March 1, 1960 J. R. BOS ET AL 2,926,859

WIRE CONNECTING TOOL

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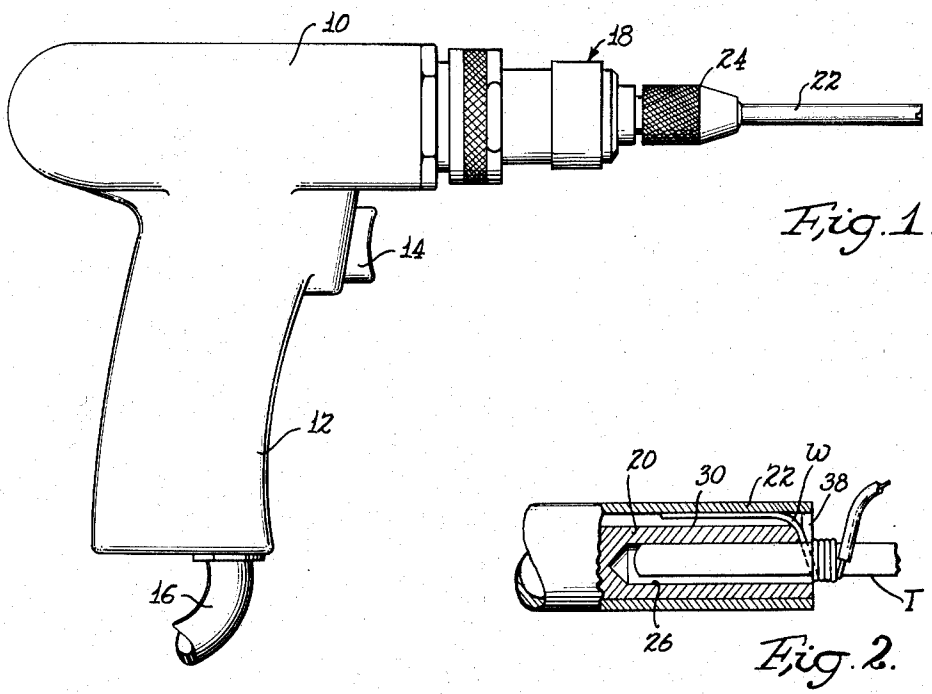


Fig. 1.

Fig. 2.

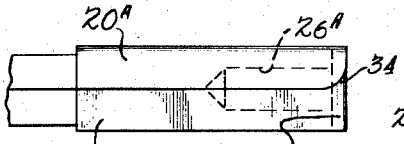


Fig. 3.

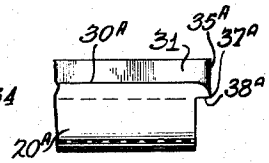


Fig. 4.

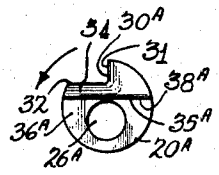


Fig. 5.

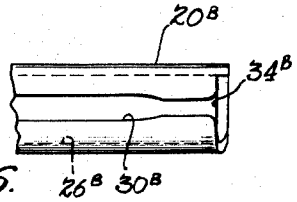


Fig. 6.

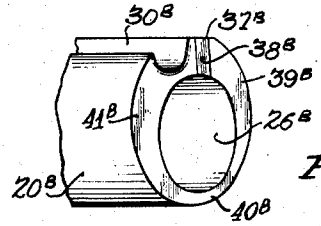


Fig. 7.

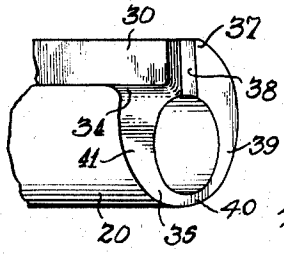


Fig. 8.

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WIRE CONNECTING TOOL

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3 Claims. (Cl. 242—7)

The present invention relates generally to the effecting of a connection between a wire and an electrical terminal and more particularly to the formation of such a connection by means of a rotary tool operative to wind the wire helically in successive convolutions about the terminal and in intimate engagement therewith.

Tools of this general character conventionally include a shaft or bit which may be journaled for rotation in a stationary guide or sleeve. The bit is provided adjacent its forward end with a longitudinal recess for the reception of the terminal and a radially offset longitudinally disposed groove for the reception of the wire so that the wire is wound about the terminal upon rotation of the bit. For an example of a tool incorporating such a device reference is made to United States Patent No. 2,585,010, issued February 12, 1952, to Bell Telephone Laboratories, Incorporated, as assignee of C. N. Hickman et al.

In a bit of the type shown in the afore-mentioned patent the wire-receiving groove comprises a substantially straight sided channel extending longitudinally of the bit being milled or otherwise formed in the outer surface thereof. The ends of the side walls of the groove are rounded to merge smoothly with the end face of the bit, the rounded portion defining a radius over which the wire is withdrawn so as to control tensioning of the wire as it is wound about the terminal. The width and depth of the groove of this bit are such as to accommodate but a single wire size, e.g., 20 gauge, thus requiring several bits to receive and wind even a small range of wire sizes. With stranded wire there is always a tendency for the ends of the individual strands of the wire to separate or to become separated upon insertion in the wire-receiving groove of the bit. Also, presoldered or "dip-tinned" stranded wire may be of larger dimension at the end thereof and at other places along the tinned portion of its length than its nominal diameter because of the presence of the solder and the afore-mentioned strand separation tendency. Further, even solid wires are quite likely to become bent or otherwise deformed. In view of this, the usefulness of a particular bit of the Hickman et al. type is limited because of the considerable difficulty which has been experienced in the insertion of stranded wire and deformed solid wire into the bit groove.

Accordingly it is one object of the present invention to provide a wire winding bit embodying an improved construction and arrangement making its manufacture more simple and economical and at the same time facilitating the reception of a wire therein.

Still another serious difficulty has been encountered in the use of wire winding bits of the type shown in the afore-mentioned Hickman et al. patent. In the operation of a bit of this type to wind a wire about a terminal, the wire forms a relatively large arc in the portion thereof between the forward end of the wire-receiving groove of the bit and the point of contact of the wire with the terminal because of the inherent stiffness of the wire. This point of contact is spaced forwardly of the forward end face of the bit. When forward pressure is applied by an operator to a tool incorporating such a bit so as to hold it in engagement with the work, the bit is moved forwardly with respect to the terminal and thus the end face of the bit moves toward the turn of wire just wound on the terminal. The result experienced is that because of the arc assumed by the wire, succeeding turns of the wire may be superimposed upon a preceding turn of wire on the terminal. Thus an imperfect connection is formed unless extreme caution is exercised by the operator so as to maintain exactly the right amount of forward force and no more on the tool so as to insure a closely wound single layer connection. Experience has shown that this is exceedingly difficult to attain consistently in the use of such tools even by skilled personnel.

Still another object of the present invention, therefore, is to provide in a wire winding bit a novel construction whereby the afore-mentioned difficulty is overcome.

The objects of the invention thus generally set forth together with other objects and ancillary advantages are attained by the construction and arrangement shown by way of illustration in the accompanying drawing, in which:

Figure 1 is a side elevation of a wire winding tool incorporating a bit embodying the present invention.

Fig. 2 is an enlarged fragmentary end elevation partly in section of the forward end of the tool shown in Fig. 1.

Figs. 3, 4 and 5 are respectively fragmentary plan, side, and end views of a bit embodying one of the features of the present invention.

Figs. 6 and 7 are respectively fragmentary plan and perspective views of the forward end of a bit embodying another of the features of the present invention.

Fig. 8 is a fragmentary perspective view of the forward end of the wire winding bit shown in Fig. 2 embodying the features of the present invention.

Referring more particularly to the drawings, there is shown in Figs. 1 and 2 a wire winding tool for effecting electrical connection of a wire with a terminal. In general this tool, which is shown for purposes of illustration, includes a body **10** which is equipped with a pistol grip handle **12** mounting a fingerpiece **14** by means of which power supply to the tool is controlled. The illustrative tool is of the type adapted for pressure fluid actuation and, suffice it to say for present purposes, it incorporates within the body **10** a rotary fluid motor to which pressure fluid is supplied by way of a suitable hose and fitting **16** connected to the tool at the base of the handle **12**. In the illustrative tool, the fingerpiece **14** is operatively associated with valve means (not shown) disposed within the handle **12** for controlling the admission of pressure fluid to the motor that is disposed within the body **10**.

At its forward end the tool terminates in a nose assembly, generally designated **18**, which may incorporate suitable speed reduction gearing and clutch mechanism for coupling the tool's motor to its wire winding bit **20**. The bit as shown is journaled within a stationary sleeve or guide **22** which is adapted to be mounted on the nose assembly **18** by means of a clamping nut **24**.

As shown in Fig. 2, the bit **20** which is journaled in the sleeve **22** is provided with a longitudinal recess **26** for the reception of a terminal T about which a wire W is to be wound so as to effect an electrical connection therebetween. The recess **26** is of a diameter greater than the maximum transverse dimension of the terminal to permit free rotation of the bit **20** with respect to the terminal so as not to twist the terminal. At the same time, however, it is desirable to make the recess of a

diameter somewhat less than the maximum transverse dimension of the terminal plus an allowance depending on the diameter of the wire with which it is to be used. Thus entry of the terminal with a wire wound thereon is limited by engagement of the wire with the end face of the bit. It will also be noted that upon insertion of the terminal T in the recess **26** the connection between the wire W and the terminal is effected in spaced relation to the end of the terminal. As a result of this relative sizing of the bit recess together with the fact that its depth causes the first connection made to be spaced inwardly from the outer end of the terminal end, permits the making of a succeeding connection of another wire to the same terminal in contiguous relation to the previously made connection but axially outward with respect thereto on the terminal, and to do so without injury to the previously made connection.

In accordance with one aspect of the invention the wire winding bit is fashioned to facilitate the reception of the wire W therein for subsequent application to the terminal T and to increase the range of wire sizes which a single bit can accommodate. In carrying out this aspect of the invention the bit is provided with a wire-receiving groove comprising in cross-section a section of a segment thereof. As shown in the bits illustrated in Figs. 2, 3, 4, 5, and 8 of the drawings, the illustrative bits are provided in their peripheral surfaces with wire-receiving grooves **30** and **30A** which are longitudinally disposed and which comprise right-angular segments in cross-section with one wall of the grooves being generally radially disposed.

In the bit **20A** shown in Figs. 3, 4 and 5, the wire-receiving groove **30A** is provided which is of the aforementioned form having a radially disposed wall **31** and a transverse wall **32** disposed substantially at right angles thereto and in spaced relation to the upper limit of the terminal receiving recess **26A**.

The outer ends of the groove walls **31** and **32** are rounded to a predetermined radius as at **34** merging smoothly with the contiguous portion **35A** of the transverse end face of the bit **20A** and with each other for the control of the tensioning of the wire W during its withdrawal from the groove **30A** upon winding the wire about the terminal T.

It will be appreciated that this form of groove together with the oppositely disposed portion of the stationary guide sleeve **22** defines an improved form of recess for wire reception which not only permits accommodation of a larger range of wire sizes than has heretofore been available but does not impair the operative effectiveness of the bit. The cross-sectional form of the groove **30A** facilitates the insertion of stranded wire and bent or otherwise deformed solid wire therein. Further this shape of groove permits its formation in the blank from which the bit is fashioned by substantially less expensive machining operations than those required for bit grooves of the type, for example, shown in the Hickman et al. patent.

In carrying out another aspect of the invention means is provided to prevent the piling up of successive convolutions of the wire W upon previously formed convolutions of the wire during the winding operation. This means is such as to utilize a previously applied convolution of the wire as a guide for feeding the bit axially outward with respect to the terminal T during its operation.

Referring more particularly to Figs. 6 and 7 of the drawing a bit **20B** is there shown which has a wire-receiving groove **30B** therein and a terminal receiving recess **26B**. The outer edge of the wire-receiving groove is rounded to a predetermined radius as at **34B** to merge smoothly with the end face of the bit and to control the tensioning of the wire as it is withdrawn from the groove during the winding operation. In both the bits **20A** and **20B** the outer end surfaces are formed having portions **35A**, **36A** and **39B**, **41B**, respectively, lying in offset planes with respect to each other and being generally transaxially positioned. The offset end surface portions **35A**, **36A**, and **39B**, **41B**, respectively define therebetween longitudinally disposed faces **38A** and **38B**. These longitudinally disposed faces **38A** and **38B** serve to wipe down the free end of a wire W into intimate engagement with a terminal T after the wire has been withdrawn from the wire-receiving groove upon completion of the winding operation. In the form of the bit shown in Figs. 6 and 7 the transverse annular end surface of the bit comprises a guide portion **39B** which is maintained at a right angle to the axis of the bit through approximately 180° as measured in the clockwise direction from the transverse face **38B**, to the point **40B**, and a portion **41B** which is angularly relieved or tapered through the remaining circumferential travel about the outer end of the bit **20B** from the point **40B** to the rounded outer end **34B** of the groove **30B**. Since the guide portion **39B** defines the point of farthest outward axial extent of the bit **20B**, this surface is employed to feed the bit axially outward from the terminal T during winding of the wire W thereon. It will be observed that the surface **39B** trails a few degrees behind the wire-receiving groove during rotation of the bit **20B** in a counterclockwise direction (when viewed from the outer end of the bit). Upon reference to the drawings it will be seen that after the end of the last wire convolution clears the point **40B**, the bit **20B** moves forward slightly as the tapered surface **41B** is urged into abutment with this last convolution so that upon rotation of the bit through approximately 180° from the point **40B**, the transverse surface **38B** wipes down the free end of the wire W to the terminal T. This construction and arrangement allows the leading face **38B** of the bit projection to perform the function of wiping down the free end of the wire W after it is withdrawn from the groove **30B**, and during the winding operation the transverse end portion **39B** of the face of the bit provides a guide surface engageable with the last portion of the wire wound about the terminal T thus urging the bit longitudinally outward with respect to the terminal during the winding operation. As a result of this outward movement the bit is positively moved so that successive convolutions are wound or laid down about the terminal in true helical form and in intimate engagement with the terminal. It will be seen, therefore, that this construction and arrangement whereby the bit is positively urged with respect to the terminal prevents piling up of successive convolutions of the wire upon each other thereby insuring the formation of a perfect connection.

While two aspects of the present invention have been separately illustrated and described it will be apparent that both are desirably incorporated in a single bit. Such a bit is shown in Figs. 2 and 8, thus these figures illustrate a bit **20** which is provided with a wire-receiving groove **30** which is of right segmental form in cross-section. The groove **30** terminates at its outer end in a smoothly rounded edge **34**. The edge **34** merges smoothly with the contiguous portion of the bit end face. The transverse end face **35** in this form of the invention is formed in the same manner as that of the bit of Figs. 6 and 7, thereby defining a guide surface **39** disposed at a right angle to the axis of the bit **20** for engagement with previously wound convolutions of the wire W on the terminal T and a tapered surface **41** extending from the point **40** to the groove **30** for coaction with a longitudinal wipe down surface **38** defined between the surface portions **39** and **41**. It will be seen, therefore, that this form of wire winding bit embraces the advantages of both of the forms of wire winding bit previously described. It permits of economical manufacture, facilitates the reception of a wire therein, increases the range of wire sizes which can be accommodated thereby as compared to previously available bits, and it prevents the piling-up of successive convolutions of wire during

its operation so as to prevent the formation of an imperfect connection between the wire and the terminal.

We claim as our invention:

1. In a tool for effecting a connection between a wire and a terminal, a bit for winding the wire about the terminal upon relative rotation in one direction comprising a generally cylindrical member rotatable about its longitudinal axis and having an outer end surface, said member having a longitudinally extending recess in said end surface for reception of the terminal, said member also having a longitudinal, wire-receiving groove in its peripheral surface extending from said end surface; said outer end surface having a raised longitudinally projecting portion defining a transverse guide surface extending from a first point adjacent said groove on the side trailing said direction of rotation to a second point around said recess substantially opposite said groove, said raised portion defining a longitudinally disposed wiping face extending from said guide surface to said end surface at said first point.

2. In a tool for effecting a connection between a wire and a terminal, a bit for winding the wire about the terminal upon relative rotation in one direction comprising a generally cylindrical member rotatable about its longitudinal axis and having an outer end surface, said member having a longitudinally extending recess in said end surface for reception of the terminal, said member also having a longitudinal, wire-receiving groove in its peripheral surface extending from said end surface; said outer end surface having a raised longitudinally projecting portion defining a transverse guide surface extending from a first point adjacent said groove on the side trailing said direction of rotation to a second point around said recess substantially opposite said groove, said portion being merged smoothly into said end surface at said second point.

3. In a tool for effecting a connection between a wire and a terminal, a bit for winding the wire about the terminal upon relative rotation in one direction comprising a generally cylindrical member rotatable about its longitudinal axis and having an outer end surface, said bit having a longitudinally extending recess in said end surface for reception of the terminal, said bit also having a longitudinal, wire-receiving groove in its peripheral surface extending from said end surface; said groove being of right segmental form in cross section and having one wall substantially radially disposed, said outer end surface having a raised longitudinally projecting portion defining a transverse guide surface extending from a first point adjacent said one groove wall on the side trailing said direction of rotation to a second point around said recess substantially opposite said groove wall, said portion defining a longitudinally disposed wiping face extending from said guide surface to said end surface at said first point.

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