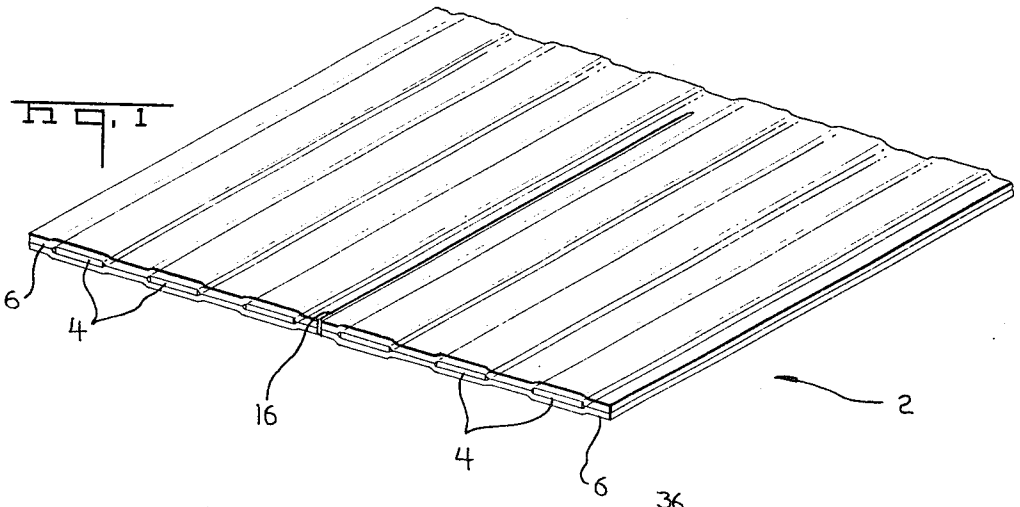
Sept. 27, 1966 W. S. McCAUGHEY 3,275,968

CONNECTOR FOR A FLEXIBLE FLAT CABLE

Filed June 23, 1964 2 Sheets-Sheet 1

Fig. 1



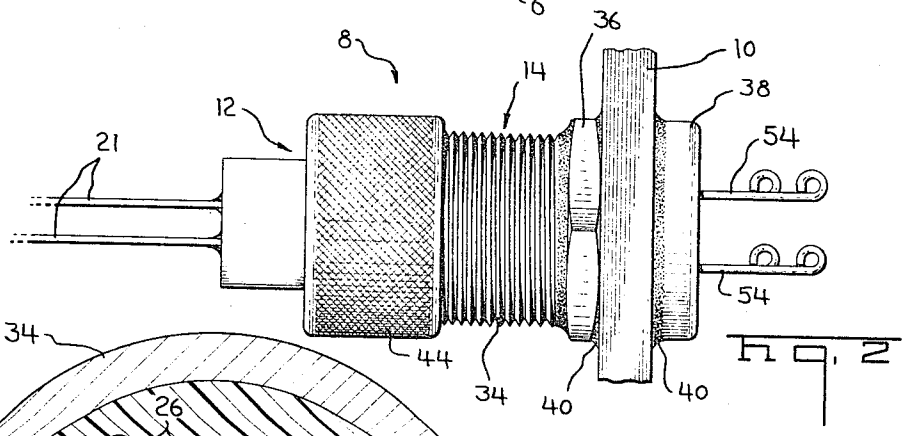


Fig. 2

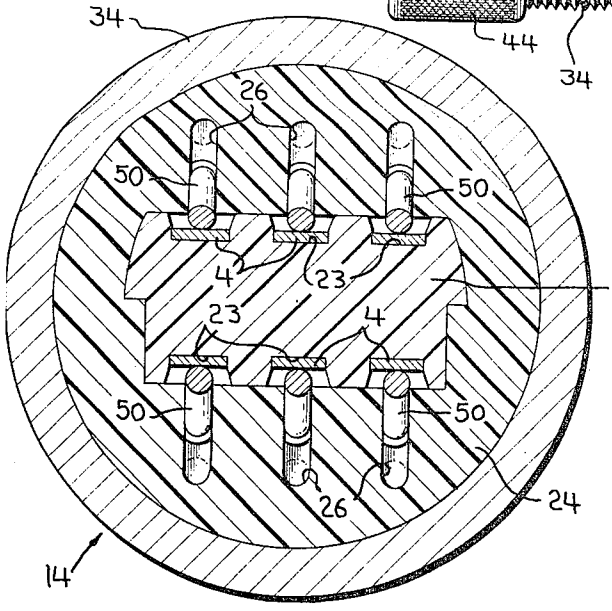


Fig. 4

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CONNECTOR FOR A FLEXIBLE FLAT CABLE

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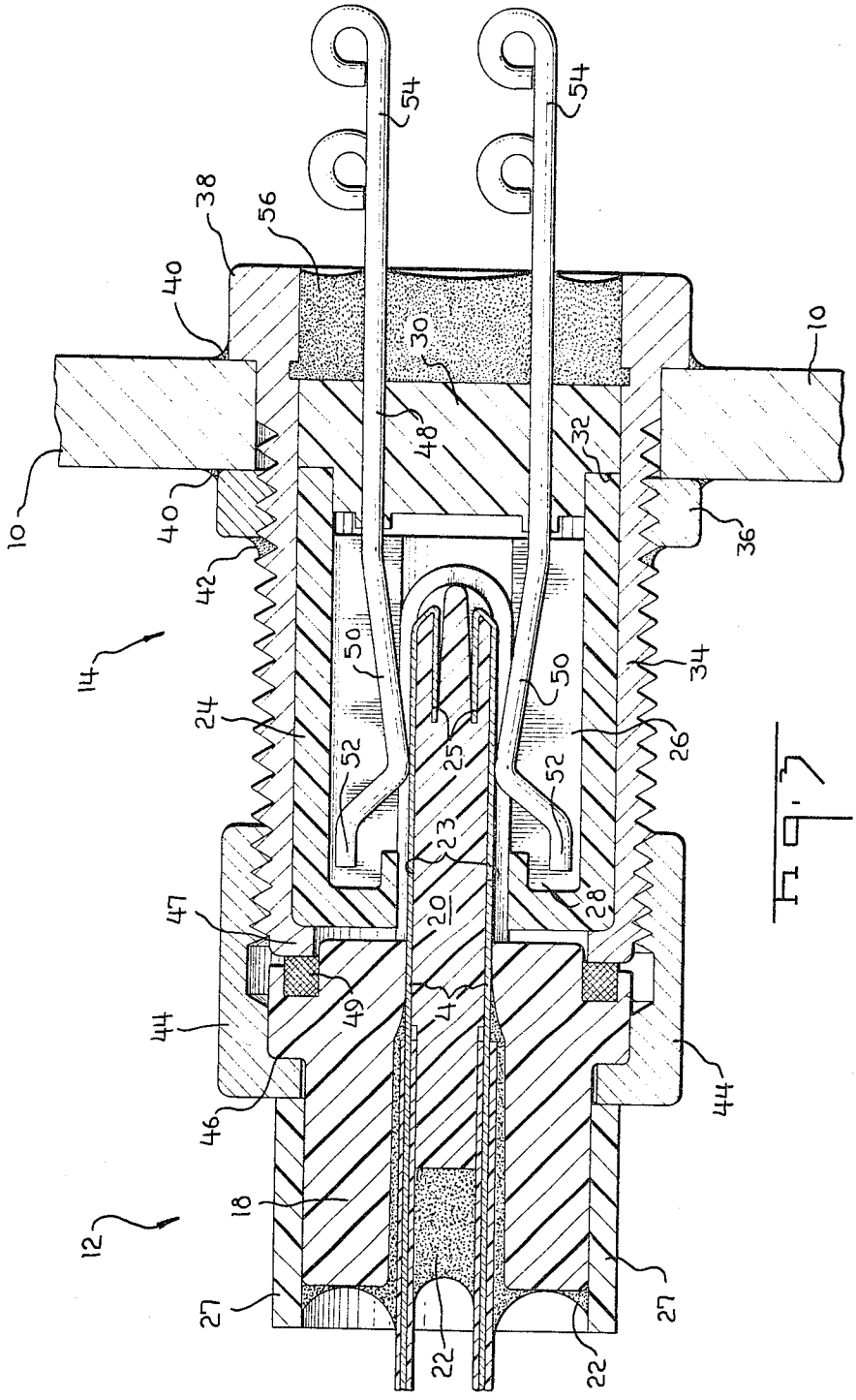


Fig. 3

United States Patent Office 3,275,968 Patented Sept. 27, 1966

3,275,968

CONNECTOR FOR A FLEXIBLE FLAT CABLE

William Stephen McCaughey, Camp Hill, Pa., assignor to AMP Incorporated, Harrisburg, Pa.

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2 Claims. (Cl. 339—89)

This invention relates to disengageable connecting devices for a flexible flat cable.

The term "flexible flat cable" is generally used with reference to a cable comprising a plurality of parallel conductors in co-planar side-by-side relationship with each conductor being surrounded by an insulating material. Conductors of this type are being used to an increasing extent, although they cannot be terminated or connected to other conductors with a conventional connecting means of the type used for ordinary single wires.

An object of the invention is to provide an improved multi-contact disengageable connector for a flexible flat cable. A further object is to provide a multi-contact connector for a flexible flat cable which can be assembled with a minimum of labor and skill. A still further object is to provide a multi-contact connector for a flexible flat cable which occupies a minimum of space. A still further object is to provide a circular connector for a flexible flat cable.

These and other objects of the invention are achieved in a preferred embodiment in which the end portion of the cable is folded along a medial fold line so that the end portion of the cable is disposed in two parallel spaced-apart planes. The insulating material is stripped from the end portion of the cable and the conductors in the two parallel planes are disposed on opposite sides of, and are secured to, a generally rectangular spacer or internal support member. This spacer or support with the conductors secured thereto is mounted in a cylindrical external support which surrounds the cable and the internal support in a manner such that the internal support projects axially beyond the cylindrical external support. The two support members constitute a plug which is engageable with a complementary receptacle having a suitable contact means therein for engagement with the exposed surfaces of the conductors of the cable. Advantageously, a lock nut is rotatably mounted on the external support which is engageable with external threads on the receptacle member to secure the two parts together when the plug is inserted into the receptacle. The receptacle itself is provided with a plurality of contact springs equal in number to the number of conductors in the cable which engage the individual conductors when the plug member is inserted into the receptacle.

In the drawing:

FIGURE 1 is a perspective view of a short section of flat conductor cable;

FIGURE 2 is a side view of a connector in accordance with the invention;

FIGURE 3 is a sectional side view of a connector in accordance with the invention; and

FIGURE 4 is a cross-sectional view taken along the lines 4—4 of FIGURE 3.

Flexible flat cable **2** of a commonly known type comprises a plurality of parallel copper ribbon conductors **4** disposed in side-by-side parallel relationship and contained within insulating material **6** which, in common practice, is of a polyester. A connector **8** in accordance with the present invention is adapted to be secured to a panel **10** and comprises a plug portion **12** and a receptacle portion **14**, the end section of the cable **2** extending into the plug portion in a manner such that the ends of the conductors **4** are contacted by suitable contacting means in the receptacle in the manner described below.

The end portion of the cable **2** is folded along an axially extending fold line **16** between the sides of the cable so that the cable fairs from its flat condition to a condition in which the conductors are disposed in two parallel spaced-apart planes **21**. It is sometimes desirable to slit the end portion of the cable at **16** along the fold line in order to facilitate the fairing of the cable from a flat condition to the folded condition.

The two end sections **21** of the cable extend through a generally rectangular opening in a cylindrical external support member **18** and extend over a generally rectangular internal member **20**. The end sections **23** of the conductors are exposed by removing of the insulation **6** therefrom and extend over the opposite surfaces of the internal support **20**. The extreme ends **25** of the conductors are dressed towards the axis of the connector and extend rearwardly into suitable pockets in the central support to secure the exposed ends of the conductors to the surfaces of the internal support. In the disclosed embodiment, the internal support or spacer **20** is manufactured as a separate piece from the cylindrical external support **18** and, in assembly, the conductors are positioned on the internal support, the internal support is inserted through the rectangular opening in the cylindrical external support and finally, the parts are sealed by a suitable potting material **22**. Advantageously, a plastic boot or sleeve **27** is provided in surrounding relationship to the projecting end of the support **18** and the portions **21** of the conductors to retain the potting material during hardening.

The receptacle member **14** comprises a generally cylindrical insulating block **24** having a rectangular opening extending therethrough which conforms to the cross-section of the internal support **20** of the plug member and which is adapted to receive the plug member as shown. Slots **26** extend leftwardly as viewed in FIGURE 3 towards the frontal end of the insulating block **24** for the reception of springs **50** which are described in further detail below. In the embodiment shown, three spaced-apart slots are provided on opposite sides of the opening for the reception of equal number of contact springs. Recesses **28** are provided at the left-hand end of each slot in order to capture the ends **52** of the springs.

A cylindrical insert **30** is mounted in the right-hand end of the cylindrical block **26** and has an annular shoulder **32** which bears against the end of the cylindrical block **24**. A metallic shell **34** surrounds the block **24** and a nut **36** is threaded onto the external surface of the shell **34** and cooperates with an enlarged end **38** of the shell to clamp the receptacle member to the panel or wall **10**. Advantageously, suitable potting material, such as an epoxy resin shown at **40**, is applied to the shell and to the nut **36** in order to achieve a seal between the panel and the socket member. It is also desirable to apply epoxy or other potting material as shown at **42** to the external surface of the shell **34** and adjacent to the nut **36** in order to secure the nut in position, particularly where the installation is intended to be a permanent one. As an alternative, the receptacle can be sealed by means of O rings clamped between the nut **36** and the panel.

The plug member **12** is coupled to the shell of the receptacle by means of a coupling nut **44** which is rotatably mounted on the cylindrical support **18** of the plug and which has internal threads which are engageable with the external threads of the shell **34**. The plug is drawn up tightly into engagement with the socket by virtue of opposed shoulders **46** which are effective between the coupling nut **44** and the external support **18** of the plug. The shell **34** has an inwardly directed lip **47** at its frontal end which cooperates with a circular gasket **49** of suitable compressable sealing material on the face of the external support **18** in order to achieve

a peripheral seal on the mating faces of the two parts of the connector.

The individual contact springs **48** are integrally molded with the cylindrical insert **30** and extend leftwardly within the slots **26** and towards the axis of the socket member as shown at **50**. The extreme end portions of these springs diverge from the axis of the socket as shown at **52** and extend into the recesses **28** at the ends of the slots **26**. Advantageously, the initial (i.e., normal) positions of these springs **48**, **50** in the insert member **30** are such that the springs are preloaded thereby to produce a relatively high contact force when the plug is inserted. The external ends **54** of the individual springs may be curled to form eyes adapted to receive the ends of wires. Alternatively, the receptacle can be arranged in a manner such that it is adapted to receive a plug member at each end; in other words, the right-hand end of the receptacle would be identical to the left-hand end of the receptacle as shown in the drawing. This arrangement would permit the making of disengageable connections between two flat conductor cables having the same number of conductors in each.

The end of the receptacle is potted as shown at **56** with a suitable potting material, again preferably an epoxy resin, in order to seal the receptacle against the passage of moisture or gases. It will be apparent that if all of the locations in the drawing are sealed, the connector itself will effectively seal the right-hand side of the panel **10** from the left-hand side thereof.

A significant advantage of the invention is that it permits the usage of a circular connector having a conventional coupling nut **44** with a flat conductor cable which, in its normal condition, is not adapted to be received in known types of circular connectors. This advantage is particularly significant where high quality, high performance disengageable connections are required with a flexible flat cable. The conventional rectangular connector for a flexible flat cable is not practical and cannot be used under some circumstances, particularly where space limitations preclude the usage of an extremely wide connector. Furthermore, the usage of a coupling nut in combination with a circular connector provides the maximum sealing effect which can be obtained in the design of disengageable connectors.

While the disclosed embodiment of the invention shows the end portion of the cable as being disposed in two parallel spaced-apart planes, it will be apparent that the conductors of the cable could be separated into three groups and the three groups arranged in a triangular pattern around an internal support which would have a triangular cross-section. As a further alternative, the internal support member **20** could itself be cylindrical and the end portion of the flat conductor cable could fair from a flat configuration to a cylindrical configuration in a manner such that the individual conductors at their ends would extend parallel to each other and along the sides of the cylindrical internal support as elements thereof. It is thus apparent that a significant feature of the

invention is that the end portion of the flat conductor cable is arranged in a manner such that the individual conductors surround, or at least partially surround, an internal support which forms the insert portion of the plug of the connector.

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. The actual scope of the invention is intended to be defined in the following claims when viewed in their proper perspective against the prior art.

I claim:

1. A plug termination for a flexible flat cable, said cable comprising a plurality of conductors in side-by-side parallel relationship with each conductor being surrounded by insulating material, an end portion of said cable being folded along a fold line extending parallel to the axis of said cable whereby said end portion comprises two group of parallel conductors disposed in at least two coextensive planes, said cable fairing from a flat condition, in which said conductors are parallel and co-planar, to said folded condition, spacer means between said coextensive planes, the end portions of said conductors being secured to, and supported by, said spacer means, a cylindrical support in surrounding relationship to said spacer and said end portions of said cable, coupling means mounted on said support, said coupling means and said end portions extending beyond said cylindrical support, said coupling means being engageable with a complementary receptacle having means therein for contacting said conductors.

2. A termination for flexible flat cable, said cable comprising a plurality of conductors in side-by-side parallel relationship with each conductor being surrounded by insulating material, said cable being arranged in two groups of parallel conductors disposed in two coextensive planes, spacer means between said coextensive planes, the end portions of said conductors being secured to, and supported by, said spacer means, a cylindrical support in surrounding relationship to said spacer and said end portions of said cable, a coupling means mounted on said support, said coupling means and said end portions extending beyond said cylindrical support, said coupling means being engageable with a complementary receptacle having means therein for contacting said conductors.

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