

[54] STATOR COIL LACING MACHINE
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[73] Assignee: Link Engineering Company
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[51] Int. Cl. D05b 3/00
[58] Field of Search 112/121.2, 2; 66/1

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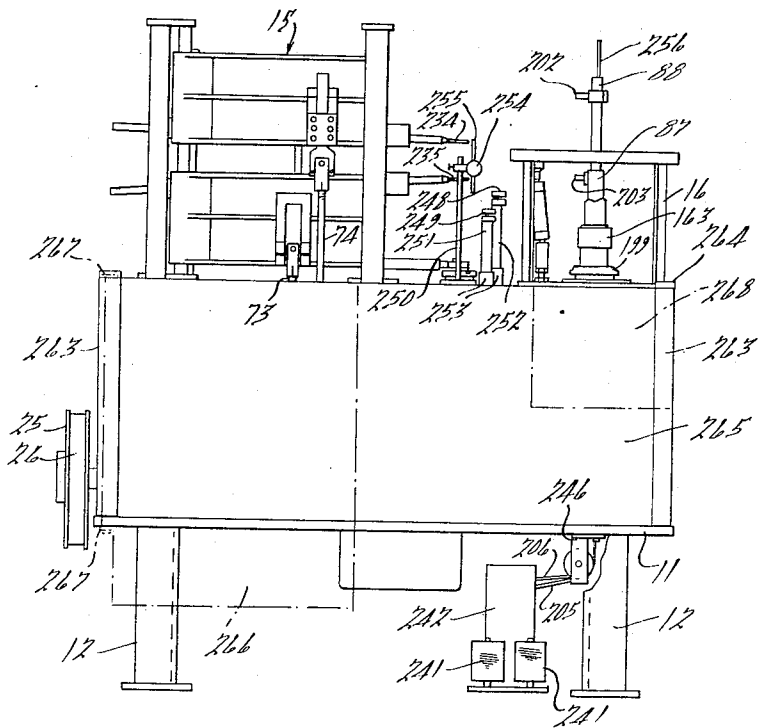
[57] ABSTRACT

The lacing machine for stator coils has a table upon which a horizontal shaft is mounted for rotation. A platform supported above the table carries a pair of needle bars on separate reciprocal supports operating from a cam having oppositely disposed cam tracks thereon. The needle bars are reciprocated toward and away from each other from a drive from the shaft and are angularly oscillated by gear sector from a cam on the shaft. A stator support on the top of the platform is driven in increments of advancement with a dwell therebetween from the shaft and a pair of telescope thread guide tubes within the stator are reciprocated and angularly oscillated from the shaft to lay loops of two threads on the needles of the needle bars as they project inwardly beyond the coils. The machine operates on one or both end sections of a stator coil and all of the operated elements are driven from the single shaft on the table and timed through the setting of the different elements one in relation to the other.

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14 Claims, 18 Drawing Figures



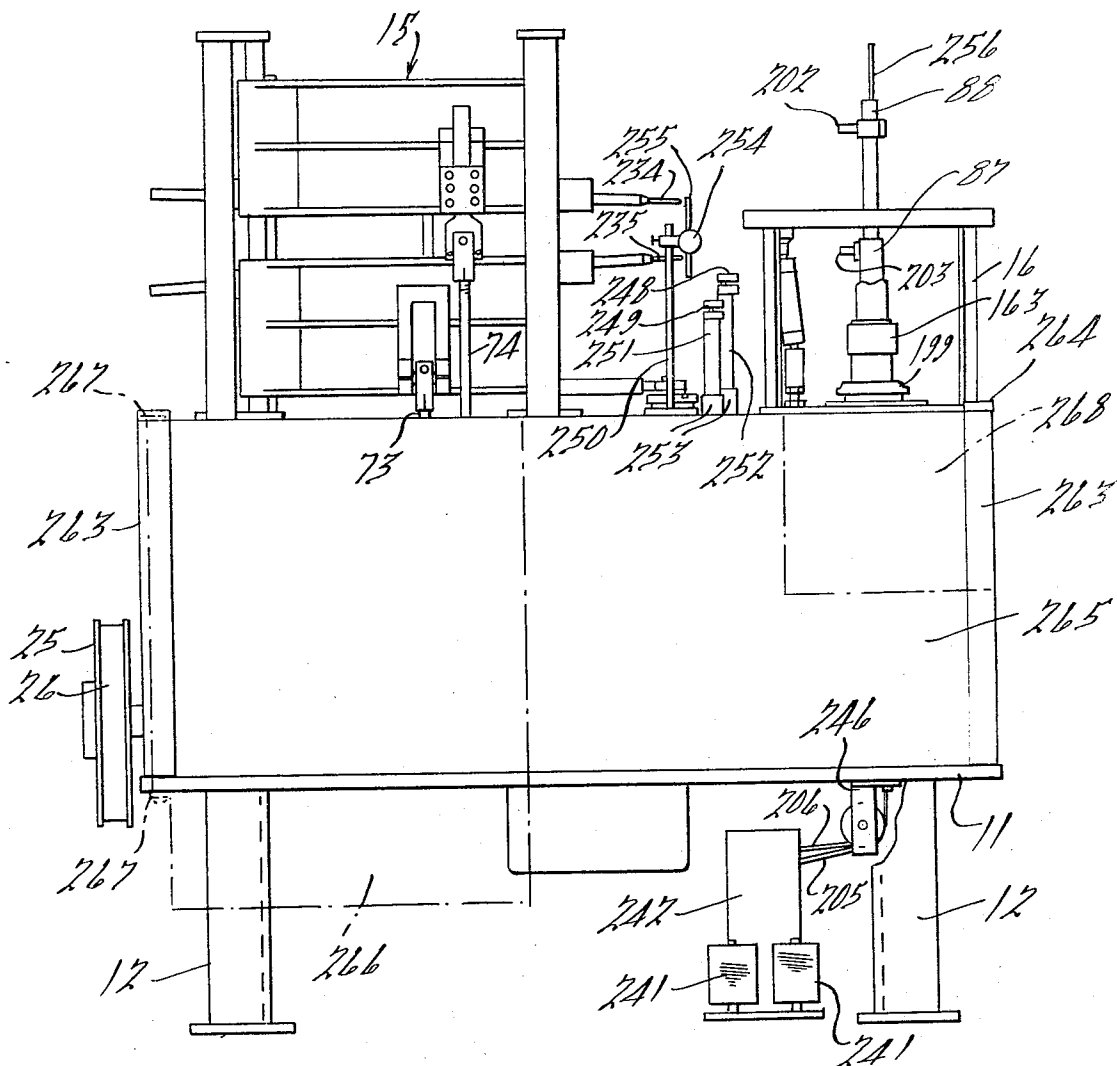


FIG. 1.

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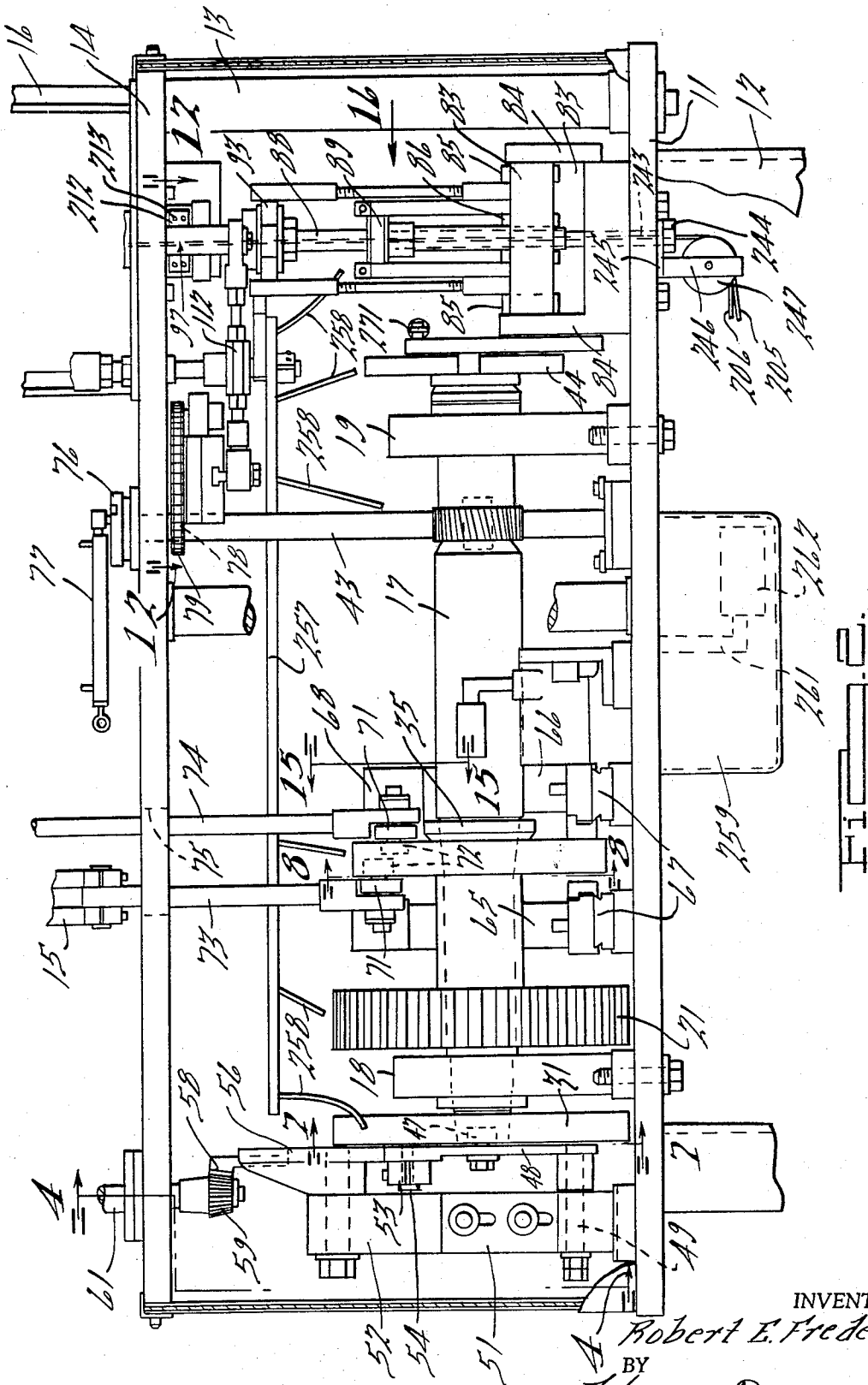


FIG. 2

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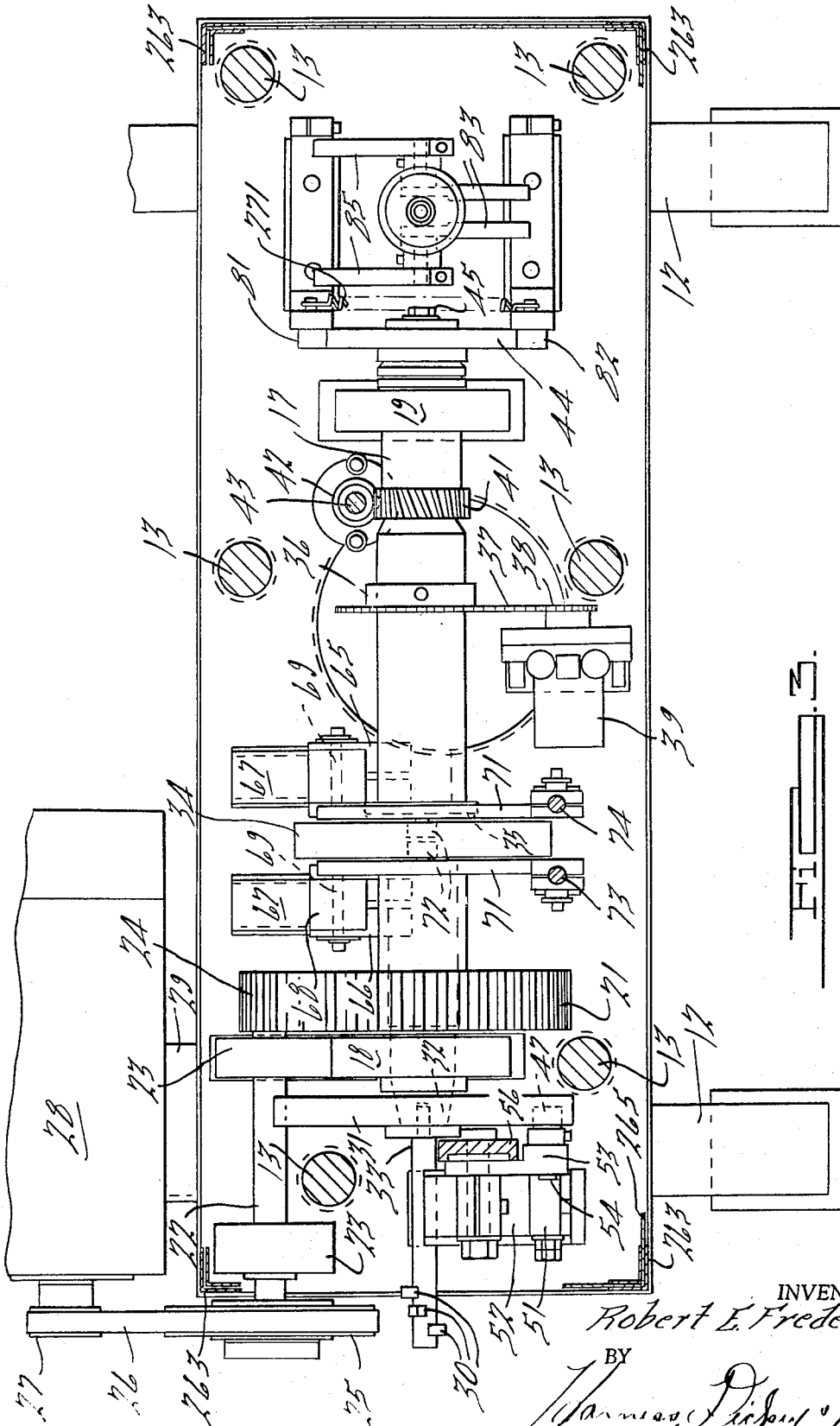


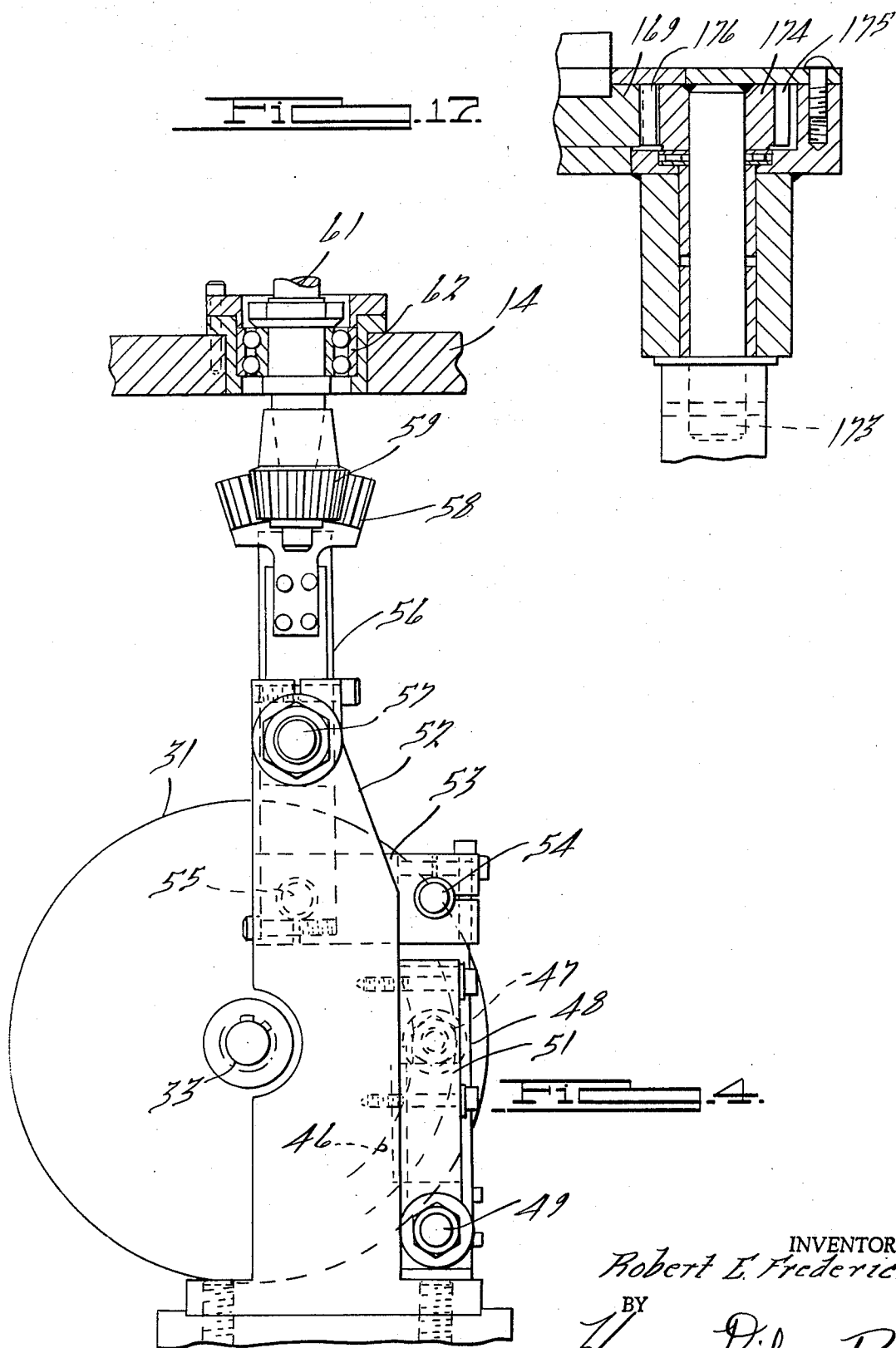
FIG. 3.

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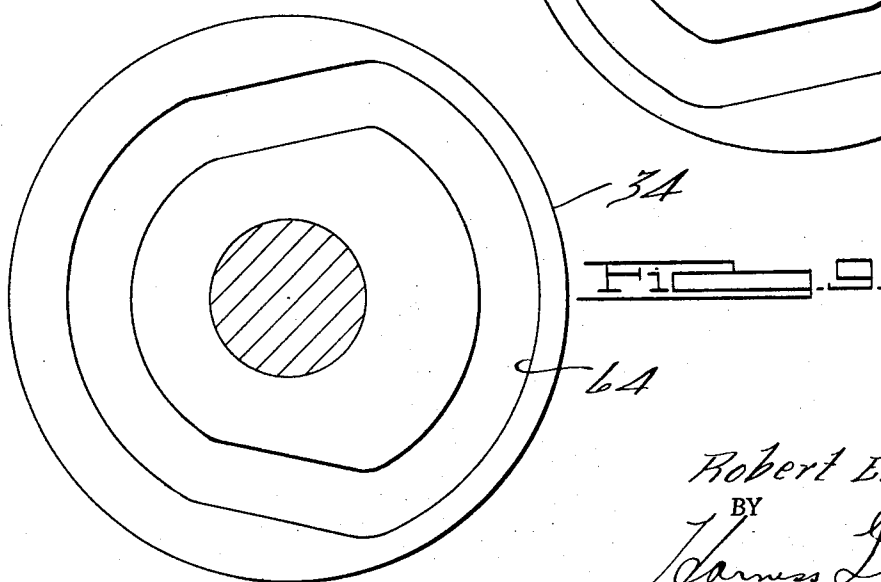
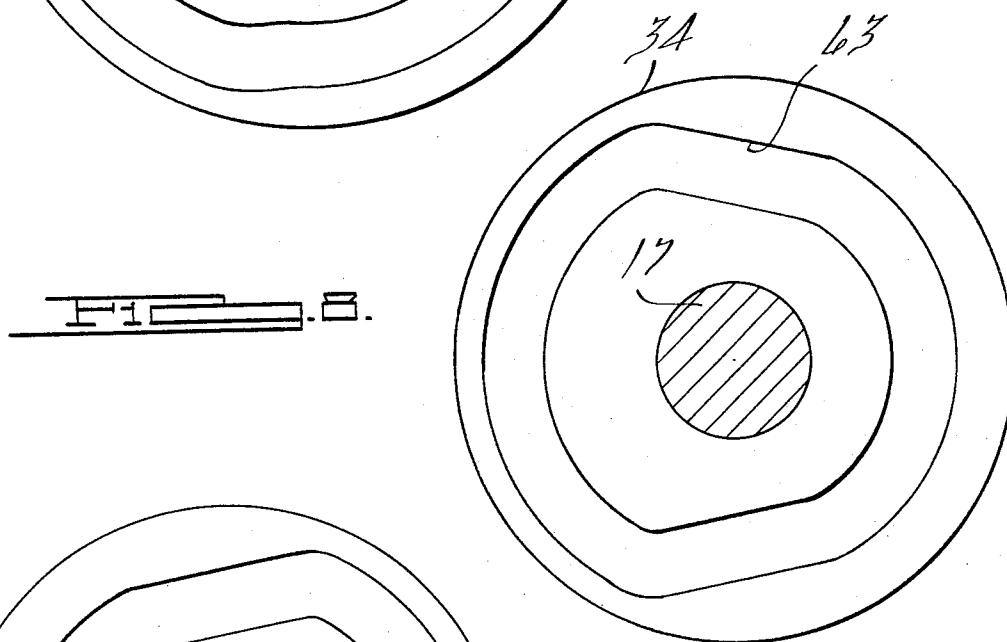
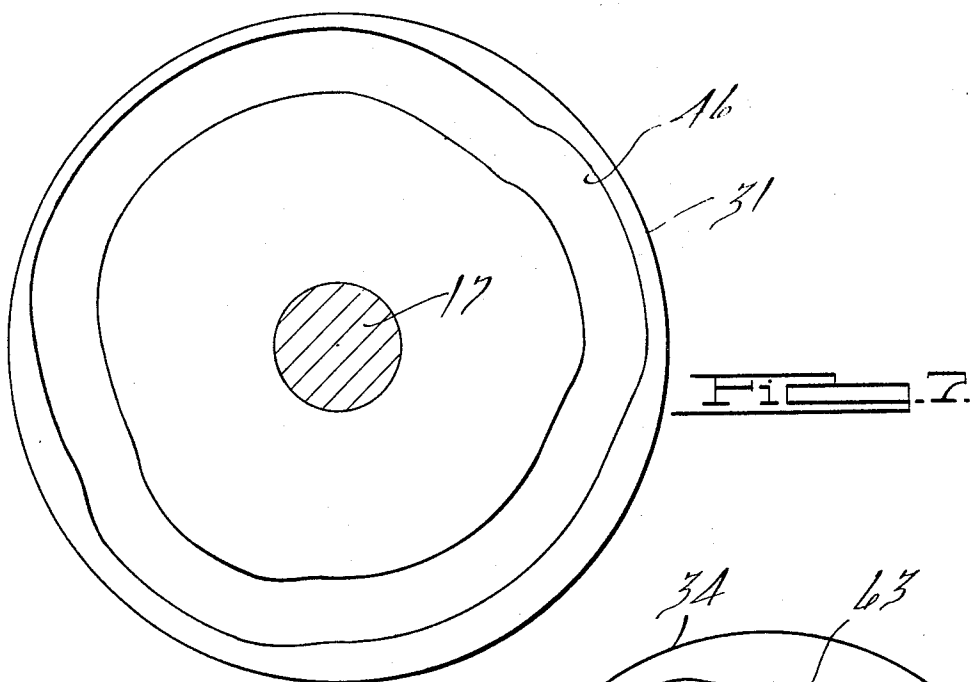
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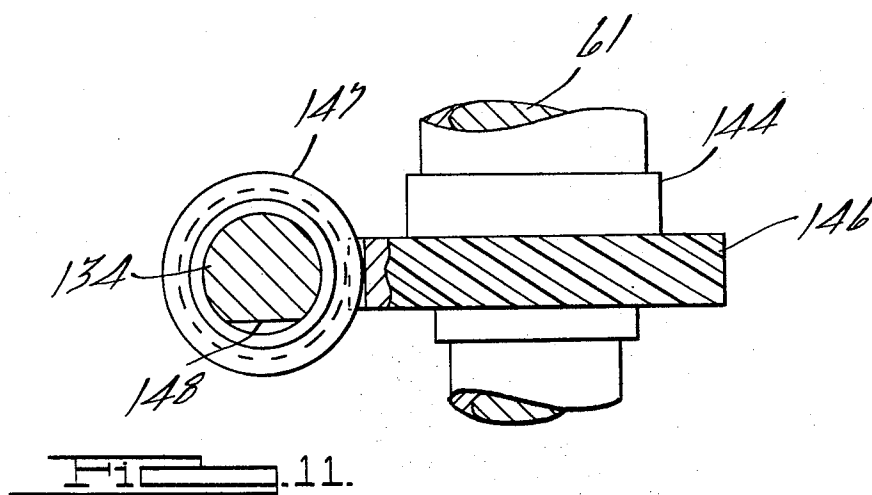
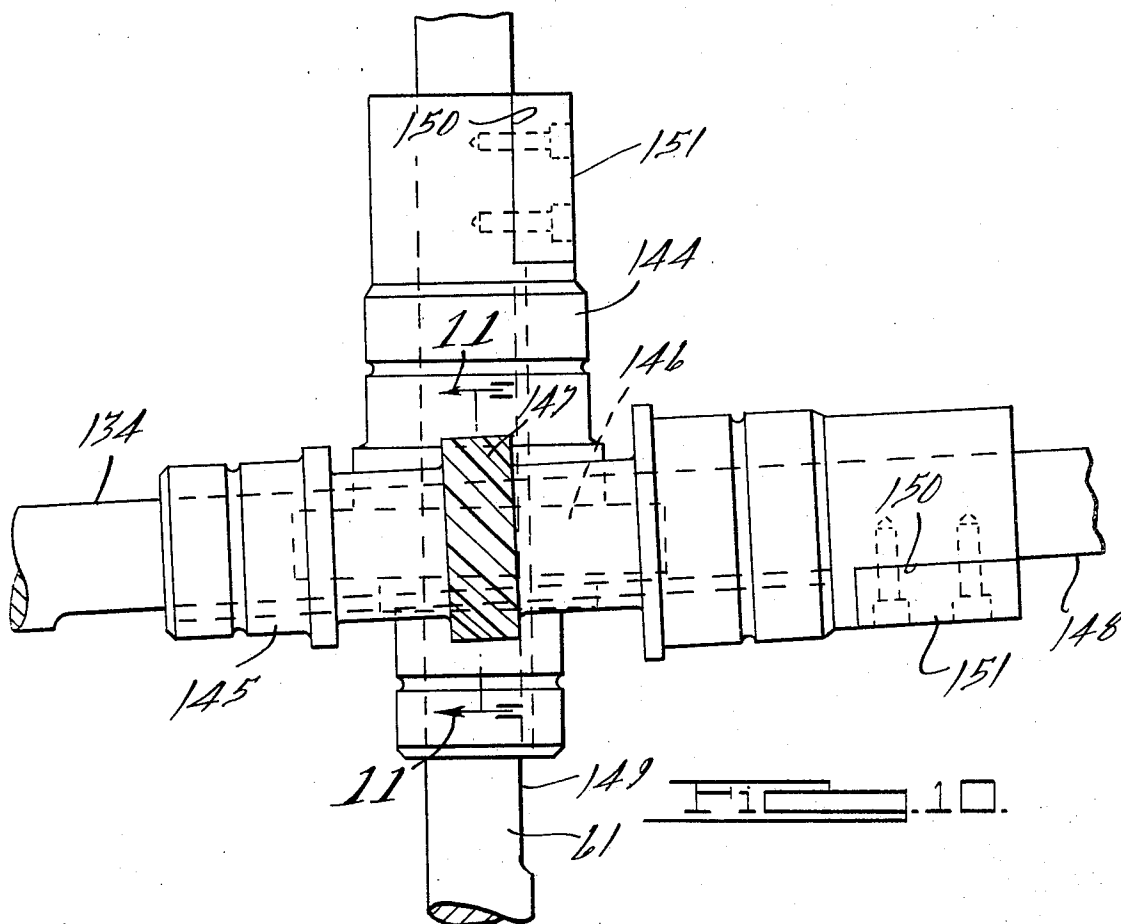
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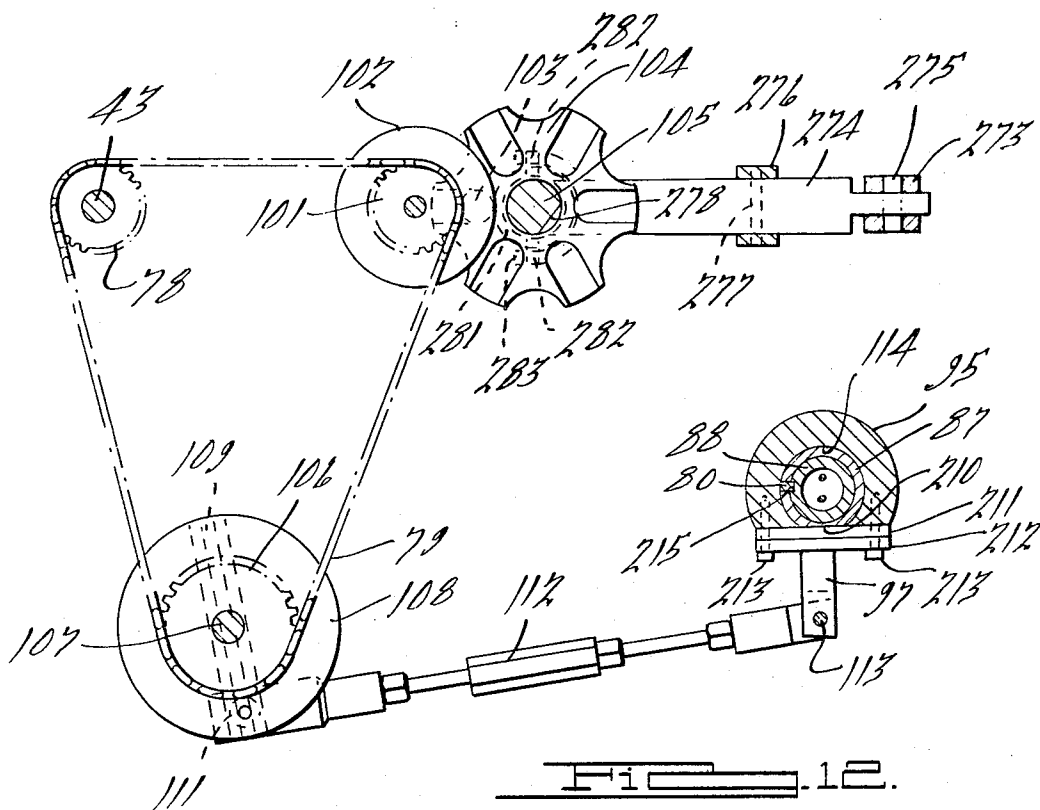


FIG. 12.

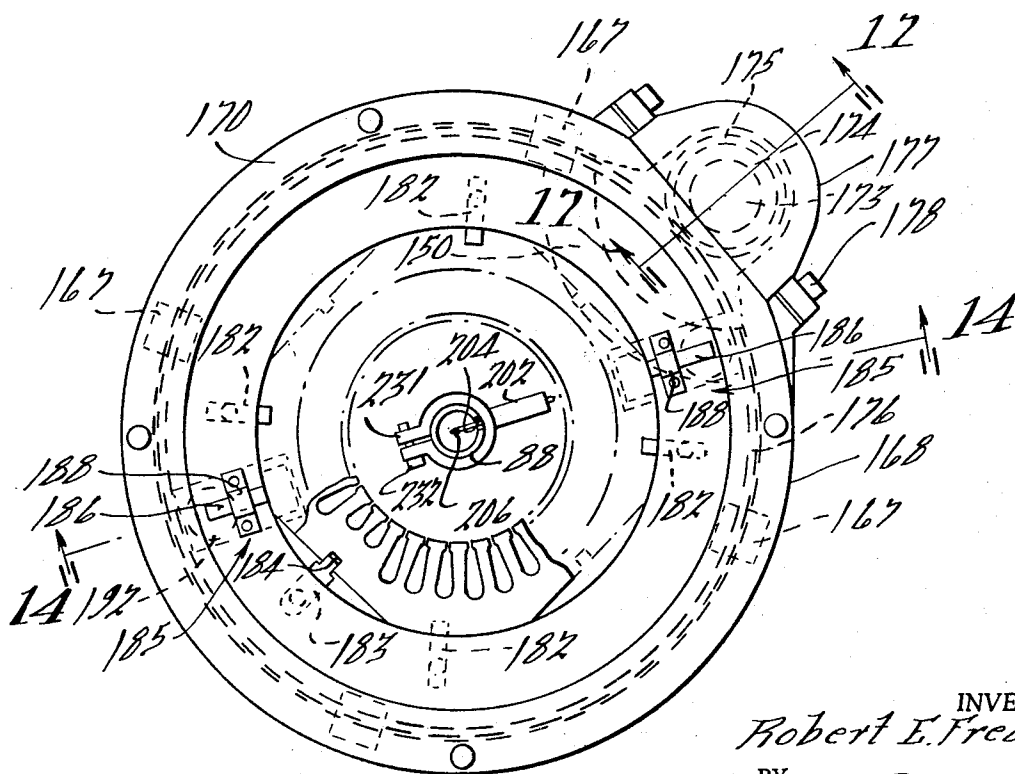
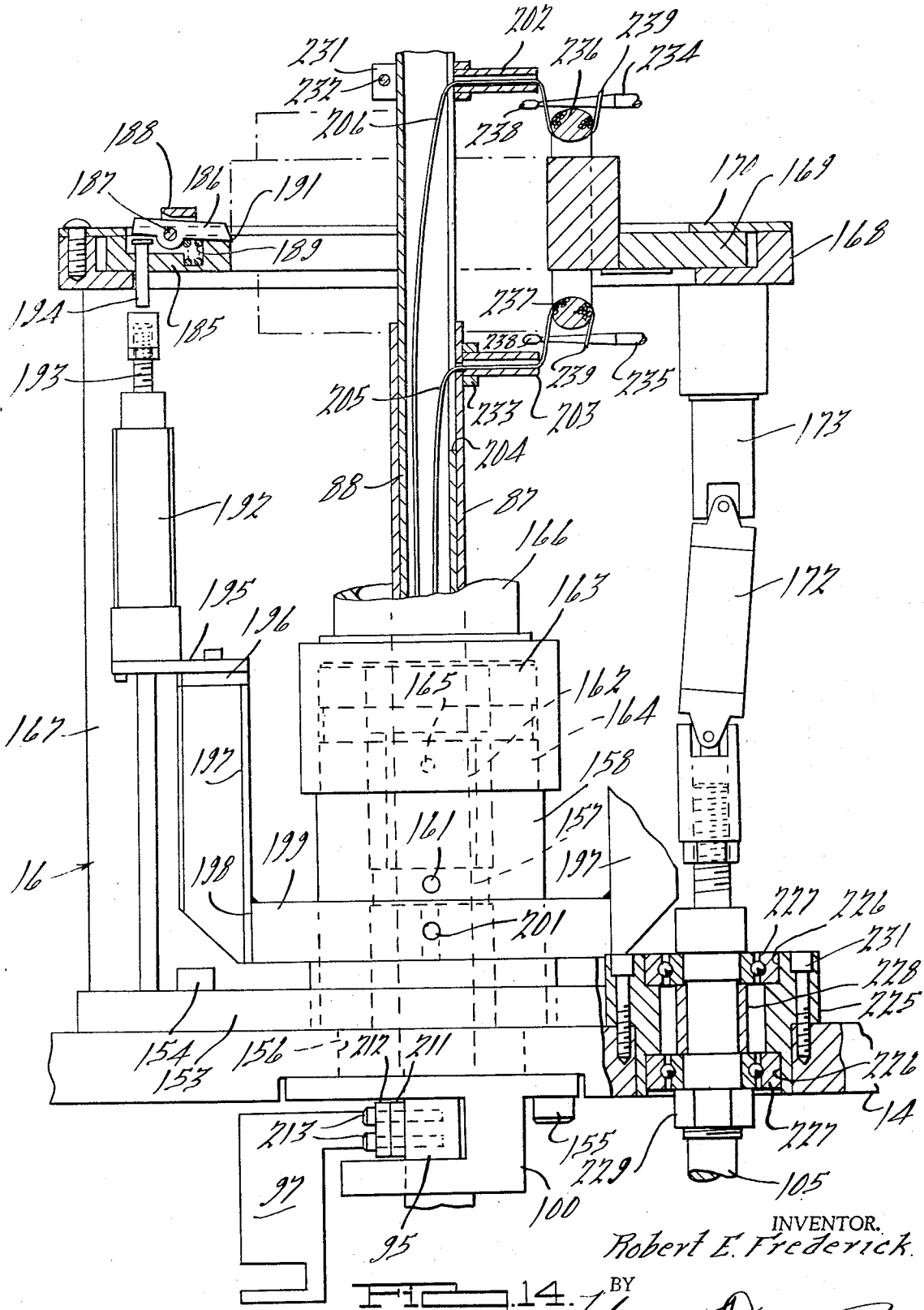


FIG. 13.

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STATOR COIL LACING MACHINE

BACKGROUND OF THE INVENTION

Reference may be had to U.S. Pat. No. 3,440,979 assigned to the assignee of the present invention and the art cited therein for a disclosure of the prior art pertaining to the subject matter of the present invention.

SUMMARY OF THE INVENTION

The invention pertains to a stator coil lacing machine of simple construction wherein the movements between the needle bars and the loop forming thread guides and the movement of the needles away from each other and longitudinally and the angular oscillation of the needles are all accomplished from a single horizontally mounted elongated rotary shaft. The needle bars are moved toward and away from each other and are advanced and retracted and angularly oscillated so as to operate above and below the coil sections at the top and bottom of the stator. The stator and the stator support are advanced in angular increments with dwell time therebetween by a Geneva movement drive from the shaft. The thread guides embody a pair of telescoped tubes which are raised and lowered in opposite direction and angularly oscillated within the stator for laying loops of threads on the needles when advanced beyond the stator coil sections.

The various operating elements driven by the shaft are so constructed and related to each other that the timing of the operations may be done in a simple manner. The assembly is such that the elements of the machine are readily removable and any play in the sleeve bearings is taken up by a squeeze pressure applied thereon. A motor is mounted on the side of the table for driving the shaft continuously through a pinion having its teeth engaged with those of a gear fixed to the shaft. While two needle bars are illustrated and described herein, it is to be understood that a single needle bar may be employed when coil sections are to be laced at only one end of a stator at a time.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a view in elevation of a machine for stitching loops about portions of a coil of a stator embodying features of the present invention;

FIG. 2 is an enlarged broken view in elevation of the driving mechanism for the machine illustrated in FIG. 1;

FIG. 3 is a broken plan view with parts in section, of the structure illustrated in FIG. 2;

FIG. 4 is an enlarged sectional view of the structure illustrated in FIG. 2, taken on the line 4—4 thereof;

FIG. 5 is an enlarged rear view of the lefthand portion of the structure illustrated in FIG. 1, located above the driving mechanism;

FIG. 6 is a front view of the structure illustrated in FIG. 5;

FIG. 7 is a sectional view of the structure illustrated in FIG. 2, taken on the line 7—7 thereof;

FIG. 8 is a sectional view of the structure illustrated in FIG. 2, taken on the line 8—8 thereof;

FIG. 9 is a view of the cam track located on the opposite side of the cam illustrated in FIG. 8;

FIG. 10 is a skeleton view of the structure illustrated in FIG. 6, as viewed within the circle 10 thereof;

FIG. 11 is a broken sectional view of the structure illustrated in FIG. 10, taken on the line 11—11 thereof;

FIG. 12 is a sectional view of the structure illustrated in FIG. 2, taken on the line 12—12 thereof;

FIG. 13 is a plan view of the structure illustrated in FIG. 1, taken at the righthand top portion thereof;

FIG. 14 is a broken sectional view of the structure illustrated in FIG. 13, taken substantially on the line 14—14 thereof;

FIG. 15 is a broken sectional view of the structure illustrated in FIG. 2, taken on the line 15—15 thereof;

FIG. 16 is a broken view of the structure illustrated in FIG. 2, as viewed from the point 16 thereof;

FIG. 17 is a broken sectional view of the structure illustrated in FIG. 13, taken on the line 17—17 thereof, and

FIG. 18 is a broken sectional view of the structure illustrated in FIG. 6, taken on the line 18—18 thereof.

DESCRIPTION OF THE PREFERRED EMBODIMENT

The machine of the present invention performs a thread lacing operation on the extending portions of coils which are wound on a stator. The extending portions of the coils are on the opposite ends of the stator and can be laced simultaneously in a double ended operation or the coil portions on one end of the stator can be laced separately in a single ended operation. The present machine is constructed to lace the coils on both ends of the stator simultaneously but by employing a single needle bar and its associated structure, the extending portions of the coils on one side of the stator can be laced and the stator turned over to have the coil portions on the other end thereof laced thereafter. The lacing operation requires a synchronized movement for the needle bars, that for advancing the needles at one end of the bars beyond the coil, for rotating the bars and needles for retracting the needle and for raising and lowering the needles so that they can be advanced above and below the coil portions. At the same time the thread guide mechanism is moved upwardly and downwardly to be located beyond the needles and to angularly oscillated to lay a loop into the hook at the needle ends. The needles pick up the thread delivered by the thread guide tubes and when retracted and turned pulls the thread through the loop on the needle as the new loop is formed and the needle is raised or lowered and advanced beyond the coil portion to have the operation repeated.

The machine, as illustrated in the FIGS., has a table 11 mounted on four short supporting legs 12 with a plurality of posts 13 extending upwardly therefrom for supporting a platform 14 above the table. A needle bar operating mechanism 15 is mounted on the lefthand top side of the platform while a stator support 16 is mounted on the righthand top side thereof, as illustrated in FIG. 1. The driving mechanism is mounted on the table 11 below the platform 14 and embodies a shaft 17 supported in bearings 18 and 19 for rotation from a gear 21 fixed thereto. A shaft 22 mounted in bearings 23 has a pinion 24 with teeth in mesh with the teeth of the gear 21. A belt driven gearlike element 25 on the opposite end of the shaft 22 is connected by a belt 26 to a belt drive gearlike element 27 mounted on the shaft of a motor 28 secured to a bracket 29 mounted on the side of the table.

The lefthand end of the shaft 17, as viewed in FIGS. 2 and 3, has a cam plate 31 secured on a tapered end 32 by a washer and stud 33 which has cam fingers 30 on the end for actuating control elements such as switches and the like. A cam plate 34 is secured to the shaft 17 and locked thereto by a tapered nut 35 which permits adjustment so that the cam 34 and 31 can be shifted into timed relation to each other. A sprocket wheel 36 is mounted on the shaft 17, as illustrated in FIG. 3, connected by a chain 37 to a sprocket wheel 38 of a pump 39. A worm gear 41 is fixed to the shaft 17 having teeth in mesh with the tread of a worm 42 secured to a vertical shaft 43. The ends of the shaft are mounted on eccentrically supported bearings which when adjusted moves the worm toward or away from the worm gear to remove any backlash therebetween. The righthand end of the shaft 17 has a cam plate 44 secured to a tapered end thereof by a washer and screw 45. The drives produced by the shaft 17 through the cam plates 31 and 34, the shaft 43 and cam plate 44 provides all the movement in synchronism required for lacing the thread about the portion of the coils of stator at one or both ends thereof.

The cam plate 31, as illustrated in FIGS. 2, 3, 4 and 7, has a cam track 46 into which a roller 47 projects. The roller is mounted on a link 48 secured for oscillating movement on a pivot 49 on a block 51 which is adjustably mounted on the side of a standard 52. A cross link 53 is secured by a pivot 54 to the upper end of the link 48 with the other end secured by a pivot 55 to the bottom end of a link 56 which is supported on a pivot 57 at the top of the standard 52. The upper end of the link 56 supports a beveled gear sector 58 which drives a beveled gear 59 mounted on the end of a shaft 61 supported by a bearing mount 62 on the platform 14. As the shaft 17 rotates, the link 48 is oscillated to oscillate the link 56 and sectors 58 for rotating the shaft 61 in oscillation for a purpose which will be explained hereinafter.

The cam plate 34 has oppositely presenting like cam tracks 63 and 64 extending thereinto from opposite faces thereof in 180° offset relationship, as illustrated in FIGS. 8 and 9. A pair of standards 65 and 66 are adjustably mounted on slides 67, the standards having bosses 68 at the top for supporting a bearing 69 on which links 71 at opposite sides of the cam plate 34 oscillate. The links support rollers 72 which operate in the cam tracks 63 and 64 to cause the outer ends of the links 71 to move upwardly and downwardly in opposite directions due to the 180° offset position of the cam tracks. The outer ends of the links 71 support a pair of rods 73 and 74 which extend upwardly through an aperture 75 in the platform 14 for opposite reciprocation for a purpose which will be explained hereinafter.

The shaft 43 extends upwardly through the platform 14 with an eccentric head 76 mounted thereon for driving a ram type connecting rod 77 for a purpose which will be explained hereinafter. The upper end of the shaft 43 also has a sprocket wheel 78 secured thereto below the platform 14 for driving a chain 79 which drives mechanism to be described hereinafter which advances the stator in increments with dwell time therebetween and which oscillates thread laying guide tubes in rotation.

The cam plate 44 is engaged by rollers 81 and 82 which rock bosses 83 pivoted on standards 84. One of

the bosses 83 has a pair of spaced arms 85 which are rocked upwardly and downwardly. The other boss 83 has a pair of adjacent arms 86 which are rocked upwardly and downwardly in opposite direction to the up and down movement of the arms 83 in synchronism with the movement of the rods 73 and 74.

The thread laying guide tubes embody an outer tube 87 having a smaller tube 88 telescoped therewithin with the inner tube 88 extending beyond both ends of the outer tube 87. A trunnion ring 89 supports a bearing 90 which has its inner race secured to the lower end of the inner tube 88 with the trunnions 91 of the ring 89 journaled in spaced links 92 which are pivoted to the ends of the arms 86. A trunnion ring 93 supports a bearing 94 the inner race of which is secured in fixed relation to the outer tube 87. With this arrangement, the rotation of the cam plate 44 operating on the rollers 81 and 82 raises the tube 87 while lowering the tube 88 and vice-versa.

The tube 87, as illustrated in FIG. 12, has an internal key 80 which extends into a slot 215 in the wall of the tube 88 so that both can be oscillated in rotation simultaneously since the inner races are rotatable within the bearing supported in the rings 89 and 93. The upper end of the sleeve 87, as illustrated in FIG. 16, extends through a housing 100 secured to the platform 14 to extend thereabove. The housing has a recess below the platform in which a collar 95 is supported for rotation. As illustrated in FIG. 12, the tube 87 has a flat 210 on one side engaged by a strap 211 which is abutted by a head 212 of a T-arm 97 and secured in fixed relation by screws 213. The flat on the outer tube 88 and the key 80 between the tubes causes the tubes to oscillate in unison when the arm 97 is actuated for a purpose which will be explained hereinafter.

The chain 79 driven by the sprocket 78 from the shaft 43 drives a sprocket 101 which rotates a plate 102 which has a downwardly extending finger 103 which advances a head 104 in increments of rotation. The head 104 and finger 103 forms a Geneva movement which produces the interrupted advancement of the head 104. The head 104 is mounted on a shaft 105 journaled in the platform on a bearing support as described herein for advancing the stator in increments as will be explained hereinafter. The chain also drives a sprocket 106 supported on a shaft 107 which drives an eccentric head 108 in rotation. The head 108 has a T-slot 109 in which a T-shaped bar is slidably adjusted having a pivot 111 projected therefrom and journaled to the end of an adjustable connecting rod 112 which is secured by a pivot 113 to the T-arm 97. The collar 95 has a D-shaped aperture 114 closed by the strap 211 which engages the flat 210 of the thread guide tube 87 permitting it to slide in the collar 95 and be rotated thereby when oscillated by the rotation of the eccentric head 108.

As illustrated in FIGS. 5 and 6, the top of the lefthand side of the platform 14 has a pair of pillars 116 and 117 on plates 121 secured thereto and extending upwardly therefrom with plates 118 secured to the top and to the top end of slide bars 119. The bottom ends of the slide bars are located in apertures in the platform and secured in blocks on the underside thereof. A frame 122 has bosses 123 at the ends containing an aperture which receives the slide bars 119 to permit the

frame 122 to slide upwardly and downwardly thereon. The frame has a clamping plate 124 which secures a bar 125 in adjusted position relative thereto. The lower end of the bar has a yoke 126 which is secured by a pivot 127 to a block 128 which is attached to the upper end of the rod 74. A second frame 129 similar to the frame 122 is mounted on the slide bars 119 below the frame 122 with a block 131 on the end of the rod 73 secured by a pivot 132 to the frame 129. The rods 73 and 74 move the frames 122 and 129 on the slide bars 119 toward and away from each other.

The frame 122 has a boss 133 provided with a sloping aperture through which a needle bar 134 extends. A similar boss 135 on the frame 129 is provided with a sloping aperture through which a needle bar 136 extends. The opposite side of the frames 122 and 129 has cylindrical housings 137 through which the needle bars 134 and 136 extend. A pair of uprights 138 are mounted on top of the platform 14 for supporting a pair of spaced horizontal slide bars 139. A block 141 has apertures through which the slide bars 139 extend permitting the block to slide backwardly and forwardly thereon. This back and forth movement is produced by the ram type connecting rod 77 operated from the adjustable eccentric head 76 on the shaft 43. The connecting rod 77 is a ram which at the end of a lacing operation is actuated to further advance the block 141 and fully retract the needle bars 134 and 136 to the right. The block 141 carries a pair of slide bars 142 on which blocks 143 are slidably mounted for up and down movement.

The needle bars 134 and 136 extend through the blocks 143, as illustrated more specifically in FIG. 18. The block 143 has an extending portion 216 containing a bushing 217 of bearing material which is secured in fixed relation to the extending portion by a screw 218. The bushing has a head 219 containing a groove 221 for receiving a plurality of spring pressed balls 222 in a bushing 223 which is secured to the needle bars 134 and 136 by a set screw 224. As the needle bars 134 and 136 are carried upwardly and downwardly by the frames 122 and 129 the blocks 143 are carried upwardly and downwardly therewith on the slide rods 142 and the needle bars are advanced and retracted by the movement of the blocks 143 on the rods 42 which are carried by the driven block 141. Should a needle on the end of the needle bars strike the stator or other obstruction the bushing 223 and balls 222 will be released from the head 219 so that the blocks 143 can continue to move while the needle bar which had its needle engage the obstruction is released so that no damage will be done to the needle or the associated mechanism.

The inner elements of the cylindrical bosses 137 are of like construction and are illustrated more specifically in FIGS. 10 and 11. The shaft 61 which is driven in oscillation by the beveled gear 59 extends upwardly and is supported in the cylindrical boss 137 by a sleeve 144 having a helical gear 146 thereon. A helical gear 147 is provided on a sleeve 145 within the cylindrical boss 137 with the teeth of the gears in meshed relation. The portion of the needle bars 134 and 136 from the lefthand side of the sleeve 145 to the righthand end thereof has a flat 148 along one side. The upper end of the shaft 61 has a flat 149 along one side thereof extending through the sleeve 144. One end of the sleeves

144 and 145 has a shoulder 150 substantially in the plane of the flats 148 and 149 over which caps 151 are secured to cause the shaft 61 to rotate the sleeves 144 and through the gears 146 and 147 rotate the sleeve 145 and the needle bars 134 and 136 while permitting the sleeve 144 to move along the shaft 61 and the needle bar to move within the sleeve 145.

The shaft 61 and gear 146 are driven in oscillation to oscillate the gear 147, sleeves 145 and the needle bars 134 and 136. The gears are so constructed that the needle bars 134 and 136 are oscillated in opposite directions, that is to say, one is rotated clockwise when the other is rotated counterclockwise.

The stator supporting standard 16, as illustrated in FIGS. 13 and 14, has a bottom ring 153 offset at 150 secured to the top of the platform 14 by a plurality of screws 154. The housing 100 having the collar 95 rotatably mounted therein is secured within a recess on the bottom face of the platform 14 by a plurality of screws 155. The housing extends through an aperture 156 of the platform upwardly to a shouldered top end 157. A cylindrical head 158 extends over the housing and is secured to the shouldered end 157 by a set screw 161. The cylindrical head 158 has a bearing 162 therein engaging the outer lacing tube 87 which is moved upwardly and downwardly and angularly oscillated therewith. A second head 163 may be applied to a shouldered end 164 of the head 158 secured thereto by a set screw 165 for the purpose of having an extending tubular portion 166 locate a stator by its inner surface on the support. The stator support has four posts 167 equally spaced and extending upwardly therefrom, as illustrated in FIG. 13. The four posts support a recessed ring 168 in which a ring gear 169 of bearing construction is supported for rotational movement.

The shaft 105 is supported on the platform 14 by a bushing 225 which has recesses 226 for supporting the outer race of bearings 227. A sleeve 228 is disposed between the inner race of the bearings 227 and are secured in unit relation by a nut 229. The bushing 225 extends through the platform 14 and is secured thereto by a plurality of screws 231. This bearing support is employed for the stub shafts which extend through the platform and which have not been described in detail hereinbefore. The shaft 61 drives through a universal drive 172, a stub shaft 173 which has a pinion 174 welded to the end, as illustrated in FIG. 17. The teeth 175 of the pinion mesh with the teeth 176 of the ring gear 169. The recessed ring 168 has a section cut therefrom covered by a casing 177 which encloses the pinion 174 when secured by screws 178 to the recessed ring, as illustrated in FIG. 13. The ring gear 169 is retained within the recess of the ring 168 by a washer-like plate 170. The incremental drive of the stub shaft 173 by the Geneva head 104 advances the ring gear 169 in steps with dwell time therebetween to permit the advancement and retraction of the needles through the portions of the coil being laced while the coils are stationary. The ring gear 169 is engaged by the outer surface of the stator and where the coils of stators of smaller diameter are to be laced a new ring gear 169 may be used or a spacing ring supported by the original ring gear may be employed. As pointed out above, the stator containing tube 166 may be utilized to locate the stator from its inner surface. A plurality of fingers 182

are secured to the underside of the ring gear 169 for retaining the bottom of the stator flush with the bottom of the ring gear.

A finger 183 has an end which extends within a slot 184 in the outer face of the stator for orienting the stator on the support. A mechanism 185 is provided on opposite sides of the ring gear 169 for releasably retaining the stator on its support. A clamping finger 186 is mounted on a pivot 187 beneath a cross bar 188. A spring 189 urges the sharp end 191 of the clamping finger 186 into engagement with the outside surface of the stator core. The sharp end 191 is located below the pivot 187 and therefor resists upward movement of the stator when engaged thereby. After the lacing operation has been completed a pair of cylinders 192 has their piston rod 193 moved outwardly to raise a pin 194 which engages the outer end of the clamping fingers 186 to move the sharp point 191 thereof downwardly to release the stator. The cylinders 192 are mounted on a plate 195 at opposite sides of the stator support and secured to a plate 196 on the upper end of angular members 197 which have one flange thereof welded to flat faces 198 of a washer-like ring 199. The ring is secured to the cylindrical head 158 by a set screw 201. It will be noted that the pins 194 are supported by the ring gear 169 to rotate therewith and that they will be aligned with the end of the piston rods 193 at the end of each 360° rotation of the ring gear which will be at the end of the lacing operation.

As illustrated in FIGS. 12 and 16, an air operated ram 271 has a piston rod 272 with a biforcated end 273 secured to the end of a rockable link 274 by a pivot 275. A biforcated finger 276 extends downwardly from the platform 14 and is connected by a pivot pin 277 to the link 274. The pin forms a fulcrum on which the link 274 is tilted by the action of the ram 271. The opposite end of the Geneva head 104 has a downwardly extending boss 280 through which the shaft 105 extends. The shaft has a flat 278 which is engaged by a plate 279 which is secured in a recess on one side of the boss 280. This produces a drive of the shaft 105 from the Geneva head 104 which can be moved upwardly and downwardly on the shaft 105. The boss 280 has an annular slot 281 in which trunnions 282 on a biforcated end 283 of the link 274 extend to permit the head 104 to be moved upwardly and downwardly on the shaft 105 by the ram 271. When the head 104 is moved to down position, it is out of alignment with the finger 103 and will not be advanced thereby. When this occurs a plurality of loops of thread are laced about the same place on the coil portion. When the ram 271 is actuated to hold the head 104 in its up-position, the shaft 105 will again be advanced in increments by the advancement of the head 104 by the finger 103.

The inner thread laying tube 88 has a tubular finger 202 extending outwardly from one side vertically aligned with a tubular finger 203 extending outwardly from the outer thread laying tube 87. A slot 204 in the inner thread laying tube 88 permits the thread 205 within the tube to be delivered therethrough to the tubular finger 203. A second thread 206 within the thread laying tube 88 is delivered directly to tubular finger 202. As can be seen from FIG. 14, the tubular fingers 202 and 203 are moved toward and away from each other to positions above and below the portions of

the coil to be laced to permit the fingers to lay a loop of thread onto the needles when projecting inwardly beyond the coil portions when located thereabove the therebelow. The finger 202 has a collar 231 which extends over the end of the tube 88 and is clamped thereon by a screw 232. The finger 203 has a plate 233 which is secured to the tube 87 by screws (not shown). As illustrated in FIG. 14, the needles 234 and 235 advance beyond the coil portions 236 and 237 on the outside thereof with the hook end 238 facing outwardly toward the threads 205 and 206. The fingers 202 and 203 are oscillated toward and beyond the needles to lay a loop of thread on the needles ahead of the hooks. The needles are retracted to have the hooks secure the threads and are thereafter oscillated, the upper one counterclockwise and the lower one clockwise to have the hooks 238 face away from the thread loops 239 on the needles so that the engaged thread portions can be pulled therethrough. The needles are moved toward each other and advanced beyond the inner coil portions as the fingers 202 and 203 are moved toward each other so that the thread laying operation can be repeated. Between the operations the needles 234 and 235 and the fingers 202 and 203 are returned to their initial positions. The needles are rotated in the opposite direction when within the coil portions to slide the engaged threads through the loops thereon.

Referring to FIGS. 1 and 2, the threads 205 and 206 are pulled from spools 241 through a thread tensioning device 242 and upwardly through a tube 243 which is screwed into a threaded aperture through the table 11 and locked in position by a nut 244. The nut also clamps a plate 245 which has a stirrup 246 extending downwardly therefrom for supporting a recessed roller 247 about which the threads 205 and 206 are drawn. The tube 243 is telescoped within the thread laying tube 88 to prevent a lubricant from contacting the threads as they pass from the tube 243 into the inner thread laying tube 88. The thread tensioning and delivery mechanism 242 is of the standard type readily procurable in the trade. This mechanism may be set in a desired position on the floor and the stirrup 246 may be adjusted to have the roller 247 aligned with the delivered threads. The threads extend from the fingers 202 and 203 and are clamped within jaws 248 and 249 supported on air and spring actuated rams 251 and 252 which have an electrically operated valve 253 at the base thereof.

A stator is mounted on the support with the threads secured in the jaws 248 and 249 by the spring pressure which returns the pistons to the bottom of the rams. A button is then pressed to start the machine which will produce the lacing operation in the manners pointed out hereinabove. At the end of the 360° rotation of the stator a similar solenoid operated ram 254 mounted on a rod 250 secured to the platform 14 has a cutting blade 255 on the forward end which severs the threads hooked by the needles after the complete retraction of the needle bars by the operation of the ram which is used as the connecting rod 77. If the blade 255 is not thereafter retracted the ends of the forward moving needles will engage the blade and rotate the ram 254 on the supporting rod 250 out of the path thereof. The thread from the finger 203 is placed within the jaws 249 and the thread from the finger 202 is placed in a notch

at the top of a supporting arm 256 extending upwardly from the thread laying tube 88. The stator is then removed and a new stator to be laced is placed upon the support and the thread on the support 256 is clamped in the jaws 248. With the threads clamped in this manner the button is again pressed to start the machine and lace all the coil portions on both sides of the stator in a continuous operation.

An oil delivery pipe 257 is mounted above the table 11 below the platform 14, as illustrated in FIG. 2, having a plurality of oil delivery tubes 258 extending downwardly therefrom in the vicinity of the operating parts for maintaining a small flow of oil thereto. The oil flows downwardly onto the table and is collected in a reservoir 259 therebelow. A pipe 261 having a filter 262 on the end extends from the reservoir 259 to the pump 39. To retain the oil within the confines of the table, slotted elements 263 are applied to the four corners thereof, the bottom ends being welded to the table and the top ends being secured to the platform by removable caps 264. Thin plates 265 slide downwardly within the slots of the elements 263, as illustrated more specifically in FIG. 2, to enclose the working parts between the table and the platform which are lubricated by the recirculated oil collected in the reservoir.

An electric control box 266 is hinged to the table and platform by hinge extensions 267 which permits the entire box to be pivoted away from the adjacent plate 265 so it can be removed to have drive mechanism between the table and the platform exposed for examination and/or repair. A similar control box 268 for fluid is hinged to the opposite face of the machine having the operating control buttons thereon which can be hinged away to permit the opposite plate 265 to be removed. It is to be understood that controls are provided on the machine for actuating the various supplemental elements thereof such as the rams 251, 252, 254 and 292 and the like by circuits from the electric control box 266 and the fluid control box 268. The operation of the needle bar and the thread laying tubes are mechanically timed to operate in the setforth manner and adjustment is provided so that when stators of different diameters and coil portions are to be laced, the various movement between the parts can be changed to conform to those necessary to produce the lacing operation.

I claim:

1. In a lacing machine for stitching loops about coils of a wound stator, a table, a platform above said table, a vertically reciprocal element supported by said platform, a needle bar on said element mounted for angular oscillation and longitudinal movement thereon, a horizontal shaft on said table, means for driving said shaft in rotation, a first means driven by said shaft for angularly oscillating said needle bar, a second means driven by said shaft for raising and lowering said vertically reciprocable element and said needle bar, a third means driven by said shaft for reciprocating said needle bar on said vertically reciprocable element in any position thereof, a stator support, means driven by said third driven means for rotating said stator support in increments of angular advancement, thread laying means within said stator support, and a fourth means driven by said shaft for reciprocating said thread laying means timed with the reciprocation of said needle bar.

2. In a lacing machine for stitching loops as recited in claim 1, wherein a second vertically reciprocable element is mounted below said first vertically reciprocable element, a needle bar carried by said second vertically reciprocable element, said first driven means oscillating both of said needle bars simultaneously, said second driven means reciprocating both said vertical reciprocable elements simultaneously toward and away from each, said third driven means reciprocating both said needle bars toward and away from said stator support, said fourth driven means reciprocating said thread laying means for each said needle bar relative to the top and bottom sections of a stator coil.

3. In a lacing machine for stitching loops as recited in claim 1, wherein said thread laying means embodies telescoped tubes which are reciprocated in opposite directions by said fourth driven means, and means driven by said third driven means for angularly oscillating said telescoped tubes in unison.

4. In a lacing machine for stitching loops as recited in claim 3, wherein a pair of threads are passed through the inner of said telescoped tubes, and a tubular finger extending from each of said telescoped tubes communicating with the inside thereof to permit the thread of the inner tube to pass outwardly through the finger thereon and the other thread therein to pass outwardly through a slot in the inner tube and through the finger of the outer tube.

5. In a lacing machine for stitching loops as recited in claim 4, wherein said means driven by said third driven means is a sprocket for driving a chain which drives said stator support and also said means for angularly oscillating the telescoped tubes of said thread laying means.

6. In a lacing machine for stitching loops as recited in claim 1, wherein said third means driven by said horizontal shaft is a vertical shaft which carries a sprocket, a Geneva movement having a head and a drive finger on a shaft having a sprocket thereon, a chain drive between said sprockets, said finger advancing the Geneva head in increments, a shaft driven by said Geneva head having a pinion thereon, and a ring gear on the stator support driven by said pinion.

7. In a lacing machine for stitching loops as recited in claim 6, wherein a horizontal slide reciprocates the needle bars, an adjustable eccentric head mounted on the vertical shaft above the platform, and a connecting rod on said adjustable eccentric head joined to said horizontal slide.

8. In a lacing machine for stitching loops as recited in claim 6, wherein means are provided for moving the Geneva head out of engagement by the finger to increase the dwell time between the stator advancements.

9. In a lacing machine for stitching loops as recited in claim 6, wherein an additional shaft having a sprocket thereon driven by said chain has an eccentric head, and a connecting rod between said head and an arm on the outer tube of the thread laying means for producing its angular oscillation timed with the forward advancement of said needle bars.

10. In a lacing machine for stitching loops as recited in claim 9, wherein the telescoped tubes have a key and slot connection so as to be oscillated in unison.

11. In a lacing machine for stitching loops as recited in claim 1, wherein said means for reciprocating said

11

needle bars has a releasable connection which permits said third means to continue to advance when a needle on the end of a needle bar strikes an obstruction.

12. In a lacing machine for stitching loops as recited in claim 1, wherein an oil delivery pipe is mounted below the platform having outlet means adjacent to said horizontal shaft and said means driven thereby to provide continuous lubrication therefor.

13. In a lacing machine for stitching loops as recited in claim 12, wherein corner elements are provided between the table and platform having slotted edges,

12

and panels removably secured in said slotted edges to enclose the sides and ends of the area between the platform and table.

14. In a lacing machine for stitching loops as recited in claim 13, wherein a pump on said table is driven from said horizontal shaft, and a reservoir on the underside of the table for collecting oil from the top thereof which is recirculated by the pump to said delivery pipe.

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