, a transmission shaft arranged to be driven by said pair of clutches, means connected to alternatively connect said high and low speed clutches, a driven shaft in said apparatus arranged to drive the apparatus and said rolls, a third clutch connected to drive said driven shaft from said transmission shaft, a second means connected to engage and disengage said third clutch, a shear bar positioned to lap against the side of a turn of a coil discharged by said apparatus, means to retain said coil in threading engagement with the bar, a slide movable in shearing relation across the turn of a coil engaged with said bar, a first lever arranged in transverse relation to said slide and having a face portion in abutting relation to said slide, a first air cylinder connected to swing said first lever to advance said slide in shearing action on said coil, a second air cylinder having a piston connected to actuate said first means to operate said high and low speed clutches, a third air cylinder means having a piston connected to said second means engage and disengage said third clutch, valves connected to reversely actuate each of said cylinders, pairs of solenoids connected to reversely actuate said valves, a timing element driven in a closed circuit by said driven shaft and having a timing lug projection thereon, a low speed switch positioned to be closed momentarily by said lug at one position of the element, a stop switch positioned to be closed momentarily by said lug after said low speed switch, a first circuit closed by said stop switch connected to the solenoid for moving the valve associated with said third cylinder means to actuate said second means to disengage said third clutch, a cut-off switch positioned to be closed momentarily by means operated by movement of said second means to clutch disengaging position, a second circuit energized by said cut-off switch and connected to condition the valve associated with said first cylinder to actuate the cylinder to cut off a coil, a cutter return switch positioned to be closed by means operated by movement of said first lever to advanced position and connected to actuate the solenoid associated with said first cylinder to actuate the cylinder to retract said first lever, a start switch positioned to be closed by means operated by actuation of said slide to retracted position and connected to the solenoids for actuating said second and third cylinders to engage the high speed clutch and engage the third clutch, and a low speed circuit controlled by said low speed switch connected to the solenoid for actuating said second cylinder means to engage said low speed clutch.

7. In combination with a spiral coil winding apparatus including a pair of coacting feed rolls arranged to feed wire into the apparatus, control and drive means for actuating said apparatus to form and eject a predetermined length of coil and form a substantially closed eye on the end of each coil comprising a drive shaft connected to drive said rolls and said apparatus, a clutch connected to drive said drive shaft, lever means connected to engage and disengage said clutch, a pair of spaced bars positioned to lap against the sides of adjacent turns of a coil discharged by said apparatus, a gate swingable into spaced relation to said bars to retain said coil in threading engagement with the bars, a slide having a nose movable in shearing relation across the turn of a coil engaged with the rearmost of said bars and having a seat in its end face arranged to press the severed turn in axial collapsing and closing relation toward the next forward turn seated against the foremost of said bars, a first lever having a fixed pivot and arranged in transverse relation to said slide, a second lever pivoted on a swinging portion of said first lever and having a face portion adjacent its pivot in abutting relation to said slide, a fixed abutment engageable with an end of said second lever, a first air cylinder connected to swing said second lever about said abutment to advance said slide in shearing action on said coil, said first and second levers having abutting parts engageable after said shearing action is complete to move both levers and said slide to collapse the severed turn against the foremost of said bars, air cylinder means having a piston connected to said lever means to engage and disengage said clutch, valves connected to reversely actuate each of said cylinders, pairs of solenoids connected to reversely actuate said valves, a timing element driven in a closed circuit by said shaft and having a timing lug projection thereon, a stop switch positioned to be closed momentarily by said lug, a first circuit closed by said stop switch connected to the solenoid for moving the valve associated with said cylinder means to actuate the lever means to disengage said clutch, a cut-off switch positioned to be closed momentarily by means operated by movement of said lever means to clutch disengaging position, a second circuit operated by said cut-off switch and connected to condition the valve associated with said first cylinder to actuate the cylinder to cut off and collapse the end turn of a coil, a cutter return switch positioned to be closed by means operated by movement of said first lever to coil collapsing position and connected to actuate the solenoid associated with said first cylinder the actuate the cylinder to retract said first lever, and a start switch positioned to be closed by means operated by actuation of said slide to retracted position and connected to the solenoid for actuating said air cylinder means to engage said clutch.

8. In combination with a spiral coil winding apparatus including a pair of coacting feed rolls arranged to feed wire into the apparatus, control and drive means for actuating said apparatus to form and eject a predetermined length of coil and form a substantially closed eye on the end of each coil comprising a drive shaft connected to drive said rolls and said apparatus, a clutch connected to drive said drive shaft, lever means connected to engage and disengage said clutch, a pair of spaced bars positioned to lap against the sides of adjacent turns of a coil discharged by said apparatus, means to retain said coil in threading engagement with the bars, a slide having a nose movable in shearing relation across the turn of a coil engaged with the rearmost of said bars and having a seat in its end face arranged to press the severed turn in axial collapsing and closing relation toward the next forward turn seated against the foremost of said bars, a first lever having a fixed pivot and arranged in transverse relation to said slide, a second lever pivoted on a swinging portion of said first lever and having a face portion adjacent its pivot in abutting relation to said slide, a fixed abutment engageable with an end of said second lever, first fluid operated means connected to swing said second lever about said abutment to advance said slide in shearing action on said coil, said first and second levers having abutting parts engageable after said shearing action is complete to move both levers and said slide to collapse the severed turn against the foremost of said bars, second fluid operated means having a piston connected to said lever means to engage and disengage said clutch, valves connected to reversely actuate each of said fluid operated means, pairs of solenoids connected to reversely actuate said valves, a timing element

driven in a closed circuit by said shaft and having a timing lug projection thereon, a stop switch positioned to be closed momentarily by said lug, a first circuit closed by said stop switch connected to the solenoid for moving the valve associated with said second fluid operated means to actuate the first lever means to disengage said clutch, a cut-off switch positioned to be closed momentarily by means operated by movement of said first lever means to clutch disengaging position, a second circuit operated by said cut-off switch and connected to condition the valve associated with said first fluid operated means to actuate the means to cut off and collapse a coil, a cutter return switch positioned to be closed by means operated by movement of said first lever to coil collapsing position and connected to actuate the solenoid associated with said first fluid operated means to actuate the means to retract said first lever, and a start switch positioned to be closed by means operated by actuation of said slide to retracted position and connected to the solenoid for actuating said second fluid operated means to engage said clutch.

9. In combination with a spiral coil winding apparatus, control and drive means for actuating said apparatus to form and eject a predetermined length of coil and form a substantially closed eye on the end of each coil comprising a constantly operated drive shaft, a driving clutch connected to control said shaft, first means connected to engage and disengage said clutch, a pair of spaced bars positioned to lap against the sides of adjacent turns of a coil discharged by said apparatus, means to retain said coil in threading engagement with the bars, a slide having a nose movable in shearing relation across the turn of a coil engaged with the rearmost of said bars and having a seat in its end face arranged to press the severed turn in axial collapsing and closing relation toward the next forward turn seated against the foremost of said bars, a first lever having a fixed pivot and arranged in transverse relation to said slide, a second lever pivoted on a swinging portion of said first lever and having a face portion adjacent its pivot in abutting relation to said slide, a fixed abutment engageable with an end of said second lever, a first fluid operated cylinder connected to swing said second lever about said abutment to advance said slide in shearing action on said coil, said first and second levers having abutting parts engageable after said shearing action is complete to move both levers and said slide to collapse the severed turn against the foremost of said bars, a pusher bar positioned to move severed coils transversely of their length, a third lever connected to actuate said pusher bar, a pawl swingable in one direction on said third lever and positioned in the path of said second lever to tilt thereover on the advancing stroke of the second lever, means limiting retracting motion of said pawl whereby retracting motion of said second lever actuates said third lever and said pusher bar, a second fluid operated cylinder having a piston connected to said first means to engage and disengage said clutch, valves connected to reversely actuate each of said cylinders, solenoids connected to reversely actuate said valves, a timing element driven in a closed circuit by said shaft and having a timing lug projection thereon, a stop switch positioned to be closed momentarily by said lug, a first circuit closed by said stop switch connected to the solenoid for moving the valve associated with said second cylinder to actuate the cylinder to disengage said clutch, a cut-off switch positioned to be closed momentarily by means operated by movement of said first means to clutch disengaging position, a second circuit controlled by said cut-off switch and connected to condition the valve associated with said first cylinder to actuate the cylinder to cut off and collapse the end turn of a coil, a cutter return switch positioned to be closed by means operated by movement of said first lever to coil collapsing position and connected to actuate the solenoid associated with said first cylinder to actuate the cylinder to retract said first lever, a start switch positioned to be closed by means operated by actuation of said third lever and connected to the solenoid for actuating said second cylinder to engage the clutch.

10. In a spring winding machine having apparatus for forming a continuous length of wire into a continuous spiral coil and including a pair of feed rolls constantly engaged on opposite sides of a wire and arranged to feed the wire into the apparatus, drive and control means comprising a continuously operable power source, a pair of alternately engageable clutches driven by said source at high and low speeds and connectable to a transmission shaft, a third clutch drivingly engageable between said transmission shaft and said apparatus, a timing element chain driven in a closed circuit by said apparatus, a cut-off member arranged to cut off a length of the coil formed by said apparatus and bend the end turn of the severed length into a substantially closed eye, a first power shift element connected to advance and retract said cut-off member, a second power shift element connected to actuate said alternately engageable clutches, a third power shift element connected to engage and disengage said third clutch, first control means actuated by means operated by movement of said first power shift element to cut-off advanced position to reverse the first element and return the cut-off member to retracted position, second control means actuated by means operated by movement if said cut-off member to retracted position and connected to said second and third power elements to respectively engage the high speed clutch and engage the third clutch, a third control means actuated by said timing element chain at one point in its circuit and connected to said second power shift element to condition the element to disengage the high speed clutch and engage the low speed clutch, a fourth control means actuated by said timing element chain at a succeeding point in its circuit and connected to said third power shift means to disengage said third clutch, and a fifth control means actuated by means operated by movement of said third clutch to disengaged position and connected to said first power shift element to advance said cut-off member.

11. In a spring winding machine having apparatus for forming a continuous length of wire into a continuous spiral coil and including a pair of feed rolls arranged to feed the wire into the apparatus, drive and control means comprising a continuously operable power source, a pair of alternately engageable clutches driven by said source at high and low speeds and connectable to a transmission shaft, a third clutch drivingly engageable between said transmission shaft and said apparatus, a timing element driven in a closed circuit by said apparatus, a cut-off member arranged to cut off a length of the coil formed by said apparatus, a first power shift element connected to advance and retract said cut-off member, a second power shift element connected to actuate said alternately engageable clutches, a third power shift element connected to engage and disengage said third clutch, first control means actuated by movement of said first power shift element to cut-off advanced position to reverse the first element and return the cut-off member to retracted position, second control means actuated by means operated by movement of said cut-off member to retracted position and connected to said second and third power elements to respectively engage the high speed clutch and engage the third clutch, a third control means actuated by said timing element at one point in its circuit and connected to said second power shift element to disengage the high speed clutch and engage the low speed clutch, a fourth control means actuated by said timing element at a succeeding point in its circuit and connected to said third power shift means to disengage said third clutch, and a fifth control means actuated by means operated by movement of said third clutch to disengaged posi-

tion and connected to said first power shift element to advance said cut-off member.

12. In a spring winding machine having apparatus for forming a continuous length of wire into a continuous spiral coil and including a pair of feed rolls constantly engaged on opposite sides of a wire and arranged to feed the wire into the apparatus, drive and control means comprising a continuously operable power source, a pair of alternately engageable clutches driven by said source at high and low speeds and connectable to a transmission shaft, a third clutch drivingly engageable between said transmission shaft and said apparatus, a timing element driven in a closed circuit by said apparatus, a pair of spaced abutments positioned to engage the sides of adjacent turns of the coil delivered by said apparatus, a cut-off member arranged to cut off a length of the coil against the first of said abutments and bend the end turn of the severed length into a substantially closed eye lying in the plane of the second of said abutments, a first power shift element connected to advance and retract said cut-off member, a second power shift element connected to actuate said alternately engageable clutches, a third power shift element connected to engage and disengage said third clutch, first control means actuated by movement of said first power shift element to cut-off advanced position to reverse the first element and return the cut-off member to retracted position, second control means actuated by means operated by movement of said cut-off member to retracted position and connected to said second and third power shift elements to respectively engage the high speed clutch and engage the third clutch, a third control means actuated by said timing element at one point in its circuit and connected to said second power shift element to disengage the high speed clutch and engage the low speed clutch, a fourth control means actuated by said timing element at a succeeding point in its circuit and connected to said third power shift means to disengage said third clutch, and a fifth control means actuated by means operated by movement of said third clutch to disengaged position and connected to said first power shift element to advance said cut-off members.

13. In a spring winding machine having apparatus for forming a continuous length of wire into a continuous spiral coil and including a pair of feed rolls constantly engaged on opposite sides of a wire and arranged to feed the wire into the apparatus, drive and control means comprising a continuously operable power source, a clutch drivingly engageable between said source and said apparatus, a timing element driven in a closed circuit by said apparatus, a pair of spaced abutments positioned to engage the sides of different turns of the coil delivered by said apparatus, a cut-off member arranged to cut off a length of the coil against the first of said abutments and bend the end turn of the severed length into a substantially closed eye lying in the plane of the second of said abutments, a first power shift element connected to advance and retract said cut-off member, a second power shift element connected to engage and disengage said clutch, first control means actuated by movement of said first power shift element to cut-off advanced position to reverse the first element and return the cut-off member to retracted position, second control means actuated by means operated by movement of said cut-off member to retracted position and connected to said second power element to engage the clutch, and a third control means actuated by said timing element at one point in its circuit and connected to said second power shift element to disengage the clutch.

14. In a spring winding machine having apparatus for forming a continuous length of wire into a continuous spiral coil and including a pair of feed rolls arranged to feed the wire into the apparatus, drive and control means comprising a continuously operable power source, a pair of alternately engageable clutches driven by said source at high and low speeds and connectable to a transmission shaft, said apparatus being connected to be driven at two speeds from said transmission shaft, a timing element driven in a closed circuit with said apparatus from said transmission shaft, a cut-off member arranged to cut off a length of the coil delivered by the apparatus, a first power shift element connected to advance and retract said cut-off member, a second power shift element connected to actuate said alternately engageable clutches, a first control means actuated by movement of said first power shift element to cut-off advanced position to reverse the first power shift element and return the cut-off member to retracted position, second control means actuated by means operated by movement of said cut-off member to retracted position and connected to engage the high speed clutch, a third control means actuated by said timing element at one point in its circuit and connected to said second power shift element to disengage the high speed clutch and engage the low speed clutch, and a fourth control means actuated by said timing element at a succeeding point in its circuit for initiating the operation of the cut-off member after the feed rolls have been decelerated to slow speed, said fourth control means including additional means connected to said first power shift element to advance said cut-off member.

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