

[54] APPARATUS FOR TRIMMING AND
INSERTING WIRES

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[51] Int. Cl. H05k 13/04
[58] Field of Search 29/203 D, 203 H,
29/203 P, 278

[56] References Cited
UNITED STATES PATENTS

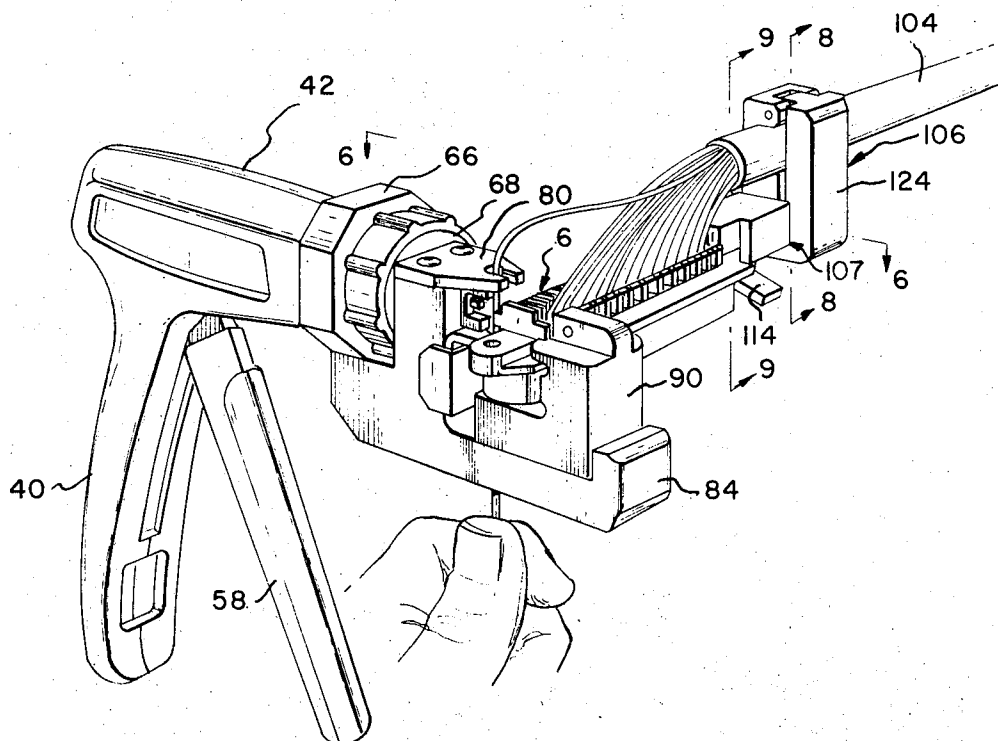
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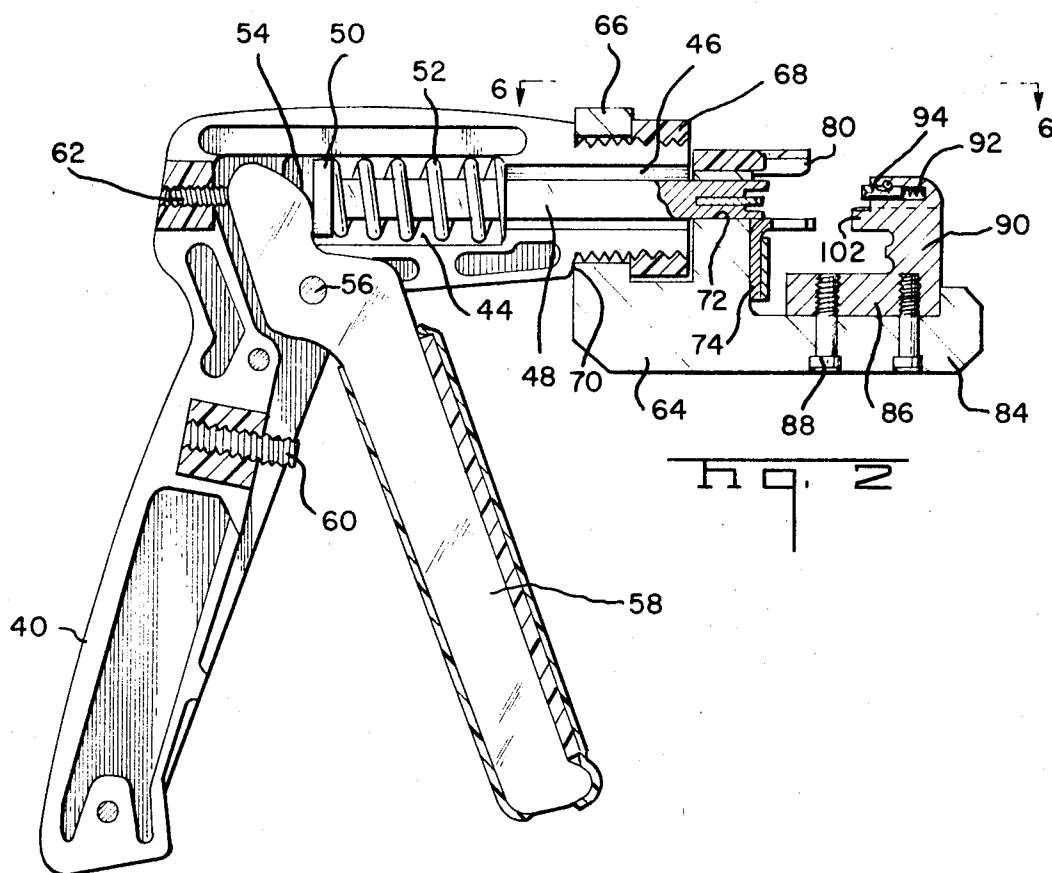
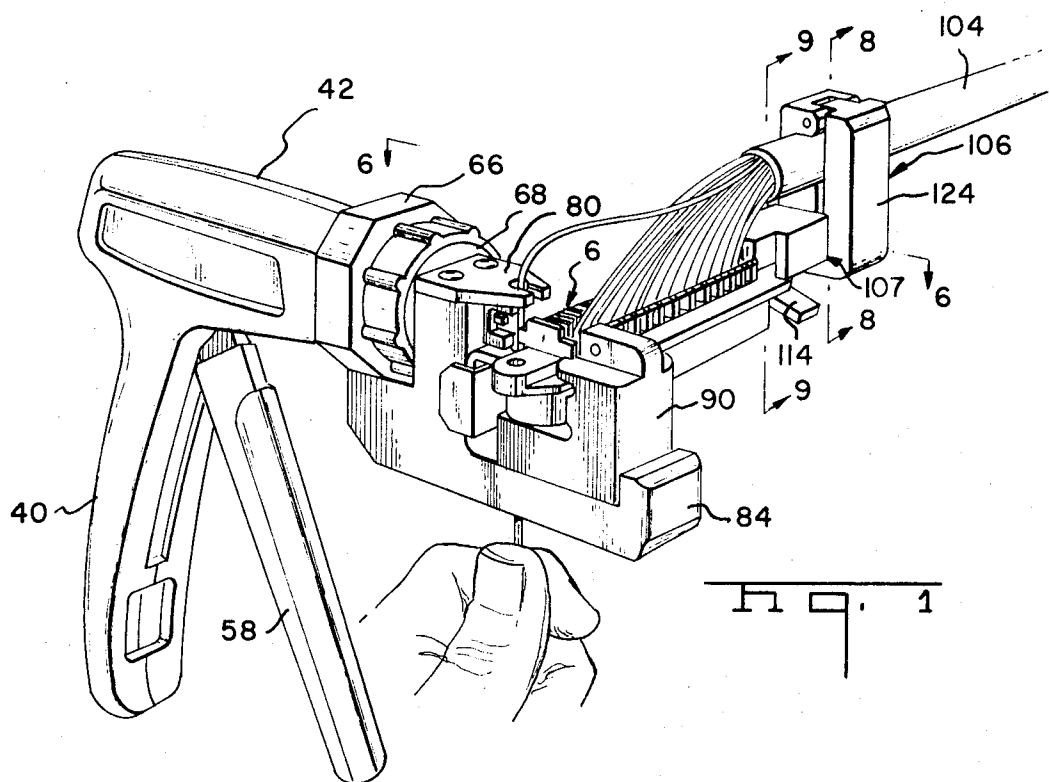
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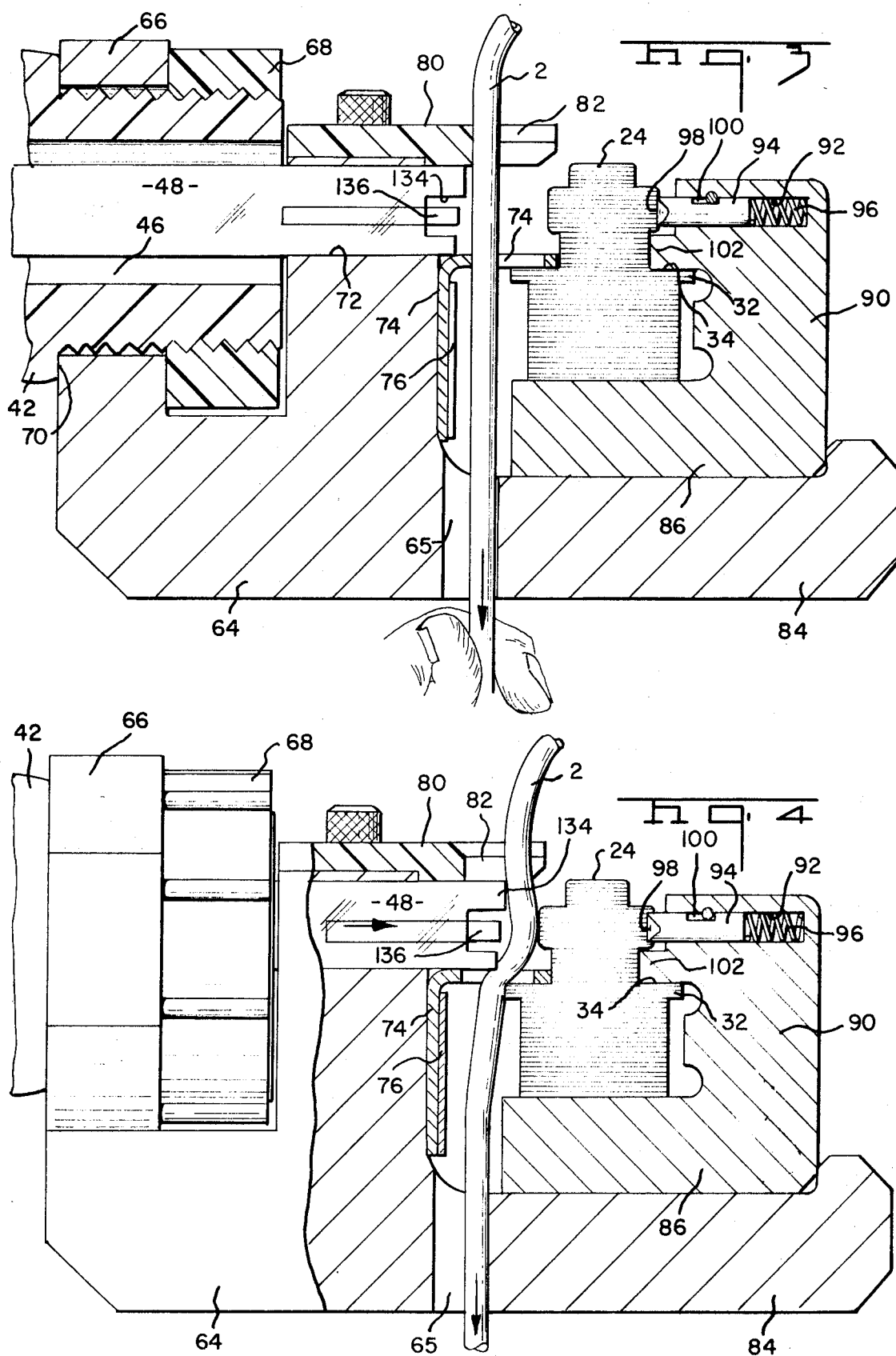
[57] ABSTRACT

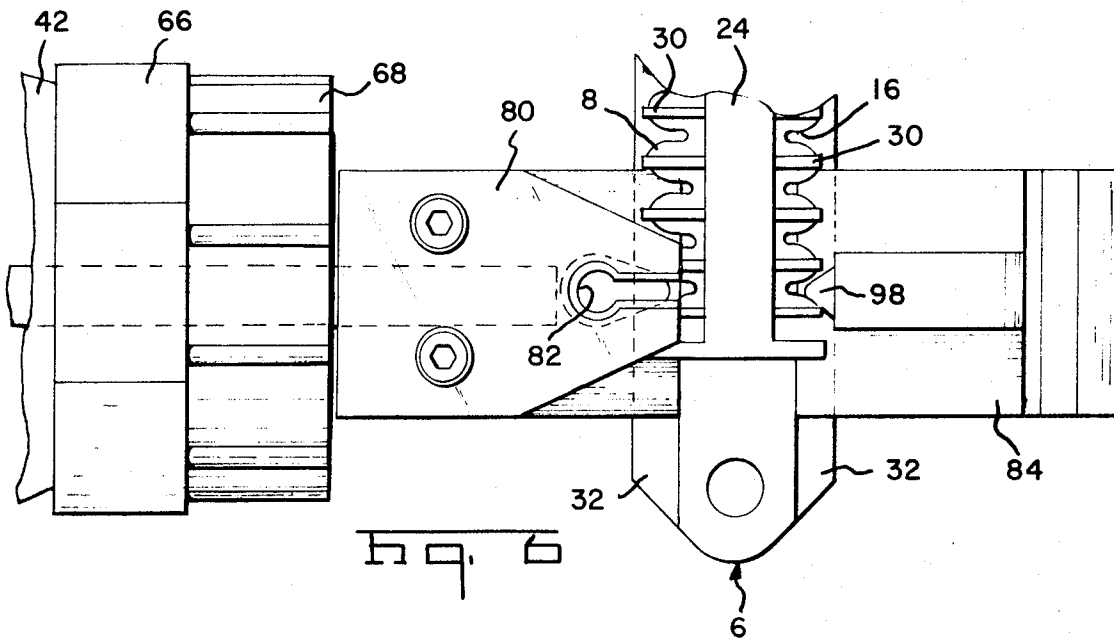
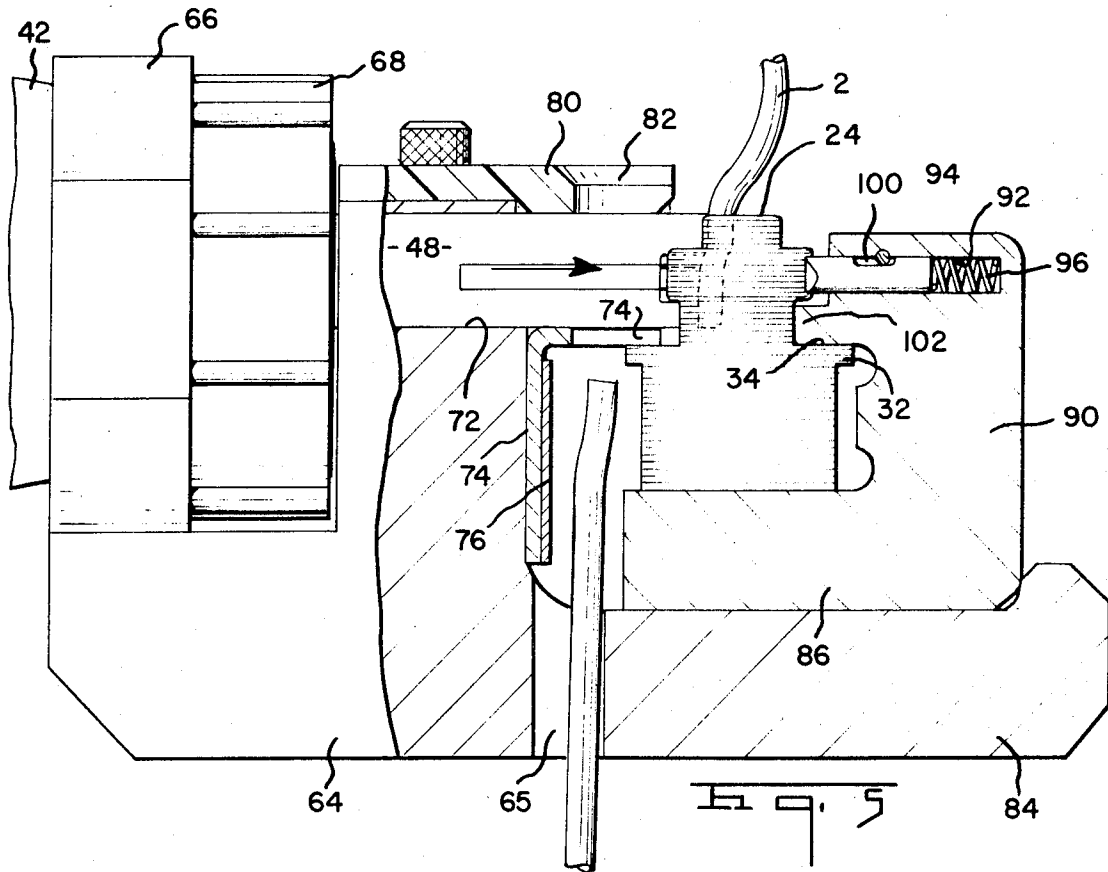
Apparatus for trimming the end of a wire and inserting the wire into a terminal in a multi-contact connector comprises a reciprocable ram and a supporting means for supporting the connector in spaced relationship to the ram. The ram cooperates with a stationary shearing member disposed beside the path of reciprocation of the ram so that upon movement of the ram towards the connector, the wire is moved past the shearing member, its end is trimmed, and the trimmed wire is inserted into the terminal in the connector.

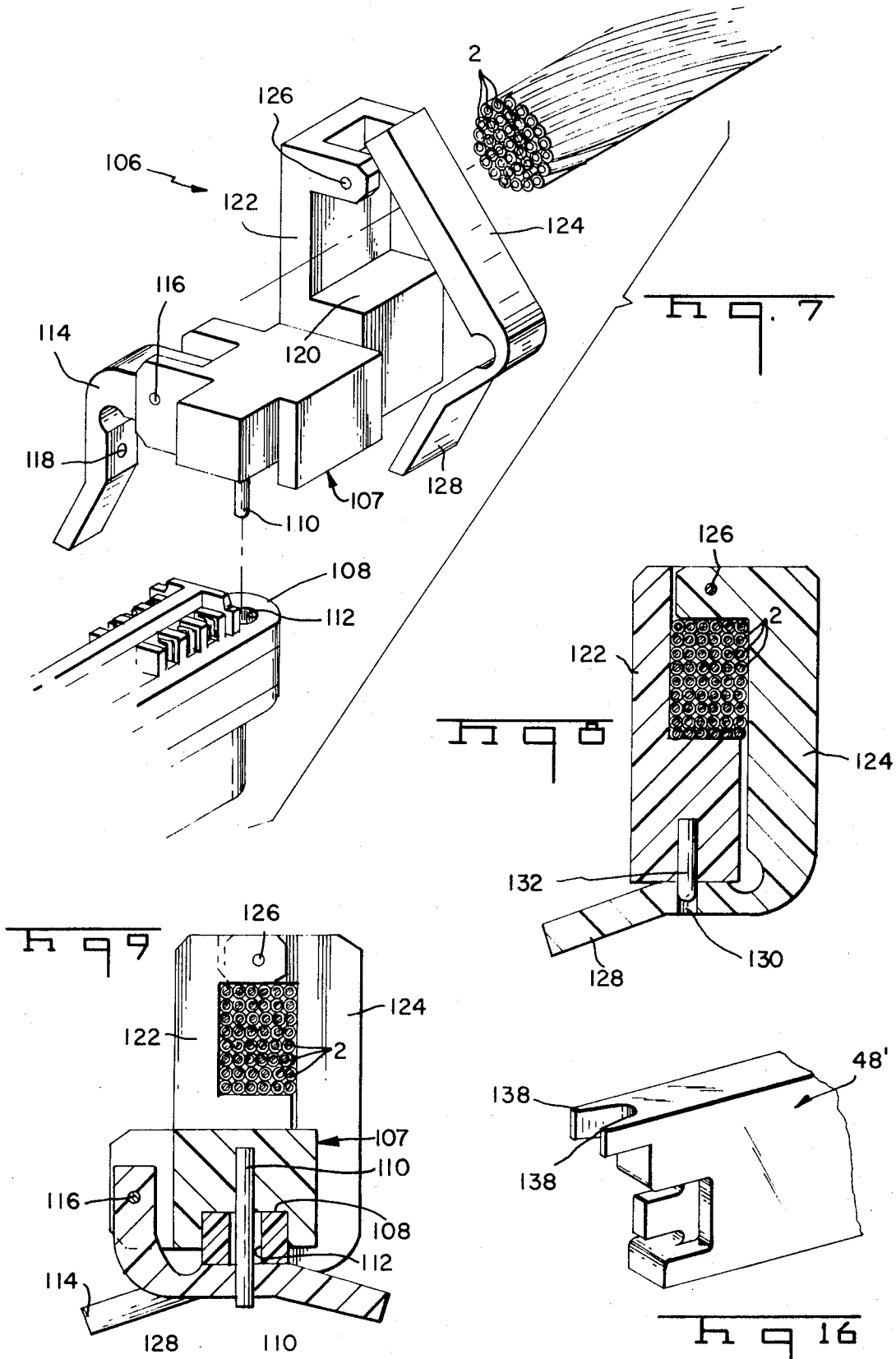
9 Claims, 16 Drawing Figures

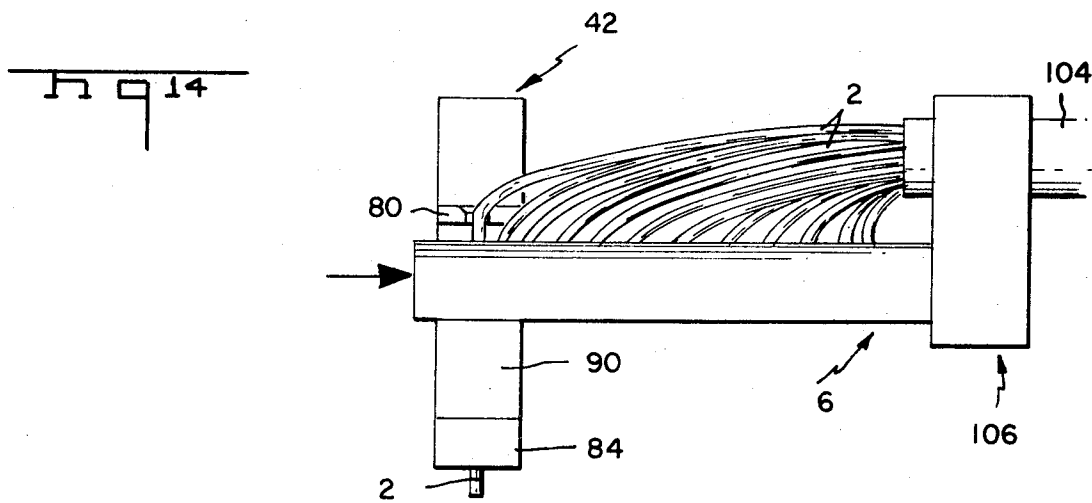
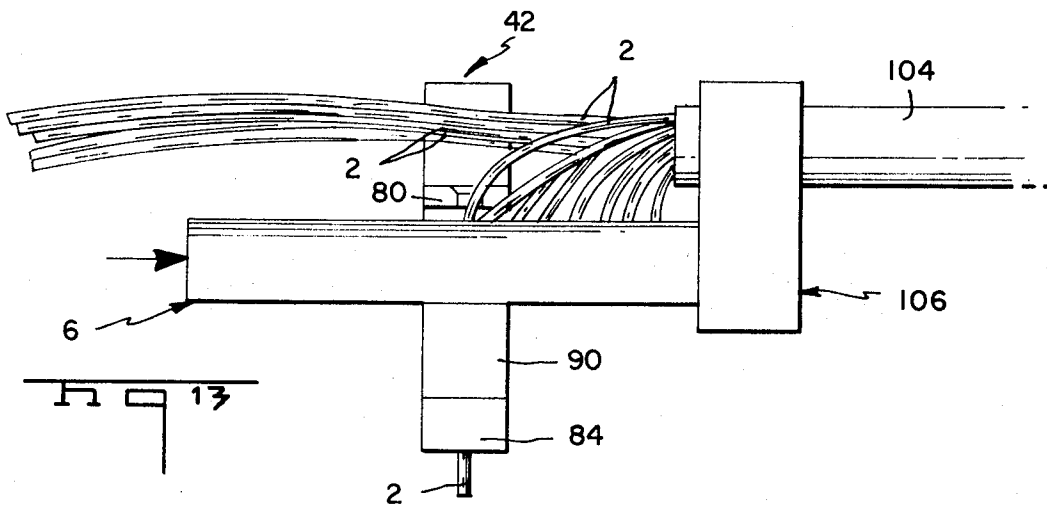
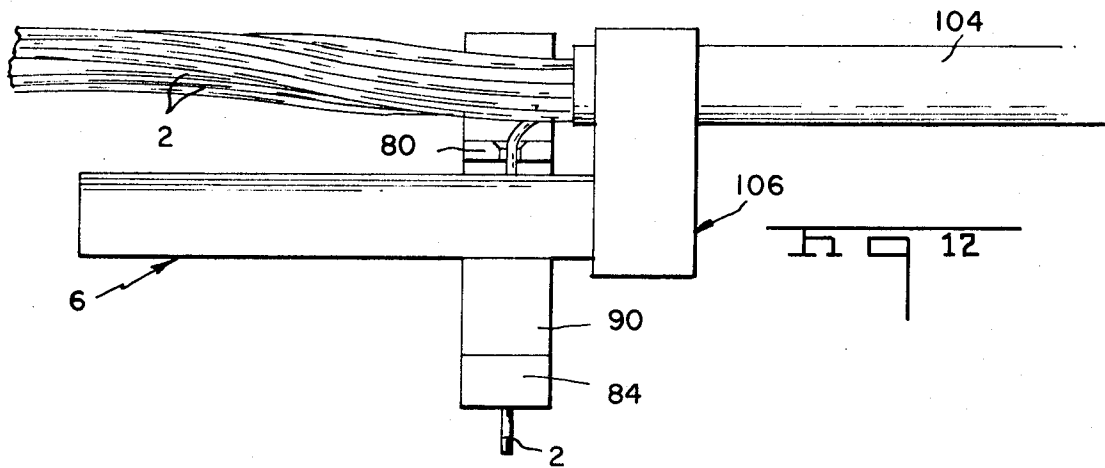








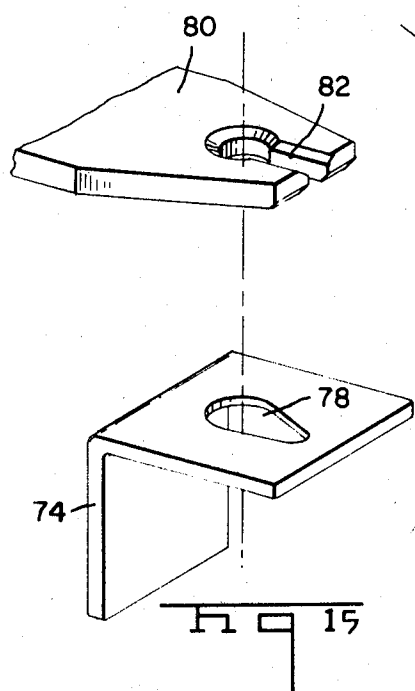
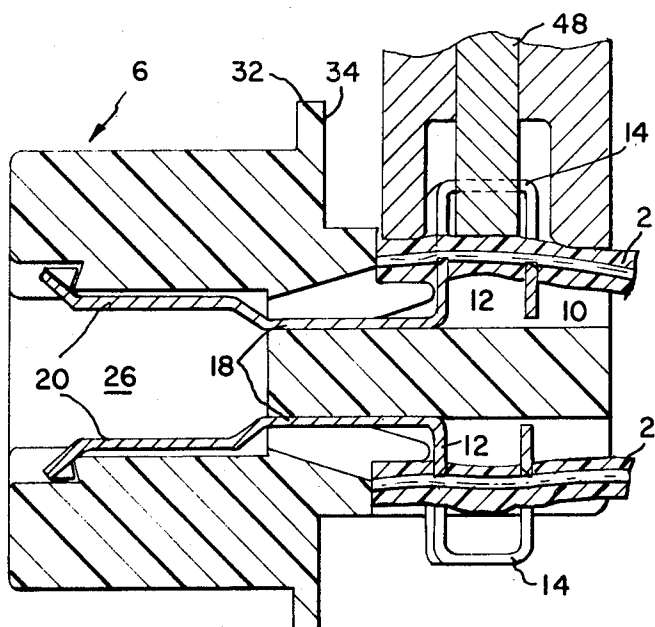
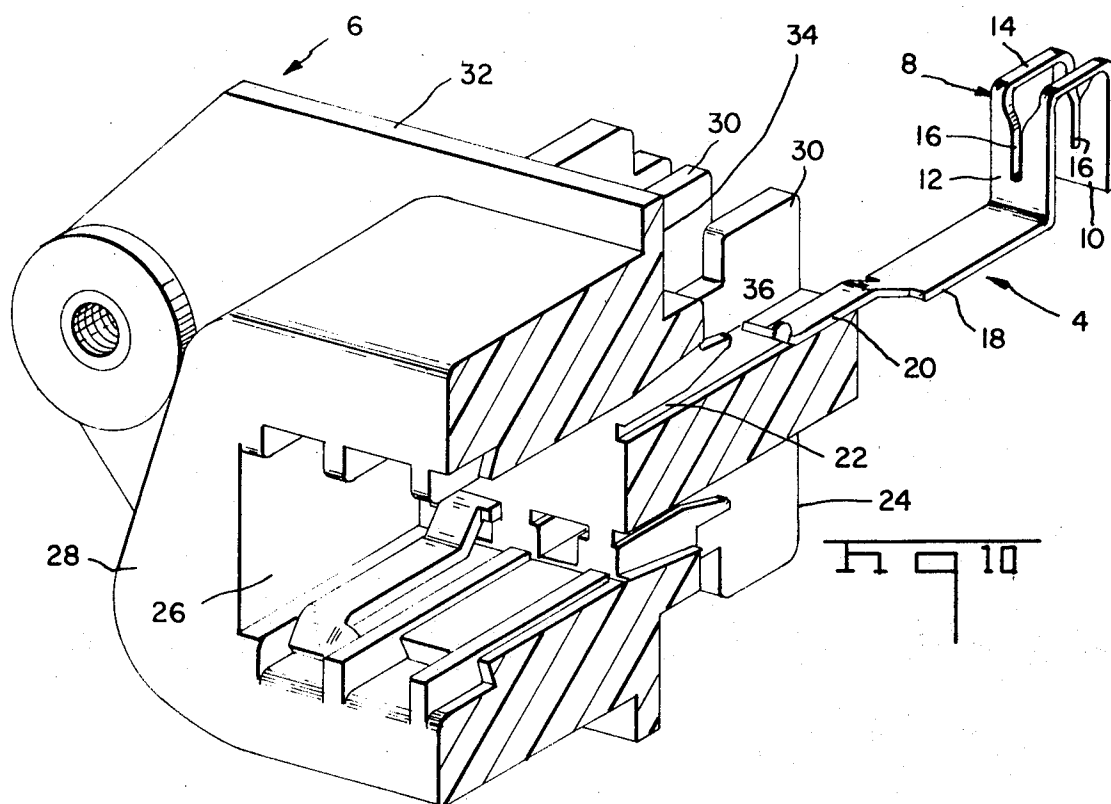




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APPARATUS FOR TRIMMING AND INSERTING WIRES

BACKGROUND OF THE INVENTION

This invention relates to apparatus for trimming the end of a wire and inserting the trimmed end into an electrical device such as a terminal. The invention as herein disclosed in an embodiment which is specifically adapted to insert wires into the terminals in a multi-contact electrical connector of the type disclosed in application Ser. No. 147,569 filed May 27, 1971, however, it will be apparent that the principles of the invention can be utilized in embodiments adapted for use with other connectors or other types of electrical devices.

The above-identified application Ser. No. 147,569, discloses a multi-contact electrical connector composed of two mateable connector parts. Each connector part has a plurality of contact terminals therein and each terminal is adapted to receive a wire in a pair of spaced apart slots in a manner such that the edges of the slots penetrate the insulation of the wire to establish electrical contact with the conducting core of the wire. Application Ser. No. 147,569 also discloses one form of tool for trimming wire ends and inserting a group of wires into the terminals of the connector. The insertion tool shown in that application is intended to be used to connect a plurality of wires to a plurality of connectors in one operation. The instant invention is directed to the achievement of a relatively compact and easily carried hand tool to insert an individual wire into a terminal of the type shown in application Ser. No. 147,569.

It is accordingly an object of the invention to provide an improved tool for trimming the ends of wires and inserting the ends into the terminals in a multi-contact electrical connector. A further object is to provide a hand tool for inserting wires into terminals which is inexpensive to manufacture and which is compact and light weight so that it can be carried by the technician to a work site for repair or servicing purposes. A further object is to provide a tool which does not require a high degree of operator skill so that its use can be mastered in a short time by unskilled or semiskilled personnel. A further object is to provide a tool which will insert wires into terminals mounted in a connector housing on closely-spaced centers without damage to the terminals.

These and other objects of the invention are achieved in a preferred embodiment thereof which is briefly described in the foregoing abstract, which is described in detail below, and which is shown in the accompanying drawing which:

FIG. 1 is a perspective view of a preferred form of a tool in accordance with the invention, this figure showing a connector positioned on the tool and illustrating the location of a wire at the beginning of an inserting operation.

FIG. 2 is a sectional side view of the tool of FIG. 1 showing the positions of the parts when the inserting ram is in its retracted position.

FIG. 3 is a sectional view, on an enlarged scale, of the frontal portion of the tool illustrating the manner in which the wire is threaded through the tool preparatory to the wire trimming and insertion operation.

FIG. 4 is a view similar to FIG. 3 but showing the positions of the parts at an intermediate stage of the in-

serting operation immediately prior to the trimming of the wire ends.

FIG. 5 is a view similar to that of FIG. 4 but showing the positions of the parts at the conclusion of the wire inserting operation.

FIG. 6 is a plan view of the frontal portion of the tool of FIG. 1.

FIG. 7 is a perspective view of a preferred form of cable clamp for clamping a cable to the end of connector to which wires are being attached.

FIGS. 8 and 9 are further views of the cable clamp taken along the lines 8—8 and 9—9 of FIG. 1.

FIG. 10 is a fragmentary perspective view of a portion of a connector of a type shown in FIG. 1 and illustrating details of the contact terminals in the connector.

FIG. 11 is a sectional side view of the connector illustrating the manner which wires are located in the terminals to which they are attached.

FIG. 12 is a schematic plan view of the frontal parts of the tool with a connector housing mounted on the holding means and a cable clamped to the righthand end of the connector housing, this view illustrating the positions of the parts at the time of insertion of the first wire of a cable into one of the terminals in the housing which is at the righthand end thereof.

FIG. 13 is a view similar to FIG. 12 but showing the positions of the parts after wires have been inserted into about one-half of all of the terminals in one of the rows of terminals.

FIG. 14 is a view similar to FIG. 13 but showing the positions of the parts while a wire is being inserted into the last terminal (the lefthand terminal) in one of the rows of terminals.

FIG. 15 is a fragmentary perspective view of a guide plate and a shearing member which are mounted on the frontal portion of the tool.

FIG. 16 is a fragmentary perspective view of an alternative form of insertion ram.

Referring first to FIGS. 10 and 11, the disclosed embodiment of the invention is particularly adapted to trim the end of a wire 2 and insert the trimmed wire end into an electrical contact terminal of the type shown at 4. The terminal 4 is one of a battery of terminals contained in a multi-contact electrical connector part 6 of the type fully described in the above-identified application Ser. No. 147,569. For purposes of the instant disclosure, it should be explained that each terminal 4 has a generally U-shaped wire receiving portion 10 at its rearward end which is defined by a pair of spaced apart plate-like portions 10, 12 which are connected to each other by relatively thin strap-like sections 14. Slots 16 extend downwardly into the plate-like sections, the width of these slots being such that when the wire is forced into the slots, the edges of the slots will penetrate the wire insulation and establish electrical contact with the conducting core as illustrated in FIG. 11.

Each terminal has a forwardly extending flat shank portion 18 and a relatively narrower contact portion 20 at its forward end. The terminals are contained in the cavities 22 in the connector 6 which cavities extend from the rearward side 24 of the connector to the forward side 28, thereof. The connector shown is the female part of the connector assembly and has a recess 26 extending inwardly from its forward side. The cavities 22 are separated by spaced-apart barrier plates 30 on the rearward face of the connector and a flange 32

extends radially from the connector body mid-way between its faces. This flange defines a rearwardly facing surface 34, which is opposed to the edges of the barriers 30, and upwardly and downwardly facing ledges 36. As will be explained below, the surfaces 34 and 36 of the connector housing are utilized to locate the connector accurately in a tool in accordance with the invention.

Turning now to FIGS. 1 and 2, the disclosed tool has a pistol type body 38 comprising a handle 40 and a barrel 42, the forward end of which is threaded externally as shown. A cylindrical cavity 44 is provided in the barrel 42 and is of reduced width at its forward end as indicated at 46. A plunger or inserting ram 38 is contained in the cavity 44 and has an enlarged head 50 on its left-hand end as viewed in FIG. 2. A helical spring 52 is interposed between the rightwardly facing side of the head 50 and the shoulder defined by the transition between the enlarged and forward cavity portions 44, 46. Spring 52 thus biases the inserting ram leftwardly to the position shown although the ram can be moved rightwardly against the biasing force of this spring.

The lefthand side of the enlarged ram head 50 bears against contoured edge 52 of a lever mounted in the housing and pivoted thereto at 56. The lower end of this lever extends externally of the housing as shown at 58 and is spaced from the fixed handle 40 so that upon squeezing the two handles, the contoured surface 52 drives the ram rightwardly as viewed in FIG. 2. The limits of the stroke of the lever, and therefore, the limits of the stroke of the inserting ram 48, are controlled by set screws 60, 62, the set screws 60 being in the handle 40 so as to limit the clockwise movement of the movable handle 58 while the set screw 62 is in the butt portion of the housing and engages the upper end of the lever to limit counter-clockwise movement thereof.

Referring now to FIGS. 3 and 6, the holding and positioning means for the connector 6 into which wires are being inserted is mounted on a block 64 which is affixed to the forward end of the barrel portion of the tool by means of a laterally extending arm 66 having an opening therethrough through which the threaded portion of the barrel extends. The leftwardly facing side of arm 66 bears against a support or bearing surface 70 at the end of the threads of the barrel and the arm is clamped against this surface by means of a lock nut 68 which is threaded on the threaded portion of the barrel. Frame block 64 has an intermediate upwardly extending arm 71 which projects past the end of the barrel and which has a recess extending therethrough in alignment with barrel opening 46. This recess has a cross section conforming to the cross section of the forward portion of the ram 48 so that it functions accurately to guide the ram along a predetermined path towards and away from a connector held on the holding means. An L-shaped bracket 74 is mounted against the forwardly facing side of the arm 71 by means of a suitable apron or other clamping device 76 and the forwardly extending portion 76 of this bracket has an opening therein as best shown in FIG. 6. As will be explained below, the righthand edge of this opening as viewed in FIG. 2 functions as a stationary shear for trimming the wire immediately prior to insertion of a wire into a terminal in the connector.

A guide plate 80 is mounted on the upper surface of the arm 71 by suitable fasteners as shown and has a keyhole-type opening therein which is in alignment

with the opening in bracket 74 as shown in FIG. 15. The width of the narrow portion 82 of this opening is equal to or slightly greater than, the diameter of the insulated wire being inserted or applied to the terminal so that the wire can pass rightwardly as viewed in FIG. 6 through this portion of the guide plate.

An L-shaped support block 86 is mounted on the forward portion 84 of the block 64 and nested against an upwardly directed lip 87 on the block for positioning purposes, the block 86 being secured to the frame block by means of suitable fasteners or screws 88. The upwardly extending arm 90 of support block 86 is thus opposed to the ram 48 and has adjacent to its upper end a recess 92 in which a cylindrical detent is slidably mounted. Detent 94 is leftwardly biased as viewed in FIG. 5 by means of a spring 96 positioned in the opening and the movement of the detent is limited by a suitable pin extending through one side of the opening and past a milled section of the detent. The forward end of detent 94 is in the form of a chisel edge as shown at 98 and is dimensioned such that it will move between adjacent barriers 30 of the connector and engage the opposed surfaces of two adjacent barriers for accurate positioning of the connector. A lip 102 extends leftwardly from the arm 90 immediately beneath the detent and is at approximately the same level as the forwardly extending portion 76 of the bracket 74.

The forward end of the inserting ram 48 is recessed as shown at 134 and a narrow inserting punch or plate 136 is mounted in the ram and projects centrally between the sides of the recess. The width of the plate 134 is such that it can move between the relatively thin strap-portions 14 of the terminal and partially towards the slots. The length of this blade is such that it can move between the two plate-sections 10, 12 of the terminal which will be described below. It should also be noted at this point that the lower side of the ram 48 moves smoothly over the upward surface of the bracket arm 76 so that the leading end of the ram can function as a movable shear to cooperate with the fixed shear defined by the opening in the arm 76.

While the instant apparatus is adapted to insert an individual wire into an individual terminal in the connector, it is nonetheless desirable to firmly clamp the cable 104 which contains the wire in order to provide a strain relief and to prevent the application of tensile stresses to the wire while it is being inserted. To this end, there is provided a clamp 106, FIG. 7, comprising a block 107 of suitable plastic material which is adapted to be accurately positioned against a surface 108 on one end of the connector housing by means of a pin 110 on its underside, this pin being dimensioned to enter a screw hole 112 in the side of the connector housing. Block 107 is firmly secured to the end of the connector by means of a clamping arm 114 which is hinged at 116 in a recess on a side of block 107 and which has an opening 118 located such that a pin will enter this opening as viewed in FIG. 9 when the clamping block is positioned accurately against the surface 108. The cable itself is clamped on a surface 120 by means of a clamping arm 124 which is pivotally mounted on a pin 126 extending between ears on a sidewall 122 which projects beside the surface 120. The arm 124 has an opening 130 in its end which receives a short pin 132 in the underside of the block 107. The cable can thus be clamped by locating it on the surface 120 and swinging

the arm from the position of FIG. 7 to the position of FIG. 8.

Many of the parts of the tool shown can be manufactured of relatively firm and durable plastic material such as a glass filled-nylon, for example, the pistol body 38, the bracket 64, and the nut 68. It is preferable to form the ram 48 of metal and the spring and brackets 71, 90 are also preferably of metal. The inserting punch 134 should, of course, be of metal since it performs the actual wire inserting operation and must be relatively thin and rigid.

The operation of the disclosed embodiment is as follows. The cable is first stripped of its outer covering sheath and clamped to the clamping member 106. The clamping member is then positioned on the end of the connector as illustrated in FIGS. 7 and 9. The connector itself is then located on the upper surface of the bracket 90 with the undersides of the bracket arm 76 and the underside of the lip 102 against the surfaces 34 of the connector. The connector can then be slid over the surface until the terminal into which it is desired to insert a wire is located opposite to the end of the inserting ram 48. The connector is easily centered in its proper position by virtue of the fact that the detent 94 will enter the space between the adjacent barriers 30 which are on the opposite side of the connector from the terminal to which a wire is to be attached. It is immediately apparent to the operator when the detent is seated between two adjacent barriers because of the fact that this detent is spring biased to the left as viewed in FIG. 4.

The operator then selects a wire from the cable 104 and inserts it downwardly through the keyhole opening 82 in the plate 80, through the opening 78 in the bracket arm 76, and through a slot 65 in the block 64, which is in alignment with the openings 78, 82. He then pulls the wire downwardly as illustrated in FIG. 3 until he has removed the slack from the wire end and squeezes the handles 58, 40 to drive the ram rightwardly from the position of FIG. 3 to the position of FIG. 5. As the ram moves towards the connector, it first engages the wire and pushes it to the righthand end of the hole 78. The end of this opening 78 and the lower surface of the ram then cooperate with each other to shear the wire in the plane of the surface of the lower side of the ram so that the portion of the wire extending downwardly from the ram in FIG. 4 drops free. Further rightward movement of the ram to the position of FIG. 5 causes the wire to be pushed between the strap portions 14 of the terminal and into the slots 16 of the plate-portions 10, 12 of the terminal as shown in FIG. 11. The operator can then move the connector manually to another position containing a terminal to which he wishes to attach a wire.

When the tool of the disclosed embodiment is used to insert the wires in a cable into the terminals in a connector, the wires will be neatly dressed towards one side of the connector as illustrated in FIGS. 12-14. As shown in FIG. 12, at the beginning of the procedure, the terminal on the extreme right in the connector will be in alignment with the insertion ram and when a wire is inserted into this first terminal, it is pulled through the tool until the proper amount of slack remains between the terminal and the end of the sheath of the cable. As additional wires are inserted into terminals, increasing amounts of slack are provided because of the fact that the connector is moved rightwardly after each

wire insertion operation by an amount equal to the spacing between adjacent terminals. When the last terminal in the row is in position for the wire insertion operation (FIG. 14), the wire inserted will have more slack than any of the preceding wires. It will be understood that the operations depicted in FIGS. 12-14 must be carried out for both rows of terminals.

As disclosed in application Ser. No. 147,569 connectors of the type shown are ordinarily provided with a cover or hood for the wires having a strain relief clamp on one side thereof. The laterally addressed wires in FIG. 14 thus have the proper amount of slack for this type of hood.

FIG. 16 shows an alternative form of insertion ram 48' which is similar to the ram 48 excepting that it is provided with two gathering fingers 138 on its upper side at its forward end. These fingers are symmetrically disposed on each side of the punch 134 and extend beyond the end of the punch as shown. The function of these fingers is to ensure that the wire will be captured as the ram moves towards the wire and engaged by the punch as it is pushed into a terminal.

It will be apparent from the foregoing description that the invention achieves, in a relatively simple apparatus capable of being manufactured inexpensively, a tool for trimming wire ends and inserting them into electrical devices such as terminals. A variety of connector designs or shapes can be accommodated by appropriately designing the supporting means 90 on the end of the block 68.

In the disclosed embodiment, the handles 40, 58 are in alignment with the support block 64 of the holding means for the connector. If for any reason, it should be more convenient for the operator to do so, he can loosen the nut 68, and orient the supporting block in any desired position relative to these handles and then re-tighten the nut 68.

What is claimed is:

1. Apparatus for trimming the end portion of a wire and inserting the trimmed wire end into the wire receiving portion of an electrical contact terminal in an electrical connector, said connector having a plurality of electrical contact terminals therein arranged in at least one row, said apparatus comprising:

frame means,

a ram in said frame means,

actuating means for moving said ram along a predetermined path from a retracted position to an extended position relative to said frame means,

connector holding means on said frame means for holding said connector proximate to the end of said ram when said ram is in said extended position

positioning means on said holding means for selectively positioning said connector relative to said ram selectively to locate each of said wire receiving portions of said terminals in alignment with said ram,

stationary shear means on one side of said path intermediate the ends thereof, and

conductor locating means for locating a conductor with its axis extending transversely of said path and between said stationary shear means and the leading end of said ram when said ram is in said retracted position whereby

upon placement of said connector on said holding means and selectively positioning said connector with one of said wire receiving portions in alignment with

said ram, and upon locating said wire by said locating means and moving said ram from said retracted position to said extended position, said conductor is pushed by said ram towards the one wire receiving portion, and upon movement of said wire past said stationary shear means, the end portion of said conductor is trimmed, and upon further movement of said ram towards said wire receiving portion, said wire is inserted into said wire receiving portion.

2. Apparatus as set forth in claim 1 wherein said positioning means comprises detent means.

3. Apparatus as set forth in claim 2 wherein contact terminals are arranged in at least two parallel rows, said wire receiving portions of said terminals in each row facing in the opposite direction from the terminals of the other row, said detent means being adapted to enter the said wire receiving portion of a contact terminal in one of said rows thereby to align the wide receiving portion of a terminal in the other one of said rows with said ram.

4. Apparatus as set forth in claim 1 wherein said frame means comprises a pistol-type frame, said apparatus being a hand tool.

5. Apparatus as set forth in claim 4 wherein said frame means comprises a barrel portion and a handle portion, said ram being slidably mounted in said barrel portion, said actuating means comprising a movable handle pivotally mounted on said frame means.

6. Apparatus as set forth in claim 1 wherein said conductor locating means comprises a locating plate having an opening therein, said plate being on the opposite side of said path from said stationary shear.

7. Apparatus as set forth in claim 6 wherein said stationary shear comprises a shear plate having an opening therein, said opening in said shear plate being in alignment with said opening in said locating plate.

8. Apparatus as set forth in claim 1 wherein said ram has a recess in the leading end thereof, said recess being adapted to receive said wire receiving portion of one of said terminals when said ram is in said extended position, and an inserting punch in said recess for engagement with a wire being inserted into one of said wire receiving portions.

9. A hand tool for trimming the end of a wire and in-

serting the trimmed wire end into the wire receiving portion of a terminal in a multi-contact electrical connector, said connector having two parallel rows of said terminals, each of said wire-receiving portions comprising a pair of spaced apart plate-like members, said plate-like members having wire-receiving slots therein which are in alignment with each other, said wire receiving portions of said terminals being oppositely directed in said two parallel rows, said apparatus comprising:

frame means,

a ram mounted in said frame means,

means for moving said ram along a predetermined path from a retracted position in said frame means to an extended position relative to said frame means and for returning said ram to said retracted position,

said ram having a leading end portion formed to engage a wire and insert said wire into the said wire receiving portion of one of said terminals, said leading end portion having a recess therein of a width sufficient to receive said spaced apart plate-like members of said terminal and having a wire inserting punch projecting centrally into said recess, said wire inserting punch being adapted to engage said wire and push said wire into said slots,

a fixed shearing member disposed beside said predetermined path intermediate the ends thereof,

means permitting positioning of said wire with its axis extending transversely of said predetermined path, past said fixed shearing member, and between said fixed shearing member and said end of said ram when said ram is in said retracted position,

holding means on said frame means for holding said connector proximate to said end of said ram when said ram is in said extended position with said wire receiving portion of one of said terminals in one of said rows in alignment with said ram, and

detent means on said holding means in alignment with said ram, said detent means being engageable with the wire-receiving portion of the terminal which is opposite to said one terminal in the second one of said rows.

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