

Aug. 12, 1924.

J. B. WHITMORE ET AL

1,504,849

COIL WINDING MACHINE

Filed Dec. 22, 1921

5 Sheets-Sheet 1

FIG. 1.

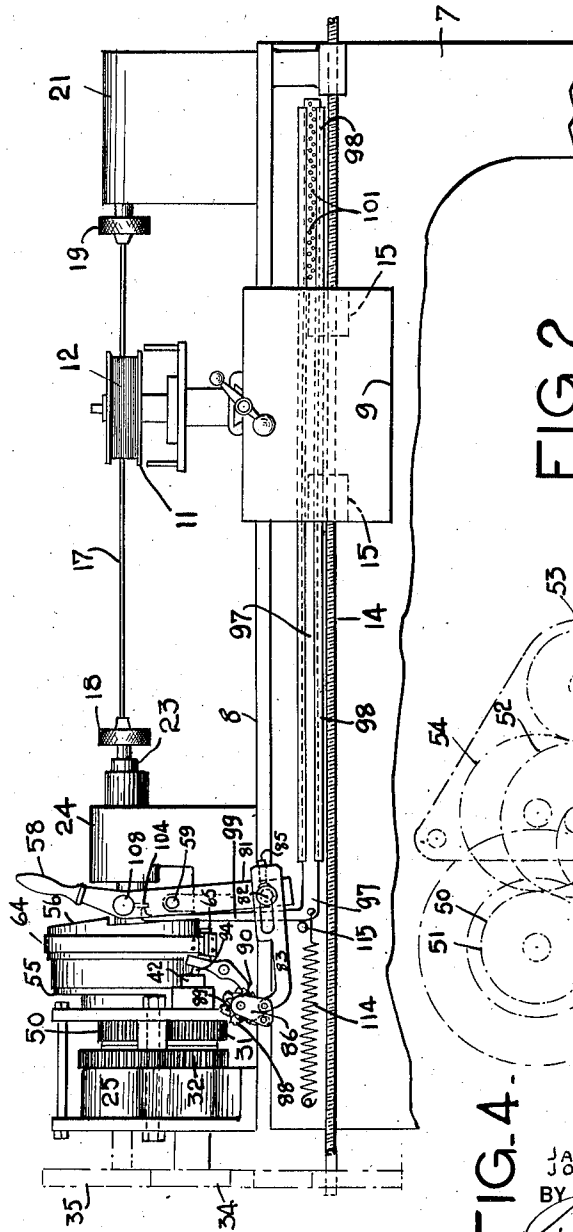


FIG. 2.

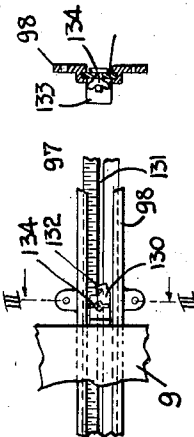
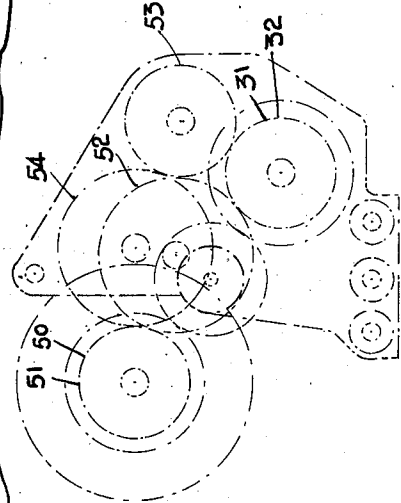


FIG. 3.

FIG. 4.



INVENTORS
JAMES B. WHITMORE
JOHN E. FERGUSON
BY *J. J. Robert*
ATTORNEY

Aug. 12, 1924.

J. B. WHITMORE ET AL

1,504,849

COIL WINDING MACHINE

Filed Dec. 22, 1921

5 Sheets-Sheet 3

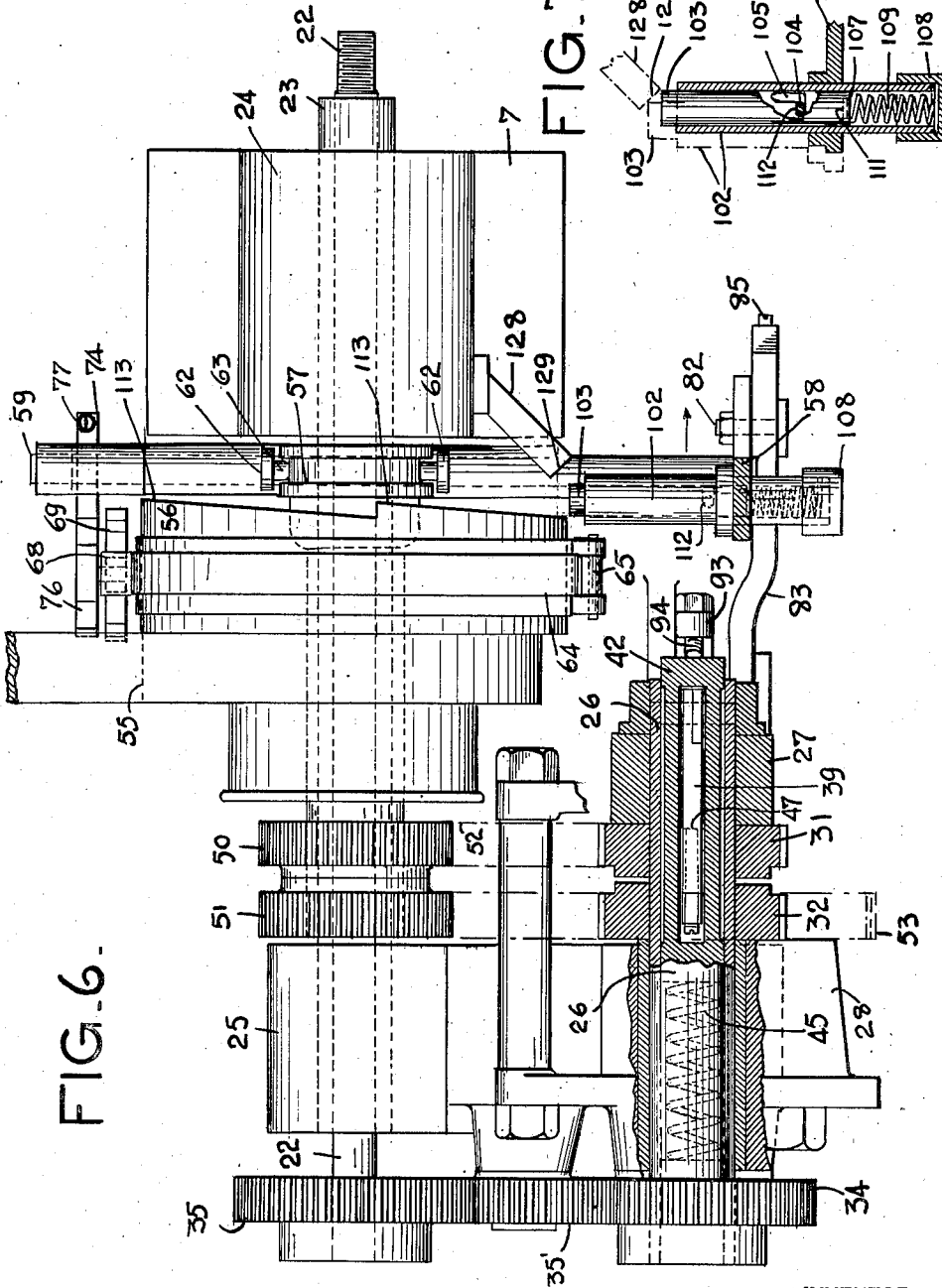


FIG. 6.

FIG. 7.

INVENTORS
JAMES B. WHITMORE.
JOHN E. FERGUSON.

BY

J. P. Ebert
ATTORNEY

Aug. 12, 1924.

1,504,849

J. B. WHITMORE ET AL

COIL WINDING MACHINE

Filed Dec. 22, 1921

5 Sheets-Sheet 4

FIG. 8.

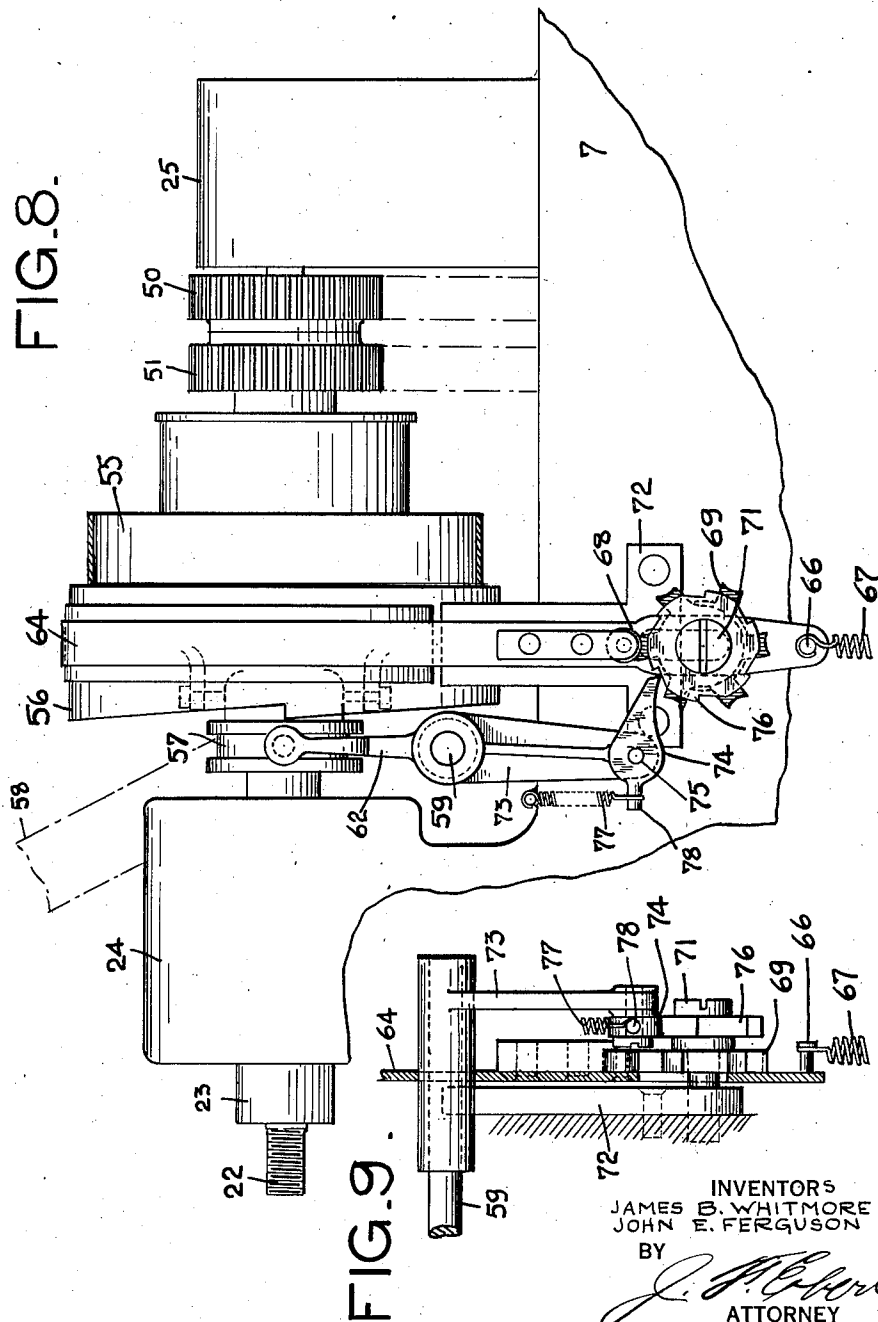


FIG. 9.

INVENTORS
JAMES B. WHITMORE
JOHN E. FERGUSON
BY

J. M. Whitmore
ATTORNEY

Aug. 12, 1924.

J. B. WHITMORE ET AL

1,504,849

COIL WINDING MACHINE

Filed Dec. 22, 1921

5 Sheets-Sheet 5

FIG. 10

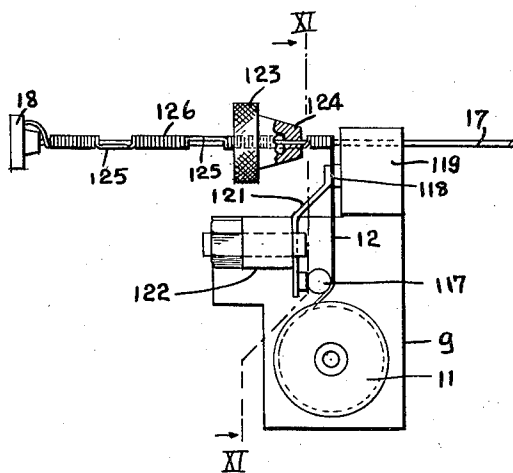
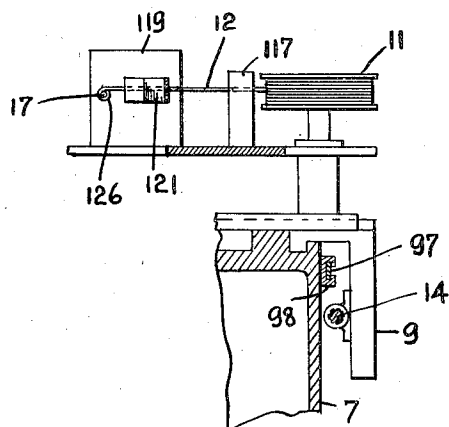


FIG. 11



INVENTORS
JAMES B. WHITMORE
JOHN E. FERGUSON

BY

J. M. Ebert
ATTORNEY

UNITED STATES PATENT OFFICE.

JAMES BRYANT WHITMORE AND JOHN EBLING FERGUSON, OF BLOOMFIELD, NEW JERSEY, ASSIGNORS TO WESTINGHOUSE LAMP COMPANY, A CORPORATION OF PENNSYLVANIA.

COIL-WINDING MACHINE.

Application filed December 22, 1921. Serial No. 524,061.

To all whom it may concern:

Be it known that we, JAMES BRYANT WHITMORE, a citizen of the United States, and a resident of Bloomfield, in the county of Essex and State of New Jersey, and JOHN EBLING FERGUSON, a citizen of the United States, and a resident of Bloomfield, in the county of Essex and State of New Jersey, have invented a new and useful
 10 Improvement in Coil-Winding Machines, of which the following is a specification.

This invention relates to machines for winding a wire upon a mandrel to produce a helical coil and relates more particularly
 15 to machines for winding coils of filament wire for use in electric incandescent lamps especially adapted for projection purposes.

An object of the invention is to provide a machine for expeditiously and efficiently
 20 winding a filament wire upon a mandrel in a given direction and which may be automatically adjusted at the will of the operator to continue the winding in a reverse direction.

A further object is the provision of co-ordinating machine elements which may be quickly controlled to reverse the rotary
 25 movement of the mandrel.

A still further object is to provide means whereby the rotary movement of the mandrel may be automatically terminated to
 30 produce a coil of a predetermined length.

The construction of a motion-picture lamp requires a coil filament of comparatively large-diameter wire. Such filaments
 35 were originally made by winding wire upon a mandrel to produce a helical coil of a given length and then terminating the winding operation to provide a straight course
 40 or portion of wire; the coiling operation was then resumed to again shape the wire into another coil having substantially the same pitch as the preceding one. The foregoing operations resulted in a plurality of
 45 coils having straight portions therebetween.

It has been found in practice, however, that coils wound unidirectionally tend to warp or buckle when made incandescent during use as a filament. This disadvantage
 50 has been greatly reduced by a reverse winding of adjacent coils, i. e., by winding adjacent coils in reverse directions.

By providing a filament with the aforesaid reverse winding, the detrimental
 55 strains and tensions are obviated because

the internal forces operating in a given direction and acting to cause a coil to warp or sag are neutralized by forces which act in the adjacent section in an opposite direction.

It has been heretofore common to employ a manually controlled device for winding coils in the manner above indicated. Obviously, with such a device, the consumption of time necessary to reverse the winding is detrimental to efficient production. Furthermore, it is difficult to accurately maintain the pitch and the necessary tension.

In the present invention, mechanism is contemplated for readily shaping a filament wire into a coil of a given length having its winding in one direction, said mechanism being capable of rapid and convenient adjustment for reversing the direction of
 75 winding. A series of coils is thereby produced, each coil being wound in an opposite direction to the adjacent coil.

The invention will be more fully understood by reference to the drawings, in
 80 which,

Fig. 1 is a side elevational view of our machine;

Fig. 2 is an enlarged detail of a modification of an adjustable stop;

Fig. 3 is a transverse cross-section of Fig. 2 taken on line III—III;

Fig. 4 is a diagrammatic end view of Fig. 1 showing the arrangement of gear-wheels;

Fig. 5 is a side elevation, partly in section, of a portion of the machine;

Fig. 6 is a plan view of Fig. 5, partly in section;

Fig. 7 is a detail of the lever-actuating mechanism partly in section;

Fig. 8 is a view, in elevation, of a portion of the machine viewed from the side opposite to that shown in Fig. 5;

Fig. 9 is a fragmentary view, partly in section, of the mechanism shown in Fig. 8;

Fig. 10 is a plan of the mechanism employed to feed wire on to the mandrel; and

Fig. 11 is a side view of the feeding mechanism taken on line XI—XI of Fig. 10.

The machine which constitutes the subject matter of the present invention conveniently divides itself into three major parts, namely, a mechanism for rotating a

80

85

70

75

80

85

90

95

100

105

110

mandrel, which includes a wire-feeding device juxtaposed with respect thereto to permit the wire to be wound about the mandrel; a mandrel-reversing mechanism which serves to permit a reversal of the direction of rotation of the mandrel to wind the wire thereon in a reverse direction; and a stop mechanism which controls the length of the coil wound upon the mandrel.

The mechanism for rotating the mandrel may comprise a lathe of the ordinary machine-shop type which, being well known, a description thereof is considered unnecessary. It may be stated, however, that the lathe or device for rotating the mandrel also employs mechanism for feeding the wire as it is being wound. Such mechanism comprises a suitable carriage or movable support which is provided to carry a spool of wire along the length of the mandrel, at which time the wire is fed, in any suitable manner, about the mandrel as it is rotated, to produce a plurality of coils. Stop mechanism, comprising certain co-ordinating machine elements, may be employed to stop the rotary movement of the mandrel after a predetermined length of coil has been wound and the carriage has necessarily moved a given distance.

Mechanism for reversing the rotary movement of the mandrel may comprise a mandrel-reversing member including a bracket or frame in which is journaled a rotatable casing containing a pair of adjustable keys. Mounted rotatably upon this casing are two gear-wheels suitably connected by interposed gearing with other gear-wheels on a main driving sleeve. The arrangement of the interposed gear is such as to effect a relative opposite rotation of the gears upon the mandrel-reversing member. Therefore, this member may be rotated in the direction of rotation of either of the gears mounted thereon by engaging one of the adjustable keys with one of the gear-wheels mounted on the casing. The mandrel-reversing member being reversible by the engagement of one of the said keys, an oscillatory arm is provided and so associated with the reversing member that a movement of said arm may effect an actuation of the keys and a reversal of the direction of movement of the mandrel-reversing member. The mandrel-reversing member is so disposed and connected to a mandrel that each change in its direction of rotation produces a change in the direction of rotation of the mandrel.

After cessation of movement of the mandrel, the carriage may be manually moved a given distance while the mandrel remains stationary for the purpose of providing a substantially straight portion of wire between adjacent coils. An actuation of the oscillatory arm hereinbefore described will

then produce an actuation of the elements comprising the mandrel-reversing member, thereby producing a reversal in the direction of rotation of the mandrel, with the result that another coil will be wound in the opposite direction. The foregoing operations are then repeated until a series of coils of the desired length have been produced.

Referring now to the drawings and more particularly to Fig. 1, it will be readily seen that an embodiment of the present invention essentially includes a supporting table 7 provided with suitable guide rails 8 adapted to support a movable carriage 9 upon which a drum or spool 11 of wire 12 is rotatably mounted. A movement of the carriage is produced by means of a screw 14 which passes through nuts 15 secured to the carriage. The screw 14 is provided with a gear-wheel which, in turn, is rotated by a main drive through the agency of suitably proportioned interposed gearing, as found in the ordinary lathe, or it may be rotated in any convenient manner.

The carriage 9 is similar to that used in a lathe in which the nuts 15 are split and means are provided to release them from the screw 14 when it is desirable to manually move the carriage longitudinally of the mandrel and to tighten the nuts upon the screw 14 when it becomes desirable to cause an automatic movement of the carriage. The particular mechanism for performing this manipulation of the nuts has not been illustrated, inasmuch that such hand adjustment of a carriage is well known.

For the purpose of winding the wire, it is necessary to provide a core or mandrel and, in the present embodiment of the invention, this mandrel consists of a flexible rod 17 secured in proper relation to the spool 11 by means of chucks 18 and 19. The chuck 19 is rotatable in a bearing 21 and the chuck 18 is secured to a spindle 22 rotatable in a hollow shaft 23 (see Fig. 5) which, in turn, is rotatable in bearings 24 and 25.

It will be obvious that, when the spindle 22 is rotated, a consequent rotation of the mandrel 17 results, and that, by alternately rotating the spindle in opposite directions, a wire may be wound upon the mandrel to produce a coil, each coil being wound in a direction opposite to that of the adjacent coil. To accomplish a reverse rotation of the spindle, the mandrel-reversing member is provided. This member includes a cylindrical casing 26 rotatably supported in bearings 27 and 28.

For the purpose of driving the casing, gears 31 and 32 are loosely positioned thereon between the bearings 27 and 28. The gears normally run free but are adapted to be engaged, one at a time, with the casing to drive it. The gears are driven in oppo-

site directions by virtue of other interposed gearing (to be later described) which connects them with a sleeve 33 which is disposed upon, and secured to, the shaft 23 and is rotatable therewith.

Having provided the casing 26 with the two oppositely rotating gears 31 and 32, it is obvious that by connecting the casing with either of said gears, it will be driven in a corresponding direction. For the purpose of driving the spindle 22, the outer or exposed end of the casing 26 has a gear wheel 34 secured to one end thereof which is connected, by a suitably positioned intermediate gear wheel 35' (see Fig. 6) to a gear wheel 35 secured to one end of the spindle 22.

Mechanism for connecting either the one or the other of the gears 31 or 32 to the casing 26 comprises a pair of keys 36 and 37 disposed at the ends of shanks 38 and 39 which are positioned in a slotted cylindrical member 42 and hinged upon a pin 41 disposed transversely to the said member and secured thereto.

The slotted member 42 is slidable longitudinally of the casing 26 and is normally maintained in a given outer position by the expansion of a spring 43 disposed between one end of the member 42 and a plug 44 secured in one end of the said casing. By reference to Fig. 5, it will be seen that one of the keys may always be maintained in engagement with one of the gears by positioning the face of a key in a slot 45 or a slot 46 disposed in the internal or bearing surface of the gears 31 and 32, respectively. A flat spring 47 is positioned between the two keys to normally force them apart.

A movement of the rod 42 within the casing serves to position one key in engagement with a gear wheel and remove the opposite key from engagement with the groove of the adjacent gear wheel. For instance, if the slotted member 42, as shown in Fig. 5, is pushed to compress the spring 43, a tapered face 48 of the key 37 will engage the beveled edge of a suitably disposed aperture in the casing, and the continued movement of the rod 42 inwardly will cause the removal of the key from the gear wheel 31. This movement also causes a beveled surface 49 of the key 36 to travel over a beveled surface at the edge of an aperture suitably disposed in the casing and in proper relation to the slot 46 to permit the entrance of the key 36 into the slot.

The movement of the keys into and out of the grooves is partly accomplished through the agency of the spring 47 which normally acts to thrust the keys against the side of the casing; therefore, the backward and forward movement of the slotted member 42, which carries the keys, serves to alternately engage a key with either of the gear

wheels 31 and 32. The mechanism which causes this movement of the member 42 will be hereinafter described.

From the foregoing, it will be understood that motion is translated to the spindle 22 from the casing 26 through the train of gears 34, 35' and 35, while the casing 26 receives its motion from its association with the sleeve 33 upon which are suitably fastened a pair of gear wheels 50 and 51. The gear wheel 50 transmits motion to the gear wheel 31 by the interposition of an idler 52, as indicated in Fig. 4, and the gear wheel 32 receives its movement through the agency of two interposed idlers 53 and 54. In the diagrammatic representation of the gear wheels, illustrated in Fig. 4, the reference numeral 31 indicates the gear wheel in the rear of the gear wheel 32, and the numeral 50 indicates the gear wheel in the rear of the gear wheel 51. It is evident that rotation of the sleeve 33 causes rotation of the gear wheels 31 and 32 in opposite directions by reason of the above mentioned interposed gearing.

The mechanism, as above described, illustrates the manner in which the spindle 22 is rotated by its connection to the casing 26, and the description points out the manner in which the casing 26 is caused to engage the driving sleeve 33 and also sets forth the mechanism for changing the direction of rotation of the casing by an adjustment of a mandrel-reversing member which permits the casing to be engaged by either of the gear wheels 31 and 32.

The sleeve 33 and the shaft 23 constitute an intermediate connection to a main drive through which the movement of all the rotary elements is derived.

The main drive comprises a pulley 55 connected to any suitable source of power, as, for instance, to the pulley of a motor (not shown). The pulley 55 is positioned loosely upon the sleeve 33 and is adapted to be continually rotated.

It is preferable to provide a suitable mechanical expedient for intermittently rotating the shaft 23. This may be accomplished by the provision of a supplemental pulley 56 keyed to the sleeve 33 and adapted to be engaged by the driving pulley 55 through any suitable clutch mechanism, the well-known type of split-cone-clutch indicated in the drawing being preferable. This clutch is actuated by a sliding collar 57 keyed to the hollow shaft 23 and capable of longitudinal movement for the purpose of causing an engagement between the pulley 55 and the supplemental pulley 56. Thus, when such engagement is made, the pulley 55 drives the pulley 56 and the hollow shaft 23, being secured to the pulley 56, is rotated therewith.

In the present invention the movement of the sliding collar 57 is effected through the

reciprocatory action of a hand lever or oscillatory member 58 pivoted upon a transverse rod 59 which is supported in a bearing 61. The rod 59 has fastened thereto a fork member 62, the tines of which embrace the sliding collar 57 and are provided with lugs 63 disposed in a slot, as commonly employed in such collars. Thus, a movement of the lever effects a movement of the sliding collar 57 along the shaft 23. It will be seen that, when the sliding collar 57 moves toward the pulley 56 and actuates the clutch, a rotary movement will be imparted to the pulley 56. It is, however, also desirable, for the purpose of preventing excess movement, to simultaneously stop or brake the pulley 56 with each outward movement of the sliding collar 57, namely, with each disengagement of the pulley 55 from the pulley 56. For this purpose, mechanism is provided, as clearly shown in Figs. 8 and 9, which comprises a brake band 64, one end of which is secured to a pin 65 fastened to the framework of the machine, as shown in Fig. 5. The band then extends over the pulley 56, and the opposite end thereof is provided with a projection 66 to which a spring 67 is secured (see Fig. 9), the opposite end of the spring being fastened to any suitable rigid portion of the machine.

The brake band may thus be normally held in sufficient tensional engagement with the pulley 56 to prevent its rotation. For the purpose of releasing the band from the pulley, a roller 68 is fastened to the brake band and positioned in the path of a multi-toothed wheel 69 that is rotatable upon a pivot 71 secured in a bracket 72 which is fastened to the body of the machine. The teeth of the wheel 69 are provided with concave faces, and the wheel is so disposed that, when the concave surface of a tooth is engaged by the roller 68, the brake band is lifted in opposition to the spring 67 and the pulley 56 is released. As stated, it is necessary to stop the pulley 56 by releasing the brake band simultaneously with the reciprocatory movement of the sliding collar 57. This is accomplished by means of a depending arm 73 secured to an end of the rod 59 opposite to that to which the lever 58 is secured and adapted to move with each movement of the lever 58. At the lower end of the arm 73, a pawl 74 is movably positioned on a pin 75 and adapted to engage a ratchet wheel 76. The ratchet wheel is secured to, and is movable with, the toothed wheel 69; therefore, when, the pawl 74 engages a tooth of the ratchet wheel and moves the wheel, through the action of the lever 58 and rod 59, the toothed wheel 69 is rotated a given number of degrees either to position the roller 68 upon a tooth, causing a release of the pulley 56, or to remove it therefrom and permit the spring 67 to re-

cover and brake and stop the rotation of the pulley 56. The pawl 74 is normally maintained in engagement with the ratchet wheel 76 through the action of a spring 77, an end of which is secured to a lug 78 integral with the pawl, the opposite end of the spring being fastened to the body of the machine.

The lever 58 also controls mechanism for operating the mandrel-reversing member referred to above, by means of which the direction of rotation of the spindle 22 may be changed through a movement of the slotted rod 42 in the casing 26, as is more clearly illustrated in Figs. 5 and 6 which show the lower end 81 of the lever slidably secured, by a pin 82 to an arm 83. The pin 82 passes through a slot 84 in the arm which permits additional motion of the lever 58, and a set screw 85 is positioned at one end of the slot for adjusting such motion. The arm 83 is pivoted to a lever plate 86 movable about a bolt 87 upon which a toothed member 88 and a ratchet wheel 89 are mounted rotatably and fastened to each other in a given relation. Adjacent the toothed member 88 is positioned a lever 90 pivoted on a pin 91 and so disposed that the lower arm 92 of the lever is adapted to make contact with the face of the teeth of said member.

The opposite arm 93 of the lever 90 is provided with a set screw 94, an end of which normally makes contact with the exposed end of the slotted member 42. A movement of the end 93 of the lever 90 toward the member 42 will, therefore, effect a movement of this member in opposition to the spring 43 and bring the key 36 into engagement with the groove 46 of the gear wheel 32.

A movement of the lever 90 is caused by an oscillation of the end 81 of the lever 58 which actuates the arm 83 to cause a movement of the lever plate 86. This lever plate is provided with a pawl 95 normally held in contact with the ratchet wheel 89 by a spring 96. Thus, a movement of the lever end 81 will actuate the toothed member 88 and cause the end 92 to be positioned either between the teeth, in which case the casing 26 will rotate in the direction of the gear wheel 31, as shown in Fig. 5, or the end 92 may be raised to the summit of a tooth with the result that a change of direction of rotation of the casing 26 will be effected with a consequent change in the direction of rotation of the spindle 22.

Although this machine may be operated to wind wire upon a mandrel in alternately different given directions by means of the above described machine elements and the machine may be manually stopped after the winding of each coil or series of coils, it has been found desirable to automatically

stop the machine after a coil of predetermined length has been wound.

Any suitable stop mechanism may be employed to perform the above mentioned operation. The stop mechanism illustrated in the drawing, however, embodies some features peculiar to the present invention and comprises certain operative parts which actuate the sliding collar 57 and the brake band 64.

The stop mechanism comprises a rod 97 (see Fig. 1) slidably positioned in guides 98 and having one end thereof projecting upwardly to provide a tripping finger 99 for actuating mechanism to be later described. The sliding rod 97 is provided with a series of holes 101 spaced at predetermined intervals and adapted to receive pins or pegs which may thus be positioned in the path of the carriage 9 so that, as the carriage moves during the winding of a wire upon a mandrel, it will, when a coil of a given length has been wound, make contact with such suitably positioned pin and move the sliding rod 97 to cause the finger 99 to actuate mechanism which will automatically stop the rotation of the mandrel. It will be evident that, by stopping the rotation of the mandrel as above described, a coil having a given number of complete turns, or fraction thereof, will be produced.

The device upon which the finger 99 acts may comprise any suitable mechanical movement and, in the drawing, is illustrated as consisting of a cylindrical housing 102 (see Figs. 6 and 7) positioned in suitable relation to the pulley 56 and secured to, and movable with, the lever 58. Within the housing 102 is disposed a sliding rod 103 having a pin or trigger 104, which will be herein termed a trip-member, secured thereto and extended through a slot 105 disposed upon the under side of the housing. Between one end 107 of the rod 103 and a cap 108, secured to the end of the housing 102 is positioned a helical spring 109. One end of the spring is secured to the housing and the opposite end is adapted to be disposed in a transverse notch at the end 107 of the rod. Thus, in assembling, when the spring is in position with one end secured to the housing, the rod 103 is pushed into the housing until the end 111 of the spring is positioned in the notch at the end of the rod which is rotated until a torsional force is produced in the spring. The pin 104 is then inserted through the slot 105 and secured in the rod. It will, therefore, be evident that the tendency of the pin is to press upon one side of the slot through the torsional action of the spring and the rod is forced outwardly through the expansive action of the spring.

For the purpose of maintaining the rod

normally in its inner position, a right-angle extension 112 is provided at the end of the slot disposed adjacent the lever 58; thus, when the rod is forced inwardly until the pin registers with the extension 112, the pin will automatically be urged into the extension which will prevent the outward movement of the rod.

Since the rod 103 is secured to the lever 58, it will be evident that a lateral movement of the rod 103 will cause a similar movement of the lever. For the purpose of effecting a lateral movement, the pulley 56 is provided with cam faces 113, and the rod 103 is so disposed that, when in its outer position, its exposed end lies normally in the path of the said raised faces and a movement of the pulley serves to make contact between the rod and one of the raised faces 113 to force the rod sideways and thereby actuate the lever 58, with the result that the sliding collar is actuated and the brake is applied to the pulley 56 and the operation of the machine is automatically terminated.

It is obvious that the number of raised faces 113 may be varied and that the action of the various parts will be governed accordingly. This movement of the rod 103 may be effected after any given number of turns of wire have been made upon the mandrel. As above described, the carriage 9, after a given movement, will make contact with a pin disposed in one of the holes 101, thereby moving the sliding rod 97 and the finger 99 which is so disposed as to engage and release the trigger 104 from the extended portion 112 of the slot in the housing 102. The rod 103 is then projected in the path of the cam faces 113, and mechanism is thus actuated to stop the machine until other mechanism is operated to reverse the rotation of the mandrel. A spring 114 (see Fig. 1) serves to normally return and maintain the sliding rod 97 against a stop 115, and the pin or peg is then manually advanced to another of the holes 101 and a repetition of the stopping operation occurs after another coil has been wound.

The wire to be coiled upon the mandrel or arbor may be guided or fed thereto in any suitable manner. One form of guide mechanism is illustrated in Figs. 10 and 11 in which the wire 12 is led from a spool 11 and guided around a post 117 and between a friction grip comprising a stationary surface 118 on a block 119 and the face of a spring member 121 secured to a rigid upright 122. The wire is secured to the mandrel by the insertion of an end thereof into a notch or aperture in the chuck 18. The mandrel 17 is disposed in, and guided by, a passage or slot in the block 119 and is thus steadied during the winding operation. A clamp 123 having movable jaws 124 is shown in Fig. 10, this clamp being applied to the

mandrel after each coil has been wound, and the jaws 124 serve as a stop to prevent the unwinding of a coil when a succeeding coil is being wound in the opposite direction. The clamp may be in the form of a chuck having jaws adapted for quick adjustment about the mandrel at the straight portions 125 of the wire between the coils 126. The wire, if desired, may be electrically or otherwise heated during the winding operation.

For the purpose of affording a more accurate adjustment for the winding of coils than can be obtained from the disposition of pegs in the holes 101, a sliding member 130 may be provided (see Figs. 2 and 3). This member may be moved along the sliding rod 97 in a longitudinal slot 131 provided in the rod. Graduations may be suitably positioned along the edge of the slot and the sliding member provided with an indexing finger 132. The slidable member has an integral projection 133 adapted to be engaged by the carriage 9. As shown, the sliding member is temporarily secured in position by a bolt and a wing-nut 134. A more convenient adjustment will thus be obtainable, inasmuch as the indexing finger may be moved more readily and the number of linear sub-divisions may be increased, thus insuring greater accuracy for controlling the movement of the carriage.

After a series of coils have been wound they are removed from the mandrel and divided into groups and shaped for service as lamp filaments. A group of attached coils may be bent to any desired shape as, for instance, to saw-toothed form, by bending at the straight portions 125.

When operating the coil-winding machine, a pin is inserted in one of the holes 101 and at a distance from the carriage depending upon the number of turns or loops desired in a coil. Wire is then led from the spool 12 to the mandrel in any suitable manner. As the pulley 55 provides a continual drive, the lever 58 may be actuated to move the sliding collar 57 toward the pulley 56 which operation causes a rotation of the sleeve 33 and, consequently, the gears 50 and 51 which latter, in turn, cause rotation of gears 31 and 32 in opposite directions. One of the keys 36 and 37, however, is engaged by one of the gears 31 and 32 on the casing 26 which is thereby rotated, and motion is transmitted to the spindle 22 through the agency of the gears 34, 35' and 35. The relative motion of the spindle 22 is accordingly transmitted to the mandrel 17, and the wire may be wound thereon in a given direction.

As the carriage 9 moves and makes contact with the pin or peg disposed in one of the holes 101, the sliding rod 97 is carried with the carriage until the finger 99 trips the trigger 104 to cause the sliding rod 103 to move in the path of the raised faces 113,

one of which almost instantly engages the rod 103. The action of the cam face 113 forces the rod and the lever 58 in the direction of the arrow "X" and causes a movement of the sliding collar 57 to disengage the pulley 56 from the driving pulley 55 and an actuation of the brake to stop rotation of the pulley 56, and consequently, rotation of the mandrel 22. The carriage 9 may then, if desired, be moved slightly to provide a straight portion of wire. The movement of the lever is then continued in the direction of the arrow "X" (Fig. 5) and the pin 82 on the end 81 of the lever 58 engages the end of the slot 84 of the arm 83 and causes an actuation of the ratchet wheel 89. The toothed member 88 is thereby moved a given number of degrees, and the end 92 of the lever 90 is thus made to traverse the inclined portion of a tooth until seated at the summit thereof, and the end 93 of the lever 90 forces the slotted rod 42 inwardly to reverse the engagement of one of the keys 36 and 37 with gear wheels 31 and 32, respectively. Continued movement of the lever 58 also serves to rock the arm 73 carrying the pawl 74 (see Fig. 8) and causes the pawl to rotate the ratchet wheel 76 a sufficient number of degrees to compel the roller 68 to move up the inclined face of one of the teeth until it takes the position shown, thereby releasing the brake band 64 from the pulley 56. Movement of the lever 58 also serves to return the sliding rod 103 to its inner position. For this purpose, a projection 128, provided with a beveled face 129, is secured to the bearing 24 and so positioned that, when the lever 58 is moved, the end of the rod 103 will make contact with the beveled surface, and the rod will be gradually forced inwardly to its normal position as the lever 58 is moved toward the end of its stroke in the direction of the arrow "X".

Movement of the lever, therefore, operates to change the direction of the travel of the casing 26 by changing its key connection to the gears 31 and 32 and it has also operated to release the brake. A return movement of the lever 58, in the direction of the arrow "Y," serves to move the sliding collar 57 toward the pulley 56 and operates the clutch which then connects the two pulleys to cause the machine to operate and rotate the mandrel 17 in a direction that is dependent upon which of the gear wheels 31 and 32 is engaged by one of the keys 36 and 37; and the mandrel continues to rotate until a given number of coils have been wound, at which time the carriage engages the peg or pin positioned in one of the holes 101. The sliding rod 97 is thus moved to trip the trigger 104 and cause a recurrence of the above described operations.

When winding a plurality of coils on the mandrel, the said coils being connected by

substantially straight portions of wire, it is important to be able to position the said straight portions in a predetermined position about the mandrel. This is accomplished in accordance with the present invention by an adjustment of the pegs or pins in the holes 101 or by the movement of the sliding member 133 shown in Fig. 2, whereby the length of coil may be varied, and it will be obvious that this variation in the length of the coil provides for the termination thereof either upon a complete turn or a fraction of a turn about the mandrel. Thus, the straight portion of the wire may be located either on the one or the other side of the mandrel and, in certain types of coils, it is desirable to alternate the position of the straight portion of the wire to make each successive portion diametrical opposite to the other.

Although the present embodiment of the invention shows a comparatively flexible mandrel, it will be evident that one of a more rigid character may be employed. Where desirable, a mandrel having various configurations in transverse cross-section are applicable and may, for certain types of lamps, be required. Furthermore, if desirable, the reversing mechanism may be employed in association with a machine in which the movement of the mandrel is longitudinal as well as rotary, in which case the spool of wire would be mounted on a stationary support.

While a single embodiment of this invention is herein described and illustrated in the annexed drawings, it is to be understood that the invention is not limited thereto and many modifications will suggest themselves to one skilled in the art and that the present invention includes all such modifications as come within the scope of the appended claims.

What is claimed is:

1. A machine for producing incandescent electric lamp filaments which comprises means for winding a filament wire in a given direction to produce a coil and means for automatically adjusting said machine to wind said wire in a reverse direction to produce a reversely wound coil.

2. In a machine for producing an incandescent electric lamp filament, the combination of means for winding a filament wire in a given direction to produce a coil and means for automatically adjusting the machine to wind said wire in a reverse direction to produce a coil.

3. In a coil-winding machine, the combination with a mandrel, means for winding a series of coils of substantially equal diameter thereon and means for alternately changing the direction of rotation of said mandrel to produce a series of coils which are alternately reversely wound.

4. In a coil-winding machine, the combination with a mandrel, means for winding a series of coils upon said mandrel, means for alternately changing the direction of rotation of said mandrel to produce a series of coils, each of said coils being reversely wound with respect to the adjacent coil, and means for varying the length of each coil.

5. In a coil-winding machine, the combination with a mandrel, means for rotating said mandrel, means for alternately changing the direction of rotation of said mandrel after the same has rotated a predetermined number of times, and means for varying the number of turns of said mandrel whereby a plurality of series of coils are produced, each coil being of reverse winding to the adjacent coil.

6. In a coil-winding machine, the combination with a mandrel, means for winding a wire on said mandrel, means for automatically stopping the winding operation after a coil has been wound, means for continuing the winding in an opposite direction until another coil has been wound and means for varying the number of loops constituting each coil.

7. In a coil-winding machine, the combination with means for successively winding a series of coils, means for automatically stopping the winding operation after each coil, means for adjusting the machine to change the direction of winding in the succeeding coil, means for starting the machine and means for varying the length of said coils.

8. In a coil-winding machine, the combination with a mandrel, means for rotating said mandrel a predetermined number of turns and automatic means for alternately changing the direction of rotation of said mandrel to produce a plurality of consecutive coils of substantially equal diameter, each coil being of reverse winding to the adjacent coil.

9. In a coil-winding machine, the combination with means for successively winding a series of coils, means for automatically stopping the winding operation after each coil, means for adjusting the machine to change the direction of winding in the succeeding coil and means for starting the machine.

10. In a coil-winding machine, the combination of a mandrel, means for securing a wire to said mandrel, means for rotating said mandrel in a given direction to wind a helix thereon and means for adjusting the machine to change the direction of rotation of said mandrel to produce a helix of reverse winding.

11. In a coil-winding machine, the combination with a mandrel, means for winding a wire on said mandrel, means for automatically stopping the winding operation

when a coil of a predetermined length has been wound and means for continuing the winding in an opposite direction until a coil of a different length has been wound.

12. In a coil-winding machine, the combination with means for successively winding a series of coils upon a mandrel, a traveling support for the wire to be wound, means associated with said support for engaging the mechanism positioned in the path of travel of said support to cause a termination of the movement thereof when said support has moved a given distance.

13. In a coil-winding machine, the combination with a mandrel, means for rotating said mandrel in a given direction, a carriage adapted to transport a spool of wire lengthwise of said mandrel during the winding of the wire thereon, means for automatically stopping the rotation of said mandrel after a given length of coil has been wound and means for reversing the rotation of said mandrel whereby a coil of a predetermined length may be wound in an opposite direction.

14. In a coil-winding machine, the combination with a mandrel, means for rotating said mandrel in a given direction, a carriage adapted to carry a spool of wire longitudinally of said mandrel, means for winding a series of coils from said wire upon said mandrel, means associated with said carriage for automatically terminating the movement of said mandrel after a coil of a predetermined length has been wound thereon, said carriage being adapted to be moved to provide a straight portion of wire, means for reversing the direction of rotation of said mandrel to wind a coil in an opposite direction and means for varying the length of said coil.

15. In a coil-winding machine, the combination with a mandrel, means for rotating said mandrel in a given direction, a carriage, means for moving said carriage longitudinally of said machine to convey a spool of wire to be wound upon said mandrel, stop mechanism, means associated with said carriage for engaging said stop mechanism to terminate the rotation of the mandrel when a coil has been wound thereon and means for varying the number of loops in said coil.

16. In a coil-winding machine, the combination with a mandrel, means for rotating said mandrel in a given direction, a carriage adapted to transport a spool of wire as said wire is wound upon said mandrel, means associated with said carriage for terminating the rotation of the mandrel when a coil has been wound thereon, means for varying the number of turns in said coil and means for causing a rotation of said mandrel in a reverse direction to produce an oppositely wound coil.

17. In a coil-winding machine, the combination of a mandrel, means for rotating said mandrel successively in opposite directions, a support for a spool of wire, means for moving said support along the mandrel as the wire is wound thereon, and means for automatically stopping rotation of said mandrel and movement of said support when a coil of a predetermined length has been wound.

18. In a coil-winding machine, the combination of a mandrel, means for rotating said mandrel successively in opposite directions, a traveling support capable of movement along said mandrel as the wire is wound thereon, said support being associated with said mandrel whereby a predetermined movement of said support causes a cessation of the rotation of said mandrel.

19. In a coil winding machine the combination of a mandrel, means for rotating said mandrel, a support for a spool of wire, means for guiding wire from said spool to said mandrel, means for securing said wire from relative movement with respect to said mandrel, means for automatically alternately rotating and stopping the rotation of said mandrel to produce a coil of wire having alternate portions thereof wound in opposite directions.

20. In a coil winding machine the combination of a rotatable mandrel, means for rotating said mandrel, a support for a spool of wire, means for guiding said wire to said mandrel, means for preventing relative movement of said wire and said mandrel, an oscillatory member associated with said rotating means whereby a movement of said mandrel effects a termination of movement of said mandrel and means alternately rotating said mandrel in opposite directions to produce a coil of wire having portions thereof wound in different directions.

21. In a coil winding machine, the combination of a mandrel, means for rotating said mandrel, an oscillatory member adapted to control said rotating means, means for automatically actuating said member to stop the rotation of said mandrel, means for alternately rotating said mandrel in opposite directions to produce a coil having portions thereof reversely wound.

22. In a coil-winding machine, the combination with a mandrel and means for rotating said mandrel for the purpose of winding a wire thereon, of a traveling support for wire to be wound, a mandrel-reversing member adapted, when actuated, to cause a reversal of the direction of rotation of the mandrel and an oscillatory arm adapted, when moved, to actuate said member and means for stopping the rotation of said mandrel after a coil of a predetermined length has been wound thereon.

23. In a coil-winding machine, the combination of a mandrel, means for rotating said mandrel successively in opposite directions, a support for a spool of wire, means for moving said support along the mandrel as the wire is wound thereon, and means for automatically stopping rotation of said mandrel and movement of said support when a coil of a predetermined length has been wound.

nation of a mandrel, means for rotating said mandrel to wind a wire thereon, means for automatically terminating the rotation of said mandrel after a coil of a predetermined length has been wound and means for reversing the rotation of the mandrel to wind a coil in an opposite direction.

24. In a coil-winding machine, the combination of a mandrel, means for rotating said mandrel for the purpose of winding a wire thereon, a traveling support for wire to be wound, means associated with said support whereby a given movement of said support causes a termination of rotation of the mandrel and means for changing the direction of rotation of said mandrel to wind the wire in an opposite direction.

25. In a coil-winding machine, the combination of a mandrel, means for rotating said mandrel to wind a wire thereon, a mandrel-reversing member for controlling the direction of rotation of said mandrel, means for automatically stopping the rotation of said mandrel and an oscillatory arm associated with said member whereby a movement of said arm effects a reverse rotation of said mandrel.

26. In a coil-winding machine, the combination with a mandrel and means for rotating said mandrel to wind a wire thereon, of a mandrel-reversing member for changing the direction of rotation of said mandrel, an oscillatory arm, means for causing a cessation of movement of said mandrel by a partial movement of said arm in a given direction and means whereby a continued movement of said arm causes an actuation of said member for reversing the direction of rotation of said mandrel.

27. In a coil-winding machine, the combination with a mandrel and means for rotating said mandrel to wind a wire thereon, of a mandrel reversing member, an oscillatory arm associated with said member, said member acting when moved in a given direction to effect a termination of the rotation of said mandrel and to cause an actuation of said member for reversing the rotation of said mandrel when the machine is again in operation and means associated with said oscillatory member whereby a movement thereof in an opposite direction causes the operation of the machine.

28. In a coil-winding machine, the combination with a mandrel and means for rotating said mandrel for the purpose of winding a wire thereon, of a traveling support for wire to be wound, a mandrel-reversing member adapted, when actuated, to cause a reversal of the direction of rotation of the mandrel, an oscillatory arm adapted, when moved, in a given direction to effect a termination of the rotation of said mandrel and to cause an actuation of said member for reversing the rotation of said mandrel when

again rotated and means associated with said oscillatory member whereby a movement thereof in an opposite direction causes a rotation of said mandrel.

29. In a coil-winding machine, the combination with a mandrel and means for rotating said mandrel to wind a wire thereon, of a mandrel-reversing member, means for automatically terminating the rotation of said mandrel after a coil of a predetermined length has been wound thereon and an oscillatory arm adapted, when oscillated in one direction, to actuate said member for effecting a reverse rotation of said mandrel when again rotated.

30. In a coil-winding machine, the combination of a mandrel, means for rotating said mandrel to wind a wire thereon, an oscillatory arm, a mandrel-reversing member and means for automatically stopping the rotation of said mandrel after a given number of revolutions, said oscillatory arm adapted, when actuated to operate said reversing member and to effect a rotation of said mandrel in an opposite direction.

31. In a coil-winding machine, the combination of a mandrel, means for rotating said mandrel to wind a wire thereon, means for automatically terminating the rotation of said mandrel after a coil of a predetermined length has been wound thereon, an oscillatory arm adapted when moved in one direction to adjust mechanism for causing a reverse rotation of said mandrel and means connected with said arm, whereby a movement thereof in an opposite direction will cause said reverse rotation of said mandrel.

32. In a coil-winding machine, the combination of a mandrel, means for rotating said mandrel to wind a wire thereon, a support adapted to move longitudinally of the mandrel and convey wire to be wound, means for automatically terminating the rotation of said mandrel after a coil of a predetermined length has been wound thereon, an oscillatory arm adapted, when moved in one direction, to adjust mechanism for causing a reverse rotation of said mandrel and means connected with said arm whereby a movement thereof in an opposite direction will cause said reverse rotation of said mandrel.

33. In a coil-winding machine, the combination of a mandrel, means for rotating said mandrel in a given direction, a movable support for a spool of wire, a positive driving means for said support, means for winding said wire on said mandrel, means for changing the direction of rotation of said mandrel and means for automatically stopping said mandrel after a given number of revolutions thereof.

34. In a coil-winding machine, the combination of a mandrel, means for rotating said mandrel in a given direction, a man-

drel-reversing member, a movable support for a spool of wire, means for winding said wire on said mandrel, means associated with said support whereby said support operates to stop the rotation of said mandrel and an oscillatory arm associated with said mandrel and reversing member, whereby a movement of said arm in one direction causes a termination of movement of said mandrel and an opposite movement causes an actuation of the reversing member.

35. In a coil-winding machine, the combination of a mandrel, means for rotating said mandrel in a given direction, a mandrel-reversing member, a relatively movable support for a spool of wire, means for automatically stopping the rotation of said mandrel and an oscillatory arm associated with said reversing member and adapted to be actuated to change the direction of rotation of said mandrel.

36. In a coil-winding machine, the combination of a mandrel, means for rotating said mandrel in a given direction, an oscillatory arm disposed in operative relation to said mandrel, a traveling support for a spool of wire and means for winding said wire on said mandrel, said support being adapted to effect a cessation of rotation of said mandrel when a predetermined number of coils has been wound, said oscillatory arm being adapted, when moved in one direction, to cause a termination of movement of said mandrel and an opposite movement to cause a reverse rotation of said mandrel.

37. In a coil-winding machine, the combination of a main driving pulley, a supplemental driving pulley and a sleeve rotatable therewith, a shaft within said sleeve, two gear wheels disposed on said sleeve, a rotatable casing having two gear wheels rotatable thereon, gearing interposed between the first and last mentioned gear wheels and adapted to effect the rotation of the two last-mentioned gear wheels in opposite directions, a gear wheel secured to one end of said casing and disposed in engagement with a gear wheel secured to said shaft, a pair of adjustable keys positioned within said casing and adapted to be engaged with the gear wheels thereon and an oscillatory arm disposed in operative relation with said keys, whereby a movement of said arm causes an engagement of one key and a disengagement of the other with a gear wheel on said casing thus reversing the direction of rotation of said casing, and consequently said shaft.

38. In a coil-winding machine, the combination of a main driving pulley, a supplemental driving pulley and a sleeve rotatable therewith, a shaft within said sleeve, two

gear wheels disposed upon said sleeve, a rotatable casing having two gear wheels rotatable thereon, gearing interposed between the first and last mentioned gear wheels adapted to effect the rotation of the two last mentioned gear wheels in opposite directions, a gear wheel secured to one end of said casing and disposed in engagement with a gear wheel secured to said shaft, a pair of adjustable members positioned within said casing and adapted to be engaged with the gear wheels thereon, an oscillatory arm disposed in operative relation with said members, whereby a movement of said arm causes an engagement of one member and a disengagement of the other with a gear wheel on said casing, thus reversing the direction of rotation of said casing, and consequently said shaft, a mandrel secured to and rotatable with said shaft and a traveling support for conveying a spool of wire, said spool being adapted to be moved along said mandrel as the wire is wound thereon.

39. In a coil-winding machine, the combination of a main driving pulley, a supplemental driving pulley and mechanism for starting and stopping said pulley, a sleeve rotatable with said pulley, a shaft within said sleeve, two gear wheels disposed on said sleeve, a rotatable casing having two gear wheels rotatable thereon, gearing interposed between the first and last mentioned gear wheels adapted to effect the rotation of the two last mentioned gear wheels in opposite directions, a gear wheel secured to one end of said casing and disposed in engagement with a gear wheel secured to said shaft, a reversing-member comprising a pair of adjustable keys positioned within said casing and adapted to be engaged with the gear wheels thereon, an oscillatory arm disposed in operative relation with said keys, whereby a movement of said arm causes an engagement of one key and a disengagement of the other with a gear wheel on said casing thus reversing the direction of rotation of said casing, and consequently said shaft, said oscillatory arm being associated with said stopping mechanism for terminating the rotation of the supplemental driving pulley and with said starting mechanism whereby a movement of said arm in one direction acts to stop the movement of said shaft, and a movement of said arm in another direction acts to permit the rotation of the shaft.

In testimony whereof, we have hereunto subscribed our names this 21st day of Dec., 1921.

JAMES BRYANT WHITMORE.
JOHN EBLING FERGUSON.