" TOOL FOR FORMING A SOLDERLESS, SCREWLESS AND STRIPLESS CONNECTION BETWEEN AN INSULATED WIRE AND A LONGITUDINALLY SLOTTED TERMINAL ELEMENT"

This invention relates to a tool for electrically connecting an insulated wire to a longitudinally slotted terminal element.

The Applicant has developed a technique for electrically connecting insulated wires to terminal contacts in such a manner that it is not necessary to strip the insulation from the wire, to solder the wire to the contact or to employ fixing screws. This technique is called solderless, screwless and stripless connection and is now widely accepted. In this technique, terminal elements are used which are made of spring sheet metal and which are mounted upright in a terminal strip. Each terminal element defines an open longitudinal slot between two lateral resilient tongues, the width of the slot being slightly less than the diameter of the insulated wire to be connected. The resilient tongues are mutually offset by deformation such that, when the wire is inserted into the slot, the relatively sharp edges of the tongues first sever the insulation and then penetrate by a predetermined amount the core material of the wire, thereby making electric -al contact.

For transversely inserting the insulated wire into the slot and withdrawing an inserted wire from the slot, special tools have been developed which permit reliable wiring of, for example, terminal strips having a relatively high contact density even by unskilled operators. However, these tools suffer from the disadvantage that they can perform only one function or, respectively, two functions. In addition, they have a relatively complex structure and entail considerable manufacturing costs. For instance, to withdraw already connected wires from the terminal element it is necessary to use special withdrawing pliers, and for releasing the terminal elements from their mounting means screw drivers must additionally be used.

It is an object of the present invention to provide a tool of the above-described type which can be manufactured at reduced cost and which permits operations additional to the connection of the wires to the terminal elements to be performed.

According to the present invention, a tool for electrically connecting an insulated wire to a longitudinally slotted terminal element comprises an elongate hollow grip member, a ram disposed within the grip member and movable longitudinally thereof, the ram having a head which projects externally of the grip member and which is operative in use to urge said insulated wire into a slot in said terminal element, said head including a pressing plate having a longitudinal slot therein for the reception of said insulated wire, a stop which is operative to limit the depth of insertion of said wire into said slot in said terminal element, and a wire cutter including a pair of scissor blades, coupling means operative to cause at least one of the scissor blades to pivot relative to the other in response to movement of the ram relative to the grip member, and a drawhook adapted for the extraction of said wire from said terminal element, the drawhook being movable between respective positions wherein it is extended from and retracted into the grip member.

In addition to having a comparatively simple structure, the tool of the present invention has the further advantage that is is possible in a single operation to urge the wire into the slot in the terminal element with an exactly predetermined force and subsequently to cut the wire at a predetermined spacing from the terminal element. In this way, faulty switching caused

by excessively projecting wire ends, for example, may be reliably prevented. Moreover, it is possible to release the electrical connections in a simple manner with the same tool by extending the drawhook from the grip member and using it to withdraw the appropriate wire from its slot.

The present invention will now be further described, by way of example, with reference to the accompanying drawing, in which:-

Figure 1 is an underneath plan view, partly in section, of a tool according to the present invention, one shell part of a grip member thereof having been omitted; and

Figure 1a is a side view of the tool shown in Figure 1.

The illustrated tool is operable to connect an insulated wire 1a to a longitudinally slotted terminal element (not shown), and comprises a hollow grip member 3 formed from two plastics shells 3a and 3b which are bolted together. Longitudinally slidable within the grip member 3 is a ram 2 having a head 2a which projects from a forward end of the member 3. The head 2a includes a longitudinally slotted pressing plate 1 by means of which the wire 1a is urged into the contact slot in the terminal element, this latter slot being in alignment with the longitudinal axis of the tool, a limiting stop 2b which limits the depth of insertion of the wire into the contact slot, and a wire cutter 6. The cutter 6 includes a pair of scissor blades, one 6a of which is secured to the ram 2 so as to be pivotable about a bolt 6b. A rear end of the scissor blade 6a has an elongate slot 6c which is inclined relative to the longitudinal axis of the tool, and a pin 5 which is fixed to the grip member 3 engages in the slot 6c. The resultant pin and slot connection, which is housed within the grip member 3, causes the scissor blade 6a to pivot as the ram 2 moves relative to the grip member.

A hollow slider 8 of rectangular cross-section is disposed within the grip member 3 and is normally locked to the ram 2 for movement therewith by means of a generally U-shaped locking bar 7 which is accommodated within a recess in the slider 8. However, the locking bar 7 can be released after an initial movement of the ram 2 by the engagement of a pin 3c fixed within the grip member 3

with an inclined ramp surface 7b formed on a lateral lug 7a of the locking bar 7. Such engagement causes the lock bar 7 to move transversely against the action of a pressure spring 9 attached to the slider 8. Like the shells 3a and 3b, the ram 2, the slider 8 and the locking bar 7 are all made of plastics material.

A compression spring 10 acts at one end thereof on a shoulder 2c on a central portion of the ram, and at its other end on a forward end wall of the slider 8. At its rear end, the ram 2 extends through the said forward end wall of the slider 8, and has a longitudinally profiled extension 2d which extends through the U-shaped locking bar 7 and which terminates at an enlarged end plate 2e, the end plate 2e being confronted by an intermediate wall 8a centrally positioned on the slider 8.

A further compression spring 4 is seated at one end thereof on a stop fixed to the interior of the grip member 3, and at its other end is supported by an end wall 8b on the rear end of the slider 8. A pin 8c fixed to the slider extends through the spring 4 and is normally in registration with a radial bore 11b in a rotatable knob 11 which is of sufficient size to receive the pin 8c therein. The knob 11 can however be rotated from the exterior of the grip member 3 to bring a closing member 1a into alignment with the pin 8c.

Inside one shell of the grip member 3, a drawhook 12 including a handle 12a and a flat piercing tool 13 including a handle 13a are pivotally mounted so that they can each be swung inwards and outwards laterally from respective side slots in the grip member 3 between a retracted or rest position (as illustrated for the tool 13) and an extended or operating position (as illustrated for the drawhook 12).

The above-described tool operates as follows. For

urging the wire 1a into the contact slot, a manual force is applied to the grip member 3 in the direction of arrow 14 against the force of the two compression springs 4 and 10, which force is sufficient to urge the wire 1a into the contact slot formed between the two resilient tongues of the terminal element aligned parallel with the tool axis, thereby cutting the insulation and making an electrical connection between the terminal element and the wire which is protected against mechanical strain. The depth of insertion of the wire into the slot is determined by the limiting stop 2b on the ram head 2a. The advancing force acting on the grip member 3 causes the ram 2 to move rearwardly with respect thereto, and the relative movement between the ram and the grip member causes, by means of the pin and slot connection 5 and 6c, the scissor blade 6a to pivot, so that a cutting edge formed at the front end thereof will sever the wire 1a at a predetermined distance from the terminal element.

During an initial part of this relative movement between the ram 2 and the grip member 3, the slider 8 is locked to the ram by means of the locking bar 7. Only after a predetermined distance has been travelled will the ramp surface 7b on the locking bar 7 come into engagement with the pin 3c fixed to the grip member, whereby the locking bar 7 is moved transversely against the action of the spring 9. Under the action of one of the compression springs 4 or 10, the intermediate wall 8a of the slider 8 will strike against the end plate 2e of the ram extension 2d. Such striking indicates to the operator that the connection operation has been completed.

In the case where the wire is not to be severed, the knob 11 (which acts as a locking member) is turned to the position shown in Figure 1, in which the closing member 11a closes an aperture formed in the grip member and

prevents the pin 8c from penetrating into that aperture. Thus a rigid coupling between the ram 2 and the grip member 3 is created by means of the slider 8, so that upon urging of the wire into the contact slot the free scissors blade 6a will not be actuated by the pin 5.

The drawhook 12 shown in Figure 1 is used to withdraw a connected wire from the contact slot of the respective terminal element. The piercing tool 13 permits releasing of latched connections between a connector strip and its mounting means, e.g. by engagement behind integrally formed projections.

CLAIMS:

A tool for electrically connecting an insulated wire to a longitudinally slotted terminal element comprises an elongate hollow grip member, a ram disposed within the grip member and movable longitudinally thereof, the ram having a head which projects externally of the grip member and which is operative in use to urge said insulated wire into a slot in said terminal element, said head including a pressing plate having a longitudinal slot therein for the reception of said insulated wire, a stop which is operative to limit the depth of insertion of said wire into said slot in said terminal element, and a wire cutter including a pair of scissor blades, coupling means operative to cause at least one of the scissor blades to pivot relative to the other in response to movement of the ram relative to the grip member, and a drawhook adapted for the extraction of said wire from said terminal element, the drawhook being movable between respective positions wherein it is extended from and retracted into the grip member.

2. A tool as claimed in claim 1, wherein the grip member is composed of a pair of shells secured together.

3. A tool as claimed in claim 2, wherein the shells are bolted together.

4. A tool as claimed in claim 1, 2 or 3, further comprising biassing means urging the ram into a position wherein said head is fully extended from the grip member.

5. A tool as claimed in any preceding Claim, wherein the coupling means comprises a pin and slot connection between at least one of the scissor blades and the grip member.

6. A tool as claimed in Claim 5, wherein the pin and slot connection is housed within the grip member.

7. A tool as claimed in Claim 5 or 6, wherein the pin and slot connection includes a slot formed in a rear end portion of one of the scissor blades, and a pin fixed to the grip member and engaging in said slot.

8. A tool as claimed in any preceding Claim, further comprising a slider, locking means arranged to lock the slider to the ram during an initial movement of the ram relative to the grip member, release means operative to release the locking means during subsequent movement of the ram relative to the grip member, and abutment means arranged to limit movement of the ram relative to the slider.

9. A tool as claimed in Claim 8, further comprising limiting means selectively operable to prevent the ram from being moved beyond said initial movement, the limiting means being housed within the grip member.

10. A tool as claimed in Claim 9, wherein the limiting means includes a member having a bore therein into which a pin on the slider enters upon said initial movement of the ram, the member being movable to bring the bore out of registration with the pin.

11. A tool as claimed in Claim 10, wherein the member is rotatable and the bore extends generally radially of its rotation axis.

12. A tool as claimed in any one of Claims 8 to 11, wherein a compression spring engages a rear end of the slider and urges the ram into a position wherein said head is fully extended from the grip member.

13. A tool as claimed in any one of Claims 8 to 12, wherein the locking means includes a locking bar which is movable transversely of the direction of movement of the ram and which is biassed into a position wherein it locks the slider to the ram.

14. A tool as claimed in Claim 13, wherein the locking bar is generally U-shaped and includes a portion having a ramp surface, the ramp surface being engaged by an abutment fixed to the grip member when the ram reaches the end of said initial movement thereby to move the locking bar against the action of its bias.

15. A tool as claimed in Claim 13 or 14, wherein the locking bar is contained within a recess in the slider.

16. A tool as claimed in Claim 14 or 15, wherein the abutment means comprises a projection on a rear end of the ram which extends through the U-shaped locating bar and which is engageable with an intermediate wall formed on the slider.

17. A tool as claimed in any one of Claims 13 to 16, wherein the grip member, the ram, the slider and the locking bar are all made of plastics material.

18. A tool as claimed in any preceding Claim, wherein the drawhook is pivotally attached to the grip member.

19. A tool as claimed in any preceding Claim, wherein a piercing tool is also movable between respective positions wherein it is extended from and retracted into the grip member.

20. A tool as claimed in Claim 19, wherein the piercing tool is pivotally attached to the grip member.

21. A tool for electrically connecting an insulated wire to a longitudinally slotted terminal element, substantially as hereinbefore described with reference to the accompanying drawing.

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