June 28, 1966 D. J. CRAWFORD ET AL 3,258,736

ELECTRICAL CONNECTOR

Filed June 24, 1964

FIG. 1

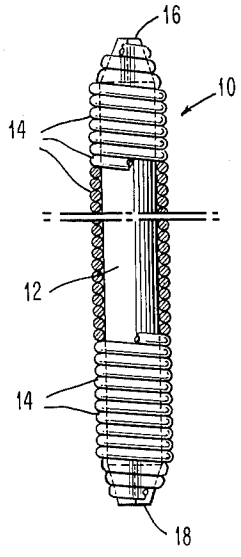


FIG. 2

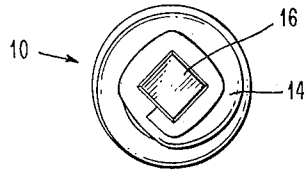
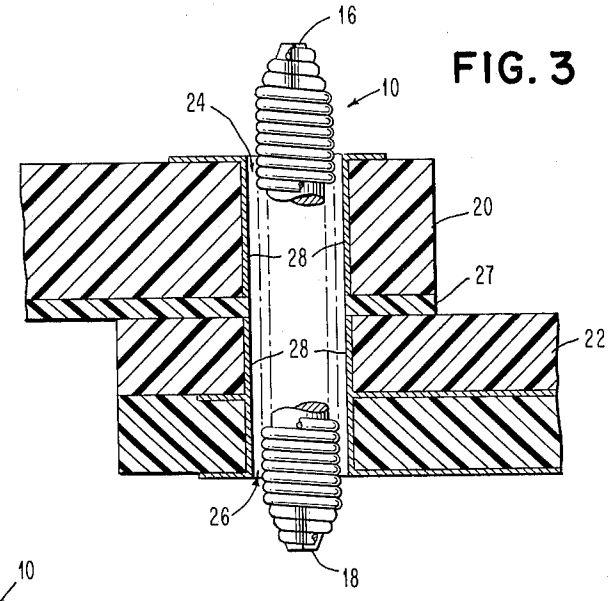


FIG. 3



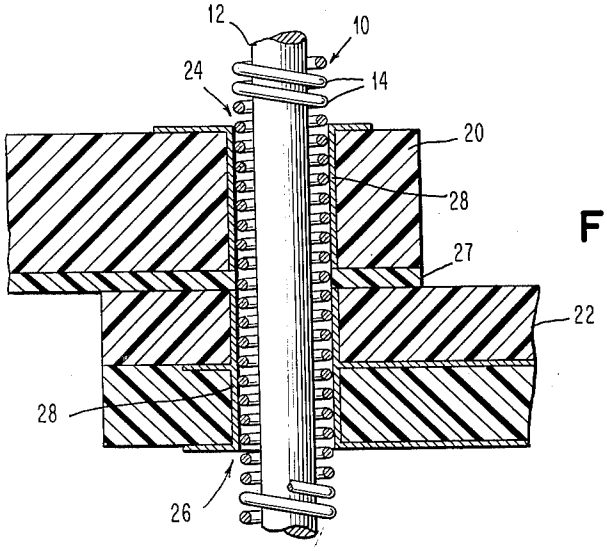


FIG. 4

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ELECTRICAL CONNECTOR

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This invention relates to electrical connectors and more particularly to an electrical connector particularly suited to connecting aligned conductive apertures.

With present electronic packaging techniques, situations often arise where it is necessary to provide electrical contact between stacked circuit boards having aligned through-hole connectors. One well known method for providing such a connection is to insert a pin into the aperture created by the aligned through holes, and subsequently solder the pin in place. While this technique provides a satisfactory electrical connection, a problem arises if it is desired to open the connection. In soldering the pin in place, the solder is apt to wet along the entire length of the pin thus creating an extremely tight bond which requires an excessive amount of heat to open. Therefore, while this technique does provide a good electrical contact, it makes no provision for eventual disconnection.

Other types of nonpermanent connectors have been used to overcome this problem. One of these is the leaf-spring type connector wherein a pair of leaf spring members are resiliently held apart and, upon insertion, are forcibly compressed toward each other by the constraints of the conductive aperture. This type of connector can be easily inserted and removed but has the disadvantage of providing excessive wear on the interior surfaces of the hole. Additionally, if the conductive through holes are somewhat misaligned, portions of the resulting electrical connection often have a higher than desired resistance due to the lessened connector-hole contact areas.

Accordingly, it is an object of this invention to provide an electrical contact for aligned conductive apertures which provides a reliable electrical connection.

It is a further object of this invention to provide an electrical connector for aligned conductive apertures which both provides reliable electrical contact and is easily inserted and removed.

Still another object of this invention is to provide an electrical connector for aligned conductive apertures which provides a good electrical connection should the apertures become misaligned.

Yet another object of this invention is to provide an electrical connector which is both simple and inexpensive.

In accordance with the above-stated objects, an electrical connector is provided which includes a central core member and resilient conductive means helically wound therearound. Restraints at either end of the core member prevent the resilient conductive means from unwinding. The exterior dimensions of the core member and wound resilient conductive means is sufficiently small to allow the connector to be inserted into the aligned conductive apertures. Once inserted, one or both end restraints are removed, allowing the helix created by the wound resilient conductive means to expand to contact the inner surfaces of the conductive apertures.

The foregoing and other objects, features and advantages of the invention will be apparent from the following more particular description of a preferred embodiment of the invention, as illustrated in the accompanying drawings.

In the drawings:

FIG. 1 is an electrical connector constructed in accordance with this invention.

FIG. 2 is an enlarged top view of the connector of FIG. 1.

FIG. 3 shows the electrical connector of FIG. 1 inserted into a pair of aligned conductive apertures but not yet providing electrical contact.

FIG. 4 shows the electrical connector of FIG. 1 after the removal of the end restraints.

Referring now to FIG. 1, electrical connector **10** includes only two components, central core member **12** and resilient conductive means **14** wound therearound. Central core member **12** may be comprised of any material which is relatively stiff and resists axial deformation. Additionally, since core member **12** provides no actual electrical conductive function when connector **12** is inserted into an aperture, it may be either a conductor or nonconductor of electricity. Resilient conductive means **14** may be any type of spring wire such as copper beryllium, phosphor bronze, or a steel wire which has successive coatings of copper and gold (for corrosion prevention). A desirable, but not necessary, attribute of resilient conductive means **14** is that it have a relatively low resistance so as to provide as nearly a resistanceless contact as possible.

To prevent resilient conductive means **14** from unwinding, each end **16** and **18** of connector **10** is lightly swagged to cause a deformation in resilient conductive means **14** and core member **12** (as shown in the top view of FIG. 2). The swagging action deforms resilient conductive means **14** thereby increasing the friction between it and the relatively sharp edges of deformed end portion **16** so as to prevent it from unwinding. Of course, any suitable restraint is acceptable to prevent resilient conductive means **14** from unwinding, but the restraint must be small enough to allow insertion of the connector into the conductive aperture.

Referring now to FIGS. 3 and 4, an exemplary connecting operation using connector **10** will be described. Assume that it is desired to interconnect printed circuitry on circuit boards **20** and **22** via conductive through holes **24** and **26**. Each through hole is plated with a copper conductor **28** which extends the entire length of the hole. Circuit boards **20** and **22** are separated by insulating sheet **27**. To provide the connection, through holes **24** and **26** are mechanically aligned and connector **10** is inserted into the aperture thereby provided. Once inserted, swagged end portions **16** and **18** of contact **10** are removed. This may be easily accomplished by simply cutting off these sections with a wire cutter. As shown in FIG. 4, once the end restraints are removed, the helix created by resilient conductive means **14** expands until it contacts the conductive surfaces **28**. This action results in electrical contact being made between the through hole **24** in circuit board **20** and through hole **26** in circuit board **22** via the conductive properties of resilient conductor means **14**. At this time, central core member **12** may either be removed or left in place. It should be realized that both end restraints need not be removed to allow the connector to operate. The removal of a single restraint is sufficient and allows the helix to expand and contact the conductive surfaces.

In using the connector of FIG. 1, it has been found desirable to cause the outer diameter of the finished connector to approximate the inner diameter of the conductive aperture. This allows for a very slight friction fit when the connector **10** is inserted and prevents the connector **10** from falling through the aperture before end restraints **16** and **18** are removed. This additionally reduces the

resiliency requirements for conductive means **14** and allows a wider range of products to be used.

While the invention has been particularly shown and described with reference to a preferred embodiment thereof, it will be understood by those skilled in the art that various changes in form and details may be made therein without departing from the spirit and scope of the invention.

What is claimed is:

1. A connector for electrically connecting at least a pair of concentrically aligned conductive through holes in a pair of overlapping circuit boards, the cross section of said through holes being small in relation to their length, comprising:

a stiff central core member having a length greater than the combined lengths of said aligned through holes; and

a resilient conductor helically wound around said central core member and restrained from unwinding by a preformed deformation of said conductor and core member at either end of said core member, the exterior cross-sectional dimensions of said core member and wound resilient conductor being sufficiently small to allow easy insertion into said through holes, the helix created by said wound resilient conductive means reacting to the removal of one or both said end deformations, by expanding until it contacts the inner surfaces of said conductive through holes.

2. A connector for electrically connecting at least a pair of concentrically aligned conductive through holes

in a pair of overlapping circuit boards, the cross section of said through holes being small in relation to their length, comprising:

a stiff central core member having a length greater than the combined lengths of said aligned through holes; and

a resilient conductor helically wound around said central core member and restrained from unwinding by a preformed deformation of said conductor and core member at either end of said core member, the exterior cross sectional dimensions of said core member and wound resilient conductor being of sufficient size to allow a slight friction fit upon insertion into said through holes, the helix created by said wound resilient conductor means reacting to the removal of one or both said end deformations by expanding until it contacts the inner surfaces of said conductive through holes.

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