No. 678,280.

Patented July 9, 1901.

J. RIDDELL.

COIL FORMING APPARATUS.

(No Model.)

(Application filed Jan. 19, 1901.)

6 Sheets—Sheet 1.

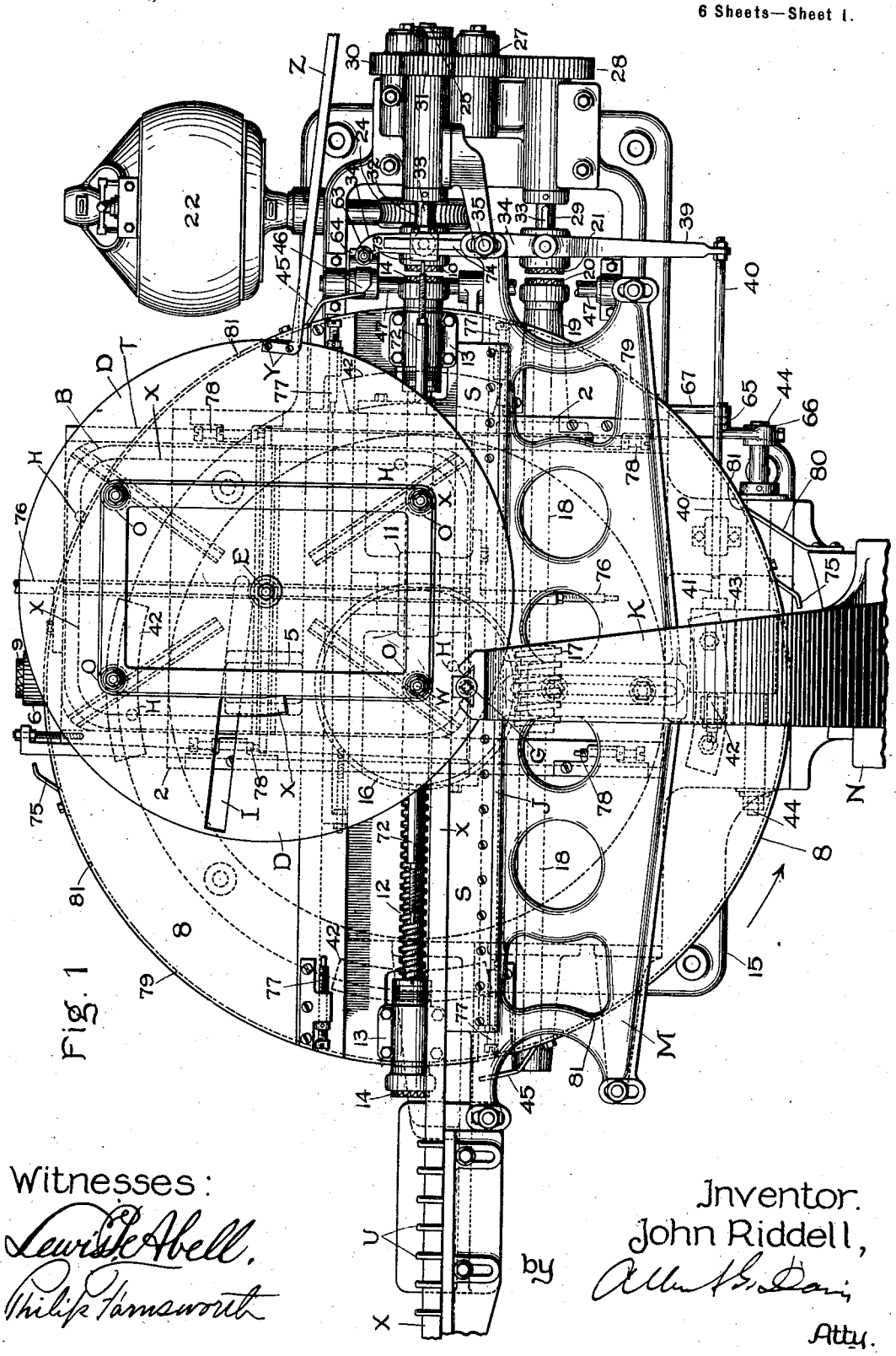


Fig. 1

Witnesses:

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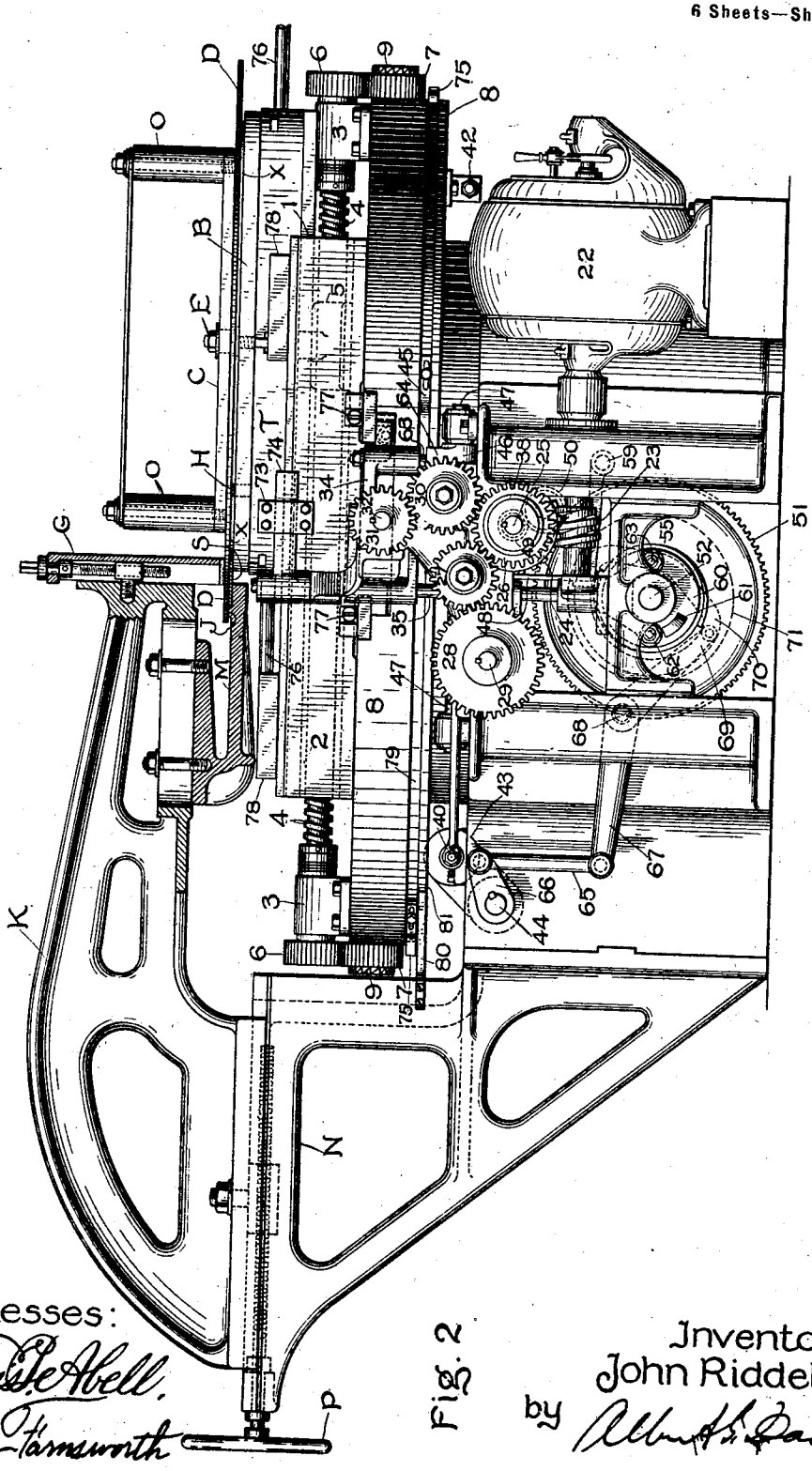
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6 Sheets—Sheet 2.



Witnesses:
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Fig. 2.

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(No Model.) 6 Sheets—Sheet 3.

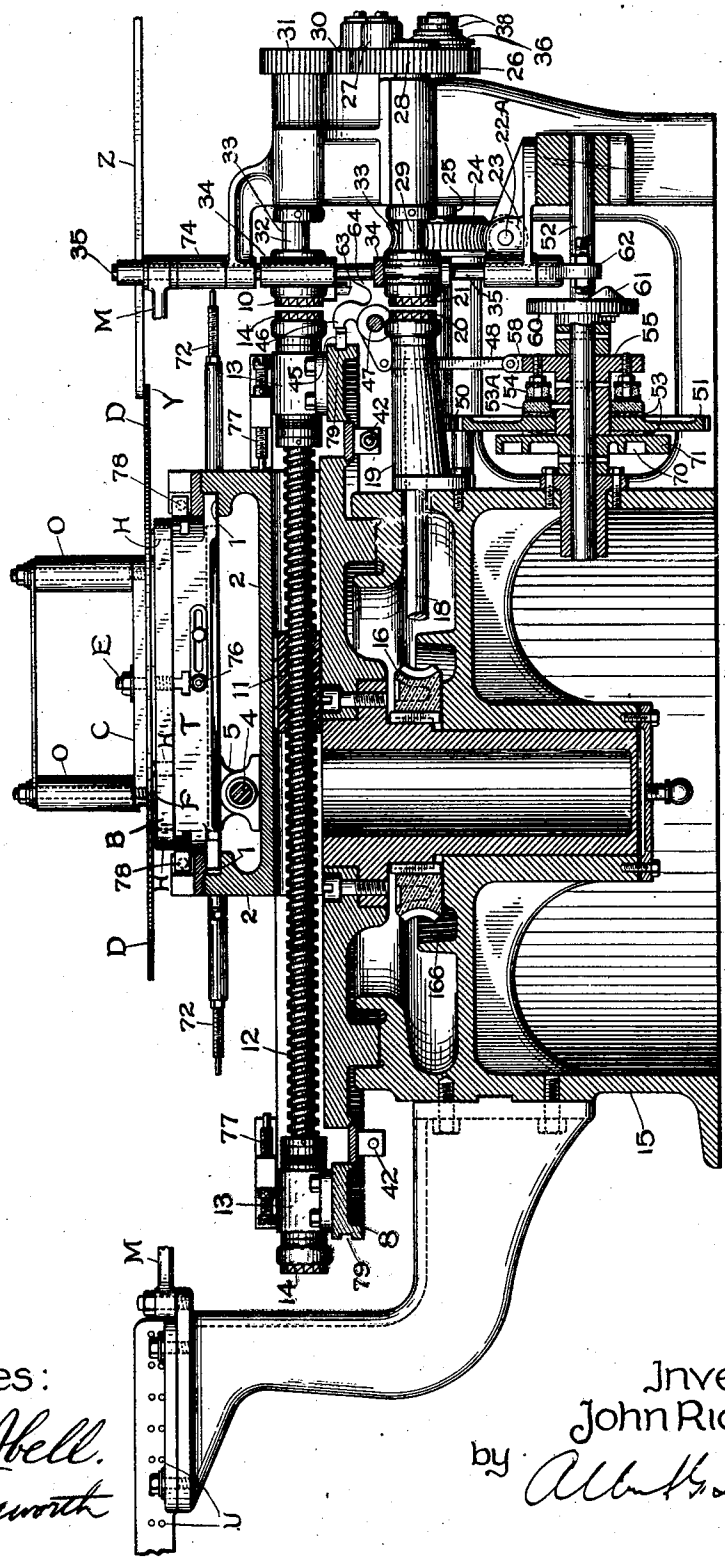


Fig. 3.

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(No Model.) 6 Sheets—Sheet 4.

Fig. 5.

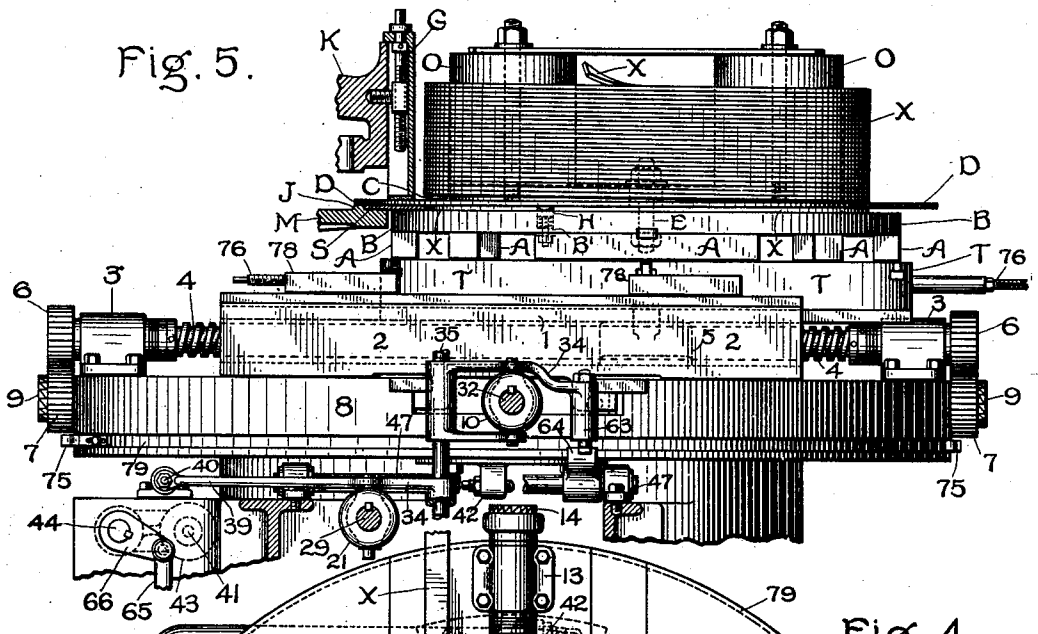
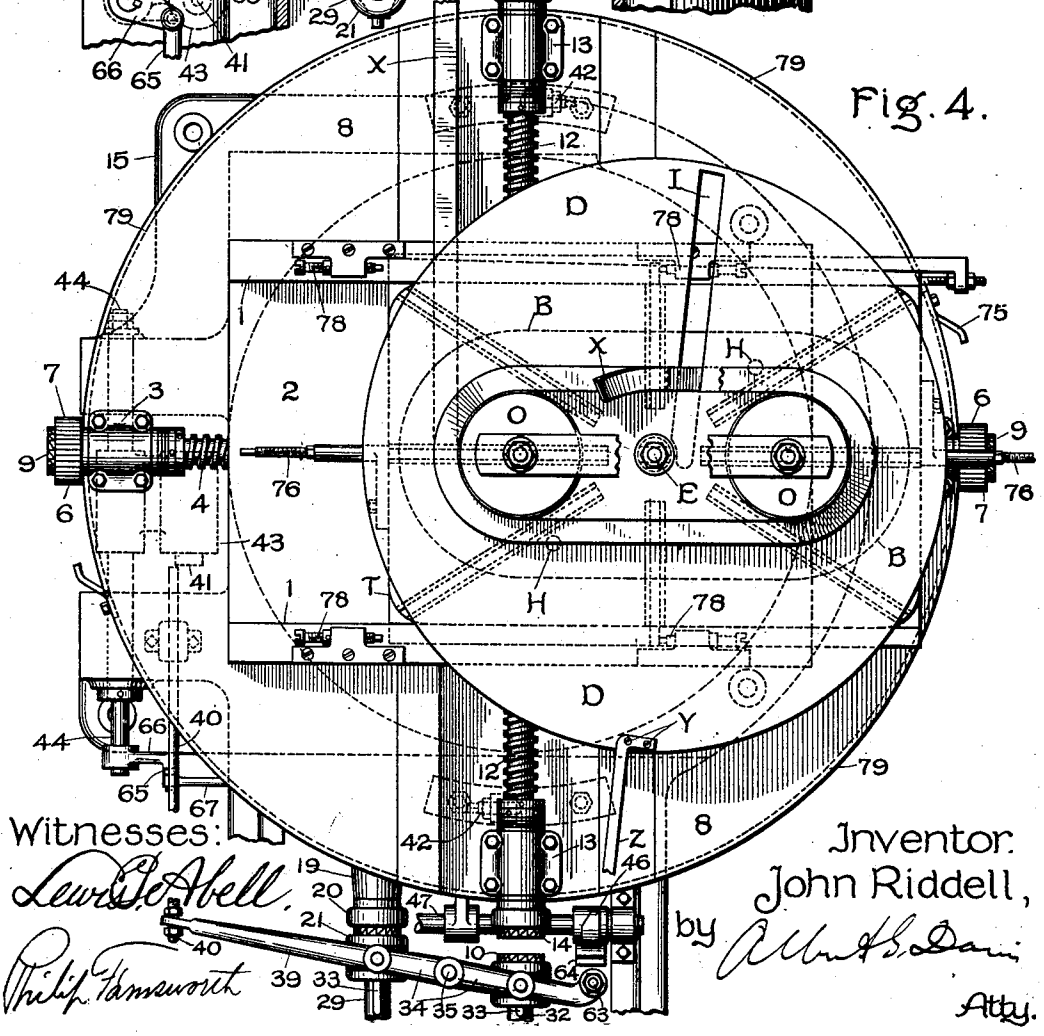


Fig. 4.



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6 Sheets—Sheet 5.

Fig. 6.

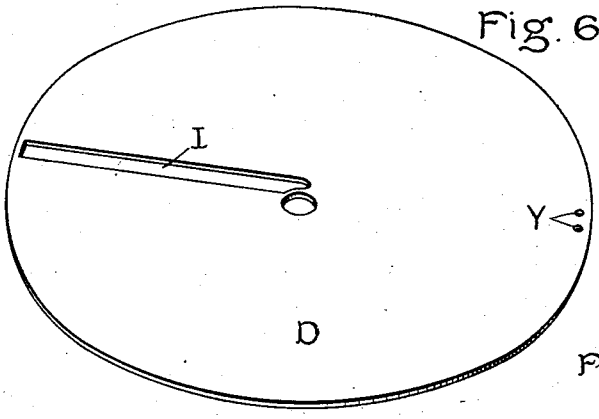


Fig. 7.

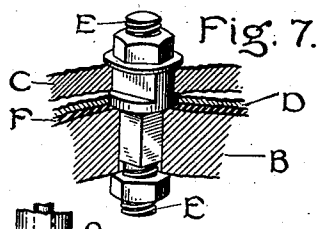


Fig. 8.

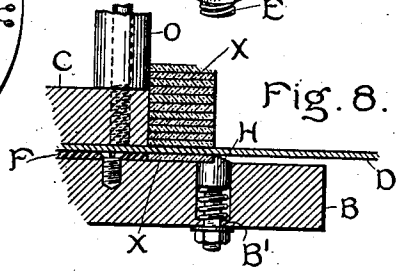


Fig. 9.

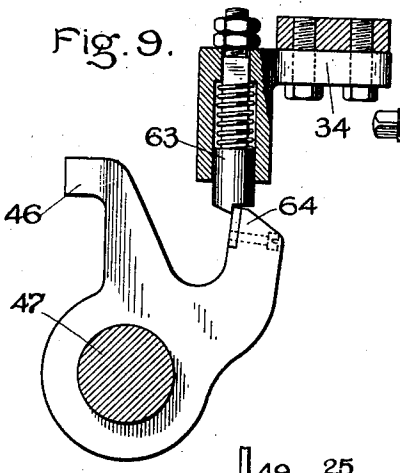


Fig. 10.

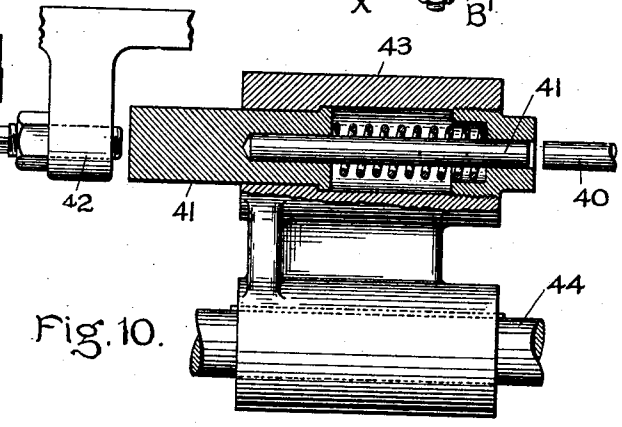


Fig. 11.

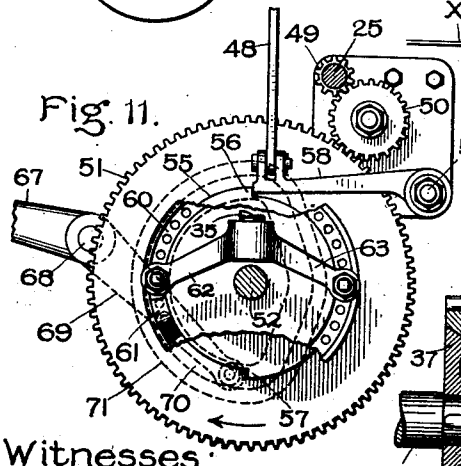


Fig. 12.

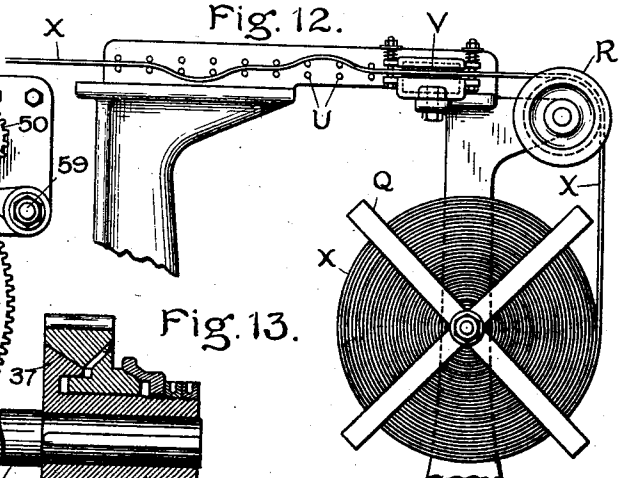
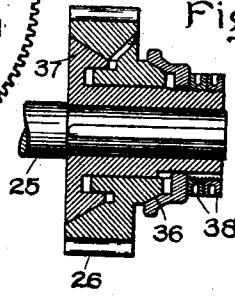


Fig. 13.



Witnesses:

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(No Model.) (Application filed Jan. 19, 1901.)

6 Sheets—Sheet 6.

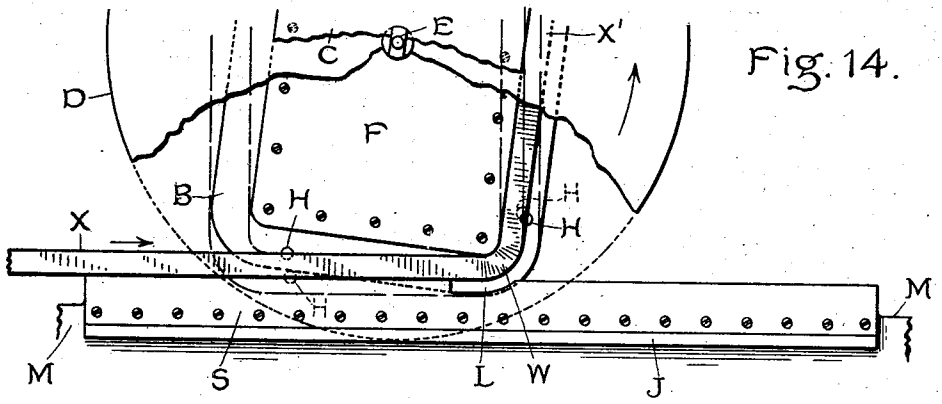


Fig. 14.

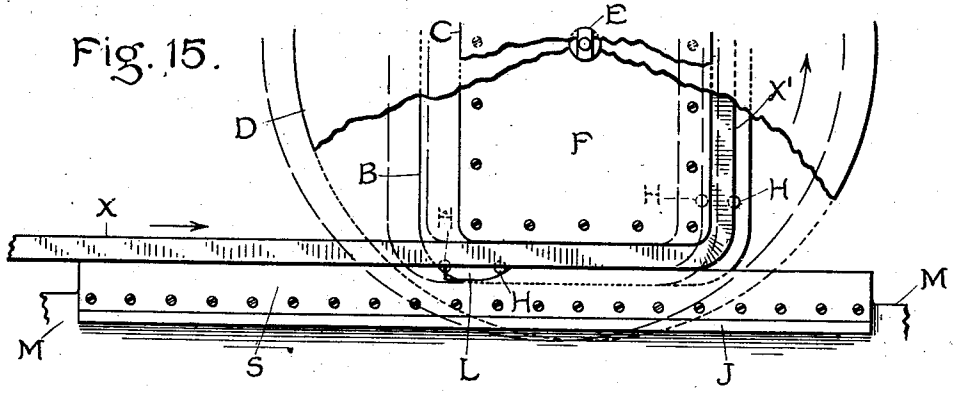


Fig. 15.

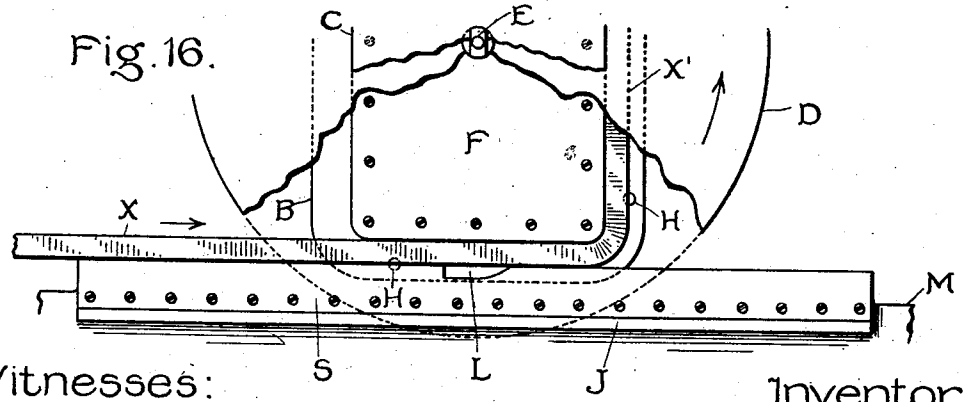


Fig. 16.

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UNITED STATES PATENT OFFICE.

JOHN RIDDELL, OF SCHENECTADY, NEW YORK, ASSIGNOR TO GENERAL ELECTRIC COMPANY, OF NEW YORK.

COIL-FORMING APPARATUS.

SPECIFICATION forming part of Letters Patent No. 678,280, dated July 9, 1901.

Application filed January 19, 1901. Serial No. 43,904. (No model.)

To all whom it may concern:

Be it known that I, JOHN RIDDELL, a citizen of the United States, residing at Schenectady, county of Schenectady, State of New York, have invented certain new and useful Improvements in Apparatus for Forming Coils, (Case No. 1,123,) of which the following is a specification.

This invention relates to improvements upon the apparatus designed by Henry Geisenhoner and disclosed in Patent No. 666,008, dated January 15, 1901, for winding metallic ribbons edgewise into coils for the fields of electrical machines or other desired purposes. The apparatus referred to was manually operated, and improvements herein comprise means for operating the machine by power, and also improvements in the structure and method of operation of the machine. In Geisenhoner's apparatus it was necessary to remove the hand-operated lever at the completion of every half-turn of each coil, whereas the machine herein described operates automatically and continuously. Furthermore, Geisenhoner's apparatus, as shown, was adapted to produce only a coil similar in shape to an ellipse, while with this machine coils of any desired shape can be made.

Of the drawings, Figure 1 is a plan view of the machine. Fig. 2 is a right-hand end elevation of the same as shown in Fig. 1. Fig. 3 is a vertical longitudinal section of the machine as shown in Fig. 1, showing in lateral elevation a portion of the actuating mechanism. Fig. 4 is a plan of that portion of the machine wherein the winding or bending operation is carried out. Fig. 5 is an elevation of a portion of the machine as shown in Fig. 2, but having the gears removed. Fig. 6 is a perspective view of the pressure-disk D, under which the metallic ribbon is held in the process of winding or bending. Fig. 7 is a detail view showing how the disk D of Fig. 6 is secured to its associated parts, as shown in Figs. 2, 3, and 5. Fig. 8 is a detail vertical section showing one of the devices which assist in holding the ribbon in position during the process of winding. Figs. 9, 10, and 11 are detail views of parts of the automatic actuating mechanism and will be described more fully hereinafter. Fig. 12 is an elevation of the safety tension mechanism, from which the strip is drawn into the machine. Fig. 13 is a section of a friction-clutch, which is interposed between the source of power and the machine. Figs. 14, 15, and 16 are plan views of the parts of the machine which carry out the winding or bending process, a part of the pressure-disk D, above referred to, being broken away to disclose the parts which actually do the work of bending the ribbon.

The essence of the invention of Geisenhoner is embodied in this machine, and by it coils of ribbon or flat strips of any desired shape and wound edgewise are produced, this result being due chiefly to a non-circular former, to which is given movements of reciprocation and rotation. Means are also provided for preventing the ribbon from buckling or wrinking in any direction under the enormous strains to which it is subjected in the process of being wound edgewise.

The machine may be divided for convenience of description into four sets or parts, as follows: first, the power connections; second, the main moving parts of the machine which are driven by the power connections and which in turn actuate the parts which actually carry out the bending operation itself; third, the automatic mechanism which controls the alternately-acting clutch connections between the power connections and the main moving parts, and, fourth, the parts which are operated by the main moving parts to carry out the bending operation. The last will be described first in order to give a clear idea of what is accomplished by the machine and of the movements which must be imparted to it to enable it to discharge its functions.

The bending operation will be best understood by a consideration of Figs. 2, 5, 6, 7, 8, 12, 14, 15, and 16. As shown in Fig. 12, the metallic ribbon or flat strip X is drawn into the machine from a reel Q, over an idler R, through an oiler V, and finally through the tension-pins U, which serve after the portion of the ribbon has been drawn into the machine to anchor it while it is being bent. The disk D, Fig. 6, is mounted on the tool-steel former F, Figs. 5, 7, 2, 3, 14, 15, and 16,

and the latter is screwed to its base B, Figs. 2, 8, 14, 15, and 16, which is in turn mounted on the upper reciprocating platform T of the machine. The former F is designed to produce the desired coil or winding, and a different former is secured to the base B for every different winding desired. The former-base B is furnished with legs A, Fig. 5, which rest on the upper platform T, these legs providing a space between said platform and the bottom of the base B, in which space is accessibly located the lower portion of the bolt E, which retains the base and disk together. This bolt E also secures to the disk E and former-base B a support C, Figs. 2, 3, 5, 7, and 8, which support carries the ribbon X after it has been wound and has passed through the slot I, Figs. 1 and 6, in the disk D, Figs. 1, 3, 4, 5, and 7. Spools O are mounted upon the support C and serve to carry the coil as it gradually increases in size as the bending operation is continued. As in the apparatus of Geisenhoner, the former F must be given both longitudinal and revolutionary movements. In Fig. 7 the bolt E is shown to be angular where it passes through the former-base B, former F, and the support C. Thus the support C, upon which the wound coil is carried, shares the movement of the former F, and the successive portions of the ribbon as they are bent and pass through the slot I in the disk D simply take their places around the support C and the spools O mounted thereon; but the bolt E, Fig. 7, is circular where it passes through the disk D, and this construction permits the disk to be held from rotation by a lever Z, Figs. 1, 3, and 4, which is attached to the disk D at Y, Figs. 1, 3, 4, and 6, and is movably mounted at its other end in any desired manner. Although the disk D is held from rotation, it has a most peculiar revolutionary movement. The function of the disk D is, like that of the slotted disk of the apparatus of Geisenhoner, to provide a path from the wound ribbon to a position beyond the winding means. In this case, however, the disk D has an additional function and serves also as a pressure-disk to hold the ribbon in place as it is being wound, whereas Geisenhoner provided a separate plate for this purpose.

As in Geisenhoner's apparatus, the ribbon is wound by the revolutionary movement of the former F and fresh portions of the ribbon are drawn from the reel Q into the machine by the longitudinal movement of the former F. In this machine the former F is subjected to a left-hand revolution, as indicated by the arrows in Figs. 1, 14, 15, and 16. In Fig. 14 is shown in full lines the position of the former F when it has nearly completed its revolutionary or winding movement. A sufficient portion of the ribbon X has by a previous longitudinal movement of the former F to the right been drawn into the machine to provide material for a quarter-turn of the coil. The dotted lines in Fig. 14 indicate the position of the former when it has completed its revolutionary movement and is about to be moved longitudinally to the right to draw or feed the ribbon X from the reel Q into the machine. A strip S, preferably of tool-steel, is screwed to a portion M, Figs. 14, 15, 16, 1, 2, and 5, of the machine and projects over the top of the former-base B, which is movable beneath it. (See especially Figs. 2 and 5.) The lower portion of the periphery of the disk D in Figs. 14, 15, and 16 is dotted; but this is because a portion of the disk is cut away in the drawings to show the parts, and the disk D actually does hang over the strip S as well as over the former-base B. The broad surfaces of the ribbon X are held between the former-base B and the disk D, and its edges are held between the edge of the strip S and the edge of the former F, Figs. 2, 14, 15, and 16. It will be seen in Figs. 2 and 5 that a lug J of the part M serves as an anchor to prevent the displacement of the strip S to the left under the bending strains. In Fig. 14, as stated above, the bending operation has been nearly completed at the corner W, (see also Fig. 1,) which is the central point of the rotating table 8; but the portion X′ of the ribbon now extends at an angle to the unwound portion and will pass through the slot I in the disk D (shown in Figs. 1, 5, and 6) and out upon the support C and the spools O before the former has turned through three-quarters of a revolution. That portion of the unwound ribbon X which lies between the edges of the former F and the strip S is securely held; but so far no means has been described by which the ribbon X can be held against sidewise movement after it has been bent and has passed around the corner W away from the supporting edge of the strip S. If such means were not provided, the ribbon might bulge edgewise at the point H under the strain to which it is subjected at the bending-point W. This means is clearly shown in detail in Fig. 8 and its application is illustrated in Figs. 3, 14, 15, and 16. A little in advance of each corner of the former F the former-base B is perforated, only an annular shoulder B′ being left. An automatic holding device H fills the upper part of this perforation and a helical spring resting on the shoulder B′ tends to move the device H upward. The lower part of the device H extends through the hole inclosed by the annular shoulder B′ and being threaded is engaged by a nut to secure the device in position. These several holding devices, one for each side of the former F, tend to extend above the surface of the former-base B, and each device is provided with a shoulder, which holds the ribbon X against the edge of the former F after the ribbon X has been bent or wound away from the supporting edge of the strip S at the corner W. In Fig. 14 the right-hand holder H is serving this purpose and continues to do so until the ribbon which it holds against the edge of the

former F passes through the slot I of the disk D and out upon the supporting-spools O. The holder H, however, continues to extend above the surface of the former-base B, although it has no ribbon to hold when it is being carried down the lower portion of its third quarter of a revolution, Figs. 1 and 3. As soon as the holder H reaches the strip S at the end of its third quarter of a revolution, Fig. 1, its beveled upper portion engages the lower surface of the strip and the helical spring is put under compression to permit the holder H to pass beneath the strip S. Then the holding device H is drawn by the former-base longitudinally beneath the lower surface of the strip S, a fresh portion of the ribbon X being drawn into the machine by the same operation. In order that one of the holders H shall hold the ribbon against the edge of the former F throughout the entire bending operation, the holder H must engage the edge of the ribbon just before the latter is carried away from the strip S at the corner W. To this end a slot L is cut in the strip S, and as the former B reaches the end of its movement the holder H, which has been held down by the lower surface of the strip S, springs up and engages the edge of that portion of the ribbon which is to be bent and holds it securely against the edge of the former F from that time on throughout the bending operation and until the bent ribbon has passed through the slot I in the disk D and out upon the supporting-spools O. In Fig. 15 the disk D, former-base B, and the former F have been carried to the right to draw a sufficient length of the ribbon X into the machine for the next bending operation. The disk D is broken away, as before, in order to clearly disclose the parts, although it should be remembered that it overhangs the strip S and that the ribbon X passes through the space formed between the disk D and the former-base B. In the left-hand or dotted position of the moving parts the holder H has been carried to the edge of the slot L in the strip S, and in the right-hand or full-line position of the parts the holder H has passed the left-hand edge of the slot and has sprung up and with its shoulder has gripped the edge of the ribbon X as a substitute for the edge of the strip S, which has hitherto held the ribbon against the edge of the former F. In this position of the holder H the revolutionary or bending motion of the former F is about to take place, and the holder H will pass out of the slot L, along the curved right-hand end of the latter, and will start on its revolution about the center W of the table, Fig. 1. This revolution is interrupted when the former-base B has been revolved, so that its left-hand vertical side in Fig. 15 has been carried to a position parallel to or adjoining the unwound ribbon X, and the parts will then be again carried longitudinally to the right and another holder H will operate to hold the new portion of the ribbon against the edge of the former F, and then another winding revolution of the parts will take place. In Fig. 16, the strip S being fixed, the entire structure held together by the bolt E is being carried longitudinally to the right to draw in the ribbon X preparatory to the bending revolution. The edge of the strip S is holding the ribbon X against the edge of the former F, and a holding device H is depressed beneath the strip S and is ready to spring up into the slot L to grip the edge of the ribbon X. The other device H is shown holding the ribbon X′ against the vertical edge of the former F.

It should be noted that each holder H is located just in advance of one of the corners of the former F. Each time that the machine is set up to wind a new form of coil the old former F and the former-base B are removed and new ones suitable for the production of the desired winding are substituted. The strip S is removed also and a new unslotted one is screwed upon the frame M in place of it. The machine is then set in operation without starting the ribbon X and the mechanic scratches on the strip S the two extreme limiting-points where the holders H leave the strip S when revolved with the new former from the position to which they are carried by the long and short sides of the latter. The slot is then cut as thus indicated and the machine is ready for operation if the actuating mechanism is properly adjusted. The disk D has a most irregular movement, as has been mentioned above. It is held from rotation as above described, but has what may be termed a "wavy" revolution, as it shares in the longitudinal and revolutionary movements of the former-base B and former F. The result is that it always covers the parts at the bending-point W and holds the ribbon X in place. As shown in Fig. 5, an adjustable device G, provided with a strip of fiber at its lower end, presses on the disk D, and this prevents the ribbon from forcing the disk D upward, which would permit the ribbon to wrinkle. This device is also shown in Fig. 2, and it will be noted that it is carried by a frame K, which is adjustable on the support N by a block and bolt, as shown. The part M, on which the tool-steel strip S is mounted, is also secured, as by the bolts shown, to the frame K. Thus by the wheel P, which turns the bolt, a longitudinal adjustment of the frame K can be obtained. The device G and the part M are both adjusted simultaneously. The wheel P is turned until the right-hand edge of the strip S abuts against the edge of the ribbon X in order that the ribbon may be securely held against the edge of the former F.

The main moving parts of the machine which are driven by the power connections to operate the above-described parts which carry on the bending operation will next be described. These main parts are the upper and lower reciprocating platforms T and 2, respectively, and the rotary table 8. It has

been seen that upon the upper platform T the former-base B and former-plate F are mounted. This upper platform T, as best shown in Fig. 3, is reciprocably mounted in ways 1 of the lower reciprocating platform 2. Bearings 3, Figs. 2, 4, and 5, are mounted on the table 8, and in these bearings is mounted a worm 4, which works through depending extensions 5, Fig. 3, of the upper platform T to reciprocate the latter along the ways 1. Upon each end of this worm 4 is mounted a gear 6, Figs. 2, 4, and 5, and these gears coact with gears 7, which are mounted on the periphery of the rotating table 8. This table 8 has a left-hand rotation, as indicated by the arrow in Fig. 1, and causes the above-described left-hand revolution of the former F. Each gear 7 is cast in a single piece with a clutch member 9, each of which two clutch members in turn, as the table 8 is rotated, engaging with its power-driven clutch member 10, Figs. 1, 3, and 4, which is driven by the gear 31 to move the upper platform T longitudinally along the ways 1 alternately in opposite directions.

The lower platform 2 is mounted on the rotating table 8 to slide across the same at an angle of ninety degrees with respect to the direction of reciprocation of the upper platform T. In Figs. 1 and 3 is shown an interiorly-threaded block 11, depending from the lower platform 2, and through this block works a worm 12, which worm is mounted in bearings 13 in diametrical depressions in the rotating table 8 and is provided at each end with a clutch member 14, each of which members coacts with the same power-driven clutch member 10 with which the upper platform clutch members coact. These four clutch members of the upper and lower tables are arranged alternately ninety degrees apart on the periphery of the rotating table 8.

As best shown in Fig. 3 the rotating table 8 is mounted in a suitable manner on the bed 15 of the machine. A worm-wheel 16 is keyed to the table and is rotated in an oil-well 16^{6} by a worm 17, Fig. 1, on the end of the shaft 18, Figs. 1 and 3. On the other end of the shaft 18, which bears in a journal-box 19, is mounted a clutch member 20, which engages with its power-driven fellow clutch member 21, which in turn is rotated by the gear 28 on the right-hand end of the shaft 29. When the machine is operating either of the clutch members 9 or 14 of the upper or lower platforms, respectively, whichever happens to face the clutch member 10 engages with the latter to move to the right the platform to which it is connected to draw the ribbon X into the machine. It may be noted here that when the lower platform 2 is moved it carries the upper platform T with it. After either platform has been thus moved the required distance it is automatically unclutched, and then the clutch members 20 and 21 are brought into engagement to rotate the table 8 until the clutch member of the other platform faces the clutch member 10, and then the other platform is moved longitudinally. The clutch members 20 and 21 are brought into engagement once more to rotate the table, so that a clutch member on the opposite end of the worm which has operated its platform faces the clutch member 10, and then these two clutch members coact to move the platform which was first moved in a direction opposite to that in which it was first moved. The table is then again rotated until the clutch member on the opposite end of the worm which was second to move its platform faces the clutch member 10, and then these two clutch members coact to move such platform in the direction opposite to that in which it was moved in the first place. This cycle of operations is continued automatically as long as power is applied to the machine and serves to carry out the bending operation above described.

The power connections will now be described. It should be again noted here that Fig. 1 is a plan view of the machine, Fig. 2 an elevation showing a broadside view of the power connections looking at the right-hand end of Fig. 1, and that Fig. 3 is a vertical longitudinal section of Fig. 1, showing the automatic mechanism at the right in elevation. A suitable motor, preferably an electric machine 22, drives a worm 23, Fig. 2, mounted on the motor-shaft 22^{A}, Fig. 3, which worm meshes with a worm-wheel 24, Figs. 1, 2, and 3. This worm-wheel is keyed to the power-shaft 25, on the right-hand end of which is mounted a gear 26. Meshing with the gear 26 is an idler-gear 27, which meshes with a gear 28, keyed to a shaft 29, which shaft carries the table power clutch member 21. A second idler 30 meshes with the power-gear 26 and with a gear 31, which is keyed to the shaft 32, which carries the platform power clutch member 10. Fig. 13 shows in detail a safety friction device partly shown in Figs. 1, 2, and 3, which is interposed between the driving-motor 22 and the machine at the gear 26. This device is intended to guard the machine from injury in case its operation is interfered with in any way. In such case if, for example, any of the gears should be clogged the surfaces 36 and 37 will slide along the inner surfaces of the power-gear 26, even although the nuts 38 be tightly screwed up, and this permits the shaft 25 to rotate freely without driving the gear 26.

The automatic mechanism which controls the coöperation of the power connections and the main moving parts of the machine will now be described. The table and platform power clutch members 21 and 10, respectively, are free to move longitudinally along the keys 33 of their respective shafts 29 and 32. These two clutch members are connected together by an arm 34, Figs. 1, 2, 3, 4, and 5. This arm between the points where it is connected to the clutch members 21 and 10 is pivoted to a vertical shaft 35. With this construction

the rotating table 8 and either one of the platforms T or 2 can never be simultaneously connected with the source of power. In Figs. 1 and 2 both power clutch members 10 and 21 are shown disengaged from the respective table and platform clutch members 9 or 14 and 20. This is a condition which is only temporary and exists only for a very short interval of time between the instant that the table 8 stops rotating and the instant that one of the platforms—as, for example, the lower one 2—begins to move. Let us assume for convenience in description that the lower power clutch member 21, Fig. 3, has been moved into engagement with its fellow member 20, which is connected to the table 8, as shown in Fig. 4. In such case as the power clutch members 21 and 10 are connected by the arm 34, which is pivoted at the vertical shaft 35, Fig. 4, the clutch member 10 is moved farther to the right from its fellow member 14 than as shown in Figs. 1 and 2. Also the end of the arm 39, Fig. 1, which is practically an extension of the arm 34, is in a position farther to the left than that shown, and the rod 40, attached at a right angle to the arm 39, is also in its extreme left-hand position, ready to have its end abutted by the plunger 41. (Shown in detail in Fig. 10 and in dotted lines in Figs. 1, 2, 4, and 5.) This plunger is resiliently mounted to decrease the shock caused by the impact of the dog 42, which is secured to the lower surface of the table 8, as shown in Figs. 1, 2, 3, 4, and 5. Four of these dogs 42 are mounted ninety degrees apart on the lower surface of the table. As shown in Figs. 1, 2, and 10, the plunger 41 is mounted in the box 43, which is mounted on the shaft 44, journaled in the machine.

As stated above, the end of the rod 40 is in position while the table is being rotated to be abutted by the plunger 41. In Figs. 1, 2, and 3 the rod 40 has just been pushed to the right to move the clutch member 21 to the right away from its fellow member 20 to unclutch the table. As soon as the table is unclutched a powerful spring-brake 80, secured to the stationary part N of the machine, Fig. 1, engages with its free end a notch 81, which is one of four notches formed in the periphery of the table 8. This prevents the continued momentum rotation of the table 8 and stops the table, so that one of the platform clutch members 9 or 14 is face to face with the power clutch member 10.

The clutch member 10, which is by the movement of the rod 40 to the right moved slightly to the left, should be so mounted on its arbor 32 that it will have sufficient friction to prevent the arm 34 from being swung farther than the positions shown in Figs. 1 and 3, where neither of the clutch members 21 and 10 are in engagement with their fellow clutch members. By the movement of the rod 40 to the right the table 8 is unclutched; but neither platform should be clutched by this movement. The clutch member 14 of the lower platform 2 has now been brought face to face with the power clutch member 10. At substantially the same time that the rod 40 has been pushed to the right by the plunger 41, when the latter is actuated by the under table-dog 42 and before the table has stopped rotating, Figs. 1 and 3, one of the long dogs 45 on the periphery of the table 8 has engaged the dog 46 on the rock-shaft 47, so that the latter is rocked to raise the locking-lever 48. (Best shown in Figs. 3 and 11.) There are two of these long peripheral dogs 45, which are adjustably mounted one hundred and eighty degrees apart in a way 79 in the periphery of the table 8. The function of each is to clutch the lower platform 2 after the table 8 has been unclutched.

The locking-lever 48 releases a friction device, (shown in longitudinal section in Fig. 3 and in end elevation in Fig. 11,) said device receiving power as follows: The power-shaft 25 carries at its left end a pinion 49, which meshes with an idler 50, which in turn drives, in the direction indicated by the arrow in Fig. 11, a gear 51, which is adapted through the friction mechanism to rotate the counter-shaft 52. The friction mechanism comprises fiber members 53, one on each side of the gear 51, and a metal ring 53^A, keyed to the shaft and forced into frictional contact with the continuously-rotating gear by rubber cushions 54, adjustably mounted on a locking-cam 55. This cam 55 is formed with two locking-shoulders 56 and 57, the diameter of the cam decreasing from the highest member of one shoulder to the lowest member of the other, thus forming two independent curved portions of the periphery of the cam. The lower end of the locking-lever 48 carries a latch 58, Fig. 11, which is pivoted at 59 and normally engages either shoulder 56 or 57 to lock the friction and prevent the cam-shaft 52 from rotating. The cam-shaft 52 carries a cam 60, provided with a lateral projection 61, and when the locking-lever 48 is raised, as above described, to release the friction and permit the gear 51 to rotate the cam-shaft 52 the cam 60 carries its projection 61 against one arm 62 of the two arms 62 and 63, depending from the vertical shaft 35. In this manner the vertical shaft is rocked so that its lateral arm 34 carries the power clutch member 21 still farther away from the clutch member 20, from which it was disengaged by the movement to the right of the rod 40, and causes the power clutch member 10 to engage with the clutch member 14 of the lower platform 2, which clutch members have been brought face to face by the rotation of the table 8. The dog 46 on the rock-shaft 47 now tends to move by gravity back to its normal position, which would be permitted by the continued rotation of the locking-cam 55, having the decreasing diameter between the shoulders 56 and 57. However, as the long peripheral dog 45 still engages the dog 46 and continues to do so until the be-

ginning of the next rotation of the table 8, which carries it away, the dog 46 is held in its raised position and the friction mechanism remains free to permit the cam-shaft 52 to continue rotating.

As shown in Fig. 1, the rocking of the vertical shaft 35 and the consequent movement of its arm 34 carries a spring catch device 63, Fig. 9, mounted on its end, to the left over a projection 64 of the dog 46. If the long peripheral dog 45 were not holding the dog 46 from rocking back into its normal position, this spring-catch 63 would do so; but as one of these long peripheral cams 45 does in this case engage the dog 46 the spring-catch 63 has no function and carries out its function only in case one of the short peripheral cams 75 engages the dog 46. The reason why the dog 46 must be held in its raised position, whether by the dog 45 or the catch 63, will now be described.

As the plunger 41, Fig. 10, lies normally in the path of the under table-dog 42 the box 43, which supports the plunger 41, must be depressed on its pivot 44 to permit the dog 42 to pass when the table 8 is rotated. The mechanism by which this is done and which is actuated when the dog 46 is held in its raised position can be seen in Figs. 2, 3, and 11. In Fig. 2 a lever 65 is movably connected at its upper end with a crank 66, which is keyed to the pivot-shaft 44 of the plunger-box 43. A bell-crank lever 67 69, which is secured to a fixed pivot 68, has its left-hand arm 67 pivoted to the lower end of the lever 65 and has the end of its arm 69 adapted to work in a cam-groove 70, formed in the side of the cam 71 of Fig. 3. This cam 71 rotates like the cam 60 only when the friction mechanism is released to permit the gear 51 to rotate the cam-shaft 52. While the long peripheral dog 45 continues to engage the dog 46 to hold up the rock-shaft 47 and the pendent locking-lever 48, the cam 71 continues to rotate and depresses the plunger 41 and its box 43 entirely out of the path of the under table-dog 42 by means of the levers shown in Fig. 2 preparatory to the next rotation of the table 8.

As the clutch members 14 and 10 have been engaged by means of the rocking of the vertical shaft 35, caused by the engagement of the long peripheral dog 45 with the dog 46, the lower platform 2 will now be moving longitudinally to the right and drawing a fresh portion of the ribbon X into the machine sufficient for a short side of the coil shown in Fig. 1. This platform 2 has a short movement only, and soon one of its stops or feelers 72, Fig. 1, engages with a block 73, carried on the arm 74 of the vertical shaft 35. This rocks the vertical shaft in a direction opposite to that in which it was rocked as described above, so that the power clutch member 10 is moved to the right out of engagement with the platform-clutch 14. The power clutch member 21 is at the same time necessarily slightly moved to the left; but on account of the friction-mounting of the member 10 the member 21 will not be moved to the left a sufficient distance to engage the table-clutch 20. As soon as the platform 2 has been unclutched it engages one of the stops 77, Figs. 1, 2, and 4, mounted on the table 8, which prevents further movement of the platform. As the platform 2 had but a short movement it was unclutched while the lateral projection 61 of the cam 60 was about midway between the depending arms 62 63 of the vertical shaft 35. As the cam 60 rotates slowly there are several seconds during which the entire machine is stationary, excepting this cam 60 and its counter-shaft and associated parts. The machine remains thus stationary until the cam projection 61 engages the depending arm 63 of the vertical shaft 35 and causes the power clutch member 21 to engage with its fellow table-clutch member 20 to rotate the table 8 and bend the portion of the ribbon X which has been drawn into the machine by the longitudinal movement of the lower platform 2. As the table 8 rotates it carries the peripheral dog 42 away from engagement with the dog 46. The locking-lever 48 does not, however, immediately abut against a shoulder of the friction locking-cam 55, but drops upon a high part of this cam just beyond one of the shoulders, so that the friction mechanism continues free and the counter-shaft 52 rotates until the locking-lever 48 engages the next shoulder of the locking-cam. This continued rotation of the locking-cam 55 permits the cam 71 to continue to rotate and carry the end of the arm 69 of the bell-crank lever 67 69 downward to cause the plunger-box 43 to move upward on its pivot 44, just behind the under table-dog 42, which has meanwhile been carried beyond the plunger by the rotation of the table. The plunger 41 is thus in position to be engaged by the next under table-dog ninety degrees to the rear to unclutch the table. As the locking-cam 55 rotates the locking-lever 48 gradually falls by gravity, as permitted by the curved periphery of the locking-cam, until it abuts against the next shoulder of the locking-cam, thereby locking the friction mechanism. The dog 46 is now in position to be engaged by the next or short peripheral dog 75 to clutch the upper platform T.

The operation of the automatic mechanism, whereby the upper platform T is moved to draw into the machine a portion of the ribbon X sufficient for a long side of the coil shown in Fig. 1 will now be described. The upper platform T is used for this purpose because it is of less mass than the lower platform 2 and has to move a longer distance; but it is evident that the functions of the two platforms might be reversed. As the table 8 rotates it carries one of its under dogs 42 against the plunger 41, which moves the rod 40 to the right, as before, to unclutch the table.

At about the same time and before the table 8 has stopped moving one of the short peripheral dogs 75 engages the dog 46 to rock the shaft 47, as was done before by the long dog 45. There are two of these short peripheral dogs 75, and they are mounted one hundred and eighty degrees apart in the peripheral groove or way 79 of the table 8, each short peripheral dog 75 being ninety degrees removed from each long peripheral dog 45. The short dog 75 does not remain in engagement with the dog 46 as the long dog 45 did, but before the table stops rotating it is carried entirely out of engagement with the dog 46. As before, however, the locking-lever 48 is raised by the movement of the rocking shaft 47, the friction mechanism is released, and the lateral projection 61 of the cam 60 engages the depending arm 62 of the shaft 35 to rock the latter and cause the power clutch member 10 to engage its fellow clutch member 9, Fig. 5, of the upper platform T. Thus through the gears 6 and 7 the upper platform is moved to the right to draw a fresh portion of the ribbon X into the machine sufficient for a long side of the coil. As soon as the short peripheral dog 75 passed beyond the dog 46 the locking-lever 48 began to fall by gravity along the curved periphery of the locking-cam 55 until it engaged the next shoulder of the locking-cam. The partial rotation of the locking-cam, which was permitted before it was thus again locked, clutched the upper platform T and also depressed the plunger-box 43, but did not depress the plunger to such an extent as before. In fact, the partial rotation of the locking-cam depressed the plunger only half-way and not entirely out of the path of the under table-dog 42. However, as the arm 34 of the vertical shaft 35 was moved to carry the clutch member 10 to the left to engage the clutch member 9 of the upper platform the spring-catch 63, Fig. 9, carried at the end of the arm 34, Fig. 1, passed over and down behind the projection 64 of the dog 46. Now when the upper platform T approaches the end of its travel one of its feelers or stops 76 abuts against the block 73, which is the same block on the arm 74 of the vertical shaft 35 which was before engaged by the feeler 72 of the lower platform 2. This engagement rocks the vertical shaft 35 and unclutches the upper platform. As soon as the platform is unclutched it engages one of the stops 78, mounted on the table, to check its further movement. The engagement of the feeler 76 with the block 73, owing to the engagement of the spring-catch 63, Fig. 9, with the projection 64 of the cam 46, rocks the shaft 47, releases the friction mechanism, and completes the depression of the plunger-box 43 through the cam 71 and the system of levers shown in Fig. 2. While the friction mechanism is released, the cam 60 is also rotated to rock the vertical shaft 35 and cause the engagement of the power-clutch 21 with the table-clutch 20, as before. The table 8 again rotates and carries its under table-dog 42 beyond the depressed plunger 41, which is immediately rocked upward behind it, as before, by the cam 71 into position to be engaged by the next under table-dog 42 to unclutch the table. Then the other of the long peripheral dogs 45 engages the dog 46, as before, to clutch the lower platform 2. These operations are continued as long as power is applied to the machine.

In Figs. 4 and 5 the machine is shown as adapted for the production of coils similar in shape to an ellipse. In this case a similarly-shaped former F is employed and either one of the platforms T or 2 (preferably the lower platform 2) is fixed in the center of the table 8, and the peripheral dogs 45 of that platform are removed from the peripheral way 79. After the movable platform T has been moved longitudinally to draw a fresh portion of the ribbon X into the machine and the feeler 76 has engaged the block 73 to unclutch the platform a peripheral dog 76 engages the dog 46 to release the friction and clutch the table 8. The table now has a half-rotation instead of a quarter-rotation, as was the case when a four-sided coil was wound, and this half-rotation forms one of the semicircular ends of the elliptical coil.

What I claim as new, and desire to secure by Letters Patent of the United States, is—

1. In an edgewise-winding machine, the combination with a former, of a reciprocable member on which the former is mounted, a rotatable member on which the reciprocable member is mounted, whereby the latter is revolved, and means for automatically reciprocating one and rotating the other member alternately.

2. In combination, a former, a plurality of reciprocable members, means for revolving said parts, and means for automatically reciprocating said members intermittently.

3. In combination, a former, a reciprocable member on which the former is mounted, a second reciprocable member on which said reciprocable member is mounted, a rotatable member on which said second reciprocable member is mounted, means for automatically actuating the reciprocable members successively, and means for automatically actuating the rotatable member intermediately.

4. In combination, a former, an upper platform, a lower platform, a rotatable table, means for automatically reciprocating the platforms successively, and means for automatically actuating the table intermediately.

5. In combination, a rotatable table, a platform which slides over the table, a former which is mounted on the platform, and means for automatically rotating the table and reciprocating the platform alternately.

6. The combination with a former, of an upper platform, a lower platform, a table, and means for automatically moving the platforms

successively, and intermediately rotating the table.

7. The combination with a former, of a plurality of reciprocable members, and means for automatically revolving and moving longitudinally each member successively.

8. In combination, a former, and a plurality of reciprocable and revoluble members, and means for automatically actuating said members alternately.

9. The combination with a former, of a rotatable member, a member mounted thereon and reciprocable thereover, a second member mounted on and reciprocable over said member, and means for automatically actuating said members in succession.

10. The combination with a former, of an upper platform, a driving-worm therefor having a clutch member on each end, a lower platform, a driving-worm therefor having a clutch member on each end, a power clutch member which coöperates with said upper and lower platform clutch members, a rotatable member having a driving clutch member, and a power clutch member which coöperates with said table clutch member.

11. The combination with a former, of means for automatically reciprocating and revolving it.

12. The combination with a former, of means for moving it longitudinally over different distances, and means for intermediately revolving it.

13. The combination with a former, of means for moving it longitudinally to draw in fresh portions of a metallic strip to be bent edgewise, a stationary member for holding the strip against the edge of the former, means for revolving the former away from the stationary member, and means carried with the former for thereafter holding the strip against the edge of the former.

14. The combination with a former, about which a metallic strip is to be bent edgewise, of a pressure-disk provided with a slot for the passage of the bent strip.

15. The combination with a former, of means for moving it longitudinally to draw in fresh portions of a metallic strip to be bent edgewise, a stationary member for holding the strip against the edge of the former, spring-catches carried with the former which are depressed beneath the stationary member, and means for revolving the former to bend the strip, said catches serving to hold the strip against the edge of the former after the latter has revolved away from said stationary member.

16. The combination with a former, of a former-base extending laterally beyond the edge of the former, a stationary member which holds the metallic strip to be bent, against the edge of the former, and a slotted pressure plate or disk which holds the strip against the former-base between the edges of the former and the stationary member.

17. The combination with a former, of a slotted pressure-plate, and a coil-support carried by said plate.

18. The combination with a former, of a stationary member for holding the strip against the edge thereof, and means for adjusting said member to the width of the strip.

19. In combination, a former, means for reciprocating and revolving it, and a pressure-plate mounted on the former and held from rotative movement only.

20. In combination, a former, means for moving it longitudinally to draw in fresh portions of the strip, a former-base, a stationary member for holding the strip against the edge of the former, a slotted pressure plate or disk for holding the strip against the former-base, means for revolving the former to bend the strip, and spring-catches mounted on the former-base, which hold the strip against the edge of the former until the strip passes through the slot in the pressure-plate.

21. In an edgewise-winding machine, the combination with a former, of a table, a platform mounted to slide across the table, power connections for the table and platform, and dogs on the table and devices on the platform for automatically controlling the power connections.

22. In an edgewise-winding machine, the combination with a former, of a rotatable table, a reciprocable platform mounted thereon, power connections, and means carried by the table and platform for controlling the power connections.

23. In an edgewise-winding machine, the combination with a former, of a rotatable table, a reciprocable platform mounted thereon, power connections, means carried by the table and platform for controlling the power connections, and means for checking the movements of the table and platform after the power connections are cut off.

24. The combination with a former, of a rotatable table, a reciprocable platform mounted thereon, power clutch members for the table and platform respectively, and a mechanical connection between said power clutch members, which connection is pivoted between the said clutch members so that both cannot operate the table and platform simultaneously.

25. The combination with a former, of a pressure-disk, and an adjustable pressure device which bears on the disk.

26. In combination, a former-base, a former mounted thereon, a slotted pressure-disk mounted on the former, a coil-support mounted on the disk, means for holding the disk from rotation, and means for reciprocating and revolving all the parts.

In witness whereof I have hereunto set my hand this 18th day of January, 1901.

JOHN RIDDELL.

Witnesses:
BENJAMIN B. HULL,
FRED RUSS.