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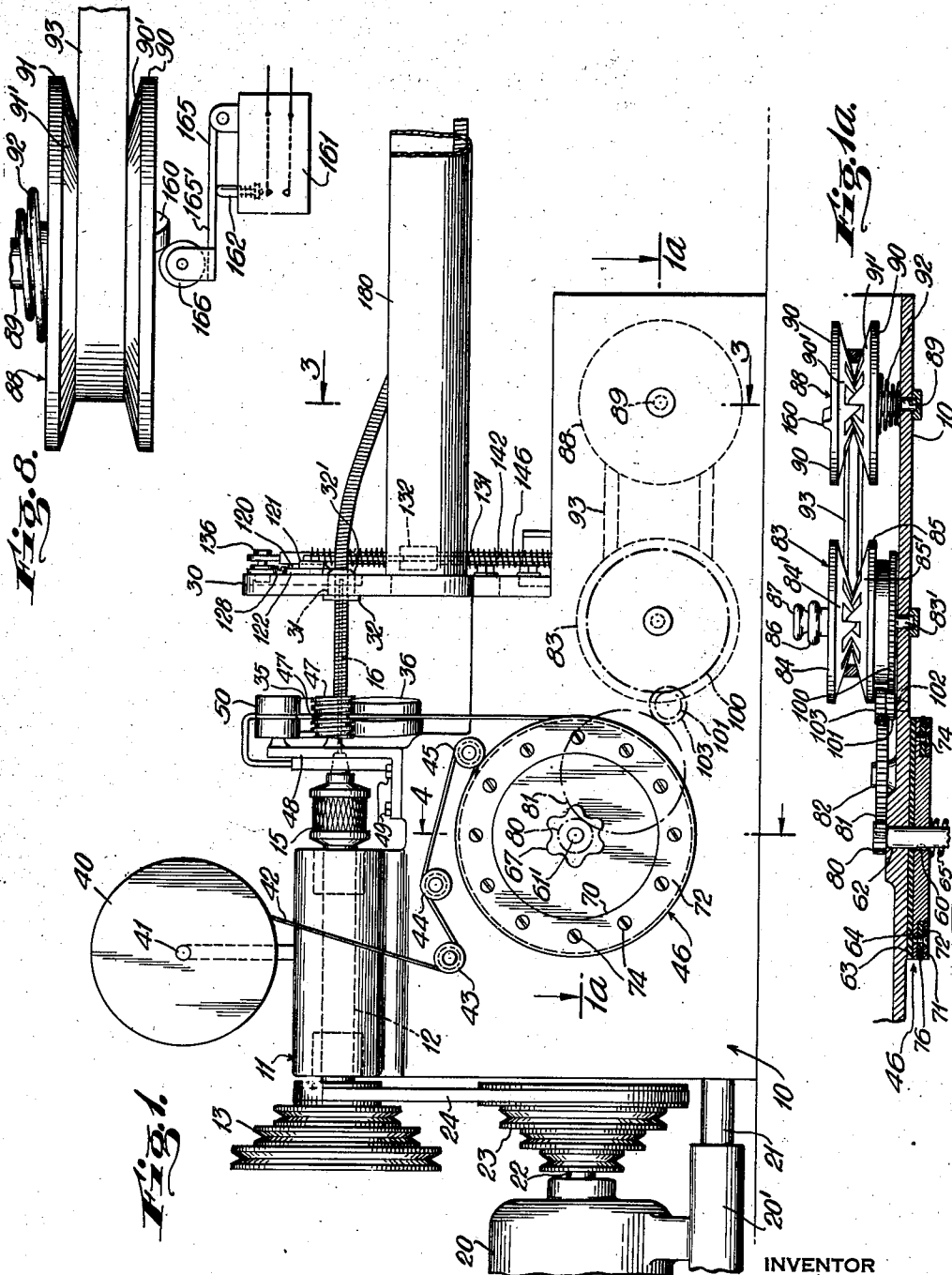
S. A. PLATT

2,260,053

AUTOMATIC COIL WINDING MACHINE

Filed Aug. 28, 1940

4 Sheets-Sheet 1



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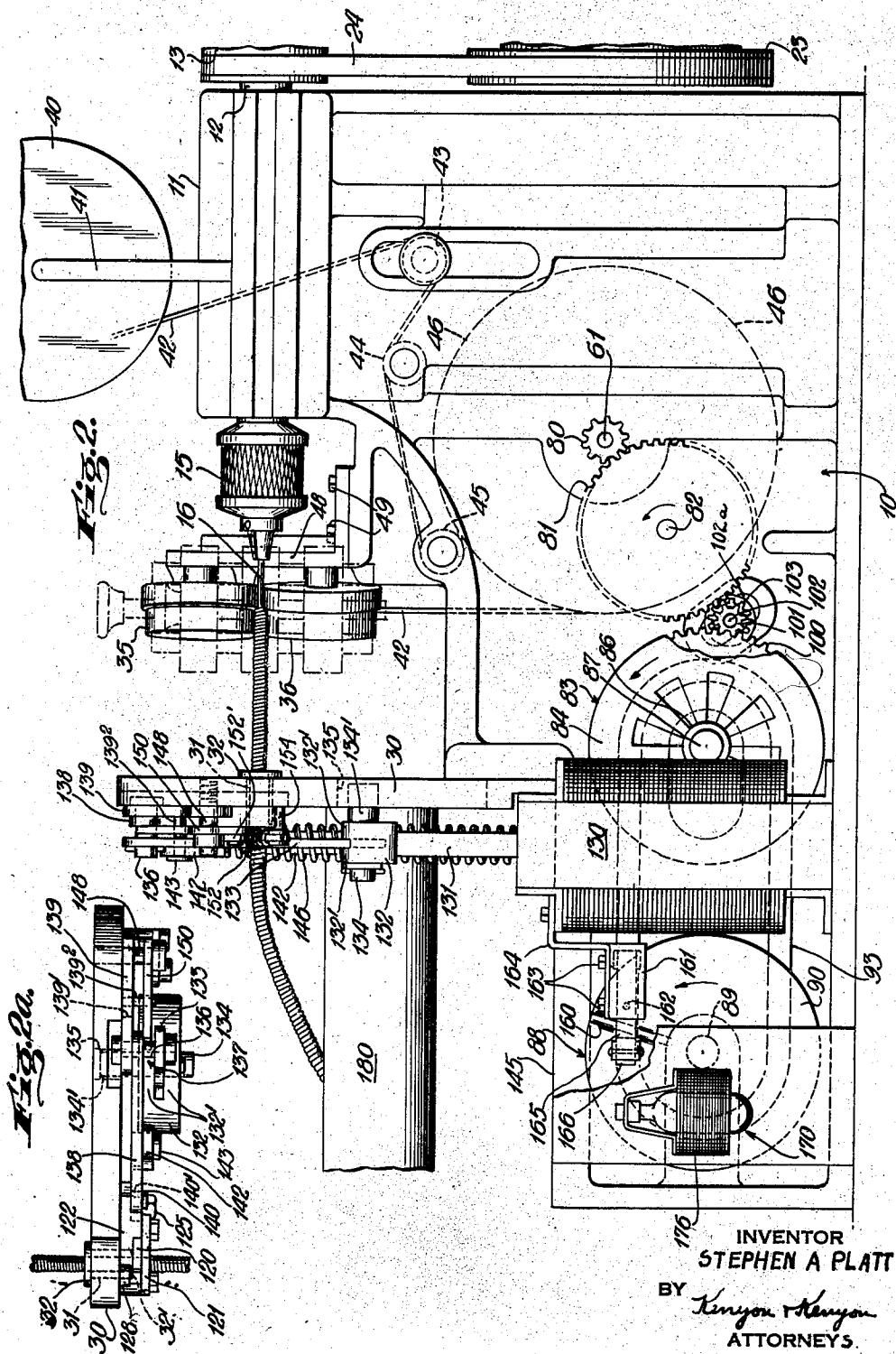
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AUTOMATIC COIL WINDING MACHINE

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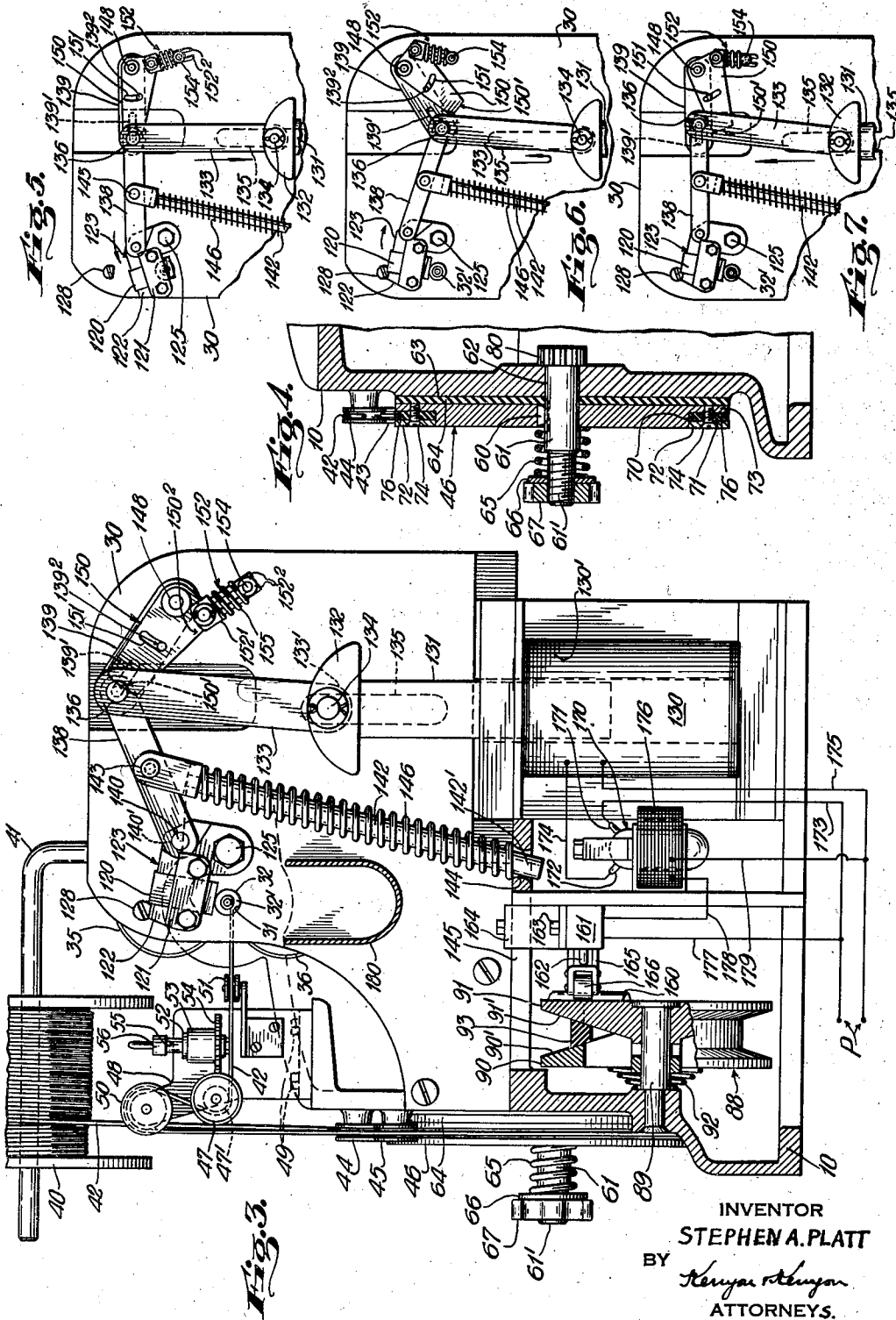
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AUTOMATIC COIL WINDING MACHINE

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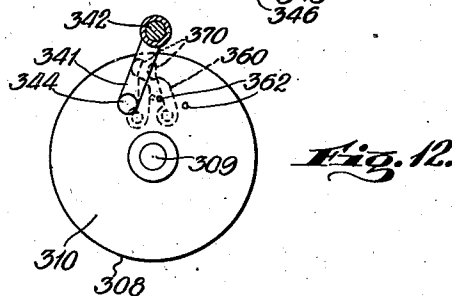
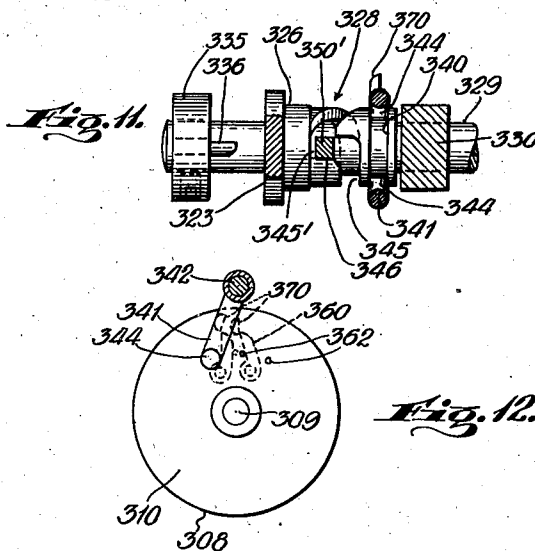
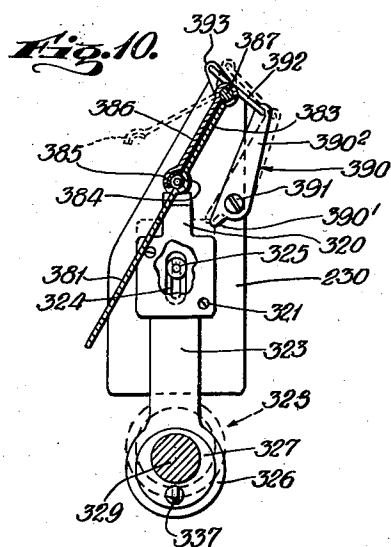
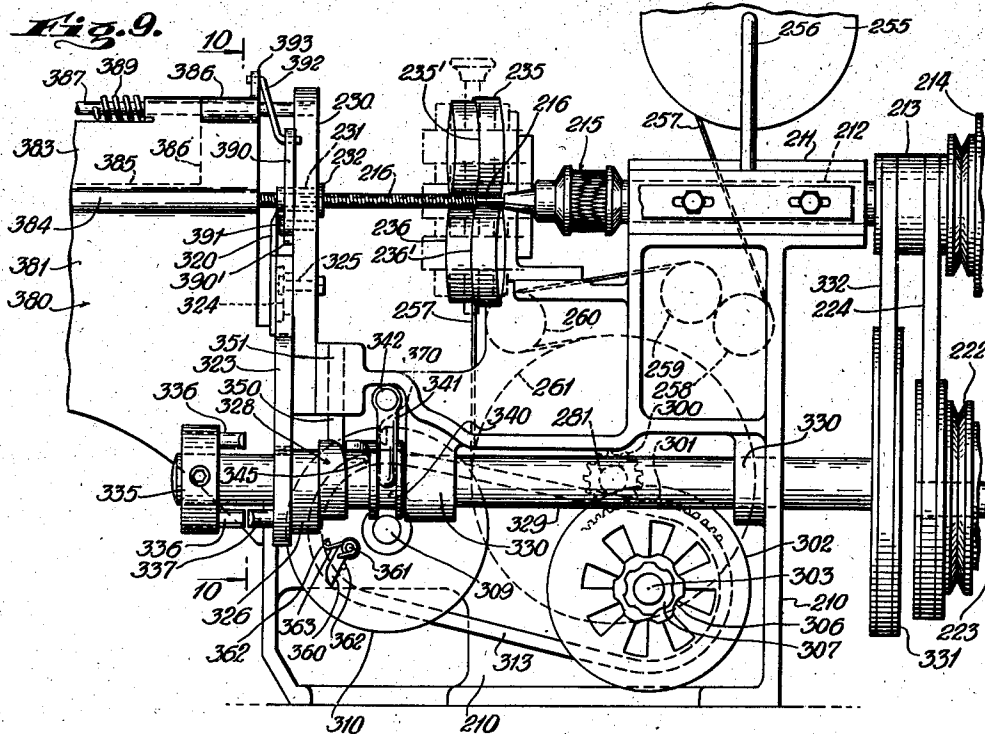
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AUTOMATIC COIL WINDING MACHINE

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4 Sheets-Sheet 4



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UNITED STATES PATENT OFFICE

2,260,053

AUTOMATIC COIL WINDING MACHINE

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Application August 28, 1940, Serial No. 354,474

16 Claims. (Cl. 153—64)

The present invention relates to automatic coil winding machinery, and more particularly to automatic machinery for manufacturing electrical resistance coils. The present application is a continuation in part of my co-pending application Serial No. 290,397, filed August 9, 1939, now United States Patent No. 2,227,602, issued January 7, 1941.

The automatic production of resistance coils on a quantitative basis requires a machine capable of producing coils of uniform physical and electrical characteristics. The coils produced should be uniformly wound and with small tolerances have the same electrical resistance ratings for a given length and wire size.

The importance of uniformity is so great that in some instances, where, for example, the resistance units operate very close to their melting point, the resistance coil units are X-rayed after being embedded in magnesium oxide, or the like, to check the spacings of the windings.

Unlike spring wire or steel wire, electrical resistance wire is soft or malleable and is not readily "pushed" or forced into coil form. It must be pulled or drawn into the desired form. Since the resistance per unit length of the wire depends upon its cross-sectional area, the pulling or drawing operation in winding of the coil must not stretch the wire, and thereby reduce its cross-sectional area and resistance. Moreover, the coiling machine must not otherwise deform the wire and thus alter its electrical characteristics.

The coil winding operation usually winds the adjacent turns of the coil in contact with each other. Thereafter, the coil is stretched to separate the adjacent turns. It is important to have uniform spacing between adjacent turns of the coil because lack of uniformity results in a concentration of heat in the region of the closest adjacent turns. If the coil is operating close to the melting point of its wire, such heat concentration at a "hot spot" between two turns which are too close results either in a quick fusing of the coil or quick deterioration thereof.

In my aforementioned co-pending application, I have disclosed in detail a machine for winding coil turns uniformly in such manner as to insure uniform stretching and uniform spacing between individual coil turns when stretched.

The operation of the machine therein described depends upon the fact that, if coil wire under necessary tension is led to a rotating polished mandrel having a comparatively low coefficient of friction, and wound around the lat-

ter under pressure from two freely rotating resilient biased rolls having high coefficients of friction, the wire will form a continuous coil of uniformly wound and spaced turns having a uniform pitch determined by the bias of the rolls. The coil turns will move along the mandrel and, after passing from the zone of pressure of the rolls, expand slightly so that the coil will slide freely along the major length of said mandrel and may then be cut off into predetermined lengths after leaving the mandrel.

Accurate automatic cut-off of predetermined lengths of coil formed on the machine embodying the principles disclosed herein and in my aforementioned co-pending application is an important feature for the quantitative rapid production of coils having given desired electrical characteristics. To achieve uniformity in rapidly manufactured large quantities of coils, it becomes essential that the cut-off mechanism associated with the coil winding machine operate within very close limits of accuracy. Such cut-off mechanism must also be capable of automatic operation, and, too, must be capable of adjustment and regulation so that differently sized predetermined coil lengths may be severed from the coil formed by the machine. Such cut-off mechanism, too, must be capable of quick adjustment during operation of the machine to compensate for variation in electrical characteristics of the coil wire wound in the machine. It is, therefore, a principal object of this invention to provide novel automatically operated cut-off mechanisms meeting the foregoing requirements.

While the cut-off mechanisms disclosed herein are shown applied to the type of coil-winding machine disclosed in my aforesaid co-pending application, it is an object of this invention to provide cut-off mechanisms applicable to other types of coil winding machines as well.

Another object of the invention comprises the provision of means for cutting off predetermined coil lengths during the winding of the coil without interfering with the winding operation. This cut-off mechanism must operate intermittently so as to sever, in highly accurate manner, coils having substantially uniform predetermined electrical and physical characteristics.

Another object of this invention is to provide both clutch controlled and electrically controlled types of cut-off mechanisms meeting the foregoing requirements.

Still another object of the invention is to provide special wear-resistant metering mechanism which serves to operate the cut-off mechanism

and which does not require frequent replacement or resurfacing.

A further object is to provide a machine adaptable for winding coils of differently sized wire, and for such coils to have desired different pitches.

It is another object of this invention to produce a successfully operating machine depending upon the principles of operation noted above which is efficient and which may be produced for commercial use at reasonable cost.

To the accomplishment of the foregoing and such other objects as may hereinafter appear, this invention consists in the construction and arrangement of parts hereinafter described, and then sought to be defined in the appended claims, reference being had to the accompanying drawings forming a part hereof and which shows, merely for the purpose of illustrative disclosure, preferred embodiments of the invention, it being expressly understood, however, that various changes may be made in practice within the scope of the claims without digressing from the inventive idea.

In the drawings, in which similar reference characters denote corresponding parts,

Figure 1 is a front elevational view of one form of my novel coil-winding machine;

Fig. 1a is a partial section taken along lines 1a—1a of Fig. 1 viewed in the direction of the arrows;

Fig. 2 is a rear elevation on an enlarged scale of the said machine shown in Fig. 1;

Fig. 2a is a plan view of the cut-off mechanism of Fig. 2;

Fig. 3 is a vertical section taken along line 3—3 of Fig. 1, viewed in the direction of the arrows, and illustrating the electrically controlled cut-off mechanism and part of the mechanism for receiving the wound coil;

Fig. 4 is a vertical section taken along line 4—4 of Fig. 1, viewed in the direction of the arrows;

Figs. 5, 6 and 7 are views on a smaller scale of the electrically controlled cut-off mechanism shown in Fig. 3 and illustrating successive operating positions thereof;

Fig. 8 is an enlarged detail of the means for controlling the electrical circuit of the cut-off means;

Fig. 9 is a rear elevational view of a modified form of machine in which clutch controlled mechanical cut-off means are employed;

Fig. 10 is a vertical section taken along line 10—10 of Fig. 9 and illustrating the cut-off mechanism and part of the guide mechanism for receiving the wound coil;

Fig. 11 is an enlarged detail view of the clutch control means for operating the mechanically controlled cut-off mechanism; and

Fig. 12 is a detail view of the yoke and clutch trip mechanism for operating the clutch means.

Referring now to the drawings and first to Fig. 1, 10 denotes generally a machine frame. This frame is provided with a bearing flange 11 which rotatably supports on suitable bearings the journal portion of an axle or shaft 12 which protrudes from each end of the flange 11. One end of the shaft has keyed to it the cone pulley wheel 13. This pulley wheel is provided with grooves to receive a correspondingly sectioned driving belt to be presently described. The opposite end of the shaft 12 is constructed to receive any standard form of chuck 15, that illustrated being a well-known key-tightening type. This chuck 15 is adapted to receive and support

horizontally by one of its ends a winding mandrel 16 upon which the wire is wound into coil form.

Suitable driving means for rotating the shaft 12 are provided. In the embodiment shown, a motor 20 has a swinging base 20' adjustably carried on a support rod 21 extending laterally from the machine frame 10. The rotor shaft 22 of the motor has a cone pulley wheel 23 fixed thereto and whose apex extends oppositely to that of cone pulley wheel 13. This pulley wheel 23 likewise has grooves shaped similarly to the grooves on the pulley 13 and a driving belt 24 passed around the two pulley wheels 23 and 13 serves to couple the motor and chuck-bearing axle or shaft 12, so that the motor drives the mandrel 16. Variability of speed is obtained by shifting the belt from step to step of the cone pulley wheels 13 and 23.

The frame 10 forwardly has an upwardly extending vertical flange 30 which has a bore 31 in axial alignment with the shaft 12. A tube 32 is fitted into this bore 31 and the free end of the mandrel extends into, but not through, the entire length of said tube whose diameter is so admeasured as to be only slightly in excess of the diameter of the wire coil wound on the mandrel, as will be presently described.

The rolls 35 and 36 (Fig. 2) of resilient material, such as rubber having a high coefficient of friction and which co-operate with the mandrel 16 in winding the coil, are supported from the frame 10 at diametrically opposite points with respect to said mandrel. These rolls which may be supported on the machine relative to the mandrel in the manner disclosed in my co-pending application 290,397, filed August 16, 1939, or in any other suitable manner, are movable toward and away from each other and the mandrel 16. They may be locked in any desired spaced position with respect to each other and the mandrel. Likewise the two rolls are normally biased with respect to each other and with respect to the mandrel axis and this bias may be varied at will. The mounting of these rolls is indicated in dot-dash line in Fig. 2 and the parts so shown are intended to represent the roll mounting means disclosed in my aforementioned application.

Wire for forming the coils is fed to the mandrel 16 from a spool 40. This spool is rotatably and removably carried on a spool spindle 41 suitably supported from the machine frame 10. The wire 42 from said spool is led around a pulley wheel 43, over a second pulley wheel 44, around a third pulley 45, and around substantially the major portion of the peripheral surface of a metering wheel 46. All of the wheels are rotatably supported on the front of the frame 10. The location of the turning center of the metering wheel and the diameter of the said wheel are so arranged that the wire leaves the surface of the metering wheel on the tangent which is perpendicular to the axis of the mandrel. The pulley wheels 43, 44 and 45, and particularly pulley wheel 45, are so positioned that the wire must pass from the latter around the major portion of the periphery of the metering wheel 46.

A worm gear wheel 47 (Figs. 1 and 3) having an annular guide groove 47' in its peripheral surface is rotatably supported from a bracket 48 with its axis horizontal and parallel to the mandrel 16 and so positioned that wire leaves the groove 47' thereof on a tangent substantially in the horizontal plane of the lower face of

said mandrel 16. The bracket 48 is carried by the frame 10 and attached thereto as by bolts 49. The groove 47' is substantially centrally located with respect to the widths of the rolls 35 and 36. The wire leaving the metering wheel surface is passed around a fourth pulley 50 also supported from the bracket 48, around the groove 47', and then past a vertical guide pulley 51 (Fig. 3), and finally between the bight formed by the mandrel 16 and the lower roll 36.

For efficient coil winding, it is desirable to lubricate only that surface of the wire which comes in direct contact with the surface of the mandrel 16. In the embodiment shown, the wire surface to be lubricated is the top surface of the wire 42 as it passes from the groove 47' to the vertical pulley 51. To this end, a hollow socket 52 is vertically and rotatably carried in a bearing flange 53 provided on the bracket 48. This socket is provided with an external gear 54 meshing with the worm gear 47. The hollow socket has a polygonal or other suitable section (not shown) and receives a polygonally or otherwise suitably shaped stick of lubricating medium 55, such as paraffin or other suitable substance. The lubricating stick is pressed against the top of the wire 42 either by its own weight or by the use of a slidably supported weight 56 which is suitably carried by the bracket 48. This weight is adapted to press downwardly on the upper end of the lubricating stick. The longitudinal axis of the lubricating stick is arranged to lie substantially perpendicular to the top face of the wire 42 and in the same plane therewith. Passage of the wire in the groove 47' rotates the worm wheel 47 and consequently causes rotation of the lubricating stick socket 52 through gear 54. As a result, the lubricating stick 55 rotates as the wire passes under it and wears down uniformly while lubricating only the one face of the wire 42 which comes into direct contact with the mandrel 16.

It is necessary to tension the wire 42 as it passes from the spool 40 to the mandrel 16 during the winding operation. This tensioning is accomplished herein through the agency of the metering wheel 46 (Figs. 1a and 4). The latter is slidably keyed at 60 to the rotatable shaft 61 borne in a bearing opening 62 in the front face of the frame 10. The said front face is provided with a pad surface 63 concentric about the bearing opening 62 and of substantially the same diameter as the metering wheel 46. A circular friction disc or mat 64 is mounted around the shaft 61 between the inner face of the metering wheel and the pad surface 63 and pressed between the two by the compression spring 65 carried on the shaft 61. The pressure of spring 65 is adjustable through the agency of the washer 66 (Fig. 4) and clamping nut 67, which latter threadedly engages the outer threaded end 61' of the shaft 61. This variability of pressure permits adjustment of the frictional resistance between the metering wheel and the frame and consequently permits variation in tension on the wire 42.

Since the wire passes over the peripheral surface of the metering wheel at high speed during the coil-winding operation, a special wear-resisting peripheral surface is necessary to eliminate the necessity for frequent replacement of the metering wheel and consequent readjustment of the machine, particularly because the metering wheel also serves to drive a novel cut-off mechanism whose accuracy must be main-

tained. To this end, the peripheral surface of the metering wheel has a portion 70 of reduced diameter. On the said reduced portion, a ring 71, preferably of rubber or of other suitable material, is mounted which is somewhat less in external diameter than the maximum external diameter of the wheel 46. A clamping ring 72, also mounted on said reduced portion 70, serves to clamp the said ring to the annular flange 73 of said metering wheel. Suitably spaced bolts 74 extending through said clamping ring, and rubber ring, and into said flange 73, serve to effect the said clamping. The rubber ring 71 may be replaced by other suitable resilient material having a high coefficient of friction. This ring, if of rubber, is compressed to about one-third of its original axial thickness by the clamping ring 72. Its peripheral surface is then slightly below that of the peripheral surfaces of the flange 73 and of the clamping ring 72 so that a groove 76 is provided in the peripheral face of the composite metering wheel in which the wire 42 travels. The friction between the wire 42 and the compressed rubber ring surface in conjunction with the retarding action of the friction pad 64 on the metering wheel surface affords an adjustable means for tensioning the wire. This specific metering wheel structure has been found to be exceedingly wear-resistant. In actual practice, hundreds of thousands of miles of wire run over such metering wheels have not required refacing thereof.

The rotation of the metering wheel caused by the passage of the wire 42 around it is used to control automatic electrically operated cut-off mechanism which serves to cut off predetermined lengths of wound coil. To this end, the metering wheel shaft 61 is provided with a pinion 80. The latter meshes with an idler 81 of larger diameter which is rotatably supported from the frame 10 by the spindle 82.

A pulley 83 of the variable speed type is rotatably supported on the frame 10 by the spindle 83'. This pulley has opposed inclined faces 84' and 85' on separate sections 84 and 85 which are adjustably movable toward or away from each other by means of a manipulating nut 86 and clamping nut 87.

A second variable speed type pulley 88 is rotatably borne on the spindle 89 carried by the frame 10. This pulley, too, has oppositely inclined faces 90' and 91' on separate sections 90 and 91, one of which is movable toward and away from the other by the action of, or against the action of, a compression spring 92 on the spindle 89 between one of the sections and the frame. This pulley 88 is coupled to the pulley 83 by a V-shaped belt 93 operating between the opposed faces of the respective pulley sections. The two pulleys and the belt constitute a variable speed drive of the "Reeves" type in which the rotational speed of the pulley 88 is adjusted by the relative adjustment of the opposing faces of the pulley 83. Pulley 83 is attached to and driven by a gear 100 carried on the spindle 83'. This gear meshes with an idler gear 101 rotatably supported from the frame 10 on the spindle 102. A second idler gear 103 rotatable with gear 101 on the spindle meshes with the idler gear 81 which in turn meshes with the gear 80 driven by rotation of the metering wheel. Thus rotation of the metering wheel through the gears 80, 81, 103, 101 and 100 drives the pulley wheels 84 and 88. Thus, it is possible to vary the lengths of the coils cut off with infinite variation with-

in the limits of the variable speed drive by the electrically-operated cut-off mechanism now to be described.

The electrically-operated cut-off mechanism comprises a reciprocally rotatable knife blade 120 capable of movement transversely of the axis of the mandrel 16 and the coil wound thereon. This knife blade 120 is adapted to move across the outer end of the tube 32 which has a cambered end 32' and to sever the wound coil whenever so moved. The knife blade is removably clamped by clamping plate 121 to one arm 122 of a double armed crank lever 123 which is pivotally supported at 125 from the machine frame flange 30 in such manner that rotation of the crank lever about the pivotal support 125 causes the knife 120 to sweep across the cambered end 32' of the tube 32 to sever wound coil emerging therefrom. The knife blade is adapted to bear reasonably tightly against the cambered end 32' of the tube 32 during the sweeping cutting stroke across the same to obtain the required shearing of the coil.

Cutting strokes of the knife may be imparted to the knife by electrically controlled apparatus. This apparatus in the embodiment shown in Fig. 3 comprises a solenoid 130 provided with a movable solenoid core or plunger 131 which, in the embodiment shown, is adapted to move vertically. A cross head 132 on the upper end of the plunger 131 limits the downward stroke of the plunger when the coil is energized in a manner to be presently described. The cross head is forked as shown in Figs. 1, 2 and 2a to receive one end 133' of a connecting link 133 between its tines. This link is pivotally supported between the tines 132' by a pivot pin 134 extending transversely through the tines and projecting laterally at 134' and into a vertical guide slot 135 provided in the flange 30. This guide slot serves to insure vertical motion of the plunger and its cross head and limit upward motion thereof.

The link 133 is connected by a pivot pin 136 to two oppositely extending links 138 and 139. The pivot pin 136 and arrangement of the linkage is such as to provide a clearance space 137 (Fig. 2a) between the link 133 and the links 138 and 139 for a purpose to be presently described.

Link 138 is pivotally attached at 140' to a pivot pin 140 supported on the crank lever 123. A downwardly extending plunger rod 142 is pivotally connected at 143 to the link 138. The lower end 142' of the rod is adapted to extend through an opening 144 in a flange 145 of the frame 10. The opening 144 is so admeasured as to permit free sliding and angular movement of the rod during operation of the device for a purpose to be presently described. A suitable compression spring 146 serves to urge the rod upwardly at all times.

A stop pin 128 suitably supported by the flange 30 and extending in the path of rotation of said crank lever 123 limits its rotary motion in clockwise direction.

The link 139 is provided with a longitudinally extending slot 139' in which the pivot member 136 may freely move for a purpose to be presently described. At its other end, link 139 is pivoted to a fixed pivot member 148 suitably carried by the flange 30.

A snap locking member 150 is also pivotally supported from the pivot member 148 in spaced relationship relative to the link 139 (Fig. 2a). This locking member is independently rotatable

relative to the link 139 and so admeasured in length that when the link 139 and said member are in parallel relationship, the free end 150' of said locking member extends into the space 137 between links 133 and 138 and bears against the pivot pin 136 maintaining it at the outer end of slot 139' most remote from pivot member 148. This locking engagement establishes a fixed arm ratio between the linkage members 133, 138 and 139 necessary to effect a severing movement of the blade 120 upon energization of the solenoid 130, in a manner to be presently described.

The locking member has an arcuate slot 151 whose center of curvature is the pivot member 148. A limiting pin 139' on the link 139 extends into this slot and limits relative rotation of the link 139 and locking member 150 with respect to each other. The locking member also has a lateral flange 150' adjacent the pivot 148.

A snap toggle assembly 152 is attached to this flange for the purpose of snap swinging of the locking member relative to the link 139 to cause engagement and disengagement of the end 150' of the member 150 with the pivot pin 136. This snap toggle assembly comprises a member having a head 152' and longitudinally extending parallel tines 152'. The tines are slidable longitudinally of and are rotatable about a fixed pivot pin 154 supported by the flange 30.

A compression spring 155 surrounds the tines between the head 152' and the pivot pin 154 and urges the said head away from the pivot pin 154.

The relative spacing and arrangement of the pivots 148 and 154 on the flange 30 is such that counterclockwise rotation of the locking member 150 and the link 139 from the position shown in Fig. 3 moves the toggle head 152' toward the pivot pin 154 and at the same time gives it clockwise rotation about said pivot pin. During this rotation, the spring 155 maintains the locking member 150 in parallel relationship with the link 139 until the forked toggle member 152 rotates past its upper dead center, whereupon the spring 155 thereof exerting leverage action on the flange 150' rotates the locking member in counterclockwise direction with a snapping motion in advance of the link 139 to the position shown in Fig. 6. Such advanced rotation of the locking member causes the end 150' thereof to disengage the pivot member 136 so that it may slide in the slot 139' toward the inner end of the latter as shown in Fig. 7. Upon return of the parts to the position of Fig. 3, the toggle action operates in reverse and serves to snap the locking member back into the position shown in this figure.

The arrangement and spacing between the pivot member 148 and pivotal support 125 as well as the dimensional characteristics of the links 133, 138 and 139 is such that the following action takes place upon energization of the solenoid.

Such energization draws the plunger 131 downwardly into solenoid 130. Such downward movement draws the link 133 downwardly, causing links 138 and 139 to assume the horizontal position shown in Fig. 5 at maximum arm ratio. This imparts counterclockwise rotation to the knife-carrying crank lever 123 of such extent that the knife 12 sweeps downwardly across the cambered end 32' of the tube 32 and severs the coil emerging therefrom. After the severing sweep has been accomplished, further downward movement of the plunger 131 continues. This carries or moves the links 138 and 139 to the position shown in Fig. 6. In assuming this position, the link 138 having passed horizontal dead

center acts positively to cause clockwise rotation of the crank lever 123, causing the knife blade 120 to sweep back across the tube into the non-cutting position above the tube 32 as shown in Fig. 6. At the same time, the toggle 152 having passed its upper dead center position snaps the locking member 150 in advance of link 139 as shown and out of engagement with the pivot 136 so that the latter is free to move in the slot 139'. As soon thereafter as the solenoid 130 is de-energized, the plunger 131 begins to move upwardly as shown in Fig. 7 under action of spring 142. However, since the pivot pin 136 now can slide freely in the slot 139' because of disengagement of the locking member 150 from behind it, it moves toward the right of Fig. 7, so that in the upward stroke of the plunger 131 under actuation of the spring 142, the combined length of links 138 and 139 is insufficient to cause any rotation of the blade crank lever 123. With the return, however, of the plunger 131 to the position shown in Fig. 3, the pivot member 136 again moves to the left or outer end of slot 139' and the toggle again having passed its upper dead center again snaps the locking member 150 into locking position, i. e., parallel relationship with the link 139 and into engagement with the pivot 136 so that on down stroke the knife will be swept once across the tube end 32' in each direction. This actuation of the linkages repeats for each energization and de-energization of the solenoid 130.

Energization and de-energization of the solenoid 130 is accomplished by an electric circuit controlled through rotation of the metering wheel 46.

To this end, a nose flange or cam member 160 is provided on the face of the section 90 of the pulley 88 (Figs. 1a, 3 and 8). A two pole electric control switch 161 of any standard type and preferably having a movable contact pole operated by a plunger rod 162 is mounted at 163 to a bracket arm 164 supported from the frame flange 145 in such position that the rod faces the pulley wheel section 90. An arm 165 carrying a rotatable cam follower or roller 166 is pivotally supported from the switch 161 and with its rearward face 165' abuts the end of plunger rod 162. The cam follower or roller 166 is so positioned to roll on the surface of the section 90 in the path of rotation of the nose flange or cam member 160, during which period the switch is open. Passage of the flange under the roller 166 will move the roller and arm and consequently the plunger rod 162 longitudinally to close the switch circuit. As soon as the cam flange has cleared the roller, the latter returns under suitable spring actuation into abutting relationship with the surface of the wheel 90 and the switch is reopened.

A two-pole mercury switch 170 of standard type serves to supply current from a power source P to the field coil 130' of the solenoid, the poles 171 and 172 of this switch normally in open circuit being in simple electrical series connection with the field coil 130' and power source P through the wires 173, 174 and 175. The mercury switch is closed by energization of an operating coil 176 which is in simple series circuit with the poles of the control switch 161 and the power source P through the wires 177, 178 and 179.

Operation of the circuit is as follows: Closure of the control switch 161 under actuation of the nose or flange 160 causes pilot current to flow from one terminal 1 of the power source P through the wire 177, the pilot switch 161, the

wire 178, the operating coil 176, and the wire 179 to the second terminal 2 of the power source. This pilot current flowing in the coil 176 closes the power circuit through the mercury switch 170 permitting power current to flow from one terminal 1 of the power source, through the wire 173, through the switch poles 171, 172, through the wire 174, through the solenoid coil 130', through the wire 175 to the second terminal 2 of the power source energizing the solenoid coil 130' to operate the solenoid plunger as hereinbefore described. Opening of the pilot switch de-energizes the mercury switch coil 176 and consequently opens the mercury switch de-energizing the solenoid coil 130'. The mercury switch remains closed only so long as the mercury switch coil 176 is energized which, as seen, depends upon the period of engagement of the nose or flange 160 with the roller 166.

In the embodiment shown, movement imparted to the nose or flange 160 acts as a trip and the latter is adapted to close the pilot switch 161 once for each revolution of the section 90 of pulley wheel 88. Therefore, the speed of rotation of said wheel determines the frequency of actuation or energization of the solenoid 130 and in consequence the cutting-off action of the blade 120 through the linkage mechanism hereinbefore described. In consequence, the frequency of cut-off action can be controlled by changing the speed of the pulley wheel 88.

The electrically controlled cut-off mechanism operated by rotation of the metering wheel is positive in its action and eliminates any irregularity in coil lengths cut off by the blade 120. There is no danger of double tripping. Simple infinitely variable adjustment of the variable speed pulley 83, which through the belt 93 drives the pulley 88 and is driven by rotation of the metering wheel 46 through the gears 80, 81, 103, 101 and 100 thus permits an infinitely variable change within the limits of the variable speed mechanism in the length of coil cut-off by changing the relative frequency of cut-off action as compared to the speed of coiling of the wire.

The lengths of coil emerging from the tube 22 which are severed by the blade 120 drop into a tray or basin 180 carried by the frame below the exit end of said tube.

Operation of the machine in brief is as follows:

Wire 42 from the spool 40 is led over the various pulleys 43, 44, 45, metering wheel 46, pulley 50 and around groove 47' of gear 47 and past pulley 51 to the bight between the lower rubber roll 36 and the mandrel 16. Then the shaft 12 and, consequently, the mandrel 16 are given a few manual rotations to start the wind on the mandrel. The rolls 35 and 36 are given the desired opposing biases with respect to each other and moved toward each other until they both press firmly on the wire-windings on the mandrel and are clamped in this position. The motor is then started, causing the mandrel 16 to rotate at high speed. The coefficient of friction between the mandrel and the wire, aided by the pressure of the lower roll 36, is sufficient to draw the wire from the spool and coil it about the mandrel. The bias of the rolls 35 and 36 determines the pitch of the wind and forces the windings to move along the mandrel and clear of the rolls 35 and 36. Once clear of the rolls, the turns on the mandrel expand slightly and slide freely along the mandrel surface in axial direction toward the guide tube, passing off the mandrel in the tube 22. The lubricant applied by stick 55 to the face

of the wire adjacent the face of the mandrel facilitates the sliding of the coil along the mandrel. At intermittent periods controlled by the trip cam 160, as hereinbefore described, the cut-off knife sweeps across the exit end of tube 32 cutting off predetermined lengths of coil which fall into the tray or basin 180 at the time of severance. The adjustable ratio of speed between the coiling speed of the mandrel and the rotational speed of the trip cam 160 determines the length of coil cut-off. This ratio can be adjusted with a high degree of accuracy to insure highly accurate cut-off of uniform predetermined lengths of coil.

In the embodiment shown, the rolls 35 and 36 have respectively the annular shoulders 35' and 36' at the mid-points of their surface peripheries. These shoulders produced by slightly reducing the diameter of the respective rolls on one side of the respective shoulders facilitate the guiding of the wire at the desired pitch angle during the coiling operation. The shoulder height depends upon the wire size and in cases of very small-sized wire can be eliminated. For the larger wire sizes, however, the shoulder is important.

Idler gears 101 and 103 are, in fact, portions of a compound gear supported on the shaft 102. The position of the latter is adjustable in the slot 102a in the frame 10 to permit a changed gear ratio if desired.

The adjustability of the speed of drive of various parts, the adjustability of tension by the metering wheel, as well as the adjustability of the pressure and degree of bias of the rolls 35 and 36 makes the machine adaptable for making accurate coils of any desired predetermined length and of desired different wire sizes.

The material of the mandrel is optional as long as it is wear-resistant and has a low coefficient of friction. "Nitrided" steel mandrels have been found satisfactory.

In some instances, it may be desirable to replace the electrically controlled cut-off mechanism described with respect to the machine of Figs. 1-8 inclusive by a modified form of clutch controlled mechanical cut-off mechanism. Such mechanism is illustrated in Figs. 9-12 inclusive.

Referring now to these drawings and first to Fig. 9, 210 denotes generally a machine frame. This frame is provided with a bearing flange 211 which rotatably supports on suitable bearings the journal portion of an axle or shaft 212 which protrudes from each end of the flange 211. One end of the shaft has keyed to it the pulley wheel 213 and the cone pulley wheel 214, each pulley wheel being provided with grooves to receive correspondingly sectioned driving belts to be presently described. The opposite end of the shaft 212 is constructed to receive any standard form of chuck 215, that illustrated being a well-known key-tightening type. This chuck 215 is adapted to receive and support horizontally by one of its ends a winding mandrel 216 upon which the wire is wound into coil form.

Pulley 214 is suitably driven as by a belt connected with pulley 222 supported on a drive shaft 223 of a motor (not shown). This pulley wheel 222 likewise has grooves similar to those of pulley 214. A driving belt 224 is passed around the two pulley wheels 222 and 214 and serves to couple the motor axle 223 and the chuck-bearing axle or shaft 212, so that the motor may drive the mandrel 216. Variability of speed is obtained by shifting the belt from step to step of the cone pulley wheels 214 and 222.

The frame 210 forwardly has an upwardly extending vertical flange 230 which has a bore 231 in axial alignment with the shaft 212. A tube 232 is fitted into this bore 231 and the free end of the mandrel extends into, but not through, the entire length of said tube whose diameter is so admeasured as to be only slightly in excess of the diameter of the wire coil wound on the mandrel, as will be presently described.

The rolls 235 and 236 of resilient material, such as rubber having a high coefficient of friction and which cooperate with the mandrel 216 in winding the coil, are supported from the frame 210 at diametrically opposite points with respect to said mandrel. These rolls are supported and operated in the same manner as the rolls 35 and 36 of the machine illustrated in Figs. 1-8 inclusive.

Wire for forming the coils is fed to the mandrel from a spool 255. This spool is rotatably and removably carried on a spool spindle 256 suitably supported from the machine frame. The wire 257 from said spool is led around a pulley wheel 258, over a second pulley wheel 259, around a third pulley wheel 260, and around substantially the major portion of the peripheral surface of a metering wheel 261. All of the wheels are rotatably supported suitably on the front of the frame 210. The location of the axis of the metering wheel and the diameter of the latter are so arranged that the wire leaves the surface of the metering wheel on the tangent which is perpendicular to the axis of the mandrel 216. The pulley wheels 258, 259 and 260, and particularly pulley wheel 260, are so positioned that the wire must pass from the latter around the major portion of the periphery of the metering wheel 261. The wire is led from the metering wheel to the bight between the mandrel 216 and the biased roll 236 in exactly the same way the wire 42 is fed to the bight between the mandrel 16 and roll 36 of the modification of Figs. 1-8 inclusive, being lubricated on its upper surface in the same way and by the same type of means as that shown in Fig. 3.

It is necessary to tension the wire 257 as it passes from the spool 255 to the mandrel 216 during the winding operation. This tensioning is accomplished herein through the agency of the metering wheel 261 in the same manner as that described with respect to the metering wheel 46 of the first modification and illustrated clearly in Fig. 4.

Since the wire passes over the peripheral surface of the metering wheel at high speed during the coil-winding operation a special wear-resisting peripheral surface is necessary to eliminate the necessity for frequent replacement of the metering wheel and consequent readjustment of the machine, particularly because the metering wheel also serves to drive a special cut-off mechanism whose accuracy must be maintained. To this end, the specific metering wheel structure described with respect to the first embodiment is embodied in this modification as well.

The rotation of the metering wheel 261 caused by the passage of the wire over its prepared periphery is used to drive automatic clutch controlled cut-off mechanism which serves to cut off predetermined lengths of wound coil. To this end, the wheel shaft 281 is provided with a pinion 300. The latter meshes with a pinion 301 of larger diameter attached to a pulley wheel 302, which latter is rotatably supported from the frame 210 by the spindle 303. The pulley 302 is of the variable speed type, and has the same

structure as the pulley wheel 88 of the first modification. It has opposed inclined faces on separate sections which are adjustably movable toward or away from each other by means of a manipulating nut 306 and clamping nut 307.

A second variable speed type pulley 308 is rotatably borne on the spindle 309 carried by the frame 210. This pulley has the same structure as the pulley wheel 88 of the first modification. It has oppositely inclined faces on separate sections, one of which is movable toward and away from the other by the action of, or against the action of, a compression spring (not shown) on the spindle 309 between one of the sections and the frame. This pulley 308 is coupled to the pulley 302 by a belt 313 operating between the opposed faces of the respective pulley sections. The two pulleys and the belt constitute a variable speed drive of the "Reeves" type in which the rotational speed of the pulley 308 is adjusted by the relative adjustment of the opposing faces of the pulley 302. Thus, it is possible to vary the lengths of the coils cut off by the mechanism now to be described.

The cut-off mechanism comprises a reciprocally movable knife blade 320 movable transversely of the axis of the mandrel 216 and the coil wound thereon. This knife blade 320 is adapted to move across the outer end of the tube 232 and sever the wound coil whenever so moved. The knife blade is removably attached at 321 to the connecting rod 323. This connecting rod is provided with a longitudinal slot 324 and a headed guide pin 325, engageable in the vertical arm 230 which serves to guide the vertical movement of the connecting rod. The latter at its lower end has a bearing 326. An eccentric 327 integrally formed with a clutch member 328 operates in the bearing and serves upon rotation to reciprocate the connecting rod and the blade carried thereby.

The clutch member 328 is rotatably borne and slidable longitudinally on a rotary shaft 329 suitably journaled in bearings 330 in the frame 210. This shaft extends parallelly to shaft 212 and at one end has a driving pulley 331. Belting 332 connects this driving pulley with the pulley 213 on shaft 212 so that when the latter is driven, the shaft 329 is likewise driven. In the embodiment shown, the pulley ratio of the diameters of pulleys 213 and 331 is such that shaft 329 is driven at a lower speed than shaft 212. The opposite end of shaft 329 has a collar 335 fixed thereto. This collar has two diametrically arranged, axially extending, engaging pins 336, one or the other of which is adapted to engage an oppositely extending pin 337 on the eccentric 327 when the latter and the clutch member 328 are moved into one position on the shaft 329, thereby serving to drive the eccentric and reciprocate the connecting rod. In another position of the eccentric 327 and clutch member 328 on the shaft, the pins 336 clear the pin 337 without engaging it and do not drive the eccentric.

The intermittent engagement of the pins 336 and 337 is such that a single revolution of the clutch 328 and eccentric, and, consequently, a single reciprocation of the connecting rod, takes place for each single revolution of the pulley 308.

To effect the intermittent engagement, the clutch member 328 has an annular yoke groove 340. A U-shaped yoke 341 is pivotally supported on a spindle 342 attached to the frame 210 and extending transversely of the shaft 329 so that

the yoke 341 swings longitudinally of said shaft. The yoke has oppositely extending lugs 344 which permanently engage in the yoke groove 340. When the yoke is swung about its spindle 342, the lugs in the groove 340 serve to shift the clutch member 328 longitudinally on the shaft 329.

The clutch member 328 (Fig. 11) has a single-turn, helical cam groove 345 in its peripheral face whose beginning and end are connected by a longitudinally extending passageway 345' which serves to define a shoulder 346 at the exit end of the cam groove and adjacent its entry end.

A cam groove follower 350 of substantially square cross section is suitably supported in vertical direction at 351 from the frame 210. The lower end 350' of the follower is adapted to engage in the cam groove 345 and normally to abut the shoulder 346 at the exit end of said groove. While so positioned, the clutch member is locked against rotation and the pin 337 is clear of the pins 336. In the embodiment shown, a shift of the clutch member 328 to the left will cause the follower 350 to clear the shoulder and enter the starting end of the cam groove, thus freeing the clutch member and permitting it to rotate. This tripping action is effected by a trip lever 360 (Figs. 9 and 12) carried on a face of the section 310 of the pulley wheel 308. Trip lever 360 is pivoted at one end to the face of said section by a pivot pin 361. Stop pins 362 also projecting from the face of said section serve to limit rotation of the trip lever about its pivot pin and a resilient member 363 serves to urge said lever against the forward stop pin in the direction of rotation of the pulley section 310.

The yoke 341 has a lug 370 projecting laterally into the path of travel of the trip lever 360. As the lever moves upon rotation with the pulley section 310, its free end engages the lug 370 causing the said lever to move back against the rear stop pin 362 whereupon said lever rotates the yoke 341 and slides the clutch to the left until the cam follower 350 clears the shoulder 346 and enters the start of cam groove 345. At this instant of clearance one of the pins 336 engages the pin 337 of the eccentric and starts to rotate the latter and the clutch member of which it is part while the follower moves in the groove 345. In so doing it, of course, follows the helical angle of the said groove and shifts the clutch still further to the left moving with it the yoke 341 into a release position (Fig. 12), where the trip lever 360 disengages the lug and is snapped by resilient member 363 to the front stop pin 362 and clear of the lug 370. The follower moving in the cam groove as the clutch rotates then causes the clutch to shift toward the right so that after a single revolution when said follower again abuts the shoulder 346, the clutch member has been so shifted that its pin 337 has disengaged the pins 336. Thus, a single rotation only of the clutch member 328 occurs each time the trip lever engages the lug 370. The latter engagement occurs once for each revolution of section 310 of pulley wheel 308. Therefore, the speed of rotation of said wheel determines the frequency of single rotations of the clutch member. In consequence, the frequency of the single reciprocations of the knife blade 320, which is reciprocated once for each revolution of the eccentric 327, is controlled and the lengths of coil cut off can be controlled by changing the speed of the pulley wheel 308.

The clutch-operated cut-off mechanism driven by rotation of the metering wheel is positive in

its action and eliminates any irregularity in coil lengths. There is no danger of double tripping. Simple adjustment of the variable speed pulley 302 permits infinite change with the range of the variable speed device in the length of coil cut-off by changing the relative frequency of cut-off action as compared to the speed of coiling of the wire.

The coil formed on the mandrel and moved off the latter at its forward end passes through the tube 232 and is received by a guide 380. This guide 380 comprises an arm 381 suitably attached to the frame 210. The upper portion 383 of this arm is provided with a semicircular groove 384 extending in the same direction as said mandrel 216 and concentric with respect to the axis of said mandrel. A semicircular tube 385 having lateral arms 386 is rotatably supported by these arms from a pivot spindle or rod 387 carried by the vertical flange 230 and extending parallel to the groove 384. The concavity of tube 385 faces that of the groove 384 and the two function when in register as a tubular guide for the coiled wire passing thereto from the mandrel. Resilient means as a torsion spring 389 acting on the rod 387 and an arm 386 tend to maintain the tube 385 in registry with the groove 384.

When a length of coil is cut off from that being wound on the mandrel, it is desirable to effect quick removal thereof from the guide 380. To this end, a crank lever 390 is pivotally mounted on a pivot pin 391 carried by the vertical arm 230. One arm 390' of the lever extends into the path of travel of the connecting rod 323. The other arm 390² is connected by a linkage member 392 to a projecting lug 393 on one of the arms 386 supporting the tube 385. Thus, as the connecting rod reaches the top of its stroke, shown in dotted lines in Fig. 10, its upper edge engages the arm 390' of lever 390 and rotates the latter to the dotted line position causing the linkage member 392 to rotate the arm 386 and tube 385 to the dotted position shown and permits the severed coil to fall from the groove 384. The impact of the cut-off stroke of the blade is sufficient to dislodge the severed coil section from said groove. Spring 389 returns the tube 385 to full line position of the figure when the connecting rod returns to non-cutting-off position.

The guide 380 and its associated mechanism may be replaced by a simple receiving tray similar to the tray 180 of the first modification.

Operation of this modified form of machine, in brief, is as follows:

Wire 257 from the spool 255 is led over the various pulleys 258, 259, 260, metering wheel 261, and thence to the bight between the lower rubber roll 236 and the mandrel 216. Then the shaft 212 and, consequently, the mandrel 216, are given a few manual rotations to start the wind on the mandrel. The rolls 235 and 236 are given the desired opposing biases with respect to each other and moved toward each other until they both press firmly on the wire-windings on the mandrel and are then clamped in this position. The machine is then started, causing the mandrel 216 to rotate at high speed. The coefficient of friction between the mandrel and the wire, aided by the pressure of the lower roll 236, is sufficient to draw the wire from the spool and coil it about the mandrel. The bias of the rolls 235 and 236 determines the pitch of the wind and forces the windings to move along the mandrel and clear of the rolls 235 and 236. Once clear of the rolls, the turns on the mandrel ex-

pand slightly and slide freely along the mandrel surface in axial direction toward the guide 380, passing off the mandrel in the tube 232 on the way to said guide. The lubricant applied (as described with respect to the first modification) to the face of the wire adjacent the face of the mandrel facilitates the sliding of the coil along the mandrel. At intermittent periods controlled by the trip lever 360, as hereinbefore described, the cut-off knife 320 sweeps across the exit end of tube 232 cutting off predetermined lengths of coil which fall from the opened guide 380 at the time of severance. The adjustable ratio of speed between the coiling speed of the mandrel and the rotational speed of the trip lever 360 on pulley section 310 determines the length of coil cut-off. This ratio can be adjusted infinitely within the limits of the variable speed drive and with a high degree of accuracy to insure highly accurate cut-off of uniform predetermined lengths of coil.

In the embodiments shown, the rolls 235 and 236 have respectively the annular shoulders 235' and 236' at substantially the midpoints of their surface peripheries. These shoulders produced by slightly reducing the diameter of the respective rolls on one side of the respective shoulders facilitate the guiding of the wire at the desired pitch angle during the coiling operation. The shoulder height depends upon the wire size and in cases of very small-sized wire can be eliminated. For the larger wire sizes, however, the shoulder is important.

The adjustability of the speed of drive of various parts, the adjustability of tension by the metering wheel, as well as the adjustability of the pressure and degree of bias of the rolls 235 and 236 makes the machine adaptable for making accurate coils of any desired predetermined length and of desired different wire sizes.

The special metering wheel construction, in both modifications, including its specially constructed wear-resisting peripheral surface, eliminates a source of error normally induced by wear and also eliminates the necessity for frequent readjustment of the machines during the preparation of a particular length of coil of a particular wire size.

The variable biasing of the rubber rolls permits the winding of differently pitched coils.

Various other advantages are inherent in the structure described. It is to be understood, however, that variations in structural features within the scope of the appended claims may be made without departing from the inventive idea. There is no intention of limitation to the exact details of construction shown and described.

I claim:

1. In a coiling machine, means for cutting off lengths of coil from the coil formed therein without impeding the coil forming operations comprising a severing member, periodic means for operating said severing member, and linkage means between said severing member and said operating means, said linkage means being so arranged as to provide a single cutting stroke and a single power return stroke of said severing member in one phase of operation of said periodic means and to maintain said severing member inactive during the entire return phase of operation of said operating means.

2. In a coiling machine, means for cutting off lengths of coil from the coil formed therein without impeding the coil forming operations comprising a severing member, means for periodical-

ly operating said severing member, linkage means between said severing member and said operating means, and means in conjunction with said linkage means for automatically changing the linkage ratios thereof during actuation of said linkage means so as to provide a single cutting stroke and a single power return stroke of said severing member in one phase of operation of said periodic means and to maintain said severing member inactive during the entire return phase of operation of said operating means.

3. In a coiling machine, means for cutting off lengths of coil from the coil formed therein without impeding the coil forming operations comprising a severing member, means for periodically operating said severing member, said means having a going and a return stroke, linkage means between said severing member and said operating means and toggle controlled means in conjunction with said linkage means for changing automatically the linkage ratios of said linkage means during periods of the operation thereof so as to effect a single cutting stroke and single return stroke of said severing member for each going stroke of said operating means and serving to maintain said severing member inactive during the return stroke of said operating means.

4. In a coiling machine, means for cutting off lengths of coil formed therein without impeding the coil forming operations comprising a severing member, electrically actuated means for periodically operating said severing member, linkage means between said severing member and said operating means, means in conjunction with said linkage means for changing automatically the linkage ratios of said linkage means during periods of operation thereof, so as to effect a single cutting stroke and a single return stroke of said severing member for each periodic operation of said operating means, and means for electrically actuating said operating means periodically.

5. In a coiling machine, means for cutting off lengths of coil formed therein without impeding the coil forming operations comprising a severing member, a solenoid, a solenoid plunger reciprocally movable therein, linkage means connecting said solenoid plunger and said severing member, means in conjunction with said linkage means for changing automatically the linkage ratios of said linkage means during periods of movement of said plunger so as to effect a single cutting stroke and single return stroke of said severing member for each complete reciprocation of said plunger and means for periodically energizing said solenoid to effect each time a single complete reciprocation of said plunger.

6. In a coiling machine, means for cutting off predetermined lengths of coil formed therein without impeding the coil forming operations comprising a severing member, a solenoid, a reciprocally movable solenoid operated member, linkage means connecting said last named member and said severing member, means in conjunction with said linkage means for changing automatically the linkage ratios of said linkage means during periods of movement of said solenoid operated member so as to effect a single cutting stroke and single return stroke of said severing member for each complete reciprocation of said solenoid operated member, electrical switching means for introducing electrical power to energize said solenoid, and means for operating said electric switching means to effect peri-

odic energization and deenergization of said solenoid.

7. In a coiling machine, means for severing lengths of coil from the coil formed therein without impeding the coil forming operations comprising a severing member mounted for reciprocal rotation at the coil emerging point of the machine and adapted in its rotation to sweep transversely across the path of movement of emerging coil, reciprocally movable means for so rotating said severing member, linkage means connecting said severing member and said reciprocally movable means, said linkage means having variable linkage ratios, one ratio thereof being effective to impart a power cutting stroke and a power return stroke to said severing member in one direction of reciprocal movement of said reciprocally movable means, and a second ratio thereof being ineffective to impart movement to the severing member in the return direction of reciprocal movement of said reciprocally movable means, and means for automatically changing said linkage ratios from the first to the second thereof prior to the return movement of said reciprocally movable means.

8. In a device as per claim 7, in which said automatic changing means comprises a locking member cooperating with said linkage means, and toggle means for automatically causing said locking member to engage and disengage said linkage means.

9. In a coiling machine, a cut-off member, a reciprocally movable plunger for operating said cut-off member and linkage means connecting said plunger and said member, said linkage means comprising a link rotatably connected to said plunger, two other links rotatably connected to said link at a common point, one of said two other links being rotatably connected at another point thereof to said cut-off member and the second of said two other links being rotatably mounted at another point thereof to a fixed center of rotation in said machine, and the connection between said first named link and said second of said two other links being variable along the length of said second of said two other links within limits, a locking member serving in one position to maintain one limiting relationship of said last named connection and in a second position to permit a second limiting relationship of said last named connection, and means for moving said locking member automatically into either of its said two positions.

10. In a coiling machine, means for cutting off lengths of coil from the coil formed therein without impeding the coil forming operation and means for automatically metering the length of each coil cut-off, said last named means including electrically operated actuating means for moving said cut-off means into operative relationship with respect to said coil, a metering wheel over which the coil forming material passes prior to being formed into a coil to rotate said wheel, trip means operable during a prescribed period of rotation of said metering wheel for controlling the electric operation of said actuating means to cause operative movement of said cut-off means, and variable speed means interposed between said trip means and said metering wheel for varying the frequency of the operation of said trip means and said cut-off means.

11. In a coiling machine, means for cutting off lengths of coil from the coil formed therein without impeding the coil forming operations and means for automatically metering the

length of each coil cut-off, said last named means including actuating means for moving said cut-off means into operative cutting relationship with said coil, a metering wheel over which the coil forming material passes prior to being formed into a coil to rotate said wheel, trip means operable during a prescribed period of the rotation of said metering wheel for controlling said actuating means to cause operative movement of said cut-off means, and variable speed means interposed between said trip means and said metering wheel for varying the frequency of the operation of said trip means and said cut-off means.

12. In a coiling machine, means for cutting off lengths of coil from the coil formed therein without impeding the coil forming operation and means for automatically metering the length of each coil cut-off, said last named means including a clutch means for operating said cut-off means, actuating means for driving said clutch means, a metering wheel over which the coil forming material passes prior to being formed into a coil to rotate said wheel, and trip mechanism operable during a prescribed period of the rotation of said metering wheel for moving said clutch means member into operative engagement with said cut-off means.

13. In a coiling machine, a clutch member for operating cut-off means therein comprising a cylindrical tubular body adapted to be borne movably on a rotatable shaft and having an eccentric, a helical cam groove on the periphery of said body for the reception of a cam follower, said groove having a stop shoulder at its exit end and a passage connecting said exit end and the entry end of said groove, and a second groove on said periphery for the reception of means for moving said body along said shaft.

14. In a coiling machine having cut-off means, a clutch member for operating said cut-off means comprising a cylindrical body adapted to be borne on a rotatable shaft and having an eccentric at one end, a cam groove on the peripheral surface intermediate its ends for the recep-

tion of a cam follower, and a yoke receiving groove on its peripheral surface for the reception of a yoke member serving to move said body along said shaft as a unit, and engaging means at one end of said body adapted to engage removably with a member fixed to and driven by said shaft.

15. In a coiling machine, means for cutting off lengths of coil formed therein without impeding the coil forming operations comprising a severing member, power actuated means for periodically operating said severing member, linkage means between said severing member and said operating means, means in conjunction with said linkage means for changing automatically the linkage ratios of said linkage means during periods of operation thereof so as to effect a single cutting stroke and a single return stroke of said severing member for each periodic operation of said operating means, and means for actuating said operating means periodically.

16. In a coiling machine, means for severing lengths of coil from the coil formed therein without impeding the coil forming operations comprising a severing member mounted for reciprocal movement adjacent the coil emerging point of the machine and adapted in its movement to sweep transversely across the path of movement of emerging coil, reciprocally movable means for so moving said severing member, linkage means connecting said severing member and said reciprocally movable means, said linkage means having variable linkage ratios, one ratio thereof being effective to impart a power cutting stroke and a power return stroke to said severing member in one direction of reciprocal movement of said reciprocally movable means, and a second ratio thereof being ineffective to impart movement to the severing member in the return direction of reciprocal movement of said reciprocally movable means, and means for automatically changing said linkage ratios from one to the other during predetermined periods of movement of said reciprocally movable means.

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