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A Wire Placing Tool

The invention relates to a tool for placing and, if necessary, cutting to length electrical conductors, with a housing suitable for connection of placing means, e.g., an industrial robot, with a placing finger which is arranged on the working side of the housing and in which a guide channel for a conductor is formed, and with means for advancing the conductor and cutting it to [the proper] length.

Wire placing tools of this type are known from, say, DE-OS 36 06 059, DE-OS 36 11 805, and DE-OS 38 20 636. They are used mainly for producing wire harnesses but they can be used for wiring components of machinery etc., too. The mouth of the guide channel of the placing finger is transferred to a particular point of connection at which the wire protruding from the guide channel is placed and contact with it is established. The wire is cut in a proper so-called cut-to-length module of the tool, which precedes the placing finger proper and is arranged at a considerable distance from the mouth of the wire guide channel.

Thus, these tools do not allow cutting the wire at the very point of contact. Yet this is particularly desired when the connection point is provided with a cut-clamp-contact, i.e., when the wire is connected with the so-called cut-clamp technique ["insulation-piercing cut-clamp blade technique"].

Therefore, the problem underlying the invention is to create a wire placing tool which has a simple structure and is particularly suitable for connecting wires with the cut-clamp technique, wherein the wire can be optionally cut at the respective connection point or can be run off to some other point after contact has been established.

In order to solve this problem, the above-identified tool according to the invention is characterised in that it has a pressure-application member which is arranged near the lateral mouth of the guide channel for the wire issuing from the mouth of the guide channel, is supported to be movable substantially across the axial direction of the guide channel near its mouth, and is coupled to proper placement means by which it can be adjusted between a standby position far from the mouth and a working position in which it extends beyond the edge of the mouth of the guide channel with a pressure-application surface substantially flush with the upper side of the edge of the mouth, and in that the wire-severing means are arranged cooperatively with a region of the wall of the guide channel near its mouth opening.

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When the placing finger has been appropriately placed, the pressure-application member makes it possible to press the wire portion which issues from the mouth of the guide channel of the placing finger directly into the blade clamping slit of a terminal configured as a cut-clamp terminal. Since the means for cutting the wire are arranged near the mouth of the guide channel, severing the wire at the terminal renders a very short free end of the wire which can be accommodated in a shock-proof manner by suitable measures near the cut-clamp terminal without need for further measures for insulation, etc.

In a preferred embodiment, the pressure-application member has near the pressure-application surface a bridge region aligned with a wire issuing from the mouth of the guide channel, with the width of the bridge across the direction of the wire being substantially smaller than, or equal to, the wire diameter. The bridge region is conveniently delimited at least on one side by regions of greater width. It is ensured in this way that, upon being urged into the cut-clamp slit, the piece of wire is properly supported over the required length so that it cannot deviate in the pressing-in operation. If necessary, a protrusion can be provided on one side of the bridge and the protrusion by itself may be movable, if required. Thus, at the exit from the mouth of the guide channel, the wire may be bent under an angle, if required, and this regardless of whether it is cut, or not cut, at the associated point of contact.

As a rule, it is advantageous to have the bridge on both sides bounded by regions of greater width, one of which is contiguous with the surface of the placing finger next to the mouth of the guide channel so that, in the placement operation, the wire receives the necessary support as soon as it exits the mouth of the guide channel.

In a convenient embodiment, the cutting means comprise a knife adapted to be moved along the placing finger and having a knife blade which is movably mounted above a substantially horizontal portion of the guide channel. With respect to obtaining good cutting conditions, the knife blade is advantageously provided with a least one cutting edge which is inclined relative to the associated wall of the guide channel, has a cutting edge tip adapted to be pressed onto the associated wall of the guide channel, and is situated near the mouth of the guide channel. Thus, the wall of the guide channel forms the counterblade or the anvil at which the wire is severed. The point of cutting

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can be situated close to the mouth of the guide channel. Since the anvil cut takes place in the guide channel proper, one obtains the advantage that practically no lateral space is required. After extended operation, only the cutting edge of the knife need be reground. The wear of the placing finger is insignificant. If necessary, the guide channel's wall region which serves as the counterblade or the anvil for the cutting edge can be made from a material particularly suitable for this purpose and can be configured even replaceable at, say, an insertion part.

Excellent space relations are obtained when the pressure-application member is supported in longitudinally movable fashion very close to the placing finger, while the knife blade can be supported, likewise in longitudinally movable fashion, next to the pressure-application member at the placing finger and/or the pressure-application member. As indicated above, the pressure-application member proper can be composed of a single part or of a number of parts. In the latter case, the wire path at the respective terminal can be influenced individually on both sides of the cut-clamp slit by bending the wire under an angle or deflecting it, for example, close to the cut-clamp slit.

The drawing shows an embodiment of the object of the invention. There show:

Figure 1, a partially cut-open side view of a placement tool according to the invention to illustrate the state of leaving a connection point that was contacted,

Figure 2, a front view, from below, of the placing finger of the wire-placing tool,

Figure 3, a section along line III-III of Figure 1 of the placing finger of the tool shown in Figure 1,

Figure 4, the placing finger of the wire-placing tool according to Figure 1 in a corresponding view illustrating the state after pressing the wire into the cut-clamp slit of a connection terminal,

Figure 5, the placing finger according to Figure 4 in a corresponding view illustrating the state as wire is being severed.

The wire-placing tool has a housing 1 schematically shown in Figure 1, which is adapted to be attached to an industrial robot. On the working side of the housing 1 there protrudes from below a vertical placing finger 2 of substantially rectangular, narrow cross sectional form (Figure 3), which is

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usually made from steel. The placing finger 2 is affixed to the housing 1 at 3; in it there is a guide channel 4 for a wire 5 which is supplied by a reel, not shown in detail. Before the placing finger 2 inside the housing there are arranged conveying means for the wire 5, which are indicated in the form of two program-controlled conveying roller pairs 7, each connected through a drive belt. Besides that, a controlled clamping device exists at 8 for the wire 5.

The guide channel 4 is substantially L-shaped. It has a substantially vertical portion 41 (Figure 1) which over a 90° arch is followed by a portion 42 which is curved like the arc of a circle and leads, in turn, to a short, substantially horizontal portion 43 from which the wire 5 issues to the outside through a mouth 10 situated on a flat vertical surface 9 of the placing finger 2. In a groove 11 of the placement tool (Figure 3), which is delimited by parallel sides, there is guided in longitudinally movable fashion a rectangular knife blade 12 one end of which is coupled to a program-controlled placement device indicated at 13 in Figure 1 and the other end of which is provided with an inclined cutting edge 14. The cutting edge 14, which extends over the major part of the width of the knife blade 12, is situated in a slit-like recess 15 of the placing finger 2 above the mouth 10 of the guide channel 4 in which wire 5 is additionally guided by a guide pin 16. Together with the cutting edge 16, with which an acute angle is included, it forms a cutting tip 18 which is situated within the recess 15 close to the opening 10 of the guide channel 4.

Thus, the knife blade 12 is arranged above the arched portion 42 and the horizontal portion 43 of the guide channel 4 so that its cutting tip 18 can cooperate with the lower bottom wall of the horizontal guide channel portion 43 which acts as a counterblade or anvil, as can be inferred from Figure 5.

Besides that, a pressure-application member 19 configured as a stamp is guided to be longitudinally movable in a grooved guide 20 (Figure 3) laterally from, and close to, the knife blade 12. The pressure-application member 19 can be optionally moved forward or backward in the vertical direction relative to the placing finger 2 through a program-controlled actuating device indicated at 21.

The pressure-application member 19 is formed with a pressure-application surface 22 on its front face, with the pressure-application surface extending over its major part on a horizontal plane and intended to bear on a wire

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issuing from the mouth 10 and to support the same.

As can be recognized particularly in Figure 2, the vertical guide surface of the placing finger 2 is followed first by a pressure-application surface portion 23 which is substantially rectangular and has the same width as the placing finger 2. This narrow pressure-application surface portion 23 is centrally followed by a narrow rectangular bridge 24 bordered by a downwardly bent protrusion 25 which, in turn, has approximately the width of the placing finger 2.

Because of the arched curvature of the portion 42 and the intrinsic elasticity of the wire 5 the same would coil upwards in the form of a spring upon exiting from the mouth 10. The objective of the protrusion 25 is to prevent this and to press the wire downward near the cut-clamp terminal during the contact-establishing operation.

Figure 1 shows the state in which the wire exiting from the mouth 10 of the placing finger 2 is contacted in a preceding step at a connection point in a connection terminal 26. On both sides of a cut-clamp terminal 28 provided with a cut-clamp slit 27, the connection terminal 26 has a groove-like recess which has rectangular cross section and is limited by straight surfaces.

After the ensuing pressing of the wire 5 into the cut-clamp slit 27 of the connection terminal 26 by the pressure-application member 19, as described with the aid of Figure 4, the pressure-application member 19 is for a short time driven into the upper position illustrated in Figure 1, in which it does not obstruct the exit of the placing finger 2 from the right, groove-like recess 29 of the connection clamp 26. As soon as the placing finger 2 has receded from the terminal 26 at which contact was made, the pressure-application member 29 goes under program control downward into a position in which the pressure-application surface 29 rests on the wire 5 issuing from mouth 10 and counters its tendency to coil.

With the pressure-application member 19 in this position, the placing finger 2 is in the proper position placed above an other terminal 26 so that it stands above the associated groove-like recess 29.

Then the placing finger 2 and the pressure-application member 19 are lowered; they enter into the groove-like recess 29 of the terminal 26, and, as a consequence, the wire portion exiting from the mouth 10 is pressed into the cut-clamp slit 27 of the cut-clamp terminal 28. Thus, the state shown in Figure 4 results.

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There the wire portion is supported on both sides of the cut-clamp slit 27 by the region 23 and the protrusion 25, whereas support is obtained at the cut-clamp slit proper through the front face of the bridge 24 the width of which across the direction of the wire is smaller than, or at most equal to, or slightly greater than, respectively [sic!], the diameter of the wire 5. The protrusion 25 presses the wire 5 onto the bottom of the associated groove-like recess 29. In an other embodiment, it can be controlled separately by itself, for which purpose the pressure-application member 19 is divided into two parts, which are supported in movable fashion at each other and separately controllable, as indicated by the partition line at 30 with dashed lines in Figure 1.

After pressing the wire 5 into the cut-clamp slit 27 as shown in Figure 4, the knife blade 12 is moved into the position of cutting as per Figure 5, in which the cutting tip 18 in cooperation with the bottom wall of the horizontal portion 43 of the guide channel 4 severs the wire 5 directly at the side of the cut-clamp terminal 28.

If necessary, at this point the bottom wall of the horizontal guide channel portion 43 can be additionally inclined downward so that a downward orientation of the severed end of the wire 5 is obtained also on this side of the cut-clamp terminal 28. In other words, also there the same effect as that of the protrusion 25 can be achieved.

After termination of the cutting operation, the placing finger 2 is lifted; the pressure-application member 19 and the knife blade 12 return to their standby position according to Figure 1 and the wire-placing operation is continued.

The lower end of the placing finger 2 is rounded at the "edge" facing the guide pin 16; it can be likewise rounded or wedge-shaped at the corresponding front edge. This measure intends to facilitate the passage of wire support elements in the wiring operation when the wire support elements have retaining elements which can be deflected elastically and which close automatically after passage of the placing finger.

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Claims



1. A tool for placing and, if necessary, cutting to length, electrical conductors, with a housing suitable for connection of placing means, e.g., an industrial robot, with a placing finger which is arranged on the working side of the housing and in which a guide channel for a conductor is formed, and with means for advancing the conductor and cutting it to length, characterised in that it has a pressure-application member (19) which is arranged near the lateral mouth (10) of the guide channel (4) for the wire (5) issuing from the mouth of the guide channel, is supported to be movable substantially across the axial direction of the guide channel near its mouth, and is coupled to proper placement means (21) by which it can be adjusted between a standby position far from the mouth (10) and a working position in which it extends beyond the edge of the mouth of the guide channel (4) with a pressure-application surface (22) or is substantially flush with the upper side of the edge of the mouth, and in that the wire-severing means (12) are arranged cooperatively with a region of the wall of the guide channel near its mouth opening (10).

2. The tool according to Claim 1, characterised in that the pressure-application member (19) has near the pressure-application surface (22) a bridge region (24) aligned with a wire issuing from the mouth (10) of the guide channel, with the width of the bridge across the direction of the wire being substantially smaller than, or equal to, the diameter of the wire (5).

3. The tool according to Claim 2, characterised in that the bridge region (24) is bounded at least on one side by at least one region (23; 25) of greater width.

4. The tool according to Claim 2 or 3, characterised in that a protrusion (25) is provided on at least one side of the bridge (24).

5. The tool according to Claim 4, characterised in that the region of increased width (23; 25) has the same width as the placing finger (2).

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6. The tool according to any one of Claims 2 to 5, characterised in that the bridge region (24) is on both sides bounded by regions of increased width (23, 25), one of which (23) is contiguous with a surface (9) of the placing finger next to the mouth (10) of the guide channel (4).

7. The tool according to any one of the preceding claims, characterised in that the wire-severing means comprise at least one knife with a knife blade (12), with the knife being guided to be movable along the placing finger (2) and the knife blade movably arranged above a substantially horizontal portion of the guide channel (4).

8. The tool according to Claim 7, characterised in that the knife blade (12) has at least one cutting edge (14) inclined relative to the associated wall of the guide channel (4).

9. The tool according to Claim 8, characterised in that the knife blade has a cutting edge tip (18) adapted to be pressed onto the associated wall of the guide channel.

10. The tool according to Claim 9, characterised in that the cutting edge tip (18) is situated near the mouth (10) of the guide channel.

11. The tool according to any one of the preceding claims, characterised in that the pressure-application member (19) is supported at the placing finger (2) to be movable in the longitudinal direction.

12. The tool according to Claims 7 and 11, characterised in that the knife blade (12) is movably supported at the placing finger (2) and/or the pressure-application member (19) after the pressing member (19).

13. The tool according to any one of Claims 2 to 13, characterised in that the pressure-application member (19) is composed of a number of parts and that a pressure-application surface section is associated with each of the parts.

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Abstract

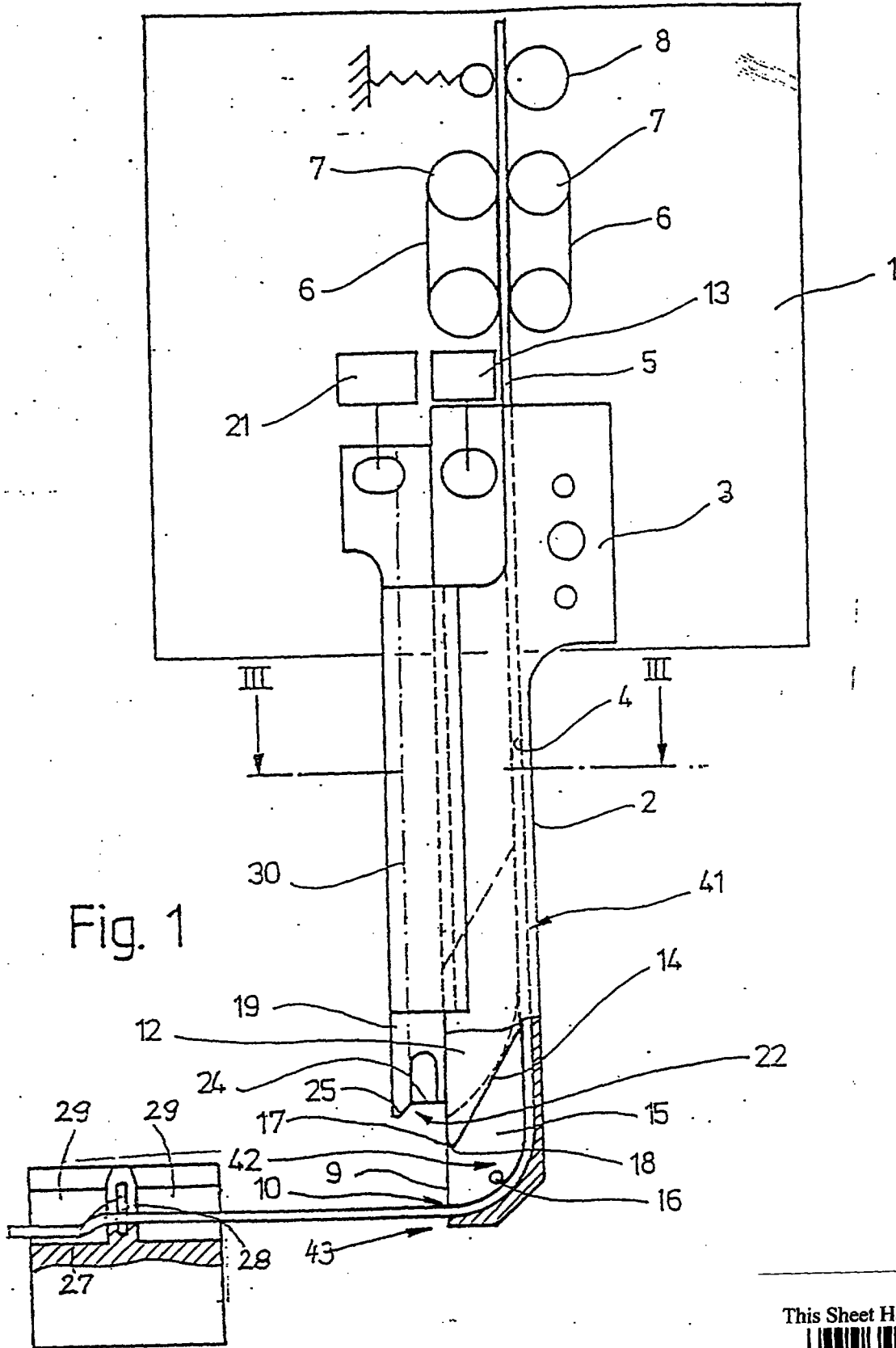
A tool for placing electrical conductors and, if necessary, cutting them to size in the automatic production of wirings in electrical apparatus comprises a placing finger (2) which is arranged at a housing (1) and in which a guide channel (4) for a conductor is formed. Near the lateral mouth (10) of the guide channel there is provided a pressure-application member (19) which supports a pressure-application surface (22) adapted to move substantially perpendicular to the axial direction of the guide channel and which is associated with wire-severing means in the form of a knife blade (12), the knife blade being movably supported by the placing finger. The knife blade cooperates with a wall region of the guide channel.

(Figure 1)

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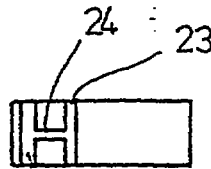


Fig. 2

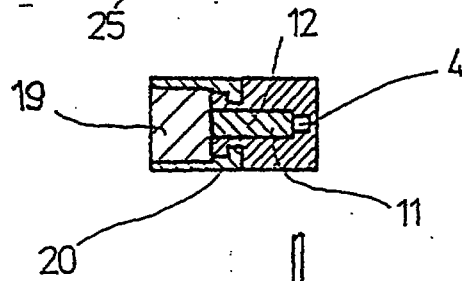


Fig. 3

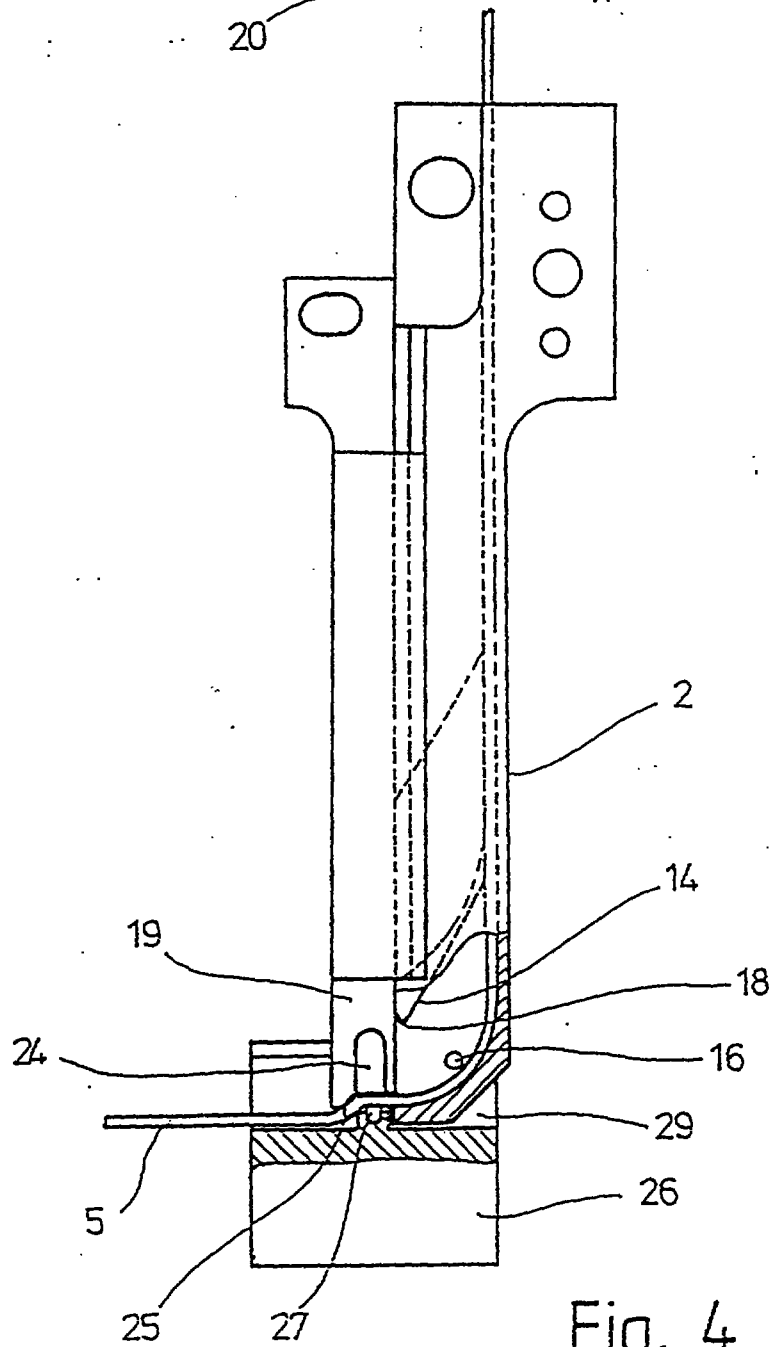
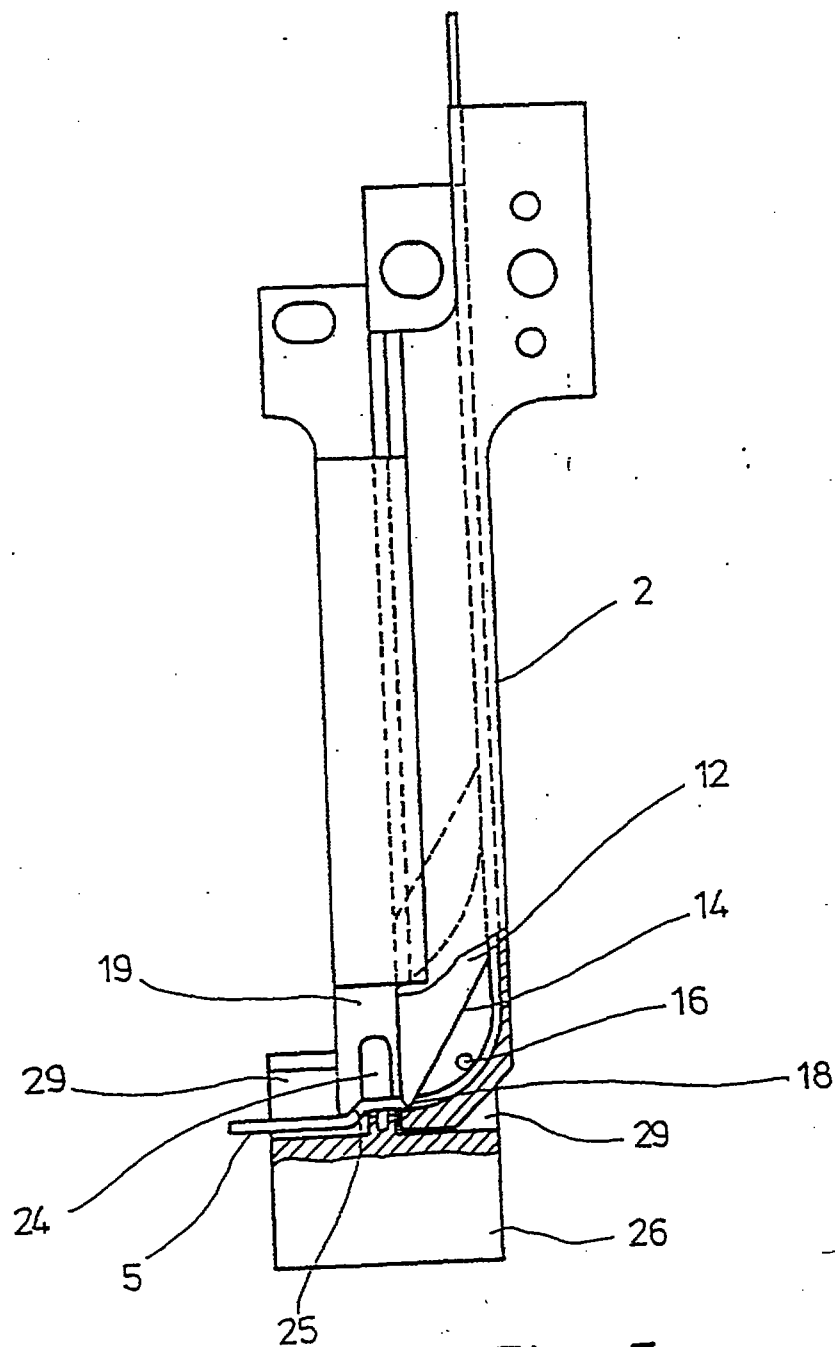


Fig. 4



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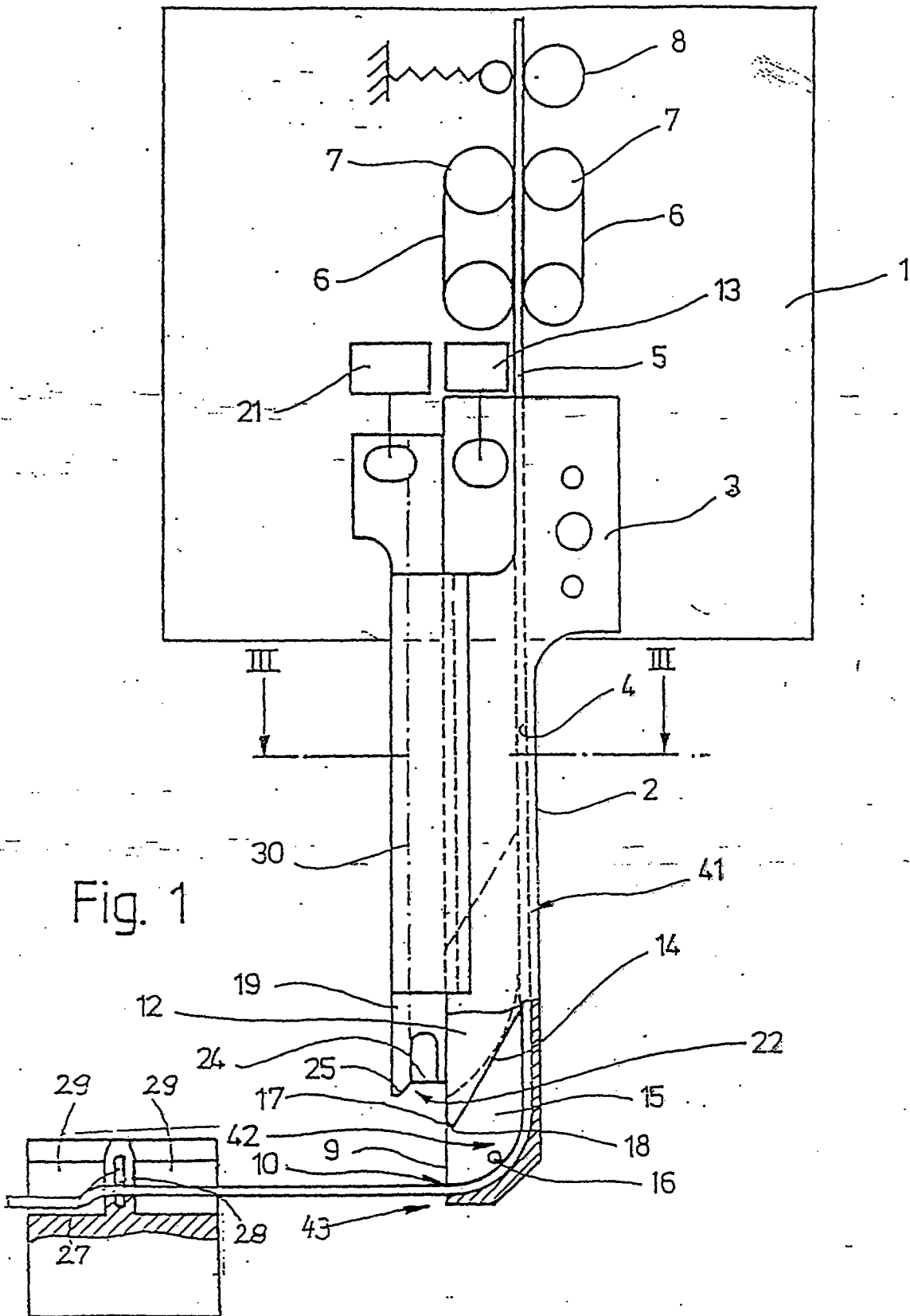
A WIRE PLACING TOOL

ABSTRACT

A tool for placing electrical conductors and, if necessary, cutting them to size in the automatic production of wirings in electrical apparatus comprises a placing finger (2) which is arranged at a housing (1) and in which a guide channel (4) for a conductor is formed. Near the lateral mouth (10) of the guide channel there is provided a pressure-application member (19) which supports a pressure-application surface (22) adapted to move substantially perpendicular to the axial direction of the guide channel and which is associated with wire-severing means in the form of a knife blade (12), the knife blade being movably supported by the placing finger. The knife blade cooperates with a wall region of the guide channel.

(Figure 1)

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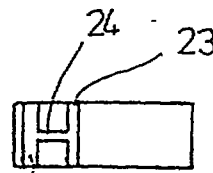


Fig. 2

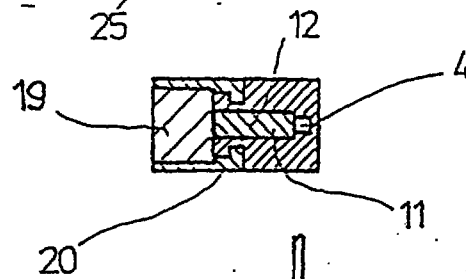


Fig. 3

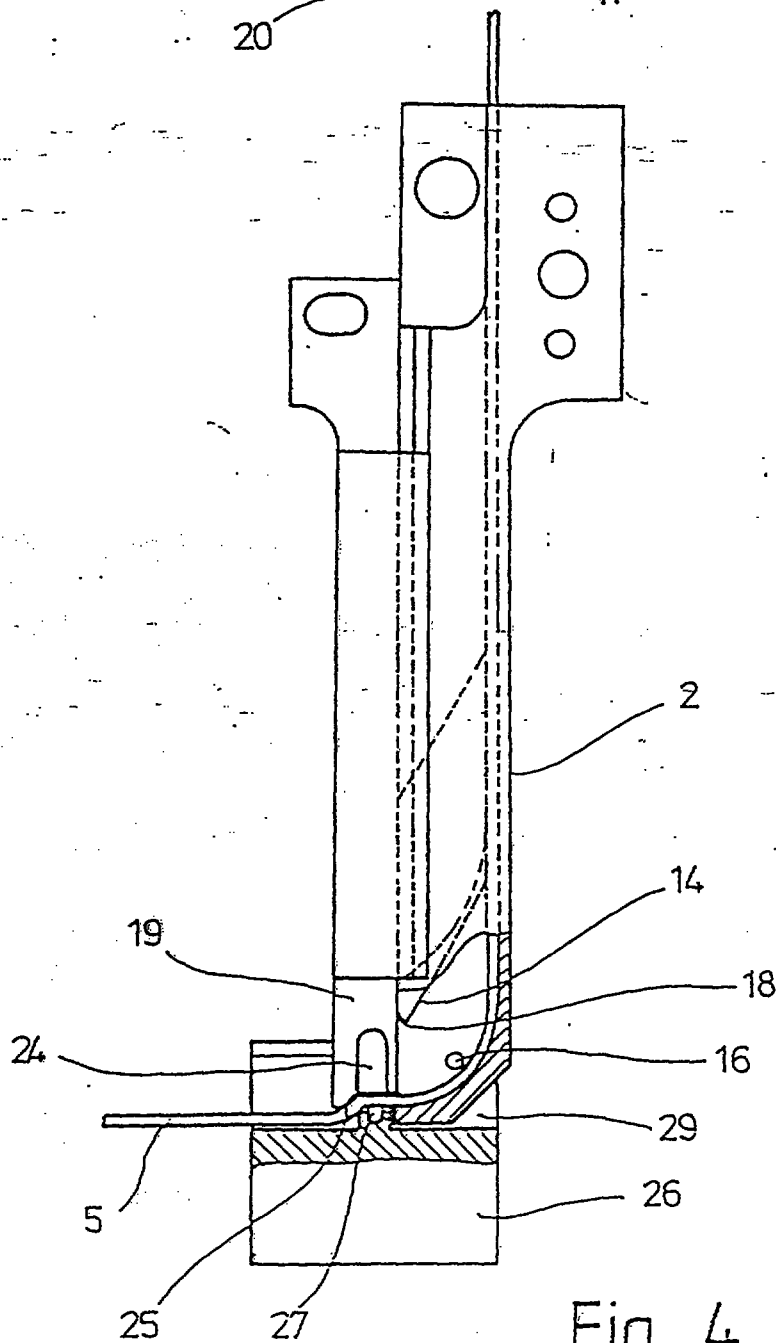


Fig. 4

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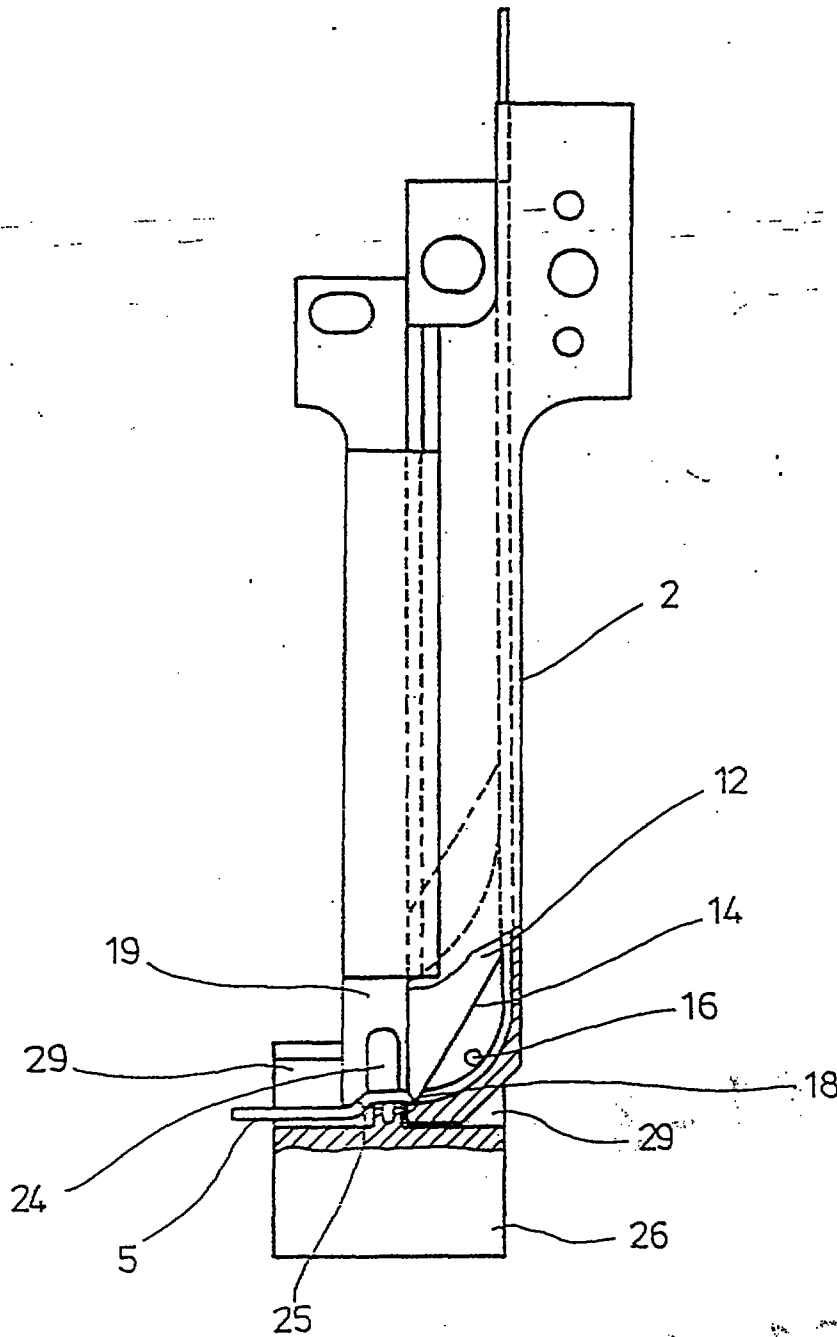


Fig. 5 - 12 13 14

A WIRE PLACING TOOL

FIELD OF INVENTION

The present invention relates to a tool to place a wire and, when placed, cut it off, which tool is specifically adapted to cut off the wire close to a terminal, and especially a solderless slit blade insulation piercing connector in which the tool can be coupled to an automatic wire placement apparatus, for example a wire placement robot.

BACKGROUND OF THE INVENTION

Wire placement tools for positioning electrical wires usually have a housing from which a positioning finger extends. The positioning finger has a guide duct for a wire and, further, is coupled to or formed with wire feed apparatus and cut-off apparatus for the wire, when cutting is desired. Wire placement tools of such type are well known, see for example the referenced German patent Disclosure Documents DE-OS 36 06 059, DE-OS 36 11 805 and DE-OS 38 20 636. Such wire placement tools are used, for example, to make wire harnesses, wire bundles, or the like. They are also used, however, to wire machine components, fixtures and the like. The wire positioning finger is brought to a particular position such that the terminal end of the guide duct is located adjacent a terminal position, in which the wire which exits from the guide duct is to be positioned and terminated. The cut-off of the wire is usually effected by a separate cut-off module of the tool, which is coupled to the positioning finger, for example in advance thereof, and usually located some distance in advance of the end of the positioning finger. Such tools make it difficult to cut off the wire immediately adjacent the terminal to which it is to be connected, and frequently make it impossible.

SUMMARY OF THE INVENTION

It is an object of the invention to ameliorate the disadvantages of the prior art.

According to one aspect of the invention there is disclosed compact combined wire positioning and cut-off tool for, in one operation, positioning a wire and cutting the wire closely adjacent said tool, comprising:

- a tool housing;
- a positioning finger extending from the housing;
- a wire guide channel or duct formed in the finger and having a wire outlet opening;

a pressing element having a pressure surface movably located adjacent the wire outlet opening for movement transversely to the axial direction of the outlet opening;

pressing element position control means coupled to the pressing element for positioning the pressing element in a quiescent position removed from the wire outlet opening, and a holding position for holding the wire projecting from the wire outlet opening, the pressure surface extending at least up to the wire outlet opening when the pressing element is in the holding position;

cutting means movably located on the positioning finger in the vicinity of the wire outlet opening and movable between a rest position clear of the wire opening and a cutting position in front of the wire outlet opening; and

wherein said pressure surface of said pressing element has a rib essentially aligned with the wire projecting from the outlet opening, and having a width transverse to the direction of said wire projecting from the outlet opening which has a dimension approximately up to the diameter of a conductor within the wire.

According to another aspect of the invention there is disclosed a compact combined wire positioning and cut-off tool for, in one operation, positioning a wire and cutting the wire closely adjacent said tool, comprising:

a tool housing;

a positioning finger extending from the housing;

a wire guide channel or duct formed in the finger and having a wire outlet opening;

a pressing element having a pressure surface movably located adjacent the wire outlet opening for movement transversely to the axial direction of the outlet opening;

pressing element position control means coupled to the pressing element for positioning the pressing element in a quiescent position removed from the wire outlet opening, and a holding position for holding the wire projecting from the wire outlet opening, the pressure surface extending at least up to the wire outlet opening when the pressing element is in the holding position;

cutting means movably located on the positioning finger in the vicinity of the wire outlet opening and movable between a rest position clear of the wire opening and a cutting position in front of the wire outlet opening; and

wherein said pressing element comprises a two-component structure, one component carrying a hold-down pressure surface and the other component carrying a holding surface projecting, when in holding position, by a lesser extent than said hold-down pressure surface.

According to yet another aspect of the invention there is disclosed a compact combined wire positioning and cut-off tool for, in one operation, positioning a wire and cutting the wire closely adjacent said tool, comprising

- a tool housing;
- a positioning finger extending from the housing;
- a wire guide channel or duct formed in the finger and having a wire outlet opening;
- a pressing element having a pressure surface movably located adjacent the wire outlet opening for movement transversely to the axial direction of the outlet opening;
- pressing element position control means coupled to the pressing element for positioning the pressing element in a quiescent position removed from the wire outlet opening, and a holding position for holding the wire projecting from the wire outlet opening, the pressure surface extending at least up to the wire outlet opening when the pressing element is in the holding position;
- cutting means movably located on the positioning finger in the vicinity of the wire outlet opening and movable between a rest position clear of the wire opening and a cutting position in front of the wire outlet opening; and
- wherein the cutting means comprises a blade element terminating in an end portion;
- and
- wherein the positioning finger, in the vicinity of said outlet opening, is formed with a knife surface for cutting cooperation with said end portion.

DRAWINGS

FIG. 1 is a highly schematic side view of a positioning system for a wire, partly in section, and illustrating the positioning finger after it has left a terminal where a wire was placed;

FIG. 1A is a fragmentary front view of a slit blade insulation piercing connector for which the tool of FIG. 1 is particularly suitable as a wire insertion tool;

FIG. 2 is an end view of the positioning finger of the positioning tool, looked at from below;

FIG. 3 is a sectional view of the positioning finger of FIG. 1 taken along section line III-III of FIG. 1;

FIG. 4 is a view of the finger only, similar to FIG. 1, and illustrating the position as the wire is being pressed into a slit blade insulation piercing connector; and

FIG. 5 is a view similar to FIG. 4, and illustrating the apparatus as the wire is being cut.

DETAILED DESCRIPTION

Referring first to FIG. 1, which illustrates the wire positioning system, in highly schematic fragmentary form, and the wire positioning finger, after the wire has been placed in the terminal and is to be guided to a further terminal, where it is to be terminated and cut. The further terminal is not shown in FIG. 1 but is shown in FIGS. 4 and 5.

As best seen in FIG. 1, the tool has a housing which can be secured to a wire positioning robot or numerically controlled positioning system, not shown, and of any suitable construction. The housing has a projecting wire positioning finger, which extends downwardly from a working position of the housing. The wire positioning finger has essentially rectangular cross section-see FIG. 3. Usually it is made of steel. The finger is secured to the housing in a suitable manner, as schematically shown by an attachment flange. The wire finger has a guide channel or duct 4 for an insulated wire, which is being supplied from a supply spool, not shown. The housing retains a feed structure for the wire formed, for example, by a pair of program-controlled feed rollers over which straightening and feed belts are looped. A clamping system positions the wire in alignment with the feed system and ensures positioning, holding and directing the wire in the housing.

The guide duct, see FIG. 3, is generally L-shaped. It has a vertical portion (FIG. 1) which then extends about a curved portion to an essentially horizontal portion. The curved portion is bent about 90° preferably in circular bent form. The portion is short and terminates in a wire exit or outlet mouth or opening formed on the finger, through which the wire can exit from the finger. The finger has a groove (FIG. 3) with parallel flanks. A knife blade, of essentially rectangular cross section, is longitudinally guided in the groove. The knife blade is coupled to a program controlled positioning element. It terminates at the bottom end in an inclined cutting edge. The cutting edge, which extends over the largest portion of the width of the blade, is located in a slit-like recess of the positioning finger above the opening of the duct. A pin additionally provides for guidance of the wire in the opening or recess of the finger. The cutting edge, together with a short cut-off edge, with which it forms an acute angle, defines a cutting tip or end edge which is positioned in the immediate vicinity of the opening of the guide duct within the recess or opening.

The knife blade is located above the curved portion and the following straight portion of the guide channel. The tip or end edge of the knife cooperates with the lower wall of the horizontal wire guide channel portion, the lower wall forming a counter surface or anvil for the cutting tip or end edge. A pressing element, in form of a punch or hold-down blade, is slidable in a slide groove, see FIG. 3, for longitudinal sliding movement along the finger. A program-controlled operating unit controls movement of the pressing element to move it vertically up and down on a forward end surface on the finger.

The pressing element is formed with a pressure surface (FIG. 1) at its end face, which extends over a large portion in a horizontal plane, and is intended to engage a wire emitted from the exit opening of the finger. As best seen in FIG. 2, a pressure surface portion adjoins the vertical guide surface of the finger. The surface is generally rectangular and has essentially the same width as the finger. A narrow rectangular rib is joined in the center to the pressure surface, followed by a downwardly projecting nose portion, which extends at an inclination, as best seen in FIG. 1 and which, again, has generally the width of the finger.

The curved portion, and inherent elasticity of the wire, would cause the wire to roll upwardly, similar to a spring. The inclined nose has the function to prevent this upward-rolling tendency of the wire when the wire is to be engaged with a terminal, and is positioned adjacent a slit blade insulation piercing connector.

Use and Operation, with Reference to FIGS. 1, 4 and 5.

FIG. 1 illustrates the operating condition in which the wire, exiting from the opening of the finger, was connected to a terminal at a connection point in a prior operation. The terminal (FIG. 1) was contacted in a prior opening step by the wire. The terminal element itself is a slit blade insulation piercing connector which is shown in plan view in FIG. 1A. The terminal, with the wire inserted, is seen in end view in FIG. 1A. It has a blade element, with a longitudinal slit. FIG. 1A illustrates the conductor of the wire inserted and clamped in the slit, with the insulation of the wire engaging against the slit blade insulation piercing connector. Two such blade elements, separated by slit, can provide resilient, springy connecting elements secured to a base, as shown in FIG. 1.

A groove-like recess or depression is formed on either side of the connector. Ribs, extending from the base, hold the connector in position.

The finger can now be moved to a second connecting position to connect and terminate the wire in a second subsequent slit blade insulation piercing connector, as illustrated in FIG. 4.

Before moving the finger, the pressing element is raised in the position shown in FIG. 1 in order to permit the finger to leave the right portion of the recess or depression of the prior connector. As soon as the finger is free from the connector, and has reached the desired connector (FIG. 4), element is moved downwardly in a position in which the surface engages the wire leaving the mouth opening from the finger; this can compensate for the tendency of the wire to roll upwardly. Only the bottom of the connector itself is visible in FIG. 4, since the remainder is behind the pressing element.

The finger, with the pressing element in the position shown in FIG. 4, is thus positioned above the further connecting terminal, such that it is above the groove-like recess or depression. Finger and the pressing element are lowered. The finger and the pressing element engage in the groove-like recess or depression of the terminal, such that the wire exiting from the opening of the finger is inserted, pressed and clamped in the insulation-piercing connector slit of the connector blade.

In this condition, the wire is supported on both sides of the slit by the region (FIG. 2) of the pressing element, as well as by the nose portion thereof. The conductor within the insulated wire is supported by the face of the rib (FIG. 2). The rib has a width transverse to the longitudinal direction of the wire which is preferably less, or at the most very slightly larger, most preferably not more than equal to the diameter of the conductor within an insulation sleeve or a coating of the wire. The nose presses the wire to the bottom of the associated groove or recess.

Although not strictly necessary, in some apparatus units the pressing element can be formed in two separate structures, permitting independent movement of the nose portion with the surface and of the conductor engagement portion and the rear portion (FIG. 2). Such a two-part pressing element is schematically indicated by the chain-dotted line, in FIG. 1, controlled by a separate pressing control unit.

The wire is cut by moving the cutter blade into the cutting position, shown in FIG. 5. It is cut after the wire has been inserted and pressed into the slit of the slit blade insulation piercing connector. As seen in FIG. 5, the finger knife control unit (FIG. 1) moves the blade downwardly, so that the blade tip or end edge, in combination with the lower wall of the horizontal portion of the guide duct, cuts the wire closely adjacent the slit blade insulation piercing connector.

In some terminal installations it can be desirable to slightly move the horizontal portion of the finger downwardly by a small distance, so that the terminal portion of the wire will receive, also on this side of the connector, a slightly downwardly oriented bend, so that the cut end of the wire will be bent downwardly. Thus, the same effect as that obtained by the nose can be achieved also at the cut end of the wire by cooperation of the blade element with the lower portion of the finger.

After cutting the wire, the finger is raised, the pressing element and the blade revert to their respective quiescent and rest positions, and further wire laying by the finger can be effected.

The finger is chamfered at its lower end in the region of the guide pin at the back side thereof, as seen in FIG. 1, at the surface. The rear surface as well as the forward surface can be inclined or rounded or wedge-shaped. Inclined end portions of the finger have the

advantage that when the finger passes by holding elements for conductors which are elastically deflectable, such holding elements can automatically snap back even if the finger has impinged thereagainst upon placing the wire.

Various changes and modifications may be made. Moving the finger, raising the knife blade, the pressing control, and timing, can all be controlled automatically, in accordance with suitable programs; such programs can, for example, position the finger in selected coordinate points with respect to a workpiece and, when placed at certain locations, then sequentially automatically control movement of, respectively, the pressing control, a separate control for the tip of the portion, if provided, and the knife control.

The tool is also useful for inserting a continuous wire into a connector, as seen in FIG. 1, by omitting the cutting operation.

Various changes and modifications may be made within the scope of the inventive concept.



CLAIMS:

1. Compact combined wire positioning and cut-off tool form in one operation, positioning a wire and cutting the wire closely adjacent said tool, comprising:
 - a tool housing;
 - a positioning finger extending from the housing;
 - a wire guide channel or duct formed in the finger and having a wire outlet opening;
 - a pressing element having a pressure surface movably located adjacent the wire outlet opening for movement transversely to the axial direction of the outlet opening;
 - pressing element position control means coupled to the pressing element for positioning the pressing element in a quiescent position removed from the wire outlet opening, and a holding position for holding the wire projecting from the wire outlet opening, the pressure surface extending at least up to the wire outlet opening when the pressing element is in the holding position;
 - cutting means movably located on the positioning finger in the vicinity of the wire outlet opening and movable between a rest position clear of the wire opening and a cutting position in front of the wire outlet opening; and
 - wherein said pressure surface of said pressing element has a rib essentially aligned with the wire projecting from the outlet opening, and having a width transverse to the direction of said wire projecting from the outlet opening which has a dimension approximately up to the diameter of a conductor within the wire.
2. The tool of claim 1, wherein the cutting means comprises a blade element terminating in an end portion; and
 - wherein the positioning finger, in the vicinity of said outlet opening, is formed with a knife surface for cutting cooperation with said end portion.
3. The tool of claim 1, wherein said pressure surface is formed with at least one region wider than said rib.
4. The tool of claim 1, wherein said pressure surface is formed on at least one side of the rib and has the shape of a projecting nose.
5. The tool of claim 3, wherein the at least one region of wider width has essentially the same width as the width of the positioning finger.
6. The tool of claim 1, wherein said rib has a central region extending in longitudinal direction with respect to the wire projecting from the outlet opening, said central region having the width of substantially up to the diameter of the conductor within said wire;
 - and two regions of wider width, located at end regions of said rib, one of said regions being located adjacent an end surface of the finger and adjacent said wire outlet opening.



7. The tool of claim 1, wherein said positioning finger has an angled-off portion, said wire outlet opening being located at a terminal surface of said angled-off portion, and said cutting means is movably located for movement across said wire outlet opening.
8. The tool of claim 7, wherein said cutting means comprises a knife having a blade element formed with an edge extending at an inclination with respect to a guide wall of said wire guide channel.
9. The tool of claim 8, wherein said blade element terminates in a cutting tip or end edge.
10. The tool of claim 9, wherein said cutting tip or end edge, when said blade element is in a cutting position, is located in the vicinity of the wire outlet opening.
11. The tool of claim 9, wherein the pressing element is longitudinally slidably on the positioning finger.
12. The tool of claim 1, wherein the cutting means comprises a knife having a blade element which is longitudinally slidable along the positioning finger.
13. The tool of claim 12, wherein the pressing element is longitudinally slidable on the positioning finger; and
the cutting blade element and the pressing element are located adjacent each other on the positioning finger.
14. The tool of claim 1, wherein said pressing element comprises a two-component structure, one component carrying a hold-down pressure surface and the other component carrying a holding surface projecting, when in holding position, by a lesser extent than said hold-down pressure surface.
15. The tool of claim 1, wherein the cutting means comprises a blade element terminating in an end edge; and
wherein the positioning finger, in the vicinity of said wire outlet opening, is formed with a cutting counter surface or anvil for the cutting end edge.
16. The tool of claim 1, wherein said cutting means comprises a knife means; and
knife operating means coupled to the cutting knife means for moving the cutting knife means between said positions.
17. Compact combined wire positioning and cut-off tool for, in one operation, positioning a wire and cutting the wire closely adjacent said tool, comprising:
a tool housing;
a positioning finger extending from the housing;
a wire guide channel or duct formed in the finger and having a wire outlet opening;
a pressing element having a pressure surface movably located adjacent the wire outlet opening for movement transversely to the axial direction of the outlet opening;
pressing element position control means coupled to the pressing element for positioning the pressing element in a quiescent position removed from the wire outlet



opening, and a holding position for holding the wire projecting from the wire outlet opening, the pressure surface extending at least up to the wire outlet opening when the pressing element is in the holding position;

cutting means movably located on the positioning finger in the vicinity of the wire outlet opening and movable between a rest position clear of the wire opening and a cutting position in front of the wire outlet opening; and

wherein said pressing element comprises a two-component structure, one component carrying a hold-down pressure surface and the other component carrying a holding surface projecting, when in holding position, by a lesser extent than said hold-down pressure surface.

18. Compact combined wire positioning and cut-off tool for, in one operation, positioning a wire and cutting the wire closely adjacent said tool, comprising:

a tool housing;

a positioning finger extending from the housing;

a wire guide channel or duct formed in the finger and having a wire outlet opening;

a pressing element having a pressure surface movably located adjacent the wire outlet opening for movement transversely to the axial direction of the outlet opening;

pressing element position control means coupled to the pressing element for positioning the pressing element in a quiescent position removed from the wire outlet opening, and a holding position for holding the wire projecting from the wire outlet opening, the pressure surface extending at least up to the wire outlet opening when the pressing element is in the holding position;

cutting means movably located on the positioning finger in the vicinity of the wire outlet opening and movable between a rest position clear of the wire opening and a cutting position in front of the wire outlet opening; and

wherein the cutting means comprises a blade element terminating in an end portion; and

wherein the positioning finger, in the vicinity of said outlet opening, is formed with a knife surface for cutting cooperation with said end portion.

19. The tool of claim, wherein said pressure surface of said pressing element has a rib essentially aligned with the wire projecting from the outlet opening, and having a width transverse to the direction of said wire projecting from the outlet opening which has a dimension approximately up to the diameter of a conductor within the wire; and

wherein said rib has a central region on the pressing element, extending in longitudinal direction with respect to the wire projecting from the outlet opening, said central region having the width of substantially up to the diameter of the conductor within said wire and two regions of wider width, located at end regions of said rib, one of said



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regions being located adjacent an end surface of the finger and adjacent said wire outlet opening.

20. The tool of claim 18, wherein said positioning finger has an angled-off portion, said wire outlet opening being located at a terminal surface of said angled-off portion, and said cutting means is movably located for movement across said wire outlet opening.