

[54] **FLAT CABLE ELECTRICAL CONNECTIONS AND METHODS OF MAKING SAME**

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[51] Int. Cl.² **H01R 9/06; H01R 31/02**

[58] Field of Search **339/95-99, 339/17, 276, 278; 206/46 ED, 56 AB, 56 F; 174/DIG. 3, 52 S, 52 PE, 84 R, 84 C**

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Primary Examiner—Roy D. Frazier

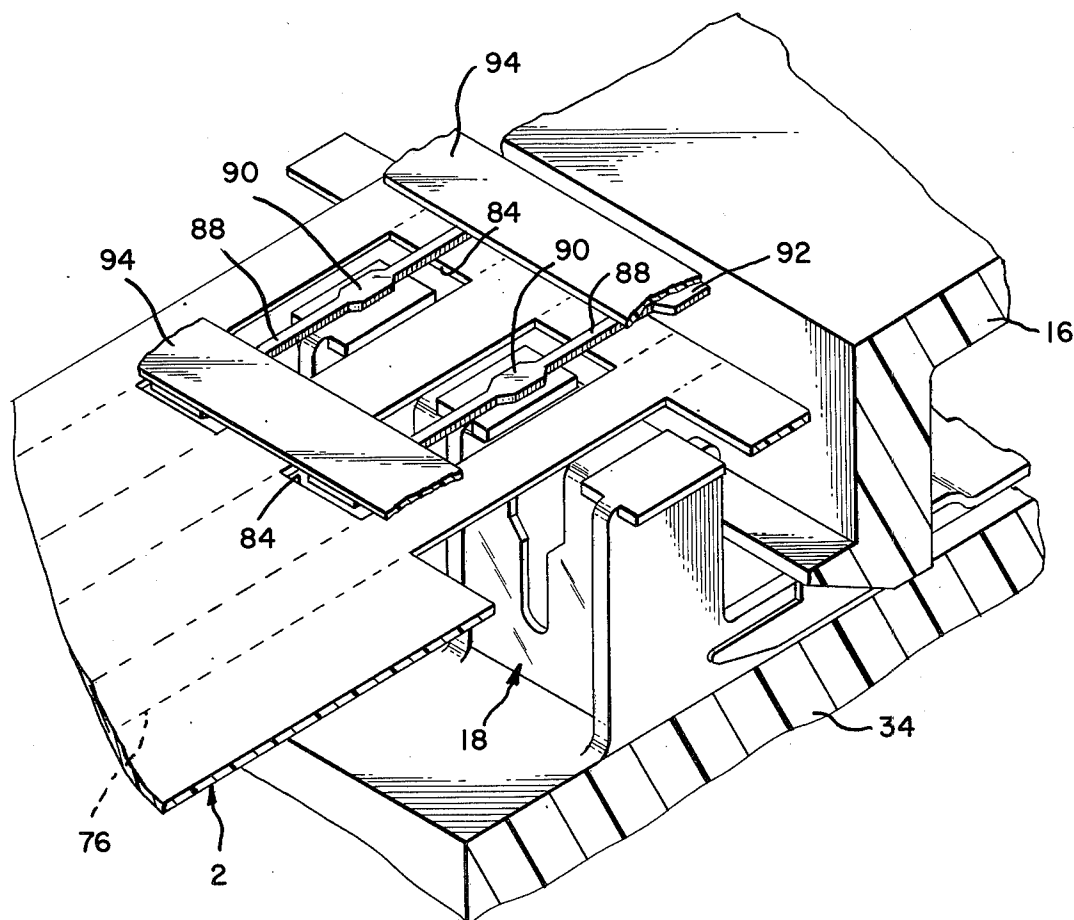
Assistant Examiner—Terrell P. Lewis

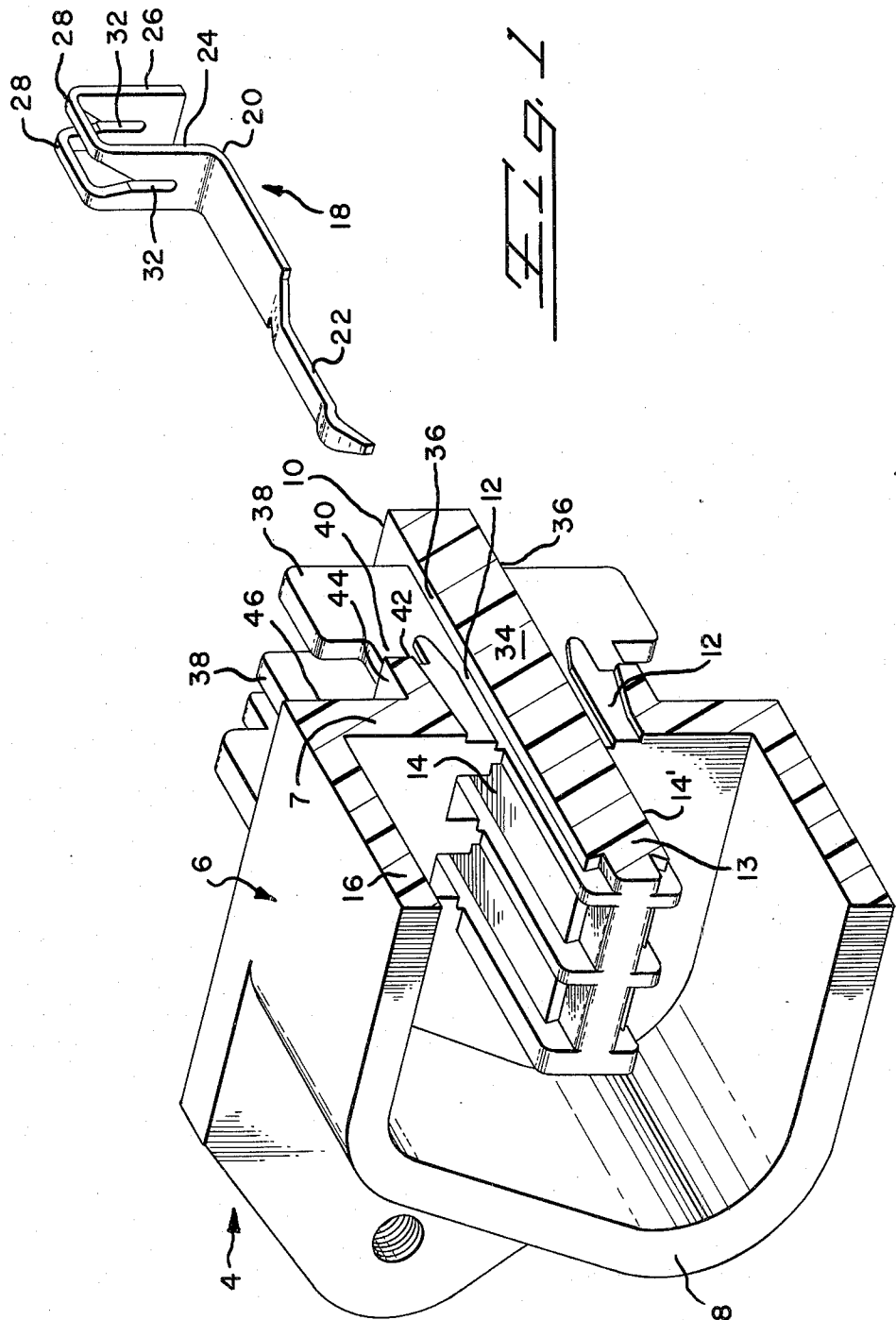
Attorney, Agent, or Firm—Robert W. Pitts; Frederick W. Raring; Jay L. Seitchik

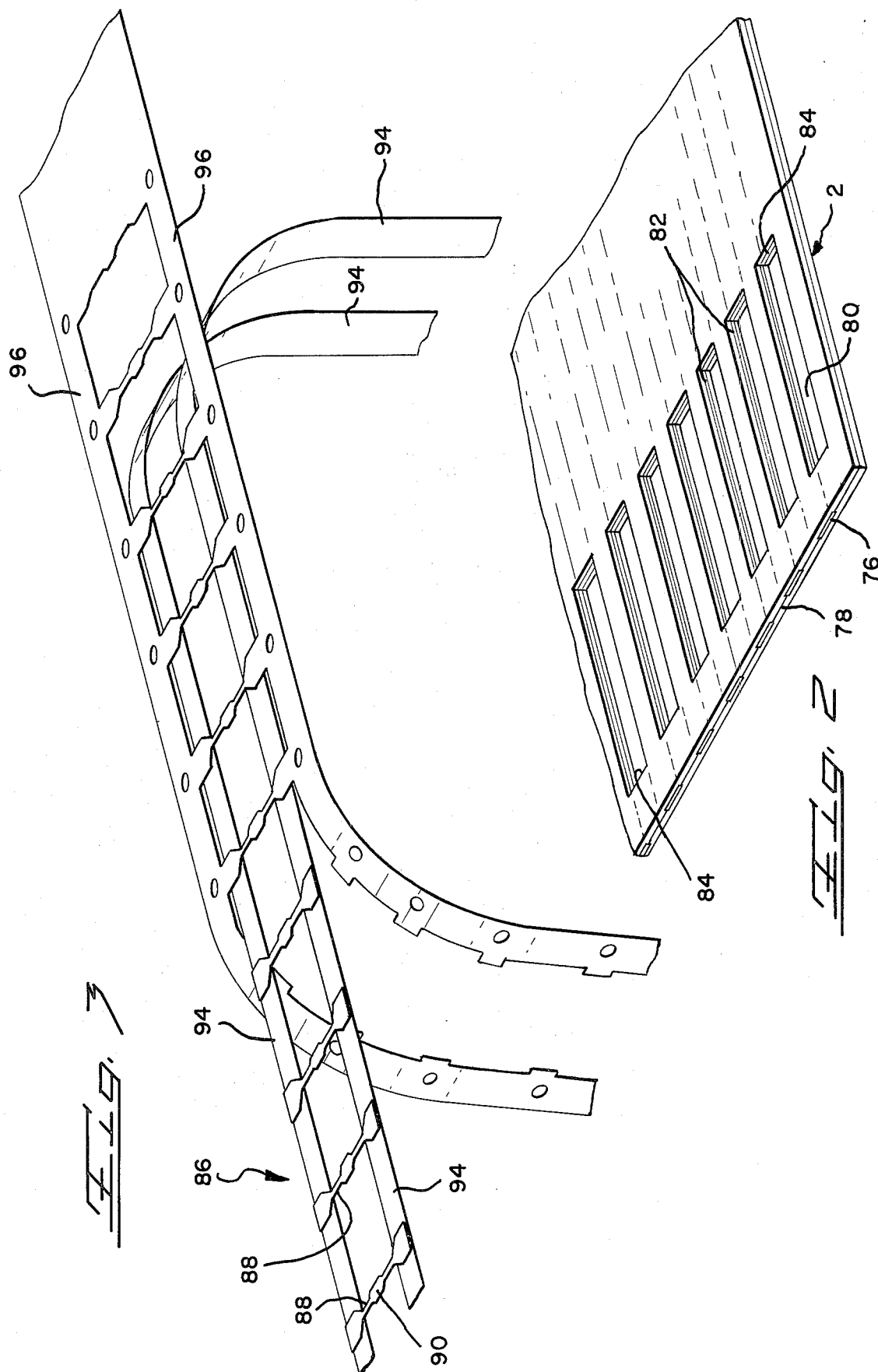
[57] ABSTRACT

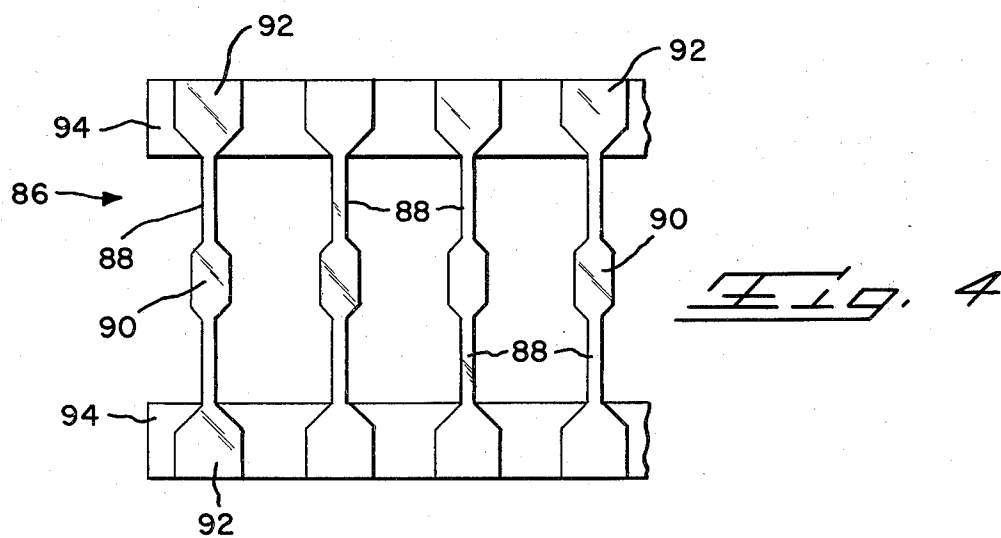
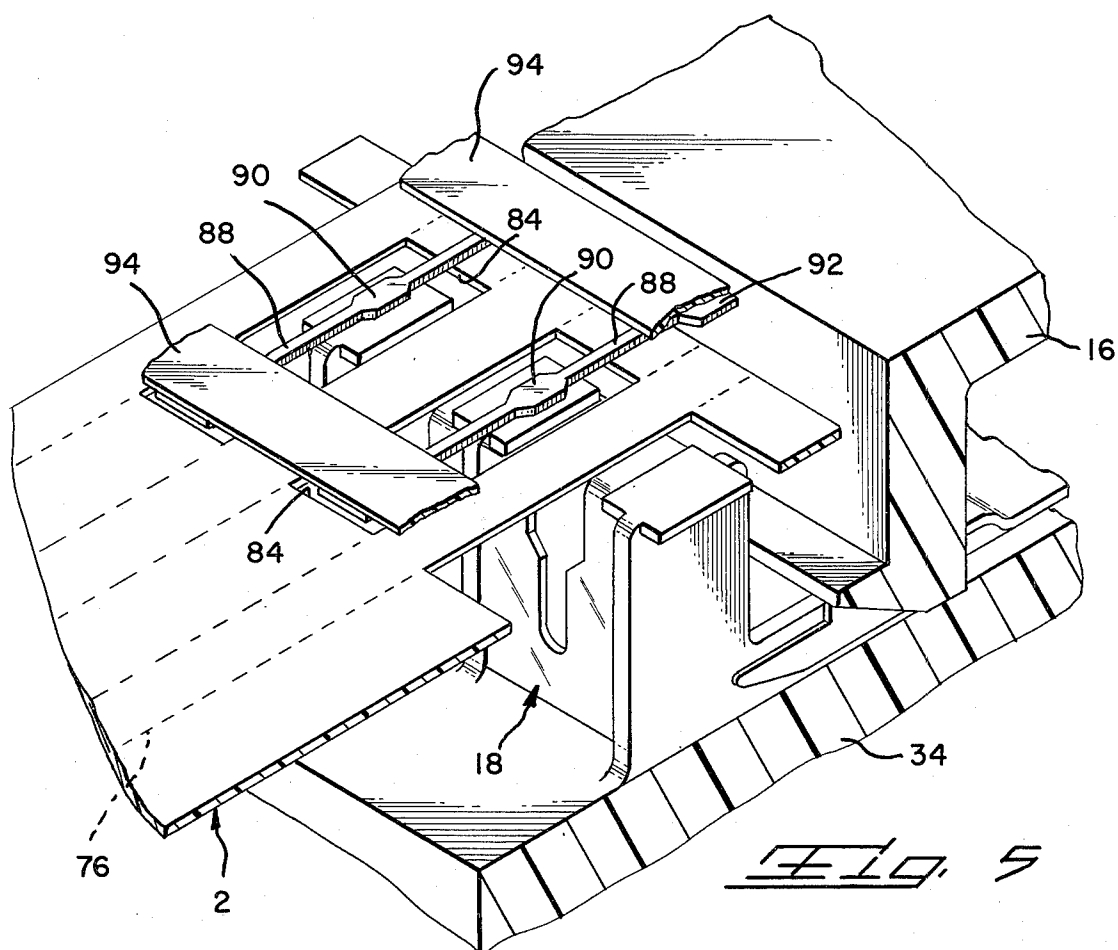
Parallel conductors in a flat cable are connected to a row of slotted terminals by punching holes in the cable between adjacent conductors, locating the portions of the conductors which lie between the holes in alignment with the slots in the terminals, and moving the conductors laterally of the plane of the cable into the slots. A ladder type strip of stuffer or wedging pins is then located adjacent to the terminals with the pins in alignment with the slots and the pins are moved into the slots to retain the conductors in the slots and to urge them against edge portions of the slots in order to establish electrical contact.

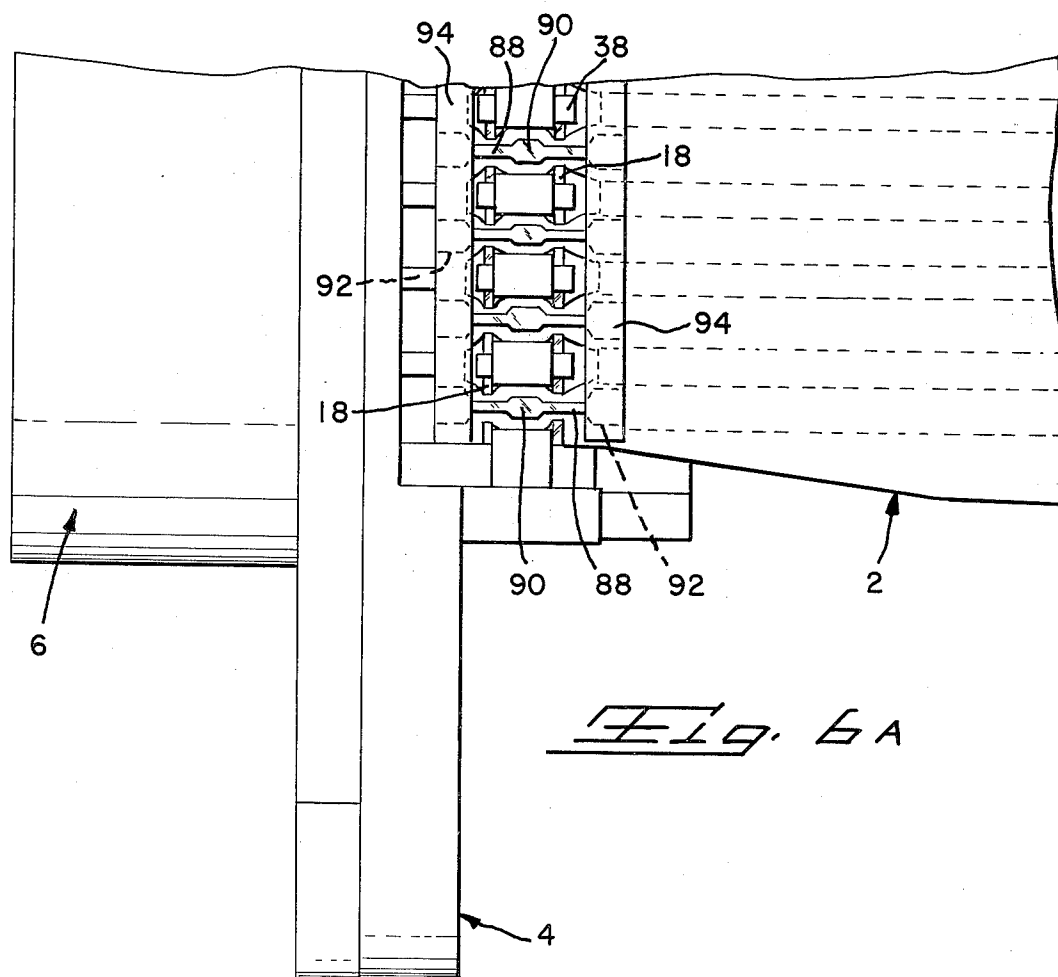
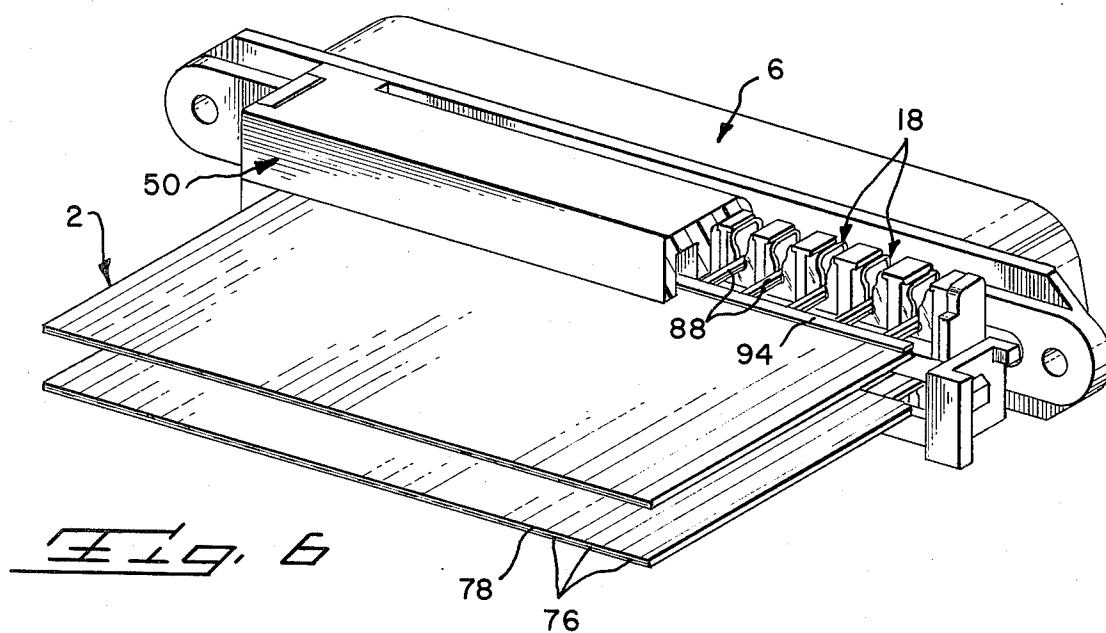
2 Claims, 13 Drawing Figures











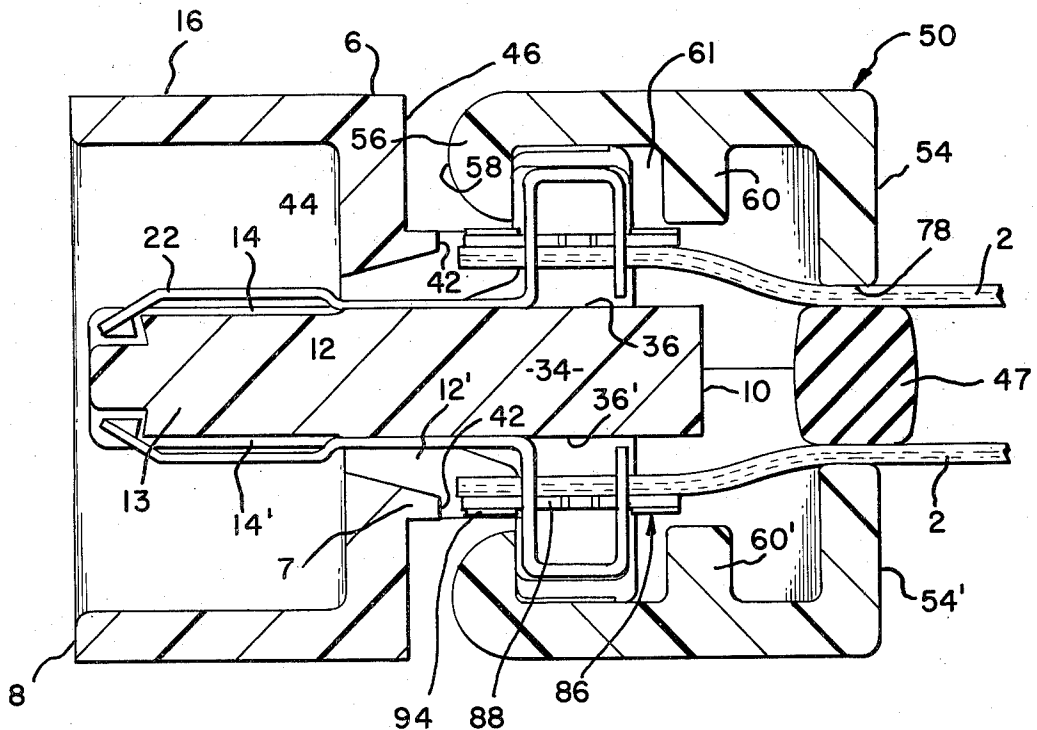
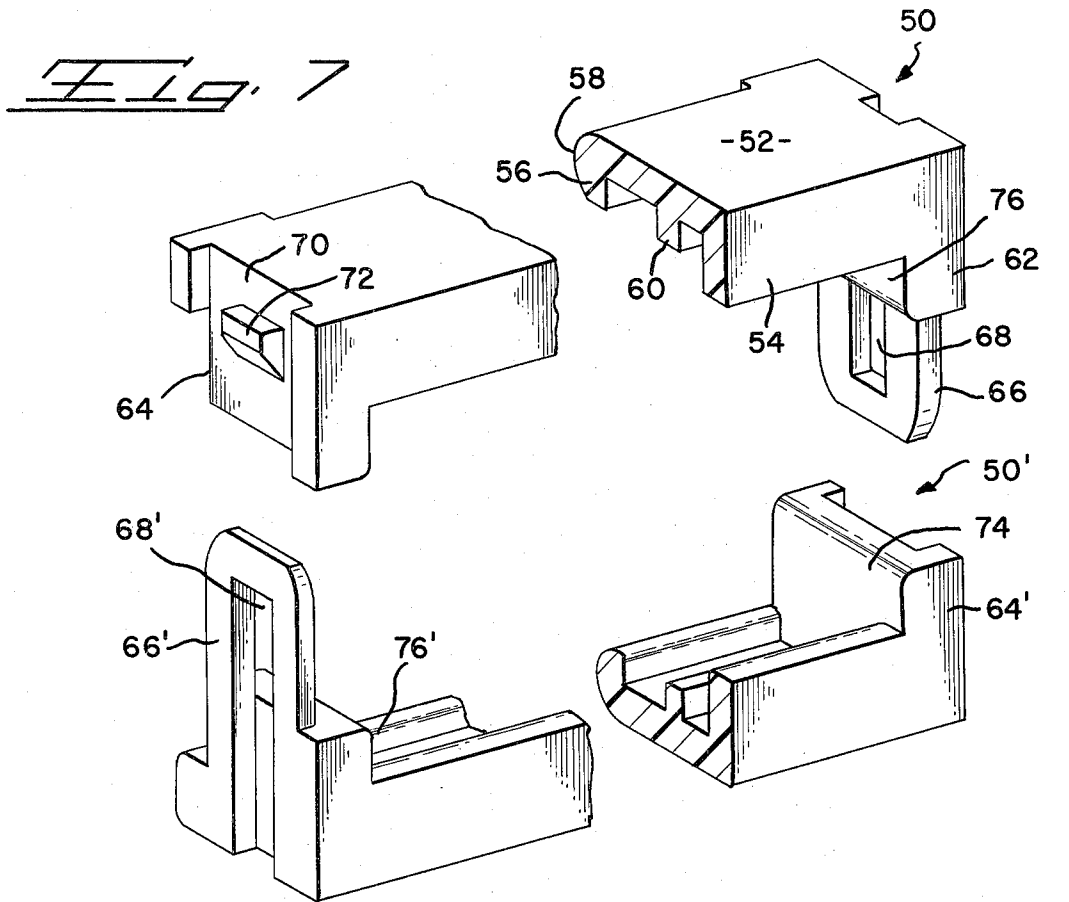


Fig. 8

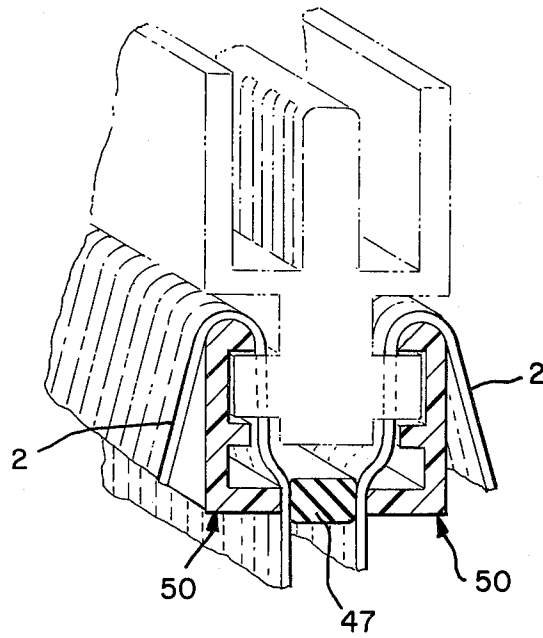


Fig. 9

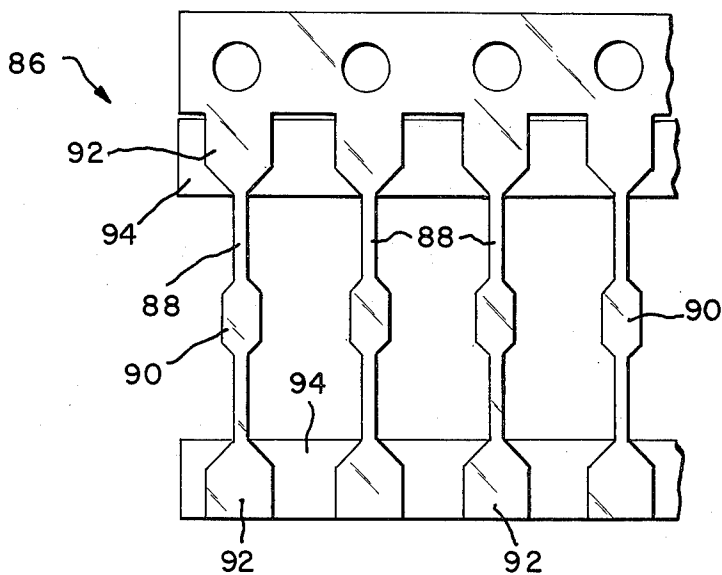


Fig. 10

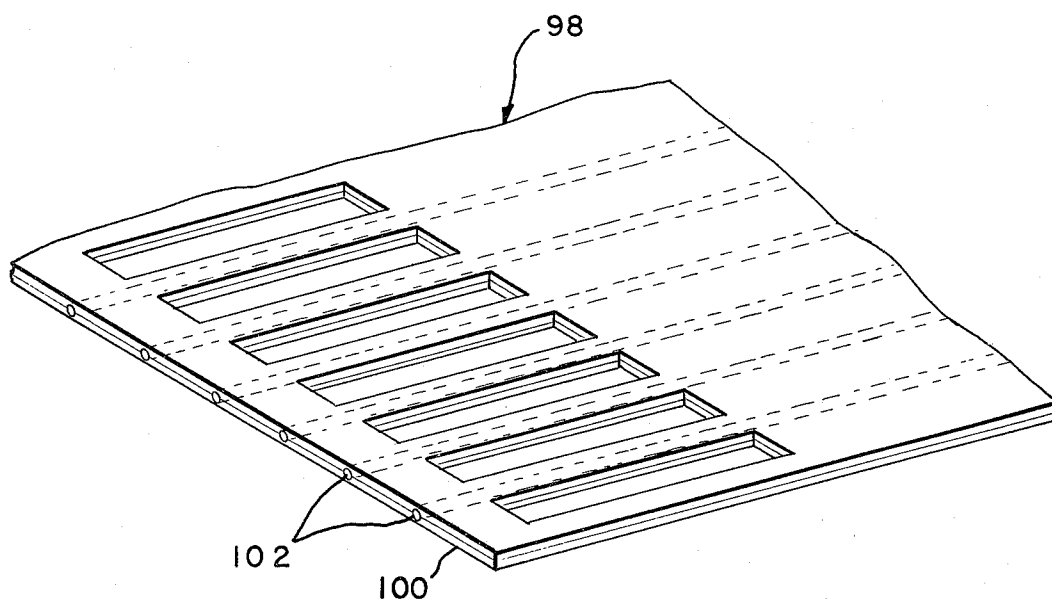


Fig. 11

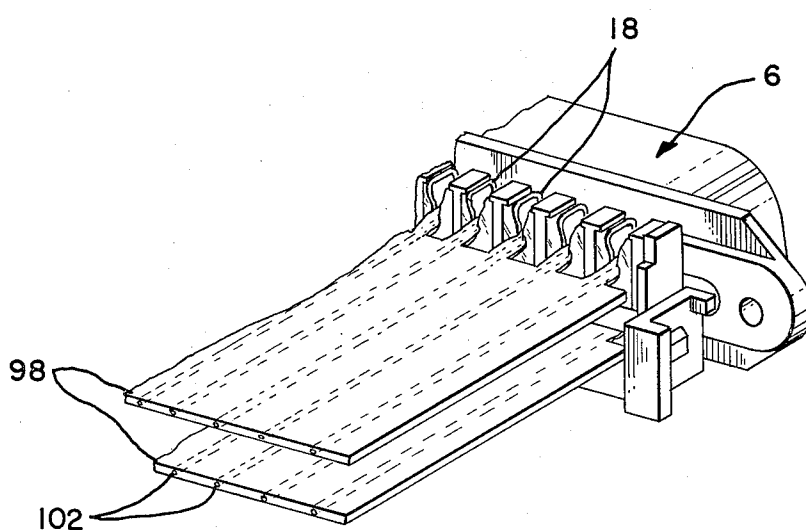


Fig. 12

FLAT CABLE ELECTRICAL CONNECTIONS AND METHODS OF MAKING SAME

BACKGROUND OF THE INVENTION

This invention is directed to improved electrical connections between the conductors of a flat conductor cable and the plate-like wire-receiving portions of terminals contained in an electrical device such as a multi-contact electrical connector.

Application Ser. No. 147,569 now U.S. Pat. No. 3,760,335 discloses and claims a multi-contact electrical connector having contact terminals therein which have plate-like conductor receiving portions. These conductor-receiving portions of the terminals have slots extending into one edge thereof for the reception of electrical conductors, the arrangement being such that when a conductor is moved laterally of its axis and into a conductor-receiving slot, the edges of the slot engage the conductor and establish electrical contact therewith. As explained in application Ser. No. 147,569 now U.S. Pat. No. 3,760,335 a plurality of conductors can be simultaneously inserted into the conductor-receiving portions of all of the terms so that the connector can be installed on the wires in an extremely short time and by a simple operation.

Application Ser. No. 310,056 now abandoned discloses a method and apparatus for connecting the conductors of a flat cable to the terminals of a connector of the general type shown in application Ser. No. 147,569 now U.S. Pat. No. 3,760,335. The flat ribbon-like conductors of the flat conductor cable are inserted into the slots of the platelike portions of the terminals and a wedge member or stuffer member, in the form of a pin, is also inserted into each slot. The stuffer or wedge maintains the thin ribbon-like conductors in engagement with the edges of the slots of the terminals to provide a low resistance electrically stable connection of the ribbon conductors to the terminals.

The instant invention is directed to the achievement of improved electrical connections between the conductors of a flat cable and the conductor receiving portions of slotted plate-like terminals. Particularly, the invention is directed to the achievement of improved stuffer or wedging pins, improved methods of installing the connector on the cable and to improved finished connections between flat cables and electrical connectors.

In accordance with a preferred embodiment of the invention, holes are punched in the cable between adjacent conductors and the portions of the conductors which separate the holes and the cable are located in alignment with the slots in the terminals. The conductors of the cable are moved laterally of the plane of the cable into the slots and a strip of stuffer pins is concominantly assembled to the connector. This strip contains a plurality of parallel stuffer pins held in spaced apart relationship in a single plane by an insulating carrier strip.

Preferred embodiments of the invention are described in detail below and shown in the accompanying drawing in which:

FIG. 1 is a fragmentary perspective view of a multi-contact electrical and connector of a type adapted to have the conductors of a flat cable connected thereto in accordance with the invention.

FIG. 2 is a perspective view of a section of flat cable having a plurality of ribbon-like conductors therein,

one end of this cable having been prepared for attachment to an electrical connector in accordance with the principles of the invention.

FIG. 3 is a perspective view showing the manufacture of a strip of stuffer pins of a type used in the practice of the invention.

FIG. 4 is a plane view of a section of stuffer pin strip in accordance with the invention.

FIG. 5 is a fragmentary perspective view showing the end portion of the cable of FIG. 2 positioned with its conductors in alignment with the conductor-receiving portions of the terminals of a connector and showing a stuffer pin strip in alignment with the conductors of the cable; this view shows the relative positions of the terminals, the cable, and the stuffer pin strip at the beginning of the conductor insertion operation.

FIG. 6 is a perspective view of the rearward side of a connector having the conductors of a flat cable connected to the terminals of the connector.

FIG. 6A is a fragmentary plan view of a connector having a cable attached thereto.

FIG. 7 is a perspective view of a strain relief device which is assembled to the connector to maintain the conductors in the terminals and to clamp the cable adjacent to the connector for strain relief purposes.

FIG. 8 is a sectional side view of a connector installed on the conductors of the flat conductor cables.

FIG. 9 is a fragmentary perspective view showing a connector installed on intermediate portions, rather than the end portions of cables.

FIG. 10 is a plan view of a modified form of stuffer pin strip.

FIG. 11 is a perspective view of a section of flat cable having conventional wires therein rather than flat conductors which has been prepared in accordance with the invention for connection to the terminals in a connector.

FIG. 12 is a perspective view showing the cable of FIG. 11 and a connector.

Referring first to FIG. 2, the instant invention is directed to the achievement of improved electrical connections between the flat ribbon-like conductors 76 of a flat cable 2 to the terminals of a connector described below. As shown in FIG. 2, the flat conductors are contained in a web 78 of suitable insulating material such as Mylar polyethyleneterephthalate in parallel spaced apart relationship.

The conductor 4 (FIGS. 1 and 8) comprises a housing 6 having a central body portion 7, a mating side 8, and a rearward side 10. Contact receiving cavities 12 extend leftwardly from the rearward side to the mating side and open onto the surfaces 14, 14' of a rib 13 which projects centrally from the body portion. As will be apparent from FIG. 1, the connector is substantially symmetrical about its horizontal center line and the same reference numerals, differentiated by prime marks, are used for the corresponding structural elements on the upper and lower sides of this center line. In the interest of brevity, only the upper portion of the connector is described in detail.

A hood 16 projects forwardly from body portion 7 in surrounding relationship to the rib 13, this hood being adapted to surround a complementary connector part when mated therewith as fully described in the above-identified application Ser. No. 147,569.

The individual contact terminals 18 which are contained in the cavities 12 have a central shank portion 20, a contact arm of reduced width 22 which extends

from the shank, and a pair of spaced apart plate sections 24, 26 on the rearward end of the shank. The plate sections are joined to each other at their upper ends by parallel straps 28 between which a conductor is moved into slots 30, 32 in the plate sections when the conductor is to be electrically connected to the terminal.

A rib 34 projects from the rearward side of the housing and has a surface 36 on which the shank portions 20 of the terminals are supported. Vertically extending barrier plates 38 extend upwardly from the surface 36 and function to isolate the individual terminals each from the other. At their right-hand ends, as viewed in FIG. 1, the dimensions of these barrier plates are such that their edges are beyond the plate sections 24, 26 and straps 28. The barriers are of reduced height adjacent to the body portion of the housing as shown at 40 and merge with a rearwardly facing surface 42 which extends normally of the surface 36. Surface 42 merges with a ledge 44 which is parallel to surface 36 and this ledge in turn merges with another rearwardly facing surface 46 of the intermediate body portion 7 of the housing.

When the conductors 76 are to be connected to the conductor receiving portions of the terminals 18, holes 80 are punched in the cable between adjacent conductors and the end portion of the cable is located adjacent to the rearwardly facing surface 46 of the housing with the individual conductors in alignment with the slots of the terminals as shown in FIG. 5. A section of stuffer pin strip 86 is located relatively above the cable with stuffer pins 88 in alignment with the individual conductors. This stuffer pin strip (FIG. 4) carries a plurality of spaced apart flat stuffer pins 88 having centrally enlarged portions 90. The pins have enlarged ends 92 which are bonded to spaced-apart parallel carrier strips 94 of suitable plastic as described below.

When the electrical connections between the conductors and the terminals are formed, the stuffer pin strip and the conductors of the cable are simply moved downwardly as viewed in FIG. 5 and into the inner portions of the slots 30, 32. The edges of the slots penetrate the insulation on the under sides of the conductors and establish electrical contact therewith and the conductors become wrapped around the pins so that the pins maintain the conductors in contact with the edges of the slots as explained in application Ser. No. 310,056 now abandoned. The insertion operation as described above can be carried out with an apparatus of a general type disclosed in application Ser. No. 310,056 now abandoned or can in fact, be carried out by simply manually aligning the cable and stuffer pin strip moving a simple stuffing tool against the pins 88 until the conductors are fully inserted. The insertion apparatus shown in application Ser. No. 310,056 has a slide member in which a plurality of insertion punches are mounted. The punches engage the pins and push the pins 88 and the conductors into the slots 30, 32. The enlarged center portions 90 of the pins provides a bearing area for the punches during insertion.

Referring now to FIG. 3, the stuffer pin strip can be manufactured by simply punching openings in a thin strip of sheet metal to form two metallic carrier strips 96 with the stuffer pins 88 integral with, and extending between, these carrier strips ladder-rung fashion. Pilot holes as shown are ordinarily punched in the carrier strips 94 at the time of manufacture. The plastic carrier strips 94 are then bonded to the enlarged portions 92 of

the stuffer pins 88 and the metallic carrier strips can then be removed by shearing the enlarged portions of the pins from these metallic carrier strips. The plastic carrier strips 94 are advantageously of Mylar (polyethyleneterephthalate) and are provided with a thin film (about 1 mil) of adhesive comprising a co-polymer of ethylene and acrylic acid. The enlarged portions of the stuffer pins can then be heat bonded to the carrier strips and the stuffer pins will thus be accurately positioned on the plastic carrier strips 94.

It is desirable to provide a cover means as shown in FIGS. 7 and 8 on the rear side of the connector housing in order to retain the conductors of the cable in the slots of the terminals and to clamp the cable for strain relief purposes. This cover means comprises two parts which are identical so that a description of one will suffice for both.

The upper part in FIG. 7 comprises an elongated web 52 having a flange 54 depending from its rearward edge and a relatively short flange 56 depending from its forward edge which is adjacent to the surface 46 after installation. The external surface of the flange 58 is advantageously cylindrical as shown in FIG. 4 so that it will confine and clamp the cables against the surfaces 42, 46. A central flange 60 is provided between the flanges 54, 56 and spaced from the flange 56 by a distance such that the barriers 38 will be received within the groove or channel 61 which is defined by the opposed sides of the two flanges. The dimensions of flanges 56, 60 are such that they serve to hold the cables in the inner ends of the slots 30, 32 of the terminals and prevent any lateral movement of the conductors which might degrade the electrical connections of the conductors to the terminals.

An end flange 62 depends from the righthand end of the upper cover part and an integral latching strap 66, having a central opening 68, projects downwardly from the lower end of this flange. Another end flange 64 depends from the lefthand end of the web 52 and has a central recess 70 on its outwardly facing side which is adapted to receive the latch strap 66' of the lower cover part, a locking boss 72 being provided in this recess for cooperation with the locking strap 66'. When the parts, as viewed in FIG. 7, are moved towards each other, the straps 66, 66' will then be flexed outwardly until the bosses enter the openings 68, 68'. The opposed surfaces 74, 74' and 76, 76' of the end flanges 62, 64 bear against the sides 48 of the central rib 34 of a connector housing so that the cover is restrained against movement.

Both the housing and the cover member are advantageously formed of a plastic insulation material, the material for the cover being such that the latch straps 66, 66' are stiffly flexible to permit assembly of the cover parts to the connector.

After the conductors have been inserted into the slots of the contact terminals in the manner described above, the cover 50 is assembled to the housing by positioning the two cover parts on the opposite sides of the rib 34 as shown in FIG. 7 and moving them towards each other until they are latched to each other. The flanges 54, 54' are spaced apart in the assembled cover member to define an opening 78 through which the incoming cables extend. Since the cables 2, 2' are usually quite thin, it may be desirable to place a block of compressible material 97, such as a soft rubber, between the cables prior to assembly of the cover to the connector housing. The block is compressed as shown in the

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drawing so that the cables are clamped between opposed edges of the flanges 54, 54'. If a tensile pull is applied to the cables, the forced applied will be transmitted from the cables to the back cover rather than to the terminals in the housing.

As shown in FIG. 9, an intermediate portion of the cable can be connected to the terminals in the connector by punching the holes at the desired location connecting the conductors 2 to terminals as described above, and then assembling the back cover to the housing.

Several of the advantages of the invention will be apparent from the foregoing description, for example, the fact that the holes 80 are spaced from the end of the cable ensures that the conductors can be easily and precisely located in alignment with the conductor receiving slots 30, 32 of the terminals. Also, the fact that the stuffer pins are held on the plastic carrier strips 94 facilitates the location of the plastic strip with reference to the conductors. The use of the stuffer pin strip 86 is advantageous for the further reason that during insertion of the conductors of the cable and insertion of the stuffer pins into the slots of the terminals, the stuffer pin strip is moved as a unit and the individual stuffer pins remain on the carrier strips 94. Because of this, it is possible to retain close control of the individual stuffer pins during insertion and the possibility of one or more pins being improperly inserted is reduced.

The operation of installing the connector on the cables thus is a relatively simple one in which there is little possibility of error and which can be carried out without a high degree of operator skill. If desired, the conductors can be formed or U-ed when the windows or openings are punched to facilitate their entry into the slots of the terminals. Whether or not this step is desirable will depend upon the size of the conductors relative to the width of the slots at their upper ends.

The teachings of the invention can also be employed to advantage when it is desired to connect the conventional round wire conductors 102 of a cable 98 to terminals in a connector. The cable 98 is similar to previously described cable 2 excepting that the conductors are ordinary round wires, either solid or stranded. As shown in FIG. 11, the web material can be removed adjacent to the end of the cable and the conductors accurately positioned over the terminals. The conductors are then moved into the slots and stuffer pins need not necessarily be used in this embodiment although they may be used if desired to improve the electrical and mechanical qualities of the connections between the conductors and the cables.

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. A continuous strip of stuffer members, each of said stuffer members being adapted to be inserted into the conductor-receiving slot of a contact terminal member

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for the purpose of retaining a conductor in the slot, said strip comprising:

two spaced-apart parallel co-planar carrier strips of polymeric insulating material,

5 said stuffer members each comprising a stuffer pin which is adapted to be moved laterally of its axis against a conductor and into said slot, each of said pins comprising a flat sheet metal member having parallel side edges, an enlarged center section, and enlarged ends,

10 said stuffer members extending between said strips of polymeric insulating material ladder-rung fashion, said stuffer members being spaced apart along the length of said carrier strips and having said enlarged ends adhered to said strips whereby,

15 upon positioning each of a plurality of conductors in alignment with the slots of each of a plurality of contact terminals, and upon positioning a section of said stuffer strip proximate to said conductors with one stuffer pin parallel to each of said conductors, and upon subsequently moving said section of stuffer strip towards said conductors and then moving said stuffer strip and said conductors into said slots, said conductors will be engaged by the edges of said slots and thereby establish electrical contact with said terminals, and said stuffer pins will retain said conductors in said slots.

2. A continuous strip of stuffer members, each of said stuffer members being adapted to be inserted into the conductor-receiving slot of a contact terminal member for the purpose of retaining a conductor in the slot, said strip comprising:

two spaced-apart parallel co-planar carrier strips of polymeric insulating material,

35 said stuffer members each comprising a stuffer pin which is adapted to be moved laterally of its axis against a conductor and into said slot,

said stuffer members extending between said strips of polymeric insulating material ladder-rung fashion, said stuffer members being spaced apart along the length of said carrier strips and having their ends adhered to said strips and

40 a third carrier strip, each of said pins being integral with said third carrier strip, said third carrier strip extending beside one of said polymeric carrier strips and parallel to the edge thereof which is remote from the other one of said polymeric carrier strips, said third carrier strip being removable from said strip upon insertion of said pins into said slots whereby,

50 upon positioning each of a plurality of conductors in alignment with the slots of each of a plurality of contact terminals, and upon positioning a section of said stuffer strip proximate to said conductors with one stuffer pin parallel to each of said conductors, and upon subsequently moving said section of stuffer strip towards said conductors and then moving said stuffer strip and said conductors into said slots, and removing said third carrier strip from said stuffer strip said conductors will be engaged by the edges of said slots and thereby establish electrical contact with said terminals, and said stuffer pins will retain said conductors in said slots.

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