

No. 709,179.

Patented Sept. 16, 1902.

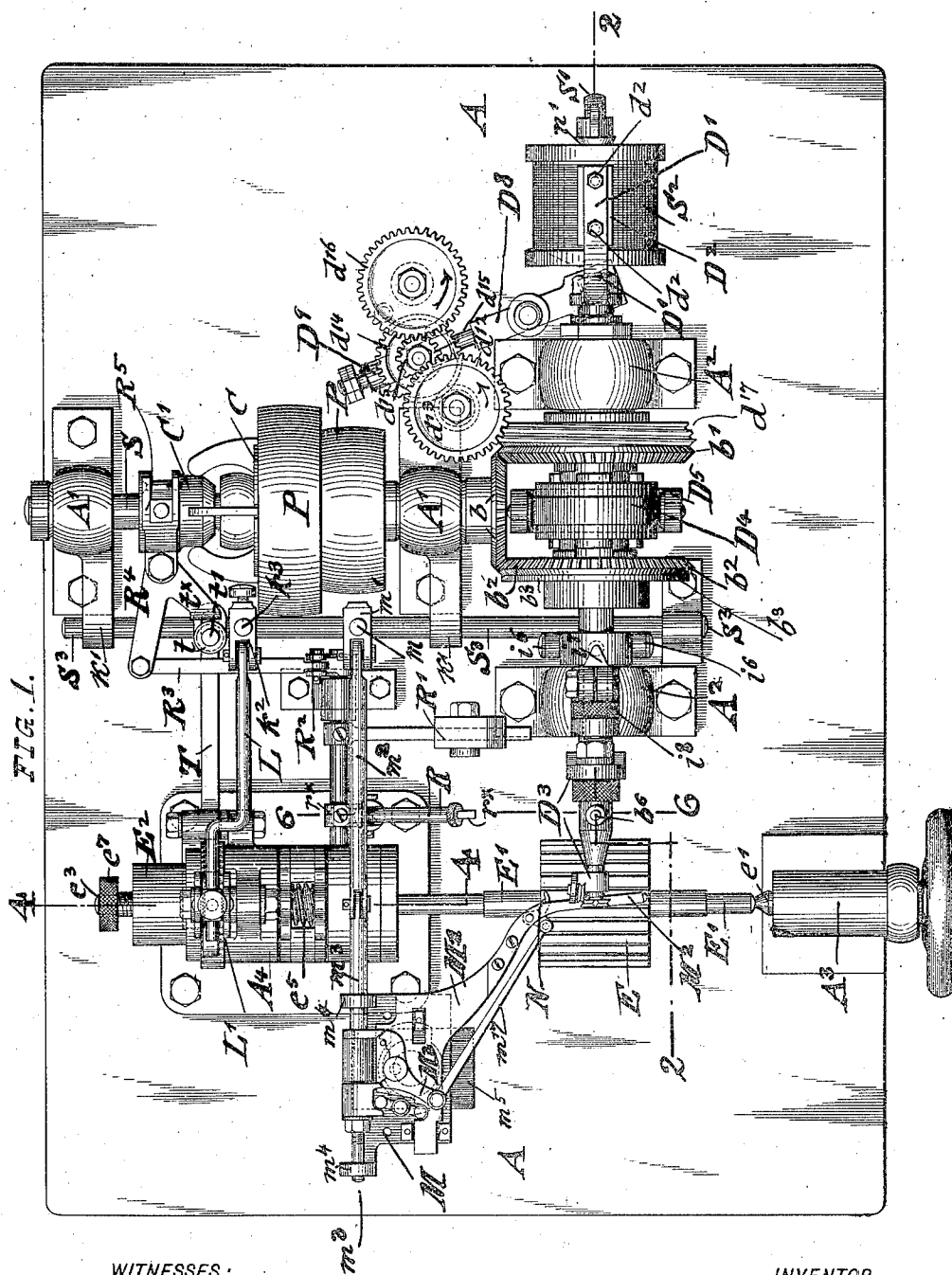
H. SCHULZ.

MACHINE FOR WINDING DRUM ARMATURES.

(Application filed Sept. 17, 1900. Renewed Feb. 20, 1902.)

(No Model.)

8 Sheets—Sheet 1.



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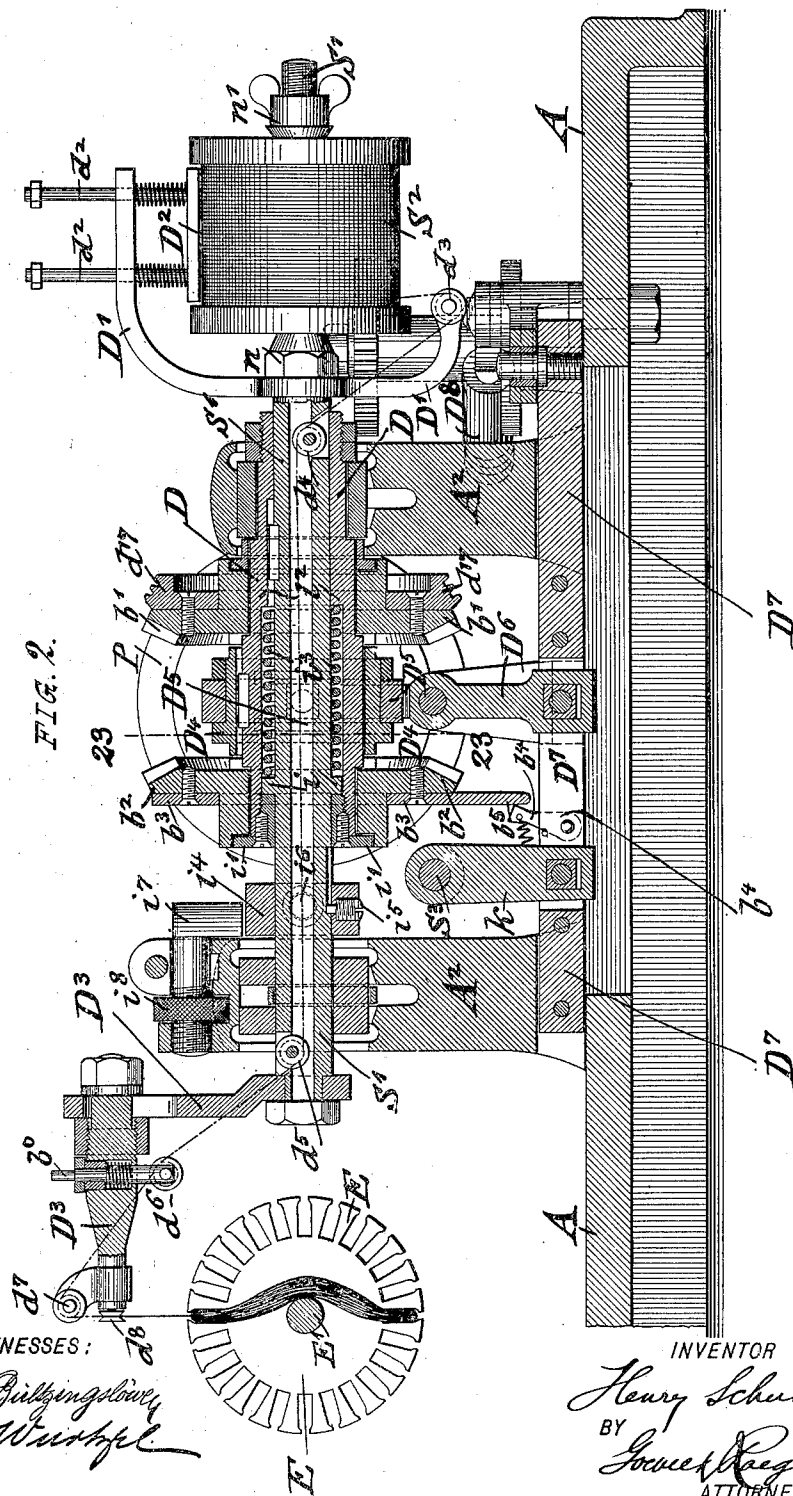
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(No Model.)

8 Sheets—Sheet 2.



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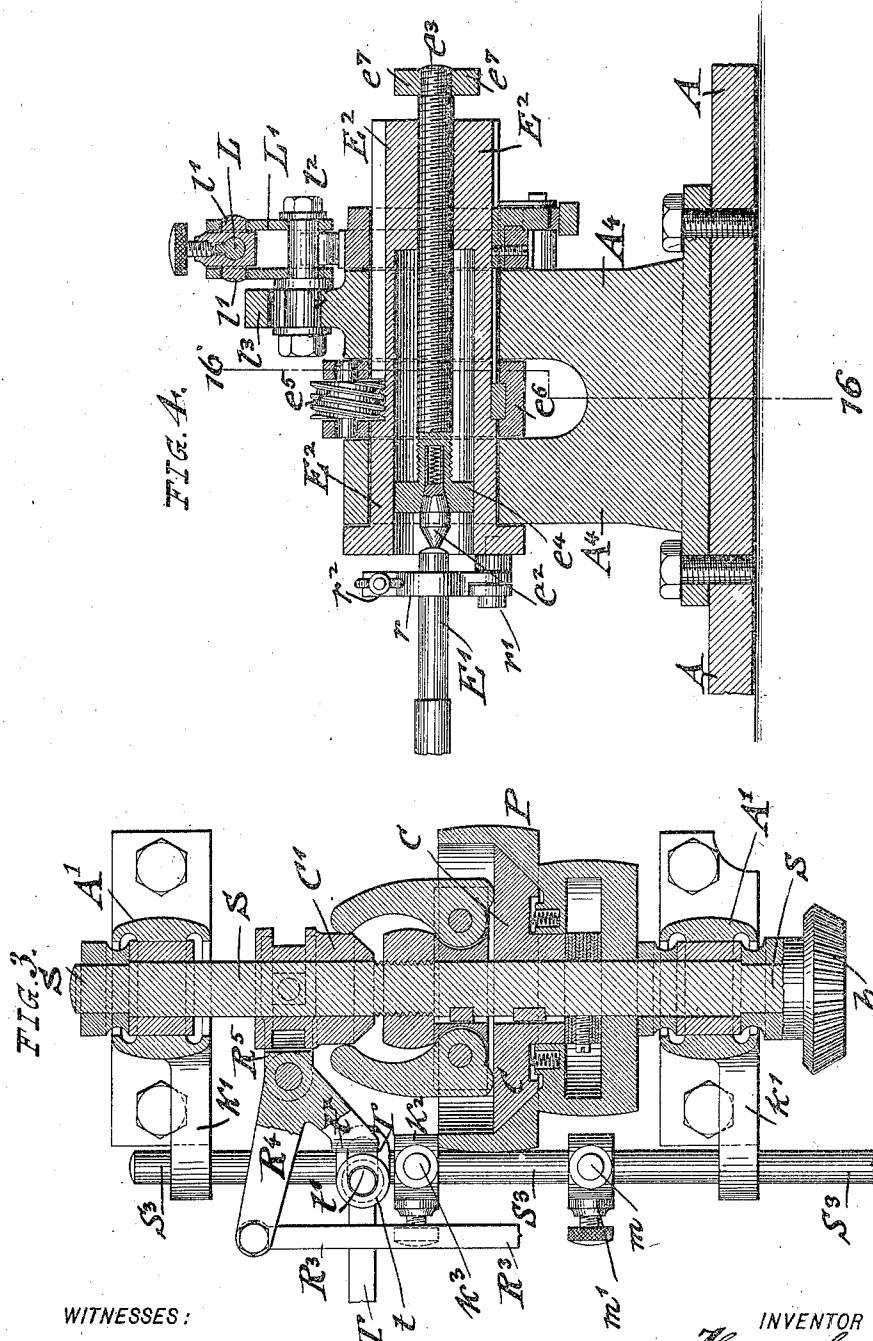
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(No Model.)

8 Sheets—Sheet 3.



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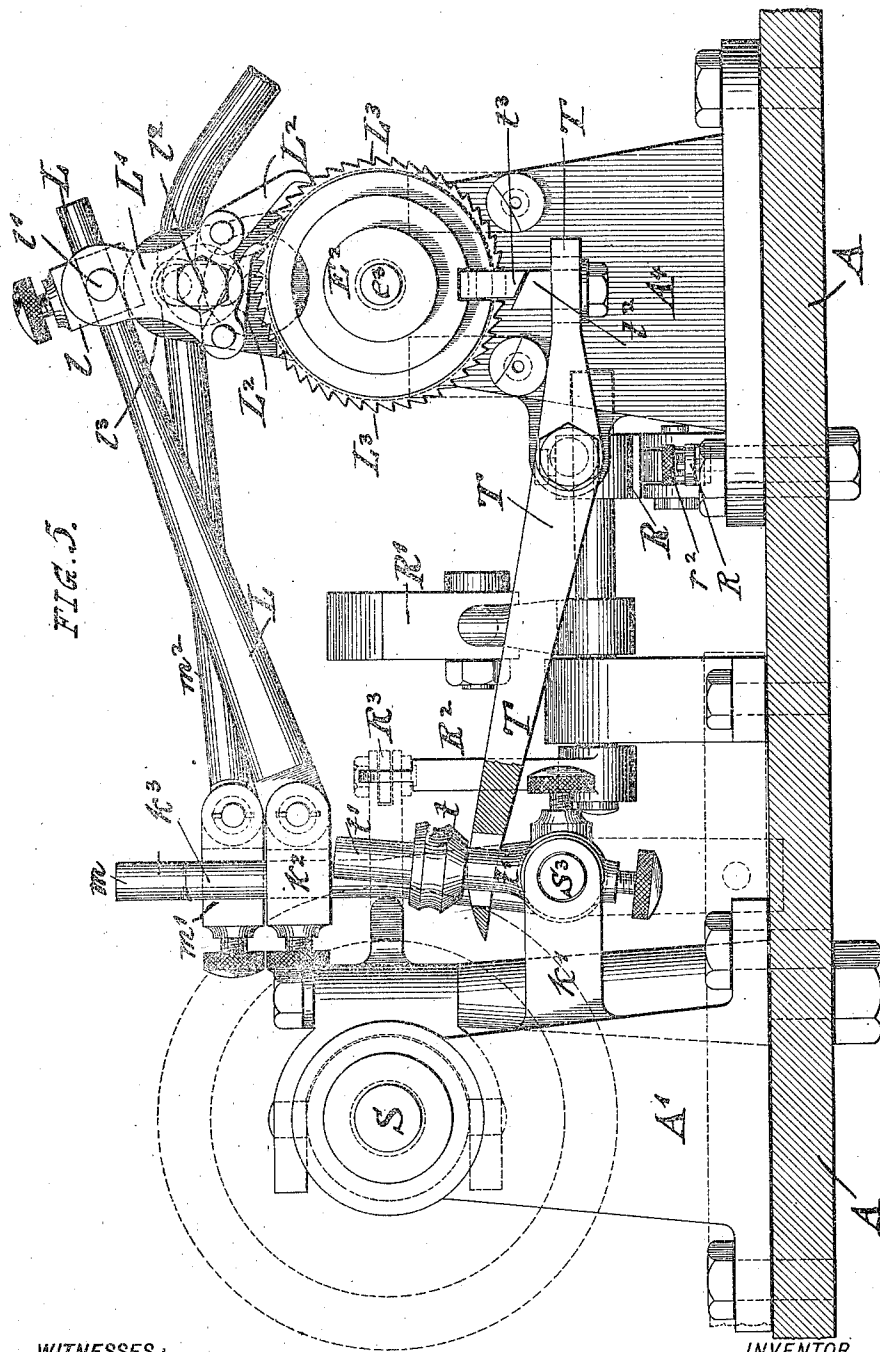
H. SCHULZ.

MACHINE FOR WINDING DRUM ARMATURES.

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8 Sheets—Sheet 4.



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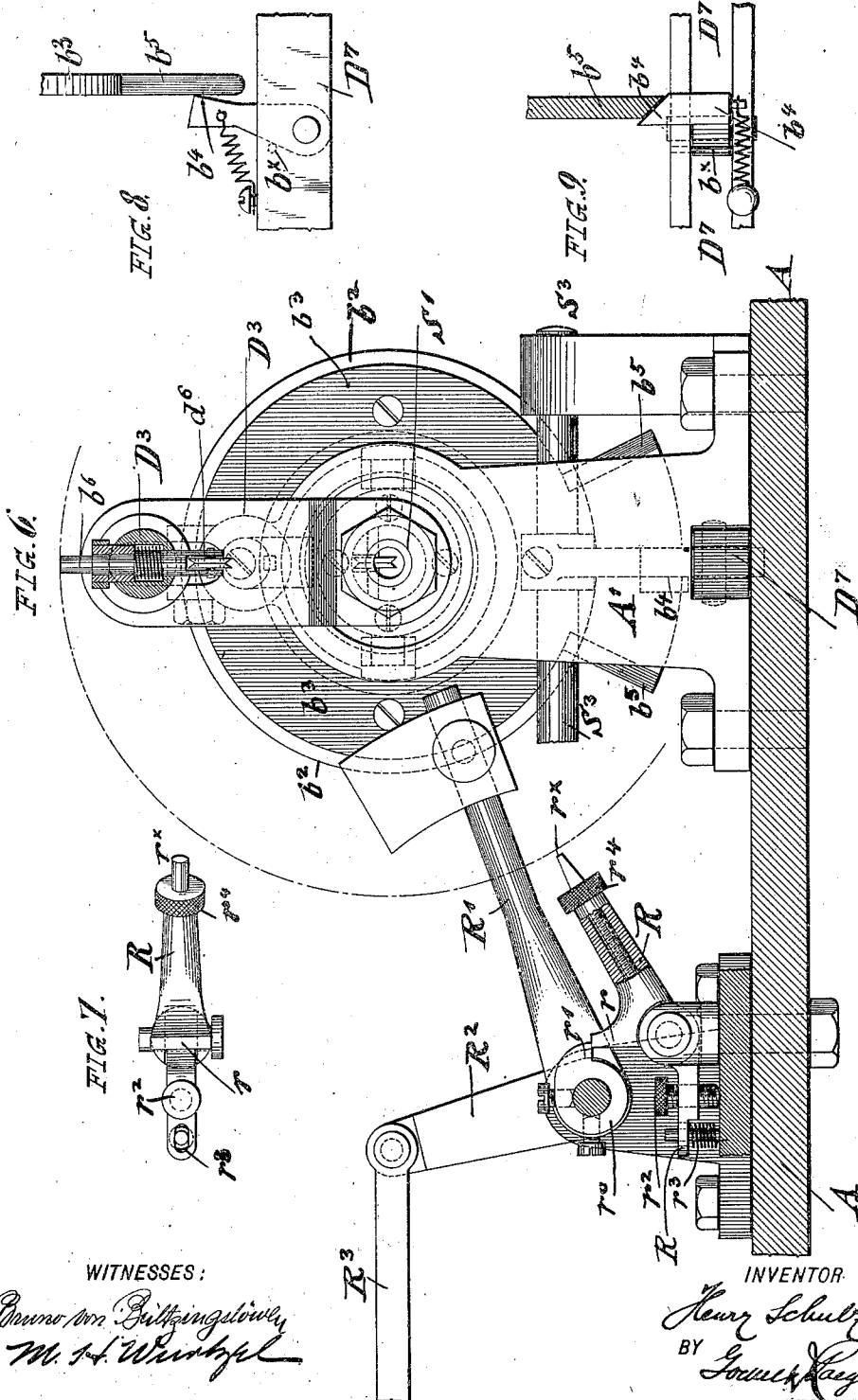
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(No Model.)

8 Sheets—Sheet 5.



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H. SCHULZ.

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8 Sheets—Sheet 6.

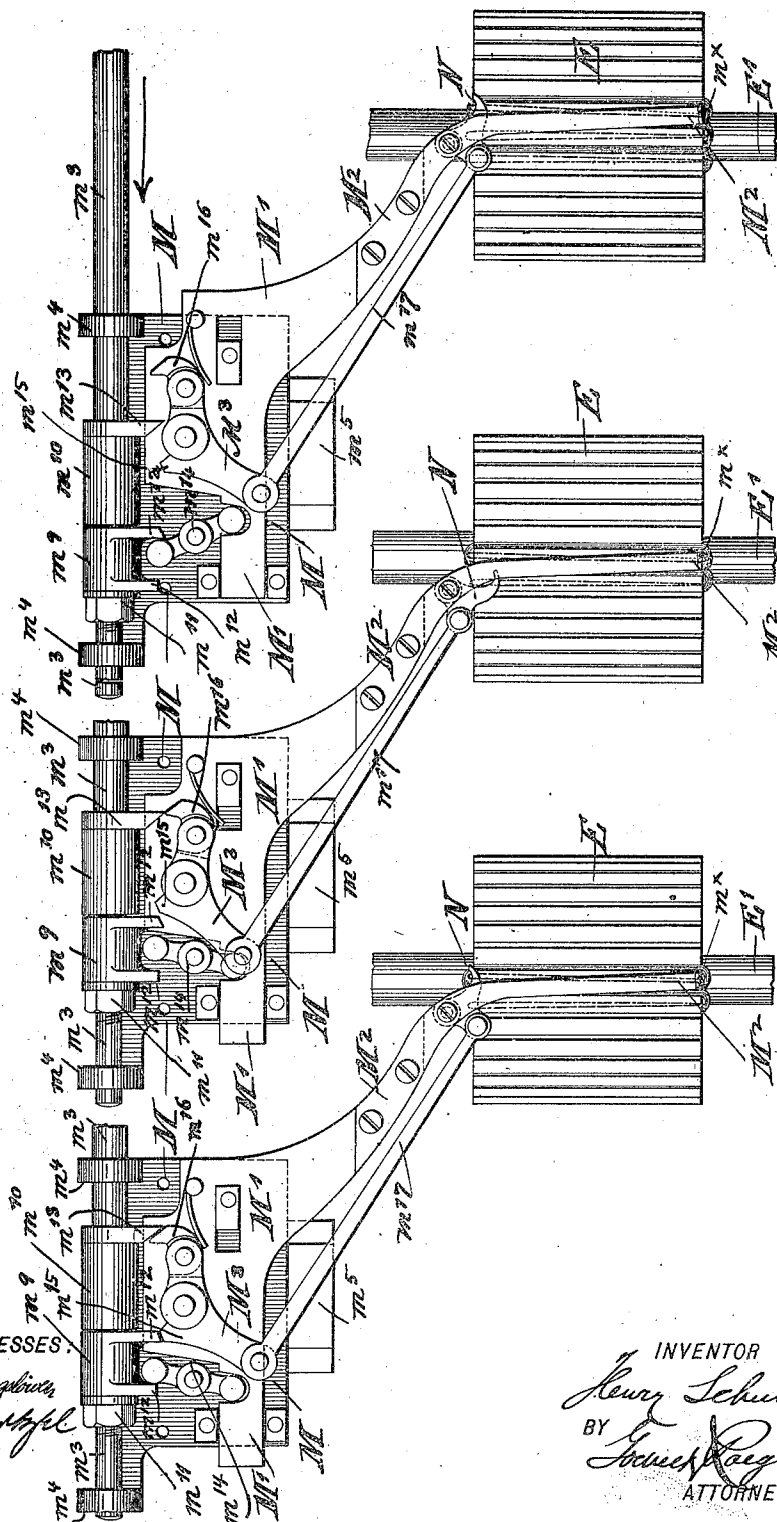
FIG. 12.

FIG. 11.

FIG. 10.

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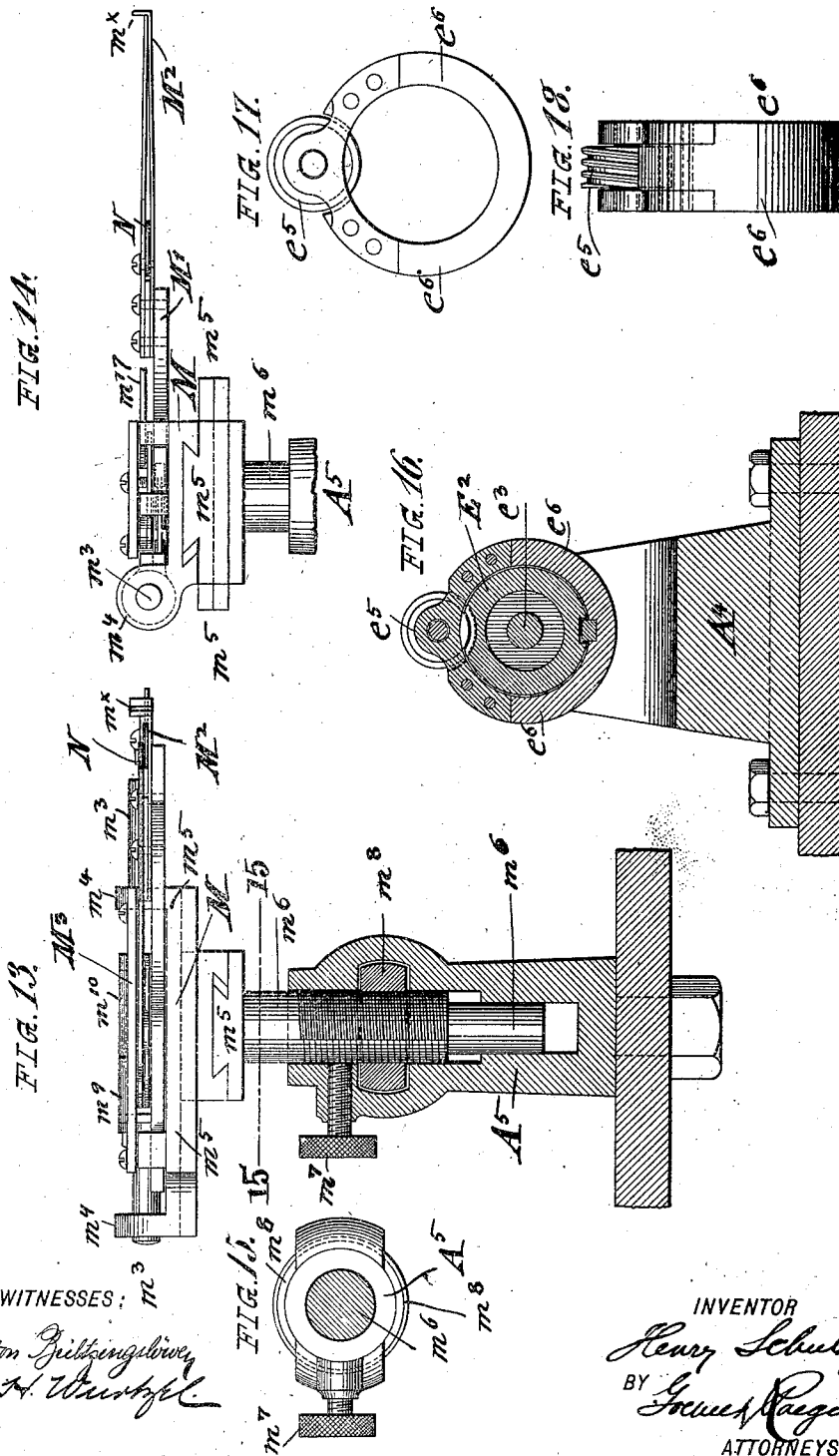
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8 Sheets—Sheet 7



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(No Model.)

8 Sheets—Sheet 8.

FIG. 22.

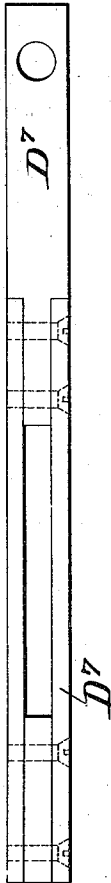


FIG. 23.

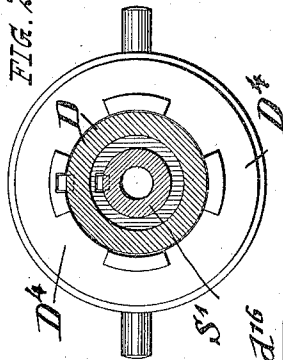


FIG. 19.

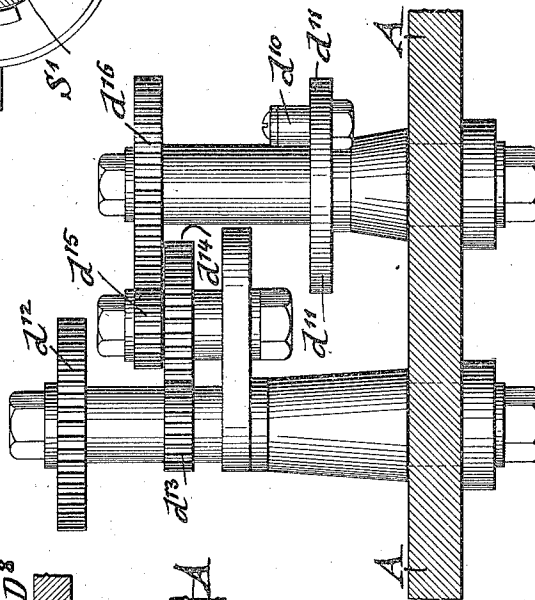


FIG. 21.

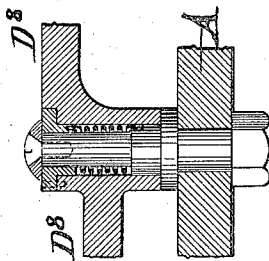
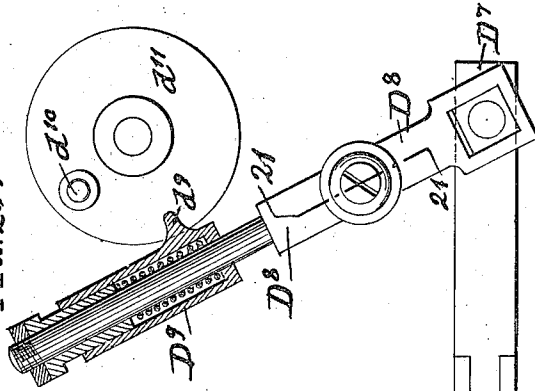


FIG. 20.



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UNITED STATES PATENT OFFICE.

HENRY SCHULZ, OF NEW YORK, N. Y.

MACHINE FOR WINDING DRUM-ARMATURES.

SPECIFICATION forming part of Letters Patent No. 709,179, dated September 16, 1902.

Application filed September 17, 1900. Renewed February 20, 1902. Serial No. 94,928. (No model.)

To all whom it may concern:

Be it known that I, HENRY SCHULZ, a citizen of the United States, residing in the city of New York, borough of Bronx, in the State of New York, have invented certain new and useful Improvements in Machines for Winding Drum-Armatures, of which the following is a specification.

This invention relates to an improved machine for winding armatures of the drum or Siemens type in a uniform, reliable, and effective manner, so that the expensive hand-winding is dispensed with and the operations of winding the different coils, forming the loops at the ends of the same, turning the armature on its axis, stopping the machine in case of breakage of the wire and when all the coils are wound on the core, are automatically performed; and for this purpose the invention consists of a machine for winding drum-armatures which comprises means for intermittently rotating the core of the armature, a crank for winding the wire successively into the grooves of the armature with the required number of turns for each coil, means for intermittently reciprocating the shaft of the winding-crank, so as to permit the winding-crank to clear the ends of the armature-shaft at each rotation, a pivoted finger for forming the loops at the ends of each armature-coil, means for reversing the motion of the winding-crank, so as to form said loops, means for withdrawing the loop-forming finger at the proper time, an automatic stop device in case of the breaking of the wire, and a stop-motion for stopping the machine when all the coils are completely wound on the cores.

The invention consists, further, in certain details of construction and combinations of parts, which will be fully described hereinafter and finally claimed.

In the accompanying drawings, Figure 1 is a plan view of my improved machine for winding drum-armatures. Fig. 2 is a vertical longitudinal section on line 2 2, Fig. 1, showing the winding-crank and the mechanism for feeding the wire and imparting the proper motion to the same. Fig. 3 is a plan view, partly in horizontal section, of the driving-pulley and its clutch connection with the driving-shaft, drawn on a larger scale. Fig. 4 is a vertical central section on line 4 4, Fig. 1,

through the adjustable center for supporting one end of the armature-shaft. Fig. 5 is a rear elevation of the machine drawn on a larger scale and shown partly in section. Fig. 6 is a vertical transverse section on line 6 6, Fig. 1. Fig. 7 is a detail top view of the releasing-lever of the stop-motion in case of breakage of the wire. Figs. 8 and 9 are details of the stop device for retaining the clutch of the shaft of the winding-crank in mesh during the reverse motion of the same when forming the loop between two adjacent coils. Figs. 10, 11, and 12 are plan views of the loop-forming finger and its actuating mechanism, showing the finger in its different positions for forming and releasing the loop at the end of each coil. Figs. 13 and 14 are respectively a front elevation, partly in section, and a side elevation of the loop-forming finger and its actuating mechanism. Fig. 15 is a detail horizontal section on line 15 15, Fig. 13. Fig. 16 is a vertical transverse section through the supporting center of the armature-shaft on line 16 16, Fig. 4. Figs. 17 and 18 are details of the mechanism for adjusting said center. Figs. 19 and 20 are respectively a front elevation and a plan view, partly in section, of the gear for reversing the motion of the winding-crank when the loop at the end of each coil is to be formed. Fig. 21 is a detail vertical section through the fulcrum of the reversing-lever on line 21 21, Fig. 20. Fig. 22 is a top view of the slide-bar for transmitting motion from the reversing-gear to other cooperating parts of the machine; and Fig. 23 is a detail vertical transverse section through the clutch member on the shaft of the winding-crank, taken on line 23 23, Fig. 2.

Similar letters of reference indicate corresponding parts.

Referring to the drawings, A represents the bed-plate of my improved machine for winding drum-armatures. On the bed-plate A are supported two upright standards A', which are provided with journal-bearings for the main driving-shaft S. On the main driving-shaft is arranged a step-shaped pulley P, to which motion is transmitted by a suitable driving-belt. A friction-clutch C is arranged in connection with the pulley P, as shown in Figs. 1 and 3, said friction-clutch being actuated by means of a sliding cone C', which

is splined to the shaft S and adapted to be shifted thereon, so that the friction-clutch engages the driving-pulley or releases the same, according as the machine is to be operated or its motion interrupted. The slide motion is imparted to the sliding cone C' by mechanism hereinafter to be described.

The winding-crank and its actuating mechanism.—To the front end of the driving-shaft S is applied a bevel-wheel b , which meshes with two bevel-wheels $b' b^2$, which are placed loosely on a stationary sleeve or thimble D and retained thereon by means of shoulders and by collars fitted into the recesses of the hubs of the bevel gear-wheels $b' b^2$, as shown clearly in Fig. 2. The sleeve or thimble D is mounted on a tubular shaft S', which is located at right angles with the main shaft S and supported in bearings of upright standards A². To one end of the tubular shaft S' is applied the spool S², on which the wire to be wound on the armature-core is wound, said spool being retained on the end of the shaft S' by means of a conical screw-nut n , which enters into the center bore of the spool S², and a clamping-nut n' , that enters into the opposite end of the spool, said nut n' being screwed home on the threaded end of the shaft S', so as to hold the spool in position thereon and permit it to freely turn thereon as the wire is fed to the armature-core to be wound. To the shaft S' is applied adjacent to the spool S² a curved arm D', one arm of which extends over the spool parallel with the same for supporting a spring-actuated tension-plate D² by means of rods d^2 , while the opposite arm is provided with a guide-roller d^3 for the wire, the wire passing over the roller d^3 to the guide-roller d^4 , located in a recess in the tubular shaft S', then through the interior of the shaft to a guide-roller d^5 , located in a recess in the opposite end of the shaft, thence over a tension-roller d^6 and guide-roller d^7 on the winding-crank D³, which crank is attached to the inner end of the tubular shaft S', as shown clearly in Fig. 2. The tension-roller d^6 is supported on a spring-actuated shank, which acts in case of breakage of the wire as an automatic stop in connection with a stop device hereinafter to be described. From the guide-roller d^7 the wire passes between two guide-rollers d^8 at the end of the winding-crank D³ to the armature-core E. The shaft E' of the armature-core E is supported parallel with the main shaft S and in a vertical plane with the end of the winding-crank. The front end of the armature-shaft E' is supported on a conical center e' of a standard A³, while the rear end of the armature-shaft is supported on an adjustable conical center e^2 in the supporting-spindle e^3 , which is mounted in a longitudinally-adjustable hollow cylinder E², supported in bearings of an upright standard A⁴, as shown in Fig. 4. The center spindle e^3 of the armature-shaft E' is screw-threaded, so as to be adjusted in the closed rear end of the adjust-

able cylinder E² in forward or backward direction. The inner end of the center spindle e^3 is provided with a disk-shaped head e^4 for supporting the center e^2 steadily in the interior of the longitudinally-adjustable cylinder E². When the armature-shaft is short, it may be necessary to move the center considerably forward, and in this case the adjustable cylinder E² is also adjusted toward the stationary center supported in the upright standard A⁴ by a worm e^5 , which is supported in suitable bearings of a ring-shaped frame e^6 , that extends around the cylinder E², said worm meshing with a worm-thread on the cylinder. By turning the worm e^5 the cylinder E² can be adjusted in one direction or the other. After the cylinder is adjusted in forward or backward direction the center e^2 is adjusted by the center spindle e^3 , which is operated by means of a button or knob e^7 at the rear end of the same, as shown in Fig. 4.

The reversing-clutch of the winding-crank.—Between the bevel gear-wheels $b' b^2$, that are supported loosely on the exterior sleeve or thimble D, is arranged a sliding clutch D⁴, which can be moved into mesh with either one of the gear-wheels $b' b^2$, according as the winding-crank is to be moved in one or the opposite direction. The clutch D⁴ is splined to the exterior sleeve or thimble D and shifted on the same in either direction by a shifting fork D⁵, that engages diametrical antifriction-rollers on the clutch and that is supported on an upright arm D⁶, which is located in a recess of a slide-bar D⁷. (Shown in Fig. 2 and in detail in Fig. 22.) The upright arm D⁶ is applied by a rectangular recess to a square boss supported on a transverse pin in the recess of the slide-bar, as shown in Fig. 2. The slide-bar D⁷ is actuated by a fulcrumed lever D⁸, which is pivoted at its front end to the end of the slide-bar D⁷ and which is provided at its rear end with a sliding and spring-actuated sleeve D⁹, that is guided on said fulcrumed lever, said sleeve being provided with a projection nose d^9 that is engaged by a pin d^{10} on a disk d^{11} , to which a slow rotary motion is imparted by a train of transmitting gear-wheels $d^{12} d^{13} d^{14} d^{15} d^{16}$ from a worm-wheel d^{17} , that is attached to the bevel gear-wheel b' , said worm-wheel meshing with the first wheel d^{12} of said train of gear-wheels, as shown in plan view in Fig. 1 and in detail in Fig. 19. The number of gear-wheels and the number of teeth of the same are so proportioned that the fulcrumed lever D⁸ is actuated by the pin d^{10} after the required number of turns for each coil have been wound on the grooves of the armature-core. Each coil is composed of a predetermined number of turns, according to the size of the armature, the clutch D⁴ being placed in mesh with the gear-wheel b' during the winding of the coil, so that the required number of turns are wound around the armature-core by the winding-crank C.

For preventing the abutting of the end of the winding-crank D³ against either end of

the armature-shaft the tubular shaft S' of the winding-crank is splined to the interior of the sleeve D , so as to be capable of longitudinal motion in the same. A shoulder i on the tubular shaft S' abuts against a flanged collar i' , attached to the sleeve D , said shoulder i and an interior shoulder i'' of the sleeve D forming the abutments for a helical spring i^3 , which is interposed between the two shoulders, said spring serving for returning the tubular shaft S' after it has been moved in backward direction to its normal position. On the shaft S' is located, adjacent to the left-hand standard A^2 , a collar i^4 , by means of a splined set-screw i^5 , said collar being provided at diametrically opposite points with anti-friction-rollers i^6 , which are placed on diametrical pins of the collar, and which are brought during each rotation of the shaft S' twice in contact with a tapering nose i^7 , that is located on the top part of the upright standard A^2 , said nose being provided with a threaded shank that is adjusted by a screw-nut i^8 , which is retained in position by a recess in the top part of the standard A^2 , as shown in Fig. 2. By turning the screw-nut i^8 in one or the opposite direction the tapering nose i^7 can be adjusted forward or backward, so as to control thereby the distance through which the tubular shaft S' and winding-crank D^3 are moved backward whenever one of the anti-friction-rollers i^6 is brought in contact with the nose. The adjustment of the nose i^7 corresponds to the radius of the armature-shaft and the distance for which the winding-crank has to be moved, so as to clear the ends of the armature-shaft for each turn of the wire wound around the armature. The anti-friction-rollers i^6 are held in contact with the tapering nose during their passage over the same by the helical spring i^3 , the hollow shaft and winding-crank being moved backward by the rollers i^6 and returned to their normal position required for winding the turns of the coils by the helical spring i^3 . When all the predetermined turns of a coil have been wound on the armature-core, the slide-bar D^7 is shifted by the actuation of the fulcrumed lever D^8 by the train of gear-wheels. The shifting of the slide-bar D^7 produces the shifting of the clutch D^4 into mesh with the bevel gear-wheel b^2 and the turning of the armature on its axis for the required distance, so as to bring a new pair of grooves in the path of the end of the winding-crank. The intermittent turning of the armature E is produced by a pawl-and-ratchet mechanism, which is actuated by a crank-arm k on the slide-bar D^7 and a shaft S^3 operated thereby. The shaft S^3 is supported in suitable bracket-bearings k' , extending from the upright standards A , as shown in Figs. 1 and 3. To the shaft S^3 is keyed a crank-arm k^2 , which carries a lug k^3 , having an oscillating arm L pivoted thereto. (See Fig. 5.) The arm L carries at its outer end a pawl-holder L' . The pawl-holder L' is pivoted to an adjustable keeper l , near the end of the arm L , and to a

pivot-bolt l^2 on the standard A^4 , and provided at its lower end with two pawls L^2 , which mesh with an exterior ratchet-wheel L^3 on the hollow cylinder E^2 . By the forward motion imparted to the crank-arm k^3 by the oscillating motion of the shaft S^3 one of the pawls L^2 actuates the ratchet-wheel and turns the same for a distance of one tooth, while during the return motion of the crank-arm k^3 the second pawl L^2 actuates the ratchet-wheel and moves it likewise for the distance of one tooth, which turns the armature-core on its axis, so that its next set of coil-grooves is placed in line with the end of the winding-crank. For turning the armature E one end of the armature-shaft E' is connected with the cylinder E^2 by a clamping-ring r , that is made of two semisections which are pivoted to a pin r' on the front end of the cylinder E^2 and firmly clamped to the armature-shaft by a bolt and clamp-nut r^2 , passing through the end of the semisections, as shown in Fig. 4. This clamping connection compels the shaft of the armature to follow the rotary motion imparted to the cylinder E^2 by the pawl-and-ratchet mechanism, so as to intermittently turn the armature-core for the required distance when all the turns of the preceding coil have been wound on the grooves. The ratchet-wheel is provided with twice the number of teeth as there are grooves in the armature-core, so that the two successive actuations of the ratchet-wheel move the armature-core sufficiently for bringing the next pair of grooves into line with the end of the winding-crank. The hub of the ratchet-wheels is splined to the cylinder, so as to be longitudinally adjustable thereon, but prevented from shifting axially on the cylinder E^2 . The pawl-holder L' consists of two plates that are applied to gudgeons l' on the keeper l and to the transverse bolt l^2 , supported on a lug l^3 on the top of the standard A^4 , the bolt acting as a fulcrum for the pawl-holder, so as to produce the proper pushing action by both pawls in the same direction by the oscillations imparted to the crank-arm and pawl-holder.

The loop-forming finger and its actuating mechanism.—To the shaft S^3 is applied in front of the crank-arm k^3 a second crank-arm m , to which is clamped a lug m' by a suitable set-screw, which is connected by an intermediate pivot-link m^2 with a slide-rod m^3 , that is guided in perforated lugs m^4 on a platform M , which carries the finger-actuating mechanism. The platform M is capable of adjustment in two directions by being mounted on dovetailed guide-plates m^5 , which are supported on a threaded shank m^6 , that is vertically adjustable in a hollow upright standard A^5 , as shown in Figs. 13 and 15. The threaded shank m^6 of the lowermost dovetailed plate m^5 is retained by a set-screw m^7 in position in the standard A^5 and is adjusted by means of a nut m^8 , which is located in a recess of the standard and which engages the threaded shank. The lower part of the shank m^6 is made of a smaller diameter than

the upper part and is guided in the lower hollow portion of the standard, so as to permit the vertical adjustment of the threaded shank in the standard A^5 and the rigid clamping of the same by the set-screw after the proper adjustment is made. The vertical adjustment of the threaded shank, as well as the lateral adjustment in two directions by means of the dovetailed guide-plates $m^5 m^5$, enables the loop-forming mechanism supported on the platform M to be accurately adjusted relatively to the winding-crank and the armature-core, according to the different diameter and length of the latter. The slide-rod m^3 carries two sleeves $m^9 m^{10}$, which are retained in position upon its reduced end by a screw-nut m^{11} , as shown in Figs. 10, 11, and 12. The sleeve m^9 is provided with two projecting lugs m^{12} and the sleeve m^{10} with one projecting lug m^{13} , the two lugs of the sleeve m^9 serving to engage one end of a fulcrumed lever m^{14} , the opposite end of which engages the recess of a laterally-shiftable plate M' , which carries a curved extension-arm M^2 , that extends over the top of the armature-core parallel with the axis of the same and that is provided with a grooved lug m^x at its end for guiding the wire fed to the armature-core by the winding-crank. The plate M' is guided by suitable lugs on the platform M , one of the guide-lugs being located in a rectangular recess in the main portion of the plate M' , as shown clearly in Figs. 10, 11, and 12. The plate M' carries a fulcrumed lever M^3 , that is provided at one side of its fulcrum with a beveled heel m^{15} and at the opposite side of its fulcrum with a pivoted and spring-actuated heel m^{16} , having a beveled face. The lugs of the sleeves $m^9 m^{10}$ serve to actuate successively by the levers M^3 and m^{14} the slide-plate M' and the loop-forming finger N . The longer arm of the lever M^3 is connected by a pivot-rod m^{17} with the loop-forming finger N , that is pivoted to the curved portion of the extension-arm M^2 of the plate M' , said finger serving to hold the wire placed over the same by the reversal of the motion of the winding-crank after one full coil is wound on the core before the winding of the next coil is commenced. Whenever one coil is completely wound on the armature-core, the oscillating motion of the shaft S^3 produces the shifting of the slide-rod m^3 in the direction of the arrow, Fig. 12, and simultaneously therewith the shifting of the lugs of the sleeves $m^9 m^{10}$, so as to move first the loop-forming finger into the position shown in Fig. 11, so as to release the loop of the coil previously formed. The finger N is then moved back into the path of the wire of the coil just formed, which wire is conducted around the end of the extension-arm M^2 , as shown in Fig. 12. As soon as the new loop is formed it is held by the finger N , while simultaneously the armature-core is turned by its pawl-and-ratchet mechanism for the proper distance on its axis so as to expose the next set of grooves to the

winding action of the winding-crank. The return motion of the finger after the loop is formed is accomplished by the return motion of the slide-bar D^7 , under the influence of the spring applied to the fulcrum of the actuating-lever D^8 . The return of the slide-bar to its former position also returns the loop-forming finger N to its normal position (shown in Fig. 10) and shifts the clutch D^4 into mesh with the bevel gear-wheel b' , so that the motion of the winding-crank is reversed and the next coil wound into the next set of grooves of the armature-core.

It is necessary to time accurately the duration of the reverse motion of the winding-crank D^3 , so as to control the proper formation of the loop of the wire at the end of each coil. This timing of the reverse motion of the winding-crank D^3 is obtained by means of a stop-plate b^3 , that is attached to the bevel gear-wheel b^2 , as shown in Figs. 1, 2, and 6. The stop-plate b^3 has a segmental portion b^5 , the edges of which are beveled, which segmental portion is engaged by a spring-actuated stop b^4 , that is pivoted to the slide-bar D^7 between the arms D^6 and k , as shown in Fig. 2, said stop b^4 being normally held by its spring against a transverse pin b^x of the slide-bar D^7 , as shown in detail in Figs. 8 and 9. The stop b^4 has a beveled shoulder which is moved past the beveled edge of the segmental portion b^5 when the slide-bar D^7 is shifted by its actuating-lever D^8 , so that the stop b^4 is held by the tension of its spring in contact with the segmental portion b^5 , so as to prevent the return of the slide-bar D^7 until the segment b^5 in following the rotation of the bevel gear-wheel b^2 liberates the stop b^4 and then permits the return of the slide-bar by the influence of the spring on the fulcrum of the lever D^8 into its normal position. The engagement of the stop b^4 with the segmental portion b^5 is so timed that during it the loop at the end of each coil can be formed in a reliable manner, the shifting of the slide-bar D^7 and the reversing of the motion of the winding-crank taking place as soon as this is accomplished by the shifting of the clutch D^4 and its reengagement with the bevel gear-wheel b' , so that the turns of the next coil are then wound into the next pair of grooves of the armature.

The stop-motions.—Two stop-motions are provided—one which is called into action on the breaking of the feed-wire, the other when all the coils of the armature are wound on the armature-core. Both stop-motions act on the slide-cone C' , by which the clutch C on the main driving-shaft is operated, so that said slide-cone is moved out of mesh with the clutch for arresting the motion of the driving-shaft. The stop-motion that is actuated on the breaking of the wire is operated in connection with the shank b^6 of the tension-roller on the winding-crank, the shank of said tension-roller being moved on the breaking of the wire under the influence of its coil-

spring and the centrifugal force in outward direction, so as to project to a greater extent beyond the winding-crank and strike a stop-lever R, which is pivoted to the base of the standard A⁴, that supports the adjustable center e², said stop-lever being arranged in the same vertical plane as the shank of the tension-roller d⁶, as shown in Fig. 1. The dotted line in Fig. 6 shows the normal circle in which the outer end of the shank b⁶ of the tension-roller d⁶ is moved. As soon as the tension of the wire on the roller d⁶ is released the shank of the tension-roller is moved in outward direction, so as to strike the end of the stop-lever R and release the shoulder r on the same from the shoulder r' of a collar 70 on the shaft of a weighted arm R'. (Shown in Fig. 6.) The position of the stop-lever R is accurately regulated by means of a set-screw r² and returned into raised position by a helical spring r³, the ends of which are connected, respectively, with the shorter arm of the stop-lever R and with the base of the standard, as shown in Fig. 6. The position of the projecting end r^x of the stop-lever is adjusted by a screw-nut r⁴, which engages the threaded shank of said projecting end. On the release of the stop-lever R from the shoulder r' on the shaft of the weighted lever 30 R' the latter is dropped, so as to operate by a crank-arm R², applied to its shaft, and an intermediate pivot-link R³ an elbow-shaped lever R⁴, which is fulcrumed to a fork R⁵, that engages the slide-cone C' of the clutch C on the main shaft, as shown in Figs. 1 and 3, so as to shift the cone, release the clutch from the driving-pulley P, and produce thereby the instant arresting of the motion of the main driving-shaft S. The stop-motion, by which the motion of the machine is interrupted when all the armature-coils are wound on the core, or, in other words, when the armature is completely wound, is also produced by the elbow-lever R⁴, the shorter arm of which is provided with a beveled edge t^x, that is engaged by a grooved sleeve t, which slides on an upright crank-arm t', keyed to the shaft S³, said sleeve t being located adjacent to the beveled end of the elbow-lever R⁴. The grooved sleeve t is beveled at both ends, so as to readily pass over the beveled edge of the elbow-lever R⁴ into engagement with the same. The upright crank-arm t' and sleeve t are engaged by the curved and recessed end of a lever T, which is fulcrumed to a projecting ear on the standard A⁴, as shown in Fig. 5, the opposite end of the lever being provided with an adjustable lug t², which is engaged by a lug t³, projecting from the ratchet-wheel T² on the cylinder E² at each full rotation of the same, so as to actuate thereby the fulcrumed lever T and produce by the lifting of the grooved sleeve the oscillation of the fulcrumed elbow-lever R⁴, and thereby the shifting of the slide-cone C' and the release of the clutch from the driving-pulley P, (shown in Figs. 1 and 5,) so that the machine is auto-

matically stopped when all the coils are wound on the armature-core.

Operation: My improved machine for winding drum-armatures is operated as follows: The shaft of the armature-core to be wound is placed between the stationary and adjustable centers which support the shaft of the armature-core, the movable center being adjustable to the length of the armature-shaft in the manner before described, so that the armature-core is placed in the proper relative position toward the winding-crank and loop-forming finger. The spool with the wire to be wound on the armature core is then placed in position on the end of the tubular shaft S', the wire being passed through said shaft and over the guide and tension rollers on the shaft and winding-crank between the rollers at the end of the latter. A loop is then formed at the end of the wire, and this loop placed in position on the finger and supporting-arm, so as to be supported thereon. The machine is then started by moving the clutch on the main driving-shaft S into mesh with the driving-pulley P, which latter is then rotated by the belt, the shaft imparting by the bevel-gear transmissions simultaneously motion to both bevel-gears on the transmitting-shaft S'. The clutch D³ is normally in mesh with the bevel-gear b', so that immediately rotary motion is transmitted to the tubular shaft of the winding-crank and to the latter, so that the wire is wound into two diametrical opposite recesses of the armature-core. Intermittent longitudinally-reciprocating motion is imparted to the shaft of the winding-crank by the stationary cam whenever the end of the winding-crank passes over the ends of the armature-shaft. When the required number of turns are wound on the core, the slide-bar D' is actuated by the worm-gear transmission and fulcrumed lever D³, so that the clutch between the bevel-gears is shifted and moved into mesh with the bevel gear-wheel b². This produces the instant reversing of the motion of the shaft and winding-crank, so that the loop is formed in connection with the finger and supporting-arm of the same. During the reverse motion of the winding-crank the slide-bar D' is retained by the segmental stop-plate b³ on the bevel gear-wheel b² until the spring-actuated stop b⁴ in the slide-bar has passed said plate, when the slide-bar is immediately returned into its normal position by the tension of the coil-spring on the fulcrum of the actuating-lever D³, and thereby the clutch D³ returned into mesh with the bevel-gear b', so that the motion of the winding-crank in the former direction is resumed and the wire wound into the next set of grooves. Simultaneously the armature-core is shifted on its axis by the pawl-and-ratchet mechanism on its supporting-center, which brings the next set of grooves into line with the end of the winding-crank. The forward motion of the slide-bar produces the axial turning of the armature-core for one half of the required distance, while the return mo-

tion of the same im arts the other half of its axial motion. As soon as the loop is formed and the armature shifted on its axis the slide-bar is permitted to return, so that the clutch is placed again in mesh with the bevel-gear *b'*, the regular rotation of the winding-crank is resumed, and the winding of the turns of the next coil commenced. When the second coil is wound, the motion of the winding-crank is again automatically reversed long enough to produce the loop at the end of the coil, after which the third coil is wound on the return of the slide-bar, and so on until all the coils are wound on the armature-core. Having thus described my invention, what I claim as new, and desire to secure by Letters Patent, is—

1. The combination, with means for supporting an armature-core, of a winding-crank, means for feeding the coil-forming wire to said crank, and means for rotating said crank, substantially as set forth.

2. The combination, with means for supporting an armature-core, of a winding-crank supported at right angles to the shaft of an armature-core supported by said means, means for rotating said winding-crank so that its end moves in a vertical longitudinal plane around the armature-core, and means for feeding the coil-forming wire from the crank to the core, substantially as set forth.

3. The combination, with means for intermittently rotating an armature-core on its axis, of a rotary winding-crank, and means for feeding the coil-forming wire to said crank, substantially as set forth.

4. The combination, with means for intermittently rotating an armature-core on its axis, of a rotary winding-crank, means for feeding the coil-forming wire to said crank, and mechanism for reciprocating the winding-crank twice for each rotation of the crank for clearing the shaft of the armature-core, substantially as set forth.

5. The combination, with means for intermittently rotating an armature-core on its axis, of a rotary winding-crank, means for feeding the coil-forming wire to said crank, means for reversing the motion of the crank after a full coil is wound, and a loop-forming mechanism placed in the path of the wire on reversing the motion of the winding-crank, substantially as set forth.

6. The combination, with means for supporting an armature-core, of a coil-winding crank, a hollow shaft for the same, means for guiding the coil-forming wire through said shaft to the end of the crank, means for imparting rotary motion to the shaft of the winding-crank, means for reversing the motion of the winding-crank when a full coil is wound, and a loop-forming mechanism adapted to engage the wire when the motion of the crank is reversed so as to form a loop at the end of each coil, substantially as set forth.

7. In a machine for winding drum-armatures, the combination of a winding-crank,

means for intermittently rotating an armature-core on its axis so as to present a new set of core-grooves to the winding-crank, means for feeding the wire to said winding-crank, means for rotating said crank, means for intermittently reversing the motion of the winding-crank, a loop-forming mechanism, and means for intermittently actuating the same so as to form a loop at the end of each coil, substantially as set forth.

8. In a machine for winding drum-armatures, the combination of stationary and adjustable centers for the shaft of an armature-core, a cylinder for supporting the adjustable center, means for connecting said cylinder with an armature-shaft supported in said centers, means for longitudinally adjusting the cylinder, a coil-winding mechanism, and a pawl-and-ratchet mechanism for intermittently actuating the cylinder so as to turn the armature-core on its axis for presenting a new set of grooves to the action of the winding mechanism, substantially as set forth.

9. In a machine for winding drum-armatures, the combination, with a driving-shaft, of a second shaft supported at right angles thereto, a bevel gear-wheel at the end of the main driving-shaft, intermeshing bevel gear-wheels mounted loosely on the second shaft, a clutch device for moving the bevel gear-wheel on the main driving-shaft into mesh with either one of the transmitting bevel gear-wheels, a worm-gear transmission operated by one of the bevel-gears, a fulcrumed lever actuated intermittently by said worm-gear transmission, a slide-bar connected with said fulcrumed lever and adapted for shifting the clutch so as to cause it to mesh with one or the other bevel gear-wheel for reversing the motion of the second shaft, and a coil-winding crank at the end of the second shaft, substantially as set forth.

10. In a machine for winding drum-armatures, the combination, with a coil-winding crank, of a longitudinally-guided and spring-actuated shaft for said crank, means for rotating said shaft, a stationary cam, and a collar on the shaft provided with antifriction-rollers that are placed twice in contact with the stationary cam for each rotation of said shaft so as to impart thereby twice longitudinally-reciprocating motion to the winding-crank during each rotation of the same, substantially as set forth.

11. In a machine for winding drum-armatures, the combination of a coil-winding crank, a rotary shaft to which said winding-crank is applied, a sleeve surrounding said tubular shaft, a helical spring interposed between said sleeve and shaft, a collar on said shaft provided with antifriction-rollers at diametrically opposite points, a stationary cam for engaging said rollers twice at each rotation of the shaft so as to produce the reciprocation of the shaft and winding-finger of the shaft twice during each rotation, substantially as set forth.

12. In a machine for winding drum-armatures, the combination of a coil-winding crank, a tubular shaft to one end of which said crank is applied, a wire-spool supported at the opposite end of said tubular shaft, guide-rollers for the wire located in the tubular shaft and on the winding-crank, a pair of guide-rollers at the end of the winding-crank, and means for imparting rotary motion to the shaft of the winding-crank, substantially as set forth.

13. In a machine for winding drum-armatures, the combination, with means for supporting the armature-core, of a rotary coil-winding crank, an intermittently-oscillating loop-forming finger, a guide-arm for said finger, and means for shifting said guide-arm and oscillating the finger after a full coil is wound on the armature-core, substantially as set forth.

14. In a machine for winding drum-armatures, the combination of means for supporting an armature-core, a coil-winding crank, a rotary shaft to which the winding-crank is applied, means for imparting rotary motion to said shaft in one direction, reversing mechanism for reversing the motion of the winding-crank after a coil is wound, a loop-forming finger located above the armature, a guide-arm for supporting the loop-forming finger, and means for actuating the arm and finger when the motion of the winding-crank is reversed so as to form a wire loop at the end of each coil, substantially as set forth.

15. In a machine for winding drum-armatures, the combination, with a rotary coil-winding crank provided with guide-rollers and a spring-actuated tension-roller for the wire to be wound, of a releasing-lever actuated by the shank of said tension-roller, and a stop-motion operated by said releasing-lever and connected by intermediate lever mechanism with a clutch on the main shaft, so as to arrest the motion of the machine on the breakage of the wire, substantially as set forth.

16. In a machine for winding drum-armatures, the combination of means for supporting an armature-core, a pawl-and-ratchet mechanism for intermittently turning an armature-core supported thereby, a winding mechanism for winding the coils on the armature-core, and a stop-motion for arresting the motion of the machine when all the coils are

wound on the armature, substantially as set forth.

17. In a machine for winding drum-armatures, a loop-forming mechanism consisting of a curved guide-arm above the armature, an oscillating loop-forming finger supported on said guide-arm, and means for moving the finger into the path of the wire for forming the loop in connection with the end of the guide-arm, substantially as set forth.

18. In a machine for winding drum-armatures, a loop-forming mechanism actuated after each coil is wound and consisting of a curved guide-arm extending over the armature-core, and loop-forming finger pivoted to said guide-arm, means for oscillating the finger for shedding the loop of the coil last formed, and means for returning the finger into the path of the wire after the succeeding coil is formed for forming the new loop in connection with the end of the guide-arm, substantially as set forth.

19. In a machine for winding drum-armatures, a loop-forming mechanism actuated after each coil is wound and consisting of a curved guide-arm extending over the armature-core, a loop-forming finger pivoted to said guide-arm, means for oscillating the finger for shedding the loop of the preceding coil, means for returning the finger into the path of the wire after the succeeding coil is wound, for forming the loop over the finger and the end of the guide-arm, and means for shifting the guide-arm finger, and loop for clearing the next pair of armature-grooves for winding the next coil, substantially as set forth.

20. In a machine for winding drum-armatures, the combination, with means for intermittently rotating an armature-core, of a coil-winding mechanism, means for reversing said coil-winding mechanism after each coil is wound, a loop-forming mechanism actuated during the reversing of the coil-winding mechanism, and a stop device for the reversing mechanism for controlling the reverse motion of the winding mechanism until the loop is formed, substantially as set forth.

In testimony that I claim the foregoing as my invention I have signed my name in presence of two subscribing witnesses.

HENRY SCHULZ.

Witnesses:

PAUL GOEPEL,
M. H. WURTZEL