

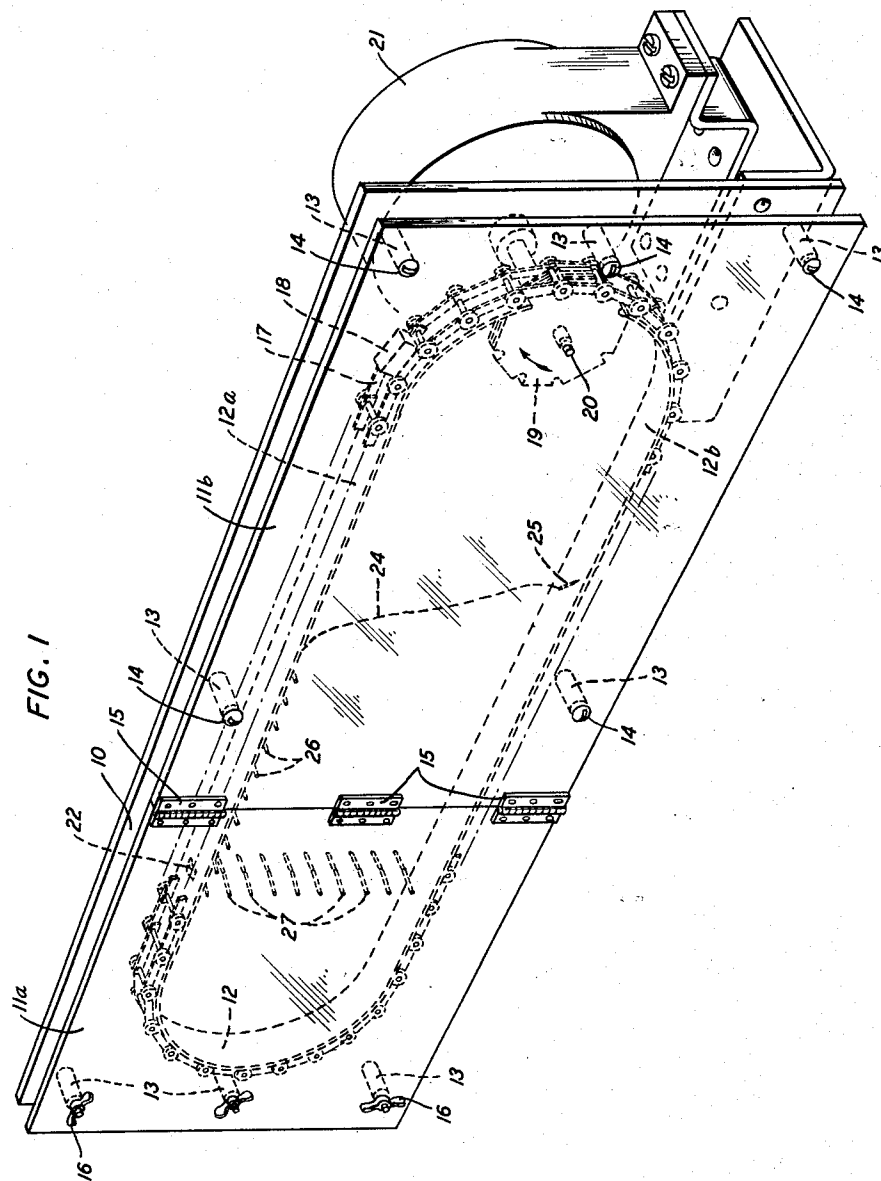
Nov. 8, 1960

D. W. GRANT ET AL
WINDING MACHINE

2,959,366

Filed Aug. 27, 1957

2 Sheets-Sheet 1



INVENTORS D. W. GRANT
M. WOHLHIETER
BY *John C. Morris*
ATTORNEY

Nov. 8, 1960

D. W. GRANT ET AL
WINDING MACHINE

2,959,366

Filed Aug. 27, 1957

2 Sheets-Sheet 2

FIG. 2

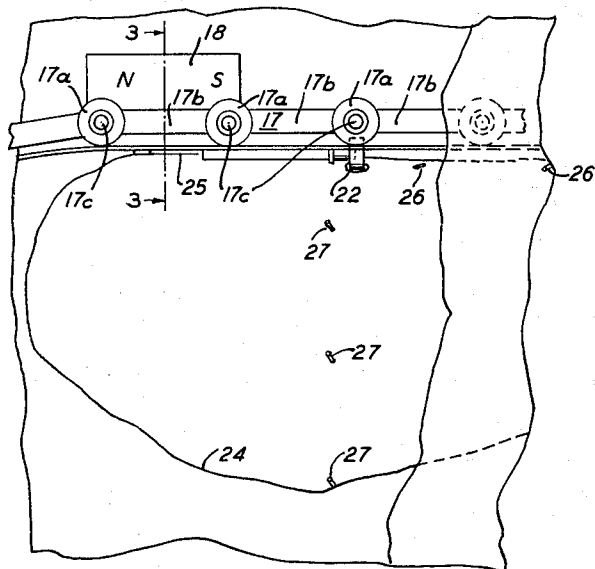


FIG. 3

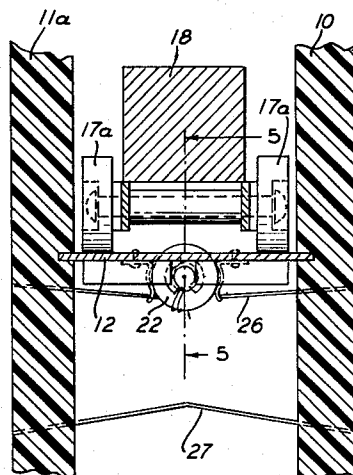


FIG. 4

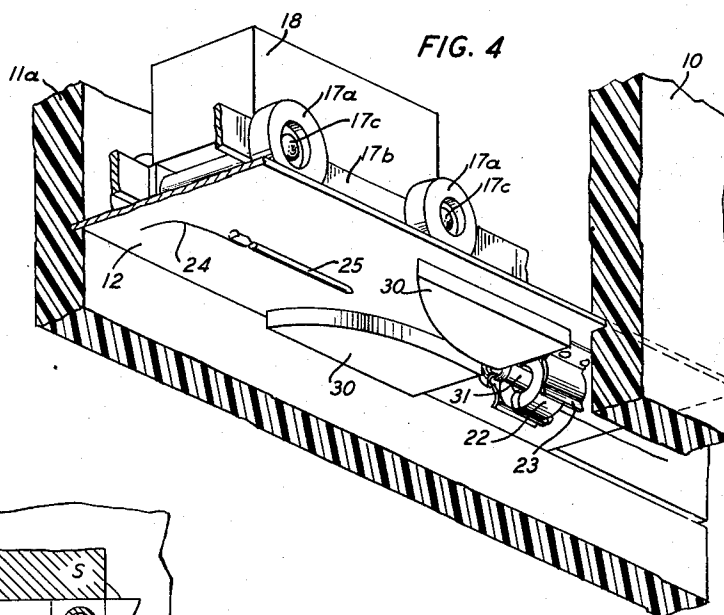
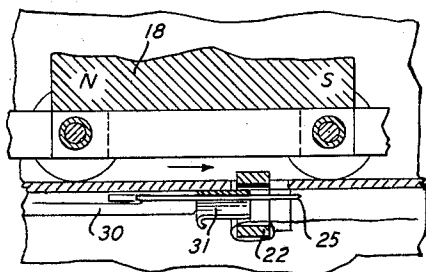


FIG. 5



INVENTORS: D. W. GRANT
M. WOHLHIETER
BY John C. Morris
ATTORNEY

1

2,959,366

WINDING MACHINE

Dwight W. Grant and Marion Wohlhieter, Andover, Mass., assignors to Bell Telephone Laboratories, Inc., New York, N.Y., a corporation of New York

Filed Aug. 27, 1957, Ser. No. 680,514

5 Claims. (Cl. 242—4)

This invention relates to winding machines, and more particularly to machines for winding wire onto toroidal cores.

One aspect of the trend toward miniaturization of electrical components has been the problem of applying multi-turn windings to miniature toroidal cores, i.e., toroidal cores having outside diameters in the order of one-quarter of an inch.

An object of this invention is to facilitate the winding of miniature toroidal cores.

More specifically, an object of the present invention is an improved winding machine.

A further object of this invention is a winding machine capable of applying turns of wire to a miniature toroidal core in an expeditious and reproducible manner.

These and other objects of the present invention are realized in an illustrative embodiment thereof wherein a wire-guiding needle of magnetic material is directed along an open loop track of non-magnetic material by a driven permanent magnet, the needle and the magnet being spaced apart by the non-magnetic track.

The track includes an aperture in which a core is positioned so that its central opening is in alignment with the guided needle. The permanent magnet, which is secured to and moved by an endless chain or belt that is driven along the outer surface of the track, causes the needle to slide along portions of the inner surface of the track and through the opening in the core.

The guided needle has secured thereto one end of a length of wire which is to be wound onto the positioned core by a mechanism illustrative of this invention, the other end of the wire being advantageously attached to the core itself.

The needle and the wire secured thereto are passed through the core center and then guided along a path which again leads through the core, each pass of the needle through the core applying another turn thereto.

The wire element which is to be wound onto a core is selected to be of a length such that it is drawn taut by the needle and magnet after being directed through the core and along a portion of the upper leg of the track. As the wire length draws taut, the needle remains stationary for an instant, and then as the magnet is moved along by the chain or belt, the needle drops to a point on the inner surface of the lower leg of the track to await there the arrival of the advancing magnet. To insure that the guiding needle will be properly oriented after the advancing magnet re-engages it, the needle may advantageously be magnetized.

As the needle drops, the wire secured thereto engages a wire tensioning and guiding arrangement comprising a plurality of spring whiskers. These whiskers maintain the wire in a looped configuration and introduce tension in the winding operation by slightly retarding the advance of the needle-guided wire.

Accordingly, a feature of the present invention is a winding machine comprising a wire-guiding needle of magnetic material which is directed along a track of non-

2

magnetic material by a driven permanent magnet, the needle and the magnet being spaced apart by the track.

Another feature of this invention is a toroidal core winding machine including a wire-guiding needle of magnetic material which is guided along a track of non-magnetic material by a driven permanent magnet, the needle and the magnet being spaced apart by the track, and whisker members for maintaining the guided wire under tension and in a looped condition during the winding operation.

A still further feature of the present invention is a device for winding wire onto a miniature toroidal core comprising an arrangement for holding a core, a looped band or track having an aperture therethrough for receiving the core, a needle of magnetic material for guiding wire through the center of the core, a member for securing one end of the wire to the core, the other end of the wire being attached to the needle, an endless driven chain or belt positioned on the outer surface of the band and having a permanent magnet secured thereto, the needle being longitudinally carried along portions of the inner surface of the band and through the center of the core by the attractive force of the driven permanent magnet, whereby the needle and the wire attached thereto are guided through the core and along the inner surface of the band until the wire is pulled taut, the permanent magnet then moving out of attractive relation with the needle, thereby allowing the needle to drop to the lower portion of the inner surface of the band to await there the arrival of the permanent magnet, and whisker elements positioned in the space contained by the band for maintaining the wire under tension and in a looped condition.

Thus, an illustrative embodiment of the present invention is a machine for winding wire onto miniature toroidal cores, which machine includes a structural arrangement in which there is no mechanical connection between a wire-guiding needle and a needle-driving mechanism.

A complete understanding of the invention and of these and other features and advantages thereof may be gained from a consideration of the following detailed description in conjunction with the accompanying drawing, in which:

Fig. 1 is a perspective view of a machine illustrative of one specific embodiment of the principles of the present invention;

Fig. 2 is a view, with parts broken away, of a portion of the machine of Fig. 1;

Fig. 3 is a view as seen from the line 3—3 of Fig. 2;

Fig. 4 is a perspective view of a portion of the structure of Fig. 2; and

Fig. 5 is a view as seen from the line 5—5 of Fig. 3.

The winding machine shown in Fig. 1 includes three frame members 10, 11a and 11b, which may advantageously be of a transparent plastic material. Positioned in grooves in the frame members 10, 11a and 11b is a looped band element or track 12 of a non-magnetic material, such as brass. (Fig. 3 shows the structural relationship between the band 12 and the grooved frame members 10 and 11a in a particularly clear manner.)

The frame members are maintained apart by spacers 13 and screws 14. The frame member 11a is connected to the member 11b by hinge elements 15. Fasteners 16 serve to secure the member 11a in alignment with the member 11b and, as is fully described hereinafter, also serve to facilitate access to the core-holding interior of the machine.

Mounted outside of the band element 12 is an endless chain 17 which has secured thereto, in any suitable manner, a permanent magnet member 18. The chain 17 is driven by a sprocket wheel 19 which is connected to a drive shaft 20. The shaft 20 in turn is driven by

a motor member 21 which is securely mounted in adjacent relation to the frame member 10 in any manner considered suitable by those skilled in the mechanical arts.

To initiate a winding cycle, the fasteners 16 are loosened to allow the frame member 11a to be hinged away from the member 10. A miniature toroidal core 22 (Fig. 4) is then inserted in any suitable core-holding structure (for example, clip members 23 of the type shown in Fig. 4).

One end of a preselected length of wire 24 is then secured to the core 22 (by means, for example, of a suitable adhesive material) and the other wire end is attached to a needle member 25. The sprocket wheel 19 is then rotated to bring the magnet 18 into attractive relation with the needle 25.

The frame member 11a is then repositioned in alignment with the member 11b, and resecured in that position by the fasteners 16.

During a typical winding cycle, the wheel 19 drives the magnet 18, and, thus, the needle 25, in a clockwise direction (Fig. 1) until the wire attached thereto is drawn taut at a point along the inner surface of the upper leg 12a of the track 12. The magnet 18 continues to move along the outer surface of the track, and so moves out of attractive relation with the wire-guiding needle member 25. Accordingly, the needle drops to the inner surface of the lower leg 12b of the track 12. (Fig. 1 shows the needle 25 after having been dropped.)

The driven magnet 18 continues its clockwise travel and at a point along the lower leg 12b of the track 12 re-engages the needle 25. The needle 25 may advantageously be a magnetized or polarized member so that it will be properly oriented upon being re-attracted. (The desired orientation of the needle 25 with respect to the core 22 is shown, for example, in Fig. 4.)

The described manner of needle travel keeps the wire-guiding needle out of the driving or sprocket wheel zone, thus avoiding entanglements between the needle and the wheel. Additionally, this novel arrangement automatically compensates for the fact that the free wire length decreases with each pass through the core.

As the needle 25 drops to the lower leg 12b of the track 12, a portion of the wire length 24 is carried into engagement with a horizontal row of whisker elements 26. The whisker elements 26 are identical in all respects, except orientation, with a vertically arranged row of elements 27 (Fig. 1).

The whisker elements 26 and 27 comprise pairs of spring wires mounted in the frame members 10, 11a and 11b. The uppermost pair of the vertically arranged group of whisker elements 27 is shown most clearly in Fig. 3. The individual whiskers of that pair are displaced a small amount from a perpendicular to the frame members 10 and 11a, and are designed to meet half way between the frame members to form a V-type figure the point of which is directed at the core 22.

Similarly, the horizontally arranged whisker elements 26 form V-type figures which are pointed or directed at the core 22.

The whisker elements are stiff enough to support the wire length 24, but cannot support the needle 25 (i.e., the weight of the needle 25 is sufficient to flex the whiskers and so open the points of their V-type configurations, thereby allowing the wire to pass therethrough). Also, the attractive force of the magnet 18 is sufficient to pull the guided wire 24 through the whisker elements.

The whiskers 26 and 27 serve to prevent kinking and tangling in the wire 24 by maintaining it in a looped condition, and they also introduce a desired drag or tension in the guided wire.

Fig. 2 shows the permanent magnet 18 directing the needle 25 and the wire 24 into position for a pass through the center of the core 22. Also, the action of

the whisker elements in maintaining the wire 24 in a looped configuration is clearly indicated in Fig. 2.

Fig. 2 also shows the component parts of the endless chain 17. These parts include wheels 17a, connecting links 17b and axle members 17c.

Fig. 3 illustrates, in particular, the manner in which the driven chain 17 straddles the mounted core 22 in passing thereover.

In Fig. 4 there is shown a needle-guiding assembly including directing plates 30 and an eyelet 31. The plates 30 direct the needle 25 to the center of the track 12 so that the needle will be positioned in alignment with the opening in the core 22. The eyelet 31, which is generally cylindrical in shape, includes a tapered end portion having flared edges. This portion of the eyelet facilitates the entrance of the needle therein. The eyelet also includes a longitudinal slot portion along the bottom thereof which permits the wire 24 to pass therethrough during the winding operation.

Fig. 5 shows the magnet 18 directing the needle 25 through the core 22. Fig. 5 also shows the position of the eyelet 31 with respect to the core 22.

The needle member employed in embodiments of the present invention advantageously comprises a cylindrical member having a restricted or grooved portion (Fig. 4) and a flattened portion. One end of the wire 24 is attached to the restricted portion and the wire to be wound is led along the flattened portion (Fig. 4). In this way there is no projection of the wire beyond the diameter of the needle. Snagging during winding is thereby minimized. Furthermore, the needle diameter is thereby the largest dimension that need be passed during winding. The use of needles having very small diameters thus makes possible the winding of cores having very small openings.

Thus, specific illustrative embodiments of this invention are winding machines characterized in that a wire-guiding needle of magnetic material is accurately directed along a non-magnetic track by a magnet member, and in that whisker elements are employed to maintain the wire in a looped condition and to introduce tension therein during the winding operation.

It is to be understood that the above-described arrangements are illustrative and not restrictive of the principles of the present invention. Other arrangements may be devised by those skilled in the art without departing from the spirit and scope of this invention. For example, while emphasis has been placed herein on the winding of miniature toroidal cores, it is to be understood that the principles of this invention are applicable to the winding of a variety of different-sized and different-shaped components.

Furthermore, while means for rotating the core 22 to obtain an even distribution of wire thereon forms no essential part of the present invention, and thus has not been shown or described, it is to be understood that such a means may be incorporated in an illustrative embodiment of the present invention by any one skilled in the art.

What is claimed is:

1. A toroidal core winding machine including a looped track of non-magnetic material having a core-receiving aperture therein, an endless driven chain having magnet means secured thereto, said chain resting on the outer surface of said track, and needle means of magnetic material for guiding a wire through a core placed in said track aperture, said needle means being directed along the inner surface of said track by said driven magnet means.

2. A machine for winding miniature toroidal cores comprising a wire-guiding needle of magnetic material, a looped track of non-magnetic material having a core-receiving aperture therein, an endless chain having a permanent magnet member mounted thereon, a frame member, chain driving means, and whisker tensioning and

5

6

guiding means, said chain being moved along the outer surface of said track by said driving means, said permanent magnet member thereby guiding said needle along the inner surface of said track and through a core placed in said track aperture, said track and said whisker means being supported by said frame member.

3. In an apparatus for winding wire onto a miniature toroidal core, means for holding said core, a band having an aperture therethrough for receiving said core in transverse relation to the longitudinal axis of said band, magnetic needle means for guiding wire through the center of said core, means for securing one end of said wire to the core, the other end of said wire being attached to said needle means, endless driven chain means positioned on the outer surface of said band and having magnet means secured thereto, said needle means being longitudinally carried along portions of the inner surface of said band and through the center of said core by the attractive force of said driven magnet means, whereby said needle means and said wire attached thereto are guided through said core and along said band inner surface until said wire is pulled taut, said magnet means then moving out of attractive relation with said needle means and thereby causing said needle means to drop to a lower portion of said inner surface to await there the arrival of said driven magnet means, and whisker means positioned in the space contained by said band for maintaining said wire under tension and in a looped condition.

4. A toroidal core winding machine comprising a track of non-magnetic material have a core-receiving aperture therein, a wire-guiding needle of magnetic material on one side of said track for guiding a wire through a core placed in said track aperture, magnet means on the other side of said track for guiding said needle along said track and through the core placed in said track aperture, and driving means for moving said magnet means along said other side of said track.

5. Apparatus for winding wire onto a toroidal core comprising a member of non-magnetic material having a core-receiving aperture therein, a magnet movably positioned on one side of said member, needle means of magnetic material positioned on the other side of said member for guiding a wire through a core placed in said aperture, said needle means being movable under the influence of said magnet through the core placed in said aperture, and means for continuously moving said magnet in a predetermined closed path such that said needle is successively moved through the core in said aperture whereby a turn of wire is wound upon the core with each passage of said needle means through the core.

References Cited in the file of this patent

UNITED STATES PATENTS

1,851,243	Egli	Mar. 29, 1932
2,102,692	Franz	Dec. 21, 1937
2,239,395	Mallory	Apr. 22, 1941
2,812,143	Goudykoontz	Nov. 5, 1957