

[54] **APPARATUS FOR CONNECTING CONDUCTORS TO WHICH ARE BACK TO BACK**
[75] Inventor: **John James Tucci**, Winston-Salem, N.C.
[73] Assignee: **AMP Incorporated**, Harrisburg, Pa.
[22] Filed: **Feb. 15, 1974**
[21] Appl. No.: **442,959**
[52] **U.S. Cl.** **29/203 MW**
[51] **Int. Cl.** **H01r 43/04**
[58] **Field of Search.** 29/203 MW, 203 DT, 203 DS, 29/203 D, 203 R, 203 J

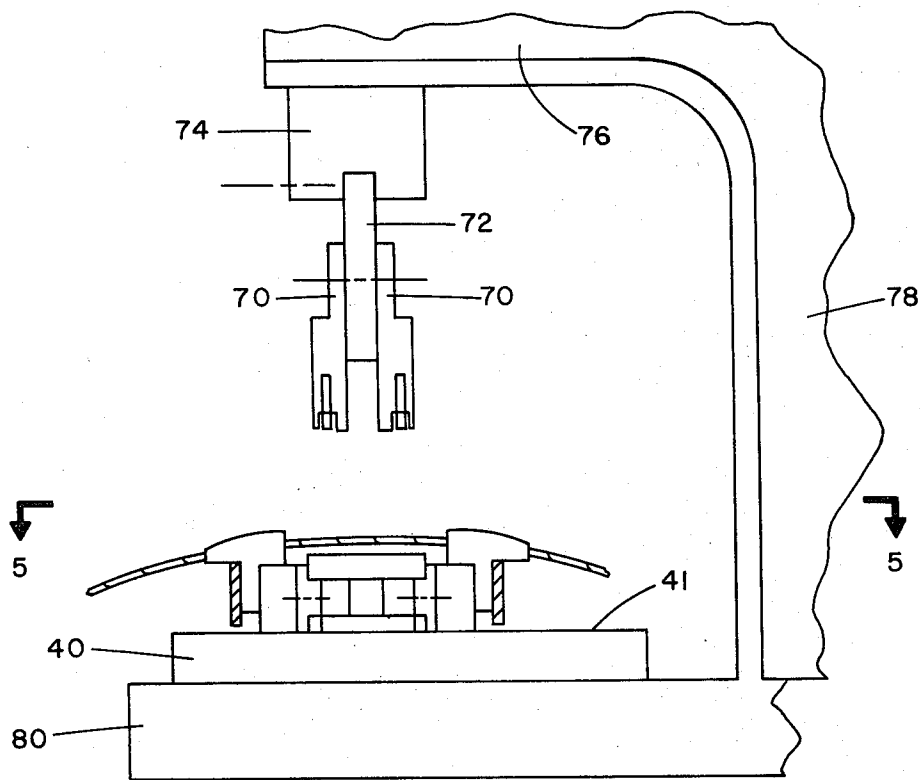
3,766,622 10/1973 Brehm et al. 29/203 MW
Primary Examiner—Thomas H. Eager
Attorney, Agent, or Firm—Frederick W. Raring; Jay L. Seitchik; William J. Keating

[57] **ABSTRACT**

An apparatus is disclosed for connecting wires to the terminals in two connectors which are in back-to-back relationship which comprises a jig for holding the connectors, wire positioning means for locating the wires, and trimming and inserting means for trimming the wires and inserting them into the terminals in the connectors.

[56] **References Cited**
UNITED STATES PATENTS
3,758,935 9/1973 Long et al. 29/203 MW

5 Claims, 13 Drawing Figures



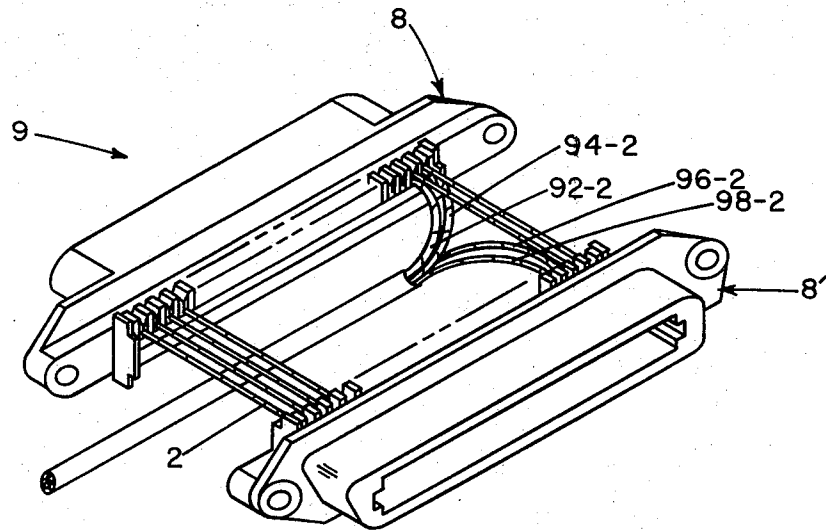


FIG. 13

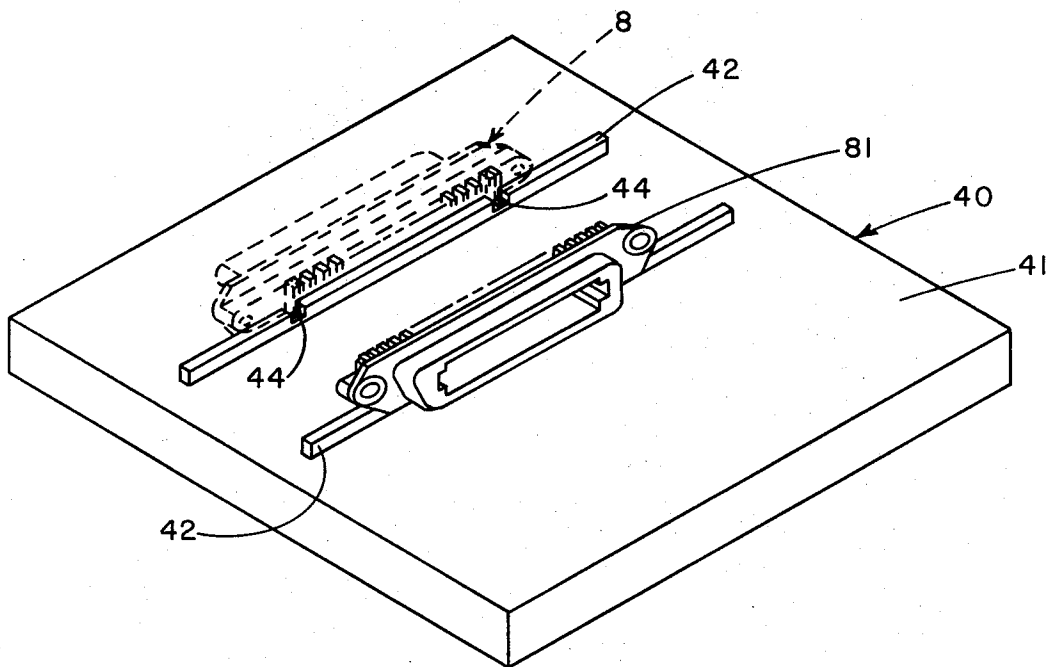


FIG. 1

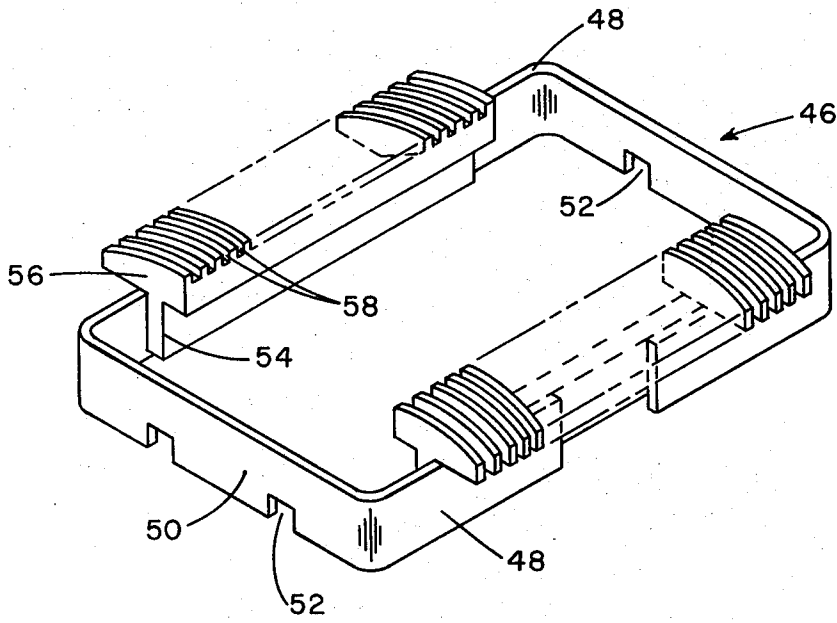


FIG. 2

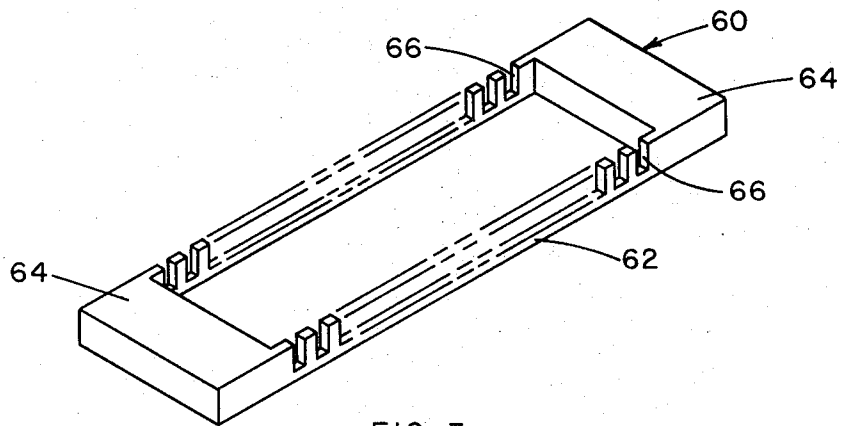
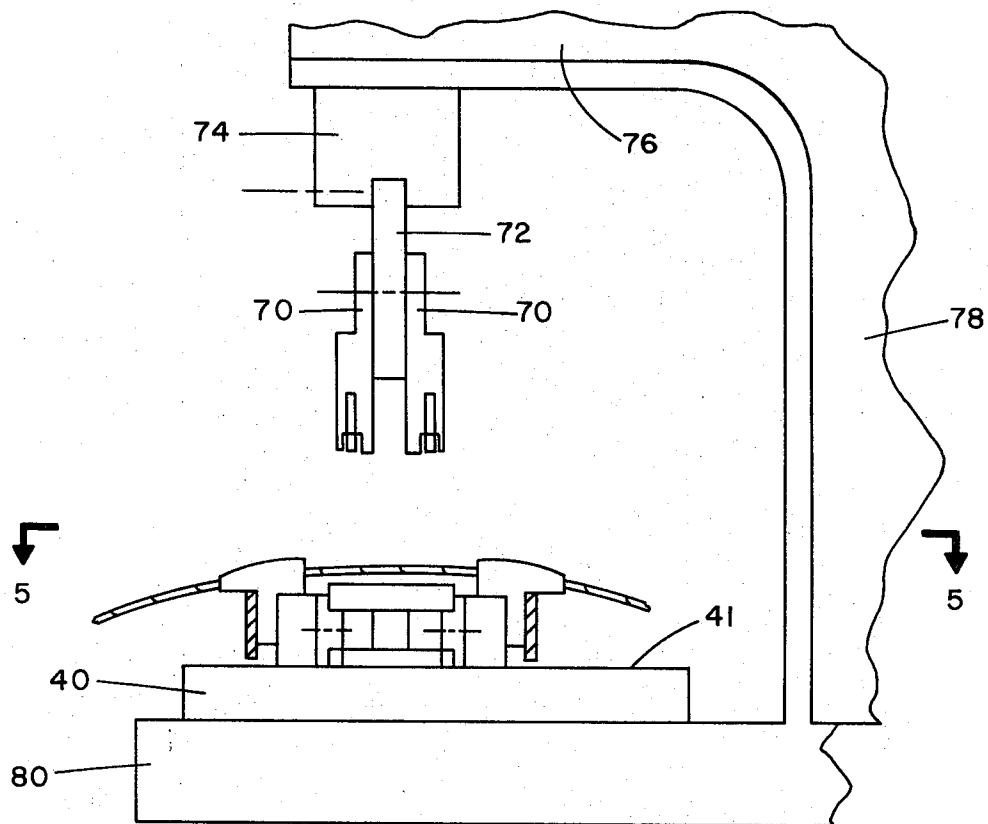
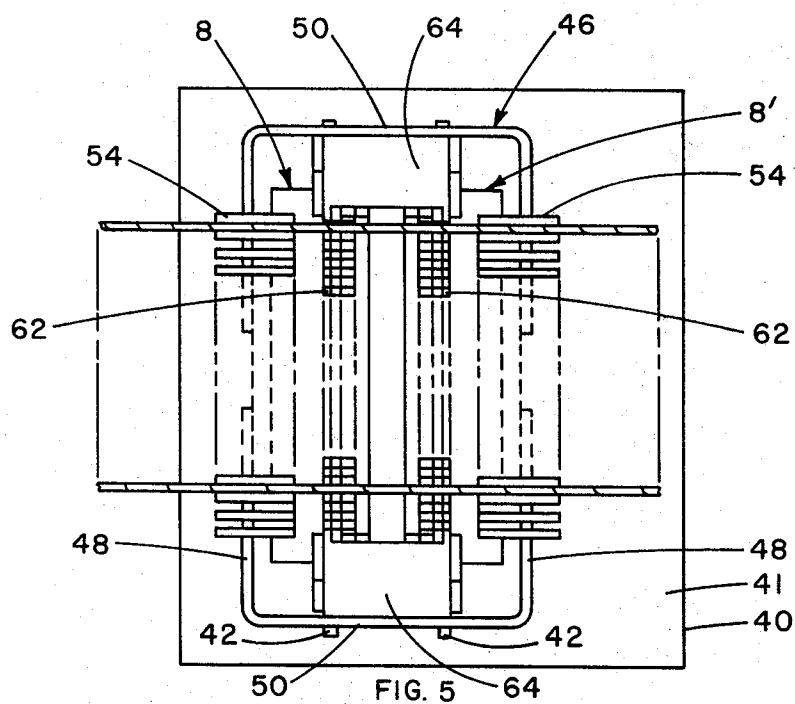


FIG. 3



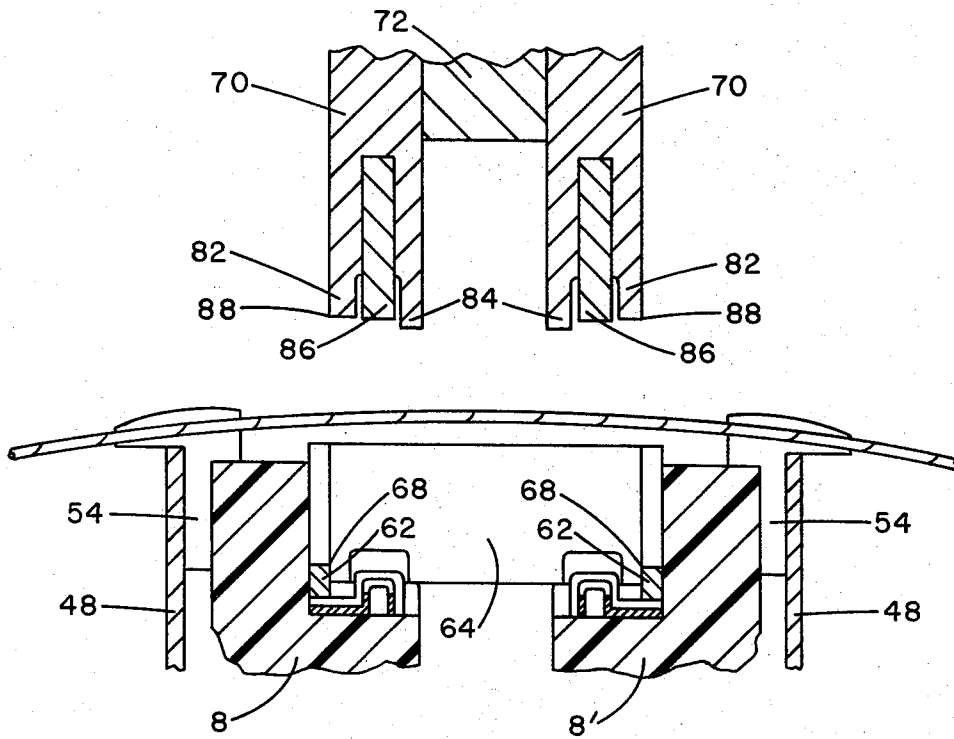


FIG. 6

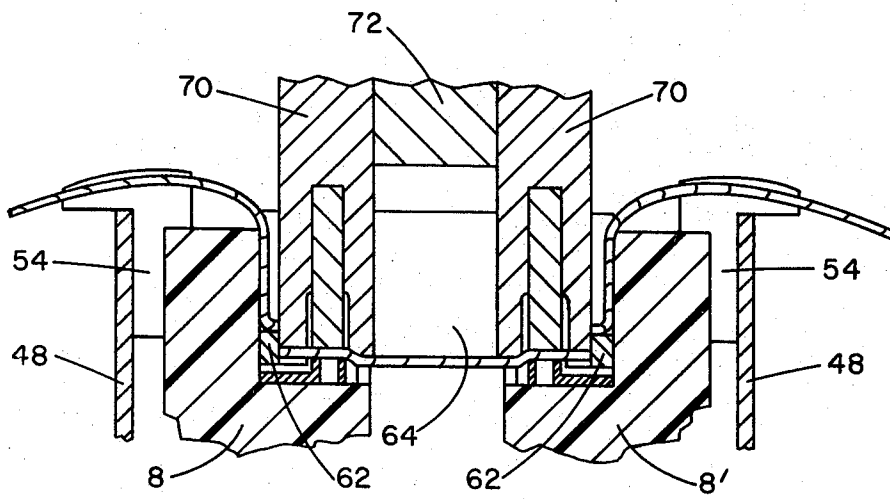


FIG. 7

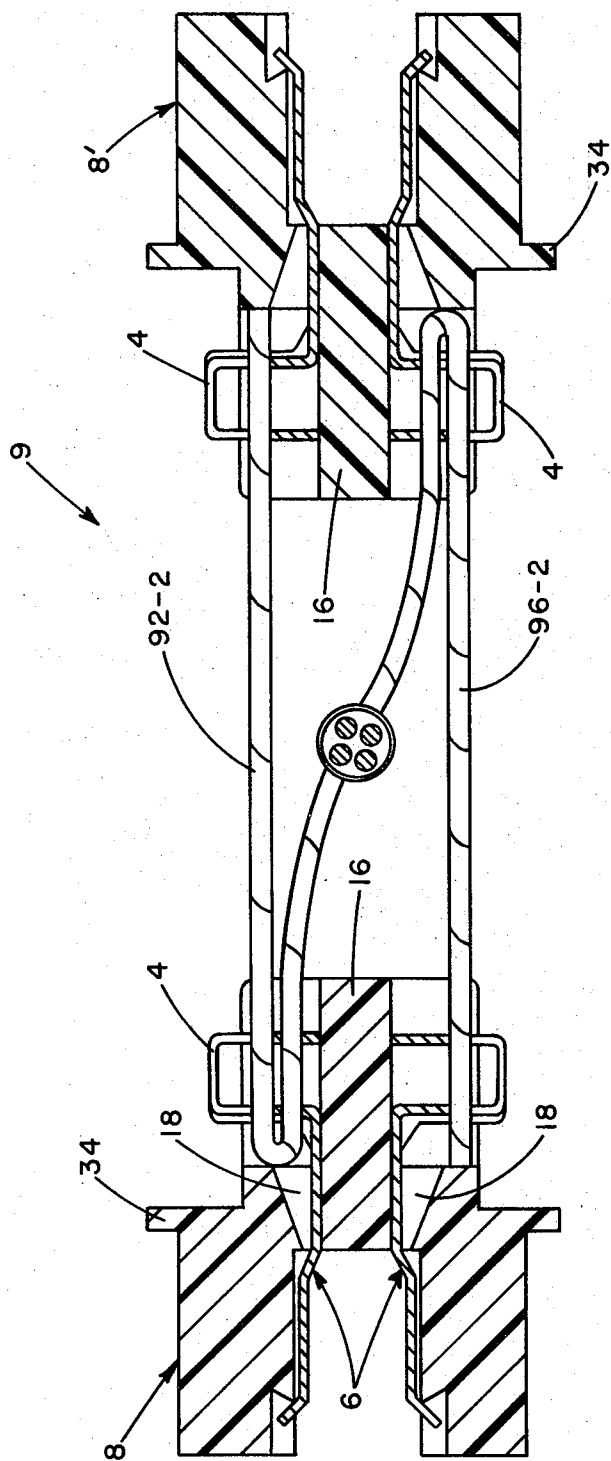


FIG. 8

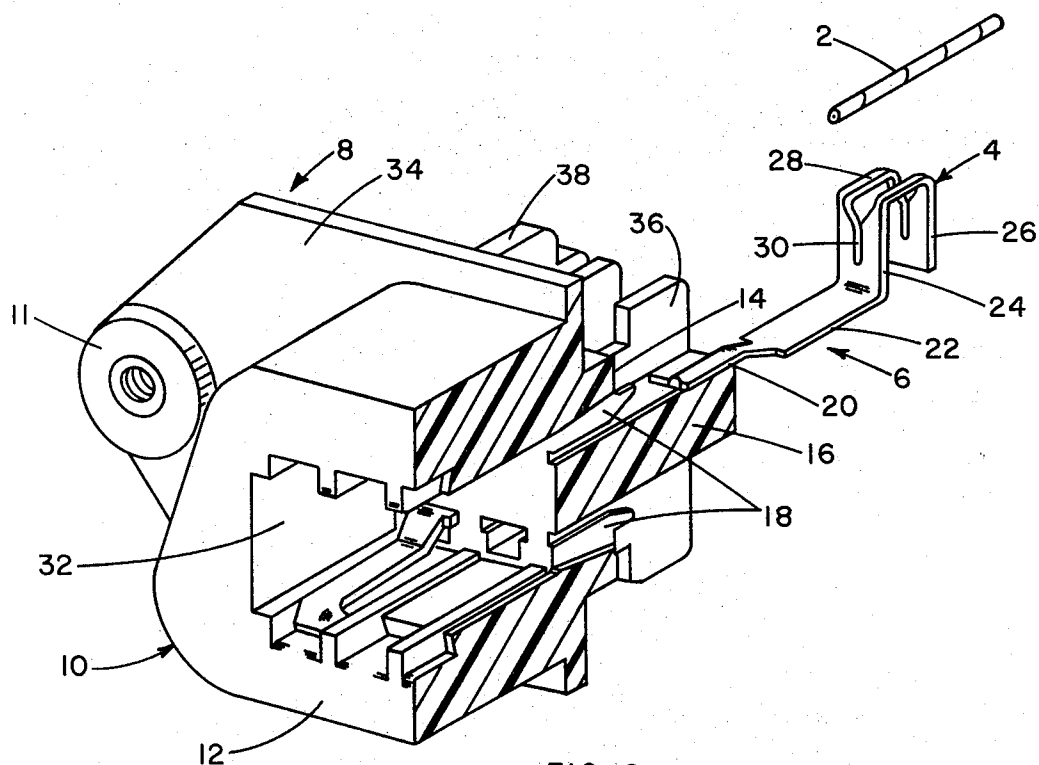


FIG. 9

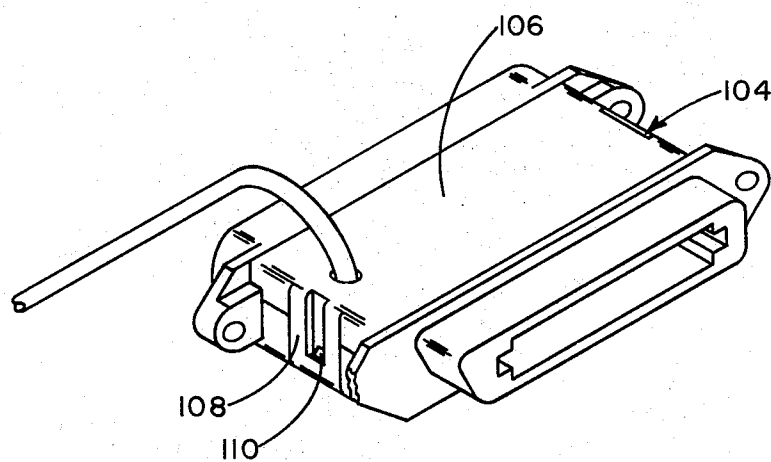
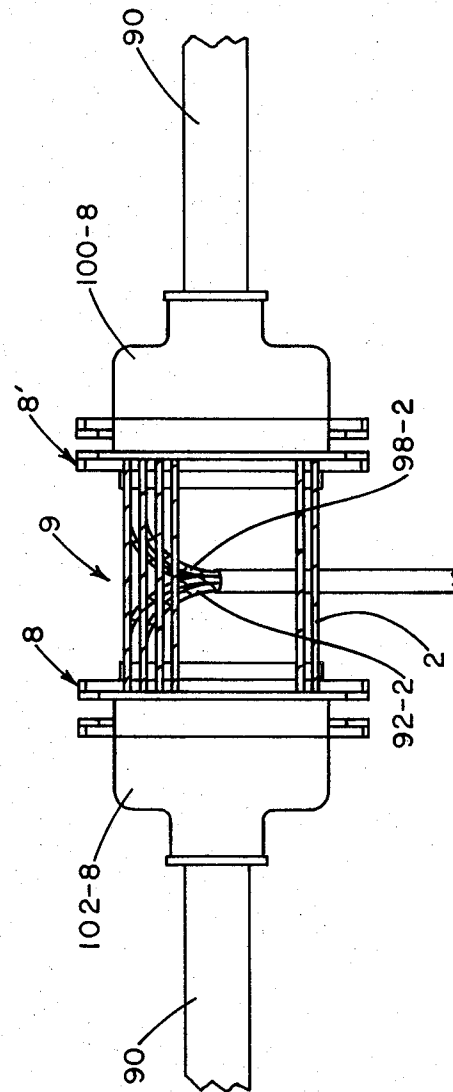
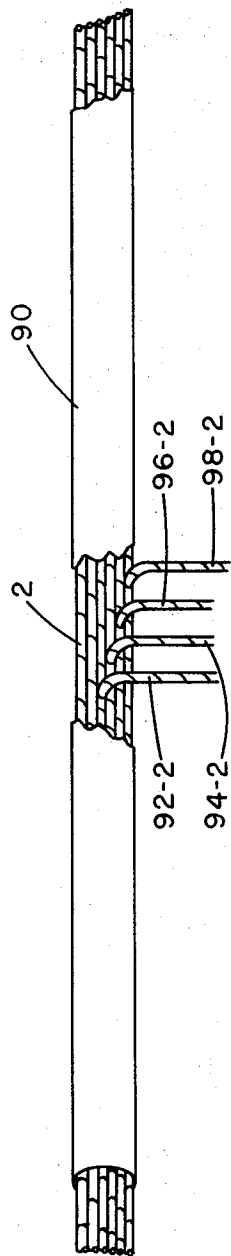


FIG. 12



APPARATUS FOR CONNECTING CONDUCTORS TO WHICH ARE BACK TO BACK

BACKGROUND OF THE INVENTION

This invention relates to a connector assembly for making tap connections with selected conductors in a multi-conductor cable and to a preferred form of apparatus for the manufacture of the tap connector assembly. The connector disclosed herein which is used in the connector assembly is disclosed and claimed in U.S. Pat. No. 3,760,335 and the preferred form of apparatus shown herein incorporates the general teachings of U.S. Pat. Nos. 3,758,935 and 3,766,622. The instant invention is also related to the inventions disclosed and claimed in applications Ser. Nos. 442,958, 442,960, and 442,941, filed of even date herewith. These co-pending applications disclose apparatus for several different types of wire inserting operations and these other apparatus have one or more parts in common with the instant apparatus.

It is common practice in the telephone industry and in other industries to use multi-conductor cables consisting of a predetermined number of wires contained in a continuous surrounding sheath. A multi-conductor cable can be connected to an identical cable by simply connecting the wires in both cables to multi-contact electrical connectors which, when mated with each other, connect corresponding wires in the two cable ends. The connector shown in the above-identified U.S. Pat. No. 3,760,335 is widely used for this purpose.

It is sometimes desirable to connect tap wires to a limited number of the conductors in a cable. There are known methods of making tap connections to a cable in which standard multi-contact connectors are used but these known methods require soldering and potting techniques and are very inconvenient and time-consuming. The instant invention is thus directed to the achievement of an easily manufactured connector assembly comprising two connectors which can be coupled to connectors on the end of cables and which has laterally extending tap wires connected to some of the terminals in the connector assembly. This arrangement permits the use of a standard connector, for example, of the type shown in U.S. Pat. No. 3,760,335 for making such tap connections. The invention is also directed to the provision of suitable tooling for the manufacture of tap connector assemblies.

It is accordingly an object of the invention to provide an improved connector assembly for effecting tap connections to a multi-conductor cable. A further object is to provide a tap connector assembly which can be manufactured in a short time and which is capable of providing tap connections to predetermined conductors in a multi-conductor cable. A further object is to provide an improved apparatus for the manufacture of connector assemblies of the type comprising two connectors in back-to-back relationship having wires extending between corresponding contact terminals in the assembly.

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

FIG. 1 is a perspective view of a connector jig plate which forms a part of the preferred form of apparatus in accordance with the invention.

FIG. 2 is a perspective view of a wire positioning jig which forms part of the apparatus.

FIG. 3 is a perspective view of a fixed shear means which forms part of the apparatus.

FIG. 4 is a side view of an apparatus in accordance with the invention, this view showing the positions of the parts to insertion of wires into the wire-receiving portions of terminals in two back-to-back connectors mounted on the apparatus.

FIG. 5 is a view taken along the lines 5—5 of FIG. 4.

FIG. 6 is a fragmentary sectional side view showing portions of the apparatus, this view showing the positions of the parts immediately prior to severing of the wires and insertion of the wires into the contact terminals.

FIG. 7 is a view similar to FIG. 6 but showing the positions of the parts at the conclusion of the wire inserting operation.

FIG. 8 is a sectional side view of a tap connector assembly in accordance with the invention.

FIG. 9 is a fragmentary perspective view of a connector of the type used in the practice of the invention.

FIG. 10 is a diagrammatic view showing tap wires extending to the wires in a cable.

FIG. 11 is a diagrammatic view showing the manner of effecting tap connections in accordance with the invention.

FIG. 12 is a perspective view of a top connector assembly in accordance with the invention having covers assembled to the connectors.

FIG. 13 is a perspective view similar to FIG. 12 but with the covers removed.

The invention is herein disclosed as an embodiment containing two connectors of the type shown in FIG. 9 and described fully in the above-identified U.S. Pat. No. 3,760,335. In accordance with the teachings of that patent, wires 2 are connected to the wire receiving portions 4 of electrical contact terminals 6 which are contained in the housing 10 of the connector 8. The housing has a mating face 12 and a rearward face 14. A central rib 16 extends from the rearward side or face and a plurality of side-by-side contact receiving cavities 18 extend through the housing on the upper and lower sides of the rib. Each cavity contains an individual terminal 6 and each terminal has a forward contact portion 20, an intermediate shank 22, and the previously identified wire receiving portion 4 which comprises two plate-like members 24, 26 which are connected at their upper ends by strap sections 28. The wire 2 is moved laterally of its axis into the gap between the strap members 28 and into slots 30 in the plate sections, the width of these slots being such that the insulation of the wire is penetrated and electrical contact is established with the conducting core. When the terminals are mounted in the cavities, the contact portions extend forwardly and into a trough-like recess 32 in the mating face 12 which is adapted to receive a complementary male connector.

Adjacent terminals in the two rows are separated from each other by barriers 36 and the end barriers 38 extend somewhat beyond the other barriers 36 as shown. The housing 10 is provided with a radially extending flange 34 by means of which it may be mounted in a panel or the like.

FIG. 10 diagrammatically illustrates the problem of tapping into a cable. The cable 90 has a plurality of conductors 2 and has a continuous insulating sheath

surrounding all of the conductors as shown. Where tap wires must be connected to some of the conductors 2, the sheath can be removed and the tap wires 92-2, 94-2, 96-2, and 98-2 can be simply connected to the pre-determined wires 2 in the cable as by soldering. This method would not be practical but is shown here only by way of illustration.

Referring now to FIGS. 12 and 13, the connector assembly 9 in accordance with the invention for making tap type connection comprises two connectors 8, 8' in back to back relationship with the corresponding contact terminals 6 in the two connectors in opposed alignment. Short sections of wire 2 extend between the wire-receiving portions of corresponding opposed terminals and electrically connect them to each other excepting for the wires extend between the terminals on the extreme right in FIG. 13. The wire 94-2 extends from the terminal on the extreme right in the connector 8' to the terminal on the extreme right in the connector 8 and is doubled back upon itself and extends thence laterally as shown. The wire 92-4 is similarly connected to the next adjacent terminal in the connector 8', to a corresponding terminal in the connector 8, and extends laterally beside the wire 94-2. Additional tap wires can be added in the same manner, only two such wires being shown in the interest of clarity.

It is advantageous to provide a cover (FIG. 12) to the rearward sides of the two connectors in the assembly in surrounding relationship to the wires 2 which extend between the connectors. This cover means comprises two identical parts 104 each of which has a flat plate like section 106 and a depending latch arm 108 at its end. The latch arm of each cover part is adapted to engage a boss 110 on a short depending arm at the other end of the part so that the two cover parts are latched to each other. Each cover part has a flange (not shown) which extends into the space between the barriers 36 and the rearwardly facing side of the housing as shown in FIG. 4 of the above-identified U.S. Pat. No. 3,760,335. The covers thus serve to hold the two connectors in assembled relationship to each other and avoid the imposition of any stresses on the wires.

Referring now to FIG. 11, a tap connection in accordance with the invention is thus made by cutting the cable 90 and installing conventional connectors 100-8 and 102-8 on the cut ends of the cable, these connectors being of the type shown in FIG. 9. Each wire in the cut ends of the cable is connected to one of the terminals in one of the connectors 100-8; 102-8 and this installation is, therefore, in all respects, conventional. The connectors 102-8 and 100-8 are then coupled to the connectors 8' and 8 of the tap connector assembly 9. Upon such coupling of all of the connectors, the conductors in the righthand portion of the cable 90 will all be connected to the conductors in the lefthand portion 90' through the connector 100-8 the connector 8, through the wires extending between the connectors 8', 8, and through the connector 102-8. In addition, the laterally extending tap wires 92-2, 94-2 96-2 and 98-2 will be connected to predetermined wires in the cable.

Referring now to FIGS. 1-5, a preferred form of apparatus for manufacturing the tap connector assembly 9 comprises a connector jig plate 40 having parallel spaced apart ribs 42 on its upper surface 41. Spaced apart notches 44 are provided in the ribs and are dimensioned to receive the enlarged end barriers 38 of the connectors so that when the connectors are posi-

tioned with the rearwardly facing sides of their flanges against the ribs 42 and with their barriers extending into the notches 44, the connectors will be precisely positioned with respect to each other on the jig plate.

The wires are located in the apparatus by wire positioning jig 46 (FIG. 2) in the form of a rectangular frame having sides 48 and ends 50. Spaced apart notches 52 are provided in the lower edges of the ends 50 to locate this wire positioning jig on the connector jig and the distance between the opposed surfaces of the ends 50 is equal to the distance between the extreme side portions 11 of the flanges 34. When the wire positioning jig is thus positioned on the jig plate, it will be precisely located with reference to the connectors 8, 8' on the jig plate. The wires are located by means of wire combs or wire jigs 54 which are T-shaped blocks bonded to the inner surfaces of the sides 48. The upper surfaces of the wire combs have spaced apart recesses 58, the distance between adjacent recesses being equal to the spacing between adjacent terminals in the connectors 8, 8' so that wires located in the recesses with intermediate portions extending across the wire jig will be in alignment with corresponding terminals in the two connectors mounted on the jig plate.

The lower or fixed tooling further comprises a fixed wire shear 60 (FIG. 3) having parallel side bar members 62 and end sections 64. The side bar members 62 have spaced apart notches 66 which are adapted to receive portions of the wires and the inner edges 68 (FIG. 6) at the inner ends of these notches function as fixed shearing edges for the wires in cooperation with movable shearing means described below. The fixed shearing member 60 is dimensioned such that it will fit snugly between the opposed rearwardly facing surfaces of the two connectors mounted in the lower tooling as best shown in FIG. 6 so that the wire-receiving portions of the terminals will be in alignment with the edges 68 and with a wire located in the associated recesses 58 in the wire combs.

The lower tooling described above is mounted on the platen 80 of a press (FIG. 4) having a neck portion 78 and a head 76 which contains a reciprocable ram 74.

The upper or movable tooling comprises a pair of shearing and inserting tool blocks 70, mounted on each side of a tool mounting block 72 which is in turn mounted on the lower end of the ram 74. Each tool block 70 has depending flanges 82, 84 at its lower end and spaced apart insertion punches 86 are mounted in the tool block between these flanges, one insertion punch being provided for each terminal in the connectors. The outside edges 88 of the blocks 70 function as shearing edges in cooperation with the fixed shearing edges 68 as is apparent from FIG. 7.

The first step in the manufacture of a tap connector assembly 9 is to connect most of the corresponding terminals in the connectors 8, 8' to each other by the short lengths of the wire shown in FIG. 13 excepting those terminals (shown on the right in the FIG. 7) to which the tap wires are to be connected. To form these straight-through connections, the connectors are located on the jig block (FIG. 1) and the wire positioning jig 46 is then positioned on the jig block in surrounding relationship to the connectors. The fixed shearing member 60 then is positioned as shown in jig 6 between the rearwardly facing sides of the connectors 8, 8'. Short lengths of wire are then positioned in corresponding recess 58 in the wire combs of the wire posi-

tioning jig so that intermediate portions of the wires extend above corresponding contact terminals as shown in FIG. 6. Wires are not positioned in the recesses 58 which are above the terminals to which the tap wires are to be connected.

The ram 74 is moved downwardly to move the upper tooling downwardly from the position of FIG. 6 to the position of FIG. 7. During such movement of the upper tooling, the individual wires 2 are engaged by the tool blocks 70 and moved downwardly and into the slots 30 in the wire receiving portions of the terminals. During movement of the wires past the edges 68, the wires are trimmed and only with central portions of the wires are moved into the terminals. The notches 66 in the side bars 62 guide the wires accurately towards the terminals during their downward movement.

The ram is then raised, the fixed tooling is removed from the jig plate, and the connector is reversed so that the remaining row of terminals are on the upper side. The process described above is then repeated to connect corresponding terminals in the two connectors in the remaining rows to each other with short lengths of wire. If tap wires are to be connected to any of the terminals in the remaining row, the terminals which are to receive these tap wires are not connected at this time.

In order to connect the tap wires 92-2, 94-2, 96-2, and 98-2 to the terminals, the fixed shear 60 is removed from the lower tooling and the tap wires are positioned as shown in FIG. 8 with the end of each tap wire located above the wire receiving portion of a terminal in one connector and with the wire dressed rightwardly towards the corresponding terminal in the other connector. The wire is reversely bent so that a double fold of wire is located over the conductor receiving portion of the terminal in the righthand connector and the wire is dressed from this terminal laterally. After the required number of tap wires have been positioned in the connector in this manner, the ram 72 is lowered so that these tap wires will be inserted into the wire receiving portions of the terminals. The folded portions of the wires are inserted into the terminals in the righthand connector in FIG. 8 and are not sheared since the fixed shear 60 also briefly removed from the lower tooling. If tap wires are to be connected to selected terminals in the remaining row of terminals, the connector assembly is reversed so that the remaining row faces upwardly and the procedure for connecting tap wires as described above is repeated. It is desirable to dress the tap wires laterally and between the two rows of short wire sections as shown and the tap wires are led to the assembly through suitable opening in the cover. In the embodiment shown, the four tap wires are contained in an insulating sheath which has been stripped away at its end.

It will be understood that variations of the procedure can be carried out or practiced if desired. The tap wires may vary in number according to the requirements of a particular situation and can be connected to any of the terminals in either of the connectors rather than to terminals at the ends of the connectors as shown.

A salient advantage of the invention is that tap connections to conductors in a cable can be made in a short time with standard connectors of the type which are also used with the same cable for end connections. The tap connections are easily serviced or changed; that is more tap connections can be added if desired by simply moving the assembly 9 and replacing it with an-

other assembly for a tap conductors extending to the desired terminals. The tap connections can be removed from the cable by removing the tap assembly 9 and simply coupling the connector 100-8 directly to the connector 102-8.

Changes in construction will occur to those skilled in the art and various apparently different modifications and embodiments may be made without departing from the scope of the invention. The matter set forth in the foregoing description and accompanying drawings is offered by way of illustration only.

What is claimed is:

1. Apparatus for connecting wires to the wire receiving portions of electrical contact terminals, said terminals being contained in two electrical connectors, said contactreceiving portions being arranged in side-by-side relationship in a row in each of said connectors, said apparatus comprising:

a connector jig plate having connector locating means thereon for locating said two connectors adjacent to each other with said rows extending parallel to each other in spaced-apart relationship,

a wire locating jig, means for locating said wire locating jig on said connector jig plate in at least partially surrounding relationship to two connectors mounted on said connector jig plate and with portions of said wire locating jig extending beside each of said rows of contact terminals, in said connectors,

fixed wire shearing means having parallel spaced-apart fixed shear bars, means on said fixed shearing means for positioning said fixed shearing means on connectors mounted on said connector jig plate with said fixed shearing bars extending parallel to said rows of conductor-receiving portions of said contact terminals,

wire locating means on said wire locating jig for locating a plurality of wires in parallel side-by-side relationship with each wire being in alignment with corresponding terminals in each of said connectors, and

movable shearing and insertion means movable along a path extending towards said jig plate, said movable shearing and insertion means having movable shearing edges for cooperation with said fixed shearing edges and having inserting punches for inserting said wires, after trimming, into said contact terminals whereby,

upon positioning said connectors in back-to-back relationship on said connector jig plate, positioning said wire locating jig on said jig plate in at least partially surrounding relationship to said connectors, positioning said fixed shearing means on said connectors, locating wires in said wire locating means on said wire locating jig, and moving said movable shearing and insertion means along said path towards said jig plate, said wires will be sheared and portions of said wires extending between said connectors will be inserted into said contact terminals.

2. Apparatus as set forth in claim 1, said wire locating jig comprising an open rectangular frame, said frame being in completely surrounding relationship to connectors mounted on said jig plate.

3. Apparatus as set forth in claim 2, said wire locating means comprising wire locating combs on two opposite sides of said frame, each of said two opposite sides ex-

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tending beside one of said rows of said contact terminals.

4. Apparatus as set forth in claim 3, said fixed wire shearing means comprising an open rectangular frame, said fixed shear bars comprising two opposite sides of said frame. 5

5. Apparatus for connecting wires to the wire-receiving portions of electrical contact terminals contained in each of two multi-contact electrical connectors, said wire receiving portions in each of said connectors being arranged in spaced-apart relationship in a single row which is proximate to the rearward side of the connector housing, said apparatus comprising: 10

a connector jig plate having connector locating means thereon for locating said connectors in back-to-back relationship with said rows of terminals in said connectors in parallel spaced-apart relationship and with corresponding contact terminals in said rows in opposed alignment with each other, 15

a wire locating jig comprising an open rectangular frame member having two opposite sides which constitute wire locating sides, said wire locating sides having wire locating means therein for locating a plurality of wires in parallel side-by-side relationship with said wires spaced apart by distances corresponding to the spacing between said contact terminals in said rows, means for positioning said 25

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locating jig on said jig plate with said wire locating sides extending on each side of said rows of terminals in connectors on said jig plate,

fixed wire shearing means comprising an open rectangular frame having opposite sides which constitute shearing sides having shearing edges, means for locating said fixed wire shearing means on connectors mounted on said jig plate with said shearing edges extending parallel to said rows of terminals, and

movable shearing edge and insertion means movable along a predetermined path extending towards said jig plate and having two parallel shearing edges for cooperation with said fixed shearing edge means and having insertion punches for inserting said wires into said wire-receiving portions of said terminals whereby, 20

upon placement of said connectors, said wire locating jig, and said fixed wire shearing means on said jig plate and upon positioning wires in said wire locating means with the axes of said wires extending between corresponding terminals, and upon movement of said movable shearing and insertion means towards said jig plate, said wires are sheared adjacent to said terminals and inserted into said contact receiving portions whereby corresponding terminals in said rows are connected to each other. 25

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