CONTACT EXTRACTION AND INSERTION TOOL

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INVENTOR

GEORGE S. JOHNSON

BY

Hueber & Worrall

ATTORNEYS.
The present invention relates to electrical connectors of the type wherein one or more contact terminals are mounted in one insulation body and a complementary contact terminal or terminals are mounted in another insulation body, one set of the contact terminals normally being pins and the complementary set being sockets, although other types of mating terminals may be used. The invention has particular reference to a novel tool which is employed in cooperation with electrical connectors of the type in extracting the contact terminals from the insulation bodies or inserting the contact terminals into the insulation bodies.

In some electrical connector designs the contact terminals are inserted into terminal receiving bores in the insulation body or block after the connector mates with the pins having been other than completely fabricated or assembled, and locking means is provided between the individual contact terminals and their respective bore walls for retaining the terminals in their respective positions in the insulation body. Some electrical connectors of this general type have contact terminals which are removable from the insulation body by insertion of a tool into a suitable clearance between the terminal and insulator to disengage the locking device and thereby permit manual withdrawal of the terminal from the insulator. In many instances it is preferable that such removable contact terminals be insertable into and removable from the rear of the insulation body, with contacting portions of the terminals either protruding forwardly or being accessible from the front of the insulation body, as this permits the wire conductors to be attached to the terminals before inserting the terminals into the insulation body. Where the terminals are thus insertable into the insulation body from the rear of the insulator, it is preferable to employ a contact extraction tool which enters the terminal receiving bores from the rear rather than from the front for releasing the locking device which retains each terminal in the insulator, so that minimum clearances can be provided in the region of the forward contacting portions of the terminals to assure good stability and alignment of the contacts.

However, where the contact terminals are thus insertable into and removable from the rear of the insulation body, and particularly where a relatively large number of small contacts are mounted in the insulation body, serious problems are presented both in the insertion of the terminals into the insulator and in the removal of the terminals therefrom. For example, when a contact terminal is inserted into the insulator from the rear, a substantial forwardly directed axial force must be applied to the terminal in order to engage the locking structure which holds the terminal in the insulator, and in the prior art it was usually necessary to apply this force by pushing inwardly or forwardly on the conductor wire that was cramped or soldered to the terminal. When small terminals and relatively fine wires were employed, or where the wires were particularly flexible, it was sometimes difficult to apply the necessary force for complete locking engagement of the terminals in the insulator. Prior art tools insertable into a rearward clearance in the bore and engageable with the locking means to release the terminal usually comprised thin metal blades which were awkward to manipulate and difficult to align with the locking structure concealed in the bore of the insulation body, and which were likely to damage the insulator, terminal or wire conductor. Positioning of a tool of this prior art type so that it would enter with a very small clearance at the rear of the insulator was difficult. Also, such a tool was not practical for use in pushing a contact terminal forwardly into its locked position in the insulator since the tool only could exert force at one side of the terminal, and would thereby tend to cock and jam the terminal in the bore, and it also would be difficult to keep the tool in abutting relationship with a shoulder on the terminal as the tool would merely be positioned adjacent to one side of the terminal so that the tool would tend to shift laterally out of abutting relationship with the terminal upon the application of a sufficient axial force to seat the terminal in the bore.

In view of these and other problems in the art, it is an object of the present invention to provide a novel tool for extracting and inserting contact terminals that are readily lockable in an electrical connector insulation body, the tool comprising an elongated tubular member adapted to be engaged over a wire attached to a terminal in axial sliding relationship with the wire so as to be guided along the wire into abutting engagement with the terminal for pushing the terminal into the insulator or for inserting the tool into an access clearance in the insulator to release the locking means engageable between the insulator and the terminal and thereby permit withdrawal of the terminal from the insulator.

Another object of the invention is to provide a contact extraction and insertion tool of the character described comprising a resilient split sleeve which has a tubular forward working portion that substantially completely circumscribes a wire conductor connected to the terminal and a part of the terminal itself, so as to be capable of applying a uniform axial force about substantially the entire periphery of the terminal when engaged against a shoulder on the terminal, to permit application of the necessary axial force for inserting and locking a contact terminal in an insulation body, and so that the tool can be inserted into a clearance from the rear of the terminal without concern as to proper orientation of the tool with respect to the locking structure. It is particular object of the invention to provide a contact extraction and insertion tool of the character described that is adapted for use in extracting and inserting contact terminals which are already connected to respective conductor wires, and which are insertable into the insulator and removable therefrom from the rear of the insulator.

A further object of the invention is to provide a contact extraction and insertion tool of the character described which is relatively rigid in an axial direction, but which is resilient circumferentially, so that the sleeve may be split for engagement over a wire connected to a terminal, and then released for close-fitting engagement about the wire. In its preferred form, the split sleeve is composed of a resilient plastic material which will not be likely to gall or otherwise damage the insulation on the wire or the insulator body or the terminal or locking means for holding the terminal in the insulator. Further, the preferred form of the invention is longitudinally split by means of a slot which is relatively narrow at the forward, operating portion of the tool so that the portion of the tool will substantially completely surround the wire and a portion of the terminal, the slot enlarging toward the rear of the tool to provide a rear entry portion to facilitate engagement of the tool over the wire attached to the terminal.

Additional objects and advantages of the invention will
appear during the following part of this specification wherein the details of construction and mode of operation of a preferred embodiment are described with reference to the accompanying drawings, in which:

FIG. 1 is a perspective view of a presently preferred tool of the type being to the invention.

FIG. 2 is a side elevation view illustrating the manner in which the tool shown in FIG. 1 is engaged over a wire extending rearwardly from a contact terminal that is mounted in an electrical connector member.

FIG. 3 is a vertical section, partly in elevation, illustrating a contact terminal releasably locked in the insulation body of the connector member shown in FIG. 2, and showing the manner in which the tool of the present invention is engaged over the wire extending rearwardly from the terminal preparatory to forward shifting of the tool for release of the terminal.

FIG. 4 is a vertical section, partly in elevation, similar to FIG. 3, wherein the tool has been moved to a forwardmost position in which it has released the locking means in the bore from engagement with the contact terminal.

FIG. 5 is a view similar to FIGS. 3 and 4 illustrating extraction of the contact terminal and tool from the bore of the insulation body after the locking means has been released as shown in FIG. 4.

Referring to the drawings, the tool 10 of the present invention is tubular, and in the presently preferred form as illustrated in the drawings the tool has a generally cylindrical forward portion 12 with an inside diameter approximately the same or only slightly larger than the wire conductor and rearward portion of the contact terminal over which the tool is to be slidably engaged as hereinbefore described in detail. The forward cylindrical portion 12 of the tool terminates at its front end in a forwardly facing shoulder 14.

To the rear of the cylindrical forward portion 12 the tool flares outwardly in a generally frusto-conical section 16 to an enlarged rearward body portion 18 which serves both as a handle and as a guide for snapping the tool into position over a wire conductor.

A longitudinal slot 20 is provided along the entire length of the tool 10 so that the tool 10 actually comprises a split sleeve or tube. The slot 20 is relatively wide in the region of the enlarged rearward body portion 18 of the tool, and tapers down in the intermediate flared portion 16 of the tool until the slot 20 is merely a thin slit in the region of the generally cylindrical forward portion 12 of the tool. The relatively wide rearward portion of the slot 20 provides a lead-in for readily accepting a wire that is attached to a contact to be extracted from or inserted into an electrical connector member, and then the wire may be easily slid forwardly along the tapered portion of the slot, spreading the slot apart and expanding the tool until the wire is completely encompassed by the tool, and then the tool will spring back to its constricted, normal condition wherein the generally cylindrical forward portion 12 of the tool substantially completely circumscribes the wire.

In its preferred form the tool 10 is composed of a plastic material which provides axial rigidity but circumferential resiliency. The axial rigidity permits a substantial axial force to be applied at the forwardly facing shoulder 14 either for pushing a contact terminal into its operative position in an electrical connector body, or for releasing a releasable locking device in a connector body to permit withdrawal of the terminal therefrom. The circumferential resiliency of the tool makes it easy to slip the tool over a wire conductor without damaging the wire.

Providing the tool of plastic has other important advantages. Thus, not only will the tool be unlikely to damage an insulation layer on a wire conductor, but similarly the tool will not damage a rubber or plastic insulator in a connector, and will not damage the terminal itself or locking structure which holds the terminal in position in the connector member. Also, with the tool composed of plastic it will comprise an insulating member so that no undesired electrical contact or grounding will occur when the tool comes into contact with a contact terminal, and so that it is impossible for the operator tool of the tool to receive an electrical shock. Further, a plastic tool is very light in weight, and this coupled with the insulation characteristic of the plastic permits the tool to be left in the field operatively engaged about one of the wire conductors leading to an electrical connector, so that one of the tools will always be handy to workers in the field to facilitate removal and replacement of contacts in case of damage to contacts or if it is desired to reconnect the circuitry associated with a connector.

Although plastic is the preferred material of which the tool 10 is composed, it will be apparent that the tool also could be composed of relatively thin metal having sufficient circumferential springiness to permit the tool to be snapped over a wire conductor.

Although the preferred form of the tool includes a constricted forward portion, with the tool flaring radially outwardly to an enlarged rearward portion, the tool may alternatively be provided in a tubular form of substantially uniform diameter. However, it is still desirable for the slot 20 to flare rearwardly to an enlarged lead-in portion communicating with the rearward end of the tool.

Normally the simple tubular construction of the tool will provide adequate gripping surface area so that the tool can be grasped and manipulated to assist in inserting and extracting contacts, and this is particularly true with the preferred form of the tool as shown in the drawings which includes an enlarged rearward body portion 18. However, if desired, additional handle means may be provided at the rearward portion of the tool, either forming an integral part of the tool or removably connectable to the tool.

Referring now particularly to FIGS. 2–5, the operation of the tool is there illustrated in connection with the removal of a contact terminal which is releasably locked in a connector body. The electrical connector member 22 illustrated includes an insulation body 24 having a forward face 26 and a rearward face 28, with a contact terminal receiving bore 30 extending between the forward and rearward faces. The bore 30 includes a relatively large rearward portion 32 and a relatively small or constricted forward portion 34. The relatively large rearward bore portion 32 is undercut to provide an annular cavity 36 within which a contact retention clip 38 is mounted.

The contact retention clip 38 includes a generally cylindrical body 40 which is preferably longitudinally slit so that the clip can be constricted and inserted into the annular cavity 36 through the rear end of the bore, and then permitted to expand outwardly against the wall of the bore in a seated position. The retention clip 38 includes one or more spring fingers or tabs 42 which may be struck inwardly from the wall of the cylindrical body 40 of the clip so as to angle forwardly and radially inwardly.

The wall of bore 30 presents a rearwardly facing shoulder 44 between the relatively large rearward bore portion 32 and the constricted forward bore portion 34. The contact retention clip 38 and the bore configuration are adapted for snap-in contact mounting, with the contact terminal being insertable into the bore from the rear and being removable from the rear. A suitable contact terminal 46 is shown in FIGS. 3, 4, 5, and includes a generally cylindrical body 48 having a forward contacting portion 50 which is illustrated in the drawing as a pin element, but which may be a socket or any other type of contacting means. An annular collar 52 is provided on the body 48 of the terminal, dividing the body 48 into a forward body portion 54 which fits within the constricted forward bore portion 34, and a rearward body portion 56 which is of tubular or cupped construction
to permit soldering or crimping therein of a bare end of an insulated wire 58.

In FIG. 3 the contact terminal 46 is shown in its releasably locked position in the connector member 22, the terminal 46 having been pushed forwardly into the bore 39 from the rear, the annular collar 52 on the terminal camming the spring fingers 43 of the contact retention clip 38 radially outwardly as the collar 52 passes under the spring fingers 42, and the spring fingers 42 then snapping radially inwardly behind the collar 52 to lock the terminal against rearward movement in the bore. Further forward movement of the terminal in the bore is blocked by engagement of the collar 52 against the rearward facing shoulder 44 in the bore. It is to be noted that in this releasably locked position of the terminal 46, there is an annular clearance 60 between the rearward body portion 56 of the terminal and the insulation about the wire 58 on the one hand, and the generally cylindrical body 40 of the clip 38 and the relatively large rearward bore portion 32 on the other hand, this annular clearance 69 providing an annular access passage for insertion of the tool 10 from the rear.

The sequence shown in FIGS. 2-5 illustrates the use of the tool 10 for extracting the contact terminal 46 from the connector member 22. The first step is to engage the tool 10 in coaxial position over the conductor wire 58 so that the reduced, generally cylindrical forward portion 12 of the tool is in relatively snug, slideable relationship over the wire 58 in the manner shown in FIG. 5. The tool 10 is shown in FIG. 2 as it is being engaged over the wire 58, the wire 58 already having been inserted into the enlarged or flared rearward portion of the slot 20 and being fed forwardly through the tapered portion slot.

After the tool 10 has been engaged over the wire 58 the tool is then pushed forwardly into the annular clearance 60 in the manner shown in FIG. 4 until the forward end 14 of the tool engages against the annular collar 52 on the terminal. As the generally cylindrical forward portion 12 of the tool passes under the spring fingers 42 it camms the fingers 42 radially outwardly so that the forward ends of the fingers will clear or be out of the path of the annular collar 52 on the terminal. The wall of the forward portion 12 of the tool is made thicker than the height of the radial extent of collar 52 on the terminal to assure that the spring fingers 42 will be cammed radially outwardly sufficiently to clear the collar. The terminal is at this point released, so that a rearward pull on the wire 58 will cause rearward extraction of the terminal and the tool as shown in FIG. 5.

In order to use the tool 10 for inserting the contact terminal 46 into its operative position as shown in FIG. 3 within the connector member 22, the tool is engaged over the wire 58 and is moved forwardly until the forward end 14 of the tool engages against the annular collar 52 on the terminal. The tool is then pushed forwardly so as to move the terminal forwardly into the bore until the collar 52 abuts against the rearward facing shoulder 44 in the bore, and then while the terminal is held in this forward position, the tool is extracted, permitting the spring fingers 42 to shift radially inwardly behind the collar 52 to the position shown in FIG. 3.

It will be apparent from the foregoing that the tool 10 has particular utility in connection with electrical connectors of the type embodying snap-in contacts which are inserted and removed from the rear of the connector member by manipulation of the rear and without inquiring any manipulation from the front of the connector member. The engagement of the tool 10 over a conductor wire that is already soldered or crimped to a contact terminal greatly facilitates this manipulation from the rear, guiding the tool into the annular clearance providing access to the rear of the terminal and without requiring any groove in the terminal or connector member engagement. It is not necessary to probe in order to fit the tool into the clearance in the manner of prior art tools which were insertable into the clearance only on one side of the wire and terminal. By providing the reduced forward portion 12 of the tool in the form of a substantially complete tube, with merely a relatively narrow longitudinal slit therein, it is unnecessary to circumferentially orient the tool so that it will register with the recess illustrated in the rear of the contact retention clip 38, thus completely eliminating a serious problem in connection with prior art tools used for the same general purpose. The assured correct alignment and proper registry of the present invention when it is used either for extracting or inserting a terminal prevents damage to the conductor wire, terminal, retention clip and the insulation body which was likely to occur in connection with prior art tools which did not substantially completely circumscribe the wire conductor and the terminal during operation.

While the instant invention has been shown and described herein in what is considered to be the most practical and preferred embodiment, it is recognized that departures may be made therefrom within the scope of the invention, which is therefore not to be limited to the details disclosed herein, but is to be accorded the full scope of the claims so as to embrace any and all equivalent devices.

I claim:
1. A contact terminal extraction and insertion tool for use in connection with a contact terminal that is releasably lockable in a bore within an electrical connector body, said tool comprising an elongated tubular member having a forward end and a rearward end and adapted to be slidably engaged over a wire attached to the terminal with said forward end facing the terminal, said tubular member having a generally cylindrical forward portion terminating at said forward end, said forward portion having an internal diameter sufficient to circumferentially embrace said wire and an enlarged rearward portion of substantially larger diameter than said forward portion, said tubular member having a longitudinal split extending through the wall thereof along its entire length, the tubular member being substantially rigid axially and being resilient circumferentially so that the tubular member can be expanded circumferentially to open the split for insertion of the wire into the tubular member.
2. A tool as defined in claim 1 wherein said forward end of the tubular member presents a forwardly directed annular shoulder disposed in a plane substantially normal to the axis of the tubular member.
3. A tool as defined in claim 1 wherein said split is relatively narrow in said generally cylindrical forward portion and flares toward said rearward end so as to be relatively wide in said enlarged rearward portion to provide a lead-in taper for inserting the wire into the tubular member.
4. A tool as defined in claim 3 wherein the tubular member includes a rearwardly flaring tapered portion extending from said forward portion to said enlarged rearward portion, said split flaring rearwardly in said tapered portion.
5. A tool for disassembling and assembling an electrical connector having an insulation body provided with a bore therethrough with a front and rear end, a contact terminal releasably mounted in the bore, a wire attached to the terminal and extending rearwardly from the insulation body, fixed stop means in the bore limiting forward positioning of the terminal in the bore, manipulatable step means engaging between the terminal and the bore and having a locking position adapted to limit rearward positioning of the terminal in the bore and a releasing position adapted to free the terminal for withdrawal rearwardly from the bore, a rearwardly opening clearance in the body immediately surrounding the terminal and extending to said manipulatable step means, said tool comprising a tubular member having a forward cylindrical end portion adapted to be removably slidably mounted on the wire with said forward end facing the terminal, the
3. A tubular member being slidably forwardly on the wire to a position wherein said forward cylindrical portion of the tubular member enters said clearance and engages said manipulable stop means to force said manipulable stop means into releasing position whereby the terminal and tubular member may be withdrawn rearwardly from the bore, said cylindrical portion having a longitudinal split extending through the wall thereof along its entire length and, being substantially rigid axially and being resilient circumferentially so that it can be expanded circumferentially to open the split for insertion of the wire laterally into and removal of the wire from the tubular member.

6. A tool as defined in claim 5 wherein said tubular member is composed of plastic material.

7. A tool as defined in claim 5 wherein the split in said generally cylindrical forward portion of the tubular member is substantially narrower than the outside diameter of the wire, whereby the tubular member can be laterally retained in slidable engagement over the wire.

8. A tool as defined in claim 5 wherein said split is relatively narrow in said generally cylindrical forward portion of the tubular member and flares toward said rearward end of the tubular member so as to be relatively wide at said rearward end to provide a lead-in taper for inserting the wire into the tubular member.

9. A tool as defined in claim 8 wherein said tubular member has an enlarged rearward portion of substantially larger diameter than said generally cylindrical forward portion.

10. A tool for disassembling and assembling an electrical connector having an insulation body provided with a bore therethrough with a front and a rear end, a contact terminal releasably mounted in the bore, a rearwardly facing shoulder on the terminal, a wire attached to the terminal and extending rearwardly from the insulation body, fixed stop means in the bore limiting forward positioning of the terminal in the bore, manipulatable stop means engageable between the terminal and the wall of the bore and having a locking position adapted to limit rearward positioning of the terminal in the bore and a releasing position adapted to free the terminal for withdrawal rearwardly from the bore, a rearwardly opening clearance in the body immediately surrounding the terminal and extending to said manipulable stop means, said tool comprising a tubular member having a forward cylindrical end portion adapted to be removably slidably mounted on the wire with said forward end facing the terminal, said forward end comprising a generally annular shoulder disposed in a plane substantially normal to the axis of the cylindrical end portion, the tubular member being slidably forwardly on the wire to a position wherein said annular shoulder engages said rearwardly facing shoulder on the terminal whereby the terminal can be pushed forwardly into the bore from the rear by forward movement of the tubular member until the terminal is stopped by said fixed stop means and the cylindrical portion of the tubular member occupies said clearance, said cylindrical portion having a longitudinal split extending through the wall thereof along its entire length and, being substantially rigid axially and being resilient circumferentially so that it can be expanded circumferentially to open the split for insertion of the wire or the terminal laterally into and removal of the wire or the terminal from the tubular member.

11. A tool as defined in claim 10 wherein the outer diameter of said generally cylindrical forward portion of the tubular member is greater than the outer diameter of said rearwardly facing shoulder on the terminal.

References Cited in the file of this patent

UNITED STATES PATENTS

1,108,748 Hampton Aug. 25, 1914
2,591,550 Kane Apr. 1, 1952