

- [54] **ELECTRICAL CABLE CONNECTOR**  
 [75] Inventor: **Frank E. Cooney**, Manhattan Beach, Calif.  
 [73] Assignee: **NCR Corporation**, Dayton, Ohio  
 [22] Filed: **May 10, 1971**  
 [21] Appl. No.: **141,737**

|           |         |                |              |
|-----------|---------|----------------|--------------|
| 3,573,704 | 4/1971  | Tarver.....    | 339/14 R     |
| 3,634,806 | 1/1972  | Fergusson..... | 339/176 MF X |
| 3,691,509 | 9/1972  | Krol.....      | 339/17 F X   |
| 3,697,925 | 10/1972 | Heuschen.....  | 339/17 F     |

## OTHER PUBLICATIONS

Malco Manufacturing Company, Bulletin 705, "Flat Cable Connectors," Printed in 1970.

*Primary Examiner*—Roy D. Frazier  
*Assistant Examiner*—Terrell P. Lewis  
*Attorney, Agent, or Firm*—J. T. Cavender; James H. Phillips; Edward A. Gerlaugh

- [52] U.S. Cl..... 339/17 F; 339/14 R; 339/103 M; 339/176 MF  
 [51] Int. Cl.<sup>2</sup> H01R 3/06; H01R 13/58; H05K 1/02  
 [58] Field of Search..... 339/17 R, 17 C, 17 E, 17 F, 339/17 L, 17 M, 18 R, 18 C, 18 P, 75 M, 75 MP, 14 R, 14 P, 14 L, 95, 97, 99, 174, 176 MP, 103, 105, 107, 176 MF, 192 R, 276 R, 276 T

## [56] References Cited UNITED STATES PATENTS

|           |        |                   |             |
|-----------|--------|-------------------|-------------|
| 3,245,024 | 4/1966 | Evans.....        | 339/103 M X |
| 3,252,126 | 5/1966 | Brown.....        | 339/99 R    |
| 3,363,224 | 1/1968 | Gluntz.....       | 339/276 T X |
| 3,403,369 | 9/1968 | Steiff et al..... | 339/192 R   |
| 3,509,513 | 4/1970 | Russin.....       | 339/14 R    |
| 3,569,900 | 3/1971 | Uberacker.....    | 339/192 R   |

## [57] ABSTRACT

Improved electrical cable connector and process for fitting a cable end thereto, featuring means for transmitting all strain between connector and cable into those elements of the cable other than the electrical conductors, simultaneous preparation of all electrical conductor end tips by a process including abrading the cable down to the level of the conductor and then crimping on tip fittings, and enclosing the cable tips loosely in the connector.

2 Claims, 6 Drawing Figures

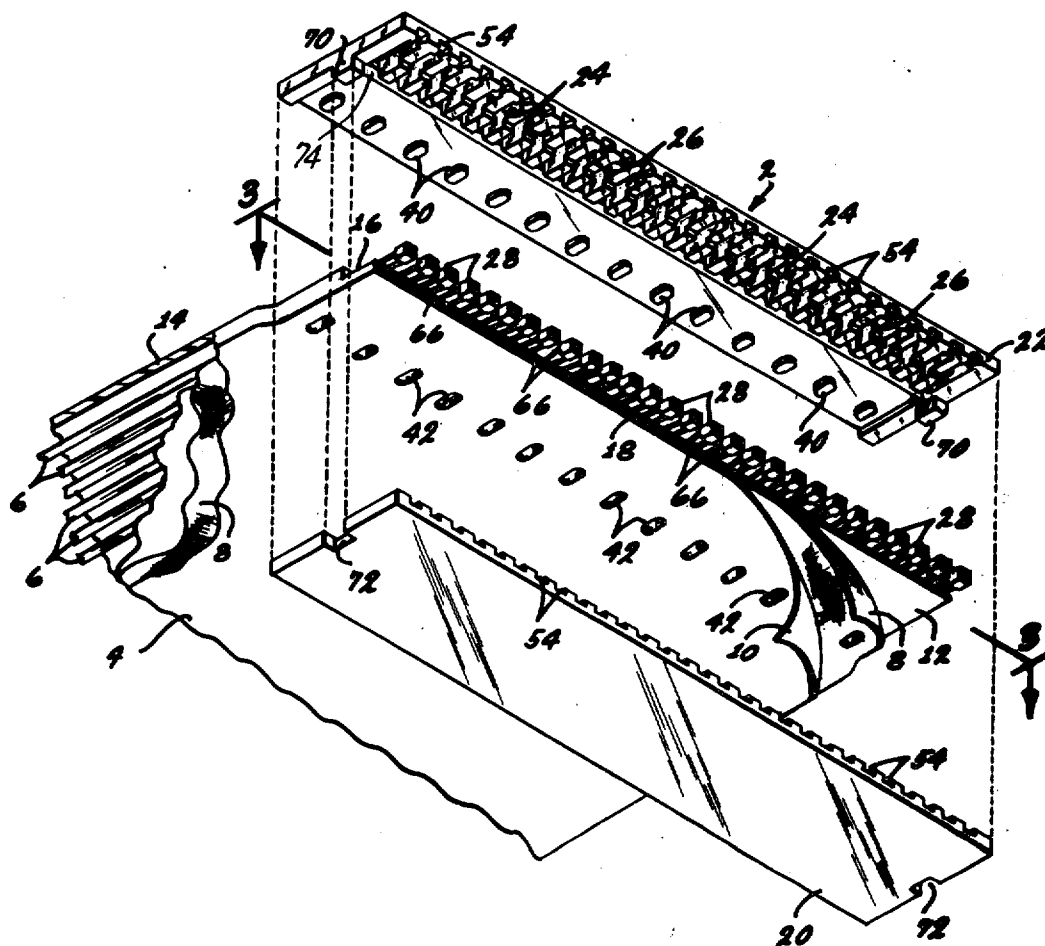


FIG. 1

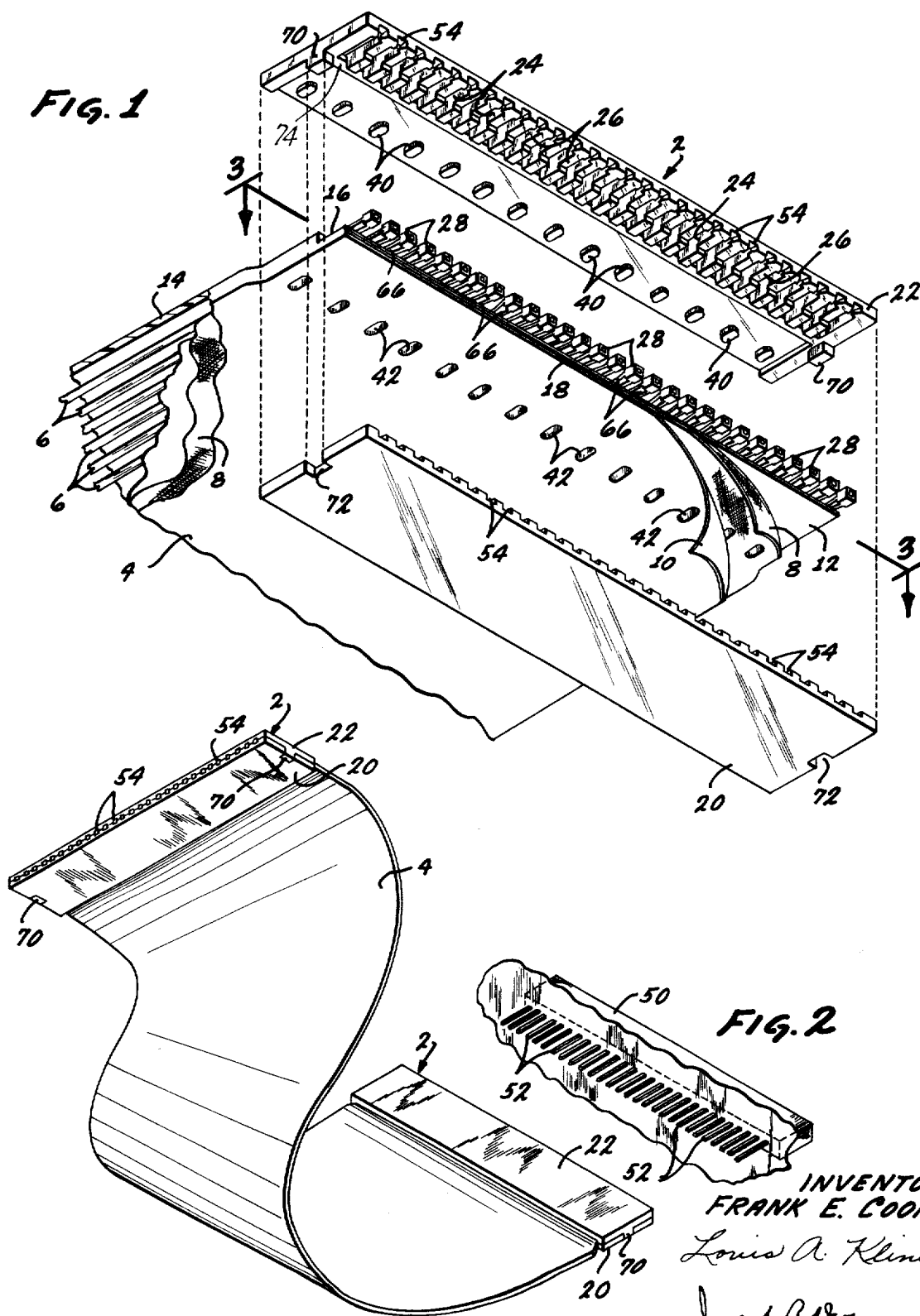
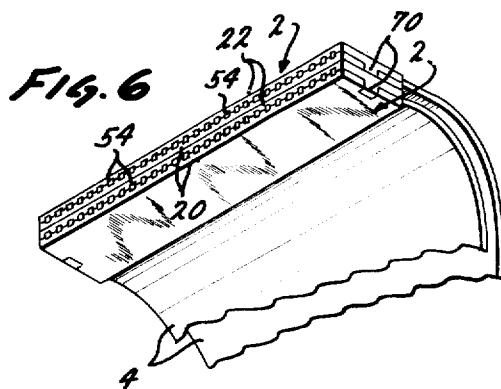
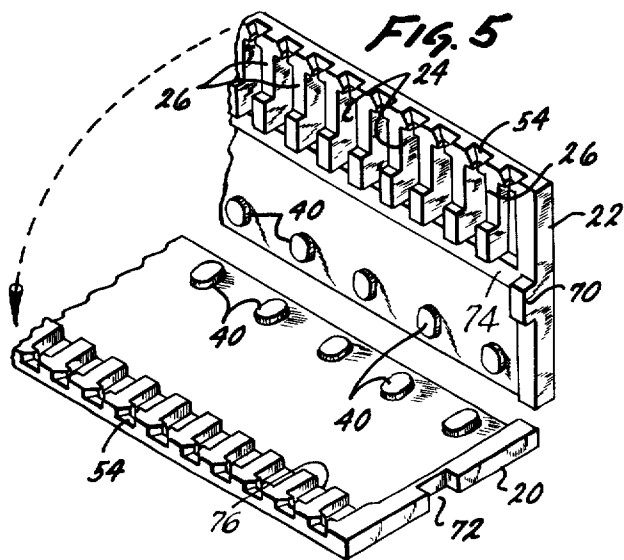
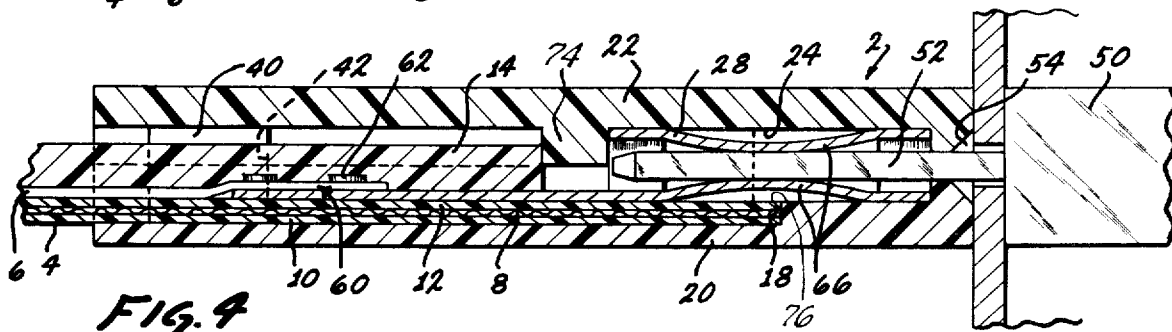
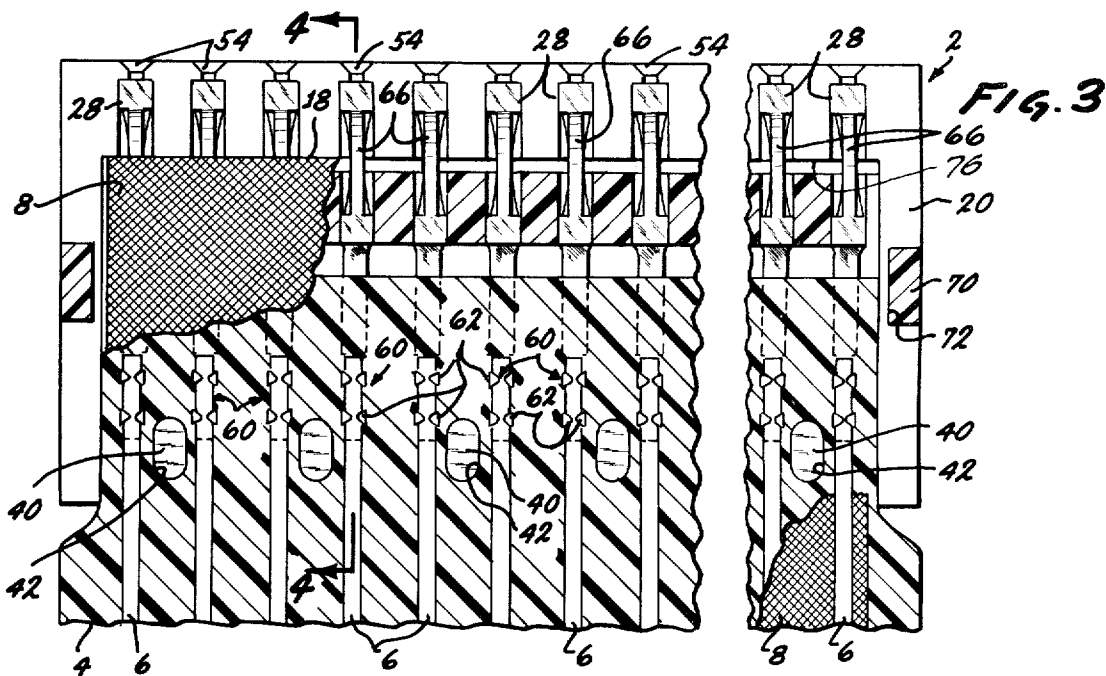


FIG. 2

INVENTOR  
FRANK E. COONEY  
Louis A. Kline  
Joseph R. Dwyer  
BY James H. Griffin  
HIS ATTORNEYS



INVENTOR  
FRANK E. COONEY

*Louis A. Kline*

BY *Joseph R. Blum*  
*James H. Coffin*  
HIS ATTORNEYS

## ELECTRICAL CABLE CONNECTOR

This invention relates to electrical connectors, and more particularly to electrical connectors for flat electrical cable containing a large number of wires or conductive strips, with insulation therebetween.

Prior art connectors for flat cable have utilized end fittings (usually female) that must be individually fitted onto and attached to the individual wires of the cable. To prepare for this, the wires must be cut and stripped of insulation. Once on, the end fittings had to be individually inserted into the proper receptacle of the connector plug, to be held in place by some mechanical connection between the end fittings and the receptacle.

These prior art connectors are extremely time-consuming to assemble, and also unsatisfactory in operation, because all the strain transmitted from the connector to the cable is transmitted through the electrical conductors. Also, the tolerances necessary for proper locking of the mechanical connection are often close; yet if locking does not occur, the electrical connection will be bad or non-existent.

Therefore, it is a general object of this invention to provide an improved cable connector which can be made more cheaply and which provides better, more long-lasting electrical connection than connectors presently in use. Another prime object is to provide an electrical connector system wherein the point of connection is shielded by a ground plane of maximum proximity, as the greatest resistance and capacitance losses occur at junction between the two plug halves. Another object of this invention is to provide a cable connector that relieves the strain on the conducting members of the cable, transferring the strain instead to the insulation. Another object of this invention is to provide a connector system and installation procedure that is fast, accurate, and usable with multi-layer cable having a bonded ground shield fully covering the cable said shield 8 extending beyond the area where female receptacles are attached and covering an area almost to the entire connector area, thereby shielding the inserted male pin 52.

In the achievement of the above and other objects and as one feature of this invention, there is provided a flat cable connector system having a simplified end fitting that does not perform any function other than making electrical contact between a cable electrical conductor (usually, an individual wire or a ribbon conductor) and the pin from the back panel to which the connector is affixed. The locking and strain-bearing functions are instead imposed upon the insulation between the electrical conductors and upon the bonded ground plane, if the cable includes such a ground plane. Strain from the cable insulation, is, in the inventive system, transmitted into the receptacle or connector housing without utilizing the electrically conductive components thereof.

Further, the cable 4 is firmly held between the upper and lower sections to facilitate insertion of the male pins 52 without buckling or bending the conductors 6 of the cable assembly upon insertion.

As another feature of the invention, the cable end is prepared by a process which replaces individual stripping of conductors with the steps of abrading off insulation across the entire cable, near to the level of the conductors, then peeling back the conductors away from the ground shield, then crimping end fittings to the

nearly exposed wiring (the crimping making the final breakthrough to electrical connection), and punching positioning holes in the insulation. After crimping, the cable is bonded, sewed, glued or the like to the ground shield, to ensure the close and permanent proximity necessary for the ground plane to eliminate stray capacitance and resistance.

According to the invention, cable end preparation is followed by bonding or otherwise affixing the cable end into a plastic connector which holds the cable end in place longitudinally only by contact with the positioning holes in the insulation. Lateral positioning of the individual conductor terminals is accomplished by laying them in channels where they can slide freely in the longitudinal direction.

Other objects and features of this invention and a fuller understanding thereof may be had by referring to the following description and claims, taken in conjunction with the accompanying drawings in which:

FIG. 1 is an exploded perspective view of a cable end according to the instant invention;

FIG. 2 shows the interaction of the cable end of FIG. 1 with a back panel plug to which the cable end is to be connected;

FIG. 3 is a plan view with partial cutaway of a cable end connector according to the invention;

FIG. 4 is a section taken along line 4—4 of FIG. 3 through the connector of FIG. 3;

FIG. 5 is a perspective view of the two halves of a cable end connector housing according to the invention; and

FIG. 6 is a perspective view of a dual cable arrangement according to another feature of the invention.

Referring to FIG. 1, the connector system 2 shown there is mounted on the end of a length of flat electrical cable 4 which is made up of conductive strips 6, a layer of ground shield 8, a bottom layer of insulation 10, a center layer of insulation 12, and a top layer of insulation 14. The bottom layer of insulation 10 is mounted upon the ground shield 8; the center layer of insulation 12 is mounted between the ground shield 8 and the conductor 6. The top layer of insulation 14 is mounted on top of the conductor 6. According to the invention, the end of the cable 4 is prepared for the connector system 2 by a process of abrading the top layer of insulation 14 to the level of the conductor 6, along a strip 16.

At the same time, according to the invention, the conductors 6 are exposed by the abrasion of the conductor layer 10 and cutting of the ground shield 8 to the point 18 of FIG. 1. It should be noted that an important feature of this invention is that it permits the ground shield 8 to remain in maximum proximity to the points 60 (where end fittings 28 are crimped to the conductive strips 6 shown in FIGS. 3-4) and the points 54 where the end fittings 28 make electrical contact with male members of some cooperating plug.

The connector system of this invention includes a bottom housing 20 and a top housing 22 which are fitted onto the end of the cable 4 after it has been prepared in a manner to be described below. The top housing 22 (or whichever portion of a connector housing according to the invention is nearest the conductive strips 6) has channels 24 formed by separation walls 26 wherein the conductive strips 6 and their end fittings 28 may lie loosely, so that no strain can be transmitted through them between the cable 4 and the housing 20-22.

Strain-transmission, or the mechanical connection function of the connector system 2, is, therefore, performed by an entirely separate portion of the housing 20-22 and cable 4. In the preferred embodiment set forth in FIG. 1, the strain is transmitted by the interaction of projections 40 of the housing 22 (although either or both housing halves could have such projections) fitted into holes 42 punched into the insulation layers 10-12-14 between the conductive strips 6, so that the conductive strips 6 are not directly involved in strain transmission. The raised portion 74 holds the cable firmly to prevent buckling of the conductors 6 when the male pins 52 are inserted in the receiving tips 28. Another great advantage of the channel 24-projection 42 feature of this invention is that it eliminates the prior art requirement that each end fitting 28 be snap-fitted into a specially built fitting, a very close-tolerance, low-reliability, and costly technique.

According to the process concepts of this invention, the end of the cable 4 is prepared by stripping away (preferably by abrasion) the layers 8, 10, 12 and 14, as shown in FIG. 1.

It should be noted that this abrasion step is optional, depending on the makeup of the cable 4 with some brands of cable 4, crimping without any preparation at all will achieve electrical contact between conductor 6 and end fitting 28. With other brands of cable 4, some removal is necessary. If the cable 4 has a ground shield 8 as one parallel layer along its length, this ground shield is peeled back prior to crimping, to avoid shorting a conductor 6 to ground 8 in the course of crimping.

Thereafter, the end fittings 28 are crimped to the ends of the conductor 6; and the ground shield 8 (if there is one) is reglued or rebonded to the cable 4. Then the holes 42 are punched; finally the housings 20 and 22, are fitted to the end of the cable 4 with the projections 40 passing through the holes 42 and with the end fittings 28 lying loosely in the channels 24. The entire assembly 4-20-22 may then be held together by any conventional means, preferably by ultrasonic bonding or gluing.

Referring to FIG. 2, the cable 4 shown there has connector systems 2 mounted on either end. These connector systems 2 are designed to interact with a plug 50 having pins 52 to make electrical connection with the electrical conductor 6 through the end fittings 28. For this purpose, the end fittings 28 each have an outer end 54 designed to act as the female fitting for the pins 52.

Referring to FIG. 3, the detailed plan view of the connector system 2 shows the end fittings 28 crimped to the conductive strips 6 at the point 60. The crimping at 60 may be accomplished by any conventional procedure and design, such as the tabs 62 of the end fittings 28 which have been bent over to surround the conductive strips 6, in the process breaking through the insulation 14 in that area (which may or may not have been stripped down near the surface of the conductive strips 6, depending on the material and thickness of the insulation 14) to make electrical as well as mechanical connection. The shield 8 rests against the abutments at point 76 for maximum electrical shielding of the plug 2 and the male pins 52.

FIG. 4 illustrates in side-view cutaway a connector system 2 interacting with a plug 50, which has been inserted with its pins 52 in the female end 54 of the crimped-on end fittings 28. It can be seen that the

crimped area 60 holds the conductive strip 6 to the fitting 28 without breaking through the layer of insulation 12 separating the ground shield 8 from the conductive strip 6. The design of the female end 54 of the end fitting 28 is a matter of the prior art; for example, the pin 52 is shown in FIG. 4 to be held in snug mechanical connection and thus reliable electrical connection by a flexible construction 66 in the female end of the end fitting. The raised portion 76 of the upper housing firmly grips the flat cable 4 to prevent buckling of the conductors 6 when the male pins 52 are inserted.

Referring to FIG. 5, an examination of the inside faces of the top connector housing 22 and of the bottom connector housing 20, shows that the two halves 20-22 are designed to ensure cooperation therebetween in several respects. Firstly, the top and bottom may be keyed to one another by any mortise 72 and tenon 70. Secondly, arrangement of the mechanical equivalent of the projections 40 on top and bottom may cooperate in engaging the punched holes 42. Thirdly, the shape of the channels 24 and separating members 26 is vital in positioning the end fittings 28 as closely as possible to facilitate entry of the pins 52, while still leaving the end fittings 28 lying loosely in the channels 24, with full freedom of longitudinal movement.

Referring to FIG. 6, it can be seen how two connector systems 2 of the sort shown in FIG. 1 can be designed so thin that numerous lengths of cable 4 can be mounted, by gluing or the like, parallel to one another with minimum space occupancy. Thus, the improved design concepts facilitated by this invention not only provide superior ground shielding at the worst-impedance points (60 and 54) of the connector system 2, but also cut down on the cost of manufacturing lengths of cable having connector systems 2 at either end and also provide a more reliable and compact system.

The great increase in reliability is mainly attributable to the concept of transmitting all strain between connector 2 and cable 4 through the insulation 10-12-14, leaving no force available to pull the electric conducting strips 6 and their end fittings 28 away from the connecting pin 52.

Although the invention has been described in its preferred form with the certain degree of particularity, it should be understood that the present disclosure of the preferred form has been made only by way of example, and that numerous changes in the details of construction and in the combinations and arrangements of parts may be resorted to without departing from the spirit and the scope of the invention as hereinabove claimed.

I claim as my invention.

1. An assembly for connecting conductors enclosed in the insulating matrix of a flat cable to an electrical circuit component, wherein a ground shield extends parallel to said conductors substantially co-extensive with said matrix and said conductors, comprising:

- a connector housing comprising a nest member and a cover member,
- a contact crimped onto a free end of at least one of said conductors,
- insulation means disposed between said contact and said ground shield,
- a plurality of apertures formed through said matrix and said shield between said conductors,

5

- e. said nest member and cover member sandwiching said contact and the end of said cable to which it is attached between them, and
- f. a plurality of anchor teeth formed on one of said nest member and said cover member and extending through corresponding ones of said apertures,
- g. the free ends of said anchor teeth being bonded to the other of said nest member and said cover mem-

6

ber.

2. The connector assembly of claim 1 further characterized in that:

- a. an ultrasonic bond is formed between the free ends of said anchor teeth and the other of said nest member and said cover member.

\* \* \* \* \*

10

15

20

25

30

35

40

45

50

55

60

65