Oct. 5, 1971 B. W. HILLS 3,609,860

METHOD OF FITTING A RESILIENT INSULATING SLEEVE ABOUT AN ELECTRICAL CONNECTOR AND MEANS FOR CARRYING OUT THE METHOD

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Fig. 5.

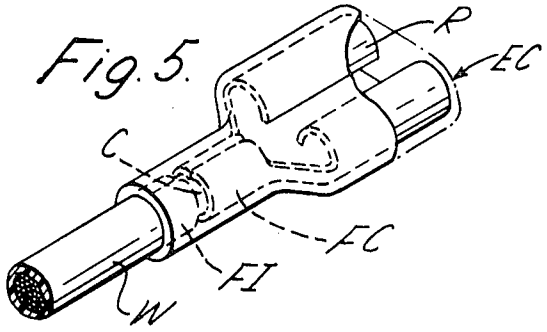
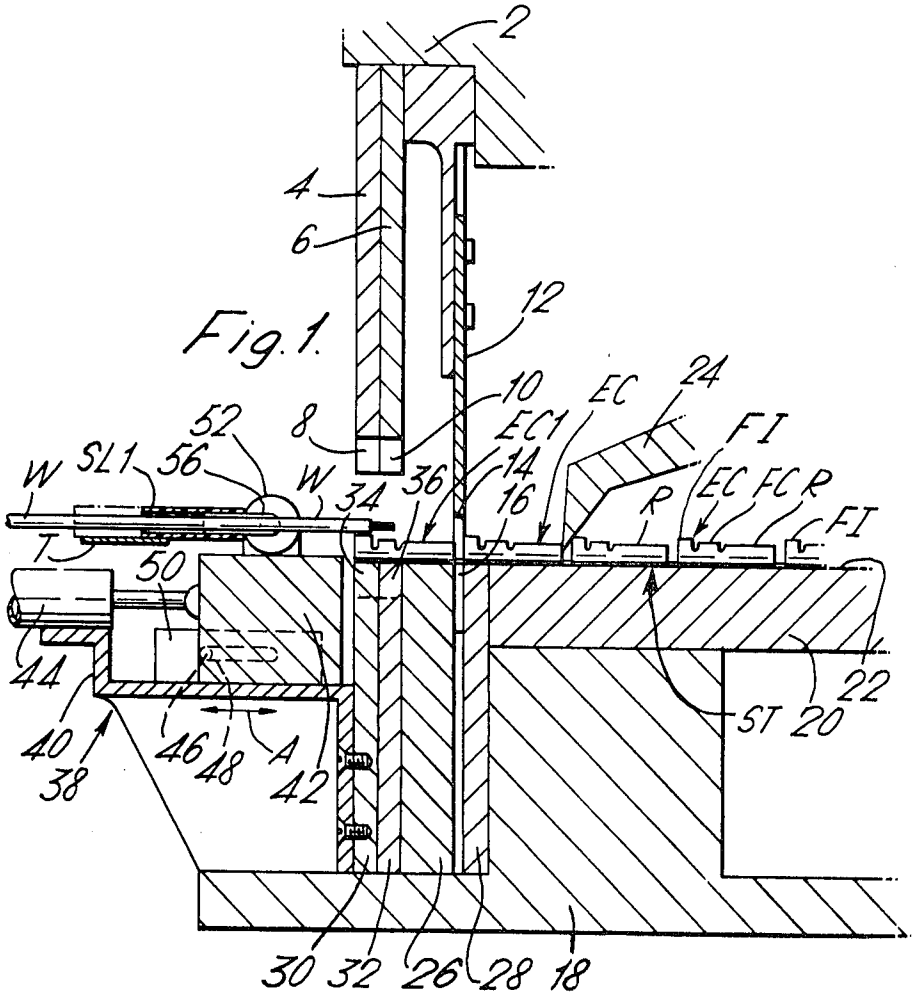


Fig. 1.



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Fig. 2.

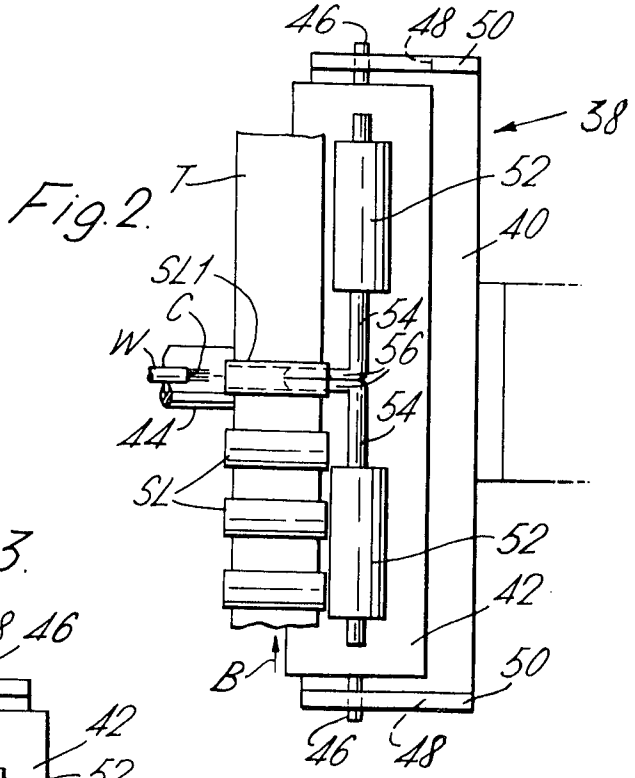
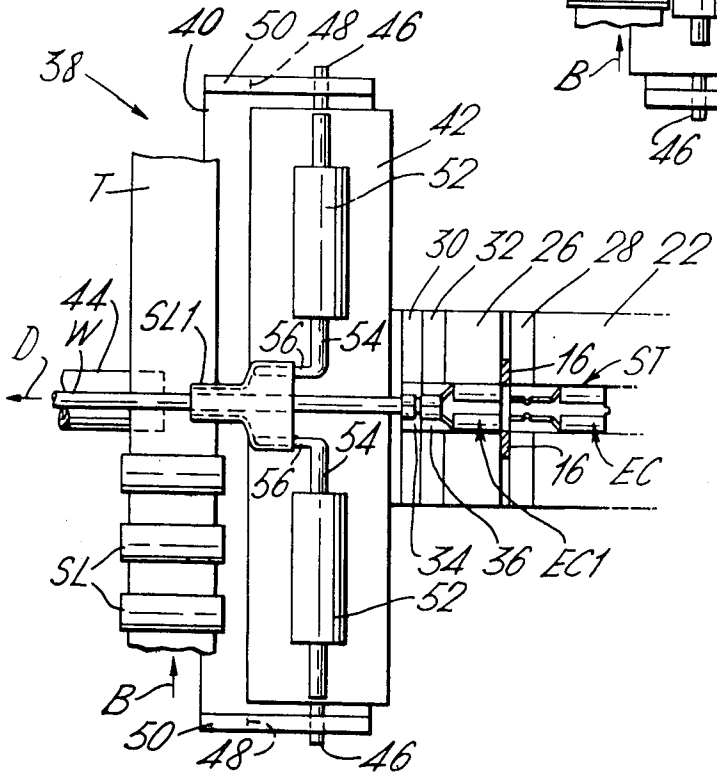


Fig. 3.



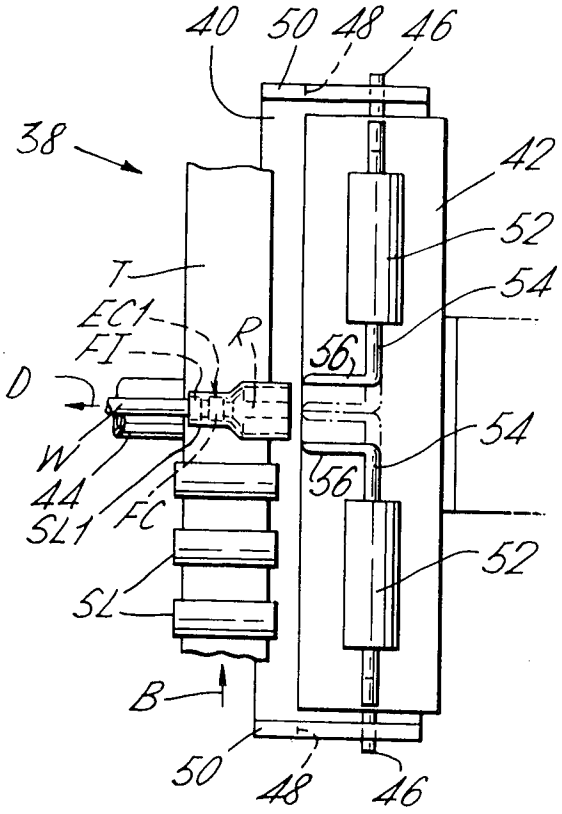
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Fig. 4.



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United States Patent Office 3,609,860 Patented Oct. 5, 1971

3,609,860

METHOD OF FITTING A RESILIENT INSULATING SLEEVE ABOUT AN ELECTRICAL CONNECTOR AND MEANS FOR CARRYING OUT THE METHOD

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Filed Oct. 13, 1969, Ser. No. 865,846
Claims priority, application Australia, Oct. 14, 1968, 44,748/68
Int. Cl. H01r 9/00, 43/04
U.S. Cl. 29—630 F 7 Claims

ABSTRACT OF THE DISCLOSURE

An apparatus comprises means for expanding a front end of a resilient insulating sleeve through which an end of an electrical conductor is then passed. The end of the conductor is crimped via crimping means in alignment with the insulating sleeve onto a leading connector of a strip of connectors whereafter the crimped connector is moved into the expanded insulating sleeve and the expanding means is released from the sleeve so that the crimped connector is completely insulated.

It is common practice to electrically connect electrical connectors to wires, with the aid of crimping apparatus comprising a pair of connector-crimping dies which are relatively movable to crimp a U-section or tubular ferrule of the connector to a wire end. Especially where the crimped connectors are to be used in close juxtaposition, for example where the connectors comprise receptacle portions for mating with electrical tabs which in some electrical apparatus extend closely adjacent one another from an insulating housing, it is desirable that each connector should be covered with an insulating sleeve so as to avoid accidental electrical interconnection between the connectors when mated with the tabs.

According to one object of the invention, a method of fitting a resilient insulating sleeve about an electrical connector comprises the steps of inserting a pair of sleeve-expanding members into the sleeve from one end of the sleeve, relatively moving these members radially to expand the sleeve to receive the connector, inserting an end of a wire through the expanded sleeve from the other end of the sleeve so that the wire end projects from the one end of the sleeve, crimping the electrical connector to the projecting wire end, pulling the wire axially of the sleeve to draw the connector into the sleeve, and removing the sleeve-expanding members from the sleeve to allow the sleeve resiliently to engage about the connector. The sleeve is preferably made of a silicone rubber or a polypropylene plastic material.

According to another object of the invention, apparatus for electrically connecting an electrical connector to an end of a wire includes a pair of connector-crimping dies which are relatively movable from an open to a closed position to crimp a ferrule of the electrical connector to the wire end, and sleeve-expanding members insertable into and relatively movable to expand radially a resilient insulating sleeve positioned with its longitudinal axis intersecting the path of movement of the dies to enable the sleeve to receive the connector when crimped to the wire end, the sleeve-expanding members being positioned so that the end of the wire can be advanced through the expanded sleeve and between the dies when in their open position to permit the ferrule to be crimped to the wire end by the dies, the sleeve-expanding members being removable from the sleeve by pulling the sleeve axially away from the path of movement of the dies.

According to a further object of the invention, an attachment for an electrical connector crimping apparatus in which connector-crimping dies are relatively movable to crimp a ferrule of an electrical connector to a wire end comprises a base arranged to be detachably secured to the apparatus, a carriage movable towards and away from the apparatus when the base is secured to the apparatus, and a pair of rectilinear sleeve-expanding members mounted on the carriage and extending in the direction of movement of the carriage, the sleeve-expanding members being relatively movable transversely of the direction of movement of the carriage between a first position in which these members can be inserted, by movement of the carriage, into a resilient insulating sleeve supported with its longitudinal axis intersecting the path of movement of the dies, when the base is secured to the apparatus, and a second position in which the sleeve-expanding members are spaced from each other sufficiently to expand the sleeve to receive the connector when crimped to the wire end.

As an additional object, the carriage may be formed by a slide driven for example by a fluid-operated piston-and-cylinder unit and it may carry a pair of rods extending at right angles to the direction of movement of the carriage and being arranged in axial alignment, each rod having a portion bent at right angles to the longitudinal axis of the rod to form one of the sleeve-expanding members, the rods being movable axially towards and away from one another, e.g. by fluid-operated piston-and-cylinder units. The slide may be formed by a block having trunnions engaging in slots in flanges extending from a plate along which the block is slidable.

As a still further object, a flexible tape to which resilient insulating sleeves, e.g. of silicone rubber or a polypropylene plastic material, are secured in side-by-side parallel relationship to extend at right angles to the length of the tape, for example by means of an impact adhesive, may be driven step-by-step along a path of movement extending at right angles to that of the carriage, the tape being so positioned and so driven that at each step of the tape one of the sleeves on the tape is brought into axial alignment with the sleeve-expanding members when relatively positioned for insertion in the one sleeve.

According to yet a further object of the invention, apparatus for crimping electrical connectors to wires, comprises a connector-crimping die, a connector-crimping anvil, means for moving the die towards the anvil from a first position to a second position to crimp a ferrule of an electrical connector on the anvil to the end of a wire positioned between the die and the anvil, a base adjacent the anvil, a carriage mounted for rectilinear movement on the base towards and away from the anvil, a pair of sleeve-expanding members mounted on the carriage and having free ends directed away from the anvil, a sleeve conveyor disposed on the side of the carriage remote from the anvil, means for moving the sleeve conveyor step-by-step transversely of the path of movement of the carriage, a series of resilient insulating sleeves releasably mounted on the sleeve conveyor to extend in the direction of movement of the carriage, means for moving the carriage between a first position adjacent the anvil and a second position remote from the anvil, means for moving the sleeve-expanding members between a first position in which the free ends of the sleeve-expanding members are closely adjacent one another and a second position in which the free ends of the sleeve-expanding members are spaced from one another by a distance exceeding the greatest width of the connector, and a synchronizing device acting upon the die-moving means, the means for moving the sleeve conveyor, the means for moving the carriage, and the means for moving the sleeve-expanding members so that the carriage is initially moved from its first to its second position with the movable die in its first position, the sleeve-expanding members in their first posi-

tion and the sleeve conveyor positioned with the leading sleeve on the conveyor in axial alignment with the free ends of the sleeve-expanding members, to cause the free ends of the sleeve-expanding members to be inserted simultaneously into the leading sleeve, and so that the sleeve-expanding members are subsequently moved to their second position and the carriage returned to its first position.

Other objects and attainments of the present invention will become apparent to those skilled in the art upon a reading of the following detailed description when taken in conjunction with the drawings in which there is shown and described an illustrative embodiment of the invention; it is to be understood, however, that this embodiment is not intended to be exhaustive nor limiting of the invention but is given for purposes of illustration in order that others skilled in the art may fully understand the invention and the principles thereof and the manner of applying it in practical use so that they may modify it in various forms, each as may be best suited to the conditions of a particular use.

For a better understanding of the invention, reference will now be made by way of example to the accompanying drawings, in which:

FIG. 1 is a side view in vertical section of apparatus for crimping electrical connectors to the ends of wires, the apparatus having an attachment for fitting resilient insulating sleeves about the connectors when crimped by the apparatus;

FIGS. 2 to 4 are diagrammatic plan views illustrating the operation of the attachment; and

FIG. 5 is an enlarged perspective view of an electrical connector crimped to a wire end and having a resilient insulating sleeve fitted thereabout with the aid of the attachment.

As shown in FIG. 1, the crimping apparatus, which is conventional, comprises a press ram **2** to which are secured connector-crimping dies **4** and **6** having crimping recesses **8** and **10** respectively, and a movable connector strip shear plate **12** having a working end surface **14** spanning a pair of spaced legs **16** (only one of which is shown in FIG. 1). The apparatus also comprises a base **18** upon which is mounted a connector strip feed plate **20** having a surface **22** along which a strip ST of electrical connectors in end-to-end strip form is arranged to be fed between guide plates (not shown) by a horizontal reciprocable feed finger **24** driven, for example, by a pneumatic piston-and-cylinder unit (not shown). Also mounted on the base **18**, are a pair of fixed connector strip shear plates **26** and **28** between which the legs **16** of the shear plate **12** extend so as to straddle the strip ST. Adjacent the shear plate **26** are juxtaposed anvil plates **30** and **32** having reduced cross-section portions providing further connector-crimping dies in the form of connector crimping anvils **34** and **36** respectively (best seen in FIG. 3) for reception in the crimping recesses **8** and **10** respectively.

The attachment, which is generally referenced **38**, comprises a base **40** which is detachably secured to the plate **30** by screws, as shown in FIG. 1. The base **40** may, however, for example be screwed or otherwise secured to a front plate of the apparatus adjacent the plate **30**. A carriage in the form of a slide block **42** is mounted on the base **40** for reciprocatory sliding movement in the direction indicated by the arrow A in FIG. 1 under the action of a pneumatic piston-and-cylinder unit **44** secured to the base **40**, the block **42** being guided in this movement by trunnions **46** fixed to the block **42** and engaging in slots **48** in side flanges **50** of the base **40**. Mounted on the upper (as seen in FIG. 1) surface of the block **42** are two further pneumatic piston-and-cylinder units **52**, each having a piston rod **54** extending at right angles to the path of movement of the block **42**. Each piston rod **54** has a sleeve-expanding member **56** extending at right angles to the axis of the piston rod **54** and thus in the direction of the path of movement of the block **42**. A sleeve conveyor in the form of a flexible plastic tape T has secured to its upper (as seen in FIG. 1) surface resilient insulating sleeves SL disposed in parallel spaced relationship. The tape T extends from a freely rotatable storage spool (not shown), along a path parallel and to the left (as seen in FIG. 1) of the block **42** at a level slightly above the upper (as seen in FIG. 1) surface of the block **42**, to a driven spool (not shown). The driven spool is arranged intermittently to advance the tape T in the direction of the arrow B in FIGS. 2 to 4. Each sleeve SL is made for example of a rubber-like plastic material and may be secured to the tape T, for example by an impact adhesive.

The strip ST comprises electrical connectors EC, each comprising a receptacle R (best seen in FIG. 5) for mating with a flat tab (not shown). Formed integrally with each receptacle R is a U-section crimping ferrule FC for crimping about the bared end of the electrically-conductive core C of an insulated electrical wire W and a U-section crimping ferrule FI for crimping about the insulation of the wire W adjacent the bared end of the core C.

At the beginning of a cycle of operation of the apparatus, the ram **2** is in its top dead center position, as shown in FIG. 1, the leading connector EC1 of the strip ST being positioned with its receptacle R on the plate **26** and its crimping ferrules FI and FC on the anvils **34** and **36** respectively, also as shown in FIG. 1. The piston rod **54** of each unit **52** is in its advanced position so that the members **56** of the piston rods **54** are in abutment, as shown in FIG. 2. The piston rod of the unit **44** is in a fully advanced position so that the block **42** is in its position nearest the plate **30** with the trunnions **46** engaging the right-hand (as seen in FIG. 1) ends of the slots **48**. The tape T is stopped with the leading sleeve SL1 of the tape T in axial alignment with the members **56** of the piston rods **54**.

Upon actutaion by the operator of a pedal switch (not shown), a synchronizing device (not shown), for example an electronic timing circuit, causes the unit **44** to retract its piston rod so that the block **42** is moved leftwardly (as seen in FIG. 2) so that the members **56** of the piston rods **54** enter the leading sleeve SL1 to penetrate the sleeve SL1 to approximately a third of its length when the trunnions **46** have reached the left-hand (as seen in FIG. 2) ends of the slots **48**. The members **56** of the piston rods **54** have, as shown in FIG. 2, chamfered free ends to facilitate the entry of the members **56** into the sleeve SL1. Each unit **52** is now caused to retract its piston rod **54** under the action of the synchronizing device so that the right-hand (as seen in FIG. 3) end of the sleeve SL1 is stretched by the members **56**, as shown in FIG. 3, to approximately three times its normal width. The synchronizing device now causes the unit **44** again to advance its piston rod so that, as shown in FIG. 3, the expanded sleeve SL1 is dragged from the tape T. The operator now inserts the end of the wire W through the left-hand (as seen in FIG. 1) end of the sleeve SL1 and advances the wire W axially towards the leading connector EC1 of the strip ST to position the stripped end of the core C of the wire W just above the crimping ferrule FC of the connector EC1 and the portion of insulation of the wire W adjacent the stripped end of the core C just above the crimping ferrule FI of the connector EC1, as shown in FIG. 1. The synchronizing device now causes the ram **2** which is driven by an electric motor (not shown) to carry out a working stroke i.e. to move downwardly (as seen in FIG. 1) to crimp the ferrule FC of the connector EC1 to the bared end of the core C and the ferrule FI of the connector EC1 to the portion of insulation adjacent the bared end of the core C. Prior to the completion of the crimping operation, the edges of the working surface **14** of the movable shear blade **12** shear the leading connector EC1 from the strip ST in cooperation with the adjacent edges of the fixed shear plates **26** and **28**. The ram **2** is now caused by the synchronizing device to carry out a

return stroke and thus to be returned to its top dead center position, i.e. the position of FIG. 1. The operator now retracts the wire W in the direction of the arrow D in FIG. 3, so that the leading connector EC1 is retracted into the sleeve SL1 with the receptacle R of the connector EC1 lying within the expanded portion of the sleeve SL1 and the ferrules FC and FI of the connector EC1 lying within the remainder of the sleeve SL1. The operator continues to retract the wire W until the sleeve EC1 is pulled from the members **56** of the piston rods **54**, as shown in FIG. 4, the sleeve snapping back into tight engagement with the portion R of the connector EC1 by virtue of the resilience of the material of the sleeve SL1 so that the sleeve SL1 is tightly fitted about the connector EC1, as best seen in FIG. 5. The synchronizing device now causes the units **52** to advance their piston rods **54** to the broken line position of FIG. 4, the tape T1 to be stepped forward to bring the next sleeve on the tape T into line with the members **56** and the feed finger **24** to be advanced to advance the strip ST to bring the next connector of the strip ST in position on the plate **26** and anvils **34** and **36**. The feed finger **24** is retracted during the working stroke of the ram **2**.

Where the connectors have tubular instead of U-section crimping ferrules, the attachment is positioned relative to the apparatus so that the leading sleeve on the tape is in axial alignment with the crimping ferrule or crimping ferrules of the leading connector of the strip.

It will, therefore, be appreciated that the aforementioned and other desirable objects have been achieved; however, it should be emphasized that the particular embodiments of the invention, which are shown and described herein, are intended as merely illustrative and not as restrictive of the invention.

The invention is claimed in accordance with the following:

1. A method of fitting a resilient insulating sleeve about an electrical connector, comprising the steps of inserting a pair of sleeve-expanding members into the sleeve from one end of the sleeve, relatively moving each of these members radially to expand the sleeve to receive the connector, moving said members and said sleeve in the direction of said one end, inserting an end of a wire through the expanded sleeve from the other end of the sleeve so that the wire end projects from the one end of the sleeve, crimping the electrical connector to the projecting wire end, pulling the wire axially of the sleeve to draw the connector into the sleeve, and removing the sleeve-expanding members from the sleeve to allow the sleeve resiliently to engage about the connector.

2. A method according to claim **1**, in which the sleeve is made of silicone rubber or a polypropylene plastic material.

3. An attachment for an electrical connector-crimping apparatus in which connector-crimping dies are relatively movable to crimp a ferrule of an electrical connector to a wire end, comprising a base arranged to be detachably secured to the apparatus, a carriage movable towards and away from the apparatus, when the base is secured to the apparatus, a pair of rectilinear sleeve-expanding members mounted on the carriage and extending in the direction of movement of the carriage, and means for relatively moving the sleeve-expanding members transversely of the direction of movement of the carriage between a first position in which these members can be inserted, by movement of the carriage, into a resilient insulating sleeve supported with its longitudinal axis intersecting the path of movement of the dies when the base is secured to the apparatus and a second position in which the sleeve expanding members are spaced from each other sufficiently to expand the sleeve to receive the connector when crimped to the wire end.

4. An attachment according to claim **3**, in which the carriage is formed by a slide driven by a fluid-operated piston-and-cylinder unit and carrying a pair of rods extending at right angles to the direction of movement of the carriage and being arranged in axial alignment, each rod having a portion bent at right angles to the longitudinal axis of the rod to form one of the sleeve expanding members, the rods being movable axially towards and away from one another by fluid operated piston-and-cylinder units.

5. An attachment according to claim **4**, in which the slide is formed by a block having trunnions engaging in slots in flanges extending from a plate along which the block is slidable.

6. An attachment according to claim **5** in which a flexible tape to which resilient insulating sleeves are secured in side-by-side parallel relationship to extend at right angles to the length of the tape by means of an impact adhesive, means to drive said tape step-by-step along a path of movement extending at right angles to that of the carriage, the tape being so positioned and so driven that at each step of the tape one of the sleeves on the tape is brought into axial alignment with the sleeve-expanding members when relatively positioned for insertion in the one sleeve.

7. Apparatus for crimping electrical connectors to wires and for applying insulating sleeves over the electrical connectors comprising a connector-crimping die, a connector-crimping anvil, means for moving the die towards the anvil from a first position to a second position to crimp a ferrule of an electrical connector on the anvil to the end of a wire positioned between the die and the anvil, a base adjacent the anvil, a carriage mounted for rectilinear movement on the base towards and away from the anvil, a pair of sleeve-expanding members mounted on the carriage and having free ends directed away from the anvil, a sleeve conveyor disposed on the side of the carriage remote from the anvil, means for moving the sleeve conveyor step-by-step transversely of the path of movement of the carriage, a series of resilient insulating sleeves releasably mounted on the sleeve conveyor to extend in the direction of movement of the carriage, means for moving the carriage between a first position adjacent the anvil and a second position remote from the anvil, means for moving the sleeve-expanding members between a first position in which the free ends of the sleeve-expanding members are closely adjacent one another and a second position in which the free ends of the sleeve-expanding members are spaced from one another by a distance exceeding the greatest width of the connector, and a synchronizing device acting upon the die-moving means, the means for moving the sleeve conveyor, the means for moving the carriage, and the means for moving the sleeve-expanding members, so that the carriage is initially moved from its first to its second position with the movable die in its first position, the sleeve-expanding members in their first position and the sleeve conveyor positioned with the leading sleeve on the conveyor in axial alignment with the free ends of the sleeve-expanding members, to cause the free ends of the sleeve-expanding members to be inserted simultaneously into the leading sleeve, and so that the sleeve-expanding members are subsequently moved to their second position and the carriage returned to its first position.

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U.S. Cl. X.R.

29—203D