Feb. 11, 1936. L. E. POOLE 2,030,764

COIL WINDING MACHINE

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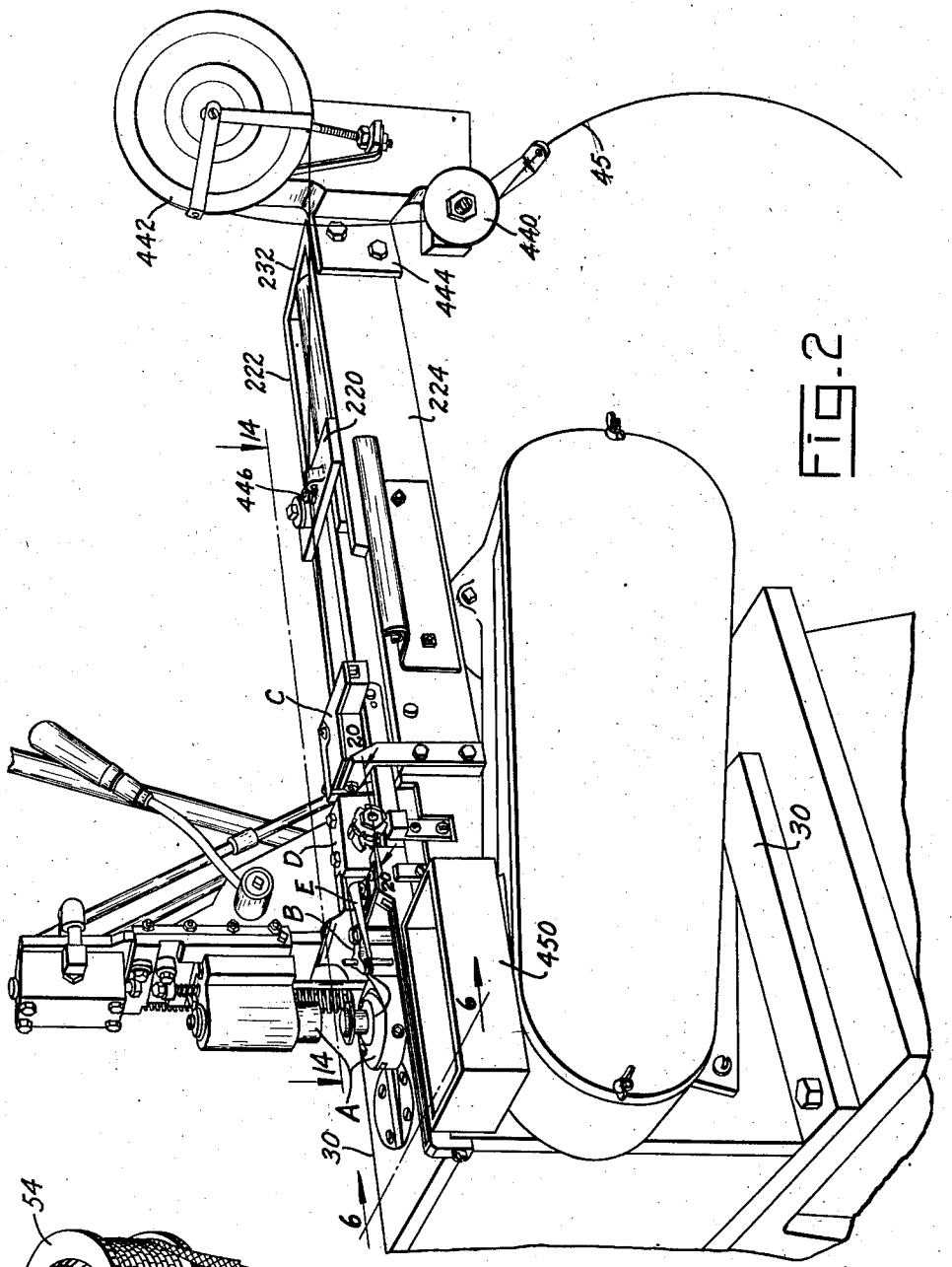


Fig. 2

Fig. 1

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COIL WINDING MACHINE

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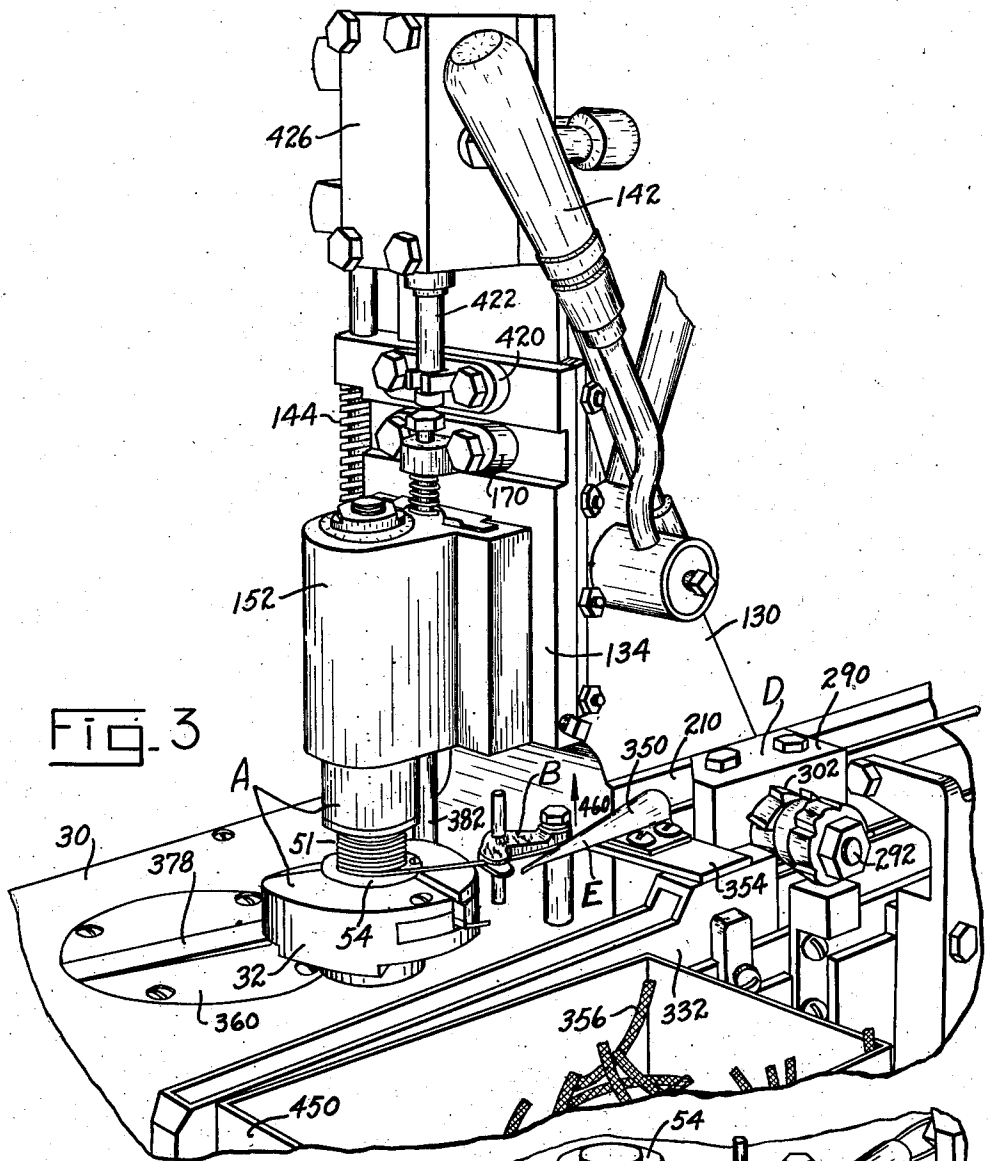


Fig. 3

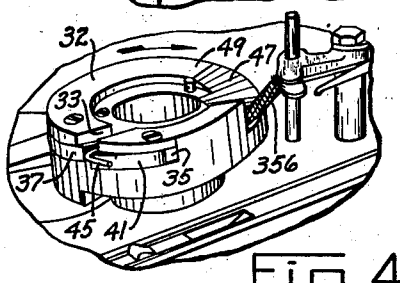


Fig. 4

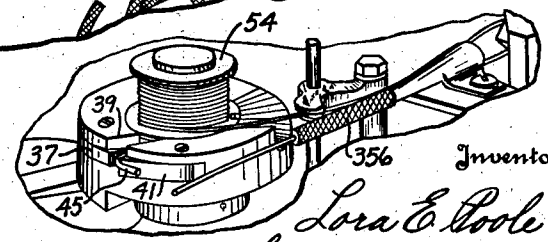


Fig. 5

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COIL WINDING MACHINE

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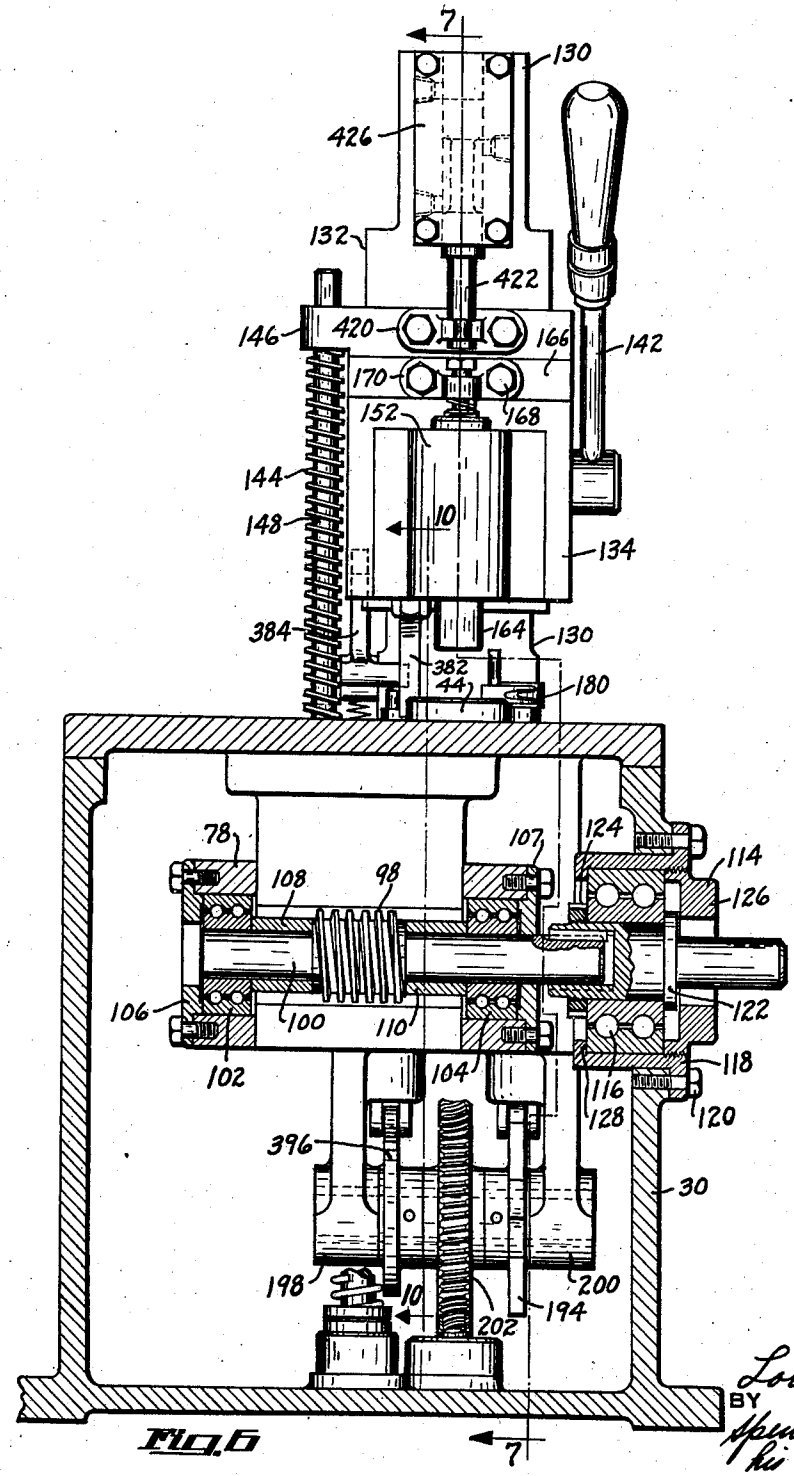


Fig. 6

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COIL WINDING MACHINE

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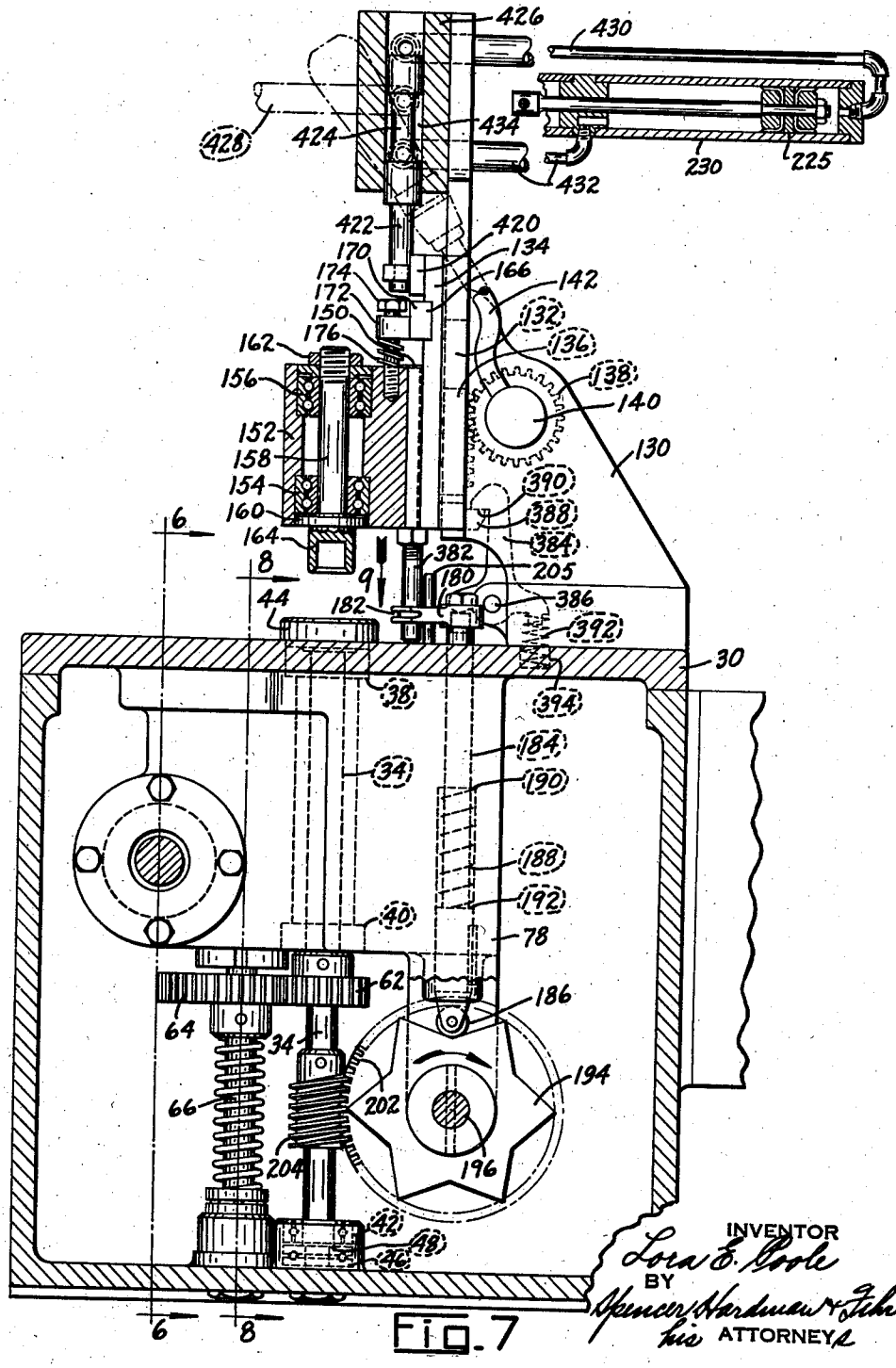


Fig. 7

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COIL WINDING MACHINE

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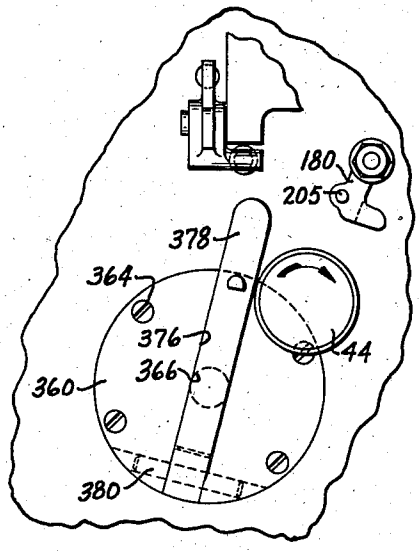


Fig. 9

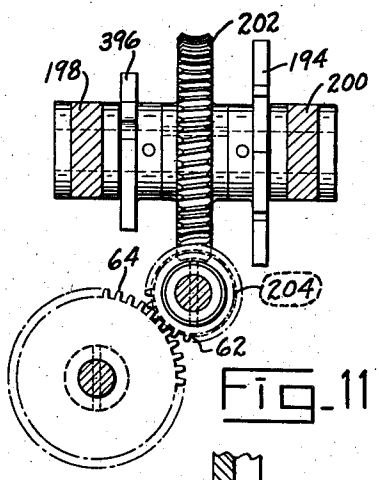


Fig. 11

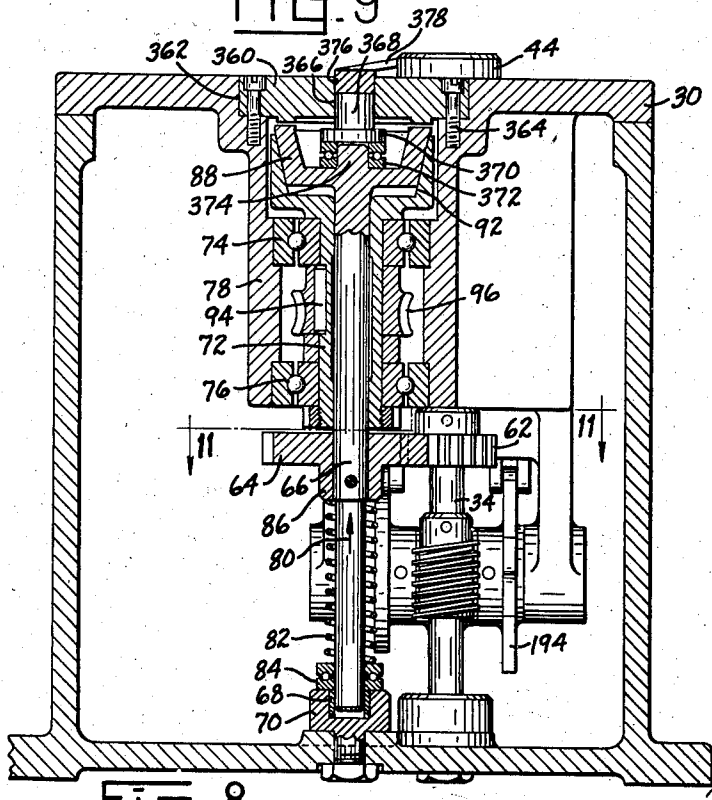


Fig. 8

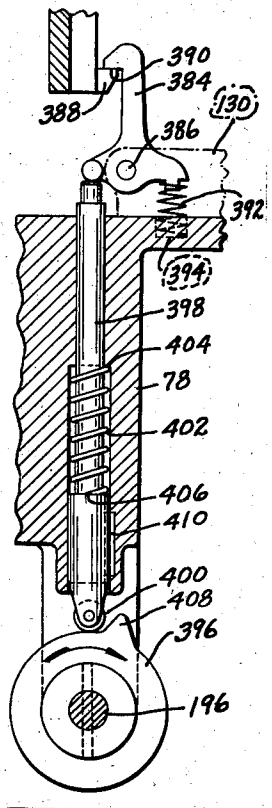


Fig. 10

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COIL WINDING MACHINE

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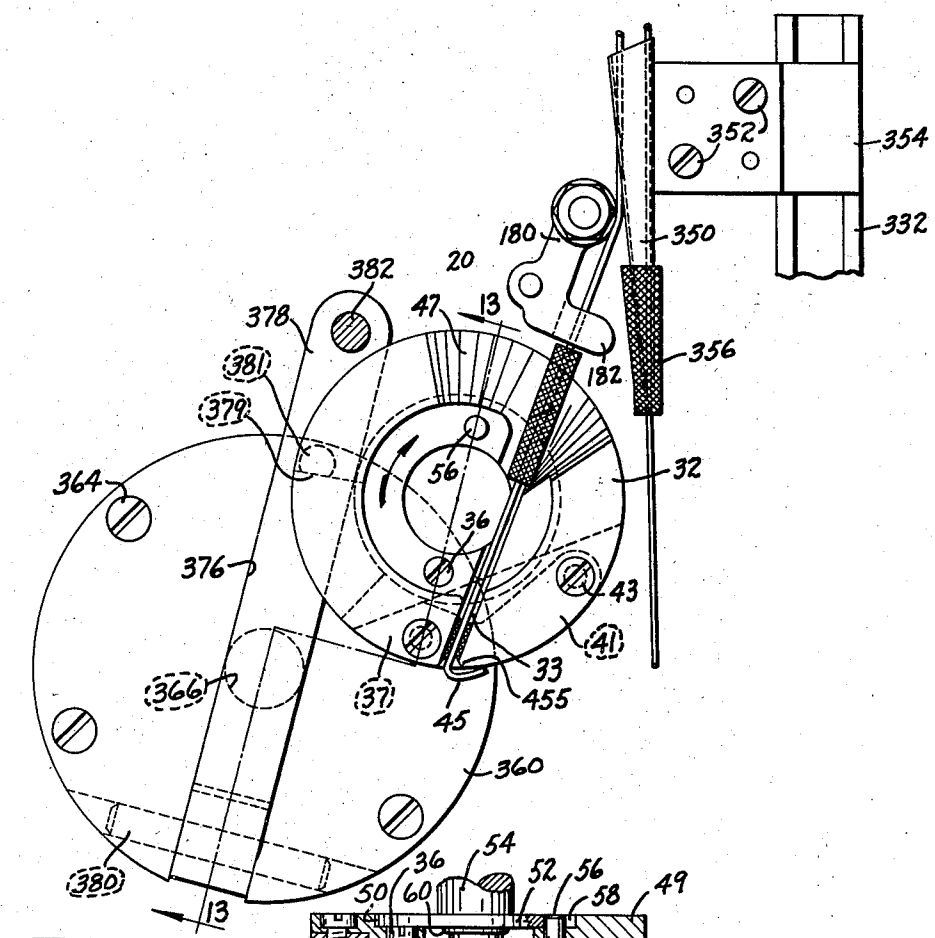


Fig. 12

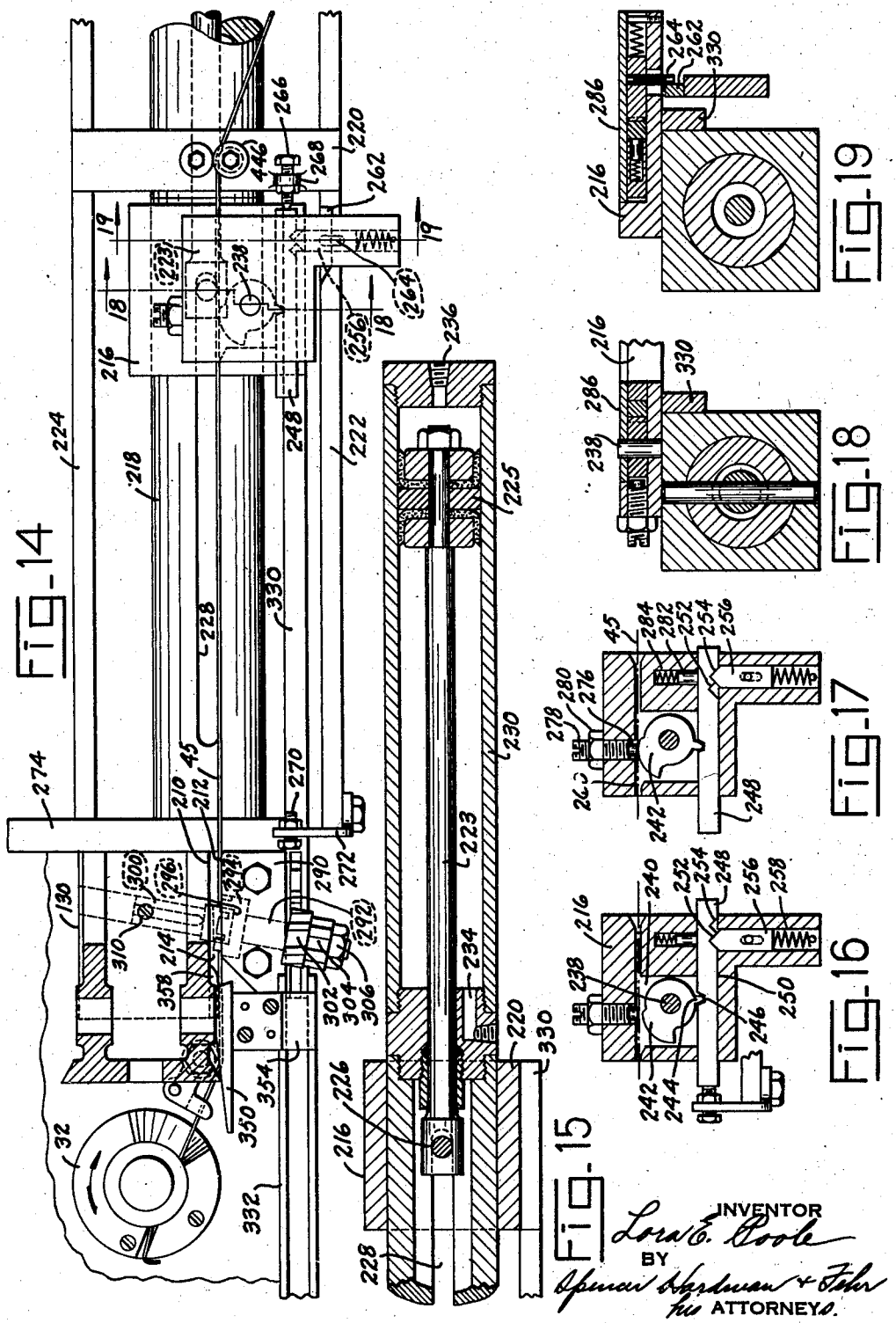
Fig. 13

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COIL WINDING MACHINE

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COIL WINDING MACHINE

Filed March 16, 1933 8 Sheets-Sheet 8

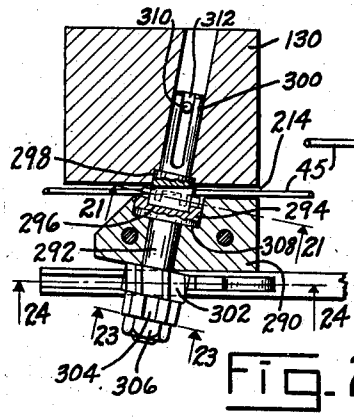


Fig. 20

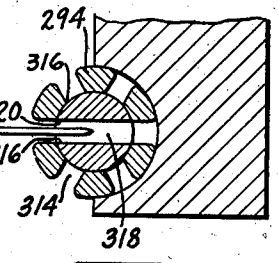


Fig. 21

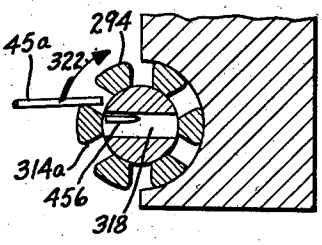


Fig. 22

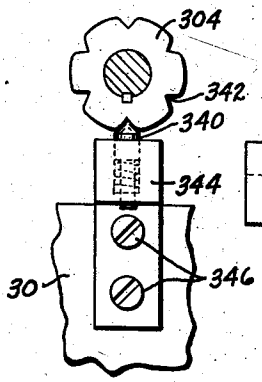


Fig. 23

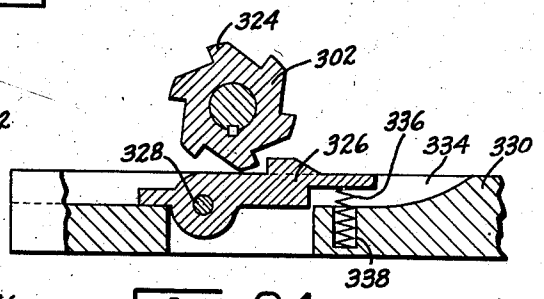


Fig. 24

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UNITED STATES PATENT OFFICE

2,030,764

COIL WINDING MACHINE

Lora E. Poole, Anderson, Ind., assignor, by mesne assignments, to General Motors Corporation, Detroit, Mich., a corporation of Delaware

Application March 16, 1933, Serial No. 661,023

31 Claims. (Cl. 242—9)

This invention relates to coil winding machines and more particularly to a machine for winding wire coils upon forms which carry the coils permanently.

It is an object of the present invention to provide a machine having a winding head for properly holding and rotating a form and for anchoring the leading end of the supply wire.

Another object of the present invention is to provide the leading end of a coil with an insulating sleeve.

Another object of the present invention is to provide for quick shifting of the anchored wire into alignment with the form upon rotation of the winding head.

Another object of the present invention is to provide for proper guidance of the individual turns of a coil on the form.

Another object of the present invention is to sever a wound coil from the supply wire and to feed the severed end of the supply wire into position to be anchored.

Another object of the present invention is to provide a machine which accomplishes all previously mentioned objects automatically, once the operator has deposited the form on the machine, anchored the fed end of the supply wire to the winding head and started the machine into operation.

Further objects and advantages of the present invention will be apparent from the following description, reference being had to the accompanying drawings wherein a preferred embodiment of one form of the present invention is clearly shown.

In the drawings:

Fig. 1 is a perspective view of a coil which is permanently wound on a form.

Fig. 2 is a perspective view of a machine embodying the present invention.

Fig. 3 is an enlarged fragmentary perspective view of the machine.

Figs. 4 and 5 are fragmentary perspective views showing the winding head.

Fig. 6 is an enlarged sectional view taken substantially along the line 6—6 of Fig. 2 and Fig. 7.

Fig. 7 is a sectional view taken substantially on line 7—7 of Fig. 6.

Fig. 8 is a sectional view taken on the line 8—8 of Fig. 7.

Fig. 9 is an enlarged fragmentary top view looking in the direction of arrow 9—9 of Fig. 7.

Fig. 10 is a fragmentary sectional view taken substantially along line 10—10 of Fig. 6.

Fig. 11 is a sectional view taken on the line 11—11 of Fig. 8.

Fig. 12 is an enlarged fragmentary top view similar to Fig. 9, however it discloses the specific construction of the winding head and illustrates a certain cooperation between a sleeve providing device and anchoring means on the winding head.

Fig. 13 is a fragmentary sectional view taken on the line 13—13 of Fig. 12.

Fig. 14 is a fragmentary top view of the machine looking down on line 14—14 of Fig. 2.

Fig. 15 is a sectional view of the wire feeder actuating means and represents the continuation of the right-hand end of Fig. 14.

Figs. 16 and 17 are sectional views through the wire feeder showing the same under different operating conditions.

Figs. 18 and 19 are sectional views of the wire feeder those views being taken substantially along the lines 18—18 and 19—19, respectively of Fig. 14.

Fig. 20 is a horizontal sectional view of the coil severing mechanisms and is taken substantially one the line 20—20 of Fig. 2.

Fig. 21 is an enlarged fragmentary sectional view taken on the line 21—21 of Fig. 20.

Fig. 22 is a view similar to Fig. 21 showing, however, the coil severing mechanism in an operating position different from that shown in Fig. 21.

Fig. 23 is an enlarged sectional view taken substantially on the line 23—23 of Fig. 20.

Fig. 24 is an enlarged fragmentary sectional view taken on the line 24—24 of Fig. 20.

As best shown in Figs. 2 and 3, the machine comprises a winding head and form retaining member A, a wire shifter B, a wire feeding device C, a coil severing mechanism D, a sleeve providing device E and various controls, all of which are mounted on a table 30.

Winding head and form retaining member A

Referring more particularly to Figs. 6 to 8 inclusive, 11 and 12, there is shown a winding head 32 which as best shown in Fig. 13 is attached to a vertical shaft 34 by a plurality of screws 36. Shaft 34 is journaled in ball bearings 38, 40 and 42, all of which are located in the table 30. Downward thrust of shaft 34 is taken up by ball bearing 38 against which the head 44 of shaft 34 rests, and by a thrust bearing 46 against which a shoulder 48 of shaft 34 bears. Winding head 32 is provided with an annular recess 50 adapted to receive one of the two circular flanges 52 of a form 54. In order drivingly to connect a form 54 with the winding head, the latter is provided with a pin 56 which projects into recess 50 and

into a slot 58 of a flange 52 of a form. The central portion of winding head 32 is apertured so as to receive the crimped end of the yoke portion 60 of a form. Shaft 34 is provided with a gear 62 which is in mesh with another gear 64 carried by a shaft 66 which is parallel to shaft 34. Shaft 66 is journaled in a bushing 68 of a block 70 which is attached to table 30 in any suitable manner, and in a driving clutch member 72 which itself is journaled in ball bearings 74 and 76 provided by an internal extension 78 of table 30. Shaft 66 is axially slidable in its journaled bearings and is normally urged in the direction of arrow 80 as viewed in Fig. 8 by a compression spring 82 which surrounds shaft 66 and is interposed between a thrust bearing 84 resting on block 70 and the hub 86 of gear 64. One end of shaft 66 is formed into a driven clutch member 88 having a cone shaped external surface 90 which, upon axial movement of shaft 60 in a direction contrary to arrow 80 will frictionally and drivingly engage an internal cone shape surface 92 of the driving clutch member 72, attached by a key 94 to driving clutch member 72 and interposed between ball bearings 74 and 76 is a worm gear 96 which is in constant mesh with a worm 98 (see Fig. 6). Worm 98 is provided by a horizontal shaft 100 which is journaled in ball bearings 102 and 104 carried by the internal extension 78 of table 30. Ball bearings 102 and 104 are held in proper position by retainer plates 106 and 107 respectively. Shaft 100 is prevented from longitudinal movement by spacing collars 108 and 110 which are interposed between the worm 98 and ball bearings 102 and 104, respectively, one end of shaft 100 is keyed as at 112 to an axially aligned stub shaft 114 which is journaled in a ball bearing 116 located in a housing 118 which is attached to table 30 by screws 120. Longitudinal movement of stub shaft 114 is prevented by a collar 122 of said stub shaft which engages one end of ball bearing 116 and a nut 124 threadedly received by said stub shaft, and engaging the opposite end of said ball bearing. Longitudinal movement of ball bearing 116 is prevented by a retainer cap 126 which is threadedly received by housing 118 and retains said ball bearing in engagement with the end surface 128 of said housing. Stub shaft 114 is drivingly connected by any suitable means with a source of mechanical power such as a motor (not shown). It is therefore obvious from the foregoing that upon axial movement of the driven clutch member 88 into driving engagement with driving clutch member 72 the winding head 32 is rotated by means of stub shaft 114, shaft 100, worm and worm gear 98, 96, clutch members 72, 88, gears 64, 62, and shaft 34.

Referring more particularly to Figs. 4, 5 and 12, the winding head 32, is provided with a groove 33 which is intersected by a transverse groove 35 in the periphery of said winding head. Attached to the winding head in any suitable manner and located in said transverse groove 35 is a jaw 37 whose gripping surface is flush with a side wall 39 of groove 33. Opposite said jaw 37 and located in the same groove 35 is another jaw 41 which is pivotally mounted as at 43 to the winding head. Upon rotation of the winding head in clockwise direction as viewed in Fig. 12, a supply wire 45, which is located in groove 33 intermediate the jaws 37 and 41 and bent around the latter jaw, will pull the pivoted jaw 41 toward the other jaw whereby the supply wire is firmly clamped between both jaws. Emerging from adjacent the bottom of groove 33 the winding head 32 is provided with a tapered surface 47 which merges after a comparatively short angular distance into the top surface 49 of the winding head. It is evident that upon rotation of the winding head the wire 45 which is anchored between the jaws 37 and 41 is quickly shifted into the winding groove 51 of a properly located form 54 by said tapered surface 47.

As best shown in Figs. 6 and 7 a bracket 130 is mounted on table 30 in any suitable manner and provides guideways 132 for vertically guiding a plate 134 which is provided with a rack 136 permanently meshing with a gear 138 mounted on a horizontal shaft 140 which is rotatably supported by bracket 130. Shaft 140 is provided with a handle 142, which is within easy reach of an operator. Plate 134 is normally urged into uppermost position by a compression spring 144 which is interposed between table 30 and a lug 146 of plate 134 and surrounds a bar 148 which is carried by the table and projects through said lug 146. Vertically movable in guideways 150 provided by plate 134 is a member 152 carrying ball bearings 154 and 156 which journal a vertical stub shaft 158. Endwise movement of this stub shaft relative to member 152 is prevented by a collar 160 of said stub shaft and a nut 162 which is threaded over said stub shaft. Collar 160 and nut 162 maintain stub shaft 158 in proper position relative to ball bearings 154 and 156 and also the latter in proper position within member 152. The lower end 164 of stub shaft 158 is adapted to maintain a form 54 in proper driving position on head 32. Located in a rectangular groove 166 of plate 134 and attached by screws 168 thereto is a bar 170 having a projecting lug 172 through which slides an adjustable screw 174 which is threaded into member 152. Surrounding screw 174 and interposed between member 152 and lug 172 is a compression spring 176. It is obvious that upon rotation of handle 142 in a counter clockwise direction as viewed in Fig. 7 into the position shown in that figure, plate 134 and therewith member 152 is moved downwardly until the lower end 164 of stub shaft 158 engages a form 54 which is properly located on the head. In order to exert some pressure upon the form, handle 142 is rotated in the mentioned direction little further than necessary whereupon lug 172 compresses spring 176 whose compression is transmitted to member 152 and by the lower portion 164 of stub shaft 158 to the form on the winding head 32.

Wire shifter B

Referring more particularly to Figs. 6 and 7 there is shown a wire shifter 180 whose forked end 182 receives wire 45 during the winding of the coil. Wire shifter 180 is mounted in any suitable manner on a rod 184 which is guided for vertical movement by the internal extension 78 of the table 30. The lower end of rod 184 is provided with an anti-friction roller 186 which, by a compression spring 188 surrounding bar 184 and interposed between shoulders 190 and 192 of said internal extension 78 and said rod 184 respectively, is kept in constant engagement with the periphery of a cam disc 194 mounted on a horizontal shaft 196 which as best shown in Fig. 6 is journaled in bearing brackets 198 and 200 which are suspended from and integral with the internal table extension 78. Mounted on the same shaft 196 is a worm gear 202 which is in constant mesh with a worm 204 attached in any

suitable manner to the already described shaft 34. In order to prevent rotation of wire shifter 180, table 30 is provided with a pin 205 which projects through said wire shifter. It is obvious that upon rotation of the winding head the wire shifter is properly moved also by intermediation of worm and worm gear 204, 202, shaft 196, cam 194 and spring 188.

Wire feeding device C

Referring particularly to Figs. 3 and 14 to 19 inclusive, it is shown that one side wall 210 of bracket 130, a side wall 212 of the coil severing mechanism D and the table 30 form a groove 214 through which the wire 45 passes at all times. Since a coil is severed from the supply wire 45 by the coil severing mechanism to be described, it is natural that the severed end of the supply wire has to be fed forwardly from the coil severing mechanism into a position readily to be anchored to the jaws 37 and 41 of the winding head 32. In order to accomplish such feeding, a feeding block 216 is slidably mounted upon a tubular member 218, interposed between table 30 and a cross bar 220 which is attached to parallel bars 222 and 224 (see Fig. 2) which in turn are attached to the table 30 in any suitable manner. This feeding block 216 is connected with a piston rod 223 of a piston 225 by a pin 226 which extends through longitudinal diametrically opposite slots 228 in the tubular member 218. Piston 225 is slidably received within a cylinder 230 which is in axial alignment with tubular member 218 and interposed between the first mentioned cross bar 220 and another cross bar 232 which is also attached to the parallel bars 222 and 224. Fluid pressure from a suitable source (not shown) may be admitted to or discharged from either side of cylinder 230 through ducts 234 and 236, such admission or discharge of fluid pressure being controlled by means to be described later.

Pivoted at 238 to the feeding block 216 and located in a recess 240 thereof is a cam-like disc 242 having a nose 244 projecting into a notch 246 of a bar 248 which is slidable longitudinally in a recess 250 of said feeding block. This bar 248 is provided with two closely approximated notches 252 and 254, either one of which may receive the beveled end of a spring urged plunger 256 located in a recess 258 of feeding block 216. As best shown in Fig. 17, the cam-like disc 242 clamps the supply wire 45 to a surface 260 of the feeding block when the beveled end of plunger 256 projects into the beveled notch 254. When the beveled end of plunger 256 projects into the beveled notch 252, the cam-like disc 242 is clearly out of engagement with the supply wire and the same may freely pass the block surface 260 as is shown in Fig. 16. As best shown in Fig. 14, bar 222 is provided with a camming block 262 which in the position of feeding block 216 shown in Fig. 14 retains spring urged plunger 256 in the position shown in said Fig. 14 by means of a pin 264, carried by the plunger and engaging said camming block 262. Upon movement of the feeding block into the position shown in Fig. 14, an adjustable screw 266 threaded into a lug 268 of cross bar 220 stops bar 248 slightly before the feeding block reaches end position when striking against cross bar 220. The slight relative movement between feeding block 216 and bar 248 places the latter into a position in which notch 254 may receive spring urged plunger 256, however, plunger 256 is prevented from completely entering said notch by the camming block 262 and the cooperating pin 264. Upon movement of the feeding block toward the left as viewed in Fig. 14, pin 264 rides down the camming surface of block 262 whereupon the plunger by its spring tension compels notch 254 to shift into alignment with the beveled end of the plunger so that the same may completely enter said beveled notch, in which case the disc 242 clamps the wire 45 to the block surface 260. Bar 248 while being shifted by the plunger from the position shown in Fig. 14 to that shown in Fig. 17 rotates cam-like disc 242 into the position shown in the latter figure. Therefore, shortly after movement of the feeding block 216 from the position shown in Fig. 14 toward the left the supply wire 45 is automatically gripped and caused to follow the feeding block until bar 248 is stopped prior to the feeding block by an adjustable screw 270 which is received by an angle 272 mounted on bar 222. Movement of the feeding block toward the left as viewed in Fig. 14 is stopped by engagement of said feeding block with a cross bar 274. To make up for different diameters of wire used and for slight wear of wire clamping disc 242, the latter clamps wire 45 to the hardened end 276 of bolt 278 threaded into the feeding block and locked therein in properly adjusted position by a nut 280. In order to prevent premature shifting of the bar 248 from the position shown in Fig. 14 to that shown in Fig. 17 by its own momentum, a spring urged plunger 282 of any suitable braking material is located in a recess 284 of the feeding block and permanently frictionally engages bar 248. The various recesses in the feeding block containing various described means are covered by a plate 286 which is secured to the feeding block in any suitable manner.

Coil severing mechanism D

Referring particularly to Figs. 3, 14, and 20 to 24 inclusive, a bracket 290 suitably mounted on table 30 rotatably supports a stub shaft 292 whose one end terminates into an enlarged head 294 having an annular recess 296 in which telescopes the enlarged head 298 of an axially aligned stub shaft 300. Endwise movement of stub shaft 292 is prevented by a ratchet disc 302, a notched wheel 304 and a nut 306 threadedly received by stub shaft 292 which maintain the enlarged head 294 of said stub shaft within a recess 308 of bracket 290. Stub shaft 300 is non-rotatable but longitudinally adjustable by means of a screw 310 received by the base of bracket 130 and projecting into a longitudinal groove 312 of stub shaft 300. The enlarged head 294 is provided with a plurality of equally spaced radial notches 314 which provide cutting edges 316. Each pair of diametrically opposite grooves 314 is adapted to align once with a diametrical groove 318 of enlarged head 300. Groove 318 terminates into a cutting edge 320 which, upon rotation of head 294 in the direction of arrow 322 (see Fig. 22), cooperates with an approaching cutting edge 316 of head 294 thereby severing the wire 45 which at all times passes through groove 318 which traverses the previously described groove 214. It will be noticed from Fig. 20 that the axes of stub shafts 292 and 300 are so inclined with respect to groove 214 that only one groove 314 of head 294 simultaneously aligns with the groove 318 of head 298 and projects into groove 214, whereby among all cutting edges 316 only the one which projects into groove 214 has access to the wire and may cooperate

with the cutting edge 320 of groove 318 in head 298 upon rotation of head 294 in the proper direction. Ratchet disc 302 which has the same number of teeth 324 as there are radial grooves 314 is indexed by a dog 326 which is pivotally mounted at 328 to a bar 330 slidable longitudinally in a guide bracket 332 which is suitably mounted on table 30. Bar 330 is attached to the feeding block 216. Dog 326 which is located in a recess 334 of bar 330 is normally urged in a counter clockwise direction as viewed in Fig. 24 by a compression spring 336 located in recess 338 of bar 330. Upon movement of the feeding block toward the left as viewed in Fig. 14 bar 330 moves in unison with the feeding block and dog 326 indexes ratchet disc 302 whereby a wire severing operation takes place as will be understood from the foregoing. In order to prevent free rotation of stub shaft 292 and especially when dog 326 rides idly underneath ratchet disc 302 while the feeding block is retracting, a spring urged plunger 340 registers with one of a plurality of equally spaced notches 342 in the periphery of wheel 304. Again the number of notches 342 is the same as the number of teeth of ratchet disc 302 or the number of grooves 314 of head 294. Plunger 340 is located in a bracket 344 which is attached by screws 346 to table 30.

Sleeve providing device E

Referring particularly to Figs. 3, 12 and 14, a cone-shaped hollow member or funnel 350 is secured by screws 352 to a horizontal plate 354 which is attached in any suitable manner to guide bracket 332. This cone-shaped member is open at one side toward the head so that a wire passing through said member may be shifted therefrom and be inserted into the wire receiving groove 33 of head 32. A sleeve 356 of any suitable insulating material which is to be received by the leading end of each coil is passed over the cone-shaped member 350, whereby the sleeve is in proper location relative to groove 214 through which wire 45 passes. In order to direct the severed end of wire 45 in a direction centrally of a sleeve 356 which is located on member 350, a cam-like lug 358 projects into groove 314. The advancing end of the supply wire 45 will strike said cam-like lug 358 and thereby be directed in the just described direction.

Various controls of the machine

Referring especially to Figs. 3, 8 and 12, there is shown a disc 360 located in an annular recess 362 of table 30 and secured therein by screws 364. This disc is provided with a central aperture 366, receiving the shank 368 of a plunger 370 which rests against a thrust bearing 372 surrounding an extension 374 of driven clutch member 88. Disc 360 is also provided with a diametrical groove 376 which receives a bar 378 pivotally mounted at 380 to disc 360. This bar 378 at all times rests against plunger 370, which in disengaged position of clutch member 88 is considerably raised above disc 360. Carried by vertically slidable plate 134 is a bolt 382 which upon downward movement of said plate depresses bar 378 thereby also depressing clutch member 88 into driving engagement with clutch member 72, by intermediation of plunger 370 and thrust bearing 372. The tendency of compression spring 82 to disengage clutch member 88 from clutch member 72 would necessitate a manual holding of plate 134 in lowermost position during a winding operation as can be readily understood. In order to avoid such prolonged holding of plate 144 in lowermost position a latch member 384 is pivotally mounted at 386 to bracket 130. Plate 134 is provided with a projecting lug 388 which in lowermost position of plate 134 is engaged by a shoulder 390 of latch member 384, which is normally urged in counter-clockwise direction as viewed in Fig. 7 by a compression spring 392 located in a recess 394 of table 30 and resting against said latch member. As best shown in Fig. 10 a cam-disc 396 is mounted on cam shaft 196. A rod 398 whose lower end is provided with an anti-friction roller 400 is guided for vertical longitudinal movement within internal extension 78 of table 30. Roller 400 is normally urged into engagement with cam disc 396 by a compression spring 402 surrounding rod 398 and being interposed between an annular shoulder 404 of said internal extension 78 and a shoulder 406 of rod 398. The uppermost end of rod 398 bears against latch member 384. As long as roller 400 rides over the concentric portion of cam disc 396, latch member 384 is free to latch blade 134 in lowermost position. During one revolution of cam disc 396 a raised lobe 408 thereof moves rod 398 against the tendency of spring 402 whereby said rod rocks latch member 384 out of latching position against the tendency of spring 392. A key and slot connection 410 prevents rotation of rod 398. It appears from the foregoing that upon manipulation of handle 142 in a direction to lower plate 134, bolt 382 causes engagement of the clutch members 88 and 72 by means of bar 378, plunger 370 and thrust bearing 372. When plate 134 reaches lowermost position, the same is latched in such position by self-latching member 384 whereby the clutch members remain engaged although handle 142 is released. After the completed winding of a coil, i. e. after one complete revolution of shaft 196 which carries the wire shifter actuating cam 194 and the cam 396, the lobe 408 of the latter cam will pass roller 400 and thereby cause movement of member 384 out of latching position whereby plate 134 and the parts carried thereby are immediately moved into uppermost position by compression spring 144 (see Fig. 6).

Plate 134 carries another horizontal cross bar 420 to which is attached in any suitable manner the stem 422 of a sliding valve 424 which is received by a valve body 426 mounted in any suitable manner to bracket 130. Three conduits 428, 430 and 432 (see Fig. 7) lead to the valve receiving bore 434 in said valve body. Conduit 428 provides communication between a suitable source of fluid pressure (not shown) and the bore 434. Conduits 430 and 432 connect bore 434 with the right-hand side and left-hand side respectively of cylinder 230, as viewed in Figs. 7 and 15. During downward movement of plate 134 valve 424 is shifted into the position shown in Fig. 7 whereby fluid pressure is admitted through conduit 428, bore 434 and conduit 432 to the left-hand side of cylinder 230 whereby piston 225 and thereby feeding block 216 is moved into the position shown in Fig. 14. During movement of plate 134 from the position shown in Fig. 7 to uppermost position, valve 424 is moved into a position in which fluid pressure is admitted through conduit 428, bore 434 and conduit 430 to the right-hand side of cylinder 230, and the fluid pressure in the left-hand side of said cylinder will be discharged through conduit 432 and bore 434 into the atmosphere. Likewise, upon admission of fluid pressure to the left-hand side of

cylinder 230, the fluid pressure in the right-hand side thereof will be discharged through conduit 430 and bore 434 into the atmosphere.

The supply wire 45 which is unreeled from a supply spool (not shown) is guided over a guide roll 440 (see Fig. 2) and from there over any conventional wire tensioning device 442 which is mounted together with guide roll 440 on a bracket 444 which itself is mounted on bar 224. After the wire leaves the wire tensioning device 442 it passes over a roll 446 which leads the wire into proper alignment with the feeding device C. Attached to the table 30 and within easy reach of an operator is a container 450 containing a supply of sleeves 356.

Mode of operation

Before starting the machine into operation, the operator strips a sleeve 356 from the cone shaped member 350 and then moves the wire which extends through the opening in said cone shaped member. Subsequently the operator inserts the wire end which extends beyond the sleeve into the groove 33 of head 32 and bends the foremost end of said wire around the edge 455 of jaw 41. The sleeve 356 is located in the manner disclosed in Fig. 4. Next the operator will properly locate a form 54 in recess 50 of head 32. The machine is now ready for operation and upon rocking of handle 142 into the position shown in Fig. 3, plate 134 is moved downwardly and the clutch members 88, 72 are engaged whereupon the head rotates and the wire shifter reciprocates. During the cycle of rotation of the winding head which is determined by the angular extent of tapered head surface 47, the wire is quickly shifted into alignment with the lowermost portion of the form 54. The first reciprocation of wire shifter B at the beginning of an operation takes place in the direction of arrow 460 (see Fig. 3). As will be understood from the contour of wire shifter actuating cam 194, the wire shifter reciprocates only within the limits of form 54. The cooperation between tapered head surface 47 and the operation of wire shifter B is obvious, the tapered head surface 47 quickly shifting the wire into alignment with the lowermost portion of a form upon rotation of the head and the wire shifter B taking care of the proper location of the individual turns of the coil to be wound upon the form. Simultaneously with the downward movement of plate 134 valve 424 is actuated so as to provide communication between the supply of fluid pressure and the left-hand side of cylinder 230 whereby the wire feeding device C is moved while being inoperative into the position shown in Fig. 14. When the plate 134 reaches lowermost position the same is latched in such position by member 384 until after one complete revolution of cam shaft 196 (i. e. after the required number of turns have been deposited on the form 54) the lobe 408 of cam disc 396 causes member 384 to release plate 134 which is then moved into uppermost position by compression spring 144. Upward movement of plate 134 also results in disengagement of the clutch members 88, 72 as has been earlier explained. Head 32 which, after disengagement of the clutch members keeps on rotating due to its own momentum, is stopped upon engagement of a shoulder 379 of said head with a pin 381 of bar 378 which only in disengaged position of the clutch projects into the path of movement of said shoulder 379. Therefore, the head is stopped always in the same angular position. The upwardly moving plate 134 also shifts valve 424 into uppermost position, in which fluid pressure is admitted to the right-hand side of cylinder 230 through conduit 428, bore 434 and conduit 430, whereby the feeding device C is advanced into the position shown in Fig. 2. Before the wire is actually gripped by said advancing feeding device, i. e. as long as pin 264 rides over camming block 262, dog 326 indexes ratchet disc 302 thereby performing a wire severing operation. As will be seen from Figs. 21 and 22, the severed end 45*a* of a wound coil is shifted out of the path of subsequent movement of the leading severed end 45*b* of the supply wire by the enlarged head 294. At the time the feeding device actually grips the wire, the groove 314*a* is in alignment with groove 318 so that the supply wire may freely pass through these grooves toward the cam lug 358 which directs the wire into a sleeve 356 on the cone shaped member 350. Therefore, at the end of a winding operation the supply wire is automatically fed through a sleeve which is part of the next to be wound coil. The operator then removes the form on which a coil has just been wound from the head 32, anchors the leading end of the supply wire in the earlier explained manner, inserts a new form 54 into the head and starts the machine into operation for another winding performance by rocking handle 142 into the position shown in Fig. 3. During a winding operation the operator passes a new sleeve 356 over the cone shaped member 350 ready to receive the leading end of the supply wire which is to be severed from the coil being wound.

While the form of embodiment of the present invention as herein disclosed, constitutes a preferred form, it is to be understood that other forms might be adopted, all coming within the scope of the claims which follow.

What is claimed is as follows:

1. In a coil winding machine, the combination of a rotatable head for drivingly supporting a form; a rotatable member movable axially toward or away from a form for retaining the latter on the head; a reciprocable wire feeder, said feeder being operative only during movement toward the head; power means for moving the wire feeder away from the head; and a controller operated in response to movement of the form retaining member into retaining position for causing the power means to move the feeder away from the head.

2. In a coil winding machine, the combination of a rotatable head for drivingly supporting a form; a rotatable member movable axially toward or away from a form for retaining the latter on the head; a reciprocable wire feeder, said feeder being operative only during movement toward the head; power means for moving the wire feeder away from the head; a controller operated in response to movement of the form retaining member into retaining position for causing the power means to move the feeder away from the head; and means responsive to movement of the feeder toward the head for severing a wound coil from the supply wire.

3. In a coil winding machine, the combination of a rotatable head for drivingly supporting a form; a rotatable member movable axially toward or away from a form for retaining the latter on the head; a reciprocable wire feeder; said feeder being operative only during movement toward the head; power means for moving the wire feeder toward the head; and a controller

operated in response to movement of the form retaining member out of retaining position for causing the power means to move the feeder toward the head.

4. In a coil winding machine, the combination of a rotatable head for drivingly supporting a form; a rotatable member movable axially toward or away from a form for retaining the latter on the head; a reciprocable wire feeder, said feeder being operative only during movement toward the head; power means for moving the wire feeder toward the head, a controller operated in response to movement of the form retaining member out of retaining position for causing the power means to move the feeder toward the head; and means responsive to movement of the feeder toward the head for severing a wound coil from the supply wire.

5. In a coil winding machine, the combination of a rotatable head for drivingly supporting a form; a rotatable member movable axially toward or away from a form for retaining the latter on the head; a reciprocable wire feeder, said feeder being operative only during movement toward the head; power means for moving the wire feeder in either direction; and a controller operated in response to movement of the form retaining member out of retaining position for causing the power means to move the feeder toward the head, and operated in response to movement of the form retaining member into retaining position for causing the power means to move the feeder away from the head.

6. In a coil winding machine, a rotatable head for drivingly supporting a form; a rotatable member movable axially toward or away from a form for retaining the latter on the head; means carried by the head for anchoring the leading end of a supply wire thereto; means provided by the head for shifting the supply wire from the anchored position into alignment with the form upon rotation of the head through a predetermined cycle; reciprocable means for properly guiding the individual turns of a coil upon the form; reciprocable means for feeding the leading end of the supply wire adjacent the anchoring means; and means responsive to reciprocation of the feeding means for severing a wound coil from the supply wire.

7. In a coil winding machine, the combination of a rotatable head for drivingly supporting a form; a rotatable member movable axially toward or away from a form for retaining the latter on the head; a reciprocable wire feeder, said feeder being operative only during movement toward the head; power means for moving the wire feeder in either direction; a controller operated in response to movement of the form retaining member out of retaining position for causing the power means to move the feeder toward the head, and operated in response to movement of the form retaining member into retaining position for causing the power means to move the feeder away from the head; and means actuated in response to movement of the feeder toward the head for severing a wound coil from the supply wire.

8. In a coil winding machine, the combination of a rotatable head for drivingly supporting a form; power means for rotating the head; a normally disengaged clutch for drivingly connecting the power means with the head; a movable clutch actuator; a rotatable member movable axially toward or away from a form for retaining the latter on the head; and means carried by the form retaining member for engaging and moving the clutch actuator into clutch engaging position upon movement of said member into form retaining position.

9. In a coil winding machine, the combination of a rotatable head for drivingly supporting a form; power means for rotating the head; a normally disengaged clutch for drivingly connecting the power means with the head; a movable clutch actuator; a rotatable member movable axially toward or away from a form for retaining the latter on the head, said member being normally urged out of retaining position; means automatically latching the retaining member in retaining position; means for releasing the latching means; and means carried by the retaining member for engaging and moving the clutch actuator into clutch engaging position upon movement of said member into retaining position.

10. In a coil winding machine, the combination of a rotatable head for drivingly supporting a form; power means for rotating the head; a normally disengaged clutch for drivingly connecting the power means with the head; a movable clutch actuator; a rotatable member movable axially toward or away from a form for retaining the latter on the head, said member being normally urged out of retaining position; means carried by the retaining member for engaging and moving the clutch actuator into clutch engaging position upon movement of said member into retaining position; means for guiding a wire upon the form, said means being reciprocated in timed relation with the rotation of the head; means automatically latching the retaining member in retaining position; and means operating in timed relation with the rotation of the head for releasing the latching means from the form retaining member.

11. A coil winding machine comprising, in combination, a rotatable head for drivingly supporting a form; power means for rotating the head; a normally disengaged clutch for drivingly connecting the power means with the head; a rotatable member movable axially toward or away from a form for retaining the latter on the head, said member being normally urged out of retaining position; means carried by the form retaining member for engaging the clutch upon movement of said retaining member into retaining position and for maintaining the clutch engaged while in such retaining position; a reciprocable wire feeder, said feeder being operative only during movement toward the head; means for severing a wound coil from the supply wire; other power means for moving the feeder in either direction; a controller operated in response to movement of the form retaining member out of retaining position for causing said other power means to move the feeder toward the head and operated in response to movement of the retaining member into retaining position for causing said other power means to move the feeder away from the head; means automatically latching the retaining member in retaining position; and means for releasing the latching means from the form retaining member in retaining position.

12. A coil winding machine comprising, in combination, a rotatable head for drivingly supporting a form; power means for rotating the head; a normally disengaged clutch for drivingly connecting the power means with the head; a rotatable member movable axially toward or away from a form for retaining the latter on the head, said member being normally urged out

of retaining position; means carried by the form retaining member for engaging the clutch upon movement of said retaining member into retaining position and for maintaining the clutch engaged while in such retaining position; a reciprocable wire feeder, said feeder being operative only during movement toward the head; means for severing a wound coil from the supply wire; other power means for moving the feeder in either direction; a controller operated in response to movement of the form retaining member out of retaining position for causing said other power means to move the feeder toward the head, and operated in response to movement of the retaining member into retaining position for causing said other power means to move the feeder away from the head; means for shifting the wire into the form, said means being reciprocated in timed relation with the rotation of the head; means automatically latching the retaining member in retaining position; and means automatically releasing the latching means from the form retaining member in retaining position after a predetermined number of reciprocations of the wire shifting means.

13. A coil winding machine comprising, in combination, a rotatable head for drivingly supporting a form; power means for rotating the head; a normally disengaged clutch for drivingly connecting the power means with the head; a rotatable member movable axially toward or away from a form for retaining the latter on the head, said member being normally urged out of retaining position; means carried by the form retaining member for engaging the clutch upon movement of said retaining member into retaining position and for maintaining the clutch engaged while in such retaining position; a reciprocable wire feeder, said feeder being operative only during movement toward the head; means actuated in response to movement of the feeder toward the head for severing a wound coil from the supply wire; other power means for moving the feeder in either direction; a controller operated in response to movement of the form retaining member out of retaining position for causing said other power means to move the feeder toward the head, and operated in response to movement of the retaining member into retaining position for causing said other power means to move the feeder away from the head; means for shifting the wire into the form, said means being reciprocated in timed relation with the rotation of the head; means automatically latching the retaining member in retaining position; and means automatically releasing the latching means from the form retaining member in form retaining position after a predetermined number of reciprocations of the wire shifting means.

14. In a coil winding machine, the combination of a rotatable head for drivingly supporting a form, said head having a shoulder and a groove in which the leading end of the supply wire is located; means carried by the head for anchoring the leading end of the supply wire in said groove; a rotatable member movable axially toward or away from a form for retaining the latter on the head; power means for rotating the head; a normally disengaged clutch, one member of which is bodily movable into or out of driving engagement with the other member; a clutch actuator movable with the bodily movable clutch member; means carried by the retaining member for moving the clutch actuator into clutch engaging position upon movement of said retaining member into retaining position and for maintaining the clutch actuator in clutch engaging position while the retaining member is in retaining position; and a shoulder on the clutch actuator, said shoulder upon movement of said clutch actuator into clutch disengaged position projecting into the path of movement of the shoulder on the head, thereby stopping rotation of the latter in a predetermined angular position.

15. In a coil winding machine, the combination of a rotatable head for drivingly supporting a form, said head including means for anchoring the leading end of a supply wire thereto, and a portion for guiding the anchored wire into alignment with a form on the head upon rotation of the latter through a predetermined cycle; a reciprocable wire shifter for properly shifting the aligned wire into the form; and means actuated in timed relation with the rotation of the head for reciprocating the wire shifter.

16. In a coil winding machine, the combination of a rotatable head for drivingly supporting a form; a rotatable member movable axially toward or away from a form for retaining the latter on the head; a reciprocable wire shifter; means operated in timed relation with the rotation of the head for reciprocating the wire shifter; a reciprocable wire feeder, said feeder being operative only during movement toward the head; power means for moving the feeder away from the head; and a controller operated in response to movement of the form retaining member into retaining position for causing the power means to move the feeder away from the head.

17. In a coil winding machine, the combination of a rotatable head for drivingly supporting a form; a rotatable member movable axially toward or away from a form for retaining the latter on the head; a reciprocable wire shifter for properly shifting a supply wire into the form; means actuated in timed relation with the rotation of the head for reciprocating the wire shifter; a reciprocable wire feeder, said feeder being operative only during movement toward the head; power means for moving the feeder toward the head; and a controller operated in response to movement of the form retaining member out of retaining position for causing the power means to move the feeder toward the head.

18. In a coil winding machine, the combination of a rotatable head for drivingly supporting a form; a rotatable member movable axially toward or away from a form for retaining the latter on the head; a reciprocable wire shifter for properly shifting a supply wire into the form; means actuated in timed relation with the rotation of the head for reciprocating the wire shifter; a reciprocable wire feeder, said feeder being operative only during movement toward the head; power means for moving the wire feeder in either direction; and a controller operated in response to movement of the form retaining member out of retaining position for causing the power means to move the feeder toward the head, and operated in response to movement of the form retaining member into retaining position for causing the power means to move the feeder away from the head.

19. In a coil winding machine, the combination of a rotatable head for drivingly supporting a form, said head having a shoulder; power means for rotating the head; a normally disengaged clutch for drivingly connecting the

power means with the head, said clutch including a movable clutch actuator which in disengaged position of the clutch engages the shoulder of the head to prevent rotation of the latter in a certain direction; and a rotatable member movable axially toward or away from a form for retaining the latter on the head, said member including means for moving the clutch actuator out of engagement with the shoulder of the head and into clutch engaging position when said member is moved into retaining position.

20. In a coil winding machine, the combination of a rotatable head for drivingly supporting a form on which a coil is to be wound; and a jaw to which a supply wire is hooked, said jaw being pivoted on the head and clamping said supply wire thereto upon the tensioning of the latter.

21. In a coil winding machine, a rotatable head for drivingly supporting a form; and a jaw to which a supply wire is hooked, said jaw being pivoted on the head and cooperating therewith for clamping said supply wire thereto upon the tensioning of the latter, and said head being provided with a notch leading the anchored wire into alignment with a form on the head upon rotation of the latter.

22. In a coil winding machine, a rotatable head for drivingly supporting a form; a jaw to which a supply wire is hooked, said jaw being pivoted on the head and cooperating therewith for clamping said supply wire thereto upon the tensioning of the latter, and said head being provided with a notch leading the anchored supply wire into alignment with a form on the head upon rotation of the latter; and reciprocable means for properly guiding the individual turns of a coil upon the form.

23. In a coil winding machine, the combination of a rotatable winding head; means adjacent the head for removably supporting a sleeve; means for feeding a supply wire toward the head; and means for directing the wire while being fed into the supported sleeve.

24. In a coil winding machine, the combination of a rotatable winding head; a longitudinally split funnel adjacent the head and adapted to support a sleeve; means for feeding a supply wire toward the head; and means directing the wire while being fed into the supported sleeve, the wire and embracing sleeve being removed from the funnel by stripping the sleeve therefrom and laterally shifting the wire through the split thereof.

25. In a coil winding machine, the combination of a rotatable winding head; means adjacent the head for removably supporting a sleeve; means for feeding a supply wire toward the head; and a cam engaged by the leading end of the fed wire which is thereby directed into the supported sleeve.

26. In a coil winding machine, the combination of a rotatable head for drivingly supporting a winding form; means adjacent the head for removably supporting a sleeve; means for feeding wire from a supply toward the head; means directing the wire while being fed into the supported sleeve; and means located between the wire supply and the wire directing means for severing a wound coil from the supply wire.

27. In a coil winding machine, the combination of a rotatable head for drivingly supporting a winding form; means adjacent the head for removably supporting a sleeve; means for feeding wire from a supply toward the head; means directing the wire while being fed into the supported sleeve; and means responsive to operation of the feeding means and located between the wire supply and the wire directing means for severing a wound coil from the supply wire.

28. In a coil winding machine, the combination of a rotatable head for drivingly supporting a form; a rotatable member movable axially toward or away from a form for retaining the latter on the head; a wire feeder; power means for operating the feeder; and a controller operated in response to movement of the form retaining member out of retaining position for causing the power means to operate the feeder.

29. In a coil winding machine, the combination of a rotatable winding head; a reciprocable wire feeder operable only during partial movement toward the head; and means operative in response to another partial movement of the feeder toward the head for severing a wound coil from the wire.

30. In a coil winding machine, the combination of a rotatable winding head; a straight track through which a supply wire is guided to the head; a wire cutting device including a stationary shearing edge in the track and a rotary member having a plurality of equi-angularly spaced shearing edges adapted to cooperate with the stationary shearing edge, the axis of rotation of said member being inclined with respect to the track so that only that shearing edge of the member which presently cooperates with the stationary shearing edge may contact the wire; a ratchet carried by the member; and a linearly movable pawl cooperating with the ratchet for rotating the member so as to bring consecutive shearing edges of the member into cooperation with the stationary shearing edges.

31. In a coil winding machine, the combination of a rotatable winding head; a straight track through which a supply wire is guided to the head; a reciprocable wire feeder; a wire cutting device including a stationary shearing edge in the track and a rotary member having a plurality of equi-angularly spaced shearing edges adapted to cooperate with the stationary shearing edge, the axis of rotation of said member being inclined with respect to the track so that only that shearing edge of the member which presently cooperates with the stationary shearing edge may contact the wire; a ratchet carried by the member; and a pawl movable with the feeder and cooperating with the ratchet to turn the member so as to bring consecutive shearing edges of the member into cooperation with the stationary shearing edge.

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