June 13, 1967 L. R. TRAVIS 3,325,769

SEPARABLE ELECTRICAL CIRCUIT ASSEMBLY

Filed Sept. 25, 1964

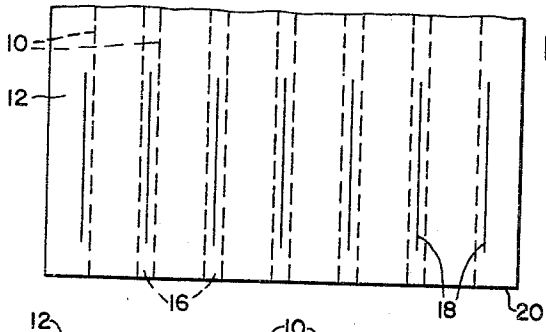


FIG.1.

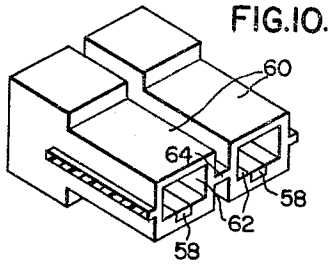


FIG.10.

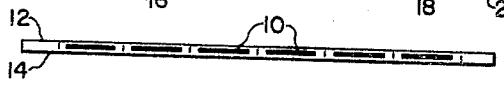


FIG.2.

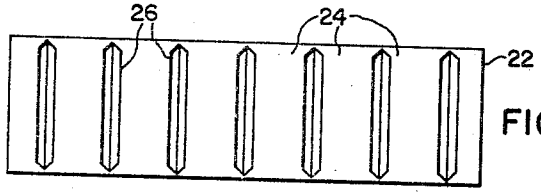


FIG.3.

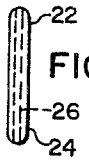


FIG.5.

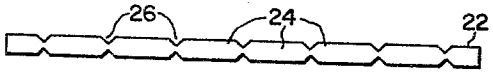


FIG.4.

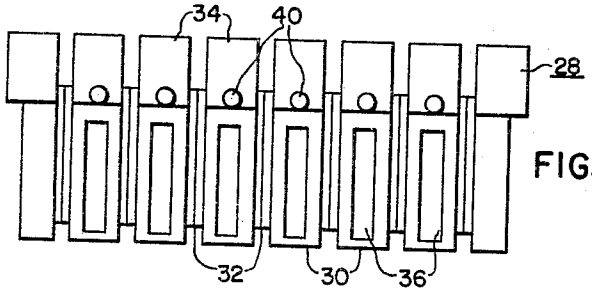


FIG.6.

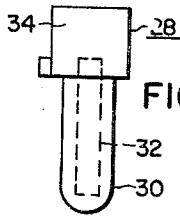


FIG.7.

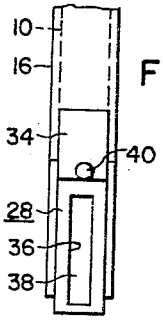


FIG.8.

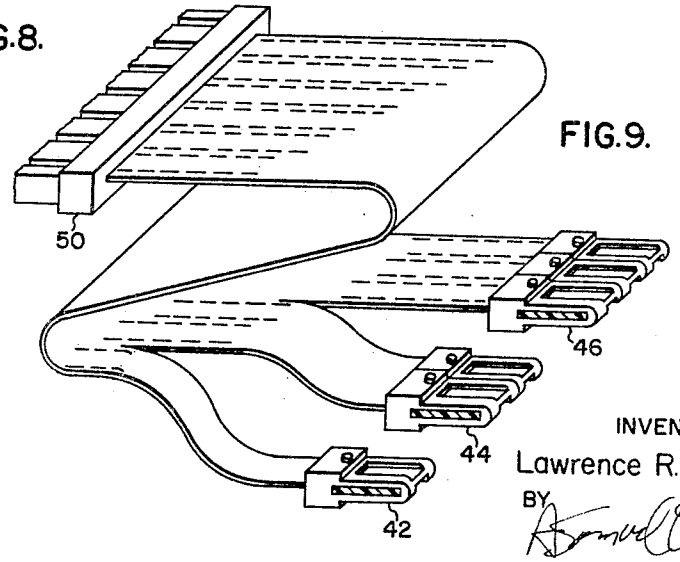


FIG.9.

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SEPARABLE ELECTRICAL CIRCUIT ASSEMBLY

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Filed Sept. 25, 1964, Ser. No. 399,217
5 Claims. (Cl. 339—176)

The present invention relates to electrical circuit assemblies for the termination and connection of electrical conductors, and more particularly to electrical circuit assemblies for use with flat flexible electrical connection conductors.

Flat flexible cables in which a number of usually flat conductors are disposed and bonded between suitable plastic insulating materials may be used to advantage in a great number of applications. One of the problems of utilizing such flat flexible cables is that of providing suitable connection or termination of the cable to other electrical circuitry. A simple, economical, and reliable electrical termination system has been disclosed in copending application Ser. No. 352,156, filed Mar. 16, 1964, and assigned to the same assignee as the present application, which adequately solves the termination problems usually associated with flexible cables.

The most common situation for termination of a flat flexible cable is to have a unitary connector at the end thereof which fits into a mating receptacle. In certain situations it would be highly advantageous to have the capability of providing a multiple connector assembly in which various of the individual conductors with the associated contacts are available for connection at different receptacle areas. Thus, by such an assembly, conductors, one or more, would have their separate connectors available for connection at a given receptacle area, while other conductors, with their associated connectors, could be provided at other connecting areas.

It is therefore an object of the present invention to provide a new and improved connector assembly utilizing a readily adaptable connector or terminating device.

It is a further object of the present invention to provide a new and improved connector assembly utilizing a connecting or terminating device which may be readily separated for different circuit applications.

It is a further object of the present invention to provide a new and improved connector assembly for use with flat flexible cable in which a connecting or terminating device is utilized which is readily separable to provide separate connectors for the various conductors of the cable.

Broadly, the above cited objects are accomplished by providing electrical connector assembly for use with flexible cable by providing a formed termination or connector member which is frangible to permit the ready separation of one or more of the conductors.

These and other objects and advantages of the present invention will become more apparent when considered in view of the following specification and drawings in which:

FIGURE 1 is a plan view of flat flexible cable as utilized herein;

FIGURE 2 is a front elevation view of FIGURE 1;

FIGURE 3 is a plan view of the mandrel as used herein;

FIGURE 4 is a front elevation view of FIGURE 3;

FIGURE 5 is a side elevation view of FIGURE 3;

FIGURE 6 is a plan view of the connector member as utilized herein;

FIGURE 7 is a side elevation view of FIGURE 6;

FIGURE 8 is an enlarged view of one of the broken away contact connector members of FIGURE 7;

FIGURE 9 is a three-dimensional view of the connector assembly as provided herein showing various conductor members separated to provide individual contact members, and

FIGURE 10 is a three-dimensional view of another form of the present invention;

Referring to FIGURES 1 and 2, a section of flat flexible cable is shown having a plurality of elongated electrical conductors **10** sandwiched between two electrically insulating layers **12** and **14**. The conductors **10**, for example, may have a rectangular cross section as shown and comprise copper. One or both of the insulating layers **12** and **14** may, for instance, comprise a film of an aromatic polyimide or aromatic polyimide-imide resin. To secure and bond the conductors **10** between the layers **12** and **14**, a flexible epoxy adhesive may be used. For further details as to the process and materials used in the fabrication of the flexible cable reference is made to the above copending application.

Between the conductors **10** are insulating portions **16**, which are parallel to the conductors **10** and thus separate the conductors **10** so as to provide separate electrical circuits through each of the conductors. Slits **18** may be cut back a predetermined distance into the insulating channel **16** from the end **20** of the flexible cable. The slits **18** permit the separating of the various individual conductors **10** at the end **20** as will be described below.

In FIGURES 3, 4 and 5, a mandrel **22** is shown about which one end of the flexible cable is wrapped. The flexible cable is secured about the mandrel with, for example, a suitable epoxy resin. The mandrel **22** includes a plurality of flat portions **24** which correspond to the respective conductors **10** of the flexible cable and over which the conductors **10** are placed. Between the flat portions **24** are web portions **26** which have a thin cross sectional area. The mandrel **22** may comprise a plastic insulating material. The web portions **26** are designed to have a thin cross section so as to be frangible so that the various flat portions **24** may be separated by the breaking of the web portion **26**. The web portions **26** need only be thick enough to permit the flowing of the plastic material during its molding process. With the conductors **10** of the flexible cable fitting over the flat portions **24** of the mandrel **22** and the insulating channels **18** fitting over the frangible web portions **26** and the cable secured to the mandrel, the cable is ready for molding into a connector or termination member **28** which is shown in FIGURES 6 and 7.

Referring to these figures, a formed connector or termination member **28** is shown which may comprise a plastic insulating material and which is molded directly over the mandrel **22** after the cable has been secured to the mandrel. The connector member **28** comprises a plurality of contact receiving portions **30** which are connected by a plurality of frangible tab portions **32**. The termination member **28** also has an optimal raised back portion **34**, better seen in FIG. 7, which serves as a means for gripping the connector member **28** for inserting or with drawing it from another connector or for mounting of an interfacial seal. In each of the contact receiving portions of the termination member **28**, a contact opening **36** is provided. The contact receiving portions and openings **36** therein are so aligned to be in position over the respective conductors **10** of the cable.

After the formed termination member has been molded directly over the mandrel **22** with the cable secured thereto, the insulation appearing on the outside of the insulating film layer **12** is removed by a chemical process. The areas exposed by the contact openings **36** establish contact areas. These contact areas are then electroplated, for example with gold, to provide a good electrical contact structure **38** as is well known in the art. The chemical removal and electroplating processes are discussed in the

above copending application. FIGURE 8 shows the contact structure **38** appearing through an opening **36** with the molded connector member **28** fitting therearound to provide a one piece connector and contact assembly. A locking lug **40** is molded into the termination member **28** so that a locking structure may be fitted over the lug **40** when a secure connector is desired or for the utilization of an adapter connector.

The frangible tab portions **32** of the formed connector member **28** are disposed over the web portions **26** of the mandrel **22**. The tab portions **32** are so molded as to have a cross section thin enough only to permit the plastic insulating material to flow therethrough during the molding process. Using such a thin web tab portion thus permits the ready breaking through of the insulating material thereof to easily separate the various contact receiving portions **30** of the termination member **28**.

In order to provide a single conductor and connector member, as shown in FIGURE 8, it is only necessary to break through the tab portions **32** of the connector member **28** and through the frangible web portions **26** of the mandrel **22**. This could be easily done since, as described above, the web and tab portions are designed to be relatively thin to permit such separation. The slits **18**, see FIGURE 1, would then serve to permit such separation of one of the conductors **10** with its associated connector member **28** to any desired length. Each separated connector would have its own contact portion **38** which would appear through the contact opening **36** to permit connection to various electrical fixtures.

FIGURE 9 shows a flexible cable assembly in which three connector members **42**, **44** and **46** are shown broken from an original unitary structure. The three connectors **42**, **44** and **46** are broken from a unitary connector member to provide, respectively, a one contact, a two contact, and a three contact connector structure. The flexible cable is shown slit back away from the connectors **42**, **44** and **46** so that these connectors may be inserted into various female receptacles. A unitary connector member **50**, which may be an unbroken member fabricated as described herein, is shown connected to the other end of the flexible cable.

In FIG. 10 is shown another form of the connector assembly as taught herein. The connector assembly as shown takes the form of a female assembly with a contact structure **58** appearing within a contact receiving structure **60** which as aperture **62** therein for receiving a male connector. A frangible web member **64** connects adjoining contact receiving members and permits the ready separation of the various contacts as described above.

It can, thus, be seen by such an assembly that a readily adaptable flexible cable connector assembly is provided which may be used in a great variety of situations and may easily be changed to accommodate a great number of circuit applications. Also it should be noted that the various individual contact elements could be cut or sawed apart after the assembly has been fabricated, if made necessary by the use of thicker areas between the conductors.

Although the present invention has been described with a certain degree of particularity, it should be understood that the present disclosure has been made only by way of example and that numerous changes in the details of construction, fabrication and the combination and arrangement of parts, elements and materials may be resorted to without departing from the scope and spirit of the present invention.

I claim:

1. An electrical connector assembly for use with flat flexible cable having a plurality of conductors disposed therein comprising, a mandrel about which a portion of said cable is disposed, said mandrel including a plurality of frangible web portions, a termination member to encapsulate said mandrel, said termination member including a plurality of frangible tab portions, each of said tab portions corresponding with one of said web portions of said mandrel so that said mandrel and said termination member may be easily broken apart.

2. An electrical connector assembly for use with flat flexible cable having a plurality of conductors disposed therein comprising, a mandrel about which an end portion of said cable is disposed, said mandrel including a plurality of frangible web portions disposed between said flat portions, a molded termination member to encapsulate said mandrel, said molded member including a plurality of contact receiving portions disposed over the corresponding conductors of said cable, and a frangible tab portion connecting said contact receiving portions, each of said tab portions corresponding with one of said web portions of said mandrel so that said mandrel and said molded member may be easily broken apart at the web and tab portions respectively to provide a number of separate contact terminations.

3. An electrical connector assembly for use with flat flexible cable having a plurality of conductors disposed therein comprising, a mandrel about which an end portion of said cable is disposed, said mandrel including a pluraltiy of substantially flat portions over which the conductors of said cable are disposed and a plurality of frangible web portions disposed between said flat portions, a molded termination member to encapsulate said mandrel, said molded member including a plurality of contact receiving portions disposed over the corresponding conductors of said cable, said contact receiving portions having a contact opening therein through which a portion of the corresponding conductor appears for contact purposes, and a plurality of frangible tab portions connecting said contact receiving portions, each of said tab portions corresponding with one of said web portions of said mandrel so that said mandrel and said molded member may be easily broken apart at the web and tab portions respectively to provide a number of separate contact terminations.

4. An electrical connector assembly for use with flat flexible cable having a plurality of conductors disposed therein comprising, a mandrel about which portion of said cable is secured, said mandrel including a plurality of substantially flat portions over which the conductors of said cable are disposed and a plurality of web portions disposed between said flat portions, said web portions being relatively thin compared to said flat portions, a formed termination member molded over said mandrel, said formed member including a plurality of contact receiving portions disposed over the corresponding conductors of said cable, said contact receiving portions having a contact opening therein through which a portion of the corresponding conductor appears for contact purposes, and a plurality of tab portions connecting said contact receiving portions, said tab portions being relatively thin compared to said contact receiving portions, each of said tab portions corresponding with one of said web portions of said mandrel so that said mandrel and said formed member may be easily broken apart at the web and tab portions respectively.

5. An electrical connector assembly for use with flat flexible cable having a plurality of conductors disposed therein comprising, a multi-section mandrel comprising an insulating material about which a portion of said cable is secured, said mandrel including a plurality of substantially flat portions over which the conductors of said cable are disposed and a plurality of frangible web portions disposed between said flat portions, a multi-section formed termination member comprising an insulating material molded about said mandrel to encapsulate said mandrel, said formed member including a plurality of contact receiving portions disposed over the corresponding conductors of said cable, said contact receiving portions having a contact opening therein through which a portion

of the corresponding conductor appears for contact purposes, and a plurality of frangible tab portions connecting said contact receiving portions, each of said tab portions corresponding with one of said web portions of said mandrel so that said mandrel and said formed member may be easily broken apart at the web and tab portions respectively to provide a number of separate contact terminations.

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