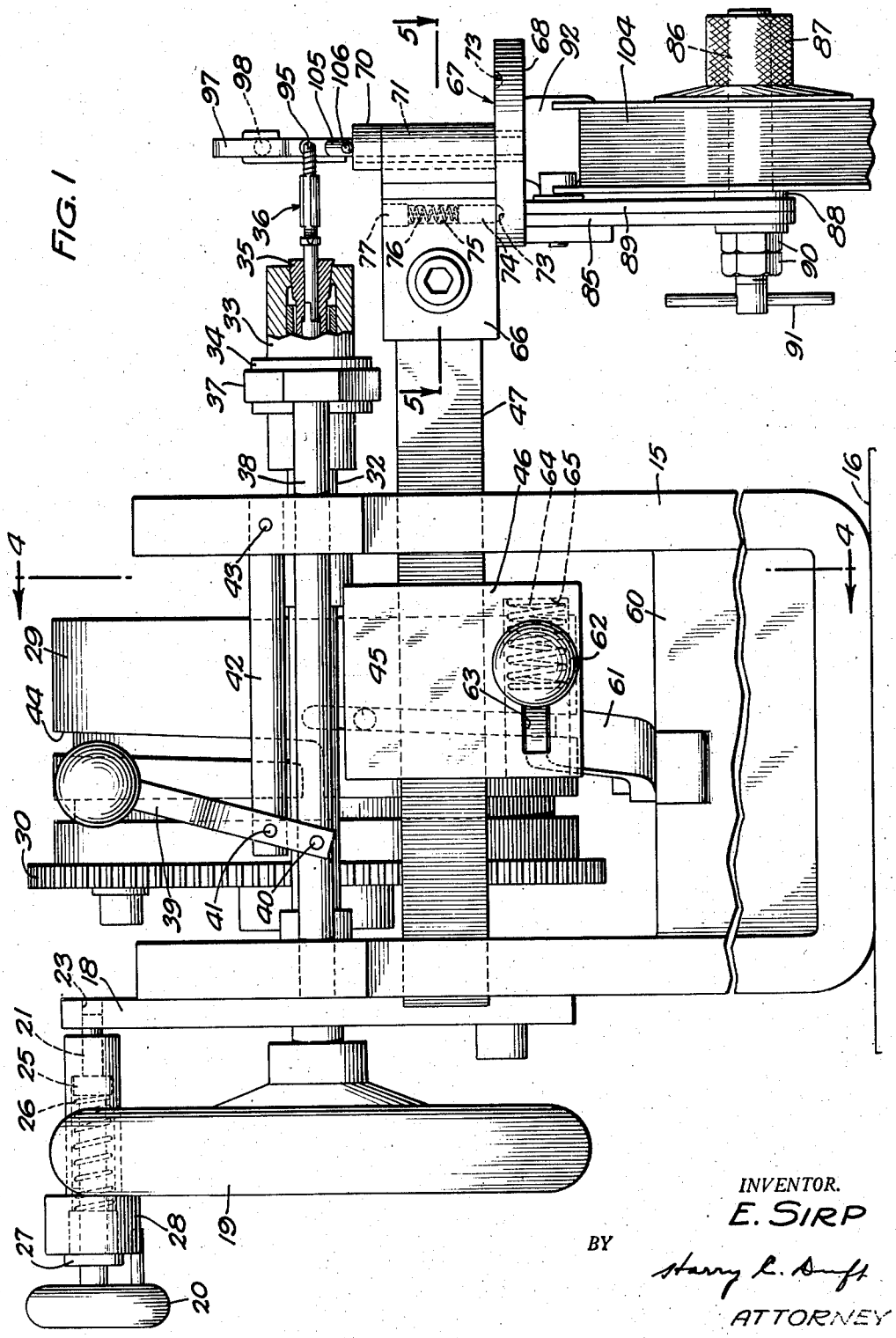
March 20, 1945. E. SIRP 2,371,782

FILAMENT WINDING APPARATUS

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FIG. 1



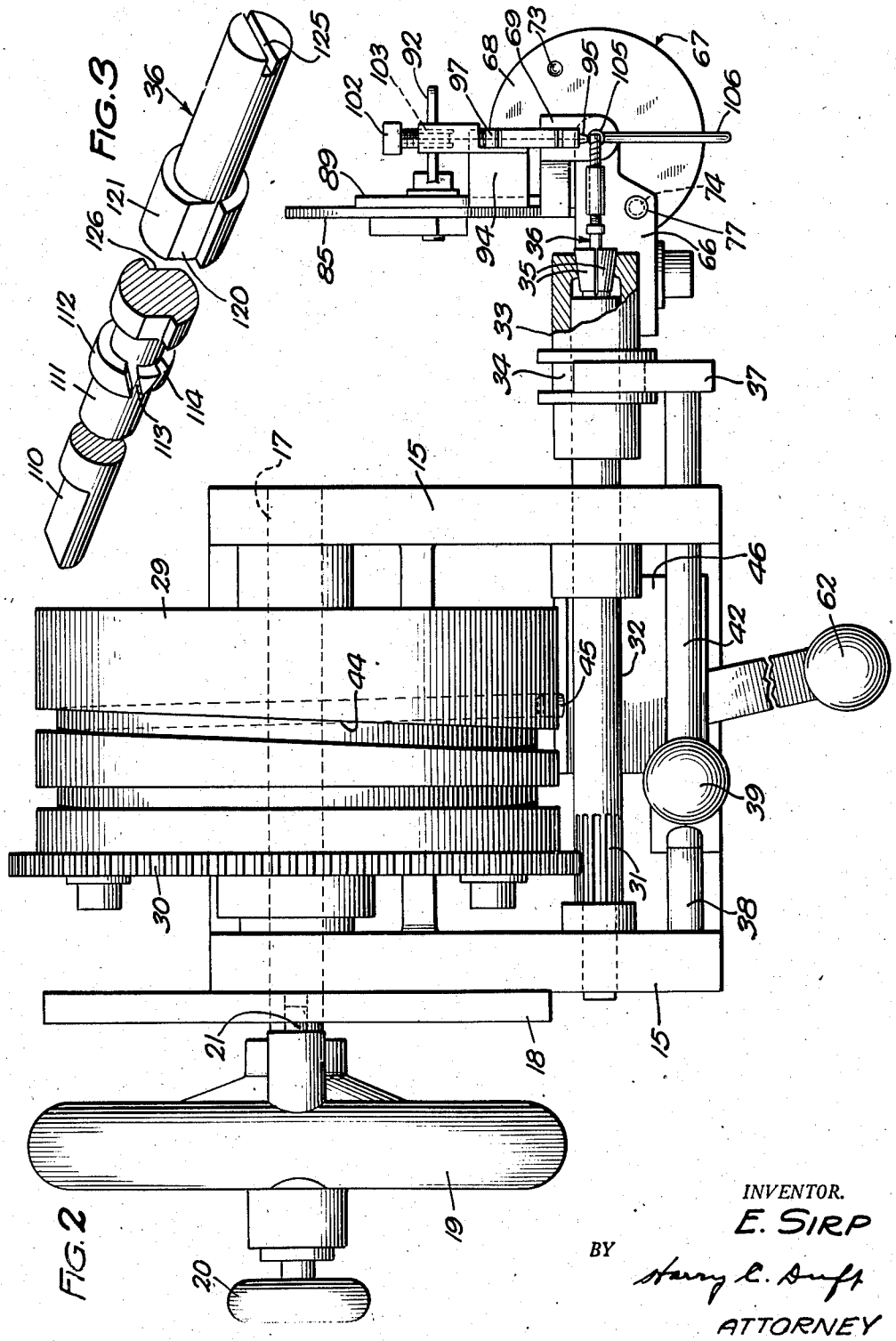
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FILAMENT WINDING APPARATUS

Filed Sept. 15, 1943 4 Sheets-Sheet 2



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FILAMENT WINDING APPARATUS

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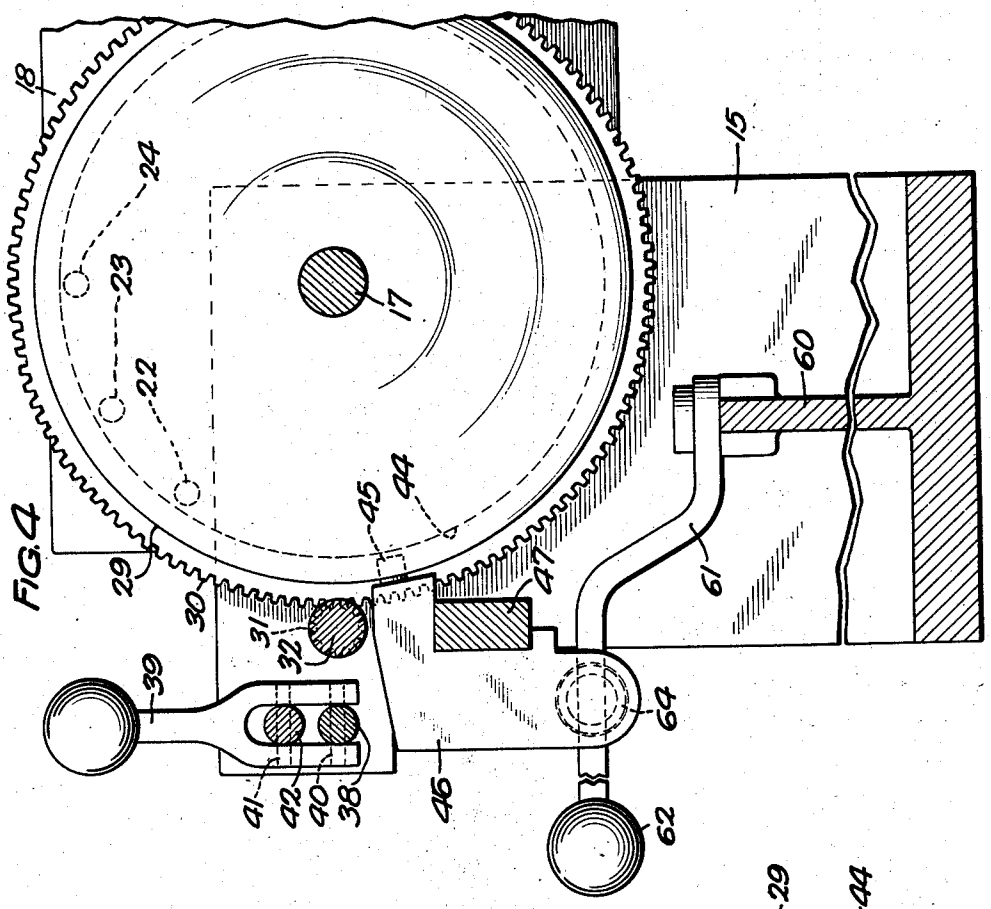


FIG. 4

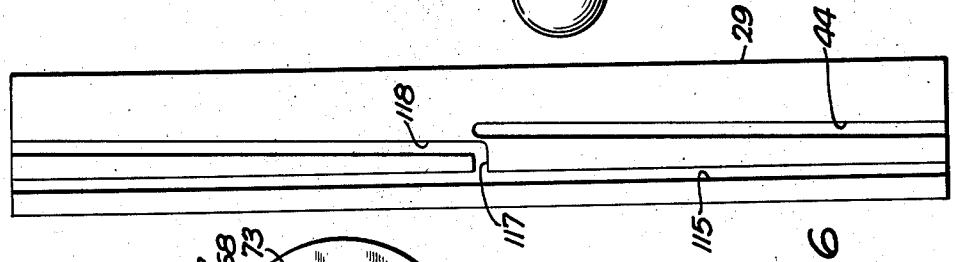


FIG 6

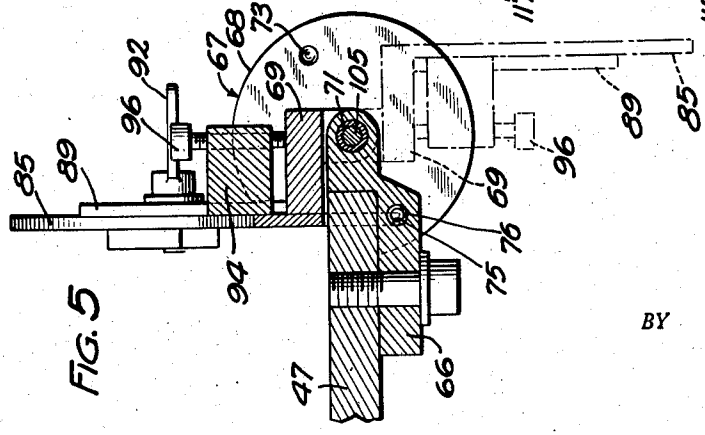


FIG. 5

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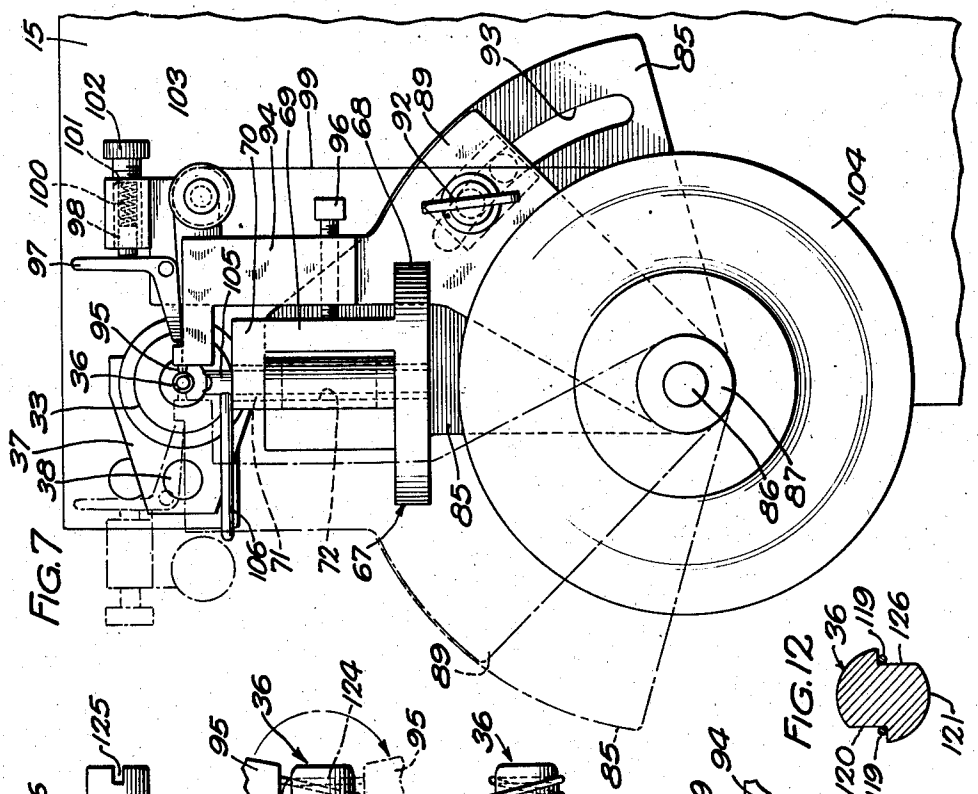


FIG. 7

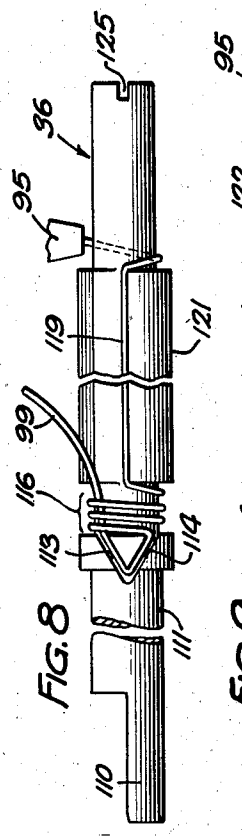


FIG. 8

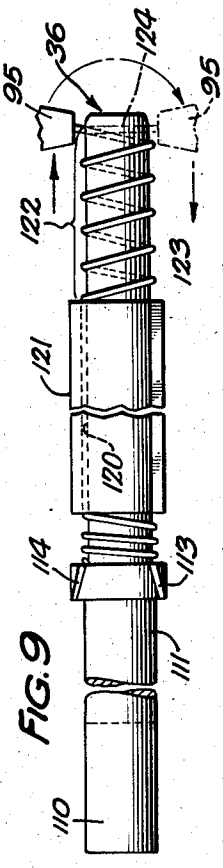


FIG. 9

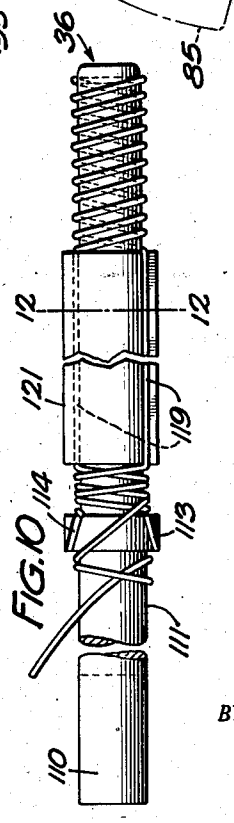


FIG. 10

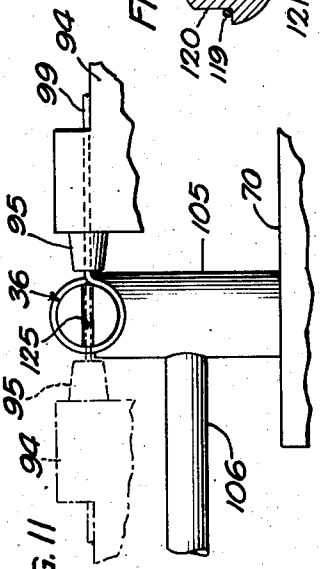


FIG. 11

FIG. 12

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UNITED STATES PATENT OFFICE

2,371,782

FILAMENT WINDING APPARATUS

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Application September 15, 1943, Serial No. 502,493

15 Claims. (Cl. 153—67)

This invention relates to filament winding apparatus and more particularly to an apparatus for winding a filament comprising a double-wound helix, all spirals of which extend in the same direction.

It is an object of the present invention to provide a simple apparatus for expeditiously winding filaments.

In accordance with one embodiment of the invention, a supply spool and associated filament guiding means are pivotally mounted on the end of a reciprocable rod adapted to be reciprocated by a cam drum and to support the supply and filament guiding mechanism adjacent a mandrel rotated in time relation to the reciprocation of the supply and guiding mechanisms, whereby a filament may be wound to form a spiral or helix on the mandrel extending in one direction and when the free end of the mandrel is adjacent the filament guiding means, the guiding means may be moved around the end of the mandrel to place the wire in a slot formed in the end of the mandrel whereby rotation of the mandrel in the opposite direction and movement of the supply in the opposite direction will interlay a helix or spiral spiralled in the same direction as that previously applied on the mandrel.

A complete understanding of the invention may be had by reference to the following detailed description when considered in conjunction with the accompanying drawings, wherein

Fig. 1 is a front elevational view of an apparatus embodying the features of the invention, part of the apparatus being broken away to show the details of a chuck for holding the mandrel;

Fig. 2 is a plan view of the apparatus shown in Fig. 1;

Fig. 3 is a detail view in perspective on a large scale of a mandrel suitable for use in an apparatus, part of the mandrel being broken away to conserve space;

Fig. 4 is a transverse vertical sectional view taken substantially along the line 4—4 of Fig. 1 in the direction of the arrows;

Fig. 5 is a fragmentary plan section taken substantially along the line 5—5 of Fig. 1 in the direction of the arrows;

Fig. 6 is a developed view on a relatively small scale of the cam used in the apparatus for advancing and retracting the filament supply and guiding mechanism;

Fig. 7 is an end elevation view showing details of the filament guiding and supply mechanism;

Fig. 8 is an enlarged detail view showing the filament applied to the mandrel at the beginning of the winding of the first helix;

Fig. 9 is a side elevational view of the mandrel shown in Fig. 8 and showing the first helix completely wound on a mandrel and illustrating diagrammatically the path of the filament guiding means;

Fig. 10 is a view similar to Fig. 9 showing the filament completely wound on the mandrel and tied thereon;

Fig. 11 is an enlarged fragmentary detail view of a means provided for holding the filament against the mandrel while the filament guiding means is pivoted around the end of the mandrel; and

Fig. 12 is a sectional view taken substantially along the line 12—12 of Fig. 10 in the direction of the arrows.

The apparatus illustrated in the drawings is designed to wind the filament in a manner illustrated graphically in Figs. 8, 9 and 10 and comprises a main U-shaped frame member 15, which may be positioned on a suitable bench or table 16 and which supports all of the operating parts of the apparatus. Journalled in the upwardly extending arms of the main frame member 15 is a shaft 17, which extends outwardly through a disc 18 mounted on the left face of the left leg (Fig. 2) of the member 15. At its left end, the shaft 17 has a hand wheel 19, suitably keyed to it and the hand wheel 19 in turn has a plunger manipulating handle 20 mounted upon it. The handle 20 is provided with an irregularly shaped shank 21, as shown most clearly in Fig. 1, the right end of which is adapted to enter any one of three apertures 22, 23 or 24 formed in the disc 18. The shank 21 of the handle 20 has a shoulder 25 formed on it against which the right end (Fig. 1) of a compression spring 26 bears. The left end of the compression spring 26 is seated against an annular collar 27 suitably attached in a projection 28 on the hand wheel 19. The spring 26 bearing against the collar 27 will thus urge the shank 21 of the handle 20 to enter the apertures 22, 23 or 24 when it moves into alignment with them. The shaft 17 has a cam drum 29 fixed to it, on the left face of which (Figs. 1 and 2) there is mounted a gear 30, which, in turn, meshes with gear teeth 31 cut into a chuck supporting shaft 32 suitably journalled in the upright legs of the main frame member 15.

The chuck supporting shaft has a spring type chuck 33 of any suitable construction mounted on its right end (Figs. 1 and 2). The chuck in-

cludes a slidable collar 34, which may be advanced to the right or retracted to the left (Figs. 1 and 2) to actuate chuck jaws 35—35 for gripping a mandrel 36 between them. The collar 34 is adapted to receive a forked member 37 mounted upon a slidable rod 38, which is adapted to be slidably supported in the main frame member 15. The rod 38 may be actuated by a handle 39, which is pivotally connected thereto by means of a pivot pin 40 and which is oscillatable about a pin 41 on the end of a fixed rod 42. The rod 42 is fixed to the right hand upright of the U-shaped member 15 by means of a pin or set screw 43.

From the foregoing, it is believed to be apparent that when the hand wheel 19 is rotated, rotation will be imparted to the shaft 32 through the action of the gear 30 and teeth 31 simultaneously with the rotation of the cam drum 29. The cam drum 29 is provided with a cam groove 44, the shape of which is most clearly illustrated in the developed view of the cam shown in Fig. 6. Extending into the cam groove 44 is a cam pin 45, which is mounted upon a sloping surface of a block 46 suitably fixed to a slide 47 slidably mounted in both legs of the main frame member 15. The main frame member 15 is provided with a transversely extending flange 60, on the upper surface of which there is pivoted a manually operable lever 61 having a handle 62 (Figs. 1 and 4). The lever 61 extends through a slot 63 in the block 46 and is normally urged against the left edge of the slot (Fig. 1) by a compression spring 64 seated in a socket 65 formed in the block 46 and bearing against the right edge of the lever 61.

Mounted upon the right end (Figs. 1, 2 and 5) of the slide 47 is a supply and guide supporting block 66, on which there is pivoted a bracket 67. The bracket 67 includes a flat disc-like member 68, having extending upwardly therefrom a vertical portion 69, which is formed integrally with a horizontally extending portion 70. The horizontally extending portion 70 extends over the top of the block 66 and cooperates with the disc-like portion 68 to receive a tube 71, which serves as a pivot pin for pivoting the bracket 67 on the end of the block 66, the block 66' being provided with an aperture 72 extending through it for receiving the shank of the sleeve or tube 71. The disc-like member 68 is provided with a pair of indentations 73, into which a stop pin 74, freely slidable in an aperture 75 in the block 66, may be urged by a spring 76, one end of which bears against the stop pin 74 and the other end of which bears against a plug 77 fixed in the aperture 75. In this manner, the bracket 67 may be locked either in the position shown in full lines (Fig. 5) or in the position shown in dotted lines in this figure.

Pivotally secured to the underside of the disc-like member 68 is a support bracket 85, which, as shown most clearly in Figs. 1 and 7, has a reel supporting shaft 86 attached to it. The shaft 86 is threaded at its right end (Fig. 1) to receive a reel retaining member 87 and this end of the shaft terminates in a shoulder portion 88 adapted to bear against a guide supporting plate 89 interposed between the shoulder 88 and the right hand face of the bracket 85. The left end of the shaft 86 is also provided to receive a lock nut assembly 90, which may be utilized to attach the shaft to the bracket 85 and also to adjust the frictional engagement of the guide supporting plate 89 with the face of the bracket 85. A handle 91 is fixed in the threaded left end of the shaft 86 to facilitate manipulation of the reel retaining member 87 and the lock nut assembly 90. The rotated position of the guide supporting plate 89 with respect to the bracket 85 may be adjusted by oscillating the plate 89 with respect to the bracket and the plate may then be fixed in any selected position by means of a wing nut assembly 92, which is adjustable along a slot 93 formed in the bracket 85. Fixed to the guide supporting plate 89 is a guide block 94 (Figs. 5 and 7) which carries a guide nozzle 95 at its upper end and the relative position of which with respect to the mandrel 36 may be accurately regulated by means of a set screw 96, which is threaded in the block 94 and has its end engaging the vertical portion 69 of the bracket 67. In addition to supporting the guide nozzle 95, the guide block 94 has a braking bell crank lever 97 pivoted on it and normally urged by a spring-pressed plunger 98 to force a strand of filament wire 99 against the upper surface of the block 94. The plunger 98 is urged against the vertically extending leg of the bell crank lever 97 by a spring 100 held in an aperture 101 by a thumb nut 102. The guide block 94 also supports a guide sheave or roller 103, which serves to guide the filament wire 99 from a reel 104 mounted on the shaft 86 in its passage to the guide nozzle 95.

In addition to serving as a pivot for the bracket 67 on the guide supporting block 66, the tube 71 serves as a positioning element to position a holding member 105 directly below the end of the mandrel 36 when the guide supporting block 66 is in its extreme right hand position, as seen in Figs. 1 and 2. The holding member 105 is loosely mounted in the tube 71 and is provided with a handle 106, whereby it may be manually moved upwardly to engage the winding filament on a mandrel in the operation of the apparatus. Further details of construction, particularly of the mandrel 36, will be described in the following brief description of the method of operation of the apparatus.

The left end of the mandrel, as viewed in Figs. 1, 2, 3, 8, 9 and 10, is semi-circular in cross section, as shown at 110, whereby it may be more readily locked in the chuck jaws 35. Adjacent the semi-circular portion of the mandrel, a straight round portion 111 is provided which terminates in a shoulder 112. The shoulder 112 is provided with two sets of grooves 113 and 114 on opposite sides of it, into which the filament wire 99 may be set in the fixing of the filament wire on the mandrel at the beginning and end of a winding operation. At the start of the operation of the apparatus, slide 47 will be in its lefthand position opposite to that shown in Figs. 1 and 2 and the guide supporting plate 89 may be in the position opposite to that shown in Fig. 7, that is, it may be moved to a position where the nozzle 95 is carried away from the mandrel 36. The bracket 67, however, will be on the same side of the mandrel as shown in full lines in Fig. 7. At this time, the cam pin 45 will be in the lefthand portion 115 of the groove 44 and the shank 21 of the handle 20 will be in the aperture 22. The operator may then lace the filament wire 99 through the grooves 113 and 114, as shown in Fig. 8, and may then, after withdrawing the shank 21 of the handle 20 from the aperture 22, oscillate the hand wheel 19 to the position where the shank 21 will enter the aperture 23 (Fig. 4) to apply the group of windings 116 after moving the nozzle 95 up to the position shown in Fig. 7.

The hand wheel 19, in being moved from the position where the shank 21 registers with the aperture 22 to the position where the shank 21 registers with the aperture 23, will bring the cam pin 45 into alignment with cross passage 117 of cam groove 44 and the handle 62 may then be moved to cause the cam pin 45 to move from left to right (Fig. 6) across the cross passage 117 and into alignment with portion 118 of the cam groove 44. This will cause the filament wire to be laid across, as indicated at 119, in a notch 120 formed along the portion 121 of the mandrel 36. The operator may then rotate the hand wheel 19 in a direction to follow the portion 118 of the cam groove 44 to apply the group of windings designated 122 on the reduced portion 23 of the mandrel by rotating the hand wheel from the position where the shank 21 registered with the apertures 23 around to the position where the shank 21 falls into aperture 24 to block further movement of the hand wheel 19 in that direction, that is, counter-clockwise, as seen in Fig. 4. In moving to the right, the slide 47 and the guiding mechanisms supported thereby will follow the lines indicated by the arrows in Fig. 9 until the nozzle 95 is in the position shown in full lines in that figure. At this time, the entire guiding mechanism and supply mechanism supported by the bracket 67 may be shifted by rotating the bracket 67 around the tube 71 from the position shown in full lines in Fig. 7 to the position shown in dot and dash lines therein, thus to lay a portion 124 of the filament wire in a groove 125 formed in the right end of the mandrel (Fig. 8). In order to prevent the filament wire from slipping off the end of the mandrel while it is being bent into the groove 125, the holding member 105 may be moved up to the position shown in Fig. 11 to bear against the last lay of filament wire applied on the mandrel until the nozzle 95 is in the position shown in dot and dash lines in Fig. 9. The direction of rotation of the hand wheel 19 may now be reversed to move the shank 21 of the handle 20 from association with the aperture 24 back to association with aperture 23, thus to apply a helical winding of wire between the group of windings 122. This will carry the cam drum 29 back to the position where the cam pin 45 again is in alignment with the cross passage 117 of the cam groove 44 and lever 61 may now be manipulated to lay the filament wire 119 in a notch 126 formed along the portion 121 of the mandrel. The handle 20 on the wheel 19 may then be moved to carry the shank 21 of the handle 20 back into alignment with the aperture 22, into which the shank 21 will enter after superposing a layer of windings over the group of windings 116. The nozzle 95 may then be moved away from the mandrel by oscillating the guide supporting plate 89 after loosening the thumb nut 72 and the filament wire may be snubbed onto the round portion 111 of the mandrel, as shown in Fig. 10, and the wire may be cut preparatory to removing the mandrel 36 from the chuck jaws 35 and inserting a new mandrel in the apparatus.

What is claimed is:

1. An apparatus for winding a double helix coil comprising a rotatable mandrel, means for guiding a wire to said mandrel, a cam having a groove of a single spiral convolution for producing relative movement between said mandrel and guiding means, means for rotating said mandrel in one direction in relation to said cam to produce one helix of a double helix coil, and means including said guiding means operative upon reverse rotation of said cam and mandrel to lay the second helix of the double helix coil on a mandrel in spaced relation to said one helix.

2. An apparatus for winding a double helix coil comprising a rotatable mandrel, means for rotating said mandrel, means for guiding a wire to said mandrel, means for producing relative movement between said mandrel and guiding means to form a helix with spaced convolutions, means for shifting said guiding means when one helix is formed to a diametrically opposite position with respect to the mandrel, and means including the means for producing relative movement between the guiding means and mandrel to form a second helix with its convolutions between the convolutions of the first helix upon rotation of the mandrel in a reverse direction.

3. An apparatus for winding a double helix coil comprising a reversibly rotatable mandrel, means for guiding a wire to said mandrel, means for moving said guide relative to said mandrel including a cam and a driving connection between said cam and mandrel of such ration that substantially one revolution of the cam will produce such a number of revolutions of said mandrel as to form one helix of a double helix coil, means for supporting the guiding means in position to guide the wire to form said one helix, and means for supporting the guiding means in position to guide the wire for forming the second helix of the double helix coil upon reversal of rotation of said mandrel.

4. An apparatus for winding a double helix coil comprising a reversibly rotatable mandrel, movable means for guiding a wire to said mandrel, means for positioning the guiding means to form one helix of a double helix coil, means for positioning the guiding means to form the second helix of the double helix coil, and means for controlling the movement of said guide means including a cam having a circular groove, an interconnecting longitudinal groove, and an interconnecting helical groove.

5. The filament winding apparatus comprising a rotatable mandrel, means operable to rotate said mandrel a predetermined number of revolutions in one direction and the same number of revolutions in the opposite direction, a filament guiding means positioned adjacent to one side of said mandrel for guiding filament radially to the mandrel during the rotation of the mandrel in one direction to form one helix of a double helix coil, and means for shifting the guiding means around the end of the mandrel to the opposite side thereof to guide the filament during rotation of the mandrel in the opposite direction to form the second helix of the double helix coil.

6. A filament winding apparatus comprising a rotatable mandrel, means operable to rotate said mandrel a predetermined number of revolutions in one direction and the same number of revolutions in the opposite direction, a filament guiding means positioned adjacent to said mandrel for guiding filament radially to the mandrel, and pivot means adjacent to said mandrel for supporting the guiding means for movement around the end of the mandrel in the plane of the axis of the mandrel.

7. A filament winding apparatus comprising a rotatable mandrel, means operable to rotate said mandrel a predetermined number of revolutions in one direction and the same number of revolutions in the opposite direction, a filament supply

reel, means for supporting said reel beneath the mandrel, filament guiding means on the supporting means for guiding filament from the reel to the mandrel, and means for pivotally supporting said supporting means for movement at right angles to the axis of the mandrel.

8. In an apparatus for winding a heater filament having a double helix, all spirals of which extend in the same direction, a reel for supporting a supply of filament to be wound, a bracket for supporting said reel, guide means pivotally mounted on said bracket including a feeding nozzle for directing the filament to a predetermined position, a mandrel rotatable on an axis at right angles to the nozzle, means for pivotally supporting said bracket at right angles to the axis of rotation of the mandrel and at right angles to the nozzle, reciprocatory means for imparting rotation to said supporting means, and means for driving the mandrel and the reciprocatory means in timed relation.

9. In an apparatus for winding a heater filament having a double helix, all spirals of which extend in the same direction, a reel for supporting a supply of filament to be wound, a bracket for supporting said reel, guide means pivotally mounted on said bracket including a feeding nozzle for directing the filament to a predetermined position, a mandrel rotatable on an axis at right angles to the nozzle, means for pivotally supporting said bracket at right angles to the axis of rotation of the mandrel and at right angles to the nozzle, reciprocatory means for imparting rotation to said supporting means, and means for driving the mandrel and the reciprocatory means in timed relation, said means for pivotally supporting the bracket being positioned to carry the guiding means around the end of the mandrel.

10. In an apparatus for winding a heater filament having a double helix, all spirals of which extend in the same direction, a reel for supporting a supply of filament to be wound, a bracket for supporting said reel, guide means pivotally mounted on said bracket including a feeding nozzle for directing the filament to a predetermined position, a mandrel rotatable on an axis at right angles to the nozzle, means for pivotally supporting said bracket at right angles to the axis of rotation of the mandrel and at right angles to the nozzle, reciprocatory means for imparting rotation to said supporting means, means for driving the mandrel and the reciprocatory means in timed relation, and means for maintaining the strand under tension between the means for supporting a supply of filament on the mandrel.

11. In an apparatus for winding a filament comprising a double wound helix, all spirals of which extend in the same direction, a mandrel, means for imparting rotation to said mandrel, guiding means positionable adjacent said mandrel to guide a filament to the mandrel, means for supporting a supply of filament adjacent to the guiding means, a common support for the supply and guiding means, a block for carrying said support, and means pivotally connecting the support to the block to position the guiding means on either side of the mandrel.

12. In an apparatus for winding a filament comprising a double wound helix, all spirals of which extend in the same direction, a mandrel, means for imparting rotation to said mandrel, guiding means positionable adjacent said mandrel to guide a filament to the mandrel, means for supporting a supply of filament adjacent to the guiding means, a common support for the supply and guiding means, a block for carrying said support, means pivotally connecting the support to the block to position the guiding means on either side of the mandrel, a slide for carrying said block, and means for imparting reciprocation to said slide in timed relation to the rotation of the mandrel.

13. In an apparatus for winding a filament comprising a double wound helix, all spirals of which extend in the same direction, a mandrel, means for imparting rotation to said mandrel, guiding means positionable adjacent said mandrel to guide a filament to the mandrel, means for supporting a supply of filament adjacent to the guiding means, a common support for the supply and guiding means, a block for carrying said support, means pivotally connecting the support to the block to position the guiding means on either side of the mandrel, a slide for carrying said block, and means for imparting reciprocation to said slide in timed relation to the rotation of the mandrel, said means for imparting rotation to the mandrel being operable to rotate the mandrel in one direction when the slide moves in a predetermined direction and being operable to rotate the mandrel in the opposite direction when the slide moves in the opposite direction.

14. In an apparatus for winding a filament comprising a double wound helix, all spirals of which extend in the same direction, a mandrel, means for imparting rotation to said mandrel, guiding means positionable adjacent said mandrel to guide a filament to the mandrel, means for supporting a supply of filament adjacent to the guiding means, a common support for the supply and guiding means, a block for carrying said support, means pivotally connecting the support to the block to position the guiding means on either side of the mandrel, a slide for carrying said block, means for imparting reciprocation to said slide in timed relation to the rotation of the mandrel, and means for imparting reciprocation to the slide comprising a cam drum rotatable in timed relation to the rotation of the mandrel, and a camming pin attached to the slide and engaging said cam drum.

15. In an apparatus for winding a filament comprising a double wound helix, all spirals of which extend in the same direction, a mandrel, means for imparting rotation to said mandrel, guiding means positionable adjacent said mandrel to guide a filament to the mandrel, means for supporting a supply of filament adjacent to the guiding means, a common support for the supply and guiding means, a block for carrying said support, means pivotally connecting the support to the block to position the guiding means on either side of the mandrel, a slide for carrying said block, means for imparting reciprocation to said slide in timed relation to the rotation of the mandrel, means for imparting reciprocation to the slide comprising a cam drum rotatable in timed relation to the rotation of the mandrel, and a camming pin attached to the slide and engaging said cam drum, the cam drum having a plurality of interconnected grooves therein for receiving the cam pin whereby at predetermined times the slide may be moved without rotating the mandrel.

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