

[54] AUTOMATIC COILS WINDING TURRET MACHINE

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[51] Int. Cl. **B21f 3/04**

[58] Field of Search 140/1, 92.1; 29/605; 242/7.09, 35.5; 269/71

[56] **References Cited**

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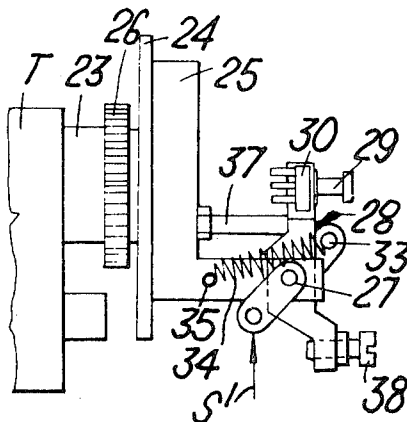
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Primary Examiner—Lowell A. Larson
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[57] **ABSTRACT**

A coil winding machine with a step-by-step rotating turret, in which the single coils are carried by support means distributed on the periphery of the turret and are mutually connected by the same wire which is used for the winding, at least through the entire path running between the coil winding station and a wire cutting station, in which said support means for the coil cores are in the form of gripping means acting laterally on the periphery of each coil core, said gripping means being adjustable in position, so as to correctly set the coil core with respect to the operating machine.

12 Claims, 9 Drawing Figures



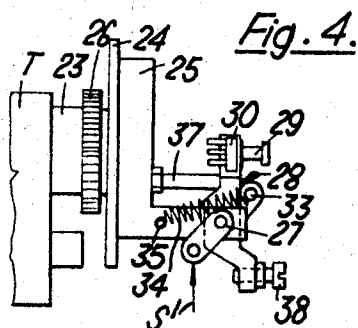
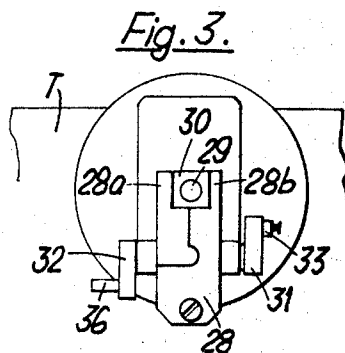
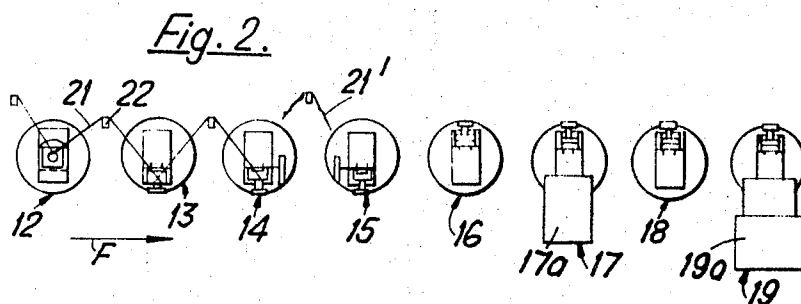
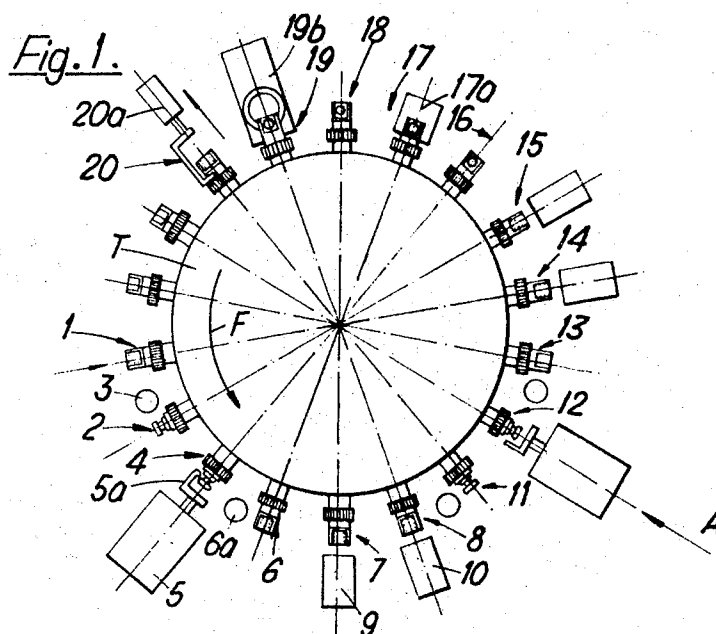


Fig. 5.

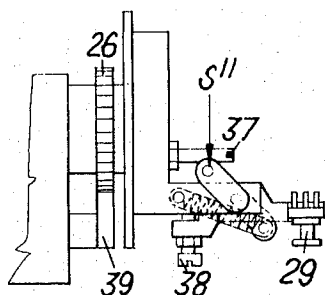


Fig. 6.

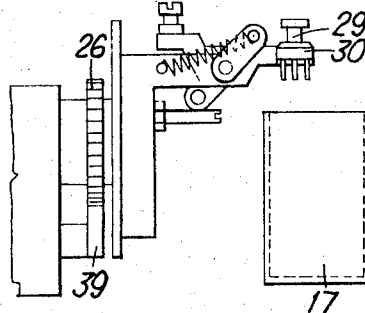


Fig. 7.

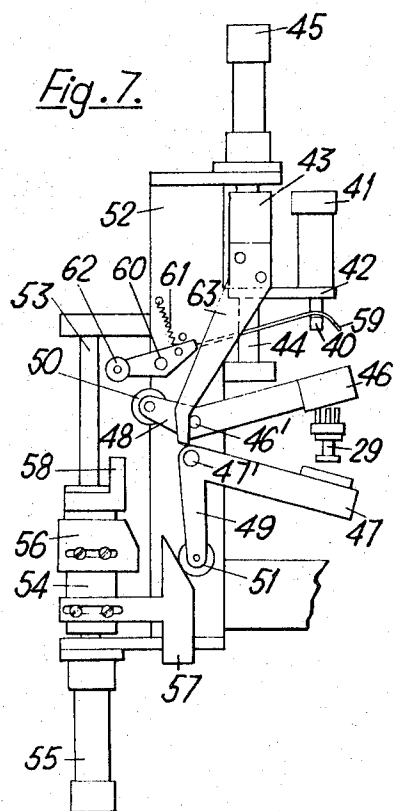


Fig. 8.

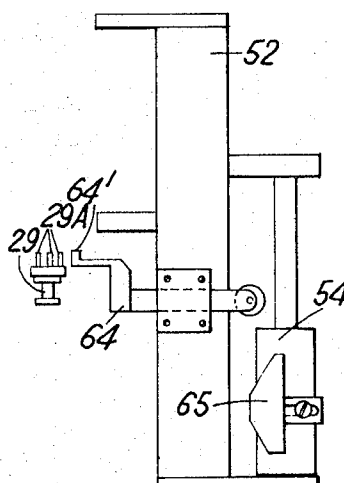
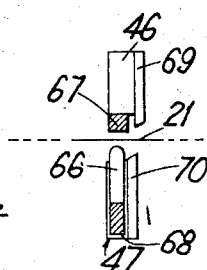


Fig. 9.



AUTOMATIC COILS WINDING TURRET MACHINE

BACKGROUND OF THE INVENTION

1. Field of the Invention

As is already known — in the most recent coil winding machines, and in particular the coil winding machines with step-by-step rotating turrets to which the present invention particularly refers — winding ends can be twisted and possibly welded onto the terminals which project from the coil cores.

The twisting systems which are applied to turret coil winding machines must all take into account one general circumstance, consisting of the fact that each coil, which is caused to advance step-by-step through the successive stations of the turret machine, remains connected to the adjacent preceding and following coils by the same wire which is used for the winding, at least over the entire path from the winding station to the station for cutting the wire.

2. Description of the Prior Art

According to a known system, the wire between two successive coils is cut downstream of the coil winding station in a position more or less close to the coils themselves, and then a twisting device is operated immediately afterwards. This device, in its most common type, is substantially in the form of a rotating bush, coaxial with the terminal on which the end of the wire must be twisted, and is adapted to cause said end to rotate by means of one of its axially projecting teeth, which are more or less differently shaped and are in any case adapted to grip the wire by simple contact.

The main drawback of this system is that it can be applied practically only to those cases in which the coil winding is carried out with wire having at least a certain intrinsic rigidity, i.e., with wire having a minimum diameter of at least some tenths of a millimetre; in fact, with a wire of this diameter, after cutting the end portions, these remain approximately in the position in which they have been left, ready to be rotated by the twisting device. On the contrary, with wires of smaller diameter, as soon as the end portions have been cut they tend to curl up, so that the rotating twisting device is completely unable to grip the wire.

In the U.S. Pat. No. 3,409,980, an improved arrangement is proposed, in which the actual twisting device, also in the form of a rotating bush having dragging teeth, directly carries the cutting means for the wire, said means simply consisting of cutting edges provided on the actual dragging teeth. This system has the advantage that the end portion of the wire is caused to rotate, for its winding onto the coil terminal, starting from the moment in which the cutting is done. In other words, if the wire has a slight tendency to curl up, the twisting device acts promptly enough to make it rotate.

However, even this apparatus does not satisfactorily solve the problem of very thin or capillary wires. In actual fact, the diameter of the rotating bush device cannot be too wide, since, in this case, it would not be able to carry out the twisting; on the other hand, if the device has a fairly small diameter, the end portion of the wire cut by it will be exceedingly short and in general — as in the case of the U.S. Pat. No. 3,409,980 — it will be adapted to twist by only one turn, or even less, onto the coil terminal. If the wire used for the winding is very thin, it happens that this single twisting turn is not apt

to remain anchored to the terminal with sufficient reliability.

A further drawback, common to the systems heretofore described, lies in the fact that the rotating bush device is able to carry out the twisting only if the coil terminals are suitably positioned with respect to the coil body, i.e., if, when the coil is mounted on the turret machine, they are in alignment with the rotation axis of the device. In the arrangements known, and in particular in the U.S. Pat. No. 3,409,980, it can in fact be noted that the coil terminals project from the coil preferably perpendicularly to the axis of the coil winding, i.e., vertically, so as to correspond to the best position of the twisting device.

In order to eliminate a large part of these drawbacks, the Applicant himself — in his Italian Pat. No. 858,122, dated 26th Apr. 1969 — has proposed an apparatus, adapted to twist the end portions of the winding onto the coil terminals before said ends are cut. This apparatus is based on the concept of carrying out the twisting by operating directly on the length of wire running between two consecutive coils, and being consequently still connected thereto; in this manner, the wire remains taut between the coil and the twisting device, and cannot escape the action of the latter.

This apparatus, although it has proved to be perfectly efficient in the majority of its applications, and particularly suitable in the case of windings of very thin wire — for example wires even with a diameter of just a few hundredths of a millimetre, or capillary wires — is however limited by the fact that the coil terminals, on which the end portions of the winding are twisted, must have a predetermined setting with respect to the coil itself; in particular, these terminals must be set according to the axis of the conical surface which the twisting device causes the wire to describe.

SUMMARY OF THE INVENTION

All the aforementioned drawbacks and the stated limitation are overcome by the coil winding machine according to the invention, which allows one to carry out the twisting of the end portions of the winding onto the coil terminals, with wires of any thinness and with the terminals set in any manner with respect to the coil core. In a coil winding machine with a step-by-step rotating turret, of the aforementioned type, this result is obtained in that support means are provided for the coil cores, in the form of gripping means acting laterally on the periphery of the coil core, and in that said gripping means are adjustable in position so as to correctly set the coil core with respect to the relative operating machine.

In a preferred embodiment, said gripping means, essentially in the form of grippers, are mounted oscillably between at least two main working positions, in which the coil is arranged with its axis horizontal and, respectively, vertical.

According to a further characteristic of the invention, the coil winding machine comprises, in combination with cutting means for the end portions of the winding, gripping and stopping means for the wire.

BRIEF DESCRIPTION OF THE DRAWINGS

Further characteristics and advantages of the present invention will be evident from the description given hereinafter with reference to a preferred embodiment, illustrated in the accompanying drawings, in which:

FIG. 1 is a diagrammatic plan view of a coil winding machine according to the invention;

FIG. 2 is a diagrammatic representation, in succession, of various working positions of the positionable coil support bracket;

FIGS. 3 and 4 are, respectively, front and lateral diagrammatic views, on a larger scale, of the positionable coil support bracket;

FIGS. 5 and 6 are diagrammatic views of the same positionable bracket in two different working positions;

FIG. 7 is a diagrammatic lateral view of the twisting and cutting unit;

FIG. 8 is a diagrammatic view of some parts of the same twisting unit, seen from the side opposite to that of FIG. 7;

FIG. 9 is a diagrammatic front view of the elements of the cutting device.

DESCRIPTION OF THE PREFERRED EMBODIMENT

As shown, the coil winding machine according to the invention comprises a turret T, having a step-by-step rotating movement according to the arrow F of FIG. 1. From the turret T project radially a number of support elements for a plurality of coils, uniformly distributed on the periphery of the turret in a substantially known manner.

In the arrangement shown in FIG. 1, a loading position 1 is provided for the empty coil cores, with which an automatic loading machine, not shown, may be associated; in the position 1, the coil core is loaded with the coil axis set vertically, while the next position 2 is used for turning the coil to a horizontal axis under control of the driving cylinder 3, as will be more fully described hereinafter. In the next position 4, the winding machine 5 carries out the winding, with its wire guide 5a rotating about the horizontal axis of the coil. The position 6 is used for again turning the coil to a vertical axis under the control of the cylinder 6a. In the positions 7 and 8, operate the twisting devices 9 and 10 respectively, the operation of which will be illustrated hereinafter. The positions 11, 12, 13, 14 and 15 are a repetition of the positions 2, 4, 6, 7 and 8, and their purpose is to carry out a second winding, on top of the first, on the same coil. In the position 16, the coil, which at 15 was lying with its axis vertical, is turned by 180°, with its axis again vertical. This new setting is used, as will be more fully explained hereinafter, for the position 17, in which the coil terminals are immersed in a welding flux, for the position 18, which is a rest position, and finally for the position 19, in which the terminals are welded. In the position 20 the finished coil is unloaded, by means of an automatic device 20a.

FIG. 2 is a diagrammatic view — in the radial direction, according to A — of the positions of the coils or coil cores and their respective support brackets, in the succession of positions from 12 to 19. In the position 12, the coil, as already stated, lies with its axis horizontal and the respective winding machine performs the winding with the wire fed through the machine itself.

In passing to the position 13, the coil remains connected by a length of wire 21 to the coil which now lies in the position 12. The length of wire 21, between the positions 12 and 13, does not keep straight and taut, but passes over an elastic take-up 22, which deviates it on to an angular path, forming a certain abundance of wire. In the position 13, the support bracket for the coil

has performed a first turning movement (from the position of FIG. 4 to the position of FIG. 5, as will be more fully described hereinafter) so as to lead the coil from the winding position, with its axis horizontal, to the vertical axis position for twisting the end portions of the wire. At the moment in which this turning takes place, the wire 21 follows the coil thanks to the take-up 22, which yields elastically, partly following the movement of the wire 21. In the final position 13, the coil has its respective terminals, in the form of pins, pointing upwards, for allowing the subsequent twisting operation.

In the position 14, the twisting and cutting is carried out on the terminal to the right of the coil, with respect to the drawing, while in the position 15, the twisting and cutting is carried out on the terminal to the left of the coil. The length of wire 21' running between the positions 14 and 15, remains free and falls naturally from the take-up 22.

In passing from position 15 to position 16, the coil support bracket is turned, moving with a rotation of 180°, from the position of FIG. 5 to the position of FIG. 6, as will be more fully described hereinafter. In position 16, the coil is still with its axis vertical. However, the terminals, in the form of pins or feet, are now pointing downwards. With this new setting, the coil now moves to the position 17, in which the terminals are immersed in a welding flux carried by the unit 17a.

With the same setting the coil passes through the position 18, which is simply a rest position, and then to the position 19. In this last position, the coil terminals are brought into contact with a bath of molten tin, contained in the unit 19a, of known type.

A detailed description is now given hereinafter, with reference to FIGS. 3 to 6, of the structure of the coil support bracket, which is particularly suited for allowing the aforementioned overturning operations, with reference to the passages from positions 12 to 13 and 15 to 16 respectively. The reference T indicates a part of the step-by-step rotating turret, which is not represented in greater detail as it may be of any known type. On the turret T is mounted the pivot 23, projecting radially and forming part of a plurality of pivots which form elements for connecting the coil support means to the turret. The pivot 23 carries a ring gear 26 and a plate 24, to which is fixed the support bracket 25. On the pivot 27, carried by the bracket 25, is mounted oscillably a gripper 28, for supporting the coil core 29. The gripper 28 comprises two arms 28a and 28b, which clamp the coil 29 laterally, by gripping the periphery of its base flange 30. As shown in FIG. 3, the base flange 30 is of square shape, which facilitates gripping, but it is evident that this flange may have any other shape. In any case, known means, not shown, will be provided for keeping the two arms 28a and 28b clamped on the flange 30, so as to firmly retain the coil.

On the pivot 27, on which is keyed the gripper 28 there are also keyed two crank levers 31 and 32. On the pin 33 of the lever 31 is fixed one end of the spring 34, the other end of which is anchored to a fixed point 35 of the bracket 25, which lies on the same horizontal plane as the pivot 27. The pin 36 of the crank lever 32 is instead essentially free; on such pin acts, on one hand, the cylinder 6a (positions 6 and 13), exerting a thrust action S' (FIG. 4) directed from the bottom upwards, in order to effect turning from the position of FIG. 4 to that of FIG. 5, and, on the other hand, the cyl-

inder 3 (positions 2 and 11) exerting a thrust action S'' (FIG. 5) from the top downwards, in order to effect turning in the reverse direction, i.e., from the position of FIG. 5 to that of FIG. 4.

In both positions of FIG. 4 and FIG. 5, adjustable stopping elements are provided, against which the gripper 28 is pushed by the action of the spring 34; thanks to its arrangement, the spring 34 is in fact able to return the oscillating gripper 28 towards one or the other of its limit positions, keeping it firmly in such position. The adjustable stop, corresponding to the position of FIG. 4, consists of a screw 37, which can be screwed and locked into a threaded hole of the bracket 25, whereas the stop corresponding to the position of FIG. 5, consists of a screw 38, which can be screwed and locked into a threaded hole provided in the gripper 28.

In order to pass from the position of FIG. 5 to that of FIG. 6, the ring gear 26 is caused to co-operate with a rack 39. The latter actually consists of a straight sector gear of limited length, integral with the machine in an area between the positions 15 and 16, and hence fixed with respect to the rotating turret T. When a coil support bracket reaches this area, the ring gear 26 engages the rack and, thanks to the movement of the turret with respect to the rack, it is caused to rotate, together with the pivot 23 and the bracket 25. The length of the rack 39 is calculated, with respect to the size of the ring gear 26, in such a manner that the ring gear 26, in rotating through 180°, is brought to the end of the rack 39. Means, for example snap means, are preferably provided for ensuring the correct positioning and the holding of the position attained, according to the setting of FIG. 5 or FIG. 6 respectively. These means may be of any of the known types and are consequently not shown, nor is it considered necessary to describe them in further detail.

FIGS. 7 and 9 show diagrammatically the means which provide for the twisting and cutting of the winding ends. These means are designed to operate with the coil supported in the position shown in FIG. 5. To prevent the drawing from being too complicated, FIGS. 7 and 8 show only the coil 29, the respective support unit being excluded.

The twisting and cutting unit comprises a rotating bush twisting device 40, of the known type as mentioned above which is rotated by a motor 41. The device 40 and motor 41 are mounted on the plate 42, integral with the slide 43. The latter is mounted slidably on the vertical shaft 44, under the control of an air cylinder 45.

The same unit also includes the cutting device, consisting of a pair of oscillating arms 46, 47, pivoted at 46' and 47' respectively. The arms 46 and 47 extend beyond the pivots 46' and 47' in the form of appendices 48 and 49 respectively, carrying at their free ends operating rollers 50 and 51.

On the main column 52, supporting the entire unit, there is mounted — besides the shaft 44 and cylinder 45 and the cutting means 46 and 47 — also a second vertical shaft 53, on which the slide 54 slides, under the action of the cylinder 55. The slide 54 carries two linear cams 56 and 57, and a stop 58. The cams 56 and 57 are designed to co-operate with the rollers 50 and 51 respectively, to cause the operation of the cutting means 46 and 47.

The unit also comprises a deflector 59, pivoted at 60 to the column 52 and held in a raised rest position by

the spring 61. This deflector is caused to oscillate downward by the stop 58 when the slide 54 moves upward, said stop 58 cooperating with the roller 62 carried by the deflector itself.

Finally, the unit comprises a cam 63, integral with the slide 43 supporting the twisting device, the function of which will be illustrated hereinafter.

On the opposite side of the column 54, as shown in FIG. 8, is provided a further positioning element 64, movable horizontally under the action, on the one hand, of a cam 65, which is in turn integral with the slide 54, and, on the other hand, of a return spring, not shown.

The operation of this twisting and cutting unit takes place as follows. When one of the positions 7, 8 or 14, 15 is reached — in each of which operates one of the twisting and cutting units heretofore described — the cylinder 55 is first of all operated. The slide 54 gradually moves upward first causing the rotation of the arm 47 in the anti-clockwise direction, by means of the cam 57 acting on the roller 51, and immediately after the rotation of the arm 46 in the clockwise direction, by means of the cam 56 acting on the roller 50.

This double movement of the arms 46 and 47 brings into mutual contact, on one side a presser 66 (FIG. 9) carried by the arm 47, and on the other side a pad 67 of friction material carried by the arm 46. Spring means 68 make sure that the presser 66 bears on the pad 67 with sufficient pressure to guarantee that the wire 21, which is caught between the two elements 66, 67, is firmly held therein. It should be noted here that the action of the slide 54, hence of the cams 56, 57, is such that the arms 46, 47 approach each other until the elements 66, 67 are brought into mutual contact under pressure, but not up to the point of also causing the closing of the cutting blades 69, 70, which are in turn integral with the arms 46 and 47 respectively.

Simultaneously with the closing of the arms 46, 47, the movement of the slides 54 also causes the shifting of the positioner 64, thanks to the action of the cam 65. Through this shifting, the head 64' of the positioner 64 is moved in such a manner as to laterally contact the wire 21 and to push said wire towards and in correspondence with the terminal 29a of the coil 29, on which the twisting has to take place. When the slide 54 stops moving, also the stop 58 operates, so as to cause the oscillation of the deflector 59 in the clockwise direction. By this oscillation, the deflector 59 moves the wire 21 from its rest position against the head 64' to a position resting on the corresponding terminal 29a. When the slide 54 has completed its entire stroke, the wire 21 is thus correctly resting on the terminal on which it has to be twisted and is furthermore held firmly by the clamp 66, 67. At this point, the wire 21 has not yet been cut.

In appropriate synchronism with the movement of the slide 54, also the cylinder 45 is operated, so as to control the downward path of the slide 43. Practically at the end of this downward path, the lower end of the cam 63 acts on the roller 51, so as to cause a short supplementary anti-clockwise oscillation of the arm 47, and, at the same time, also the rotation of the twisting device 40 is started. The supplementary oscillation of the arm 47 causes the final closing of the blades 69, 70 and hence the cutting of the wire 21. The twisting device starts to operate immediately after the cutting.

It should be noted that the wire length to the left

(with respect to FIG. 9) of the cutting position, i.e., the wire length being held by the clamp means 66, 67, is that running towards the coil terminal, whereas the length to the right of the cutting position is that running towards the elastic take-up 22. In this manner, immediately after the cutting and until the twisting device starts to operate, the end portion of the winding lies taut between the coil and the clamp means 66, 67, firmly held by the latter. The action of the clamp means is a friction clamping action, whereby, as soon as the device 40 starts the twisting, it withdraws the wire 21 without the clamp means 66, 67 opposing any appreciable resistance.

As can be easily understood from the foregoing description, the machine according to the invention offers considerable advantages with respect to the known art and principally:

it provides the possibility to set the coil, at the end of the winding, in the most suitable position for carrying out the twisting of the end portions of the wire onto the terminals, however the latter may be arranged, and, in particular, also in the event of such terminals being in the form of pins or feet projecting axially from the base flange of the coil core;

it allows the exact positioning of the end portions of the winding close to any one of a plurality of terminals, for its anchoring thereon;

it allows the end portions of the winding to be held in position, even after their cutting from the remaining wire, until after the action of the twisting device has started, so as to make it perfectly possible to twist also capillary or Litz wires.

It is to be understood that the invention is not limited to the particular embodiment illustrated, or to the specific types of movements described for the coils support unit, and that there may be several other embodiments without thereby departing from the scope of the present invention.

I claim:

1. In a coil winding machine having a step-by-step rotating turret, and support means spaced about the periphery of the turret for coils to be wound in a coil winding station with subsequent cutting of the wire in a wire cutting station; the improvement in which said support means comprise gripping means that act laterally on the periphery of each coil core and expose both ends of the coil core, and means mounting said gripping means for vertical swinging movement between a position in which the axis of the coil core is horizontal and a position in which the axis of the coil core is vertical.

2. A coil winding machine as claimed in claim 1, said support means comprising a bracket mounted for rotation about a horizontal axis, and means mounting said gripping means on said bracket for rotation about an axis spaced from and perpendicular to said horizontal axis.

tion about a horizontal axis, and means mounting said gripping means on said bracket for rotation about an axis spaced from and perpendicular to said horizontal axis.

3. A coil winding machine as claimed in claim 1, in which said gripping means, in the form of grippers, grip the coil by its base flange.

4. A coil winding machine as claimed in claim 1, in which means for gripping and retaining the wire are provided in combination with means for cutting the end portions of the winding.

5. A machine as claimed in claim 4, in which are provided means for operating said cutting means and said wire retaining means, the cutting means being operated after the intervention of the wire retaining means.

6. A machine as claimed in claim 4, in which said cutting means are in the form of a pair of blades, rigidly connected to a pair of operating arms having a scissor movement, on said arms there being also mounted said wire retaining means, in the form of a pair of gripping elements, at least partially yielding.

7. A machine as claimed in claim 6, in which said pair of gripping elements consists of a pad of friction material integral with one of said operating arms, and a presser yieldably mounted on the other of said operating arms and pressed by spring means.

8. A machine as claimed in claim 4, in which are also provided means for twisting the end portions of the wire onto the terminals integral with the coil core, said twisting means being caused to operate before the release of said wire gripping and retaining means.

9. A coil winding machine as claimed in claim 8, in which said means for twisting the end portions of the wire onto the terminals are in the form of a rotating bush.

10. A coil winding machine as claimed in claim 4, in which are also provided means for positioning the wire emerging from the winding, in order to place said wire close to any one of a plurality of terminals integral with the coil core, said positioning means operating before the intervention of said cutting means and said wire gripping and retaining means.

11. A machine as claimed in claim 10, in which said wire positioning means comprise a positioner for shifting the wire in the horizontal direction, and a deflector for shifting the wire in the vertical direction.

12. A coil winding machine as claimed in claim 5, in which are also provided means for deviating the wire which connects two adjacent coils, said means being in the form of a take-up which creates a reserve of wire which can be slackened between said two coils.

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