United States Patent

[11] 3,628,228

[72] Inventor **Lodevicus Lambertus Johannes van de Kerkhof**
's-Hertogenbosch, Netherlands

[21] Appl. No. **17,411**
[22] Filed **Mar. 9, 1970**
[45] Patented **Dec. 21, 1971**
[73] Assignee **AMP Incorporated**
Harrisburg, Pa.
[32] Priority **Mar. 28, 1969**
[33] **Netherlands**
[31] **69.04810**

[54] **APPARATUS FOR CRIMPING ELECTRICAL CONNECTORS TO WIRES**
5 Claims, 9 Drawing Figs.

[52] U.S. Cl. ..... **29/203 DTS**, 29/628
[51] Int. Cl. **H01r 43/04**
[50] Field of Search ..... 29/203 DT, 203 DS, 628, 629, 203 D, 203 P; 72/21, 22, 410, 417, 421

[56] **References Cited**

UNITED STATES PATENTS

3,135,310	6/1964	Stoltz	29/203 DTS UX
3,481,018	12/1969	Kerkhof	29/203 DTS
3,538,581	11/1970	Collins et al.	29/203 D
3,555,865	1/1971	Sebastian	72/21

Primary Examiner—J. Spencer Overholser
Assistant Examiner—Norman E. Lehrer
Attorneys—Curtis, Morris and Safford, William J. Keating, William Hintze, Frederick W. Raring, John R. Hopkins, Adrian J. La Rue and Jay L. Seitchik

ABSTRACT: A method of and apparatus for crimping a ferrule part of an electrical connector to a wire end is disclosed for use with connectors wherein a portion of the contact part of the connector extends beyond the base of the U-section ferrule part in the opposite direction to that in which the U-arms of the ferrule part extend.

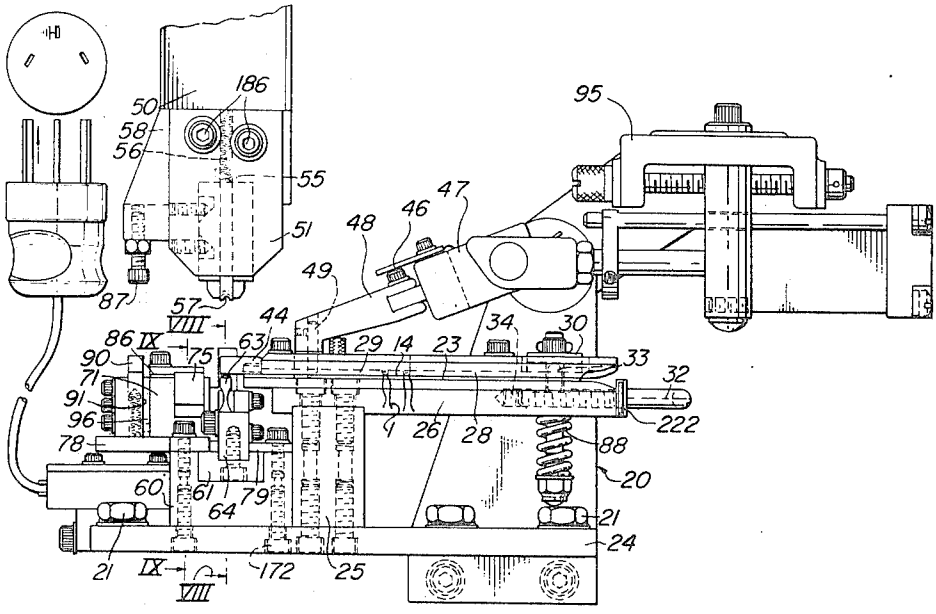


FIG. 1.

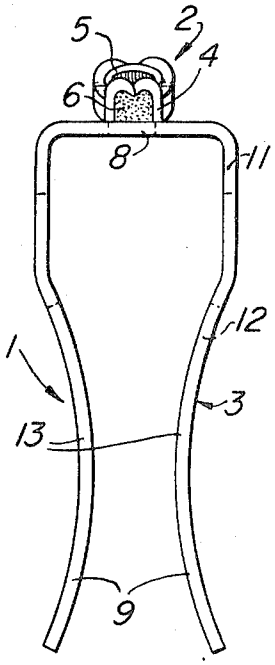


FIG. 2.

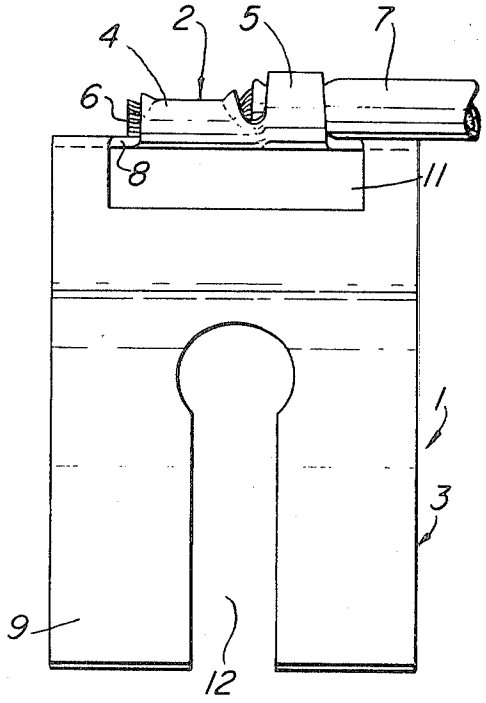


FIG. 3.

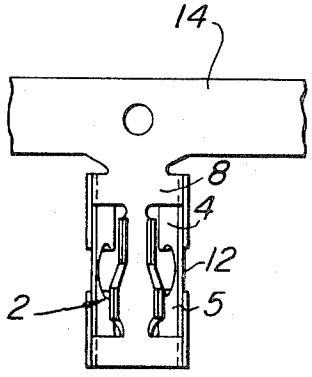
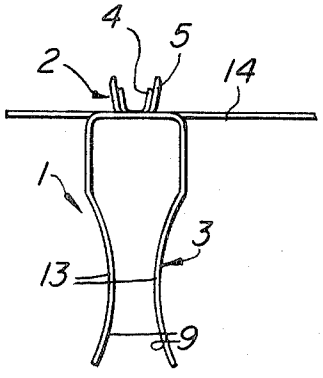


FIG. 4.



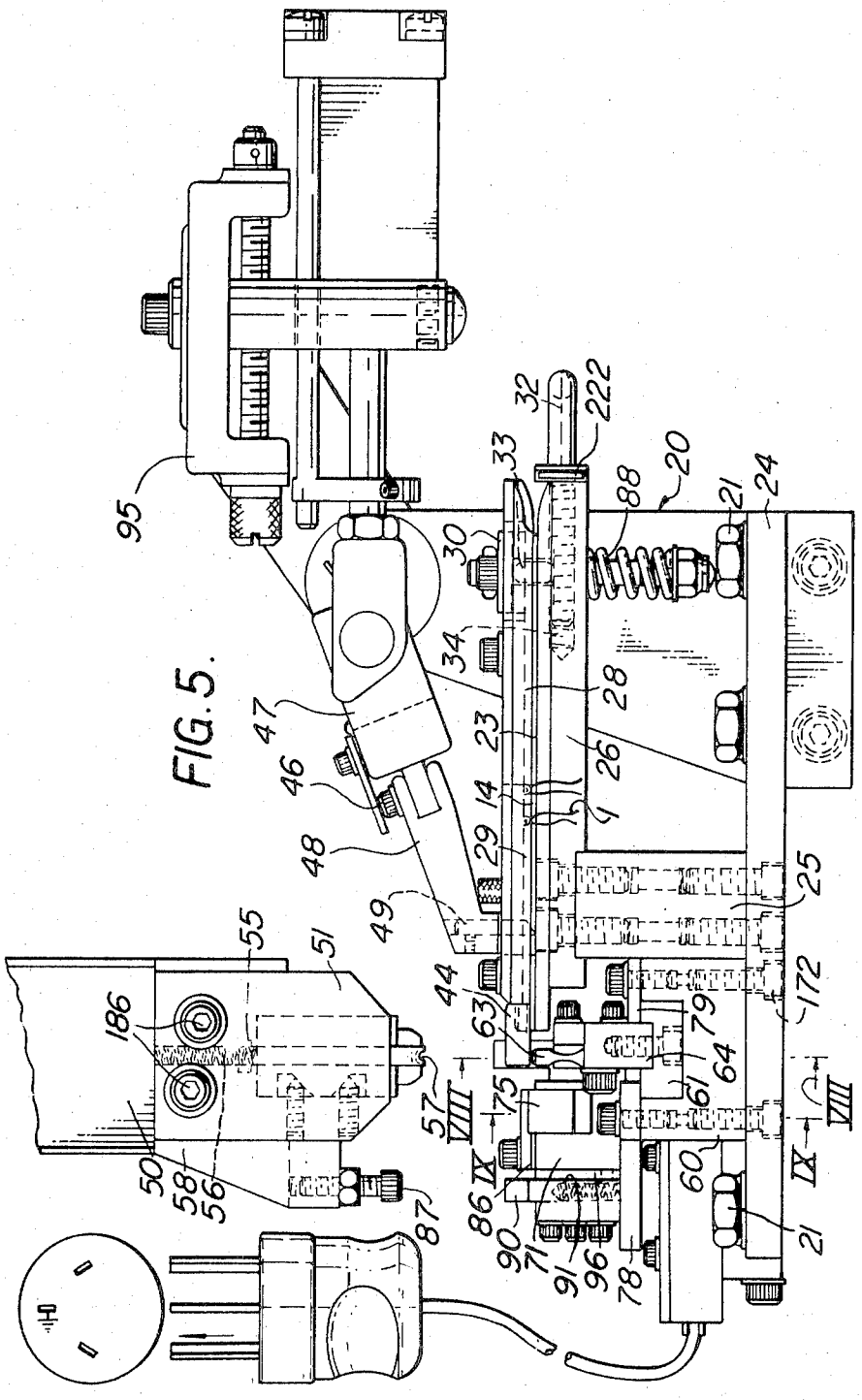

95
32
222
33
20
88
21
24
30
34
28
47
23
26
46
14
29
48
49
25
55
51
44
172
186
63
79
64
57
VIII
75
61
VIII
IX
IX
60
50
58
56
87
86
90
71
91
96
78
21

FIG. 5.

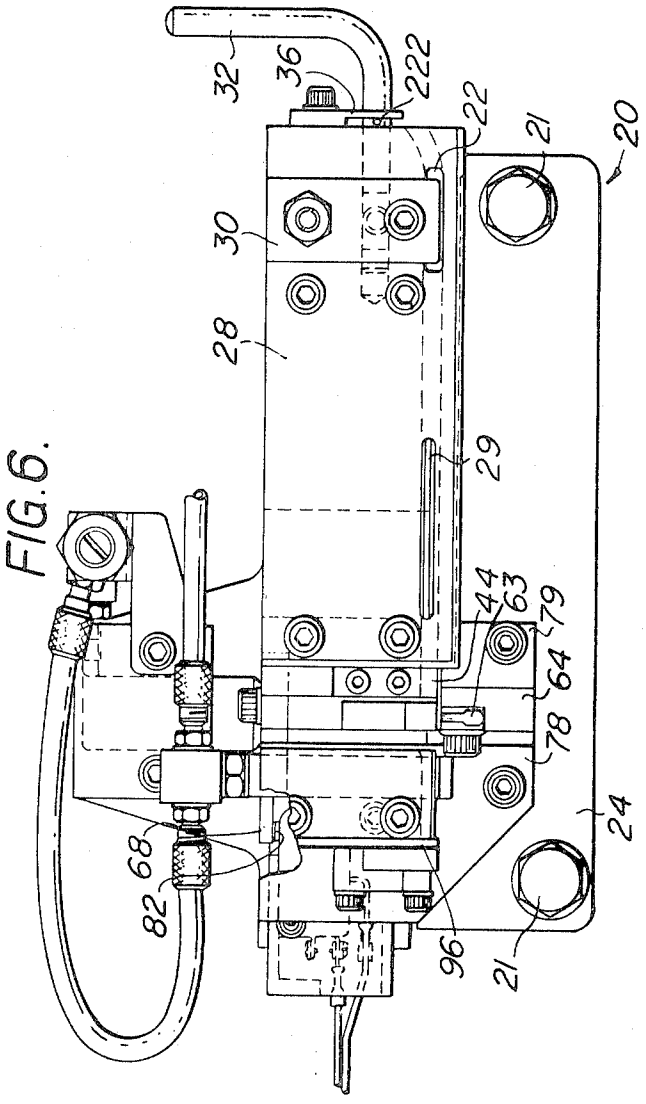


FIG. 6.

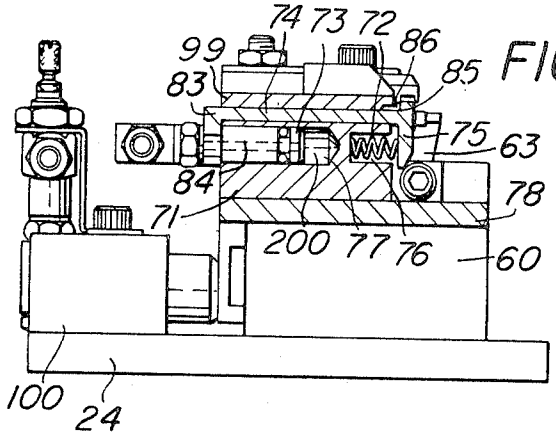


FIG. 9.

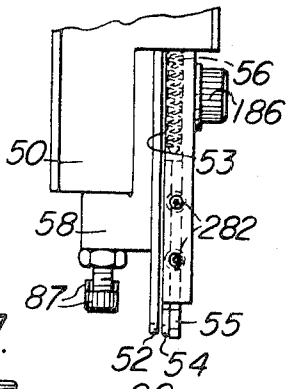
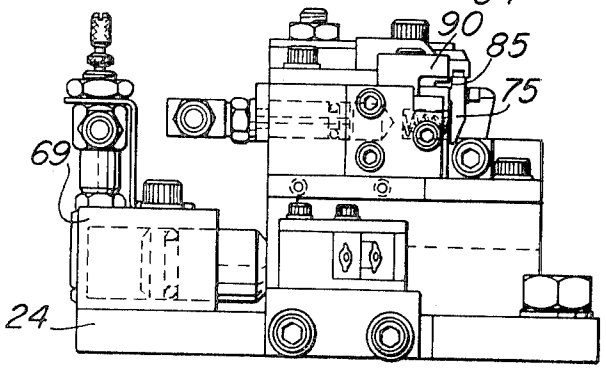


FIG. 7.



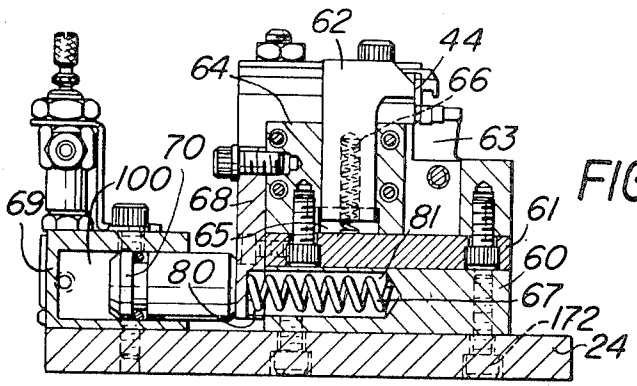


FIG. 8.

APPARATUS FOR CRIMPING ELECTRICAL CONNECTORS TO WIRES

This invention relates to a method of and apparatus for crimping U-section ferrule parts of electrical connectors to ends of wires. A series of electrical connectors, each having a contact part and a U-section ferrule part may be connected together by a carrier strip formed integrally with the connectors. The connectors are spaced along the carrier strip and project transversely of the strip in side-by-side form. Such a strip of connectors is most conveniently produced by a progressive die-forming operation from a single length of sheet metal stock.

It is known to crimp the ferrule part of such an electrical connector to an end of a wire by feeding a connector of the strip onto a crimping anvil, placing the wire end within the ferrule part, moving a die towards the anvil to crimp the ferrule part to the wire end and severing the crimped connector from the strip. Apparatus for performing this method includes a crimping die and a crimping anvil, a mechanism for feeding the strip of connectors towards the anvil to dispose the leading connector of the strip in position on the anvil, a mechanism to drive the die towards the anvil to crimp the connector to the wire end and a mechanism for severing the crimped connector from the strip.

When however, a portion at least of the contact part of the connector extends beyond the base of the U-section ferrule part in the opposite direction to that in which the U-arms of the ferrule part extend, then connectors in side-by-side form cannot be advanced onto the anvil.

According to one aspect of the present invention, an apparatus for crimping a ferrule part of an electrical connector to a wire end, comprises means for intermittently feeding a strip of connectors along a predetermined path to position successive leading connectors at a crimping zone, a die and an anvil each having cooperable crimping surfaces for crimping the ferrule part of the connector to a wire end at the crimping zone, and each being movable between the crimping zone, and a retracted position remote from the crimping zone, the direction of movement of the anvil being at substantially 90° to the feed path of the connectors, means for maintaining the die and the anvil in their respective retracted positions while the connectors are being fed, means for advancing the anvil from its retracted position to the crimping zone to position its crimping surface adjacent the base of the ferrule part, after the connector has reached the crimping zone, to support the base during the crimping operation, means for advancing the die from its retracted position to the crimping zone after the anvil has been advanced, to cause the crimping surfaces of the die and the anvil to cooperate to crimp the ferrule part to a wire end when operatively inserted in the ferrule part and means for severing the connector from the strip after the ferrule part has been crimped to the wire end.

Such apparatus can be used to crimp a ferrule part of an electrical connector to a wire end, the connector having a contact part at least a portion of which extends beyond a base of the ferrule part in the opposite direction to that in which the ferrule part extends, the connector forming part of a strip of connectors arranged in side-by-side strip form.

According to a further aspect of the invention, a method of crimping a ferrule part of an electrical connector to a wire end, the connector having a contact part at least a portion of which extends beyond the base of the ferrule part in the opposite direction to that in which the ferrule part extends, the connector forming part of a strip of connectors arranged in side-by-side strip form, the method comprising the steps of intermittently feeding the strip of connectors along a predetermined path to position successive leading connectors at a crimping zone, advancing an anvil having a crimping surface, after a connector has reached the crimping zone, from a retracted position to a position in the crimping zone so that the crimping surface of the anvil lies adjacent the base of the ferrule part to support the ferrule part during crimping, the direction of movement of the anvil being at substantially 90° to the feed path of the connectors, advancing a die having a crimping surface cooperable with the crimping surface of the anvil, after the anvil has reached the crimping zone, from a retracted position to a position in the crimping zone so that the crimping surfaces of the die and the anvil cooperate to crimp the ferrule part to a wire end operatively inserted in the ferrule part, and severing the crimped connector from the strip after the ferrule part has been crimped to the wire end.

An embodiment of the invention will now be described by way of example with reference to the accompanying drawings, in which:

FIG. 1 is an end view of an electrical connector crimped to a wire;

FIG. 2 is a side view of the connector of FIG. 1;

FIG. 3 is a plan view showing the connector in its uncrimped condition and formed integrally with a carrier strip only part of which is shown;

FIG. 4 is an end view of the connector and carrier strip of FIG. 3;

FIG. 5 is a front elevation of apparatus for crimping electrical connectors shown in FIGS. 3 and 4 to wire;

FIG. 6 is a plan view of the apparatus of FIG. 5 with some parts removed;

FIG. 7 is an end view of the apparatus of FIG. 5;

FIG. 8 is a section on the line VIII—VIII of FIG. 5; and

FIG. 9 is a section on the line IX—IX of FIG. 5.

Referring to FIGS. 3 and 4, an electrical connector 1 comprises a substantially U-section ferrule part 2 and a contact part 3. The ferrule part 2 includes two pairs 4, 5 of arms upstanding from a base 8 for crimping to an electrically conductive core 6 and the insulation 7 respectively of a wire as seen in FIGS. 1 and 2. Two spring legs 9 forming the contact part 3 of the connector 1 depend from base 8 of the U-section ferrule part 2. As shown in FIG. 2, each leg 9 has an aperture 11 adjacent and extending into base 8 and a keyhole aperture 12 extending to the free end of the leg 9 to form a pair of contacts.

Each connector 1 is formed integrally with a carrier strip 14. The connectors 1 extend transversely of the carrier strip 14 and are connected to the strip 14 by an extension of base 8.

The carrier strip 14 with the side-by-side connectors 1 can be reeled on a drum for ease of transportation and for feeding to an apparatus for crimping connectors to conductor wire ends. If the connectors are arranged in in-line strip form, it has been found that due to the configuration of the connectors they are susceptible to damage when being reeled. The legs 9 tend to be pressed flat and the strip 14 tends to twist.

Apparatus 20 for crimping a connector 1 as described above to a wire 6 will now be described, with reference to FIG. 5 to 9. The apparatus 20 comprises a base plate 24 adapted by means of bolts 21 to be rigidly attached to the bed (not shown) of a press tool. A base block 25 is secured to the base plate 24 and supports a lower strip guide plate 26. An upper strip guide plate 28 is mounted above the guide plate 26 and spaced from the guide plate 26, the space 23 between the guide plates 26, 28 receiving the carrier strip 14, as shown diagrammatically in FIG. 5.

A slot 22 is arranged in the guide plate 28 through which extends an arm of a strip clamp 30. Strip clamp 30 maintains a downward clamping pressure on the strip 14 by means of a spring 88. A lifter pin 33 is provided immediately below the clamp 30, the lifter pin 33 being operable by means of lever 32 to lift the clamp 30 to release the pressure on the strip 14. The lever 32 is maintained in position in a bore 34 in guide plate 26 by a pin 222 engaging the inside surface of bracket 36.

A further slot 29 is provided in guide plate 28 through which extends the tip 49 of a feed finger 48 for engaging the strip 14. The feed finger 48 is attached to a feed finger holder 47 by means of screw 46 and is biased counterclockwise as seen in FIG. 5. The holder 47 is reciprocated by any conventional means but preferably by a pneumatic piston and cylinder arrangement indicated generally at 95.

A wire stop 44 is attached to the left-hand side of guide plate 26, as seen in FIG. 5.

A die block 51 is provided for attachment to a ram 50 of the press. The die block 51 has secured thereto (FIG. 7) a wire crimping die 52, a spacer 53, an insulation crimping die 54 which is adjustably held by screws 282 and a spring loaded connector holding down tool 55. A spring 56 for biasing the tool 55 is arranged in a bore in the block 51. Tool 55 has a recess 57 at its working tip to provide clearance for the wire to be crimped when the tool 55 holds down the connector 1 in position on an anvil 63 during crimping. Immediately behind the die block 51 a carrier block 58 is provided which supports depressor screws 87 for actuating shear blades 62, 90. The die block 51 and carrier block 58 are attached to the ram by screws 186. The ram 50 is coupled to an electrical driving motor (not shown) through a "one-shot clutch" (not shown) which is operated by actuation of a microswitch 82 as described below, to drive the ram 50 through a working and return stroke.

Immediately below the die block 51 there is an anvil slide assembly which includes a slide support member 60 rigidly attached to base plate 24 by screws 172. On the upper surface of support member 60, a channel is provided in which an anvil slide 61 is slidably arranged. An anvil holder 64 supporting the anvil 63 is mounted on the upper surface of anvil slide 61 for movement therewith. The anvil 63 has a cross-sectional shape corresponding substantially to the space between the legs 9 of the connector 1. A shear blade 62 is slidably retained within a guide channel 65 in the anvil holder 64 and a spring 66 biases the shear blade 62 upwardly as seen in FIG. 8. A vertical slide stop 68 is attached to the rear surface of anvil holder 64. The lower end of slide stop 68 has a recess 80 which is in horizontal alignment with a bore 81 in support member 60. Bore 81 contains a spring 67 which urges slide stop 68 rearwardly against a piston 70 of a pneumatic piston and cylinder assembly 100. In the advanced position of anvil slide 61, that is, when the piston 70 extends from the cylinder 69 under air pressure, as shown in FIG. 8, slide stop 68 abuts the rearward surface of support member 60 to prevent further forward movement of the anvil slide 61. In this position slide stop 68 triggers the microswitch 82. The microswitch 82 is only triggered when the anvil 63 is in the correct crimping position.

Mounted on the support member 60 and extending partially across the channel containing anvil slide 61, there are provided left- and right-hand retaining plates 78, 79 for maintaining the anvil slide 61 within the channel. Retaining plate 78 has mounted on its upper surface a block 71. It also has a bore arranged in its rear surface, the bore forming the cylinder 77 of a pneumatic piston and cylinder arrangement 200. A second bore 76 in its front surface contains a spring 72 which engages an arm 75 depending from a strip clamp 74 slidably mounted within a guideway in block 71 to bias the strip clamp 74 to the right as seen in FIG. 9. A retaining plate 99 is provided for maintaining strip clamp 74 in its guideway, the retaining plate 99 having a recess 86 for receiving the carrier strip 14. Piston 73 of the piston and cylinder arrangement 200 is bolted to a flange 83 depending from the rear edge of strip clamp 74. Piston 73 has a central bore 84 to allow air into the front working end of cylinder 77. When air enters the working end of the cylinder 77, piston 73 bolted to flange 83 moves the strip clamp 74 rearwardly so that a surface 85 of arm 75 engages the edge of the carrier strip 14.

A carrier strip shear blade 90 is mounted on retaining plate 78 adjacent block 71 and cooperates with a shear plate 96 to shear the carrier strip 14. Shear blade 90 is urged upwardly, as seen in FIG. 5, by a spring 91. Shear blades 62 and 90 are both actuated by depressor screws 87 mounted on carrier block 58.

Shear blade 62 has a shearing edge which cooperates with a shear surface of the anvil 63 to shear the connector 1 from the carrier strip 14 while leaving the carrier strip 14 intact to be gripped by the strip clamp 74 downstream of the anvil 63.

To prepare the apparatus 20 for operation, the end of a strip of electrical connectors 1, is led from a storage spool (not shown) into the space 23 between guide plates 26, 28. The carrier strip 14 extends beneath the clamp plate 30 and the leading end of the carrier strip is located in slot 86 formed in retaining plate 99. To enable the strip to be inserted into space 23, the feed finger 48 is lifted clockwise as seen in FIG. 5 against the action of the biasing means and the strip clamp 30 is lifted by means of lever 32.

In operation, with the ram in its raised position and a connector 1 in position in front of the anvil 63, the end of an insulated conductor wire, the terminal portion of the electrically conductive core of which has been stripped of insulation, is located in the arms 4, 5 of the connector 1 by positioning it against a surface of the stop plate 44, so that the stripped portion of the core lies between the arms 4 and the terminal part of the insulation of the wire lies between the arms 5. A foot pedal (not shown) is then depressed which initiates the operation of the piston and cylinder arrangements 100 and 200. Air enters cylinder 77 via bore 84 and piston 73 bolted to flange 83 moves surface 85 of the arm 75 of the strip clamp 74 against the edge of the carrier strip 14 downstream of the crimping station. At the same time, air enters cylinder 69 to actuate piston 70. Piston 70 engages the rear surface of slide stop 68 and pushes slide stop 68 together with anvil slide 61 forward against the action of spring 67 until slide stop 68 abuts the rear face of support member 60 (see FIG. 8).

Movement of anvil slide 61 forwardly, positions the anvil 63 between the legs 9 and under the ferrule part 2 of the connector 1. When the slide stop 68 reaches its abutting position against the support member 60, it triggers the microswitch 82 which actuates the "one-shot" clutch to move the ram 50 through a working stroke and a return stroke. Ram 50 descends on its working stroke and towards the end of the working stroke, dies 52, 54 cooperate with anvil 63 to crimp the pairs of arms 4, 5 to the electrically conductive core and insulation of the wire respectively. The depressor screws 87 during the crimping operations, depress shear blades 62, 90 downwardly against the action of springs 66, 91. Shear blade 62 shears the crimped connector 1 from the carrier strip 14 whereby the conductor wire and the connector 1 crimped thereto can be removed from the apparatus 20. Shear blade 90 cuts the carrier strip 14 upstream of the strip clamp 74 to reduce the carrier strip into easily handled scrap pieces.

While the ram 50 descends, the feed finger 48 is retracted to the right (FIG. 5).

During the earlier part of the return stroke of the ram 50, the strip clamp 74 is moved forwardly by means of spring 72 to release the carrier strip 14, anvil slide 61 is moved rearwardly by spring 67 to retract the anvil 63, and depressor screws 87 release the shear blades 62, 90. During the later part of the return stroke, feed finger 48 engages the strip 14 and feeds it to the left (FIG. 5) to position the lead connector 1 in front of the anvil 63. The apparatus is then ready for the next cycle of operation.

The invention is claimed in accordance with the following:

1. An apparatus for crimping a ferrule part of an electrical connector to a wire end, the apparatus comprising means for intermittently feeding a strip of connectors along a predetermined path to position successive leading connectors at a crimping zone, a die and an anvil each having cooperable crimping surfaces for crimping the ferrule part of the connector to a wire end at the crimping zone, and each being movable between the crimping zone and a retracted position remote from the crimping zone, the direction of movement of the anvil being at substantially 90° to the feed path of the connectors, means for maintaining the die and the anvil in their respective retracted positions while the connectors are being fed, means for advancing the anvil from its retracted position to the crimping zone to position its crimping surface adjacent the base of the ferrule part, after the connector has reached the crimping zone, to support the base during the crimping operation, means for advancing the die from its retracted position to the crimping zone after the anvil has been advanced, to cause the crimping surfaces of the die and the anvil to cooperate to crimp the ferrule part to a wire end when operatively inserted in the ferrule part and means for severing the

connector from the strip after the ferrule part has been crimped to the wire end.

2. An apparatus as claimed in claim 1, in which the anvil is supported on a movable anvil slide to which is attached a slide stop for limiting the advance movement of the anvil slide, a spring maintaining the slide stop in a first position corresponding to the retracted position of the anvil, and a piston and cylinder arrangement engaging the slide stop and operable to advance the slide stop against the action of the spring into a second position corresponding to the position of the anvil in the crimping zone.

3. An apparatus as claimed in claim 2, in which in the second position, the slide stop engages a member which initiates operation of a die support means to move the die towards the crimping zone.

4. An apparatus as claimed in claim 1, in which a strip clamp is provided for clamping the strip when a connector is at the crimping zone, the strip clamp being movable from a first retracted position in which the strip is free to move, to a second clamping position in which it engages the carrier strip.

5. An apparatus as claimed in claim 4, in which the strip clamp is engaged by a spring to bias the strip clamp towards the first position and a piston and cylinder position is provided for moving the strip clamp from the first to the second position against the biasing action of the spring.

* * * * *