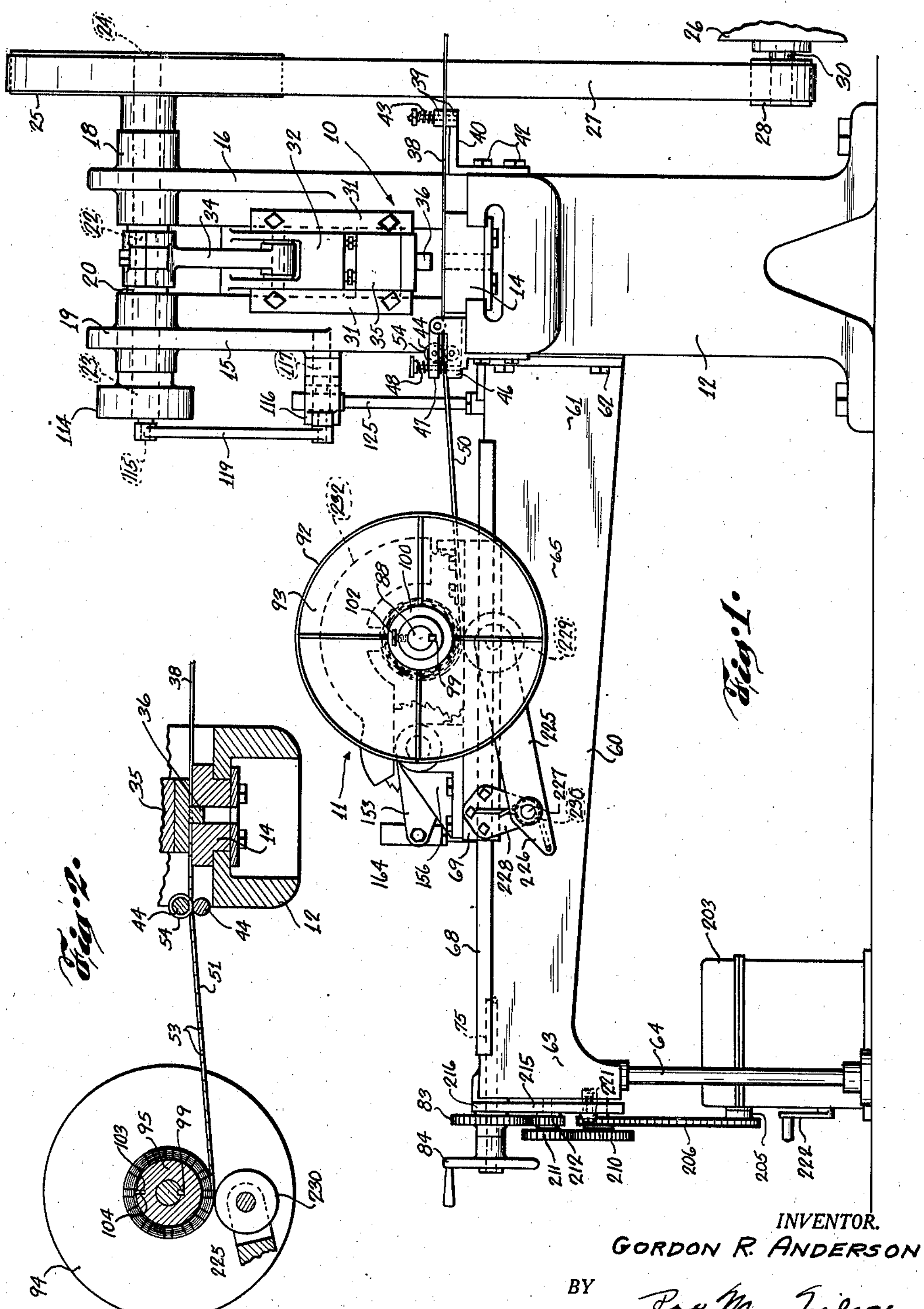
July 12, 1938. G. R. ANDERSON 2,123,350

STRIP FEEDING MECHANISM

Filed Aug. 15, 1936 4 Sheets-Sheet 1



INVENTOR.
GORDON R. ANDERSON

BY Ray M. [signature]

ATTORNEY.

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STRIP FEEDING MECHANISM

Filed Aug. 15, 1936 4 Sheets-Sheet 2

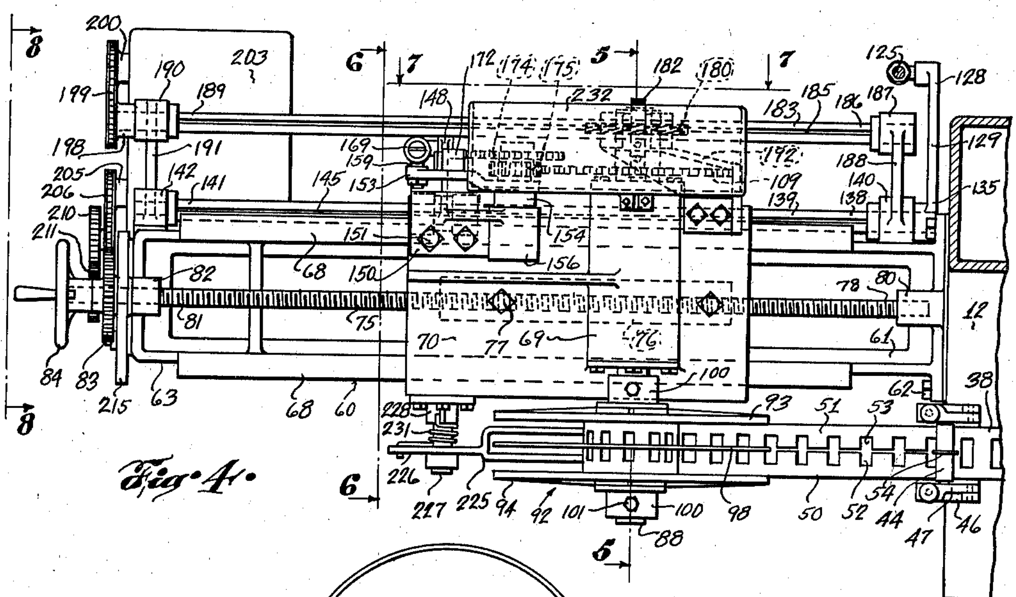

Fig. 4.

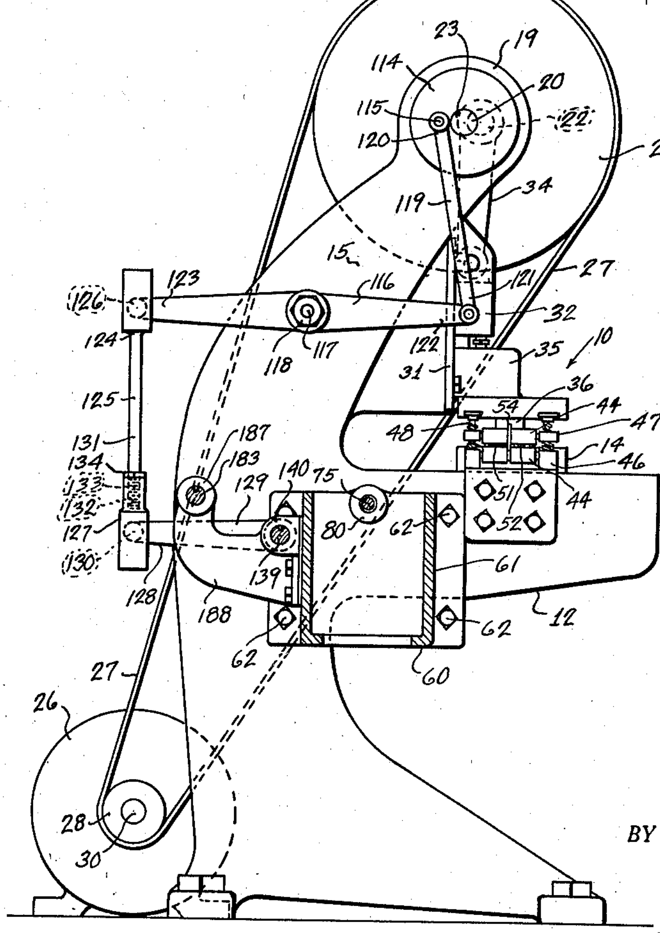

Fig. 3.

INVENTOR.
GORDON R. ANDERSON
BY Roy M. Eilers
ATTORNEY.

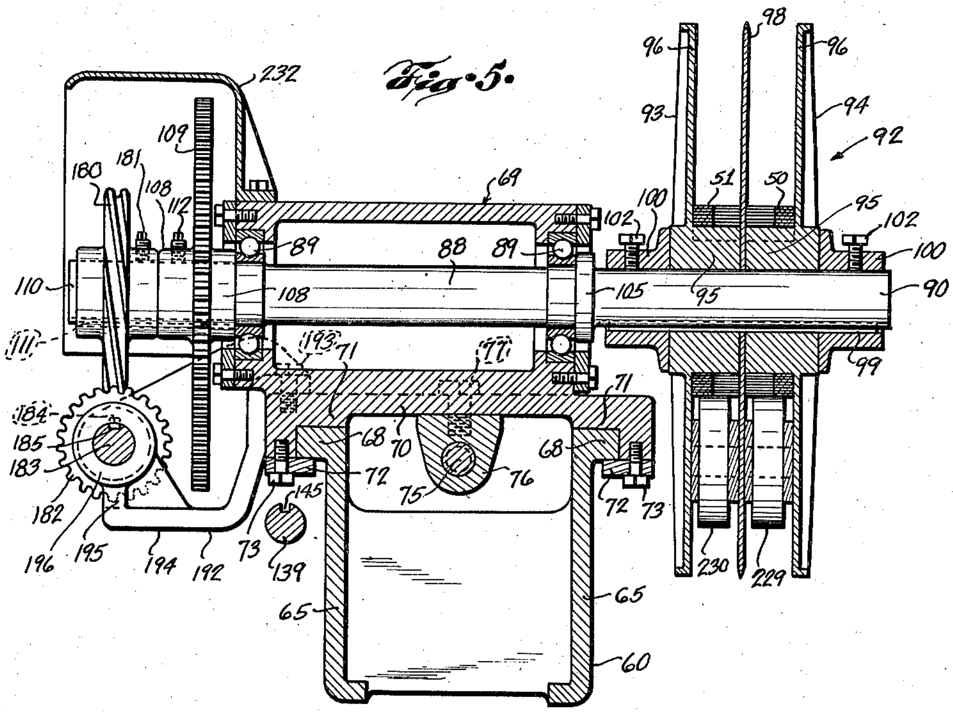

Fig. 5.

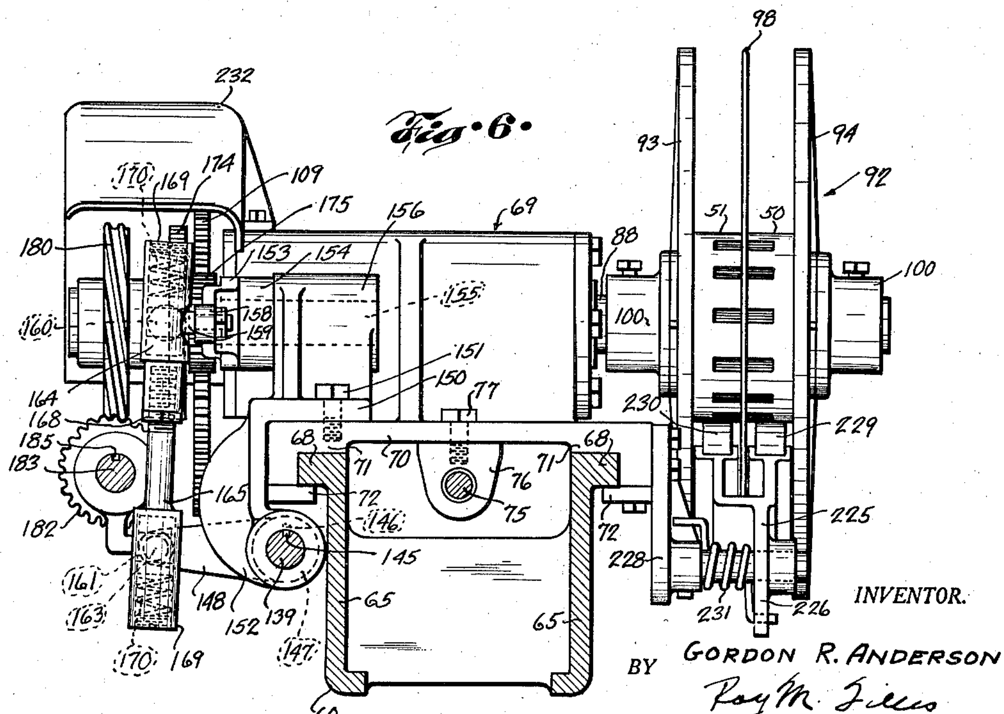

Fig. 6.

INVENTOR.
BY GORDON R. ANDERSON
Roy M. Eilers
ATTORNEY.

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Fig. 7.

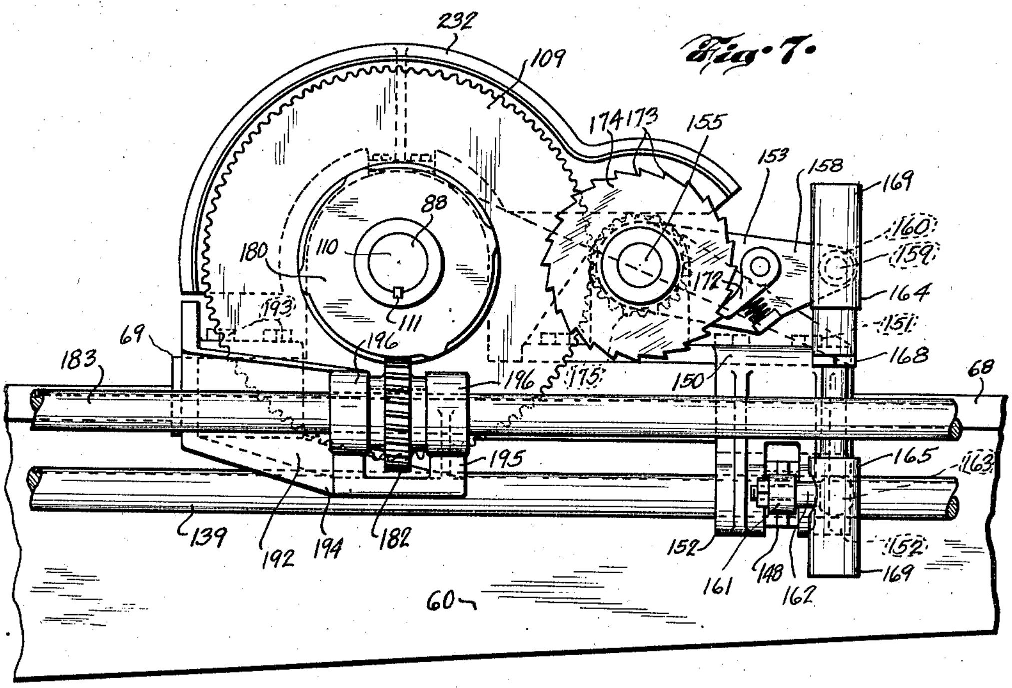
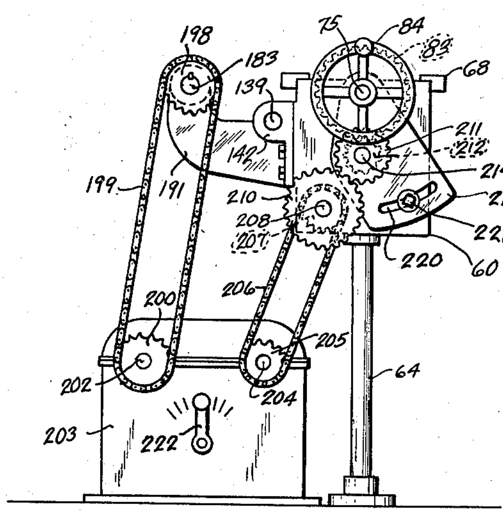


Fig. 8.



INVENTOR.
GORDON R. ANDERSON

BY Roy M. Files

ATTORNEY.

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UNITED STATES PATENT OFFICE

2,123,350

STRIP FEEDING MECHANISM

Gordon R. Anderson, Beloit, Wis., assignor to Fairbanks, Morse & Co., Chicago, Ill., a corporation of Illinois

Application August 15, 1936, Serial No. 96,192

20 Claims. (Cl. 164—87)

This invention relates to an improved strip feeding mechanism, having particular application to the feeding of sheet material of ribbon or strip form in the production of so-called disc or ring type armature or core elements for electrical machines and the like. More specifically stated, the invention contemplates an improved method and apparatus for producing slotted, armature core assemblies of disc type, wherein the slots provided for receiving electrical windings, are all disposed in the plane of a transverse face of the core. While the improved mechanism of the present invention is particularly suitable to the production of slotted core assemblies for electrical machines, it may be utilized with equal facility for feeding material of strip or other form, in the production of objects other than armature core assemblies.

The improved mechanism hereinafter to be fully described and claimed, includes a slot punching device and core winding mechanism of automatic type. In the winding process, a strip of suitable armature core-forming material is fed by the winding mechanism, through the slot punching machine, so as to provide slots in the strip, and thence the slotted strip is wound on a core winding spool, provided as a part of the winding mechanism. The forming of the core assembly is attained by winding the strip in successive spiral or substantially annular layers, beginning at the axial portion of the core and increasing in diameter as the strip is wound. In this process, the slotted portions of successively wound layers of the strip are properly and automatically aligned so as to produce, in the final assembly of the armature core, the required armature slots.

In the present embodiment of the invention, the operation of the slot punching machine and that of the core winding mechanism are correlated by novel means, whereby the spacing of the slots punched in the strip in its passage through the punching machine, is uniformly increased or graduated as the diameter of the armature core increases during the winding process. The purpose for this, as will be readily understood by those skilled in the art, is to attain the proper aligning of related slots in the successive layers or laminations of the strip-wound armature core. The means provided for correlating the punching and winding operations, is fully automatic in its operation, and further, is capable of being regulated, whereby core slots of substantially any desired sectional aspect may be attained in the final core assembly.

In accordance with the foregoing, it is an object of the present invention to provide improved mechanism of the type described, for producing armature, field or other core elements of disc type for electric machines and the like, the mechanism being fully automatic in its operation and capable of producing a slotted armature core assembly of any desired size to meet the requirements of an electrical machine of predetermined capacity.

Another object is attained in the provision of mechanism of the type described, in which the mechanism is automatic and positive in its operation, and is fully adjustable to provide armatures of varying sizes, the mechanism further being adapted to produce slotted core assemblies in which the core slots may be of substantially radial, of tangential disposition, or of curved extent or trend, the slots in a core of disc type, of course, being usually disposed in a transverse face of the core assembly.

A further object is attained in the provision of improved mechanism for the purpose noted, in which the mechanism automatically compensates for the successive increases in the core diameter as the core is wound, so as to provide automatically and with certainty for the predetermined relative locations of the slotted portions of successive layers of the strip.

A still further object is found in the provision of improved mechanism of the type described, in which the mechanism is comprised of a slot punching device, a core winding device, and improved mechanism for operating said devices and for correlating and synchronizing the several operations of the devices in such manner that the cut-away portions of the core forming strip are, when the strip is wound, located in final, predetermined relation.

Further objects and advantages will appear from the following description and from the accompanying drawings, in which:

Fig. 1 is a side elevation of a preferred embodiment of the invention; Fig. 2 is a longitudinal sectional elevation of certain elements of the improved core winding and punching machine; Fig. 3 is an end elevation of the machine, with part thereof shown in transverse section; Fig. 4 illustrates, in plan, the core winding mechanism of the improved machine; Fig. 5 is an enlarged, transverse sectional elevation of a portion of the winding mechanism, as taken along line 5—5 in Fig. 4; Fig. 6 is a transverse elevation of the winding mechanism, as viewed from line 6—6 in Fig. 4; Fig. 7 is a longitudinal elevation of the winding mechanism, as viewed from line 7—7 in Fig. 4, and Fig. 8 is an end elevation of a part of the machine, as viewed from line 8—8 in Fig. 4.

The improved core punching and winding organization exemplifying the features of the present invention, is comprised of a material punching device, improved core-winding mechanism, and novel operating means for the winding mechanism, including mechanism adapted for correlating and synchronizing the operation of the winding mechanism with that of the punching device, whereby in the winding of the core strip, the slotted portions thereof may be properly aligned to attain the desired shape and trend of the core slots in the final core assembly.

Referring now to the drawings by suitable reference characters, and particularly to Fig. 1, wherein is shown in side elevation an assembled embodiment of the invention, the machine includes a slot punching device or machine which may be denoted generally by the numeral 10, and an armature core winding mechanism designated, generally, by the numeral 11. The punching machine, which may be of any well known type suitable to the production of slots in electrical armature core-forming material, is comprised of a frame 12 supporting a removable slot die element 14. The frame 12 includes, preferably as an integral part thereof, a pair of spaced substantially vertical members 15 and 16 provided with bearing portions 18 in the upper ends 19 thereof. A crankshaft 20 is journalled in the bearings 18, with the crank portion 22 of the shaft disposed between the members 15 and 16, substantially as shown. The ends 23 and 24 of the shaft extend outwardly beyond the members 15 and 16 respectively, and to the end 24 of the shaft is keyed or otherwise secured, a driven element or pulley 25. By preference, the pulley 25 is formed to serve as a fly wheel in order to attain a smooth and uniform action of the punch, later to be described. The crankshaft is operated by a suitable driving means such as an electric motor 26 which is suitably drivingly connected with the fly wheel 25, as by a belt 27 interconnecting the fly wheel and a drive pulley 28 on the motor shaft 30.

The inner, opposed faces of the members 15 and 16 are provided with guide elements 31 for a vertically reciprocating cross-head 32. The cross-head is operated from the crankshaft 20, through a connecting rod 34 operatively connecting the cross-head with the crank 22 of the crankshaft 20. Removably secured to the lower end 35 of the cross-head is a slot punching tool or die 36 which cooperates or mates with the stationary slot die 14 during the punching stroke of the cross-head. It is to be understood, of course, that since the slot punching dies 14 and 36 are necessarily provided as cooperating punching elements, any number of mating pairs of such dies may be provided for the machine, each of the several pairs being of different slot punching sizes or characteristics in order to care for the desired capacity of armature core to be produced.

The core-forming material to be punched, which is shown as a single, continuous strip 38, extends from a supply spool (not shown), to and through the punching machine, the strip being arranged to pass between the die elements 14 and 36 in the manner best illustrated by Figs. 1 and 2. As a means for guiding the strip in its passage through the punching machine, a pair of cooperating guide elements 39 are provided on the punch inlet side of the punching device, the guide elements being by preference, mounted upon a bracket 40 secured, as by the bolts 42, to the frame 12. It will be noted from an inspection of Fig. 1, that the lower guide element is stationary, while the upper guide element is resiliently urged by suitable spring means 43, into guiding contact with the strip 38. Located adjacent the punching elements and on the outlet side of the punch machine, are a second pair of guide elements 44, these guide elements being by preference, of roller type with the lower roller journalled in a stationary support 46 carried by the frame 12, while the upper roller is by preference, carried by a pivoted member 47. The member 47 is biased toward the stationary support 46 by suitable spring means 48, whereby the upper roller is resiliently urged into guiding contact with the strip 38.

Although the strip 38 may be of such width as to provide for the production of but one armature core element, it is preferred in the present example to illustrate and describe the punching and winding mechanism as providing for the production of two similar armature elements in one operation. Accordingly, the strip 38 is provided of such width that it may be perforated by the punching machine, and thereafter separated along its longitudinal center line so as to produce two properly slotted core-forming strips 50 and 51 as illustrated in Fig. 4. Obviously, by dividing the portions 50 and 51 along other than the original center line, there may readily be formed two strips of dissimilar width and slot depth. As may be observed from the illustration of the slotted strip elements 50 and 51 in Fig. 4, the original single strip 38 in its passage through the punching machine, is punched to provide longitudinally spaced, rectangular apertures in the central portion of the strip, so that when the strip 38 is divided after the punching operation, to form the two strips 50 and 51, these strips will have slots 52 and 53 formed, respectively, in a marginal edge of each strip. The cutting or dividing of the single strip 38 after its passage through the punching machine, and before being wound to form armature core assemblies, may be effected by a suitable means now to be described. For this purpose, one or both of the roller guides 44 heretofore described, may be provided with an annular projection 54 located intermediate the ends of the roller, the peripheral portion of the projection being formed to provide a cutting edge arranged to engage and part the single strip 38, as along its longitudinal center line. Thus the single strip 38 is first treated by the punching machine to provide the required core slots, and then the punched strip is divided by the cutting element 54 to form two similar strip elements 50 and 51, with the respective slotted portions 52 and 53 of the strips disposed in opposed, marginal edges of the strips, as shown in Fig. 4.

Proceeding now with a description of the improved armature core winding mechanism incorporating the features of this invention, the mechanism is carried by a frame 60 which has one end 61 thereof secured to the frame 12, as by the bolts 62, while the other end 63 thereof is preferably supported by a pillar or leg element or elements 64. As clearly illustrated in Figs. 5 and 6, the frame 60 includes a pair of spaced, horizontal members 65, each thereof having an outwardly extending flange portion 68 formed along the upper margin of the member, these flanges being adapted to serve as supporting and guide surfaces or ways for a slidable carriage 69. The carriage frame 69 includes a base portion 70 which extends transversely of the members 65 and is provided with flanged seat portions 71 which slidably engage the flanges 68 in the manner illustrated. In order to maintain the carriage seated upon the flanges 68, suitable members 72 are secured to the flanges 71, as by the bolts 73, with portions thereof extended adjacently to and beneath the flanges 68. Thus the carriage is slidably mounted upon the members 65, but cannot be removed therefrom without first removing the assembly elements 72.

The carriage is slidingly actuated along the flanges or ways 68 preferably by a screw 75 (Figs. 4 and 5) which threadedly engages a lug or member 76 secured to the underside of the base 70 of the carriage, as by the bolts 77. The screw 75 is disposed parallel to and between the members 65, and is substantially coextensive in length with these members. One end 78 of the screw is journalled in a bearing 80, carried by the frame end 61, while the opposite end 81 of the screw is journalled in and extends through a bearing 82 carried by the end 63 of frame 60. The extension of screw end 81 outwardly beyond the frame end 63, is provided with a gear element 83 and a hand wheel 84, both being operatively connected to the screw end in any suitable manner. The gear 83 forms a part of the automatic driving mechanism, later to be described, for the screw 75, while the hand wheel 84 serves to provide for a manual actuation of the screw when such is desired, as for return of the carriage to an initial or starting position.

The carriage 69 is provided as a movable support for the armature core winding mechanism now to be described. A horizontally arranged shaft 88 having its axis disposed at a right angle to that of the carriage propelling screw 75 (Fig. 5), is journalled intermediate its ends, in spaced bearings 89 mounted on the carriage 69. These bearings may be of anti-friction type, such as the ball-bearings shown. One end portion 90 of shaft 88 is extended outwardly beyond the carriage 69 (on the right-hand side of Fig. 5) to provide a driving connection and operative support for the armature core winding spool structure which may be denoted, generally, by the numeral 92.

The winding spool is comprised of a pair of similar, but oppositely arranged, spool elements 93 and 94, each thereof being characterized by a cylindrical hub portion 95 providing a winding seat for a core-forming strip, such as one of the strips 50 or 51, and a winding guide and strip confining flange 96. Since in the present example of the invention, it is preferred to wind at least two armature cores in the same operation, a disc partition element 98 is arranged between the hub portions 95 of the spool elements 93 and 94, substantially in the manner shown in Figs. 5 and 6. The partition element 98 serves in common with the spool elements 93 and 94, to confine the several core-forming strips to their respective winding seats, as 95, and also, in cooperation with each of the spool flanges 96, to confine the core strips to their respective spools during the winding process.

The spool-forming elements 93, 94 and 98 are all mounted upon the shaft end 90, and are operatively secured to the shaft as by a key 99. In order to maintain these elements in assembly longitudinally of the shaft end 90, and also to permit of assembly adjustment of the winding spool structure along the shaft end, adjustable shaft collars 100 are arranged on the shaft, one on each side of the assembled spool, the collars being provided with set-screws 102 for securing them in adjusted position on the shaft. The adjustable arrangement of the spool and collar elements axially of the shaft end 90, serves to enable the proper aligning of the core strip-receiving portions of the spool with the punching machine, through which the strip passes in its travel to the winding spool, and also permits, through the use of suitable spacers (not shown), a variation in the width of winding seats to care for strips of greater or lesser width. Moreover, it is preferred to form the key 99 of such extent as to provide in addition to the set screws, an operative connection of the collars 100 to the shaft end 90.

As will be observed from an inspection of Figs. 2 and 5, each of the core-receiving hubs 95 of spool members 93 and 94, is provided with an axial groove or slot 103 in the periphery of the hub, for the reception of one end portion 104 (i. e. the starting end of the core strip), of one of the strips 50 and 51. The end portion 104 is preformed or bent over to seat in the groove 103, thereby securing the strip end to the winding spool, so that in the winding process and as the spool is rotated, the strip will be compelled to rotate with the spool. Also, this connection of the strip ends to the winding spool structure provides a drive for the strip material, so that as the spool is rotated, it will effect a displacement of the core material from the supply source thereof, and will keep the strip desirably tensioned through the punching machine and to the winding spool. It will be noted from an inspection of Figs. 4 and 5, that the end 104 of strip 51 is inserted in the hub slot 103 of spool element 93, while the end 104 of strip 50 is inserted in the slot 103 of spool element 94. Thus, as the spool structure is operated, two armature cores will be simultaneously wound, and in case the two strips are identical, the cores will be similar in depth and slot arrangement.

In order to prevent endwise displacement of the shaft 88, the shaft is flanged as at 105, near the shaft end 90. Cooperating with the shaft flange 105 in preventing endwise movement of the shaft, is the hub portion 108 of a gear 109, the gear being operatively secured to the shaft end 110, as by a key 111 and a set screw 112. Gear 109 serves as an element of the driving mechanism for the shaft 88 and winding spool structure 92, now to be described.

Referring to Figs. 1 and 3, the drive for the core winding mechanism is taken from the crankshaft 20 of the punching machine heretofore described. Operatively secured to the end 23 of shaft 20 so as to be driven thereby, is a disc or wheel element 114 having a pin element 115 extending from a face of the wheel, the pin being axially offset from the axis of the wheel in the manner illustrated, so as to serve as a crankpin for driving the winding mechanism.

A rocker arm 116 is pivotally secured, intermediate its ends, to the member 15 of punch frame 12, the pivotal connection being effected by a pin or stud 117 carried by the member 15 and upon which the arm is pivotally journalled in a suitable manner. An assembly nut 118 is provided on the end of the stud to retain the arm 116 thereon. The rocker arm 116 is actuated by the crank wheel 114 through a connecting rod 119, one end 120 of which is pivotally connected to the crank pin 115, while the opposite end 121 thereof is pivotally connected to the end 122 of arm 116. To the opposite end 123 of arm 116 is pivotally connected one end 124 of a connecting rod structure 125, the pivotal connection preferably being effected through a ball and socket assembly 126. The opposite end portion 127 of rod structure 125 is likewise pivotally connected to one end 128 of a lever or rocker arm 129, as by the ball and socket connection 130. By preference, the rod 125 is formed in two parts, the part 131 and the end portion 127 being separate elements which are adjustably connected together in any suitable manner, as by providing the element 127 with an internally threaded bore 132 for threadedly receiving a threaded end 133 of the element 131 in the manner shown in Fig. 3. An assembly nut 134 serves to lock the elements together. The described structural arrangement of the rod 125 provides for a ready longitudinal adjustment of the operative length of the rod.

The arm 129 is operatively connected on its end 135, to one end 138 of a rock shaft 139, this connection being best illustrated in Figs. 3 and 4. The shaft end 138 is journalled in a bearing member 140 carried by the end portion 61 of frame 60, the shaft extending parallel to and substantially the length of one of the side members 65 of the frame, as shown in Figs. 4, 5 and 7. The opposite end 141 of this shaft is journalled in a bearing 142 carried by the end portion 63 of frame 60.

The presently described drive mechanism for the shaft 139, attains a rocking movement of the shaft when the crank wheel 114 is rotated, through the operation of crankshaft 20 by the motor 26. In this connection, during rotation of wheel 114, the shaft arm 129 will be actuated by the power transmission elements 119, 116 and 125 to produce a rocking movement of the shaft 139, and by substituting arms 129 of different length, and correspondingly adjusting the length of the transmission element 125, provided for as heretofore described, the extent of rocking movement of the shaft may be determined to suit varying operating conditions. The rocking movement of shaft 139 thus attained, is utilized in a manner now to be described, to operate the armature core winding mechanism heretofore referred to.

The shaft 139 is provided with a key way or groove 145 extending substantially the length of the shaft. Journalled on the shaft 139 and operatively connected thereto, as by a key element 146 seated in the groove 145, is one end portion 147 of a rocker arm 148. As this rocker arm is to be utilized as a drive transmission element between the shaft 139 and the gear 109 on the winding spool shaft 88, this rocker is arranged to travel with the movable frame or carriage 69, so that the arm operatively secured to the shaft 139 will slide along this shaft as the carriage 69 is operated along the ways 68. During the sliding movement of the arm along the shaft, the key 146 securing the arm to the shaft, will, of course, slide along the key way 145 provided therefor in the shaft. As a means for moving the arm with the carriage, a member 150 is secured to the carriage 69 as by the bolts 151, and is provided with a pair of spaced arms 152 engaging the shaft 139, one on each side of the hub or eye portion 147 of the arm 148, as shown in Fig. 7. Thus, as the carriage is moved, the arms 152 engaging the arm 148 will slide this arm along the shaft 139 so as to maintain the arm in a predetermined position relative to the carriage, in all positions of the carriage. Also, it will be noted that the arms 152 receiving the shaft 139, may serve as intermediate bearing supports for the shaft.

The rock movement of arm 148 is transmitted to a pivoted member 153 (Fig. 7), the member having a hub portion 154 (Fig. 6) near one end thereof, pivotally seated upon a stationary stub shaft 155 carried by a supporting member 156. The support 156 may be and is, by preference, formed as an integral part of the frame 150. To the opposite end 158 of the pivoted member 153, is secured an element 159 provided with a spherical or ball type head 160. Likewise, the outer or free end 161 of arm 148 is provided with an element 162 having a ball head 163. Operatively interconnecting the arm 148 and pivoted member 153, through the ball portions 160 and 163, is a two-part link structure comprised of the elements 164 and 165. These elements are adjustably connected in any suitable manner, as at 168, so that the operative length of the link may be regulated as desired. Each of these link elements 164 and 165 is provided with a recess or socket portion 169 for the reception respectively, of the ball portions 160 and 163. Moreover, as is clearly illustrated in Fig. 6, each ball portion is resiliently retained in its seat in the socket by a spring element 170. Thus the described arrangement provides a resilient, though positive power transmission from the rocker shaft 139 to the pivotal member 153.

The drive from the member 153 to the gear 109 on shaft 88, is preferably effected through a spring-pressed pawl 172 carried by the member 153 and engaging the segments or teeth 173 of a ratchet wheel 174 which is freely journalled on the stub shaft 155. Also freely journalled on the stub shaft, but operatively connected to the ratchet wheel 174 in any suitable manner (not shown), is a pinion 175 which operatively engages the gear 109, the described drive arrangement being clearly shown in Figs. 4 and 7. Also, it will be noted from the above description and from the drawings, that the drive mechanism connecting the drive shaft 139 with the core winding shaft 88 is carried by, and hence moves with the winding carriage 69, so that the winding operation may continue irrespective of the position of the carriage 69 along the ways 68.

The operation of the described power transmission arrangement for the core winding shaft 88, is such that as the shaft 139 is rocked as a result of the operation of the crankwheel 114 as heretofore described, the arm 148 through the link structure 164—165, will effect a pivotal rocking of the member 153. The described movement of member 153 effects an alternate or step-by-step, unidirectional actuation of the ratchet wheel 174 when the pawl operatively engages one of the ratchet teeth, and this in turn, effects a step-by-step, unidirectional rotation of the winding shaft 88, through the gear 109 as impelled by pinion 175. Noting particularly Figs. 6 and 7, as the rocker arm 148 is actuated downwardly, it pivotally displaces the member 153 downwardly, through the resilient linkage connection 164—165, so that the pawl 172 having its actuating end engaging one of the teeth 173 of the ratchet wheel, will rotate the ratchet wheel through a predetermined angle in a clockwise direction. On the upward movement of arm 148 and hence of the member 153, no rotational movement of the ratchet wheel occurs, the pawl 172 simply riding idly over the ratchet wheel teeth 173. Through the pinion 175, the clockwise movement of the ratchet wheel results in a counterclockwise rotation of the gear 109, as viewed from Fig. 7. As viewed from Fig. 1, the gear 109 and hence the shaft 88 and the winding spool structure 92 rotate in a clockwise direction. Thus, in the manner described, a step-by-step, unidirectional rotation of the winding spool 92 is effected, the step-by-step rotation thereof serving, in addition to winding the core strips in the forming of core assemblies, to correlate the punching operation with the winding operation as will be later described.

Proceeding now with the description of the drive mechanism for the screw 75, provided for effecting a displacement of the carriage 69 along the ways 68, a worm wheel 180 is operatively secured to the end 110 of shaft 88, as by the key element 111 and by a set screw 181. The worm operatively engages a worm gear 182 which is journalled upon and operatively connected to a shaft 183, as by the shaft key 184 seated in a key way 185 provided in the shaft. The shaft 183 is formed of a length substantially coextensive with that of the frame 60, and has one end 186 journalled in a bearing 187 carried by a bearing arm 188 secured to the end portion 61 of frame 60, as shown in Figs. 3 and 4. The opposite end portion 189 of the shaft is journalled in and extends through a bearing 190 carried by a bearing arm 191 which is secured to the end portion 63 of frame 60. It may here be noted that although the gear members 180 and 182 are referred to as worm elements, spiral or helical gears or those of any suitable, angulately related type may be utilized.

Since the worm 180 and its shaft 88 move with the carriage 69, the worm gear 182 must be arranged for movement along the shaft 183 responsively to movement of the carriage 69 in order to maintain an operative connection between the worm and worm gear. For this purpose, the shaft key way 185 is provided of a length substantially coextensive with that of the shaft 183, whereby as the worm 182 is actuated along the shaft 183, the worm key 184 may slide along the key way, so that in any position of the worm gear along the shaft, as determined by the position of the carriage 69 along the frame 60, the operative connection between the gear and shaft will be maintained. Also, as a means for actuating the gear along its shaft in response to movement of the carriage 69, an angulate, substantially U-shaped member 192 is secured to the carriage frame 69, as by the bolts 193, with the bridge portion 194 of the U extending beneath the gear 109, as shown in Figs. 5 and 7. The arm portion 195 of the member is formed to provide spaced elements 196 which engage the shaft 183 on each side of the gear 182. Thus the gear 182 is axially confined between the elements 196, and hence will be maintained thereby in a fixed position relative to the carriage 69 so as to maintain an operative engagement between this gear and the worm 180 in any position of the carriage along the ways 68. In attaining this end, the elements 196 engaging the gear 182 simply slide the gear along its shaft 183 as the carriage 69 is moved.

Since the drive for the winding spool shaft 88 effects a step-by-step rotation thereof, rotation of the shaft 183 will be effected in a similar manner, through the worm 180 and gear 182. The drive for the carriage actuating screw 75 is taken from this shaft 183 in a manner now to be described.

To the end 189 of shaft 183, is secured a gear or sprocket wheel 198 (Fig. 8) which is connected as by a chain 199, with a sprocket 200 on the driven shaft 202 of a speed changer apparatus of any suitable type, indicated generally by the numeral 203. The driving shaft 204 of the speed changer carries a sprocket 205 which is connected as by the chain 206, with a sprocket 207 journalled on a stub shaft 208 carried by the end portion 63 of frame 60. Also on stub shaft 208 is a gear 210 which is operatively associated in driven relation with the sprocket 207. This gear 210 drives the gear 83 and screw 75 heretofore described, through gear and pinion elements 211 and 212 operatively connected together in any suitable manner (not shown) with the gear 211 engaging the gear 210 while the pinion 212 engages the gear 83. The gear 211 and pinion 212 are carried on a stub shaft 214 mounted on a pivoted member or plate 215, the plate having its upper end portion 216 pivotally journalled on the end 81 of the screw shaft 75, as shown in Figs. 1, 4 and 8, so that its pivotal axis is the same as that of the screw 75. The plate 215 carrying the gear and pinion assembly 211—212 is therefore, adapted to be pivotally actuated in a manner either to effect engagement of the gear 211 and pinion 212 with the gears 210 and 83 respectively, or to effect a disengagement thereof so as to break the gear train drive between the sprocket 207 and screw 75. The described provision for disconnecting the gear drive to the screw 75, enables the manual actuation of the screw independently of the power drive therefor, as by the hand wheel 84, as for the purpose of returning the carriage to an initial or starting position. As a means for maintaining the plate 215 in its adjusted position, the plate is provided with a slot 220 through which extends a securing bolt 221 engaging the end 63 of frame 60. Loosening this bolt permits the plate 215 to be adjusted about its pivotal axis, and when the desired adjusted position of the plate is attained, the bolt may be threaded up to hold the plate securely in place.

The speed changer 203 is fully adjustable, through an adjusting handle 222, to attain any desired speed ratio between the driving shaft 204 and driven shaft 202 thereof, the speed ratios obtainable of course, being determined by the characteristics of the particular speed changer utilized.

In connection with the winding spool structure 92, it is desired in the present embodiment of the invention, to include means for resiliently urging the incoming portions of the core strips 50 and 51 against the core structure as it is wound on the spool, as shown in Figs. 2 and 5. For this purpose, a furcated arm structure generally denoted by the numeral 225 has one end portion 226 thereof pivotally mounted upon a pin 227 which is carried by a supporting frame 228, secured to a portion of the carriage 69. The furcated end of the arm carries, in properly spaced relation, a pair of roller elements 229 and 230, the roller 229 being disposed to engage the core strip 50 (Fig. 5), while the roller 230 engages the strip 51 as it is wound. These rollers are urged into engagement with the strips by a bias element such as a torsion spring 231 acting on the arm in the manner shown in Fig. 6.

As shown in Figs. 5, 6 and 7, a guard frame or cover 232 is arranged substantially to enclose the gear mechanism carried by the carriage 69, whereby to protect these elements and to prevent accidental contact with these parts during operation of the winding machine.

Proceeding now with a discussion of the operation of the complete mechanism, the correlation of the core punching and core winding operations is effected in a predetermined manner, so that during the punching stroke of the punch cross-head **32**, the drive from the crankshaft **20** to the arm **153** carrying the pawl **172**, produces an upward movement of this arm which effects a re-engagement of the pawl with the ratchet wheel **174**, preparatory to the down stroke of the arm **153** to produce in the manner heretofore described, rotation of the shaft **88** and hence of the spool structure **92**. Thus, during the core punching stroke of the punch machine, the winding spool **92** remains stationary, but during the return stroke of the punch, the spool is rotated so as to wind the punched strips, and also in so doing, serves to displace the strip portion in the punch machine to provide for successive punching operations thereupon. Moreover, the drive mechanism for the winding spool structure **92** and its carriage **69**, is adapted, as will be readily understood from the foregoing description thereof, to produce in a simultaneous and step-by-step manner, rotation of the winding spool **92** and displacement of the spool in a direction away from the punching machine, the displacement of the spool of course, being effected through the movement of the carriage **69** along the ways **68**. The provision of the step-by-step recession of the spool from the punching device, is made in order to effect an increasing or graduated spacing of the punched portions, to attain the desired alignment of the slotted portions as the strips are wound on the spool, and as the diameter of the core increases during the winding process. The necessity for such a provision becomes obvious when it is considered that upon increasing the diameter of the core as a result of the winding operation, the outer layers of the core necessarily have a greater circumferential dimension than obtains with those strip elements nearer the axial portion of the core. Hence, as the strips are wound to produce cores of increasing diameter up to the final diameter desired, the punched portions of the strips must be spaced farther and farther apart with the increase in diameter of the core, in order to effect a proper alignment of the slotted portions to provide core slots of desired form. This factor is, therefore, taken care of by the variations in the resultant of shifting and rotational movements of the spool **92**.

From the foregoing, it will be readily understood that by regulating the speed of displacement of the spool **92** relative to its rotational speed, as by changing the speed ratio of the speed changer **203**, the space relation of the slotted portions of successively wound layers of the strips may be varied to obtain any desired form and sectional aspect of the final core slots.

It will be noted from Figs. 1, 4 and 8 that when the spool structure **92** and its carriage **69** have been displaced along the guide ways **68** to a zone adjacent the end **63** of the frame **60**, in which position of the spool the armature cores wound thereon normally will be completed, the armature assemblies may be removed from the spool and the spool and carriage returned to the starting zone for the winding process, i. e., near the end **61** of the frame **60**. The return of the carriage and winding spool structure to a point adjacent the frame end **61** for further winding operations, may be effected readily and easily, and without reversing the automatic drive to the screw **75**, simply by interrupting the gear train from the sprocket **208** to the screw **75**, as by pivotally displacing the plate **215** carrying the gear and pinion assembly **211**—**212**, and then manually operating the hand wheel **84** in the proper direction to move the carriage toward the frame end **61**. This done, the plate **215** may be then moved to effect re-engagement of the gear and pinion assembly **211**—**212** for further automatic drive of the spool **92**.

The described and illustrated mechanism embodying the improvements of this invention fully attains the foregoing objects and advantages, and further, attains a readily regulated and positive acting arrangement for producing disc type armature core assemblies having slots of substantially any desired form or sectional aspect.

It is to be understood that this invention is not limited to the particular described and illustrated embodiment thereof, but that alterations and modifications of the mechanism and arrangement thereof may be effected without departing from the spirit and full intended scope of the invention, as defined by the claims appended hereto.

I claim:

1. The method of forming disc-type slotted core assemblies for electrical machines, which consists in advancing a continuous strip of material successively through a perforating device, thence onto a winding device, in actuating the devices in coordinate manner, and in automatically and uniformly varying the distance relation between said devices coordinately with their respective operations on the strip.

2. The method of forming disc-type slotted core assemblies for electrical machines, which consists in advancing a continuous strip of metal successively through a perforating device, thence onto the winding device, in actuating the said devices in coordinate manner, and in effecting automatically a uniform linear recession of the winding device from the perforating device, in timed relation to the operations of said devices on the strip.

3. The method of forming disc-type slotted core assemblies for electrical machines, which consists in advancing a continuous rectilinear strip of metal of which the core is to be formed, successively through a punching device, thence onto a winding and core-forming device, in actuating the devices in coordinate manner, and in effecting automatically and in an intermittent manner, a recession of the winding and core-forming device, from the punching device in a direction lengthwise of the strip under treatment, and in timed relation to the operation of said devices.

4. The method of forming disc-type slotted core assemblies for electrical machines, which consists in advancing a continuous rectilinear strip of metal of which the core is to be formed, successively through a punching device, thence onto a winding and core-forming device, in actuating the devices in coordinate manner, and in automatically varying the spacing of the punched portions of the strip by variation in the resultant of intermittent shifting and rotational movements of the winding and core-forming device.

5. In a machine for producing slotted core assemblies of the general type described, the combination of a slot punching device, a core winding device, operating means for said punching device, and mechanism actuated by said means for automatically effecting alternately with slot punching operations of said punching

device, coordinate rotational and linear displacement movements of the winding device.

6. In a machine for producing slotted core assemblies of the general type described, the combination of a slot punching device, a core winding device, operating means therefor common to said devices and mechanism cooperating with said means operable alternately with slot punching operations of said punching device, for imparting to the winding device in a synchronous manner, both linear displacement and rotational movements.

7. In a machine for producing slotted core assemblies of the type described, the combination of a slot punching device, a core winding device, operating means for said devices, and mechanism coacting with the operating means for imparting to the winding device in a synchronous manner, intermittent linear displacements and rotational movements.

8. In a machine for producing slotted core assemblies of the type described, the combination of a slot punching device, a core winding device, operating means for said punching device, and means operated by said punch operating means, for actuating said winding device, said actuating means including reciprocating elements, arranged for coordinately effecting step-by-step rotation and linear displacement movements of the winding device.

9. In a machine for producing slotted core assemblies of the type described, the combination of a slot punching device, a core winding device, and operating means therefor common to said devices, said means being adapted for effecting alternately, operation of the punching device, and uniform rotational and linear displacement movements of the winding device.

10. In a machine for producing slotted core assemblies for electrical machines from a strip of core-forming material, the combination of a strip punching device and a strip winding device, operating means therefor common to said devices, and mechanism forming a part of said operating means, and operatively associated with said winding device, adapted for effecting simultaneously, step-by-step rotational and linear displacement movements of the winding device.

11. In a machine for producing a slotted armature core assembly from a strip of core-forming material, the combination of a slot punching device for the strip, a winding device upon which the slotted strip is wound to form a core assembly, said winding device serving in operation to displace the strip through the punching device, and operating mechanism for the winding device, of a type adapted to effect in a simultaneous manner, step-by-step displacement and rotational movements of the winding device.

12. In a machine for producing slotted core assemblies for electrical machines, from a strip of core-forming material, the combination of a slot punching device, a core winding device, operating means for the punching device, including a crankshaft, means operated from the crankshaft, adapted for producing a step-by-step rotation of the winding device, and mechanism responsive to the step-by-step rotation of the winding device, adapted for effecting a step-by-step displacement of the winding device.

13. In a machine for producing slotted armature core assemblies of the type described, the combination of a slot punching device, a movable carriage, a winding device on said carriage, operating means for said devices, and mechanism associated with the operating means and adapted for imparting a uniform rotational movement to the winding device and a uniform linear displacement movement to the carriage.

14. In a machine for producing slotted core assemblies of the type described, the combination of a slot punching device, a core winding device, a carriage for said winding device, operating means for said devices, and mechanism adapted for imparting to the winding device a step-by-step rotational movement and simultaneously therewith, a step-by-step linear displacement movement to the carriage, said mechanism being so associated with the operating means as to coordinate said movements with those of the punching device.

15. In a machine for producing slotted armature core assemblies of the type described, the combination of a slot punching device, a core winding device, a movable carriage supporting said winding device, and operating means for said devices, said means being adapted for effecting in an alternate manner, operation of the punching device and a combined rotational movement of the winding device and displacement movement of the carriage therefor.

16. In a machine for producing wound structures from a continuous, processed strip, a winding device upon which the strip is wound to form the desired structure, a movable carriage for said winding device, and operating means therefor, adapted for imparting coordinately and in a step-by-step manner, rotational movement to said winding device and a linear displacement movement to said carriage, for controlling the rate of movement of the strip prior to winding.

17. In a machine for producing slotted armature core assemblies from a strip of core-forming material, the combination of a slot punching device for the strip, a winding device upon which the slotted strip is wound to form an armature core assembly, the mechanism of the punching device including a crankshaft, and means for operating the winding device through said mechanism including a rock shaft operated from the crankshaft, and mechanism associated with said rock shaft, adapted for effecting in a synchronous manner, step-by-step linear displacement and rotational movements of the winding device.

18. In combination in a machine of the type described for producing a wound, slotted core assembly from a strip of core-forming material, a slot punching device for the strip, of a type including a crankshaft, a winding device upon which the slotted strip is wound, a rock shaft operated from said crankshaft, mechanism operated by said rock shaft, adapted for effecting a step-by-step rotational movement of the winding device, and mechanism operated responsively to the rotational movement of the winding device, adapted for effecting a coordinate linear displacement thereof.

19. In combination in a machine for producing a stator core assembly of wound type from a strip of slotted core-forming material, a rotatable strip winding element, a movable support for said element, operating means for said winding element including a ratchet and pawl assembly for imparting to the element a step-by-step, unidirectional rotation, and means for moving said winding element support coordinately with the winding operation.

20. In combination in a machine of the type described for producing an armature core assem-

bly or the like from a strip of slotted core-forming material, a rotatable strip winding element, a movable carriage supporting said winding element, operating means for said element including a ratchet and pawl assembly adapted for imparting to the element a step-by-step, unidirectional rotation, and mechanism functionally responsive to said operating means, and including a gear train, adapted for effecting a linear movement of said carriage coordinately with the rotation of the winding element.

GORDON R. ANDERSON.