United States Patent

Kelly et al.

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[54] **FLAT CABLE CONNECTOR**

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[73] Assignee: **International Telephone and Telegraph Corporation**, New York, N.Y.

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[52] **U.S. Cl.** .....**339/99 R**, 339/176 MF

[51] **Int. Cl.** **H01r 7/04**

[58] **Field of Search**.....339/97–99, 176

[56] **References Cited**

UNITED STATES PATENTS

3,201,745	8/1965	Williams	339/99 R
3,235,833	2/1966	Elm	339/97 P

FOREIGN PATENTS OR APPLICATIONS

1,169,158	12/1958	France	339/99 R

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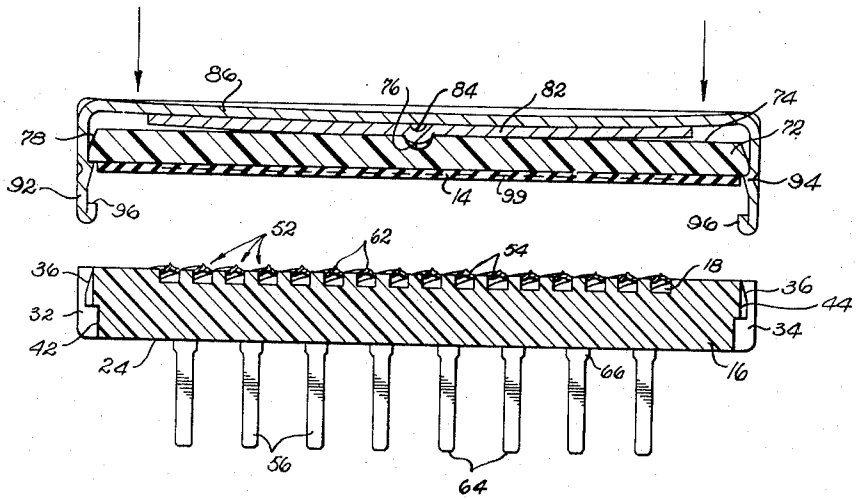
[57] **ABSTRACT**

An electrical connector member having an insulated flat cable having conductors embedded therein. The electrical contacts have insulation piercing portions formed thereon with the contacts mounted in an insulator member. The contacts are connected to the flat cable conductors by the piercing portions which penetrate the cable insulation when a clip is secured to the insulator. A cover member may be interposed between the clip and the flat cable for positioning the cable in the connector. Also, a spring member allows the cover member and insulator member to be securely held together.

10 Claims, 8 Drawing Figures



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SHEET 1 OF 2

Fig. 1.

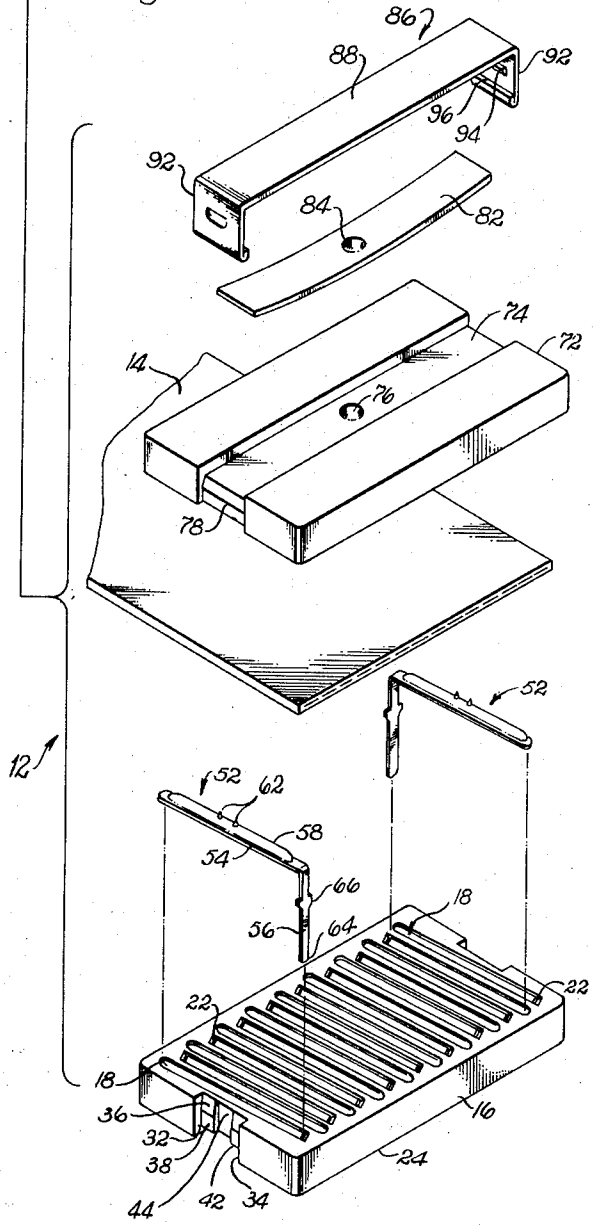
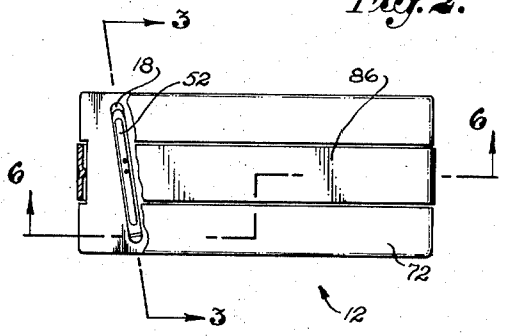


Fig. 2.



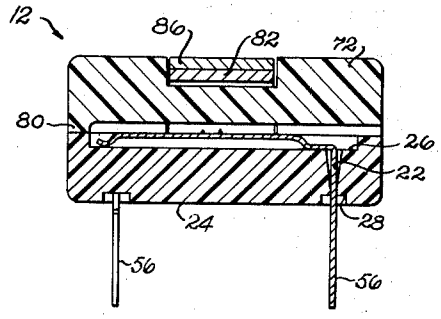


Fig. 3.

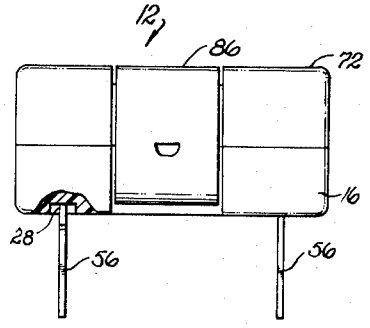


Fig. 4.

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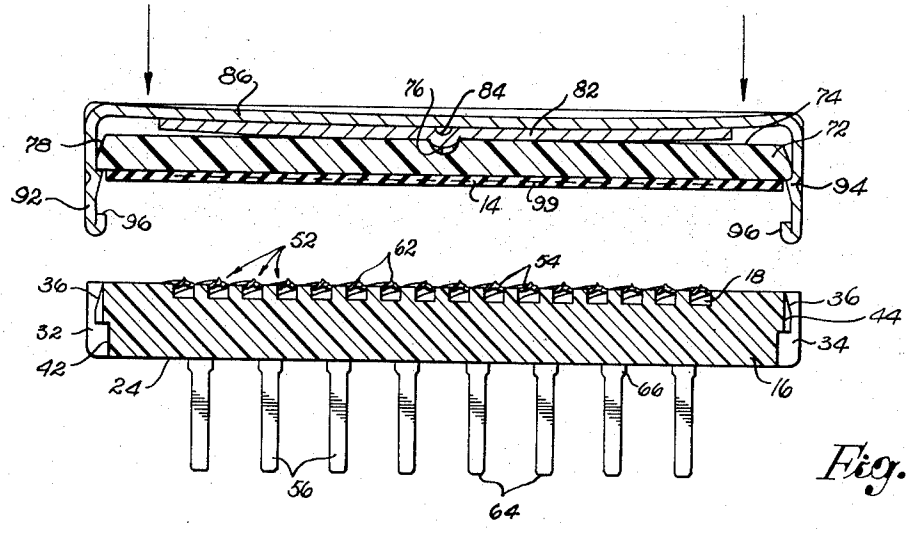

Fig. 5.

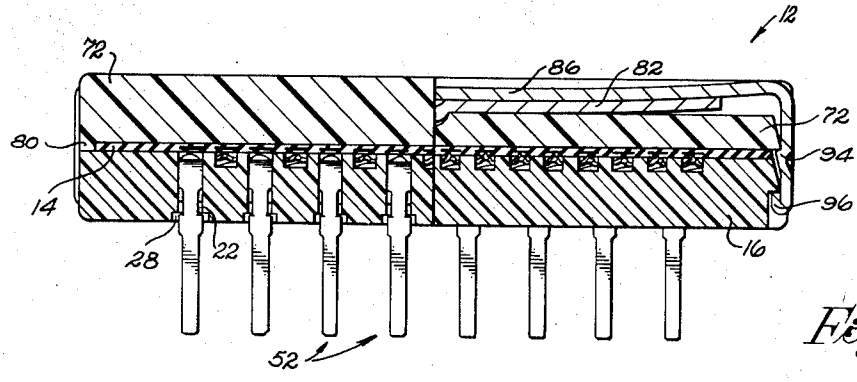

Fig. 6.

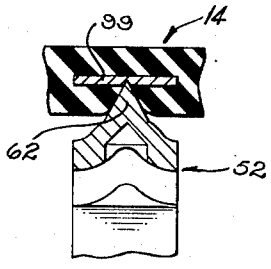

Fig. 7.

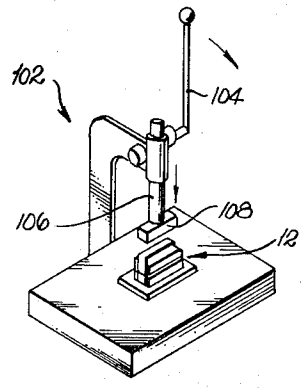

Fig. 8.

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FLAT CABLE CONNECTOR

The invention relates, in general, to an improved flat cable termination and, more particularly, to a connector for terminating a flat cable without removal of the cable insulation therefrom.

BACKGROUND OF THE INVENTION

In U.S. Pat. application Ser. No. 885,033, filed Dec. 15, 1969, there is depicted a flat cable termination wherein a plurality of contact spring members are mounted in a bore, each of the spring members terminating in a piercing surface. An actuating plate is inserted in the bore, causing the spring members piercing surfaces to pierce the insulation of the flat cable and thus make contact with the conductors of the cable. This flat cable termination device, while sufficient for certain uses, cannot provide the higher piercing force required for high temperature cables. Moreover, it has been found that movement can occur between the actuating plate and the cable insulation resulting in an unsatisfactory connection between the conductors and the spring members.

In order to overcome the attendant disadvantages of prior art flat cable terminating connectors, the present invention provides an electrical connector having a pair of connector halves which are snapped together over the end of the flat cable to insure a permanent and reliable termination. Moreover, the piercing forces are provided so as to allow the termination to readily operate with substantially all types of flat cables. Clip means are provided to lock the assembled connector halves together, while simultaneously spring loading the connector halves against the flat cable.

The advantages of the invention, both as to its construction and mode of operation, will be readily appreciated as the same becomes better understood by reference to the following detailed description when considered in connection with the accompanying drawings in which like referenced numerals designate like parts throughout the figures.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 depicts an exploded perspective view of the flat cable terminating connector in accordance with the invention;

FIG. 2 illustrates a top view of the flat cable connector of FIG. 1 assembled and partly in section;

FIG. 3 shows a sectional view of the flat cable connector of FIGS. 1 and 2 taken along the line 3—3 of FIG. 2;

FIG. 4 illustrates an end view of the connector of FIG. 2;

FIG. 5 depicts a sectional view of the connector taken along the line 5—5 of FIG. 2 prior to complete termination of the connector to the flat cable;

FIG. 6 depicts a sectional view of the connector of FIG. 5 with the flat cable fully terminated;

FIG. 7 illustrates the piercing of the flat cable by the electrical connector; and

FIG. 8 depicts a tool which may be utilized in assembling the connector of FIGS. 1 through 7.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now to the drawings, there is shown in FIG. 1 an exploded perspective view of a connector **12** used to terminate a flat cable **14** in accordance with the invention. The connector is formed of an insulator block **16** of generally rectangular shape having grooves or channels **18** extending diagonally across the top surface of the insulator block **16**. Near alternate ends of adjacent channels openings **22** are formed which extend from the channel surface through to the bottom surface **24** of the insulator. As shown more clearly in FIGS. **3** and **4** the openings **22** may be chamfered at the top end **26** and a bore may be formed near the bottom surface **24** with a downwardly facing shoulder **28** formed by the bore.

At the opposite ends of the insulator block **16** a groove is formed defining a pair of side walls **32, 34**. Adjacent the side walls inwardly extending sections are formed by a tapered top section **36** and a rectangular bottom block **38** which terminates prior to the bottom surface of the insulator to form a downwardly facing shoulder **42**. Further, intermediate the inwardly extending sections a slot **44** is formed in a plane perpendicular to the side walls.

Contacts **52** which are generally L-shaped are positioned in the channels **18**. The contacts are typically made from sheets of beryllium copper which have been stamped or formed and then heat treated. The contacts are constructed of a terminating portion **54** and a vertical portion **56**. The terminating portion **54** is made in the form of a convex leaf spring portion **68** which is **58** positioned within the channels **18**. At the center of the portion **58**, the contact protrudes slightly above the top surface of the insulator **16** and formed therein are a pair of sharply pointed projections **62** which are designed to pierce the flat cable insulation. Although two projections **62** are depicted in the drawing, it should be understood that only one projection could be utilized or even a large number of projections could be used.

The vertical portion **56** of the contact **52** is inserted into the openings **22** with the free end **64** thereof extending through the bottom surface of the insulator and acting as a mating pin contact or other terminating device. Further, a barb **66** in the vertical portion **56** of the contact is used to position the contact with respect to the insulator. The vertical portion of the contact **52**, when inserted into opening **22** will emerge from the bottom surface of the insulator normally at a slight angle from the insulator's longitudinal axis. However, a slight twist is normally recommended to allow the top surface of the barb **66** to abut the insulator shoulder **28**. Moreover, a twist is normally required to realign the mating portions **64** with respect to each other. The twist could be preformed at the proper location during fabrication of the contacts to provide snap-in self-retaining as well as self-aligning contacts. As can be seen, the channels for one row of contacts extend angularly across the insulator interspaced between the channels for another row of contacts, with the portion of the insulator between adjacent channels forming an insulator barrier.

A cover **72** is generally of the same rectangular dimensions as the insulator **16** and is made of insulating

material also. A central recess **74** is formed longitudinally along the top surface of the cover with a dimpled surface **76** formed at the center of the recess and a tapered end surface **78** terminating the recess short of the end walls of the cover. The bottom surface of the cover is generally smooth and flat except for thin peripheral ribs **80** along one side and at both ends which serve to preposition the flat cable prior to termination while allowing the cable to extend outwardly from the connector side where there are no peripheral ribs.

Further, the bottom surface of the cover could be pre-coated with a pressure sensitive adhesive having a peel-off paper liner. The adhesive would aid in prepositioning of the flat cable for termination, as well as enhancing the cable retention capability of the terminated plug assembly.

A spring member **82** which is generally rectangular in shape fits in the recess **74** in the cover member. The spring member is shorter than the length of the recess. A downwardly extending dimple **84** formed therein is positioned in the cover dimple **76** to allow correct lengthwise positioning of the spring. The width of the spring is slightly smaller than the recess which allows the spring to move in a transverse direction. Further, the ends of the spring member are generally prestressed to bend upwardly when the dimple **84** is positioned in the cover dimple **76**.

A retaining clip **86** is formed of generally U-shaped configuration and is formed of a top portion **88** which is slightly concave and a pair of side legs **92**. At approximately the center of each of the legs **92** a coined inwardly extending tab **94** is formed. The ends of the legs **92** are folded back upon its inner surface to form retaining shoulders **96**. The retaining clip **86** as well as the spring member **82** may be made from spring tempered sheet metal such as stainless steel.

To assemble the connector, the spring member **82** is inserted in the recess **74** of the cover member with the dimple **84** positioned in the dimple **76**. Then the clip **86** is positioned in the recess so that the bottom edge of the end surface **78** is secured to the tabs **94** trapping the spring between the clip and the recess of the cover member as shown in FIG. **5**. Then, the flat cable **14**, having conductors **99**, is inserted from the side where the peripheral ribs **80** have been removed from the cover **72**. As previously pointed out, the bottom surface of the cover may have an adhesive covering to allow the flat cable to be secured thereto. Then the combined clip, spring, cover and flat cable are positioned on the insulator member so that the retaining shoulders **96** are adjacent the tapered top section **36** of the insulator **16**.

A sufficient force is then applied to the top surface of the clip **86** as it is positioned in FIG. **5** of the drawings. The slight concave shape of the portion **88** of the clip is temporarily flattened out by the force, allowing the retaining shoulders **96** to grip to engage the downward facing shoulder **42** of the insulator. To allow for dimensional tolerances in the various parts of the connector, full flattening of the portion **88** of the retaining clip results in slight overtravel of the clip shoulders **96** past the insulator block shoulder **42**. When the force applied to the top of the clip is removed, the spring force produced by the spring member **82** causes the locking shoulders **96** to engage securely and hold the cover **72** and insulator **16** together.

Simultaneous with the application of the force to the retaining clip **86**, the contacts **52** are terminated to the conductors **99** of the cable **14**. The force applied to the clip causes the insulator **16** and cover **72** to be pressed together tightly against the flat cable **98**. The flat cable, in turn, compresses the convex leaf spring portions **58** of the contacts into their respective channels **18**. However, when the bottom of the contact leaf spring flattens against the bottom of the channel, the sharp terminating projections **62** still protrude above the top surface of the insulator **16** and will penetrate the flat cable insulation.

Since the flat cable is backed on its side opposite the projection **62** by the smooth flat bottom surface of the cover **72**, the cable is fixed in its position and the termination point **62** penetrates the cable insulation sufficiently to impinge against the conductor **99** of the cable, thus establishing electrical contact. When the force applied to the cover **86** is removed, the compressive force holding the insulator **16** and cover **72** together is reduced to that provided by the spring **82** and the retaining clip **86**. The spring force exerted by the flattened leaf spring portion **58** of the contact **52** insures that electrical contact is maintained permanently between the contact **52** and the flat cable **14**. This inherent contact spring force also is used to compensate for dimensional tolerance variations in the parts of the connector, for surface irregularities in the insulator **16** and cover **72**, as well as for cold-flow of the flat cable insulation above the termination points **62**.

Referring now to FIG. **8**, there is depicted a typical fixed tool **102** which can be utilized to impart a uniform force to the retaining clip **86**. The tool contains a rotatable arm **104** whose rotation causes linear movement of a lever **106**. Mounted at the end of the lever is a block of metal **108** which upon operation of the tool is forced against the retaining clip correctly positioning the clip in place.

Alternatively, a special pliers-type tool could be employed to assemble the two connector halves together on the flat cable. Such a tool would have a special seating block for the connector assembly in its lower jaw. The seating block would have clearance holes to accept the protruding ends **64** of the contacts of the assembly to protect them from damage during termination. The seating block would also include features to position and support the insulator during the termination operation.

With the insulator assembly positioned properly in its seating block in the tool, the cover **72** would be positioned upon the insulator **16** with the flat cable in position, and with the protruding ends of the clip positioned as in FIG. **5**. The handles of the tool would then be compressed together to complete the termination assembly.

What is claimed is:

1. An electrical connector member for an insulated flat cable having conductors embedded therein comprising:

electrical contacts having insulation piercing means formed thereon;

an insulator member having means for mounting a plurality of electrical contacts therein; and

means for connecting said electrical contacts to said flat cable conductors comprising: a clip member mounted on said insulator member, said insulator member having means formed thereon for guiding said clip member onto said insulator member, said piercing means penetrating said cable insulation when said clip is secured to said insulator by a force positioning said clip on said insulator.

2. An electrical connector member in accordance with claim 1 and further comprising a cover member interposed between said clip member and said flat cable, said cover member having means for positioning said cable in said connector.

3. An electrical connector in accordance with claim 2 wherein said cover member positioning means comprising peripheral ribs formed on the bottom surface of said cover member.

4. An electrical connector in accordance with claim 1 wherein said contact piercing means are positioned on a leaf spring portion of said contacts for insuring electrical contact between said piercing means and said cable conductors.

5. An electrical connector in accordance with claim 1 wherein said contacts are formed of a leaf spring portion and a vertical portion, each of said leaf spring portions being mounted in channels formed in said insulator, with channels for one row of contacts being interspaced between channels for another row of contacts.

6. An electrical connector in accordance with claim 2 wherein said clip member contains shoulders for positioning said cover member therein prior to mounting said clip on said insulator.

7. An electrical connector member for an insulated flat cable having conductors embedded therein comprising:

electrical contacts having insulation piercing means formed thereon;

an insulator member having means for mounting a plurality of electrical contacts therein;

means for connecting said electrical contacts to said flat cable conductors comprising: a clip member mounted on said insulator member, said piercing means penetrating said cable insulation when said clip in secured to said insulator; and

a cover member interposed between said clip member and said flat cable, said cover member having means for positioning said cable in said connector and wherein bottom surface of said cover member contains an adhesive surface.

8. An electrical connector member for an insulated flat cable having conductors embedded therein comprising:

electrical contacts having insulation piercing means formed thereon;

an insulator member having means for mounting a plurality of electrical contacts therein;

means for connecting said electrical contacts to said flat cable conductors comprising: a clip member mounted on said insulator member, said piercing means penetrating said cable insulation when said clip is secured to said insulator; and

a cover member interposed between said clip member and said flat cable, said cover member having means for positioning said cable in said connector, said cover member further containing a central recess formed along the top surface thereof, said central recess height being sufficient to allow said clip member to be positioned therein when said clip member is secured to said insulator member.

9. An electrical connector member for an insulated flat cable having conductors embedded therein comprising:

electrical contacts having insulation piercing means formed thereon;

an insulator member having means for mounting a plurality of electrical contacts therein;

means for connecting said electrical contacts to said flat cable conductors comprising: a clip member mounted on said insulator member, said piercing means penetrating said cable insulation when said clip is secured to said insulator;

a cover member interposed between said clip member and said flat cable, said cover member having means for positioning said cable in said connector; and

a spring member is interposed between said clip member and said cover member, said spring member allowing said cover member and insulator member to be securely held together.

10. An electrical connector in accordance with claim 9 wherein said cover member contains a dimpled positioning means for accurately positioning said spring member on said cover member.

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