July 30, 1963 S. H. SHAW 3,099,409

COIL WINDING APPARATUS

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FIG. 1

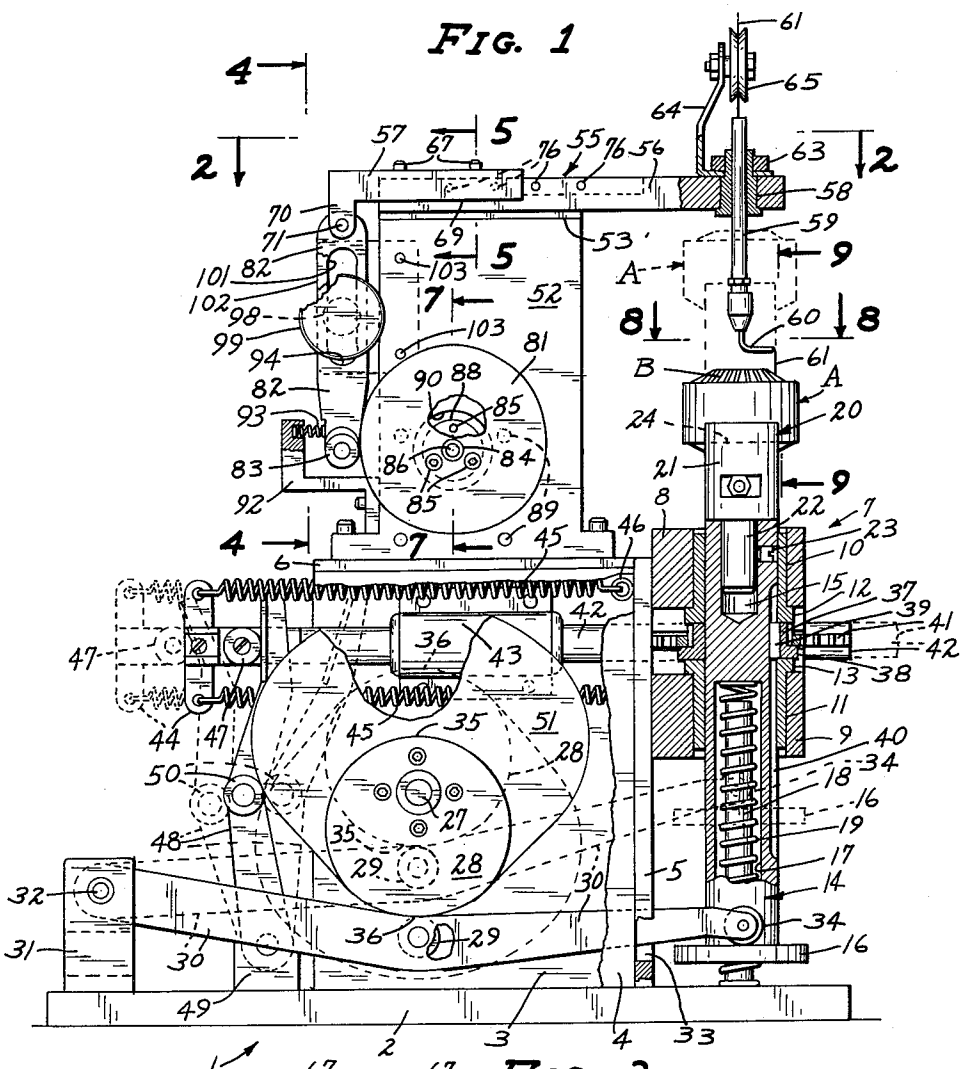
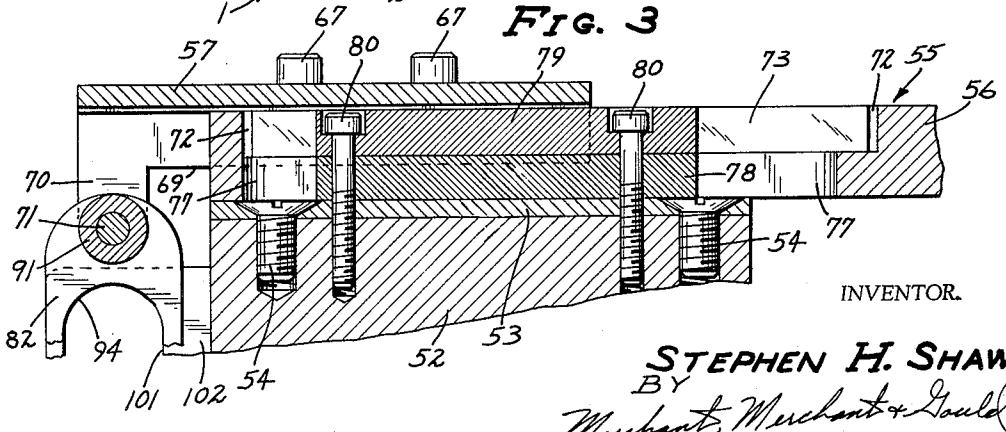


FIG. 3



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COIL WINDING APPARATUS

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FIG. 2

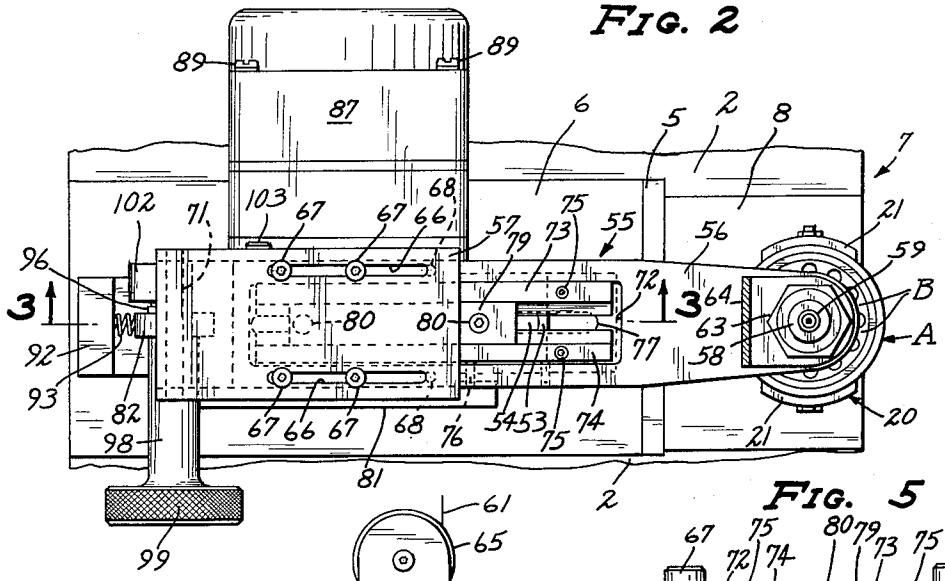


FIG. 4

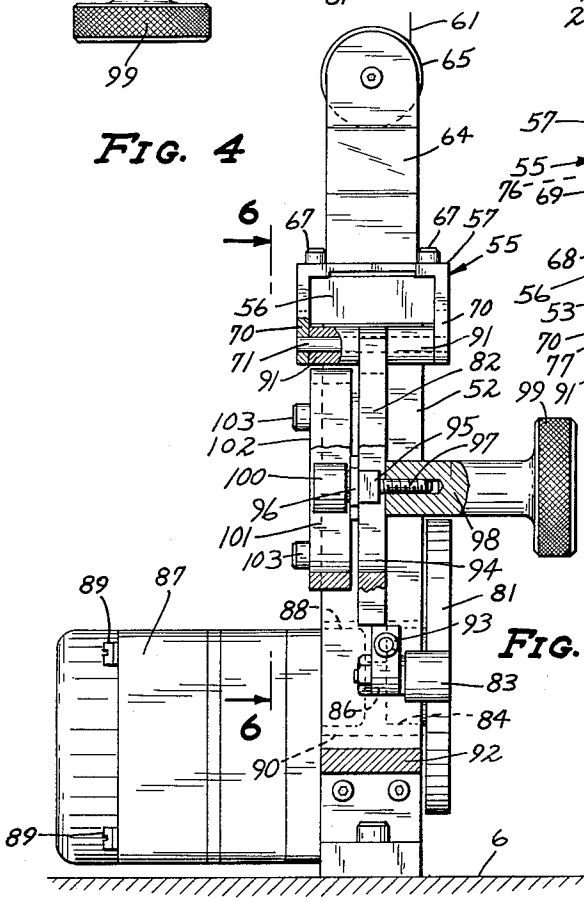


FIG. 5

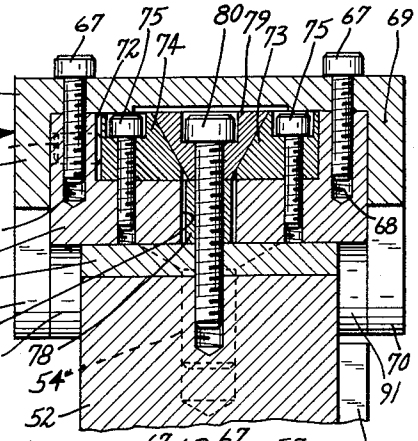
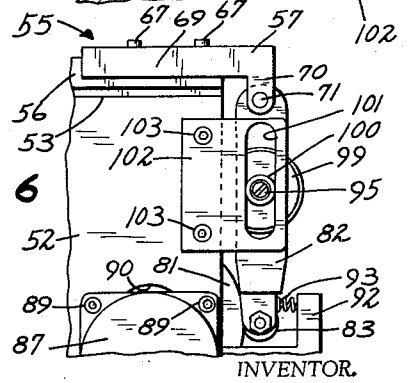


FIG. 6



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COIL WINDING APPARATUS

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FIG. 7

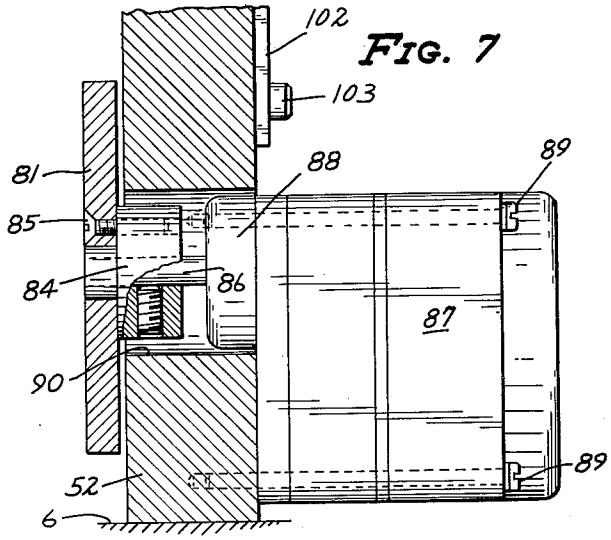


FIG. 8

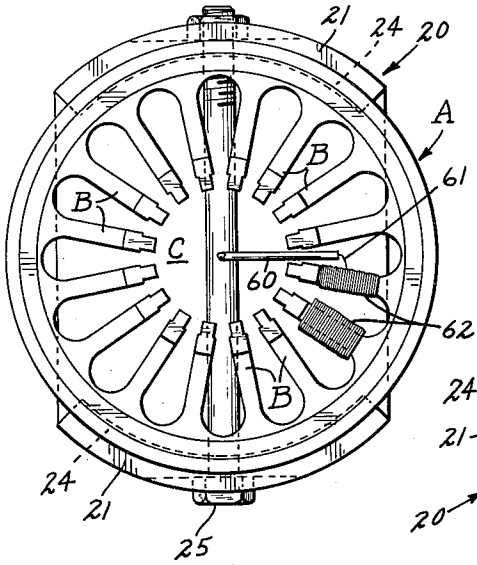
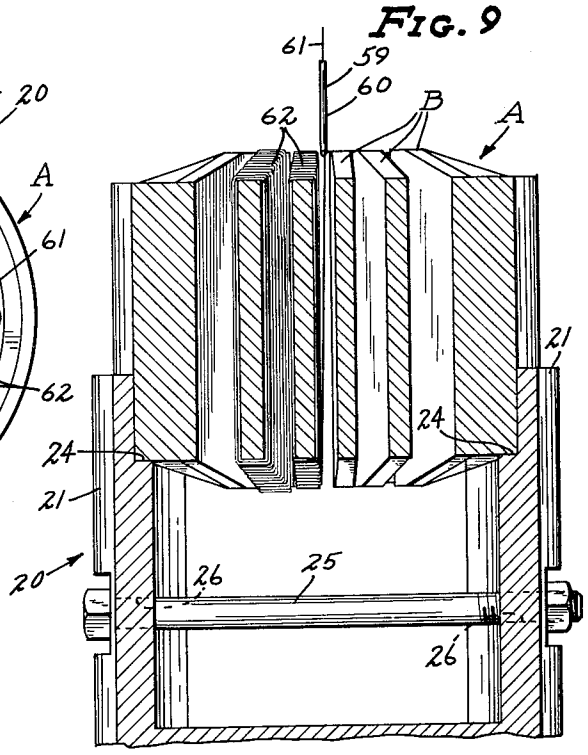


FIG. 9



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United States Patent Office 3,099,409 Patented July 30, 1963

3,099,409

COIL WINDING APPARATUS

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Filed Mar. 19, 1962, Ser. No. 180,722
6 Claims. (Cl. 242—1.1)

My invention relates generally to devices for winding coils of wire on magnetic cores of electrical motor components and the like, such as armature and field cores.

More particularly, my invention relates to an improvement on apparatus of the type disclosed and claimed in United States Letters Patent No. 2,969,195, issued January 24, 1961, to Marvin I. S. Leithe, and involves mechanism for controlling the winding of wire on cores whereby to produce uniform and level layers of wire in the coils thereof.

An important object of my invention is the provision of a device as set forth which will produce uniform and level windings on magnetic cores without the necessity for auxiliary fixtures on the cores and without regard to the shape of the pole pieces over which the wire is wound.

Another object of my invention is the provision of winding apparatus which is quickly and easily adjusted to produce level winding of wire on cores of various diameters and having pole pieces of various radial lengths. To this end, I provide a support for a wire guide tube, means mounting and guiding the guide tube support for reciprocatory movements, means for imparting reciprocatory movements to the guide tube support, novel means for varying the extent or range of said reciprocatory movements, and means for shifting the range or area of said reciprocatory movements.

Still another object of my invention is the provision of apparatus as set forth which is relatively simple and inexpensive to produce, which is highly accurate in operation, and which is rugged in construction and durable in use.

The above and still further highly important objects and advantages of my invention will become apparent from the following detailed specification, appended claims and attached drawings.

Referring to the drawings, which illustrate the invention, and in which like reference characters indicate like parts throughout the several views:

FIG. 1 is a view in side elevation of a coil winding machine incorporating my invention, some parts being broken away and some parts being shown in section;

FIG. 2 is an enlarged view, partly in top plan and partly in section, taken substantially on the line 2—2 of FIG. 1;

FIG. 3 is a still further enlarged fragmentary section taken on the line 3—3 of FIG. 2;

FIG. 4 is an enlarged fragmentary view, partly in rear elevation and partly in section, taken substantially on the line 4—4 of FIG. 1;

FIG. 5 is an enlarged fragmentary transverse section taken on the line 5—5 of FIG. 1;

FIG. 6 is a fragmentary view in side elevation, on a reduced scale, as seen from the line 6—6 of FIG. 4;

FIG. 7 is an enlarged fragmentary view in transverse section, taken substantially on the line 7—7 of FIG. 1;

FIG. 8 is an enlarged detail, partly in top plan and partly in section, taken substantially on the line 8—8 of FIG. 1; and

FIG. 9 is an enlarged fragmentary transverse section taken substantially on the line 9—9 of FIG. 1.

Referring with greater detail to the drawings, the numeral 1 indicates in its entirety a frame structure comprising a base plate 2, plate-like side frame members 3 and 4, a front wall element 5 connecting the side frame members 3 and 4, and a plate-like top cross member 6 connecting the upper ends of the side frame members 3 and 4.

A bearing mount 7 comprises a pair of vertically spaced blocks 8 and 9 that are rigidly secured to the front wall element 5 by suitable means, not shown. The blocks 8 and 9 are bored to receive axially aligned upper and lower bearing sleeves 10 and 11 respectively, said sleeves having diametrically enlarged heads 12 and 13 respectively that engage the bottom and top surfaces respectively of their respective blocks 8 and 9.

An elongated vertically disposed rockshaft 14 is mounted for rotary and axial sliding movements in the bearing sleeves 10 and 11, and is provided with an upwardly opening axial recess 15 in its upper end portion and a diametrically enlarged head or flange 16 at its lower end. The rockshaft 14 is further provided with a relatively deep downwardly opening axial recess 17 in which is received a vertically disposed stem 18 that is rigidly connected at its lower end to the base plate 2. The stem 18 provides support for an elongated coil compression spring 19 which loosely encompasses the stem 18 and which is interposed between the base plate 2 and the inner end of the recess 17 to yieldingly urge the rockshaft 14 in an upward direction of its axial movement. A work-holding chuck 20 includes a pair of opposed jaws 21 and an axially extended mounting stem 22 that is slidably received in the recess 15 of the rockshaft 14, and which is adapted to be releasably locked for common movements with the rockshaft 14 by means of a set screw or the like 23. The opposed jaws 21 are formed to provide internal shoulders 24 that are adapted to support a workpiece such as a magnetic field core or stator element A. The core element A is of the type having a plurality of axially extending radially inwardly projecting pole pieces B in circumferentially spaced relationship, the inner ends of the pole pieces B defining a central opening C adapted to receive a cooperating armature, not shown, when the core A is wound and included in a motor assembly, not shown. A nut-equipped clamping bolt 25 extends through aligned transverse openings 26 in the jaws 21, and is operative to releasably clamp the workpiece or core element A between the jaws 21. The arrangement is such that the core element A, when mounted in the chuck 20, is axially aligned with the rockshaft 14.

A horizontally disposed drive shaft 27 is suitably journalled in the side frame members 3 and 4, and may be assumed to be driven by conventional means, such as a motor or the like, not shown. A cam element 28 is suitably anchored on the shaft 27, and has operative engagement with a cam follower roller 29 that is journalled to the intermediate portion of a lever 30 pivotally secured on a horizontal axis to a mounting bracket 31, as indicated at 32, the mounting bracket 31 being suitably anchored to the base plate 2 adjacent the rear end thereof. The front end portion of the lever 30 extends through a suitable opening 33 in the front wall element 5, and has journalled at its front end a roller 34 that engages the flange or head 16 of the rockshaft 14, whereby to impart downward reciprocatory movement to the rockshaft 14 against yielding bias of the spring 19, responsive to rotation of the drive shaft 27 and cam 28. Yielding bias of the spring 19 causes the rockshaft 14 to move in an upward direction of its reciprocatory movement during part of the rotation of the drive shaft 27 and cam 28, and maintains the cam follower roller 29 in operative engagement with the cam 28.

The top and bottom portions of the cam 28, as positioned in FIG. 1 and indicated at 35 and 36 respectively, constitute relatively short dwell portions which cause the rockshaft 14 to remain stationary at its upper and lower limits of reciprocatory movement for very brief periods of time, during which periods limited rotary or

oscillatory movements are imparted to the rockshaft 14. A toothed gear 37, provided with a hub portion 38 is mounted on the rockshaft 14, by means of a key 39, and between the flanges 12 and 13 of the bearing sleeves 10 and 11 respectively, for common oscillatory movements with the rockshaft 14 and for axial sliding movements with respect thereto. The key 39 is slidably contained in an axially extending keyway 40 in the rockshaft 14. A gear rack 41 has meshing engagement with the gear 37 and is carried by a reciprocating rod 42 that extends through a suitable opening in the front wall element 5 and which is slidably supported by a bearing element 43 suitably anchored to the side frame member 3. At its rear end, the rod 42 is notched to receive a vertically disposed cross piece 44, to the opposite ends of which are connected the rear ends of a pair of vertically spaced coil tension springs 45, the front ends of said springs being connected to the front wall element 5 by anchoring screws or the like 46. The tension springs 45 yieldingly urge the rod 42 in a direction to impart limited rotary movement in one direction to the rockshaft 14. A roller 47 is journalled to the rear end portion of the rod 42, said roller engaging the outer end of a lever 48 that is journalled to and extends generally upwardly from a mounting bracket 49. The mounting bracket 49 is suitably anchored to the base plate 2 adjacent the rear end portion of the side frame member 3. A cam follower roller 50 is journalled to the intermediate portion of the lever 48, said roller 50 being yieldingly biased by the springs 45 through the connection thereof to the reciprocatory rod 42 and engagement of the roller 47 with the upper end portion of the lever 48, into engagement with the marginal surface of a second cam 51 which is mounted on the shaft 27 for common rotation therewith. The shape of the cam 51 is such that, when the rockshaft 14 is at its lower limit of reciprocatory movement, the rod 42 will be caused to be moved by the cam 51 in one direction of its reciprocatory movement to impart oscillating rotary movement to the rockshaft in one direction; and when the rockshaft 14 is at its upper limit of reciprocatory movement, the rod 42 will be caused to move in the opposite direction to impart oscillating rotary movement to the rockshaft 14 in the opposite direction. The cam 51 is so shaped that periods of dwell occur in the oscillating movement of the rockshaft 14 during axial reciprocation thereof.

The details of construction of the above-described mechanism are clearly shown and described in the Leithe patent, above identified, reference being had thereto. Hence, in the interest of brevity, further detailed showing thereof herein is omitted.

For the purpose of guiding wire to the core A during the winding operation, and for producing uniform winding layers of wire about the pole pieces B thereof, I provide novel means, now to be described. Bolted or otherwise rigidly secured to the top plate 6 is a vertically disposed generally rectangular pedestal 52 having a wear plate 53 rigidly secured to the upper end thereof by means of screws or the like 54. An elongated support 55 comprising front and rear support sections 56 and 57 respectively is longitudinally slidable on the wear plate 53, the front end of the support section 56 having a vertical bore therethrough for reception of a vertically extending bushing 58. The bushing 58 snugly slidably receives a vertically extended guide tube 59 having a diametrically reduced lower discharge end portion 60 which is curved to extend angularly outwardly or radially outwardly from the axis of the guide tube 59. The tube 59 is of a diameter sufficiently small to pass freely through the axial opening C in the core element A, the discharge end portion 60 having an external diameter sufficiently small to enable the same to pass freely between the inner end portions of the radially inwardly projecting pole pieces B of the core element A. The inner diameter of the discharge end portion 60 is sufficiently great to permit free passage therethrough of electrical conductor wire 61 which is

utilized to form coils 62 wound on selected pole pieces B or groups thereof. The upper end of the bushing 58 is threaded to receive a clamping nut 63 which not only anchors the bushing 58 in place, but also secures a mounting bracket 64 to the front end portion of the support section 56. A guide pulley 65 is journalled to the upper end of the bracket 64 and guides the wires 61 to the upper inlet end of the guide tube 59, from a suitable source of supply, not shown.

As shown particularly in FIG. 2, the guide tube support section 57 is provided with a pair of longitudinally extended slots 66 through which extend headed bolts or machine screws 67 that are screw threaded into cooperating threaded openings 68 in the rear end portion of the support section 56, see also FIG. 5. Further, the support section 57 is formed to provide downturned longitudinal flanges 69 that closely slidably engage opposite sides of the cooperating guide tube support section 56 to hold the sections 56 and 57 in alignment. At their rear ends, the flanges 69 are downwardly extended to provide ears 70 which mount a horizontally extended cross pin or the like 71.

The guide tube support section 56 is formed to provide a longitudinally extended upwardly opening recess 72 in which is mounted a pair of laterally spaced parallel gibs 73 and 74, both of which are rigidly secured to the support section 56 by machine screws or the like 75, and the latter of which is laterally adjustable by means of a plurality of set screws or the like 76, see FIGS. 1 and 5. The support section 56 is further formed to provide a longitudinally extending slot 77 centrally of the recess 72, the slot 77 containing an elongated spacer element 78 which rests upon the wear plate 53, see FIG. 3 and 5. A guide member 79 rests upon the spacer 78, the guide member 79 and spacer 78 being rigidly anchored to the upper end of the pedestal 52 by means of a pair of machine screws or the like 80 screw threaded into the upper end of the pedestal 52. The guide member 79 has downwardly converging opposite longitudinal sides that engage adjacent inner longitudinal faces of the gibs 73 and 74, which gib faces diverge upwardly. The gib 74 is adjusted to provide for free sliding engagement between the guide tube support 55 and the pedestal 52 with a minimum of vertical and transverse play therebetween.

Means for imparting longitudinal reciprocatory movement to the guide tube support 55, whereby the discharge end portion 60 of the guide tube 59 moves radially with respect to the core A, comprises a rotary cam 81 and a rocker arm 82 having a cam engaging follower roller 83 journalled at the lower end thereof. The cam 81 is mounted on a bushing 84, by means of screws or the like 85, the bushing 84 being rigidly mounted on the drive shaft 86 of a motor 87 that is provided with conventional speed reduction gearing, not shown, but which may be assumed to be contained within a head casing or the like 88. As shown in FIG. 7, the motor 87 is secured to one side of the pedestal 52 by screws or the like 89, the head 88 and drive shaft 86 extending through an opening 90 in the pedestal 52. The upper end of the arm 82 is journalled on the pin 71 intermediate the ears 70, and is maintained centrally between the ears 70 by a pair of tubular spacers or the like 91. A mounting bracket 92, bolted or otherwise rigidly secured to the lower end portion of the pedestal 52, has interposed therebetween and the lower end portion of the rocker arm 82 a coil compression spring 93 that yieldingly urges the rocker arm 82 in a direction to maintain the cam follower roller 83 in operative engagement with the marginal cam surface of the cam 81. Intermediate its ends, the rocker arm 82 has extending therethrough a transverse slot 94 that is elongated in a direction longitudinally of the rocker arm 82, and through which extends a pivot bolt or the like 95. The pivot bolt 95 is formed to provide a diametrically enlarged flange 96 that engages one side of the rocker arm 82, and a diametrically reduced threaded shank 97 on which is screw threaded a clamping screw 98 the inner end of which engages the

opposite side of the rocker arm 82. As shown, the clamping screw 98 is provided with an enlarged knurled head 99 by means of which the same may be easily turned to loosen the pivot bolt 95 for movements longitudinally of the slot 94 to shift the axis of rocking movement of the rocker arm 82. Longitudinally outwardly of the flange 96, the pivot bolt 95 has journalled thereon a roller 100 that is contained in a slot 101 formed in a bracket 102 that is rigidly secured to the pedestal 52 by means of machine screws or the like 103. As shown, the bracket slot 101 is elongated in a direction generally longitudinally of the rocker arm 82, and engagement of the roller 100 by the bracket 102 prevents movement of the pivot bolt 95 in a direction parallel to the direction of reciprocatory movement of the guide tube support 55. Hence, as the cam 81 rotates, the rocker arm 82 rocks about the axis of the pivot bolt 95 irrespective of the position in which the pivot bolt 95 is locked relative to the opposite ends of the slots 94 and 101.

When it is desired to provide the core element A with the necessary wire coils, the guide tube support sections 56 and 57 are adjusted relative to each other to properly position the guide tube 59 relative to the core element A, and the pivot bolt 95 is adjustably moved longitudinally of the rocker arm 82 and bracket 102 to provide for the desired travel of the guide tube 59 radially with respect to the core element A. With the core element A properly mounted in the chuck 20, a length of wire 61 is manually drawn through the discharge end portion 60 of the guide tube 59 to enable an end of the wire 61 to be temporarily fastened to the exterior surface of the core element A, after which rotary movement is imparted to the drive shaft 27, and the motor 87 energized to initiate rotation of the cam 81. With the free end of the wire 61 being thus secured to the core element A, reciprocatory movement of the rockshaft 14 and the core element A carried thereby will cause wire 61 to be drawn downwardly through the guide tube 59 and outwardly of the discharge end portion 60 thereof until the core element A reaches one end of its reciprocatory movement, whereupon the rockshaft 14 will be caused to rotate in one direction of its oscillatory movement to cause the discharge end portion 60 of the guide tube to be aligned with the space between a different pair of pole pieces B than the same was initially disposed between. Continued rotation of the drive shaft 27 then causes the rockshaft 14 and core element A to be moved axially in the opposite direction, such movement causing more wire to be drawn from the guide tube 59. Upon reaching the opposite limit of its reciprocatory movement, the rockshaft 14 is then rotated in the opposite direction of its oscillatory movement to align the discharge end of the guide tube with the original space between the selected pole pieces B. It will be noted that the discharge end portion 60 of the guide tube 59 is disposed in overlying spaced relation to the upper end of the core element A when the rockshaft is at its lower limit of reciprocatory movement, whereas the discharge end portion 60 is disposed in downwardly spaced relation to the core element A when the rockshaft 14 is at its upper limit of reciprocatory movement. It will be noted further that, during the reciprocatory and oscillatory movement of the rockshaft 14, the cam 81 is rotating at a slow speed to impart radial movement to the guide tube 59 in a direction radially with respect to the core element A. This radial movement of the guide tube 59 causes the wire 61 to be wound about the pole pieces B in an even and uniform layer. As the machine continues to operate, the wire 61 continues to be wound on the selected pole piece or pieces with one layer of coils 62 being uniformly built up until the desired number of turns of wire are wound about the selected pole pieces B. When the desired number of turns has been thus wound, the motor 87 is de-energized and rotation of the shaft 27 is stopped, the clamping bolt 25 loosened, and the core element A rotated with respect to the chuck 20 to properly position the core element for winding of a subsequent coil about one or more other selected pole pieces B. The process is then repeated until the entire core element has been properly wound, the whole operation being efficiently completed within a minimum of time.

From the above, it will be noted that longitudinal adjustment of the support section 56 longitudinally with respect to its cooperating support section 57, enables the field of reciprocatory movement of the guide tube 59 radially of the core element A to be shifted, so that the machine may be used to wind core elements of various diameters. Further, by shifting the pivot bolt 95 longitudinally with respect to the rocker arm 82 and bracket 102, the extent or range of reciprocatory movement of the guide tube 59 may be varied to enable the pole pieces B of various radial lengths to be properly wound with the wire 61.

While I have shown and described a commercial embodiment of my improved coil winding machine, it will be understood that the same is capable of modification, and that modification may be made without departure from the spirit and scope of the invention, as defined in the claims.

What I claim is:

1. In a coil winding machine,
(*a*) a frame structure,
(*b*) means for supporting a generally cylindrical core element of the type having circumferentially spaced axially extending radial pole pieces,
(*c*) means for imparting axial reciprocatory movements and limited oscillating rotary movements to said core element,
(*d*) a wire guide tube extending generally parallel to the direction of reciprocatory movement of said core supporting means and having a wire discharge end portion extending in an angular direction generally radially with respect to a core element carried by said supporting means,
(*e*) said end portion being alternately received between selected circumferentially spaced pole pieces during reciprocatory movement of said supporting means,
(*f*) a support for said guide tube,
(*g*) means mounting guiding the guide tube support on said frame structure for reciprocatory movements in a direction radially of a core element mounted in said core supporting means,
(*h*) and means for imparting said reciprocatory movements to said guide tube support and comprising,
(*i*) a cam,
(*j*) power operated means for imparting rotary movement to said cam at a predetermined constant slow speed relative to the speed of reciprocatory and oscillatory movements of said core element supporting means, whereby to produce a single movement in one direction of said reciprocatory movement of said guide tube during a plurality of reciprocatory movements of said core supporting means,
(*k*) a rocker arm,
(*l*) means mounting said rocker arm on said frame structure for rocking movements,
(*m*) a cam engaging follower on said rocker arm,
(*n*) and means pivotally securing said rocker arm to said guide tube support in spaced relation to said rocker arm mounting means and said follower, whereby rotation of said cam will impart said reciprocatory movements to said guide tube.

2. In a coil winding machine,
(*a*) a frame structure,
(*b*) means for supporting a generally cylindrical core element of the type having circumferentially spaced axially extending radial pole pieces,
(*c*) means for imparting axial reciprocatory movements and limited oscillating rotary movements to said core element,
(*d*) a wire guide tube extending generally parallel to the direction of reciprocatory movement of said

core supporting means and having a wire discharge end portion extending at an angular direction generally radially with respect to a core element carried by said supporting means,

(e) said end portion being alternately received between selected circumferentially spaced pole pieces during reciprocatory movement of said supporting means,

(f) a support for said guide tube,

(g) means mounting and guiding the guide tube support on said frame structure for reciprocatory movements in a direction radially of a core element mounted in said core supporting means,

(h) and means for imparting said reciprocatory movements to said guide tube support and comprising,

(i) a cam,

(j) means for imparting rotary movement to said cam at a predetermined low speed relative to the speed of reciprocatory and oscillatory movement of said core element supporting means,

(k) a rocker arm member pivotally connected at one end to said guide tube support,

(l) a cam follower on the other end of said rocker arm member and engaging said cam,

(m) a bracket member,

(n) a pivot releasably secured to one of said members for adjustable movements relative thereto and to said arm member in a direction longitudinally of said rocker arm member,

(o) said pivot defining the axis of rocking movement of said rocker arm,

(p) the range of movement of said guide tube support being determined by the position of said pivot between the limits of movement thereof relative to said rocker arm and bracket members.

3. The structure defined in claim 2 in which said bracket and rocker arm members define transverse slots extending in directions generally longitudinally with respect to said rocker arm member, said pivot comprising a shaft and means for releasably locking said shaft in the slot in said rocker arm member, said shaft having a portion received in the slot in said bracket member and engaging opposite sides of the slot therein.

4. In a coil winding machine,

(a) a frame structure,

(b) means for supporting a generally cylindrical core element of the type having circumferentially spaced axially extending radial pole pieces,

(c) means for imparting axial reciprocatory movements and limited oscillating rotary movements to said core element,

(d) a wire guide tube extending generally parallel to the direction of reciprocatory movement of said core supporting means and having a wire discharge end portion extending in an angular direction generally radially with respect to a core element carried by said supporting means,

(e) said end portion being alternately received between selected circumferentially spaced pole pieces during reciprocatory movement of said supporting means,

(f) a support for said guide tube,

(g) means mounting and guiding the guide tube support on said frame structure for reciprocatory movements in a direction radially of a core element mounted in said core supporting means,

(h) and means for imparting said reciprocatory movements to said guide tube support and comprising,

(i) a cam,

(j) power operated means for imparting rotary movement to said cam at a predetermined constant slow speed relative to the speed of reciprocatory and oscillatory movements of said core element supporting means, whereby to produce a single movement in one direction of said reciprocatory movement of said guide tube during a plurality of reciprocatory movements of said core supporting means,

(k) a rocker arm,

(l) a pivot element mounting said rocker arms on said frame structure and adjustably movable longitudinally of said rocker arm to vary the range of reciprocatory movement of said guide tube support, and means for releasably locking said pivot in desired set positions longitudinally of said rocker arm,

(m) a cam engaging follower on said rocker arm, and

(n) means pivotally securing said rocker arm to said guide tube support in spaced relation to said rocker arm mounting means and said follower, whereby rotation of said cam will impart said reciprocatory movements to said guide tube.

5. In a coil winding machine,

(a) a frame structure,

(b) means for supporting a generally cylindrical core element of the type having circumferentially spaced axially extending radial pole pieces,

(c) means for imparting axial reciprocatory movements and limited oscillating rotary movements to said core element,

(d) a wire guide tube extending generally parallel to the direction of reciprocatory movement of said core supporting means and having a wire discharge end portion extending in an angular direction generally radially with respect to a core element carried by said supporting means,

(e) said end portion being alternately received between selected circumferentially spaced pole pieces during reciprocatory movement of said supporting means,

(f) a support for said guide tube,

(g) means mounting and guiding the guide tube support on said frame structure for reciprocatory movements in a direction radially of a core element mounted in said core supporting means,

(h) said guide tube support comprising a pair of cooperating support sections, one of said sections being movable relative to the other thereof longitudinally of the direction of reciprocatory movement of said guide tube support to shift the area of reciprocatory movement of said guide tube,

(i) means for releasably locking said support sections against relative movement therebetween,

(j) and means for imparting said reciprocatory movements to said guide tube support and comprising,

(k) a cam,

(l) power operated means for imparting rotary movement to said cam at a predetermined constant slow speed relative to the speed of reciprocatory and oscillatory movements of said core element supporting means,

(m) a rocker arm,

(n) means mounting said rocker arm on said frame structure for rocking movements,

(o) a cam engaging follower on said rocker arm,

(p) and means pivotally securing said rocker arm to said guide tube support in spaced relation to said rocker arm mounting means and said follower, whereby rotation of said cam will impart said reciprocatory movements to said guide tube.

6. In a coil winding machine,

(a) a frame structure,

(b) means for supporting a generally cylindrical coil element of the type having circumferentially spaced axially extending radial pole pieces,

(c) means for imparting said axial reciprocatory movements and limited oscillating rotary movements to said core element,

(d) a wire guide tube extending generally parallel to the direction of reciprocatory movement of said core supporting means and having a wire discharge end portion extending in an angular direction gen-

erally radially with respect to a core element carried by said supporting means,

(*e*) said end portion being alternately received between selected circumferentially spaced pole pieces during reciprocatory movement of said supporting means,

(*f*) a support for said guide tube,

(*g*) means mounting and guiding the guide tube support on said frame structure for reciprocatory movements in a direction radially of a core element mounted in said core supporting means and including a pair of elongated cooperating members adjustably secured together for longitudinal movement relative to each other to shift the range of said reciprocatory movements of said guide tube,

(*h*) and means for imparting said reciprocatory movements to said guide tube support and comprising a

cam and a cooperating cam follower engaging said cam,

(*i*) means operatively connecting said cam follower to said guide tube support and including an adjustment element for varying the range of reciprocatory movement imparted to said guide tube support by said cam,

(*j*) and means for imparting reciprocatory movements to said cam at a predetermined slow speed relative to the speed of reciprocatory and oscillating movement of said core element supporting means.

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