Nov. 8, 1960 P. S. GIULIANO 2,959,365

TOROIDAL WINDING MACHINE

Filed March 11, 1957 3 Sheets-Sheet 1

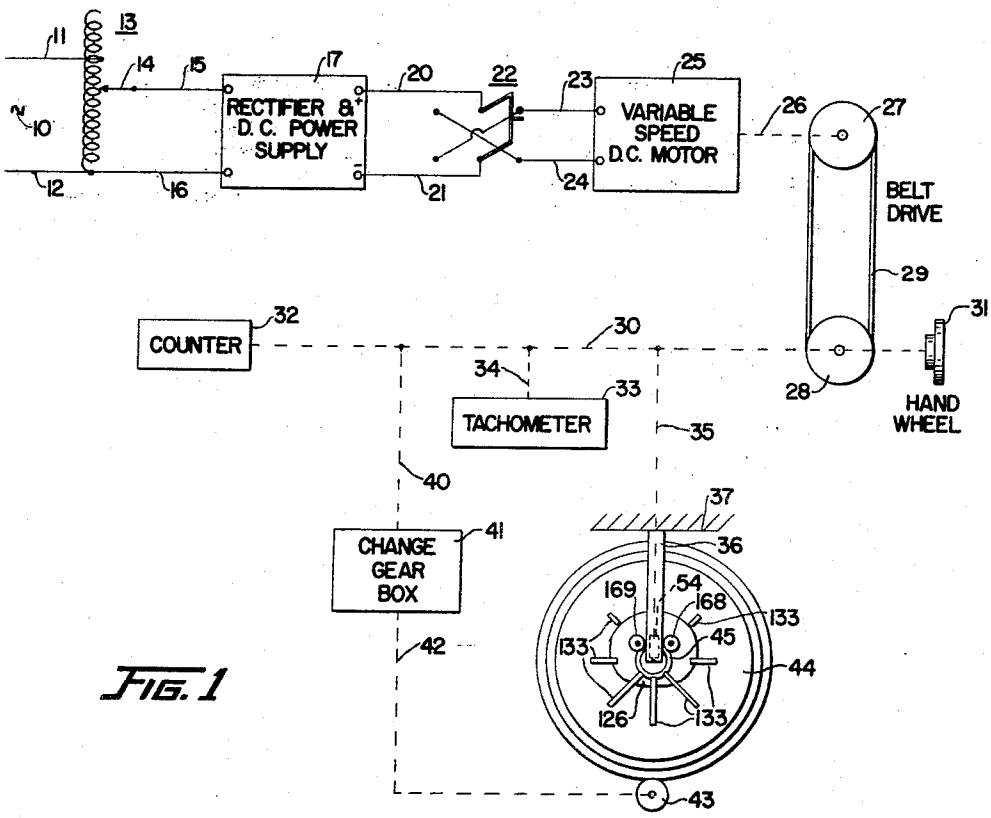


FIG. 1

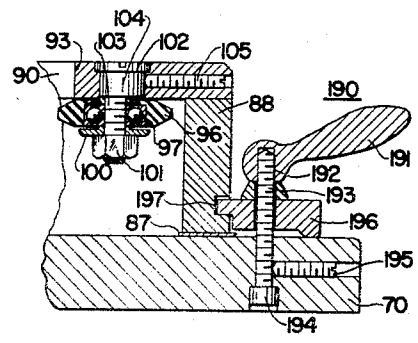


FIG. 4

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TOROIDAL WINDING MACHINE

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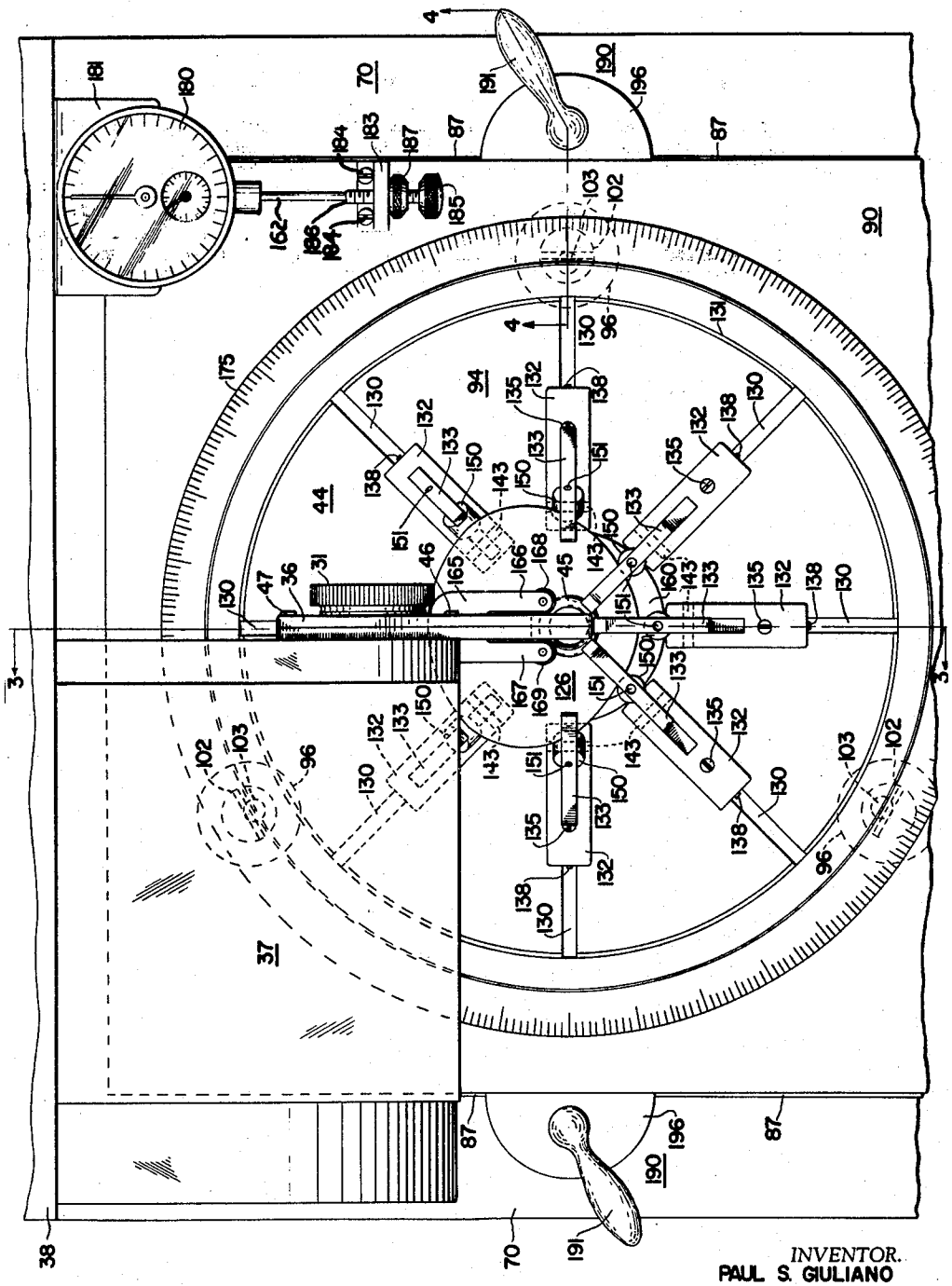


FIG. 2

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TOROIDAL WINDING MACHINE

Filed March 11, 1957 3 Sheets-Sheet 3

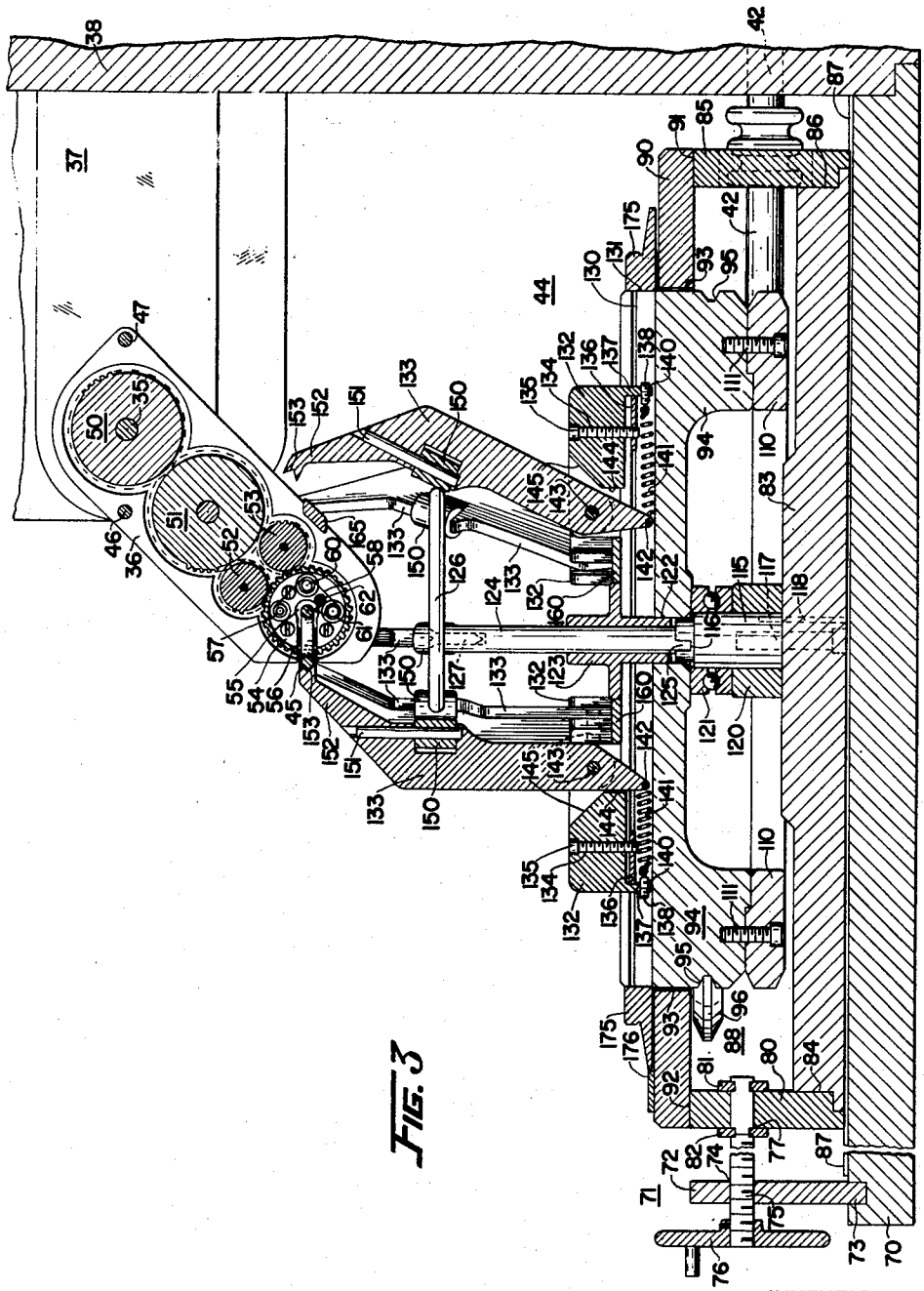


FIG. 3

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United States Patent Office 2,959,365
Patented Nov. 8, 1960

2,959,365

TOROIDAL WINDING MACHINE

Paul S. Giuliano, North Hollywood, Calif., assignor to Minneapolis-Honeywell Regulator Company, Minneapolis, Minn., a corporation of Delaware

Filed Mar. 11, 1957, Ser. No. 645,348

4 Claims. (Cl. 242—4)

This invention is directed to a toroidal winder, and more specifically it discloses a toroidal winder capable of being used to produce small, high precision toroidal potentiometers and coils. For convenience in the present disclosure the device will be referred to as a coil winder, but it is understood that the device is not limited to that sole use.

The toroidal coil winder has been known and in general use for many years. Two main problems are encountered in this type of device, and are: (1) a means of winding a wire through the opening of a toroidal core, and (2) a means for supporting the core for rotation relative to the wire being wound. The first problem has been solved by the use of various types of shuttle heads and shuttles and forms no part of the present invention. Many types of shuttles and shuttle heads could be used and in the specific embodiment disclosed, one specific type will be described.

The problem of supporting the core upon which the wire is wound creates a major problem, and this is particularly true where the core is of small physical size. In early toroidal winders the core was clamped in a fixed support and a wire wound on the unclamped section. The core was then released and reclamped so that the unwound portion could be wound. This method of winding is expensive and leads to inaccuracies in the uniformity of the windings. Further, the movement of the core from its original support placed a limitation on the accuracy that could be gained in commercial quantities of wound toroidal cores.

Where large size toroidal cores were to be wound this problem could be overcome by supporting the core from its inner surface with removable supports at a plurality of positions and progressively removing and replacing the supports by manual or complex mechanical means. For winding cores of small size, this was not practical due to the small space available in the opening of the cores. In recent years complex mechanical winding machines have been produced which are capable of winding small size toroidal cores by clamping the cores in scissors-like clamps, but these machines are extremely costly, complex, and slow in operation. An example of such a machine is shown in Patent 2,569,657 to De Beauregard. This type of machine had the further disadvantage of requiring that each core wound be individually centered by the operator prior to its winding.

The object of this invention is to provide for the construction of a toroidal coil winder capable of winding very small cores. This is accomplished by supporting the cores about their exterior diameters by a plurality of spring biased fingers. These fingers are progressively displaced by a cam so that the fingers pass between the shuttle head of the machine and the platform that supports the fingers.

Another object of the present invention is to disclose a toroidal coil winder which is capable of winding a coil progressively over any part of a torodial core. This winder can be used to wind only a segment of a core or

may be used to wind continuous layers one on top of another.

A further object of this invention is to disclose a toroidal coil winder which has been built at a cost of only 15% to 20% of existing, comparable winders.

Still a further object is to disclose a winder that is capable of producing accurate toroidal coils at a rate 30% to 50% faster than comparable winders available. Part of this advantage is gained by the winder providing for the automatic centering of the cores that are wound.

Yet another object is to provide a toroidal coil winder that can be operated in a reverse direction to overlap windings of a coil, if so desired.

These and other objects will become apaprent when the drawings are fully considered in connection with the following description. In the drawings:

Figure 1 is a schematic representation of the entire winding machine;

Figure 2 is a top view of a section of the winding machine;

Figure 3 is a partial section of Figure 2 along lines 3—3, and;

Figure 4 is a sectional detail of a locking device along lines 4—4 of Figure 2.

In the schematic representation shown in Figure 1 there is an alternating current source shown at **10** which supplies an alternating current voltage across conductors **11** and **12** to a variable auto transformer generally shown at **13**. The variable auto transformer **13** has a sliding tap **14** which permits the selection of any alternating current potential between conductors **15** and **16** for the power supply **17**. Power supply **17** contains a conventional rectifier and filtering means so that a constant direct current is in turn available on conductors **20** and **21**. It is obvious that the direct current potential supplied to conductors **20** and **21** will vary with the movement of slider **14** and thereby a wide range of direct current potential is available at the reversing switch generally shown at **22**. This reversing switch permits the direct current potential to be applied to conductors **23** and **24** in either a positive-negative or negative-positive arrangement to control the variable speed reversible direct current motor **25**. Motor **25** further has a mechanical output at **26** which drives a pulley **27**. The arrangement for driving pulley **27** is conventional in nature and may be replaced by any type of rotational power source that may be convenient.

Pulley **27** is in turn connected to pulley **28** by means of a frictional belt drive **29**. The belt drive **29** has been utilized for convenience sake and affords a safety feature in that, if the equipment driven by pulley **28** should become jammed or inoperative for some reason, the frictional belt drive can act as a clutch means to prevent mechanical damage either to the winding machine or the rotational power source.

Pulley **28** is connected to a drive shaft **30** which supplies a rotational power for the winding machine. A hand wheel **31** is connected to the shaft **30** and may be utilized to operate the machine manually where small, accurate amounts of rotational input are desired. The shaft **30** is further connected to a counter **32** which is geared to shaft **30** in such a manner that the counter reflects the number of turns of wire wound by the machine. As a further aid to the operator of the winding machine, a tachometer **33** is connected mechanically at **34** to shaft **30** so that the speed of winding may be conveniently controlled. Shaft **30** is in turn connected to a mechanical drive means or shaft **35** which is connected to the shuttle head **36** of the winding machine. Shuttle head **36** is fixedly mounted to a gear housing **37** and remains stationary in space as will become more apparent in the description of the machine which follows.

A further mechanical output **40** is connected to the

shaft 30 and the mechanical output 40 operates into a gear box 41. The gear box 41 provides a means of changing the rotational speed ratio between the output shaft 42 and shaft 35. By means of the change gear box 41 an endless number of gear ratios can be provided so that any fixed ratio of rotational speeds may be maintained between the drive means 35 and the shaft 42. The shaft 42 is further connected to a worm gear 43 which rotates the platform 44 of the winding machine. The platform 44 supports a core 45 in a manner which will be described in detail below and it is obvious that as the platform 44 and core 45 rotate that wire can be wound upon core 45 by means of the shuttle head 36. Since a mechanical speed ratio can be maintained between the drive means 35 and shaft 42 it becomes obvious that any fixed wire spacing may be obtained along the core 45 and that no slippage will occur since the inter-relation of the drive means 35 and 42 is by means of gears rather than any frictional type of drive mechanism.

In considering Figures 2 and 3 it becomes apparent that the shuttle head 36 is supported by the gear housing 37, which is in turn joined (by means not shown) to a back wall 38 of the winding machine. The shuttle 36 is held by screws 46 and 47 in a fixed spaced relationship from the platform 44.

The shuttle head 36 is of a substantially conventional design and contains a gear 50 which is driven by drive means 35. The gear 50 in turn drives a second gear 51 which then in turn drives two idler gears 52 and 53. The idler gears drive the shuttle 54 so that it rotates around the core 45. The shuttle 54 has a central opening 55 which encircles the core 45 and further has a slit 56 so that the core 45 may be inserted into the opening 55. In effect, the shuttle 54 is a wide C-shaped member that is supported for rotation in the end of shuttle head 36 and which is driven by the idler gears 52 and 53. The shuttle 54 further supports a wire supply spool 57 which holds a supply of wire 58. The wire 58 passes over pulleys 60 and 61 before passing through a guide and tension controller 62. The wire 58 is then wound about the core 45. The shuttle and shuttle head just described are substantially conventional in nature and it becomes obvious that as the drive means 35 rotates that the shuttle 54 is caused to rotate in a manner which winds wire 58 around the core 45. As long as the center of the rim of core 45 coincides with the center of the opening 55 of the shuttle 54 and the center of the core 45 coincides with the center of rotation of platform 44, it is apparent that a continuous even winding of wire 58 can be accomplished by rotating the core 45 relative to the shuttle 54.

It becomes obvious that since the shuttle and shuttle head are fixed permanently in space, that the rotation of the core 45 relative to the center opening 55 of the shuttle 54 can only be accomplished by a support means for the core 45 which can be removed as the core 45 passes through the shuttle 54. The arrangement for just such a support is described in detail below in connection with the platform 44.

Attached to the vertical back wall 38 there is shown a horizontal table 70 which forms the base for the platform 44. The table 70 may be of any convenient material but should be strong enough to conveniently support the weight of the winding machine and provide an anchor for the horizontal traverse means shown generally at 71. The horizontal traverse means 71 consists of a vertically disposed plate 72 which is fixed by any convenient means to table 70 at 73. A tapped hole 74 is provided in support 72 and a threaded shaft 75 is inserted therethrough. The shaft 75 has a hand wheel 76 attached to its outer end and is journalled at 77 to a vertical support member 80 of the platform 44. The end of shaft 75 is held in a fixed horizontal relationship to the support 80 by means of the lock rings 81 and 82. The manner in which the horizontal traverse mechanism 71 is used will become apparent in the subsequent description and will not be described in detail at this point.

A base plate 83 is provided and this base plate is rigidly attached to the vertical support 80 at 84 in any convenient manner. An additional support member 85 is placed at the rear of the plate 83 and is attached rigidly thereto at 86. The two vertical support members 80 and 85 together with the base plate 83 are separated from the table 70 by means of a smooth track 87. It is obvious that if the handle 76 is rotated that the shaft 75 moves in and out of the threaded opening 74 thereby carrying the vertical supports 80 and 85 along with the base plate 83 backward or forward. Fixedly supported to vertical support members 80 and 85 is a cover plate 90. The cover plate 90 is rigidly attached to the vertical support members 80 and 85 at 91 and 92 by any convenient method. The cover plate 90 further has an annular opening 93 which substantially includes the entire center section of the plate 90. The annular opening 93 allows for the insertion of a circular mounting support 94. The support 94 forms the main support member for a plurality of arms which in turn hold the core 45. The construction of these arms and their mounting will be described in detail below. The support 94 has a circumferential groove 95 which forms a track by which the support is in turn held in place. Riding in track 95 are three rollers 96 which are adjustably mounted through the plate 90. Details of construction of the rollers 96 and their mounting through the plate 90 can be seen in Figure 4.

The rollers 96 are supported on a conventional roller bearing 97 which is supported by a flange 100 and nut 101 on an adjustable bolt member 102. The adjustable bolt member has a threaded shaft 103 which is offset from a rotatable head 104. Inserted into the side of plate 90 is a threaded set screw 105 which is used to lock the bolt 102 in place after it has been properly adjusted. It is apparent from considering the details in Figure 4 that as the bolt 102 is rotated, due to the eccentric location of shaft 103 with respect to head 104, that the bolt 103 moves the roller 96 in and out with respect to the opening 93 in the cover plate 90. By the use of three of the rollers 96 it is possible to support the circular mounting support 94 for rotation in the center of opening 93 and to conveniently insert or remove the circular mounting support 94 as may be needed. Once the support 94 has been inserted into opening 93 and the rollers 96 have been properly adjusted by turning the head 104 of bolt 102, the lock screw 105 is tightened down. The tightening of the lock screw prevents the inadvertent loosening of the bolt 102 and thereby retains the support 94 in its proper location until it is desired to remove it. As previously pointed out three of these members are disclosed in a device but more may be used on large machines having a substantial amount of weight. The disclosure of three of these devices is adequate to properly center and support the structure in the present disclosure.

Attached to the bottom of support 94 is a ring gear 110. The ring gear 110 is held to support 94 by a plurality of screws 111. The ring gear 110 meshes with worm gear 43 (Figure 1) which is in turn driven by shaft 42. It is understood that with a worm gear 43 that it is possible to continuously drive the ring gear 110 and also to move the ring gear to the right or left (in Figure 3) with the support 94 and cover plate 90 by means of the horizontal traverse mechanism 71. It will thus be seen that any rotational power supplied on shaft 42 will be delivered through gear 43 to the ring gear 110 thereby rotating the ring gear 110 and the support 94. This rotation is easily permitted by the three rollers 96.

A post 115 having a key-way 116 is supported on the base plate 83 by means of a screw 117 and a pin 118. The screw locks the post 115 in place and the pin

118 prevents the post from rotating under any circumstance. A bearing support 120 is placed around post 115 and in turn supports a conventional roller bearing 121 about the upper portion of the post 115. The upper portion of post 115 passes through a hole 122 in the support 94. The bearing 121 acts as a support for the center of the circular mounting support 94 and it is obvious that the upper part of bearing 121 rotates with support 94 due to the frictional engagement while the lower part of the bearing 121 remains fixed with the bearing support member 120. Inserted through the hole 122 in the support member 94 is a bushing 123 which in turn supports a shaft 124. The shaft 124 has a key 125 at its lower end which mates with the key-way 116. It is therefore obvious that since the post 115 is restrained from rotating that the post 124 is also restrained due to the keyed connection between the key-way 116 and key 125. Due to the nature of the opening in the bushing 123 and its relationship to post 124 the bushing 123 is capable of freely rotating about post 124 but yet it is capble of holding the post 124 in a substantially vertical position. At the top of post 124 is a cam 126 and this cam is fixedly supported to the top of post 124 by means of a bolt 127. The purpose of the post 124 and the cam 126 will become obvious and will be described in detail in a subsequent section of the discussion contained below.

The mounting support 94 has eight identical, substantially cross-shaped grooves 130 cut radially from the outer edge 131 to the central opening 122. The grooves 130 are equally spaced radially around the support 94 as can best be seen in Figure 2. Into each of the grooves 130 there is slidably inserted a pivot block 132 which acts as a support for core support fingers 133. The slidable blocks 132 have a tapped hole 134 for the insertion of a locking screw 135. The locking screw 135 passes through the block 132 into a locking plate 136. The locking plate 136 has a threaded hole therein so that as screw 135 is tightened locking plate 136 clamps the block 132 into the groove 130. With this arrangement it can be seen that the block 132 can be fixedly mounted at any radial distance in groove 130 and therefore the location of the core support arms 133 can be readily adjusted from the top of the winding platform 44. The block 132 further has a projection 137 which passes into the bottom of the groove 130. This projection in turn supports a tension adjusting screw by means of a threaded opening at 140. The end of the screw 138 is attached pivotally to a coil spring 141 and the coil spring in turn is hooked through a small hole 142 in the end of the support arm 133. The support arm 133 is supported by a pivotal connection at 143 in the block 132. The pivotal connection 143 is by means of two ball bearings (not shown). It can be seen therefore that the spring 141 applies a bias to the end of the arm 133 to pivot it about the connection 143. A stop 144 is formed by the back edge of a groove cut into block 132 into which the support arm 133 is pivoted. With this arrangement the pivotal freedom of the support arm 133 is limited against the tension of spring 141 by the stop 144. A second stop surface 145 is cut into the groove supporting the arm 133 and the stop 145 acts as a limit when the arm 133 is pivoted such that spring 141 is in its most extended position. With the arrangement shown each of the arms 133 is normally biased by spring 141 to a position slightly beyond the vertical and the arm 133 can be pivoted about the connection 143 until it reaches the stop 145. Upon reaching the stop 145 the arm 133 is at approximately a 45° angle from the vertical.

Each of the core support arms 133 further has a roller 150 inserted on its inner side and held in place by a pin 151. The roller 150 is free to revolve about pin 151 freely and acts as a bearing surface against the outer edge of cam 126. The upper end or neck 152 of the core support arm 133 narrows. The neck 152 further has a V-shaped groove 153 in the end thereof and the V-shaped groove actually forms the surface which supports the core 45 in its winding position. The center line of groove 153 is horizontal when the groove 153 engages the core 45. At this time the support arm 133 is vertical and spring 141 is under a slight tension.

In considering Figure 2, it will be noted that each of the core support arms 133 rides against the edge of cam 126 except during a small part of the device's cycle when the V-shaped grooves 153 are in contact with the core 45. The cam 126 is shaped in such a manner that as the ring gear 110 rotates, and in turn causes the support 94 to rotate, that the arms 133 progressively ride against the core 45 when the cam has decreased in size such that it no longer meets the rollers 150. As the support 94 rotates to a point where the cam 126 is again riding against roller 150, the cam forces the arms 133 against the springs 141 in such a manner that the arms 133 pass under the shuttle head 36. It will be noted that as the device rotates the arms 133 progressively are pushed out of position by cam 126 so that they ride between the shuttle head 36 and the platform 44 to clear the shuttle head and then come up the reverse side to once again contact the core 45. With the arrangement just disclosed it is possible to wind a wire 58 continuously around 360° of the core without removing the core from the winding machine or disturbing it in any manner. This continuous winding method also allows for the winding of any multiple of 360° so that layer after layer can be continuously wound if desirable.

In order to accurately control the placing of the wire 58 on the core 45 additional features which have not been described as yet have been incorporated into this winding machine. A ring 160 has been placed around the bushing 123 and the width of the ring 160 determines the exact location of the blocks 132. By the insertion of ring 160 it is possible to slide each of the blocks 132 up tight against the edge of the ring and thereby form a perfect alignment of the core support arms 133 before the screws 135 are tightened. With rings 160 of different sizes it is possible to set up the present winding machine for any size core. Due to the symmetrical arrangement of the components utilized in holding the core 45 it is only necessary to use the ring 160 in the initial setup of the winding machine.

With the presently disclosed device an additional support means for the core 45 has been provided. This support means is a U-shaped support 165 which is attached to the shuttle head 36. The U-shaped support 165 has two legs 166 and 167 which in turn support two V-type ball bearing rollers 168 and 169. The rollers 168 and 169 are grooved much in the manner of the V-shaped groove 153 and act as additional support for the core 45. This can best be seen in Figure 2 where the core 45 is supported by the V-shaped grooves 153 of three of the core support arms 133 and by the two rollers 168 and 169. It should be pointed out that by properly shaping the cam 126 the additional support member 165 can be eliminated but that its use has been found convenient in winding exceedingly small cores 45.

It often becomes desirable to wind a small segment of a toroidal core or coil and the number of degrees wound around the arc of the core must be accurately controlled. To provide for accurate measurement of windings which only cover a sector of the core a gauge ring 175 is placed around the outside periphery of the platform 44 and is attached by any convenient means thereto. The gauge ring 175 is large enough to be conveniently divided into degrees and in addition to the gauge ring 175 there is located a vernier scale 176 on cover plate 90 which allows for accurately reading the number of degrees rotated to one-tenth of one degree. With the gauge ring 175 and the vernier 176 it is possible to conveniently wind any number of degrees and fractions thereof with great accuracy.

In order to accurately align the platform 44 with the

shuttle head **36** and to keep the alignment once it has been made, additional features have been added to the presently disclosed winding machine. In Figure 2 there is disclosed a dial indicator **180** which is mounted on a bracket **181**. The bracket **181** is in turn supported by the back wall **38** in any convenient manner. The dial indicator **180** has a sensing stem **182** which projects horizontally over the cover plate **90**. Attached to the cover plate **90** is a bracket **183**. Attachment is by means of two screws **184**. The bracket **183** further has a threaded opening (not shown) through which a threaded screw **185** is inserted. A lock nut **187** is provided so that the screw **185** can be conveniently locked against vibration or accidential movement. The end of the screw **185** meets the stem **182** at **186**. By adjusting the screw **185** against the stem **182** it is possible to establish an exact location of the platform **44** with respect to the back wall **38**. With this arrangement it is possible to relocate the platform **44** whenever it has been disturbed for any reason or when it is desirable to set the winding machine up for winding a core of a predetermined size. By this arrangement it is possible to supply the operator of the winding machine with a table indicating the dial indicator setting that corresponded to the proper centering of a particular size and type of core **45**.

Once the platform **44** has been properly centered two locking mechanisms generally shown at **190** can be operated to clamp the platform **44** to the horizontal table **70**. The details of this locking mechanism are disclosed in Figure 4. Each of the two locking mechanisms has a handle **191** which has a threaded opening **192**. The threaded opening **192** engages the end **193** of a threaded bolt **194**. The bolt **194** is inserted through the bottom of the table **70** and is held in place by a threaded set screw **195**. As the locking mechanism is tightened by rotating the handle **191** relative to the screw **194**, the handle **191** moves in a downward direction. The downward movement clamps against a block **196** which rides against the top of the table **70** and in a groove **197** in a vertical support member **88**. The vertical support member **88** is similar to the vertical support members **80** and **85** and acts to support the cover plate **90**. The vertical support member **88** further rides on a smooth hardened track **87** and it can therefore be seen that as the handle **191** is tightened the vertical support member **88** is locked against a track **87** which is in turn held fixedly to the table **70**. By the use of the locking mechanisms **190** it is possible to prevent the platform **44** from moving relative to the shuttle head **36** once the proper alignment of the machine has been obtained.

In operation, the platform **44** is properly located by use of the dial indicator **180** by turning handle **76**. This moves the center of the rim of core **45** into the proper location with respect to the shuttle **54**. The locking mechanisms **190** are then set to prevent any possibility of the platform **44** moving out of position. The wire **58** is started about the core **45** and held in place by cement. The switch **22** is closed and the winder begins to operate. The shuttle **54** turns under power of drive means **35** while the platform **44** rotates under power of output shaft **42** and worm gear **43**. This places an even winding of wire **58** on core **45**. As each core support finger **133** approaches the shuttle head **36** it is deflected by cam **126** so that it passes between the shuttle head **36** and platform **44**. After the support finger **133** passes the shuttle head **36** the cam **126** allows the support finger **133** to return to its upright position. Thus, it can be seen that a novel continuous means of winding wire **58** on core **45** has been provided.

The mechanical details of the presently disclosed winding machine have been simplified to some extent for convenience in presenting the principles of the winder. It is understood that many mechanical modifications could be made in the present winder by those skilled in the art and the applicant wishes to be in no way limited to the specific details shown by the present disclosure. Since many modifications will become apparent to those versed in the art, the applicant wishes therefore to be limited in his invention only by the appended claims.

I claim as my invention:

1. In a machine for winding a wire on a core: a shuttle head including a core support and a shuttle; a stationary support mounting said shuttle head in a fixed relationship to said stationary support; a platform rotatably supported on said stationary support; motor and gear means rotating said shuttle and said platform relative to each other at a predetermined speed ratio; a post passing through the center of said platform and supporting a cam on said stationary support in a fixed relationship to said support; a plurality of pivotal core support fingers having stationary V-shaped grooves mounted radially on said platform; and a spring biasing each said finger toward said cam; said core support and some of said core support fingers holding the core in said grooves in a winding relationship to said shuttle; said plurality of core support fingers rotating with said platform and progressively engaging and disengaging the core by riding against said cam as said platform rotates relative to said shuttle head; said core support fingers that are not engaged with the core being deflected by the action of said cam riding against the core support fingers; said core support fingers passing between said platform and said shuttle head as said platform rotates.

2. In a machine for winding a wire on a core: a shuttle head including a core support and a shuttle; stationary support means holding said shuttle head in a fixed relationship to said stationary support means; a platform rotatably supported on said stationary support means; motor and gear means rotating said shuttle and said platform relative to each other at a predetermined speed ratio; a post passing through the center of said platform and supporting a cam on said stationary support means in a fixed relationship to said support means; a plurality of pivotal core support fingers mounted radially on said platform means; and a spring biasing each said finger toward said cam; said core support and some of said core support fingers holding the core in a winding relationship to said shuttle; said plurality of core support fingers rotating with said platform means and progressively engaging and disengaging the core by riding against said cam as said platform rotates relative to said shuttle head; said core support fingers that are not engaged with the core being deflected by the action of said cam riding against the core support fingers; said core support fingers passing between said platform means and said shuttle head as said platform means rotates.

3. In a machine for winding a filament on a core: shuttle head means including a core support and a shuttle; stationary support means holding said shuttle head means in a fixed relationship to said stationary support means; a platform rotatably supported on said stationary support means; motor means rotating said shuttle and said platform at a predetermined speed ratio; a post supporting a cam on said stationary support means in a fixed relationship to said support means; and a plurality of core support fingers mounted on said platform means and biased toward said cam; said core support and some of said core support fingers holding the core in a winding relationship to said shuttle; said plurality of core support fingers rotating with said platform means and progressively engaging and disengaging the core by riding against said cam as said platform rotates relative to said shuttle head means and the core support; said core support fingers that are not engaged with the core being deflected by the action of said cam riding against the core support fingers; said core support fingers passing between said platform means and said shuttle head means as said platform means rotates.

4. In a machine for winding a filament on a core: shuttle head means including a fixed core support and a

shuttle; stationary support means holding said shuttle head means in a fixed relationship to said stationary support means; platform means rotatably supported on said stationary support means; rotational output means rotating said shuttle and said platform means simultaneously; mounting means supporting a cam on said stationary support means in a fixed relationship to said support means; and a plurality of core support means including cam engaging means mounted on said platform means and said cam engaging means biased toward said cam; said fixed core support and some of said core support means holding the core in a winding relationship to said shuttle; said plurality of core support means rotating with said platform means and progressively engaging and

disengaging the core by riding against said cam as said platform means rotates relative to said shuttle head means; said core support means that are not engaged with the core being withdrawn by the action of said cam riding against the cam engaging means; said core support means passing between said platform means and said shuttle head means as said platform means rotates.

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