

July 7, 1959

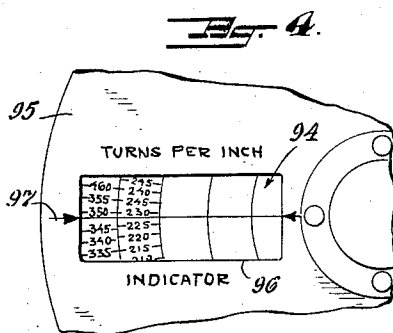
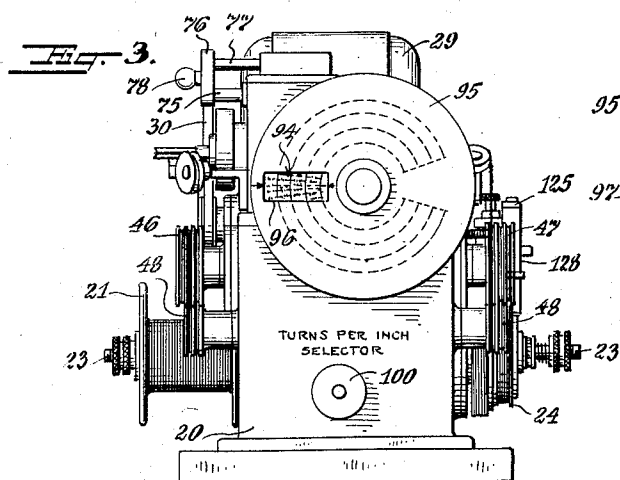
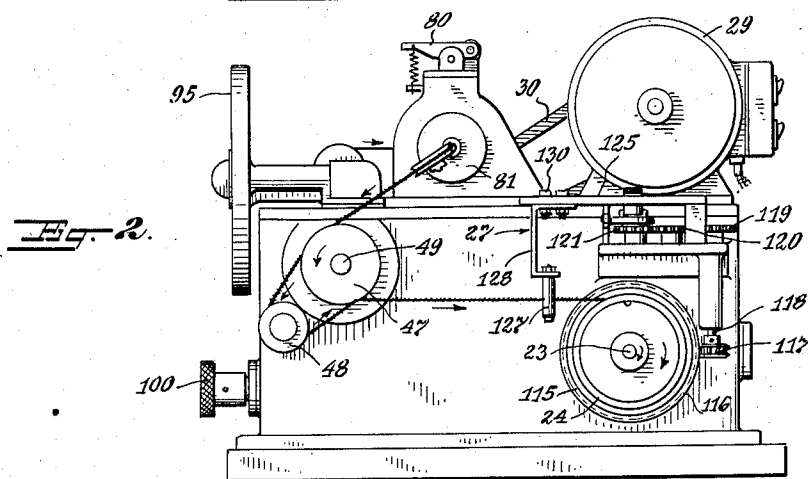
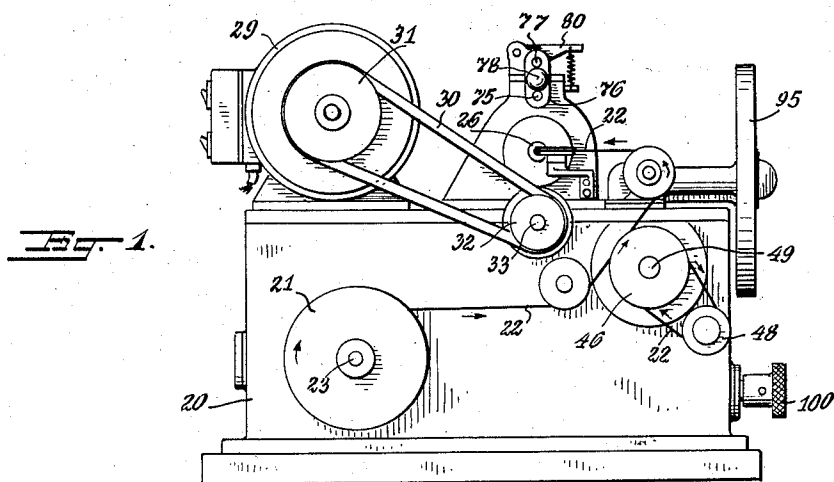
A. GREINER

2,893,195

COIL WINDING MACHINE

Filed June 17, 1958

5 Sheets-Sheet 1



INVENTOR.
ARNO GREINER.

BY
Howard P. King
ATTORNEY.

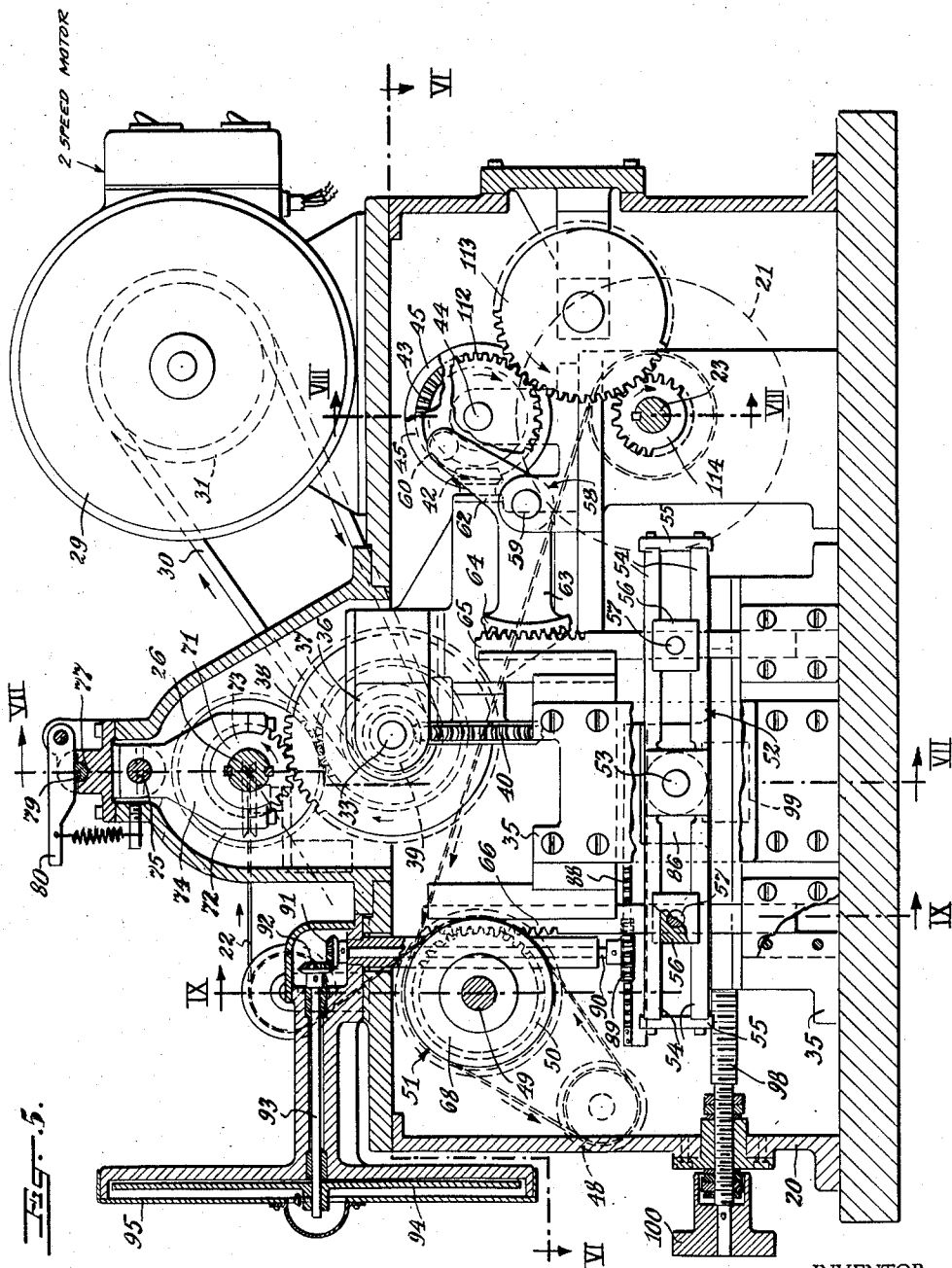
July 7, 1959

A. GREINER
COIL WINDING MACHINE

2,893,195

Filed June 17, 1958

5 Sheets-Sheet 2



INVENTOR.
ARNO GREINER

BY
Howard P. King
ATTORNEY.

July 7, 1959

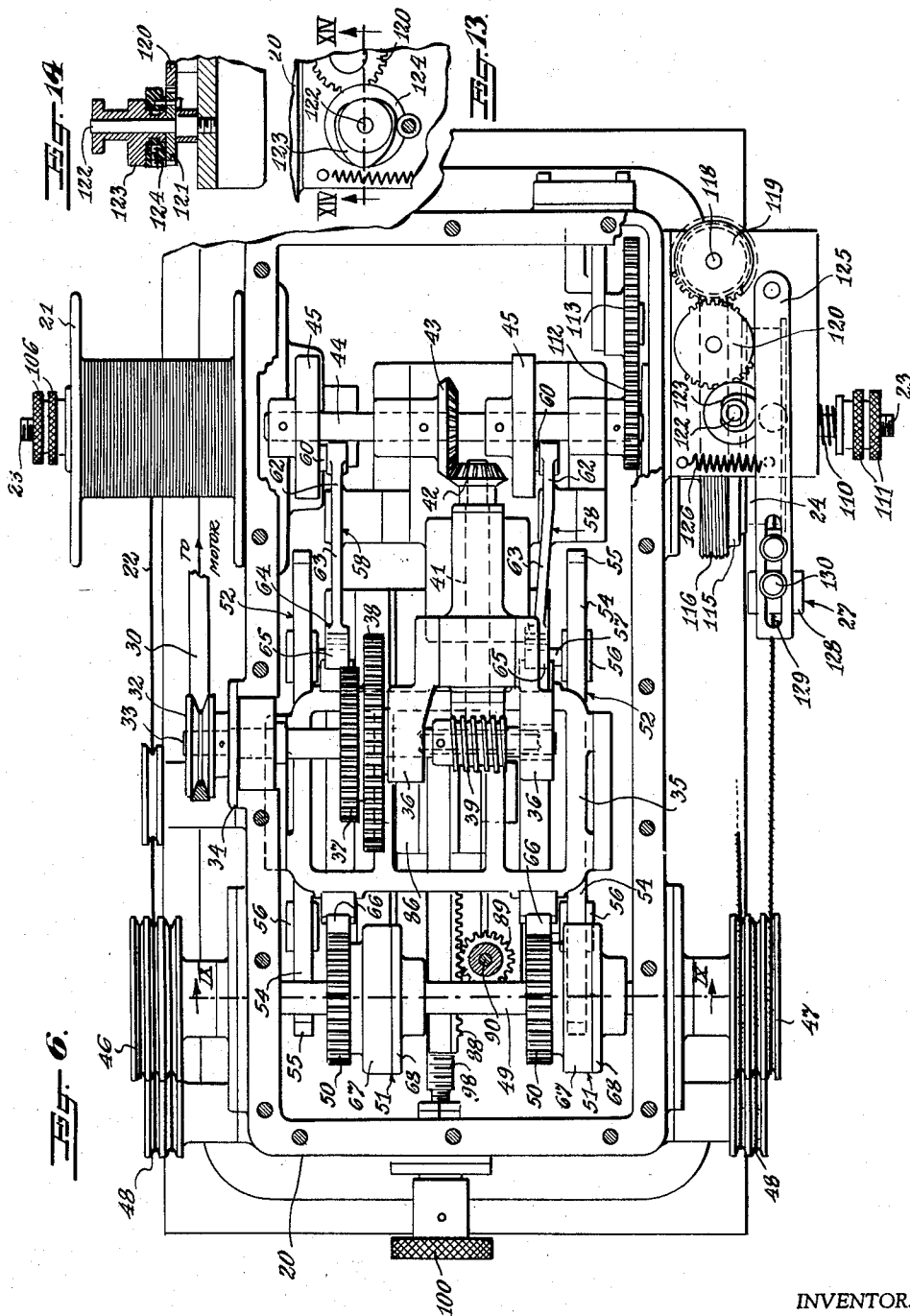
A. GREINER

2,893,195

COIL WINDING MACHINE

Filed June 17, 1958

5 Sheets-Sheet 3



INVENTOR.
ARNO GREINER

BY
Howard P. King
ATTORNEY.

July 7, 1959

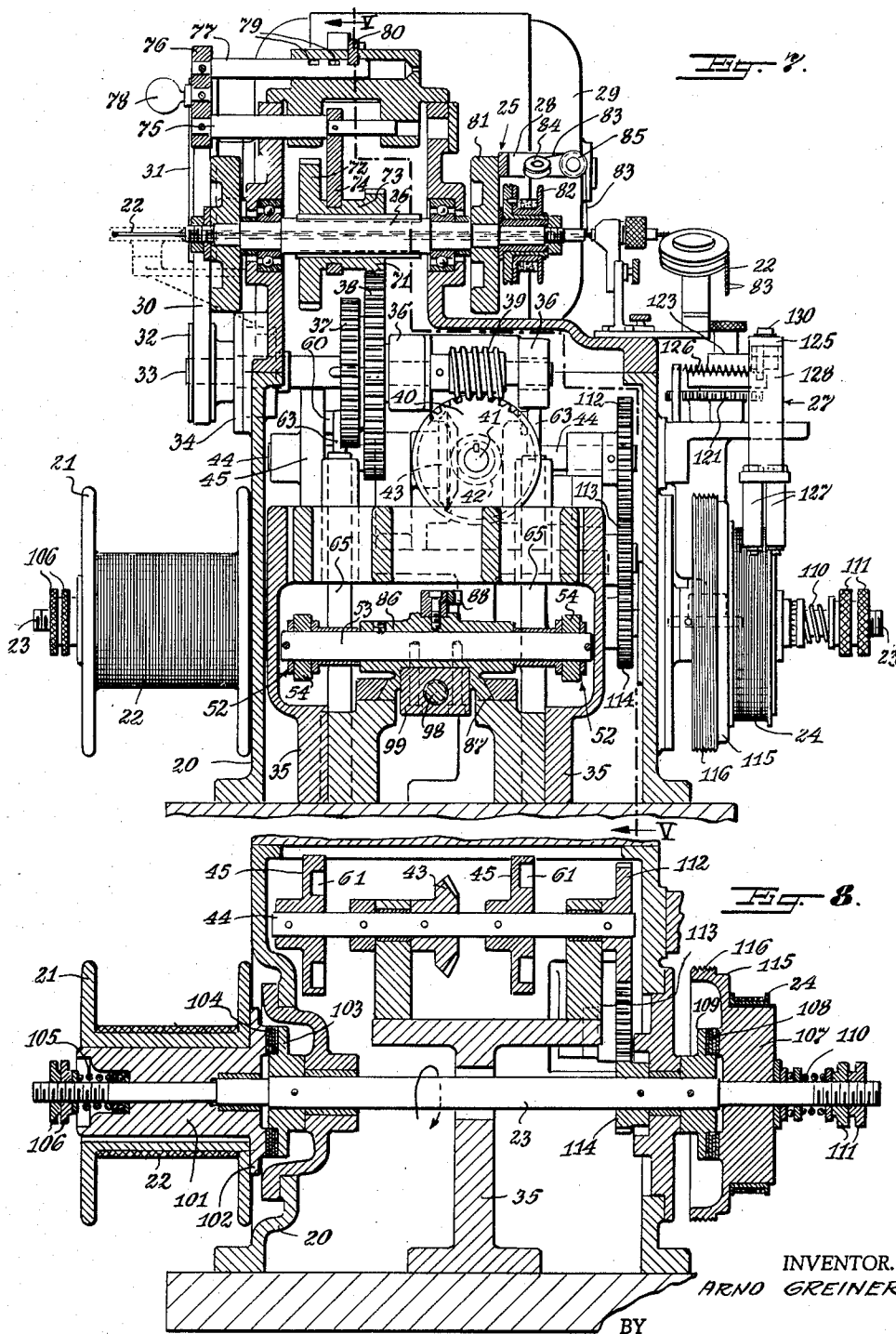
A. GREINER

2,893,195

COIL WINDING MACHINE

Filed June 17, 1958

5 Sheets-Sheet 4



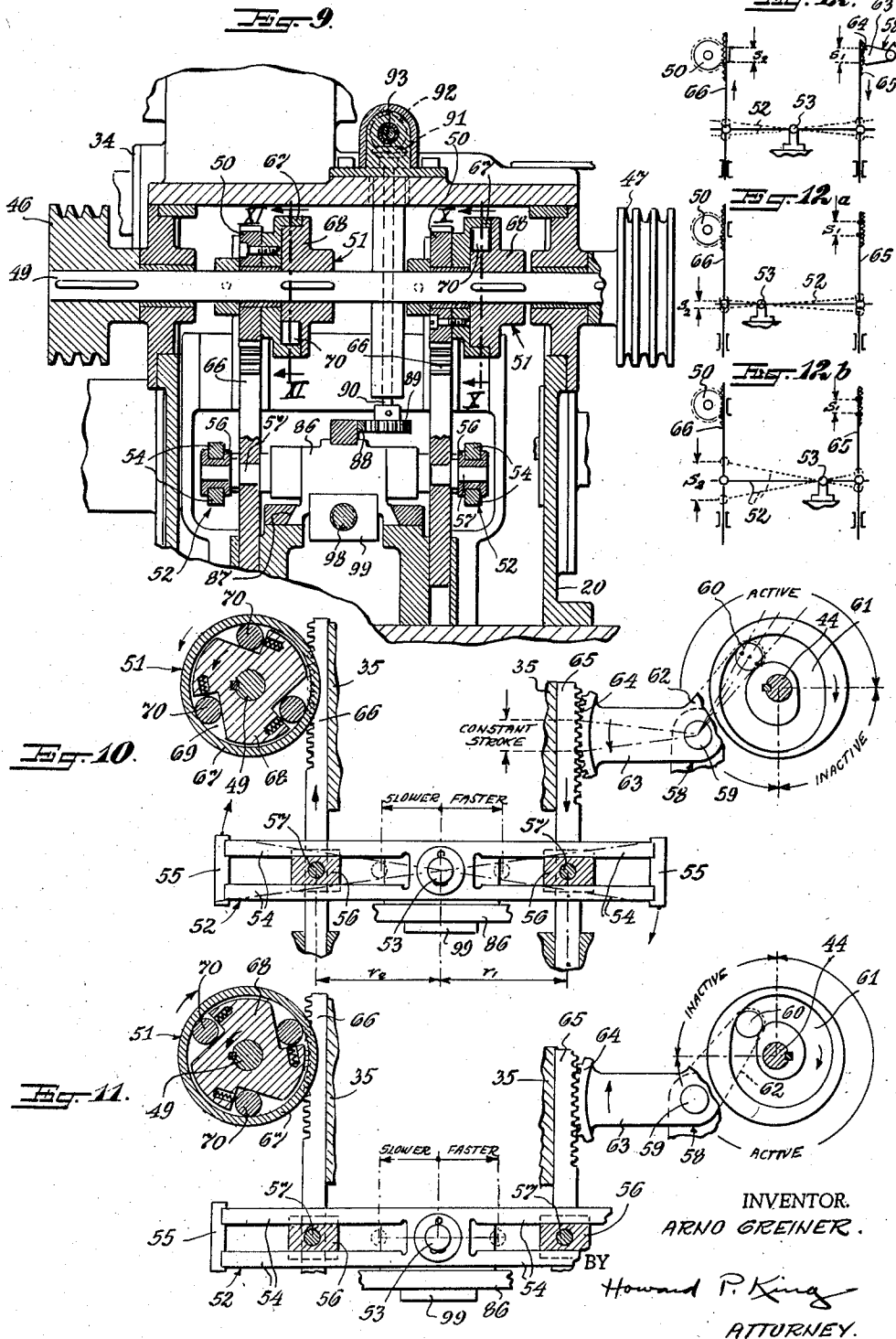
July 7, 1959

A. GREINER
COIL WINDING MACHINE

2,893,195

Filed June 17, 1958

5 Sheets-Sheet 5



1

2,893,195

COIL WINDING MACHINE

Arno Greiner, Irvington, N.J., assignor to Uwimco, Inc.,
Springfield, N.J., a corporation of New Jersey

Application June 17, 1958, Serial No. 742,675

12 Claims. (Cl. 57—3)

This invention relates to coil winding machines and more particularly to machines which wind a coil on a continuously fed mandrel.

The coils made by the present invention are predominantly used as filaments for lamps, and it is consequently of great importance that the winding shall be uniform and made precisely with a predetermined number of convolutions or turns of filament per unit length of the mandrel. Heretofore attempts have been made to attain the specified number of turns by calculation of gear ratios determinative of the advancement of the mandrel in its relation to the number of revolutions of the winding head. Even with the most careful calculations and construction, the prior art machines often fail to produce the intended and desired accuracy. Furthermore, in the prior art machines it is necessary to laboriously change the gears or t.p.i. drums (abbreviation used in the trade meaning turns per inch) in order to obtain any change from a fixed number of convolutions of filament produced by the machine to any other number of convolutions.

Basically, the present invention proposes a machine wherein extremely accurate precision of number of convolutions per unit length of the mandrel can be readily accomplished.

Of similar nature, the invention proposes a construction permitting both adjustment and large change of the number of convolutions by a readily manipulated means under operator control, and without requiring present-day elaborate calculations, or in fact, without requiring any calculations by the operator or any mechanical replacement of gears or drums.

More specifically, the invention provides a machine wherein minute or other adjustment as well as large change of the convolutions per unit length of mandrel may be accomplished by a simple control and dial indicator that can be readily manipulated by the operator of the machine, and requires neither a mechanic, nor tools.

Additionally, the construction devised permits the adjustment or change just referred to above, to be made with the machine in motion or not in motion, and requires no material delay in productive operation of the machine.

The invention also features mandrel wire motion by improved means obtaining forward motion only thereof and completely eliminating detrimental occurrences of hesitation thereof heretofore caused by gear back-lash and similar mechanical deficiencies.

In conjunction with the foregoing last-recited object, the invention also provides for applying desired tension in the mandrel wire both in feeding the same to the coil winding head and in subsequent travel thereof to the reel on which the coil, with its mandrel, is wound.

A further important consideration of the invention is provision of one that is usable for winding a selected one of various sizes of coil wire on a selected one of various sizes of mandrel wires, thereby providing a machine of universal character.

The invention also incorporates an improved spreader

2

mechanism at the re-winding end of the machine that will automatically adjust itself according to rotary motion of the rewinding drum.

Other objects, advantages and beneficial structural features will appear to persons skilled in the art to which the invention appertains as the description proceeds, both by direct reference thereto and by implication from the context.

Referring to the accompanying drawings, in which like numerals of reference indicate similar parts throughout the several views;

Figures 1 and 2 are side elevations of a machine, looking at opposite sides thereof, incorporating the present invention;

Figure 3 is a front elevation of the machine;

Figure 4 is an enlarged fragmentary portion of the dial control for setting the turns per unit length on the mandrel;

Figure 5 is a sectional view on line V—V of Fig. 7;

Figure 6 is a sectional view on line VI—VI of Fig. 5;

Figure 7 is a sectional view on line VII—VII of Fig. 5;

Figure 8 is a sectional view on line VIII—VIII of Fig. 5;

Figure 9 is a sectional view on line IX—IX of Fig. 5; Figures 10 and 11 are corresponding sectional views on lines X—X and XI—XI respectively of Fig. 9;

Figures 12, 12a and 12b are diagrammatic views showing three different possible settings for the actuating lever;

Figure 13 is a plan of a fragmentary part of the showing in Fig. 6, illustrating the tracking cam in a different position; and

Figure 14 is a sectional view on line XIV—XIV of Fig. 13.

In the specific embodiment of the invention illustrated in said drawings, the general organization of the machine provides a hollow casting or housing 20 which contains essential portions of the mechanism, and on the outside of which a spool 21 containing a supply of mandrel wire 22 may be mounted upon a shaft 23 that extends from side to side of the housing and projects at one side to receive said spool 21, and projects at the other side to receive a reel 24 on which the finished product is wound. At the top of said housing 20 is provided a winding head 25 which is carried by and rotates with a tubular shaft identified in the trade as the winding spindle 26, parallel to the spool and reel shaft 23. The mandrel wire is passed around appropriate sheaves and a t.p.i. drum on the spool side of the housing to be properly tensioned and fed and introduced into an end of said winding spindle 26 to pass therethrough to the other side of the housing where the filament or coil wire is wound around it. From thence the mandrel wire, with the coil of wire or filament upon it, for brevity hereinafter referred to as the wound mandrel, passes around appropriate sheaves and another t.p.i. drum and thence to the reel 24 under guidance of tracking mechanism 27 so as to be evenly wound in sequentially close convolutions and in successive layers on said reel.

For descriptive purposes, the winding head 25 includes a winding frame 28 which revolves with the spindle 26 around the axis thereof and may be considered at this stage of the description as operating at a constant rate and therefore the number of turns or convolutions of the coil upon the mandrel will be varied only by varying the forward rate of travel of the mandrel wire. An essential feature of the present invention is provision of a novel drive for the mandrel wire so as to readily vary or adjust the number of convolutions of filament applied per unit length thereof.

An electric motor 29 mounted at the top of the hous-

ing 20 proximate to what is herein termed the rear end of the machine, provides the actuating motive power, through a belt 30 and appropriate pulleys 31, 32 to a drive shaft 33 located near the top of the housing approximately midway from front to rear thereof and parallel to afore-mentioned shaft 23 and spindle 26. Said drive shaft 33 rotates at the selected rating of the motor at a constant speed and continuously while the machine is in operation, but to accommodate operation with different sizes of wire, I prefer to use a two-speed motor so as to use the machine either with one or the other of the selected speeds. Drive shaft 33 is shown projecting at one side, here termed the left side, of the housing, and there carries the belt pulley 32 in fixed position thereon so as to be driven thereby. Next to that pulley, and mounted in the proximate wall of the housing is a bearing 34 for the shaft 33 and within the housing is a fixed frame 35 providing, inter alia, two other and spaced apart bearings 36, 36. Fixed on said drive shaft, between housing bearing 34 and the most proximate of frame bearings 36 are two adjacent drive gears which may be distinguished by calling them respectively small drive gear 37 and large drive gear 38 and constitute selective drive for speed of drive for the above-mentioned winding head 25 which will be hereinafter more fully described. Between the pair of spaced apart bearings 36, 36 a worm 39 is fixed on said drive shaft 33. The small and large drive gears 37, 38 and the worm 39 accordingly will be subject to the selected speed of the motor, and any change of speed of the motor reflects a corresponding change of speed of both of said drive gears and of the worm.

Worm 39 meshes with a worm wheel 40 therebelow (see Figs. 6 and 7) which is mounted upon what will be termed an intermediate shaft 41 that extends from the worm wheel in a direction toward the rear of the housing and suitably journaled in said frame 35. At the rear end of said intermediate shaft 41 is a bevel gear 42 which is in mesh with a driven bevel gear 43 on yet another shaft 44 which for convenience in distinguishing by terminology, will be referred to as the cam shaft since there are two cams 45 thereon toward opposite sides of the housing from driven bevel gear 43 as may be clearly seen in Fig. 6. It will be understood that the cam shaft 44 and the intermediate shaft 41 are axially in a common horizontal plane and are entirely within the housing and with the cam shaft parallel to drive shaft 33 and in constant rotation from said drive shaft.

General mention has been made hereinbefore that the mandrel wire passes around appropriate t.p.i. drums. More specifically, it may now be stated that at the left or feeding side of the machine there is a multiple-groove t.p.i. drum 46 which may be called the feeding drum, and the opposite side of the machine there is another multiple-groove t.p.i. drum 47 for distinguishing purposes here called the discharge drum. For passing the mandrel wire from one groove to another in said multiple-groove t.p.i. drums, idler sheaves 48 are provided adjacent thereto with the wire from one groove of the drum going around the idler and then back to another groove of the t.p.i. drum, making at least partial convolutions in selected grooves of the drums so as to be positively driven and controlled in speed by said drums. T.p.i. drums 46 and 47 are both of the same diameter and are mounted on opposite ends of a drum shaft 49 that extends through the housing 20 and projects at the sides thereof near the front end. Said drum shaft 49 is at about the same level as and parallel to afore-mentioned cam-shaft 44 which is near the rear end of the housing so that said shafts have considerable distance between them.

The outstanding feature of the present invention comprises means for effecting continuous steady drive for said t.p.i. drum shaft 49 from the cam shaft 44, but with capability of adjusting or altering the speed of the drum

shaft while the cam shaft continues at its previous speed. It has been stated that there are two cams 45 on the cam shaft, and now it may be said that there are two gears 50 rotatably journaled on the drum shaft 49, and for reasons that will presently appear, these may be termed oscillating gears. Each of said oscillating gears has a one-way clutch 51 (see Figs. 6, and 9 to 11) connecting it to the drum shaft 49 so that when an oscillating gear 50 rotates in one direction it will actuate the drum shaft, but when the gear oscillates in the other direction the clutch therefor releases so the gear merely rotates on said drum shaft without then actuating it. One of said oscillating gears is driven by one of the cams 45 and the other of said oscillating gears is driven by the other one of the cams.

The driving connections for the oscillating gears is the same construction for each, so description of one will suffice for both. Generally speaking, the said driving connection is in the nature of a walking-beam and accordingly comprises a lever 52 which is carried by a pivot rod 53 transverse to both levers and located medially between the opposite ends of the levers (see Figs. 5 and 9 to 11). Beyond the pivotal mounting of the lever, longitudinally toward both ends, said lever is bifurcated, there by providing oppositely extending pairs of rails 54 conveniently kept from spreading by end caps 55. A slide block 56 is carried between each pair of rails, so there will be one block at one lever portion beyond the pivot 53 toward the front of the housing and another block at the opposite side of the pivot in the other end portion of the lever toward the rear of the housing. Each slide block 56 has a pivot pin 57 projecting laterally therefrom at the side of the lever. Said lever is lower down in the housing than the level of the cam shaft 44 and drum shaft 49 and has a general direction from front to rear of said housing so the ends of said lever are located more or less beneath said shafts.

Associated with each cam 45, is a rocker 58 pivoted at 59 to frame 35 and having an arm 62 at the side of the cam with a cam-follower 60 riding in the cam groove 61. That groove has a contour such that for part of the rotation of the cam, here shown as one quadrant and designated the inactive portion of the complete rotative cycle, it actuates the rocker on a return swing; whereas another and much longer portion of the cam groove 61, here shown as three quadrants and designated the active portion of the complete rotation, has a contour which applies an advancing or driving actuation to swing the rocker in a direction opposite to said return swing. By this construction, the actuation of one rocker in the return portion of its swinging cycle will prevail during a part only of the active or driving portion of the cycle of swing of the other rocker, and vice versa. Each rocker 58 has an arm 63 projecting from the pivot 59 away from both said pivot and cam, and according to the present showing that arm 63, which is more or less horizontal, has a downward driving stroke or swing due to its cam (see Fig. 10) during and in excess of the interval that the corresponding arm 63 of the other rocker 58 is on upward inactive or return portion of its swing under actuation from its cam. Thus at all times, one or the other of said horizontally projecting arms 63 is operating in a downward or driving direction, and each will begin its downward stroke before the other has completed its downward stroke, which briefly may be referred to as overlap of downward or driving strokes.

At the projecting end of each arm 63 is an arcuate gear segment 64 the center of curvature of which is at the axis of pivot 59 for the rocker. A rack 65 is slidably mounted in the frame in a vertical direction and in mesh with said gear segment 64 so that as the gear segment oscillates up and down under influence of the cam rocking the rocker, said rack will have a corresponding up and down but guided straight-line longitudinal motion. Said rack depends at the side of the afore-mentioned bi-

furcated lever 52 proximate to block 56 and is trunnioned connection therewith by pivot pin 57 projecting from said block into said rack. Thus swing of the rocker imparts swinging actuation for said walking-beam lever 52.

The other block 56 in the other end portion of said lever 52 makes trunnioned connection by its pivot pin 57 with another rack 66 which also is vertically and slidably mounted to have straight-line longitudinal movement in the frame. There is, of course, a different rack 66 for each lever, and each is in mesh with a respective one of afore-mentioned oscillating gears 50. Cylinder 67 of the respective clutch 51 is fixed with respect to its oscillating gear, whereas the internal rotor 68 of both of the clutches are fixed on the drum shaft 49. The rotors have tapered pockets 69 next to the cylinders, and therein are rollers 70 which frictionally wedge between the rotor and cylinder when the cylinder rotates in one direction and release when the cylinder rotates in the other direction. This or any suitable type of one-way clutch may be employed, and by use thereof the clutches will each function to rotate the drum shaft upon upward movement of the rack 66 in mesh with and oscillating the respective oscillating gear 50. Downward movement of the rack 66 consequently applies no driving impetus to the drum shaft, and this inactivity occurs during the functioning of the above-described inactive or return portion of the swing of the corresponding rocker 58. The overlap of driving strokes of said rockers also applies to the oscillating gears, so said drum shaft is driven without intermission. It may now be said, furthermore, that the cam groove contours are such that the imparted rotation of the oscillating gears during the active or driving direction of oscillation applies a constant or even rate of movement thereto so that the drum shaft has a smooth constant rate of rotation for any given setting of the speed-regulating mechanisms as well as for the selected speed of the motor.

One speed changing mechanism is a selective drive at either one or two speeds for the winding head obtained by utilization of large drive gear 38 meshing with a small gear 71 on tubular shaft or spindle 26, or by utilization of small drive gear 37 in mesh with a large drive gear 72 on said spindle 26. These two gears 71 and 72 on the spindle are on a common hub 73 slidably splined on said spindle and will be referred to as the small and large shift gears respectively. The hub 73 spaces the shift gears laterally far enough apart so that only one at a time can mesh with its respective drive gear, the spacing also being sufficient to accommodate both of the driving gears between and free from the shift gears for a neutral or non-driven location. A suitable gear-shift mechanism is provided, and as here shown, a yoke 74 rides in a circumferential groove in hub 73 and projects upwardly to and secured on a slide rod 75 that extends parallel to the spindle to one side of the machine where it has a run 76 fixed thereon and to another rod, here called lock-rod 77, parallel to and above slide rod 75. The rung 76 has a knob 78 at its outside for ease of manipulation. The lock-rod has three notches 79 at its upper side for receiving a latch 80 to hold said lock-rod in any one of three positions. The spacing of the notches is made to correspond to the proper movement of the shift gears to cause either one to register with its driving gear or to straddle both in neutral or non-driven position. There is thus a choice afforded of different rates of speed for rotating spindle 26, and as the winding head 25 is on that spindle, the choice of speed will determine the number of coils produced per rotation of the drive shaft.

It may here be noted that the winding head 25 provides a face-plate 81 fast on the spindle 26 so as to be rotated at the selected speed. Outwardly beyond the face plate 81 the hollow shaft projects far enough to rotatably carry thereon the bobbin of filament or wire to be wound onto the mandrel wire. Said bobbin is designated by numeral 82 and the wire therefrom by numeral 83. Projecting from the face-plate 81 is winding frame 28

having guiding pulleys 84, 85 thereon for guiding passage of the wire 83 off of the reel and back down to the mandrel. As the frame revolves around the mandrel, coiling of wire 83 around the mandrel will be effected.

This or any suitable winding head may be employed.

The important speed-changing mechanism featured in the present invention is one affecting the speed of travel of the mandrel wire at the selected speed of winding the filament coils therearound. In other words, the faster the mandrel wire feeds, the less number of filament coils will be wrapped around it per unit length of the mandrel wire, and vice versa the slower the mandrel wire moves, the greater will be the number of filament coils wrapped around it, on the premise of course that the coiling continues at the same selected speed. This speed changing mechanism is for the purpose of effecting change of speed of the mandrel wire only, and the range of change is such that the number of filament coils per unit of length of the mandrel may be greatly increased or diminished if desired, or may be changed only slightly for precise adjustment of coils per unit length. This change and/or adjustment of speed of the mandrel is obtained by varying the length of lever-arms of the walking-beam lever 52 between pivot 53 thereof to the respective pivots 57 of slide blocks 56 for racks 65 and 66. For this purpose, pivot rod 53 has both of its ends, as shown in Fig. 7, protruding from the sides of a carriage 86 riding in a trackway 87 that extends in the same general direction as the lever toward the front and rear of the housing, said trackways being formed as part of said frame 35 in the housing.

It may now be observed that whereas the total distance along lever 52 from one rack 65 to the other rack 66 always remains constant, the leverage length from the fulcrum of the lever to the respective racks may be varied by shifting the lever pivot 52. It is also a fact that the cam 45 always produces the same stroke S_1 to its associated rack 65 as diagrammatically indicated in Figures 12, 12a and 12b. With the lever pivot 53 midway between the racks, both of said racks will have equal stroke, so that the stroke S_2 of the second rack will then be an amount equal to S_1 of the first rack, this condition being illustrated in Fig. 12. By moving pivot 53 closer to the second rack 66, as in Figure 12a, the stroke S_2 produced in that rack will be less than the constant length of stroke S_1 of the first rack 65. Likewise when the lever pivot is moved from its midway position toward the first rack 65 as in Fig. 12b, the constant stroke of that rack will produce a greater stroke S_2 in the second rack. The variable distances of the lever pivot 53 to the pivot pins 57 that connect the lever to the first and second racks are indicated in Figure 10 as variables r_1 and r_2 respectively. When r_1 is shortened, the second rack not only has greater stroke, but has to accomplish that stroke in the same fixed time of the constant stroke of the first rack, and as a result the second rack has to move faster and thus will rotate the t.p.i. drum shaft 49 faster. When r_2 is shortened, the second rack 66 has a shortened stroke and the rack moves slower and drives the drum shaft correspondingly slower. As adjustment of r_1 and r_2 may cover a wide range, the speed of the drum shaft may thus be changed minutely or greatly as desired and thereby obtain the corresponding change in movement of the mandrel.

Adjustment for lengths r_1 and r_2 is placed conveniently under the immediate control of the operator, so that should the count of number of coils per unit length of mandrel show a discrepancy from the desired number, the operator may make the change to the desired number in a quick and convenient manner without stopping the machine. In carrying out this feature of the invention, a horizontally disposed rack 88 is provided at one side of carriage 86 next to the top thereof and has a pinion 89 in mesh therewith which will be rotated by

the rack when the carriage is moved back and forth. The pinion is on a vertical shaft 90 shown protruding through the top of the housing and there has a bevel gear 91 meshing with a similar bevel gear 92 on a horizontal shaft 93 that extends to the front of the machine and on which is a dial 94 rotatable in a casing 95. The casing has an opening 96 for viewing the dial and has a set line 97 for reading the setting shown on the dial. The dial is shown as having several scales thereon, one of which would apply, for instance, at one speed of the two-speed motor and another scale for the other speed of the motor, and another scale would apply for one location of the gear shift and another scale for a different location of gear shift.

Adjusted movement of the carriage is effected by a worm 98 that rotates in a nut 99 fixed on the bottom of the carriage. The worm projects at the front of the housing, and appropriately retained from longitudinal movement so that its rotation will advance or retract the carriage. A knob 100 on the front end of the worm may be manipulated by the operator who can, at the same time, watch the dial change and obtain the desired number of coils per unit of length of mandrel.

Spool and reel shaft 23 has a constant drive, and associated therewith are means for keeping the mandrel wire taut to the t.p.i. drum at that side of the machine, and for keeping the wound mandrel taut in its approach to and winding upon its reel. Said shaft 23 is rotated in a direction to wind the wound mandrel on its reel and therefore also in a direction which will tend to wind the mandrel wire onto the spool, but the spool is adapted to rotate on said shaft permitting the wire to unwind therefrom. However, a frictional engagement is maintained upon said spool so as to take up any slack in the wire as it feeds to the t.p.i. drum. More specifically, the construction here shown comprises an arbor 101 rotatable on said spool and reel shaft 23 and having an outside diameter appropriate to receive the spool 21 thereon with sufficient frictional contact so that the spool and arbor function as a unit. The inner end of the arbor has a peripheral flange 102 directed toward an annular seat 103 fixed on and rotatable with said shaft 23. A friction washer 104 is interposed between said seat and flange and frictional engagement is maintained by a spring 105 at the outer end of the arbor held under compression by nuts 106 on the end of the shaft. As the unwinding of the mandrel wire from the spool rotates the spool counter to the direction of rotation of the shaft, any slack in the wire is immediately taken up by counter rotation transmitted to the spool from the shaft.

Similarly, at the other end of the spool and reel shaft 23, is an arbor 107 rotatable thereon and receiving the reel 24 frictionally thereon. A friction washer 108 is interposed between the inner end of the arbor and an annular seat 109 fixed on and rotatable with said shaft 23. Frictional contact of said washer with the arbor and seat is maintained by a spring 110 at the outer end of the arbor held under compression by nuts 111 on the end of the shaft. The diameter of the reel is made larger than the t.p.i. drum 47 from which the wound mandrel is received, so the greater surface speed of the reel will keep the wound mandrel under tension, slippage of the arbor on shaft 23 accommodating the difference. It may here be noted that the spool and reel shaft 23 is driven by a gear 112 on the cam shaft 44 in mesh with an idler gear 113 in turn meshing with a driven gear 114 fixed on the spool and reel shaft 23.

Tracking mechanism for guiding the filament-wound mandrel onto the reel with the convolutions juxtaposed in sequential order and successive layers, acquires its motivation from the reel arbor 107 so the tracking will conform to the speed of rotation of the reel. As here shown, the reel arbor has an integral ring 115 at the

end thereof toward the housing and of greater diameter than the reel, the outer periphery of the ring having worm threads 116 thereon. A worm wheel 117 (see Fig. 3) meshes with said worm threads and through the agency of a vertical axle 118 at the upper end of which is a gear 119 (see Fig. 6) drives an idler 120 (Figs. 6, 13 and 14) in turn in mesh with a gear 121 on a vertical cam shaft 122, on which both said gear and a cam 123 are rotatable. A friction engagement 124 is interposed between said gear 121 and cam 123 by which the cam is normally driven by rotation of the gear. The frictional engagement 124 permits setting the cam to proper position for starting the tracking at the proper part of the reel. The cam rides against an arm 125 pivoted next to its rear end and swung toward the cam by a spring 126. A guide throat constituted by two parallel and proximate rollers 127 depending from a bracket 128 at the forwardly projecting end portion of said arm, is provided and as the wound mandrel passes through said throat in its approach to the reel, the gradual back-and-forth swing of the arm will feed the wound mandrel with successive convolutions close to each other. Preferably the arm 125 has a longitudinal slot 129 adjustably receiving a screw 130 which holds the bracket 128 on the arm, whereby the amplitude of swing of the throat may be made more or less agreeable to the requirements of the reel.

I claim:

1. A coil winding machine comprising a tubular spindle, a revolvable frame having a path of rotation coaxial to said spindle, means for continuously advancing a mandrel through said spindle and out of a forward end thereof, a walking-beam actuating said means, said frame coiling a filament around said mandrel where advancing from said spindle, and means for shifting the fulcrum of said walking-beam and thereby varying the rate of advancement of said mandrel from said spindle for thereby varying the number of coils of filament applied to said mandrel per unit length of advancement of said mandrel.

2. A coil winding machine comprising a tubular spindle, a revolvable frame having a path of rotation coaxial to said spindle, means for continuously advancing a mandrel through said spindle and out of a forward end thereof, a pair of walking-beams with overlapping strokes applying continuous and constant rate of actuation to said means, said frame coiling a filament around said mandrel where advancing from said spindle, and means for shifting the fulcrums of said walking-beams and thereby varying the rate of advancement of said mandrel from said spindle for thereby varying the number of coils of filament applied to said mandrel per unit length of advancement of said mandrel.

3. A coil winding machine comprising a tubular spindle, a revolvable frame having a path of rotation coaxial to said spindle, rotating means for continuously advancing a mandrel through said spindle and out of a forward end thereof, said frame coiling a filament around said mandrel where advancing from said spindle, a walking-beam, a first reciprocating member at one end portion of the walking-beam always applying the same length of stroke thereto, a second reciprocating member at the other end portion of said walking-beam actuating said rotating means, said walking-beam having a fulcrum between said first and second members, and means for shifting the fulcrum of said walking-beam with respect to said first and second members and thereby varying the rate of advancement of said mandrel from said spindle for thereby varying the number of coils of filament applied to said mandrel per unit length of advancement of said mandrel.

4. A coil winding machine comprising a tubular spindle, a revolvable frame having a path of rotation coaxial to said spindle, rotating means for continuously advancing a mandrel through said spindle and out of a forward end thereof, said frame coiling a filament around said mandrel where advancing from said spindle, a pair of

walking-beams, a first reciprocating member at one end portion of one of the pair of walking-beams and another first reciprocating member at a corresponding end portion of the other walking beam, both of said first members always applying the same length of stroke to its respective walking-beam, a second reciprocating member at the other end portion of one of said walking-beams and another second reciprocating member at the corresponding end portion of the other walking-beam, said second reciprocating members successively actuating said rotating means, said walking-beams having a fulcrum between said first and second members, and means for shifting the fulcrum of said walking-beams with respect to said first and second members and thereby varying the rate of advancement of said mandrel from said spindle for thereby varying the number of coils of filament applied to said mandrel per unit length of advancement of said mandrel.

5. A coil winding machine in accordance with claim 4, wherein each of said first reciprocating members is a slidable rack, and wherein there are two cams and two oscillating gear segments respectively actuated by said cams, said gear segments each in mesh with a respective one of said racks for reciprocating the same.

6. A coil winding machine in accordance with claim 4, wherein each of said second reciprocating members is a slidable rack, and wherein there are two oscillating gears respectively in mesh with and actuated by said racks, said gears each having a one-way clutch on a common shaft and said shaft having the afore-mentioned rotating means for continuously advancing the mandrel mounted thereon.

7. A coil winding machine in accordance with claim 4, wherein each of said first reciprocating members is a slidable rack, and wherein there are two cams and two oscillating gear segments respectively actuated by said cams, said gear segments each in mesh with a respective one of said racks for reciprocating the same, and wherein each of said second reciprocating members is a slidable rack, and wherein there are two oscillating gears respectively in mesh with and actuated by said last-mentioned racks, said gears each having a one-way clutch on a common shaft and said shaft having the afore-mentioned rotating means for continuously advancing the mandrel mounted thereon.

8. A coil winding machine in accordance with claim 7, wherein a slidable carriage is provided carrying the fulcrum for said walking-beam, and wherein slide blocks are slidably mounted in said walking-beam and each pivoted to a respective one of said racks whereby sliding said carriage varies the length of lever arm of the walking-beam from the fulcrum to each rack.

9. A coil winding machine in accordance with claim 7, wherein a slidable carriage is provided carrying the fulcrum for said walking-beam, said carriage having a worm control for manually sliding the same, and wherein slide blocks are slidably mounted in said walking-beam and each pivoted to a respective one of said racks whereby sliding said carriage by operation of said worm varies the length of lever arm of the walking-beam from the fulcrum to each rack.

10. A coil winding machine in accordance with claim 7, wherein a slidable carriage is provided carrying the fulcrum for said walking-beam, said carriage having a worm control for manually sliding the same, and a dial connected with and responsive to sliding motion imparted by said worm control to said carriage.

11. A coil winding machine comprising a tubular spindle, variable speed actuating means for advancing a continuous mandrel through said spindle out of a forward end thereof, a gear-driven winding head proximate to said forward end of said spindle adapted to coil a filament around said mandrel upon passage of the mandrel from said forward end of the spindle, a shaft adapted to mount a spool for feeding supply of mandrel and to mount a reel for the wound mandrel, said shaft rotating in a direction tending to wind the mandrel back onto the spool and to wind the wound mandrel onto the reel, and means permitting slippage of the spool on the shaft for withdrawal of the mandrel from the spool.

12. A coil winding machine comprising a tubular spindle, variable speed actuating means for advancing a continuous mandrel through said spindle out of a forward end thereof, a gear-driven winding head proximate to said forward end of said spindle adapted to coil a filament around said mandrel upon passage of the mandrel from said forward end of the spindle, a shaft adapted to mount a spool for feeding supply of mandrel and to mount a reel for the wound mandrel, means permitting slippage of the reel with respect to the shaft, and tracking means for feeding the wound mandrel to said reel, said tracking means having a drive coordinated to the rotation of the reel and its slippage.

References Cited in the file of this patent

UNITED STATES PATENTS

1,094,047	Ames	Apr. 21, 1914
2,706,376	Kerr	Apr. 19, 1955
2,815,638	Curtiss et al.	Dec. 10, 1957