Dec. 6, 1932. H. H. EATON 1,890,111

AUTOMATIC ARMATURE WINDING MACHINE

Filed March 10, 1925 6 Sheets-Sheet 1

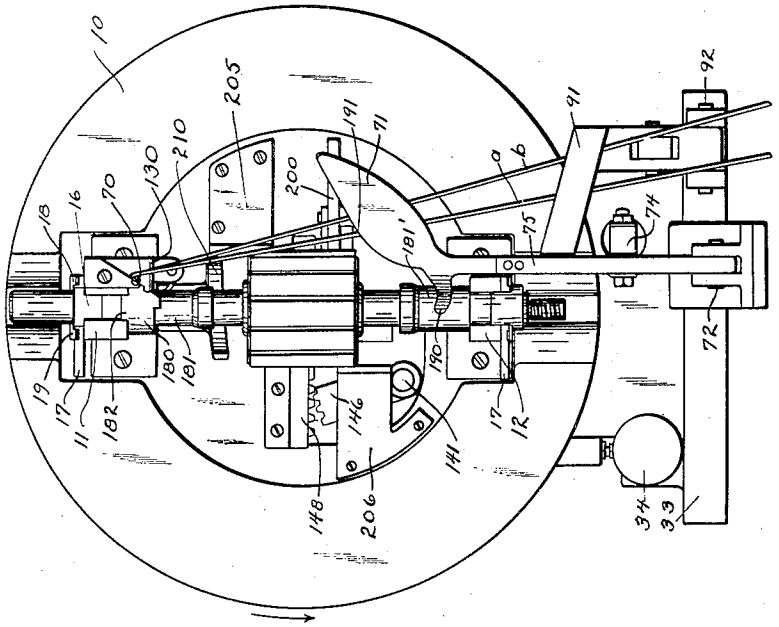


Fig. I.

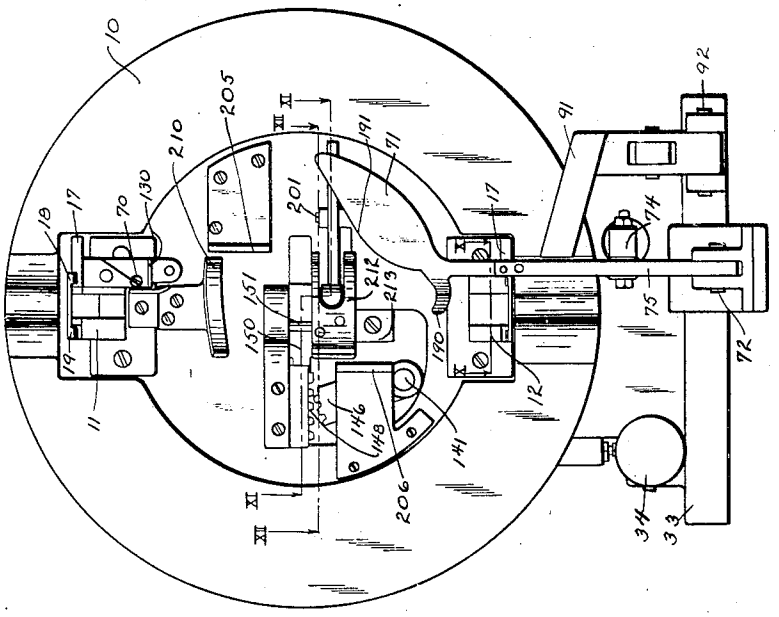


Fig. II.

INVENTOR.
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Dec. 6, 1932. H. H. EATON 1,890,111

AUTOMATIC ARMATURE WINDING MACHINE

Filed March 10, 1925 6 Sheets-Sheet 2

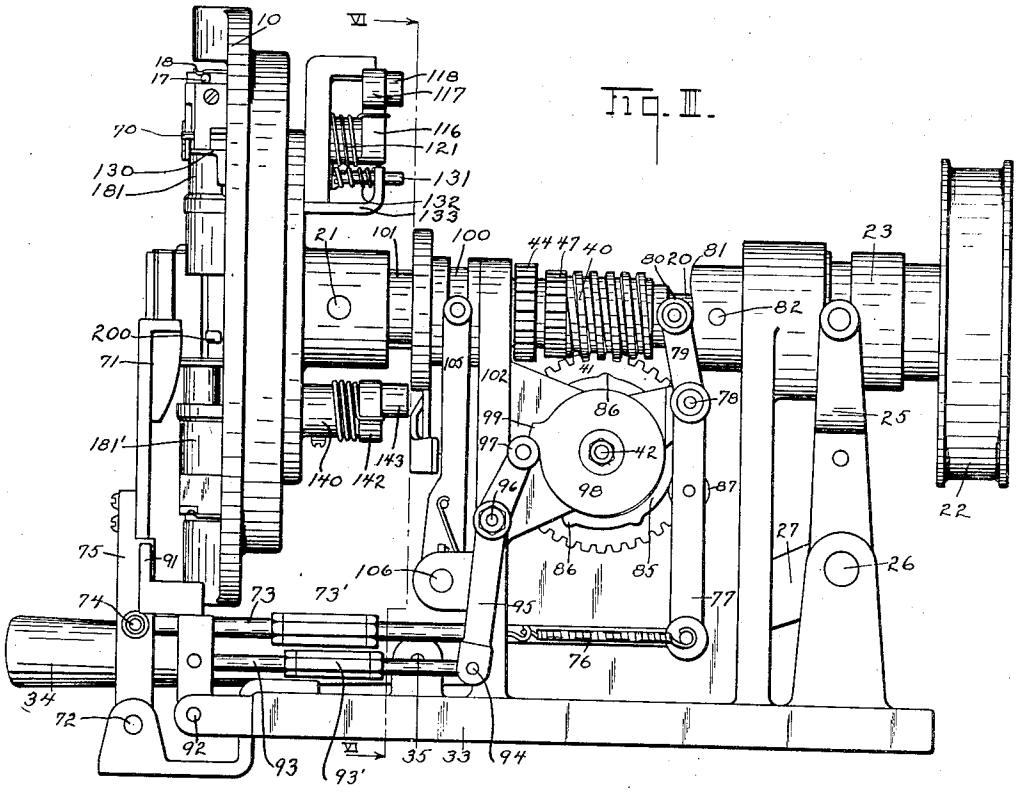


Fig. III.

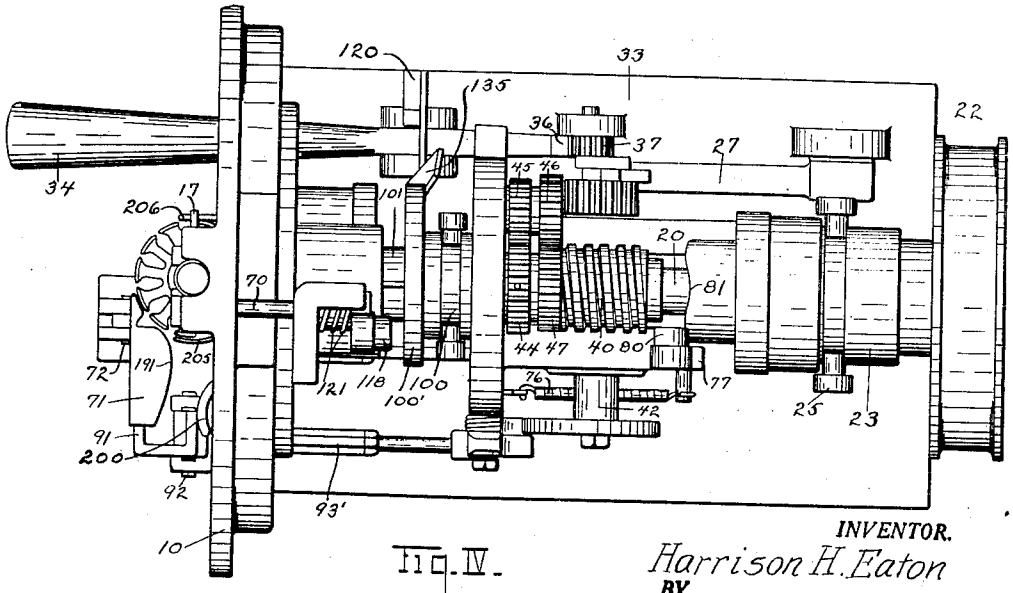


Fig. IV.

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Dec. 6, 1932. H. H. EATON 1,890,111

AUTOMATIC ARMATURE WINDING MACHINE

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Fig. V.

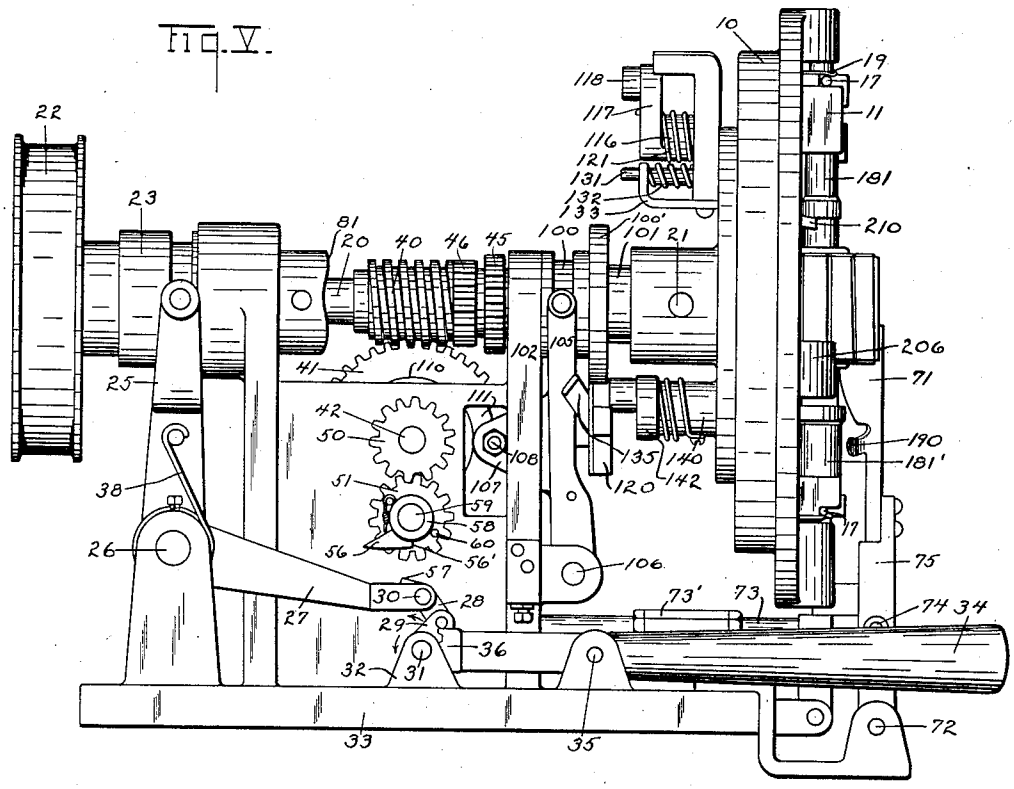
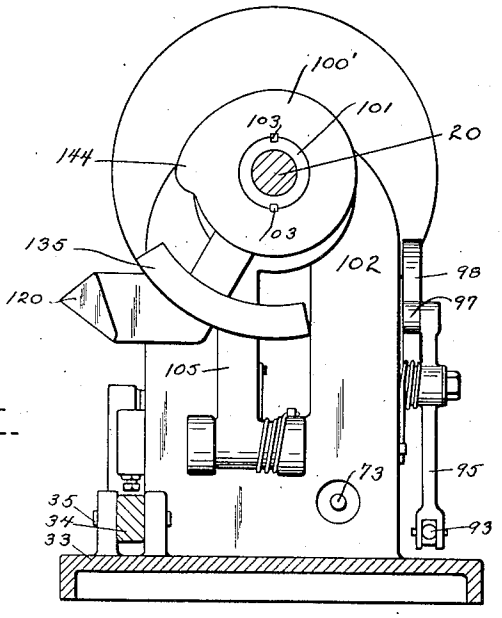


Fig. VI.



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Dec. 6, 1932. H. H. EATON 1,890,111

AUTOMATIC ARMATURE WINDING MACHINE

Filed March 10, 1925 6 Sheets-Sheet 4

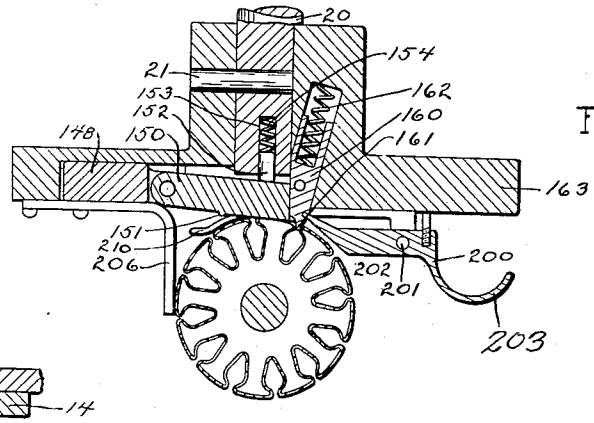


Fig. XI.

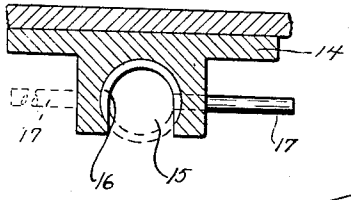


Fig. X.



Fig. XA.

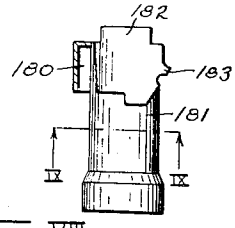


Fig. VIII.

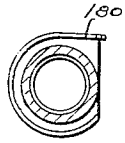


Fig. IX.

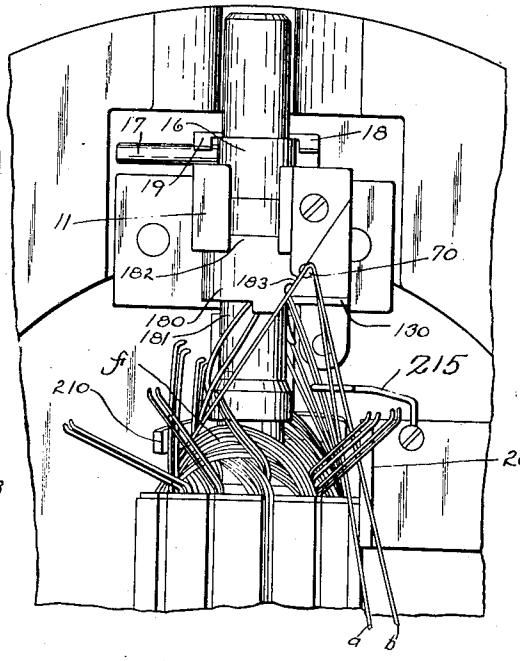


Fig. VII.

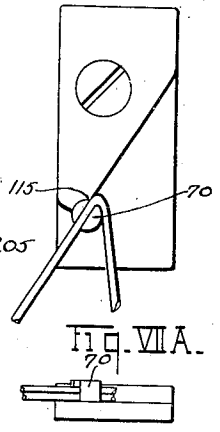


Fig. VII A.

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Dec. 6, 1932. H. H. EATON 1,890,111

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Fig. XII.

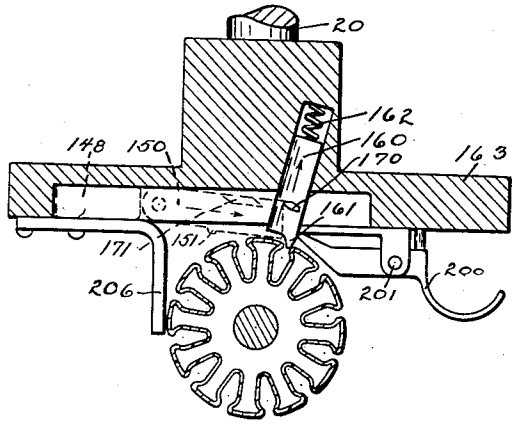
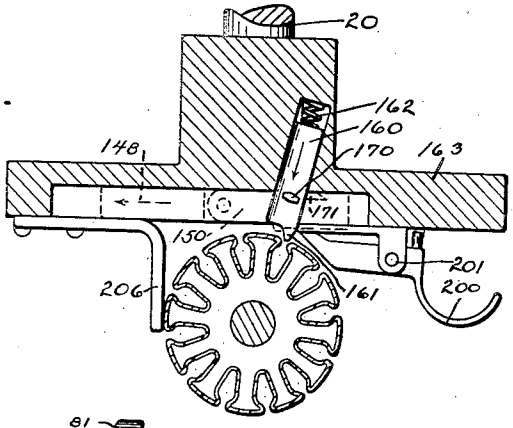


Fig. XIII.



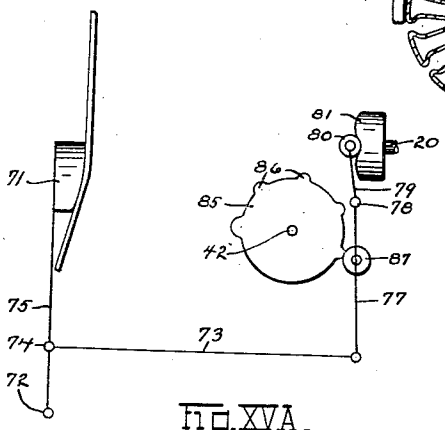


Fig. XVA.

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Dec. 6, 1932. H. H. EATON 1,890,111

AUTOMATIC ARMATURE WINDING MACHINE

Filed March 10, 1925 6 Sheets-Sheet 6

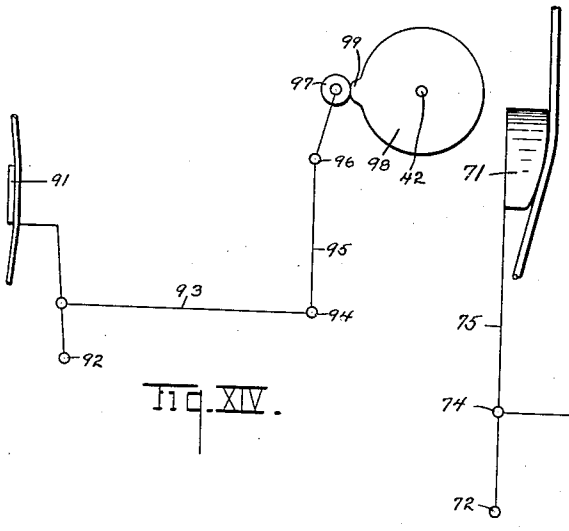


Fig. XIV.

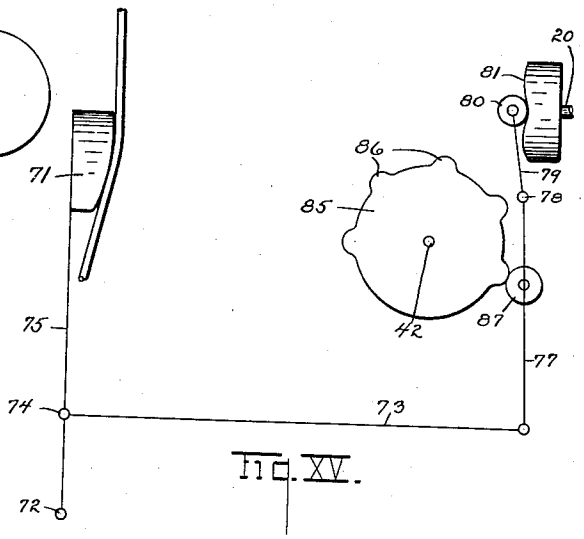


Fig. XV.

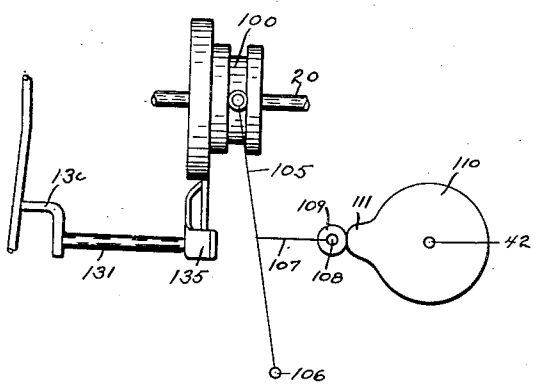


Fig. XVI.

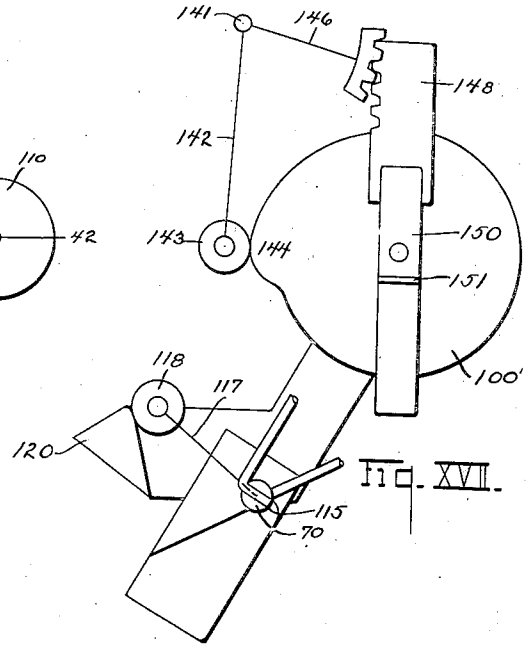


Fig. XVII.

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Patented Dec. 6, 1932 1,890,111

UNITED STATES PATENT OFFICE

HARRISON H. EATON, OF TOLEDO, OHIO, ASSIGNOR TO THE ELECTRIC AUTO-LITE COMPANY, OF TOLEDO, OHIO, A CORPORATION OF OHIO

AUTOMATIC ARMATURE WINDING MACHINE

Application filed March 10, 1925. Serial No. 14,367.

The present invention relates to a machine for automatically winding a plurality of coils of wire in slots,—for example in the slots of an armature of a dynamo-electric machine.

One of the features of the present invention is to provide a machine which will lay the wires in the slots to such a degree of nicety as will require no packing by hand in building up the number of turns for the coils in the slots, either during the winding or after the required number of turns per coil have been laid or after one coil is laid and it is proposed to lay another coil, or series of wires in the same slot. In this connection, the invention, therefore, comprehends means for controlling and locating the wire in the slots in such a manner as will avoid the necessity of any packing. The invention also includes, in this connection, means for so positioning, laying or applying the wires at the end of the armature that the wires at the ends of the coils will be firmly and properly located, not only for each coil, but for each of the several successive turns of wire used in building up any one coil.

A further underlying feature of the present invention is to provide a machine of the general character indicated which operates to automatically wind armatures in such a manner as to provide for a substantial saving of material. For example, the entire armature may be wound from the continuous source of wire, the armature consisting of a plurality of separate coils, the present invention contemplating such an arrangement of structure as will cut off a coil wound from the reel of wire with the free end so held as to be ready for the winding of the next coil in the armature without any waste of material. The invention also contemplates a great time saving mechanism because the hand looping at end of each coil is eliminated.

The present invention has for a further object to provide a mechanism in a class of machine of the character indicated in which the beginning and ends of a coil—and each successive coil—is so left that an operator in assembling the coils to the commutator, can easily pick out the beginning and ends of the coil. The immense practical value of this feature, in addition to those heretofore indicated, will be obvious.

The present invention also includes the provision of a mechanism which automatically indexes the armature to bring the proper slots into position in line with the wire as the same is being laid as hereinbefore indicated. The present invention, moreover, provides for a particular cooperation between the indexing of the armature and the coil winding and wire laying mechanism.

A further object of the present invention is to provide a mechanism which is extremely safe in operation avoiding the possibility of the armature becoming loose in any way or accidentally thrown out of the machine in operation.

Further objects are within the scope of this invention such as relate to the arrangement of the related elements or the structure, to various details of construction and to economies of manufacture and numerous other features as will be apparent from a consideration of the drawings and related description of a form of the invention, which may be preferred, in which,

Figure 1 is a front elevation showing an armature core just after location in the machine with the parts ready to start winding, the same shown in this instance in a vertical position;

Figure 2 is a similar view with the armature removed;

Figure 3 is an elevation of the right side of the machine;

Figure 4 is a top plan view of the machine;

Figure 5 is an elevation of the left side of the machine;

Figure 6 is a section taken on the line 6—6 of Figure 3;

Figure 7 is a front view of a portion of the machine showing the arrangement of the wire during operation, the position of the leads and how the successive turns of the coils as wound at the end of the same are positioned in a fan-like location.

Figure 7*a* includes two detail views of the cutting arrangement shown in Figure 7;

Figure 8 is an elevational detail showing a

protecting sleeve for one end of the armature;

Figure 9 is a section along the line 9—9 of Figure 8;

Figure 10 is a section along the line 10—10 of Figure 2 showing a detail of the armature holding and locking means;

Figure 10*a* is a detail view;

Figure 11 is a section along the line 11—11 of Figure 2 showing the armature indexing and holding mechanism;

Figures 12 and 13 are diagrammatic sectional views taken along the line 12—12 of Figure 2 to show the cam operating and indexing operation;

Figure 14 is a diagrammatic view showing the operation of a means for pressing the wire into the wire holder.

Figure 15 is a diagrammatic view of a mechanism operating the main wire guiding member;

Figure 15*a* is a diagrammatic view similar to Figure 15 but with certain parts in somewhat different form.

Figure 16 is a diagrammatic view illustrating the mechanism for positioning certain operating cams to operate in timed relation; a wire cutting mechanism; and an automatic armature indexing mechanism; while

Figure 17 is a diagrammatic view showing the action of the wire cutting and indexing controlling mechanisms.

It is to be understood from the outset that the machine illustrated may be varied widely, still retaining the principles herein indicated. However, in one satisfactorily operating machine for accomplishing the objects hereinbefore set forth, I have provided a mechanism which includes 1, a main armature rotating means; 2, a wire guiding means; 3, a wire holding, cutting and end shaping mechanism; 4, an automatic main clutch releasing mechanism; 5, means for properly positioning the cut leads, 6, and automatic armature indexing means and several other operative means which will hereinafter more fully appear.

Referring to Figures 1 and 2 of the drawings, it will be seen that the armature is held in a rotatable disc 10 by locking means 11 and 12 located at either end of the armature shaft. A specific type of locking means shown in Figure 10 which includes a bedpiece 14 provided with a cylindrical recess 15 within which is positioned a locking sleeve 16 provided with a handle 17, the sleeve 16 having a cut-away portion at the mouth of the slot 15 in order to permit the insertion laterally, as shown in Figure 1, of the armature shaft. After the armature shaft is in position the operator may turn the handle 17 which will rotate the locking sleeve 16 around the armature shaft and close the throat or opening 15, the action being indicated by the dotted lines in Figure 10. A pair of spring clips 18 and 19 are arranged to cooperate with the handle 17 and spring lock the handle in either open or locked position, as the case may be.

Main armature rotating mechanism

The plate 10, in the specific embodiment of the present invention illustrated in the drawings, is arranged to rotate the armature inserted in the machine, there being wire guiding mechanism to provide for the proper laying of the wires as the armature is rotated. To this end, as will be seen in Figures 5, 3 and 4, I have provided a main central shaft 20 to which is secured by pin 21 the disc 10 at the front end. At the other end of the shaft 20, a drive pulley 22 is driven from a source of power to operate the shaft 20 through a sliding clutch mechanism 23. Any suitable type of clutch may be employed, the operation of which is controlled by a preferably but not necessarily combined manual and automatic control. To this end, I have provided a fork 25 pivoted at 26 and having an extension 27, forming with the fork 25 a bell crank lever in effect. The forward end of the arm 27 of the bell crank forked lever is provided with a link mechanism including two links 28 and 29, the link 28 being pivoted at 30 to the arm 27 and the link 29 being pivoted at 31 to the plate 32 on the base plate 33 of the machine (see Figure 5). In referring to Figures 5 and 6, it will be seen that the operating handle 34 is pivoted at 35 to the base plate 33 and carries a rack 36 at the opposite end, said rack adapted to mesh with a pinion 37 secured to the shaft 31 for the link 29. From this it will be seen that as the operator pushes down on the handle 34 the rack 36 will be moved upward and the pinion 37, shown in Figure 4, will be rotated to swing the link 29 in the direction of the arrow shown in Figure 5, which will likewise move the bell crank lever 27 upward by reason of the link connection 28. This will throw the clutch 23 into engagement against the tension of the spring 38. It will be noted that the links 28 and 29 form a sort of toggle mechanism which will be thrown past dead center when the operator pushes down on the handle 34.

I have provided a timing mechanism which will throw the clutch into released position after a certain number of rotations of the disc 10 or after a certain number of turns of wire have been laid in the armature slot, for example. To this end, the main driving shaft 20 is provided with a worm 40 meshing with the worm wheel 41 which has a shaft 42 supported with suitable bearings in the machine. The worm 40 might be connected direct to the shaft 20, but I have provided a further gear reduction from the shaft 20 by reason of a set of spur gears, shown in Figure 4. The spur gearing referred to includes a gear 44 fixed to the shaft 20 meshing with a gear 45

on an idler shaft which carries a gear 46, the gear 46 in turn meshing with a gear 47 connected with the worm 40. This arrangement not only provides for the further gear reduction from the main driving shaft 20 to the wormwheel 41, but it also provides an arrangement in which the gear ratio may be varied by substituting different sets of spur gearing for accomplishing a certain different gear ratio.

The worm shaft 42 carries the spur gear 50, shown in Figure 5, meshing with a spur gear 51, the latter carrying a tripping dog 56, the latter adapted to contact with a projection 57 on the link 28 of the clutch setting toggle mechanism.

A suitable mechanism for forming this tripping dog comprises a hub 58 loosely mounted on the stub bearing shaft 59 of the spur gear 51. A pin 60 on the spur gear 51 will move into contact with the edge 56′ of the dog 56 after the dog has contacted with the projection 57 on the link 28. This will cause sufficient tripping of the link 28 to move it past dead center and the spring 38 will then throw the clutch mechanism out of driving engagement. The dog 56 is pulled forward to move the same out of way for resetting.

Wire guiding means

As will be seen in Figure 1, in the present machine I propose to lay two wires at once. These wires are illustrated at *a* and *b*. The wires are held in a carrier which is also a part of the cutting mechanism as will hereinafter appear, indicated at 70, being illustrated in Figures 7 and 7*a*. The wires *a* and *b* are located on spools so positioned relative to the machine that there is a tendency for the wires *a* and *b* to move forward, Figure 1, against the main guide 71 which moves toward and away from the face plate 10, as the case may be by reason of suitable controlling mechanism, to properly control the laying over ends and also in slots the wires *a* and *b*. Suitable mechanism may be used herein for winding one wire *a*, alone. Thus, the wire holding means 70 may be modified for one wire only to accomplish this purpose.

As one means forming a suitable wire guiding mechanism, I have illustrated herein a construction in which the main guide 71 is pivoted as at 72 with operating rod 73 connected by any suitable connection 74 to the main guide arms 75 of the guide 71. The operating rod (see Figure 3) is provided with a spring connection 76 to one end 77 of a lever pivoted at 78 having an extension 79 and cam roller 80 thereon. The roller 80 is adapted to contact with a cam surface 81 which in the particular instance illustrated herein is fixed to the main driving shaft 20 of the machine, being pinned thereto as illustrated in Figure 3 by a pin 82. The cam surface 81 is so designed as to give the operating rod 73 and hence the main guide 71 the proper movement for guiding the wire over the ends of the armature and into the slots thereof as will appear.

In order to variably control the positioning of the wire at the ends of the armature, where a plurality of turns of the wire, is made per coil, as is the practice, I provide a further mechanism cooperating with the main guide operating control rod and lever therefor, consisting in this particular instance of a cam 85, which is driven in unison with the release timing worm wheel 41. Although the speed ratio of the worm wheel 41 and hence the cam 85 to that of the main drive shaft 20 and hence the cam surface 81 may be varied, the arrangement I provide herein is such that cam 85 makes one revolution during the winding of the complete number of turns of wire per coil. For example, during seven turns of the main shaft 20 and cam face 81, the cam 85 turns once, assuming that coils of seven turns of wire are being wound on the armature. The cam 85 has a plurality of variable sized cam rises 86 thereon arranged to contact with a roller 87 on arm 77, operating as a stop as it were to prevent the lever 77 to main guide 71 to which, as stated, lever 77 is connected from returning under the tension of the spring 76 as far as it would otherwise travel. In this manner, the various sized rises 86 of cam 85 controls the guide 71 and causes the guide to so lay the wires as each successive turn comes over to prevent the wires from spreading as the same are laid over the ends of the armature, the result being a building up of the wires in a regular compact manner close to the armature shaft in a somewhat fan arrangement as illustrated in Figure 7.

As will hereinafter appear in the description of the operation of the mechanism, particularly the wire end holding and cutting mechanism,—I also provide in addition to that just described, additional wire guiding mechanism for the purpose of inserting the wires into the holding and cutting mechanism after the wire for a previously wound coil has been cut and pushed out of the cutting and holding carrier. Thus, I provide an auxiliary wire guide 91 pivoted at 92 to be operated by an operating rod 93 similar to the rod 73, both of said rods having adjustable links 73′ and 93′ therein in the form of a turn buckle for example, the operating rod 93 being pivotally connected at 94 to a cam control lever 95, said lever 95 pivoted at 96 and carrying at its other end a cam roller 97 adapted to be engaged by cam 98 having a rise 99 thereon. The cam 98 is preferably connected to the main worm wheel 41 and rotates in unison therewith. The cam 98 has but one rise 99. Consequently, the gear ratio of the worm wheel 41 to the main shaft 20 being 7 to 1, as heretofore described, where

7 turns are wound per coil, the lever 95 will operate once for every 7 revolutions of the main shaft, or once for every 7 rotations of the armature. In other words, the auxiliary wire guide 91 operates once for every coil of seven turns applied to the armature and is for the purpose as will hereinafter appear more fully in the description of the operation of inserting the wires in the holding and cut-off mechanism after one coil of a plurality of turns has been completely wound and completely severed from the main continuous source of wire supply. The cams may be changed when a different number of turns is being applied for different armature specification.

Wire cutting mechanism

In the specific embodiment of the present invention herein illustrated, I have provided a mechanism operating in timed relation to the other mechanism, for cutting the wire and pushing the ends of the coil out of the cutting and holding device, which is controlled by operating cams normally entirely out of operative engagement but adapted to be moved at the proper time into operative relation to actuate the cutter and pusher. Referring to Figure 5, I have illustrated a longitudinally movable cam carrier 100, which is in the form of a hub sliding on the exterior surface of a bearing within which bearing is located the main shaft 20. The bearing 101 is supported by bracket 102 (see Figure 6). The cam carrier 100 is preferably connected to slide on the hub 101 by the key-way and key construction shown at 103 in Figure 6, the keys preventing the cam part from rotating at all times.

In order to slide the carrier 100 at the proper time, I provide a yoke 105 pivoted at 106 to the bracket 102, which yoke carries an extension 107 having a hub 108 for carrying a cam roller 109 adapted to ride on a cam surface 110 having a rise 111, so arranged as to operate the yoke 105 and slide the cam 100 into position to effect a contact therewith by mechanism which operates the cutter and wire pushing devices.

A suitable combined wire holder and cutter is illustrated herein as embodying the holder 70 which is in the form of a rod with a slot within which the wires are held cooperating with which slot is a knife edge 115, which is carried as is shown in the drawings adjacent to the rotary wire holding shaft. As shown in Figures 3 and 5, the rod 70 extends rearwardly through the face plate 10 into the hub 116 with which rod 70 is fixedly connected, the hub 116 being connected with lever 117 carrying a cam roller 118 thereon. The cam roller 118 will contact with a cam surface or projection, properly shaped, 120, carried by the slidable cam carrier 100. As the roller comes in contact with the surface 120, the roller 118, rotating with the main face plate, as will be understood, being fixed and carried by the arm 117, will cause the rotation of the hub 116 against the tension of the spring 121, thereby rotating the rod 70 on its own axis. This will cause the wires to come in contact with the knife edge 115, thus completely cutting the wires at this point.

The mechanism for pushing the wire out of the carrier after the same has been severed will now be described, reference being had to Figures 3, 5 and 6. As one suitable mechanism for accomplishing this object, I provide a wire pushing member 130, which is carried by a rod 131 extending through the face plate 10 normally held in retracted position by spring 132, said spring arranged to contact with the rear face of the plate 10, or a part thereof, and with a finger piece 133, which also forms a guide for pin 131. The rear end of pin 131 is adapted to be engaged by cam 135, the latter being carried by the slidable cam carrier 100. As the face plate 10 revolves, after the carrier has been moved into operative position, the pin 131 will contact with the curve cam 135 and push the pin 131 forward carrying with it the wire pushing member 130, which moves the wires having been cut as heretofore indicated out of the carrier 70.

Armature indexing mechanism

After a plurality of turns have been wound to form one coil, the armature is indexed so as to bring the next adjacent set of slots in proper position to receive the wire for winding the next coil. I have provided a means for accomplishing this automatically but I have also provided auxiliary means for manual indexing. Suitable automatic mechanism includes devices also operated by the sliding cam carrier 100 heretofore described, as it is periodically moved into contacting position with the various cam operating or controlling devices which are carried and rotated with the main face plate 10. The face plate 10 carries, for example, a hub 140 forming a bearing for stub shaft 141 carrying at its rear end a lever 142 provided at its extremity with a cam roller 143 adapted to contact with the cam 100′ of the cam carrier 100, the cam 100′ having a rise 144 for contacting with the cam roller 143. The pivot shaft 141 has a lever 146 forming, as indicated in Figure 17 with lever 142, a sort of valve crank lever mechanism with the arm 146 thereof carrying a toothed segment cooperating with the rack 148, which rack carries the armature indexing device proper, indicated more fully in Figures 11, 12 and 13.

The rack and pinion segment described causes a lateral reciprocation of the part 148 illustrated in Figures 11 and 13 and is also provided with a pivot dog 150, which carries a projection 151. Means are provided to nor-

mally force the pivoted dog 150 toward the surface of the armature by the pin 152 located in a recess 153 provided at the center and end of the main shaft 20. A spring 154 is located in the recess back of the pin 152 to tend to force the pivot dog forward against the surface of the armature.

In view of the pull of the wires as will appear, it is desirable to hold the armature from revolving on its own axis at all times except at the instance of indexing. To this end, I provide normally for retaining the armature in fixed position in the rotating face plate 10 by means of a locking pin 160 which has an extended portion 161 suitably shaped to enter the throat of the armature slots thus preventing rotation of the armature about its axis. In the particular arrangement shown, the locking pin 160 is constantly urged forward by a spring 162 located in the recess in the member 163 which carries the pin, the spring bearing against the locking pin as shown. The mechanism I have provided for indexing includes means for releasing the locking pin and immediately the projection 151 of the indexing dog 150 engages the armature slot just as the locking pin has been retracted. To accomplish this operation, I provide on the side of the locking pin 160 a projection 170, adapted to be engaged by a cam 171, the latter being carried by the indexing dog 150, and arranged to contact with the knob 170 and cam the locking pin back into released position. The parts are so positioned and proportioned that the indexing projection 151 of the dog 150 now enters the slot in the armature, revolving the armature about its axis to position the same properly for winding the next adjacent coil.

During this time, the cam 171 contacting with the pin knob 170 holds the locking pin 160 in retracted position. When the armature has been indexed one slot, the pin 170 has reached the end of the cam surface 171 and the spring 162 immediately forces the locking pin 160 back into its normal locking position for holding the armature in its new indexed location. The indexing dog 150 now returns to normal position, such operation being accomplished by the spring 140′ located around the hub 140 which controls the bell crank lever 142, 146 pivoted at 141, previously described. As the indexing dog moves backward to normal position, the same is cammed out of contact with the armature by the mechanism I have illustrated by the same cam and pin arrangement 170 and 171 just described as the means for releasing the locking dog. Thus, upon the return movement of the locking dog 150, the cam 171 rides on the opposite surface of the pin 170, which effects a slight turning of the indexing dog 150 about its pivot, compressing the spring 153 and permitting the return of the indexing dog to normal position out of contact with the surface of the armature, the dog returning into and remaining in contact therewith during the normal operation of the armature winding mechanism.

Attention at this point is called to a construction I have provided, which keeps the ends of the coil, as the same are cut off, in a satisfactory location to avoid interference with the winding. In reference to Figures 7, 8 and 9, these show a collar or hood 180 formed on a sleeve 181 which slips over the armature shaft and is held from rotation by an extension 182 which fits up into the armature shaft locking means heretofore described. The collar 180 is open-sided as shown in Figure 9 and has as shown in Figure 8 a bevelled side edge 183, so arranged and so positioned relative to the wire holding and cutting mechanism that as holder 70 rotates, it turns the wire toward the sleeve 181 at the free side of the collar 180. Hence, when the armature is indexed as previously described, these cut wires will be positioned underneath the hood or collar 180 and are so held until the armature has been indexed to such a position that it becomes necessary for the operator to move the spring ends out from underneath the hood 180 to prevent the ends from being caught between the wire being wound in the latter slots and the armature shaft or armature sleeve 181, just referred to.

Attention is also called to the fact that the main guide 71 is provided with a hook 190, which is arranged to move the other end of a coil out of interfering position during winding. This is accomplished at the proper instance by an operation of the main guide operating levers and cams in that as the main guide 71, operated by the cam 81, actuates or moves the wires into the bottom of the slot to form the compact laying of the wire as herein indicated moves back by reason of the spring 76 in pull of the wires *a* and *b*, the hook 190 contacting with the free ends of the wires of a coil, moving said free ends outward from the face plate 10, whereupon the cam-shaped edge 191 of the guide 171 further positions these three ends out of interfering position. As shown in Figures 11, 12 and 13, I have provided means for permitting manually indexing of the armature if desired. To this end, I pivot handle 200 by a pin 201 to a suitable portion of the face plate, the handle 200 having a pointed end 202 engaging a recess in the locking dog 160 as illustrated particularly in Figure 11. By moving the finger catch 203, of the handle 200, the operator may thus manually retract the locking dog 160 and thereupon turn the armature around one slot by hand, or any number of slots that may be desired.

Attention is called to the fact that the face plate 10 carries two diagonally arranged guiding plates 205 and 206, arranged to co-

operate, as will be seen in Figure 4, with the wire guiding members 71 to facilitate the location of the wires in the slots in the armature and prevent the guide 71 from tending to force the wires too far toward the rear, thus interfering with the proper laying of the wires in the slot.

Attention is called to the fact that a curved guide 210 is properly positioned on face plate 10 to hold the cut ends of the coils in proper position during indexing.

The face plate also carries a curved guide so positioned as to hold an insulating material wrapped around and in the slots of the armature during indexing of the same, particularly the free ends of the insulation—the same being in the form of a curved plate 212 shown riveted to a small piece 213, which, in turn, is fixed to the face plate 10. The curved plate is slotted, as shown, to permit swinging of the armature locking dog 160 to pass therethrough.

Referring to Figure 7, there is shown a wire hook 215 so positioned that as the armature is indexed from slot to slot, the free ends of the wire are held back and will not interfere with the winding of a second coil in the same slot.

Attention is also called to the fact that I have provided means for cutting the wire by hand in the lever 117, so positioned and connected that the operator may rotate the holder shaft 70 by hand.

Operation

In addition to the sleeve 181 described above, I provide a similar sleeve 181′ for the other end of the armature shaft. The sleeve 181 and 181′ are first slipped on the opposite ends of the armature shaft and the armature is then inserted in the holding and locking means illustrated in Figure 10, the handle 17 being turned to locking position rotating the sleeves 16 so as to close the mouth of the slot 15 as will be apparent from the consideration of the mechanism described.

The wires *a* and *b*, assuming two wires are being wound simultaneously, are located in the slots of the holder 70, the mechanism being shown in the front face view of Figure 1, the initial position. The operator pushes down on the clutch handle 34 illustrated in Figure 5 which throws the clutch 23 into operation to drive the main shaft 20, thus rotating the face plate 10. At this instance, the guide 71 is in such position that the wires *a* and *b* are directly opposite the initial slot into which they will pass as the armature rotates in the direction of the arrow shown in Figure 1. The cam face 81 of the controlling cam governs this position of the guide. As the armature revolves and the wires *a* and *b* being unreeled from the source of supply by the rotation of the armature relatively thereto are laid in the bottom of the slot and pass over the end of the armature, the guide 71 moves forward sufficiently to let the armature shaft pass by without interference, at the same time, however, holding the wires in proper place. After the shaft has passed the guide, the cam 81 operates to cause the guide 71 to move backward toward the face plate in order to carry the wires into proper position to enter the opposite slot for the particular coil being wound, there being a span for example, of 1 to 6, if this is the span for the particular armature being wound. As the face plate tends to continue to rotate, approaching 360°, it will be seen that the wire has been laid in the two opposite slots and is being laid or wound around the opposite ends of the armature core, the specific manner being hereinafter more fully set forth. At each end the cam 81 causes the guide to move away from the face plate 10 just a sufficient distance to permit the armature shaft to pass by the guide, holding the wires *a* and *b* snugly up against the armature shaft. These operations continue until the face plate 10 has made the number of revolutions required by the armature specifications as for seven turns for example whereupon the timing mechanism for the main clutch release operates, the pin 56 contacts with the projection 57 with the toggle arrangement shown in Figure 5 tripping the clutch setting mechanism, the spring 38 throwing the clutch out against the brake, stopping the rotation of the face plate 10.

After the winding of the first coil and during or also after 6½ turns have been wound (if seven turns are being used) of the second coil, several operations take place: the wires *a* and *b* are cut off to form the end of the first and the beginning of the second coil; they are pushed out of the carrier; the wire is replaced in holder 70 to permit the winding of the third coil and the armature is automatically indexed.

To accomplish the first, the cam carrier 100 has been moved into operative position by the engagement of the rise 111 of the cam 110 with the cam roller attached to the yoke 105 and the roller 118 for the cutting mechanism, previously described, comes in contact with the surface 120 and as the face plate revolves further around, the lever 117 is caused to rotate and turn the carrier 70 around and bring the wires against the knife edge 115 and sever the same.

The wire displacing mechanism, previously described, is now brought into play by reason of pin 131 riding on the cam 135 pushing the piece 130 forward thus moving the wires *a* and *b* out of the carrier 70, the spring 132 returning the pusher 130 to normal position after the pin rides off the cam 135.

It will be noted that the wires held in the holder after the cutter has operated constitute the lead wires for the beginning of another coil. When these wires have been

pushed from the holder, they have a bend in the ends thereof due to being bent around the rod 70 and this provides a means of identifying them from the end wires of the coil which are left straight by the cutter.

The mechanism for replacing the wire into the carrier 70 now becomes effective. The guider 91 now operates through the link mechanism 93, lever 95, roller 97 and cam rise 99 in order to move the wires *a* and *b* back against the face plate a sufficient depth to cause the wires to enter the carrier 70.

The armature is now indexed by the mechanism heretofore indicated, the operation of which will be understood from foregoing description of the construction in which the cam rise 144 shown in Figure 17 for example turns the bell crank lever 142 and 146 to operate the rack and pinion segment sliding the indexing carrier 148 and pivoted dog 150, shown in Figures 11, 12 and 13, and operating in the manner already set forth.

Mechanism is now in position to continue to another coil and the operations just described are repeated until the fifth coil is wound where a span when 1 to 6 is used whereupon the cut crooked ends of the fifth preceding coil is either automatically or manually pushed backward to permit the double winding of the sixth coil in the slot already having a coil therein or two coils assuming as in the present instance two wires *a* and *b* are being wound simultaneously.

During the rotation of the face plate 10, in winding the several coils, as heretofore indicated, I have provided means for variably positioning the main guide 71 in order to more satisfactorily lay the wire on the end of the armature opposite the commutator in what I have heretofore indicated as more or less fan-shape and is shown as *f* in Figure 7, for example. In Figure 15 is diagrammatically illustrated the operation of the mechanism for accomplishing this where it will be seen that the cam 85 has a plurality of rises 86 of different heights. When the wires are laid for the first turn, the main cam roller 80 contacting with the cam surface 81 permits the springs 76 to return the guide 71 to its farthest position at this particular portion of the winding,—that is at the end opposite the commutator end of the armature. However, after the first or second or at whatever time it may become necessary one of the cams 86 is turned in such a position to contact with the roller 87 to prevent the cam roller 80 from returning to the bottom of the low point of the cam 81, thus preventing the wires from coming down or spreading at this end of the armature, but causing same to be built up in a more or less fan-shape manner indicated as *f* in Figure 7.

It will be noted that the rises on the cam 85, to wit; the portions 86 thereof are of varying degrees in height to vary the laying of this fan construction as may be found expedient in practice. For example, instead of having the outermost turns fan the greatest distance as would appear from Figure 7, it may be found desirable to bring the wire down further after it has been previously fanned out at this end in previous turns in the manner just described.

It is apparent that, within the scope of the invention modifications and different arrangements may be made other than as herein disclosed, and the present disclosure is illustrative merely, the invention comprehending all variations thereof.

Having thus described my invention, what I desire to secure by United States Letters Patent and claim is:

1. In a machine, the combination of a wire holding means, an armature supply holding means, means for causing relative movement between said means to effect a winding of wire from a source thereof on the armature in a plurality of separate coils, and guiding means for variably controlling said wire to lie in layers against the armature shaft at both ends of said armature, said guiding means being dependent upon the increase in the number of coils wound on said armature.

2. In a machine, the combination of a wire holding means, slotted armature supply holding means, means for causing relative movement between said means to wind coils of a plurality of turns of wire on the armature and in one set of the slots thereof, means for variably guiding the wire dependent upon the number of turns of wire laid on said armature to compactly lay the wire thereon, means to cut off the wire after one coil has been wound, and means for automatically indexing the armature to cause the wire to be laid in another set of slots.

3. In a machine, the combination of a wire holding means, slotted armature supply holding means, means for causing relative movement between said means to wind coils of a plurality of turns of wire on the armature and in one set of the slots thereof, means for variably guiding the wire dependent upon the number of turns of wire laid on said armature to compactly lay the wire thereon, means to cut off the wire after one coil has been wound, means for automatically indexing the armature to cause the wire to be laid in another set of slots, said wire cutting means cooperating to form a wire holding means during indexing.

4. In an armature winding machine, including a wire holding mechanism, a combined holder and cutter comprising a slotted rod for receiving wire being wound, a cutting edge adjacent thereto and means for causing relative rotation between said cutting edge and said rod to sever wire in the holder.

5. In an armature winding mechanism, a

releasable armature holding means, and an armature indexing means including an indexing dog, means carried by said dog for releasing said holding means, means carried by said dog for indexing the armature, means for returning said dog to normal, and means for holding said dog out of contact with the armature during its return.

6. In a mechanism; the combination of a source of wire supply; wire holding means; armature holding means; means for causing relative movement between said means and said source of wire to effect a winding of wire therefrom on the armature; means to form the end of one coil and the beginning of another; means to sever the wire and means to operate said severing means at periodic intervals of the operation of the mechanism.

7. In a mechanism; the combination of a source of wire supply; wire holding means; armature holding means; means for causing relative movement between said means and said source of wire to effect a winding of wire therefrom on the armature in a series of separate coils; means to sever the wire and means to operate said severing means at periodic intervals of the operation of the mechanism to simultaneously form the end of one coil and the beginning of another coil.

8. In a mechanism; the combination of a source of wire supply; wire holding means; armature holding means; means for causing relative movement between said means and said source of wire to effect a winding of wire therefrom on the armature; means to sever the wire and simultaneously forming the end of one coil and the beginning of another coil after the latter coil has had certain turns thereof wound.

9. In a mechanism; the combination of a source of wire supply; wire holding means; armature holding means; means for causing relative movement between said means and said source of wire to effect a winding of wire therefrom on the armature; guiding means for controlling said wire; means to form the end of one coil and the beginning of another; means to sever the wire and means to operate said severing means while the mechanism is in operation.

10. In a mechanism; the combination of a source of wire supply; wire holding means; armature holding means; means for causing relative movement between said means and said source of wire to effect a winding of wire therefrom on the armature; and guiding means including an arm positioned adjacent the armature and relatively movable with respect thereto for variably controlling said wire as the turns of a coil increase to lie in layers against the armature shaft at both ends of said armature.

11. In a mechanism; the combination of a source of wire supply; wire holding means; armature holding means; means for causing relative movement between said means and said source of wire therefrom on the armature in a plurality of separate coils, of a plurality of turns; guiding means for variably controlling said wire as said plurality of turns and coils are wound; means to sever the wire and means to operate said severing means at periodic intervals to form the end of one coil and form the beginning of another coil.

12. In a mechanism; a source of power; a wire supply; a wire holding means; armature holding means; means for causing relative movement between said means and said wire supply to effect a winding of wire therefrom on the armature; a clutch between said source of power and said last mentioned means; guiding means for said wire; timing means for disconnecting said clutch after a predetermined number of turns of wire for a coil have been laid on said armature; means to sever the wire and means to operate said severing means at periodic intervals of the operation of the mechanism.

13. In a mechanism; a source of power; a wire supply; a wire holding means; armature holding means; means for causing relative movement between said means and said wire supply to effect a winding of wire therefrom on the armature; a clutch between said source of power and said last mentioned means; guiding means for said wire; timing means for disconnecting said clutch after a predetermined number of turns of wire for a coil have been laid on said armature; a single cutter for cutting said wire and means to operate said cutter at periodic intervals of the operation of the mechanism.

14. In a mechanism; the combination of a source of wire supply; wire holding means; armature holding means; means for causing relative movement between said means and said source of wire to effect a winding of wire therefrom on the armature in a plurality of coils, means to provide lead wire for the beginning and ending of each of said coils and means to cause a difference in appearance between lead wires, said means being actuated at periodic intervals of the operation of the mechanism forming the beginning of said coils and the lead wires forming the endings thereof.

15. In a mechanism; the combination of a source of wire supply; wire holding means; armature holding means; means for causing relative movement between said means and said source of wire to effect a winding of wire therefrom on the armature; automatic cam operated means for severing said wire and automatic means to place the wire in the holding means at periodic intervals of the mechanism.

16. In a mechanism; the combination of a source of wire supply; wire holding means; armature holding means; means for causing

relative movement between said means and said source of wire to effect a winding of wire therefrom on the armature; automatic cam operated means for severing said wire; automatic means to place the wire in the holding means at periodic intervals of the mechanism and means to release said wire from the holding means after the wire is cut.

17. In a mechanism; the combination of a source of wire supply; wire holding means; armature holding means; means for causing relative movement between said means and said source of wire to effect a winding of wire therefrom on the armature; automatic means to place the wire in the holding means for cutting and differentiating the end of a coil and the beginning of another coil.

18. In a mechanism; the combination of a source of wire supply; wire holding means; armature holding means; means for causing relative movement between said means and said source of wire to effect a winding of wire therefrom on the armature in a plurality of coils; and means operating as holding, cutting and differentiating means for said coil and lead wires.

19. In a mechanism; means for rotating a slotted armature core upon an axis perpendicular to its normal rotating axis; non-rotating means to guide a wire to the armature core; said guiding means moving toward and away from said core; means for periodically cutting said wire and means for indexing said core.

20. In a mechanism; a source of power; armature holding means; means to rotate said holding means and armature in a plane corresponding to the armature normal rotating axis a clutch between said source of power and said armature holding means; timing means for disconnecting said clutch after a predetermined number of rotations of said holding means; means to guide wire to the armature; means for periodically cutting said wire and means for indexing said armature after said wire has been cut.

21. In an armature winding mechanism, a frame means for holding an armature against rotation on its axis; automatic cam operated means for releasing the armature; and means including a cam operated member for indexing the armature simultaneously with the operation of the armature releasing means.

22. In an armature winding mechanism, a frame means for holding an armature against rotation on its axis; automatic cam operated means for releasing the armature; means including a cam operated member for indexing the armature simultaneously with the operation of the armature releasing means; and means including a manually operated finger for rendering said automatic indexing means inoperative.

23. An armature winding machine comprising in combination, a rotatable winding head for supporting an armature core with the core axis transverse to the axis of rotation of the winding head, means for rotating the winding head, mechanism for rotating the core to index the core into successive winding positions, and means driven by the winding head rotating means for automatically operating the indexing mechanism after a certain number of revolutions of the winding head have taken place.

24. An armature winding machine comprising in combination, a rotatable winding head for supporting an armature core with the core axis transverse to the axis of rotation of the winding head, means for rotating the winding head, mechanism for rotating the core to index the core into successive winding positions, a locating member for normally maintaining the core in a desired location relative to the winding head, and means driven by the winding head rotating means operating after a certain number of revolutions of the head automatically to retract the locating member from the core and then to operate the core indexing mechanism.

25. An armature winding machine comprising in combination, a rotatable winding head for supporting an armature core with the core axis transverse to the axis of rotation of the winding head, means for rotating the winding head, mechanism for rotating the core to index the core into successive winding positions, and means under the control of the winding head rotating means for automatically stopping the winding head after a certain number of revolutions and for operating the indexing mechanism.

26. An armature winding machine comprising, in combination, a rotatable winding head for supporting an armature core with its axis transverse to the axis of rotation of the winding head, power operated means including a clutch for rotating the winding head, mechanism for connecting and disconnecting the clutch, and core indexing means including a member for engaging a core tooth and mechanism for advancing said member to rotate the core in response to the disconnection of the clutch, said mechanism retracting the indexing member to position for the next indexing operation in response to the connection of the clutch.

27. The machine defined by claim 24 provided with manually operated means for retracting the locating member.

28. An armature winding machine comprising in combination, a rotatable winding head for supporting an armature core with the core axis transverse to the axis of rotation of the winding head, means for rotating the winding head, mechanism for rotating the core to index the core into successive winding positions, a locating member for normally maintaining the core in a desired location relative to the winding head, and

means under the control of the winding head rotating means for automatically stopping the winding head after a certain number of revolutions and for retracting the locating member and for operating the indexing mechanism.

29. An armature winding machine comprising, in combination, a rotatable winding head for supporting an armature core with its axis transverse to the axis of rotation of the head, a tubular shaft supporting the head, and means for indexing the core including a dog spring actuated into a core slot for engaging a core tooth, a rod slidable endwise within the shaft, and mechanism connecting the dog and rod.

30. An armature winding machine comprising, in combination, a rotatable winding head for supporting an armature core with its axis transverse to the axis of rotation of the head, a tubular shaft supporting the head, and means for locating the core in a desired position relative to the head, said means comprising a member adapted to be received by a core tooth and a rod slidable through said shaft for operating said member.

31. An armature winding machine comprising, in combination, a rotatable winding head for supporting an armature core with the core axis transverse to the axis of rotation of the winding head, a drive shaft upon which the winding head is mounted, a driving member, a clutch movable longitudinally of the shaft but rotatable therewith, a clutch operating member manually movable into engagement with the driving member to operatively connect said member with the drive shaft, a latch for maintaining the clutch operating member in the connecting position, means operated by the drive shaft for moving the latch to release the clutch operating member, after the drive shaft has been rotated a predetermined number of revolutions, and means adapted to rotate the armature core in the winding head to index said core into the next adjacent winding position, upon movement of the clutch out of engagement with the driving member.

32. An armature winding machine comprising in combination, a rotatable winding head for supporting an armature core; means for rotating said head; a wire loop receiving means carried by said head, said loop providing leads for successively wound coils applied to said armature; and automatic means actuated by the winding head rotating means for removing the leads from said loop receiving means.

33. In a mechanism; a wire holding means; a combined holder and cutter comprising a slotted rod for receiving wire; a cutting edge adjacent thereto; periodically operated cam actuated means for moving said rod relative to said cutting edge to sever the wire, said rod distorting one end thereof causing thereby differences in appearance between the severed ends of said wire.

34. In a mechanism; a wire holding means; a combined holder and cutter comprising a slotted rod for receiving wire; a cutting edge adjacent thereto; cam operated means for periodically rotating said rod to bend the wire and sever a portion therefrom whereby the ends of the severed wire have different configurations.

In testimony whereof I affix my signature:

HARRISON H. EATON.

CERTIFICATE OF CORRECTION.

Patent No. 1,890,111. December 6, 1932.

HARRISON H. EATON.

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows: Page 7, lines 84, 95 and 108, claims 1, 2 and 3, respectively, strike out the word "supply" and insert the same after "wire" in lines 83, 94 and 107 respectively; and that the said Letters Patent should be read with these corrections therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 28th day of February, A. D. 1933.

M. J. Moore,
Acting Commissioner of Patents.

(Seal)