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[54] **DEVICES FOR MAKING WRAPPED-WIRE CONNECTIONS**

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[52] **U.S. Cl.** ..... **7/14.1 R**, 29/203 H, 140/124, 242/7.06

[51] **Int. Cl.** **B25f 1/00**, B21f 3/00

[58] **Field of Search** ..... 140/111, 117–119, 140/122–124; 242/7.17, 7.06, 7.18; 29/203 H; 7/14.1 R

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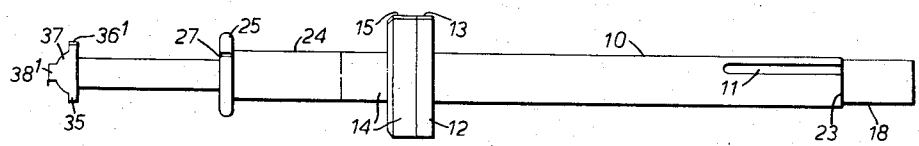
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[57] **ABSTRACT**

A wire-wrapping bit which enables an electrical wrapped-wire joint to be made upon a terminal tag by a sequence involving cutting, stripping and wrapping operations performed as a result of rotation of a spindle with respect to a stationary supporting sleeve comprises a spindle formed in two sections, the section of which that is adapted to be placed over a terminal tag, has at the pertinent end, a nose portion having two stripping slots in substantially diametrically opposed positions of its periphery. The other end of this section is arranged to interlock in either of two opposite angular positions with one end of the other spindle section to determine which of the two stripping slots is operatively positioned with respect to a slot in a wire guiding disc affixed to the second section of the spindle.

5 Claims, 8 Drawing Figures



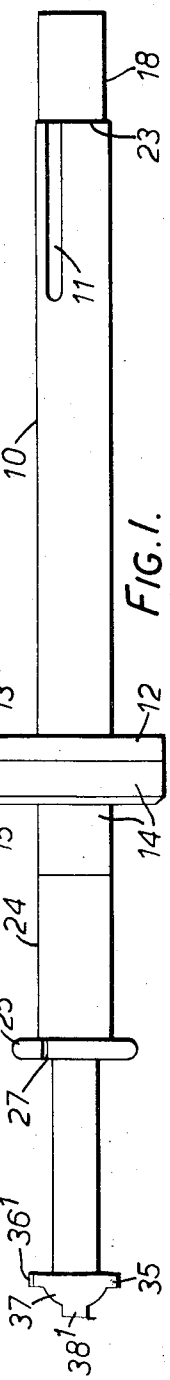


FIG. 1.

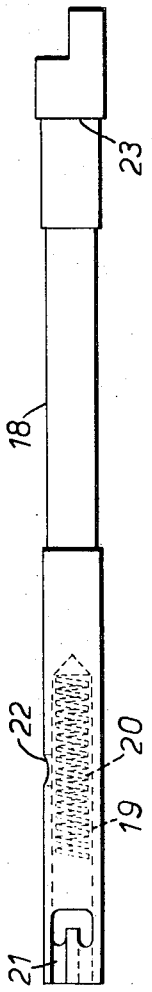


FIG. 2.

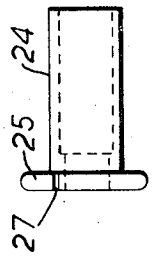


FIG. 5.

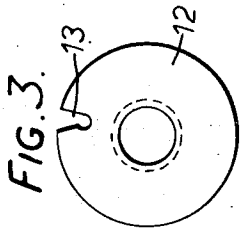


FIG. 3.

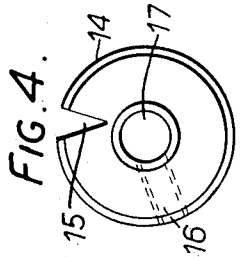


FIG. 4.

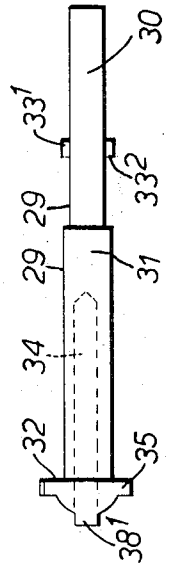


FIG. 7.

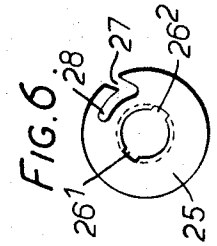


FIG. 6.

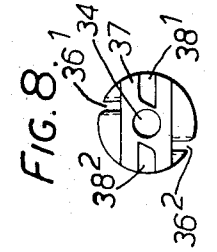


FIG. 8.

DEVICES FOR MAKING WRAPPED-WIRE CONNECTIONS

The present invention relates to devices for making wrapped-wire connections to terminal-tags and is particularly concerned with that kind of device which, in one continuous process, cuts the end of a plastics-coated wire to a predetermined length, removes the plastics coating from the end region and wraps that end region tautly around a terminal-tag as a series of side-by-side convolutions.

The invention is applicable to those wire-wrapping devices which are held in one hand in the manner of a pistol and are driven from a power source, e.g. electrical or pneumatic, under the control of a finger-operated trigger. However the invention is not necessarily limited to devices of this particular form.

Wire-wrapping devices of the general form mentioned are finding increasing use for instance in the telephone equipment industry where vast numbers of single-core wires, covered with polyvinyl chloride (p.v.c.), are required to be connected to terminal-tags protruding from multipoint tag blocks or the like. Using tags of elongated form and rectangular cross section, a known type of wire-wrapping device is capable of the high-speed production of highly reliable and neat solderless connections, each in the form of a predetermined number (preferably six) of taut side-by-side convolutions. Indeed the device may be used in producing a succession of wrapped connections along the length of a tag starting at or towards its base.

The known form of wire-wrapping device, comprises a so-called gun for providing the motive power and a so-called bit which is concerned with manipulation of the wires in the formation of the connections. The gun, provided with a hand-grip and trigger-operated switch, has a rotatable shaft within its barrel region; the shaft being driven by a small electric motor, incorporated in the gun, under control of the trigger-operated switch. A collet-type chuck which is not rotatable by said shaft is provided at the end of the barrel portion of the gun for the securement of the outwardly extending bit coaxially with respect to the rotatable shaft. This bit comprises concentric sleeve and spindle portions of tool steel which are rotatable with respect to each other, and is about 4½ inches long. This dimension represents the length of the spindle; the sleeve being approximately half this length and being mounted upon the spindle with but a small portion of the latter emerging from the end which is inserted in the gun barrel. This emergent end of the spindle is arranged to "key" in one angular position with the end of the before-mentioned rotatable shaft within the barrel of the gun. Moreover that end of the bit-sleeve which is inserted in the barrel-chuck is "keyed" in a particular angular position with respect to fixed jaws of the chuck, and when the chuck is tightened the sleeve is held stationary with respect to the body of the gun, whereas the spindle is coupled to, and in effect is an extension of, the gun shaft.

It should be mentioned that, in the known form of wrapping device, when the motor is de-energized the rotatable shaft and therefore the bit-spindle is caused to come to rest in a particular angular position; an arrangement, for example incorporating a permanent magnet, being provided within the gun for this purpose.

The unclamped end of the sleeve is provided with an integral concentric disc, known as a cropping-disc, having a cutting slot in its edge; the slot being at the top of the disc when the gun is in the aiming position. The bit-spindle, fabricated from two parts clamped in end-to-end relationship, has a similar cropping-disc rigidly secured to it, and this is positioned in face-to-face manner with the cropping disc of the sleeve, so that, when an insulated wire is passed into the aligned slots and the spindle is rotated, the wire and its p.v.c. covering is cleanly cropped by a shearing action. The bit sleeve is longitudinally located upon the spinle, with barely perceptible clearance, by a shoulder towards the chuck-end of the spindle and by the co-operating faces of the two cropping-discs.

The bit-spindle is provided with an integral co-axial wire-guiding disc at a point approximately midway between the free end of the spindle and the cropping region of the bit. The disc is provided with a slot in its edge for wire-guiding purposes, and this slot is substantially in alignment with the slot of the spindle cropping disc. The entry portion of slot in the wire guiding disc is so dimensioned as to be a snug fit with respect to the covered wire duly passed through it; the entry portion merging into an enlarged region which freely accommodates the diameter of the covered wire.

Also in the known type of wire-wrapping device, the free end of the spindle is provided with an integral annular nose-portion having a stripping-slot in its edge. This slot has a chamfered entry-portion merging into an insulation stripping section having a width slightly in excess of the conductor-wire from which the covering is to be removed. The configuration of the stripping slot is such that an edge, for the lateral semi-piercing or nicking of the wire-covering, is formed at the end face of the nose-portion of the bit.

The nose-portion of the bit-spindle has a central hole extending into the spindle to an extent sufficient to accommodate the length of the terminal-tag to be served; the diameter of the hole being sufficient to enable the spindle to be rotated freely around the tag without excessive lateral play.

Also in the known wrapping device, the extreme face of said nose-portion is provided with a smoothly stepped raised portion embracing the tag-locating hole, and this is surmounted by an integral raised pad which is located in a trailing position with respect to the wire-stripping slot as the spindle is operatively rotated. Accordingly since the spindle is arranged to be driven clockwise, when viewed from the body of the gun, the pad is located anti-clockwise of the slot. The pad is of such configuration, and is so located with respect to the tag-locating hole, as to guide the bared wire, of a connection being formed, smoothly around the terminal-tag in a manner which obviates damage to the wire by the stripping slot and which also ensures that the free end of the wire does not protrude from the body of the completed wrapped joint.

The stripping-slot of the nose-portion and the slots in the wire-guiding and cropping discs of the spindle are substantially in alignment, and furthermore, in the rest position of the spindle the last-mentioned slot is aligned with the slot in the cropping disc of the bit-sleeve.

In using the particular wire-wrapping gun, the end section of the covered wire is looped manually around the base of the terminal-tag, and holding the gun in the other hand, the bit is directed into co-operation with

the tag; the tag being fully entered into the central hole of the bit. The end region of the covered wire is now drawn through the substantially aligned stripping, guiding and cropping slots of the bit. With the gun still pressed gently in the direction of the terminal-tag, the trigger is operated so that the motor drives the bit-spindle. Thereupon rotation of the spindle cropping-disc with respect to stationary cropping-disc of the bit-sleeve causes the unwanted end-portion of the covered wire to be cropped-off, and so determines the amount of wire, and therefore the number of wire convolutions, to be involved in the connection. Also during the initial part of the rotation of the bit-spindle, the plastics covering is severed, in the region of its previous incision, by the stripping-slot which also allows the wire to be drawn lengthwise out of the severed section of covering as the bared wire-end is wrapped tightly around the terminal-tag. During this process, the severed section of covering is retained by the bit due to the action of the guide disc. With the connection completed in a fraction of a second, the trigger is released to stop the motor, and generally the unwanted portion of covering falls clear as the motor rapidly decelerates.

Wire-wrapping bits of the kind described and variants thereof are each dedicated for use in conjunction with a particular guage of wire, since this determines the width of the stripping-slot and the location of the pad with respect to the central hole. In many instances, for example on telephone-exchange installation work, an operator may be required to make wrapped connections to tags of identical cross-section but using two guages of wires, e.g., 23 and 25 S.W.G. Up to the present this has involved making two complete wrapping devices available to the operator, or resorting to the practice of interchanging bits with respect to a single gun. Both of these practices are somewhat uneconomic on the grounds of redundancy of equipment and delays, and moreover the second of the alternatives is undesireable because the improper insertion of a bit into the gun by an unskilled operator could lead to production of unsatisfactory connections and wire breakages.

Under circumstances such as this there is a need for a bit which is readily adaptable for use on two guages of wire and one object of the invention is to fulfil this need in a simple and reliable manner.

According to the invention there is provided a wire-wrapping bit of the general type referred to characterised in that the spindle which is subjected to a particular direction of rotation in the performance of a wire-wrapping operation comprises first and second parts of which the first part is rotatable within a sleeve, and the second part has an annular nose-portion and a stem-portion which is inter-locked, in either of two diametrically opposite positions, with said second part, and the nose-portion of said second part is provided with (a) two wire-stripping slots which enter the peripheral surface thereof at diametrically opposite positions and (b) two raised wire-forming pads upon its end face at opposing positions about central circular cavity formed in said second part for the acceptance of a terminal tag preparatory to application of a wire-wrapped connection thereto; each pad being in a trailing position with respect to a particular wire-stripping slot when the spindle is rotated in said particular direction.

Also according to the invention the wire-stripping slots are differently dimensioned for stripping wires of different core diameters or are identically dimensioned for stripping wires of the same core diameter.

The invention will be better understood from the following description of the preferred manner of carrying it into effect and should be read in conjunction with the accompanying drawings, comprising FIGS. **1** to **8** of which FIG. **1** represents an assembled wire-wrapping bit according to the invention whereas FIGS. **2** to **8** are views of component parts of the bit.

Referring to FIG. **1**, the bit incorporates a sleeve portion **10** which is substantially identical to that of the known wrapping-bit; having a keyway **11** at its right-hand end and an integral concentric cropping-disc **12** at its left-hand end. The keyway is provided for orientation of the sleeve, with respect to the non-rotatable jaws of the chuck of an electrically powered gun used in conjunction with the bit, when the sleeve is clamped by said jaws. The cropping-disc **12**, as viewed from the left as regards FIG. **1**, is shown in FIG. **3** which demonstrates the configuration of the slot **13** in its periphery; the root of the slot being of bulbous form to accommodate the plastics-covered wire which is to be worked upon.

Another component of the bit which is substantially identical to a component of the known bit, is cropping-disc **14** with its integral leftwardly extending bush. The second cropping-disc **14**, as viewed from the left as regards FIG. **1**, is shown in FIG. **4** and it is observed that a V-shaped slot **15** is formed in its periphery and moreover that a threaded hole extends through the disc into the central circular passage **17**. Components **10** and **14** are fabricated from silver-steel.

Another component of the present bit, which is also of silver-steel, is the main spindle **18** which is shown in some detail in FIG. **2**, and this spindle is embraced over most of its length by the sleeve **10**. The spindle is free to rotate axially within the sleeve, and the longitudinal location of the sleeve upon the spindle is determined by the spindle shoulder **23** and by the right-hand face of cropping-disc **14**. The latter is secured to the shaft, in face-to-face relationship with the face of cropping-disc **12**, by a grub screw (not shown) threaded into hole **16** of the disc; the tip of the screw passing neatly into a transverse hole **22** provided in spindle **18**. The right-hand end of the spindle, emerging from the sleeve of the assembled bit, is so shaped as to interlock with the end of the drive-shaft of the before-mentioned electrically powered gun. Thus a rotational coupling is provided between the spindle and the drive-shaft when the sleeve is clamped by the gun-chuck.

Referring particularly to FIG. **2**, the main spindle is concentrically bored from its left-hand end to form the cavity **19** which accommodates a helical compression spring **20**. The wall of the cavity is provided with two cut-outs, such as **21**, which have forms like those found in bayonet-type lampholders, and have their entrances at diametrically opposite positions. In the assembled bit, the grub screw, which secures the cropping-disc **14** to spindle **18** in a predetermined angular relationship, also serves to retain the helical spring **20** in cavity **19** of the spindle.

Also in the assembled bit, that portion of the spindle **18** which extends leftwardly of the bushed cropping-disc **14** is enclosed by a tight-fitting tubular member **24** having an integral wire-guiding disc **25**. Details of member **24**, which is also of silver-steel, are shown in FIGS. **5** and **6**; the latter being a view from the left as

regards FIGS. 1 and 5. As can be deduced from FIG. 5, a concentric tunnel through the member provides a large-diameter region to the right and a smaller diameter region to the left. When the member is fitted upon the main spindle, the right-hand region tightly accommodates the left-hand portion of spindle 18 with the extremity of the latter well clear of the shoulder formed at the junction of the two internal regions of the tunnel. As can be seen from FIG. 6 the smaller diameter region is provided with diametrically opposite slots 26^1 and 26^2, whereas the disc portion 25 is provided with a foot-shaped wire-guiding slot 27 extending from its periphery. The member 24 is so angularly located upon the spindle 18 that the toe-region 28 of the slot is substantially aligned with the root of slot 15 in the cropping-disc 14. The width of the slot 27 is such as to freely accommodate the overall diameter of the insulated wire which is to be worked upon.

The complete bit, as shown in FIG. 1, incorporates a two-positional spindle-extension member 29 which is illustrated in more detail in FIGS. 7 and 8; the latter being a view of the integral nose-portion 32 as viewed from the left of FIGS. 1 and 7. From FIG. 7 it can be appreciated that the member 29, which is fabricated from silver-steel, has three main concentric sections namely the nose-portion 32 and the large and small diameter stem-portions, 31 and 30, respectively, of which the latter is provided with the diametrically opposite square-section pins 33^1 and 33^2. An axially drilled cavity 34 is provided in the spindle-extension member, and this passes through the nose-portion and into stem-portion 31; the depth and diameter of the cavity being such as to snugly accommodate a terminal-tag which is to be subjected to wire-wrapping. The diameter of stem-portion 30 is such as to be a sliding-fit in cavity 20 of the spindle, and the diameter of stem-section 31 is such that, for steadying purposes it will pass, with barely perceptible clearance, into the small diameter section of the tunnel of member 24.

The mounting of the spindle-extension member into the body of the bit is accomplished entering the stem-portion 30 into the tubular member 24, passing pins 33^1 and 33^2 through slots 26^1 and 26^2 whereupon, against the pressure of spring 20, the smaller diameter stem-portion is pushed into cavity 19 of the spindle with said pins guided into the bayonet-type slots such as 21 of the spindle. The spindle-extension member is then rotated clockwise (as viewed from the left of FIG. 1) and released so that it is interlocked with the spindle, under pressure of the spring, in much the same manner as a bayonet-type lamp in its holder. It will be appreciated that the spindle-extension member 29 may be so located in either of two diametrically opposite positions with respect to spindle 18.

Even though the spring may be compressed by axial pressure applied to the spindle-extension member during the performance of a wire-wrapping operation, the direction of drive of the spindle and its extension member, with reference to the configuration of the before-mentioned bayonet-type slots, is such that their angular relationship is not disturbed and the fully interlocked state is re-assumed as the bit is removed from the terminal tag. When it is required to position the spindle-extension member 29 in the alternative angular position with respect to spindle, the member is depressed against the spring, turned anti-clockwise, withdrawn to an extent where the pins 33^1 and 33^2 are clear of the spindle, but still within large bore section of the tubular member 24, and then turned through 180° for entry into the new position.

The configuration of the nose-portion 32 of the spindle-extension member is illustrated in FIGS. 1, 7 and 8 of which the latter is a view from the left as regards FIGS. 1 and 7. The nose-portion incorporates an annular-disc 35 provided with two peripheral insulation-stripping slots 36^1 and 36^2 which are chamferred at the inward face of the disc to produce opposing sharp edges for semi-piercing or nicking the insulation of a wire which is to be wrapped. The width of each slot is determined by the guage wire with which it is concerned, and is such as to allow the clear passage of bared wire of the particular guage whilst gripping the covering at the nicked regions. Assuming that stripping slots 36^1 and 36^2 are for 25 S.W.G. (0.020 in. diameter) and 23 S.W.G. (0.024 in. diameter) wires respectively, then slot 36^1 is 0.022 in. wide and slot 36^2 is 0.026 in. wide. Thus in each case the bared wire can be drawn clearly through its particular slot in the leftward direction when the well-known stripping function is being performed.

The midpoints of the entrances of the insulation-stripping slots are 180° apart, and the slots extend along parallel paths to the bounds of a smoothly stepped rib 37 extending across outward face of the nose-portion. The rib has two aligned pads 38^1 and 38^2 emerging from it; each pad having a curved inner-wall. Pads 38^1 and 38^2 are in trailing relationship to slots 36^1 and 36^2 respectively when the spindle extension is being driven anti-clockwise with respect to FIG. 8 in the performance of a wire-wrapping operation. The innermost ends of the pads are identically positioned with respect to the central hole 34 which is to snugly accommodate any terminal-tag to be wrapped. The trailing region of the curved surface of both pads come to the same distance of the central hole and duly serves to smoothly form the wire around the terminal-tag; the distance being slightly greater than the uncovered diameter of the thicker of the two wires appertaining to the spindle-extension.

When the bit is fitted in the chuck of a gun of the kind described with reference to the known bit, the bit spindle and its interlocked extension are so oriented with respect to the sleeve that the cropping slots 15 and 13 are in alignment at the top of the assemblage and moreover the root of that stripping slot 36^1 or 36^2 which is ready for use and the toe 28 of the guide-slot 27 of member 24 are substantially aligned with the roots of said cropping slots to define a substantially straight path for that end region of a wire which is to be cropped to length, stripped and wrapped. Accordingly the gun and bit are ready for use in precisely the same manner as was described with respect to the known bit.

Suitable markings (not shown) are provided adjacent to stripping slot of the spindle extension to notify the user as to which guage of wire is to be used.

Although the bit is primarily intended for use with two guages of wire, as an alternative the nose-portion of the spindle extension may be provided with two identical stripping slots catering for the same guage of covered wire. With this arrangement, if one of the slots is damaged or is otherwise found to be unsatisfactory, the spindle extension can be changed to its alternative position.

The wire-wrapping device, which is grounded, may be required in the establishment of a connection to a terminal-tag having a "live" terminal-tag adjacent to it. This raises the possibility of the stem of the spindle extension of the bit coming into contact with the live terminal-tag if the gun is tilted when in situ for wrapping. To obviate the possibility of a short-circuit, the invention envisages the fitting of a sleeve of insulating material around the exposed stem-portion of the spindle extension.

We claim:

1. In a wire-wrapping bit of the type having a rotatable spindle and overfitting sleeve, the improvement comprising a sectional spindle including first and second rotatable spindle members, each said spindle member including means for releasably connecting said first and second rotatable spindle members, one with the other, in first or second positions for a corresponding selected guage wire, said second spindle member including an annular nose-portion having an axial workpiece receiving cavity and a pair of peripherally located opposed wire-stripping slots in said nose-portion annulus, and a pair of opposed, radially extending wire-forming pads located on said nose-portion annulus, each of said pads trailing respective lead wire stripping slot for wrapping said selected guage wire carried in one of said wire-stripping slots about a workpiece received in said workpiece receiving cavity as said spindle is driven.

2. The improved wire wrapping bit of claim **1** wherein said second rotatable spindle member includes axial nose, body and stem portions, said first rotatable spindle member having an axial stem receiving cavity for receiving said stem portion of said second rotatable spindle member.

3. The improved wire-wrapping bit of claim **2** wherein said releasable connecting means includes a pair of equispaced pins on the stem portion of said second rotatable spindle member for connecting said stem portion to a side wall of said axial stem receiving cavity of said first rotatable spindle member and a pair of equispaced configured slots in said sidewall of said axial stem receiving cavity for releasably receiving said pair of pins, interchangably.

4. The improved wire-wrapping bit of claim **3** wherein said first rotatable spindle member includes a biasing means located within said axial stem receiving cavity thereof for biasing said first and second rotatable spindle members in relatively fixed rotating positions, said biasing means cooperating with said equispaced configured slots in said sidewall of said axial stem receiving cavity for providing an axial clearance for thereby releasing said pair of equispaced pins from respective equispaced configured slots in said sidewall of said axial stem receiving cavity.

5. The improved wire-wrapping bit of claim **1** including a first concentric sleeve member overfitting said first rotatable spindle member and slidably secured thereon at one end by a spindle shoulder located at an end of said first rotatable spindle member, said first concentric sleeve member including a first wire-cropping disc, a second concentric sleeve member overfitting said first rotatable spindle member, said second concentric sleeve member having a second wire-cropping disc connected thereto alignable face-to-face with said first wire-cropping disc, means for releasably securing said second wire-cropping disc, face-to-face with said first wire-cropping disc, each of said first and second wire-cropping discs having a peripheral cropping slot, and a third concentric sleeve member overfitting said first and second rotatable spindle members at the releasable connection therebetween, said third concentric sleeve member including a radially extending concentric disc having a peripheral wire-guiding slot therein, said concentric disc being located substantially midway between said second wire-cropping disc and said annular nose-portion located on said second spindle member.

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