Oct. 17, 1967 R. J. KINKAID 3,348,191

ELECTRICAL CONNECTOR ELEMENTS

Original Filed March 5, 1964

Fig. 3

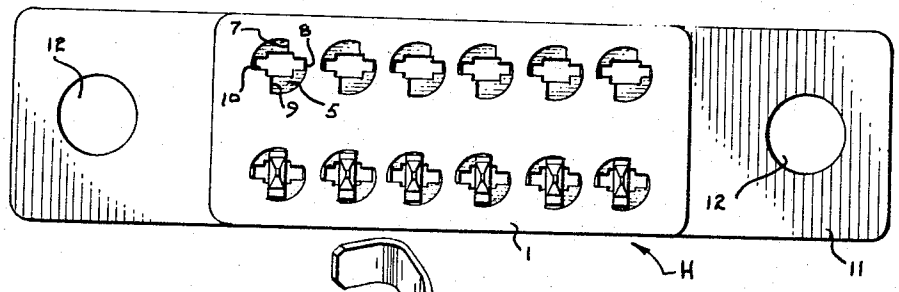


Fig. 4

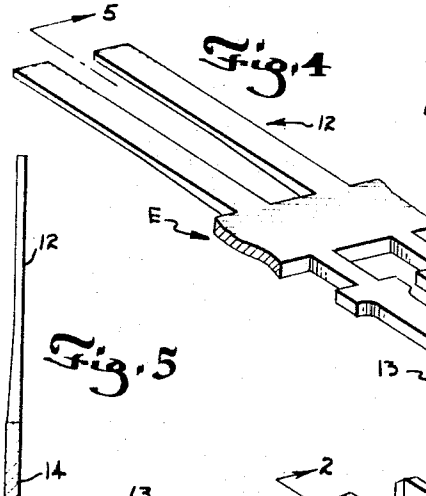


Fig. 7

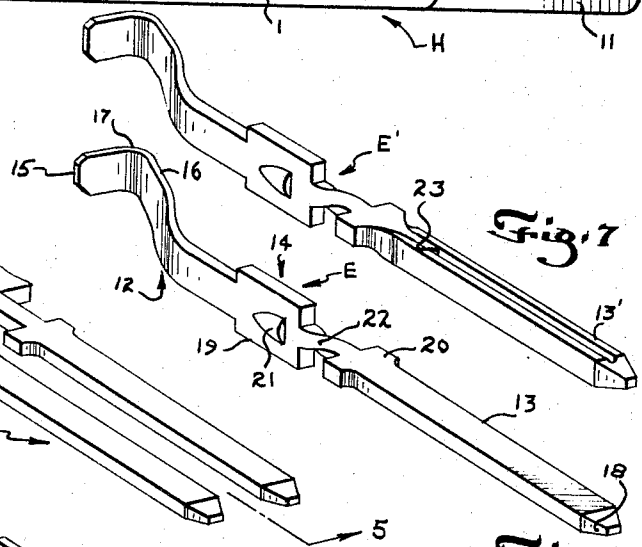


Fig. 5

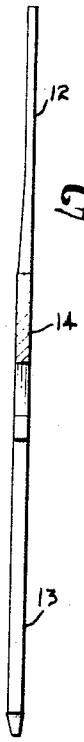


Fig. 6

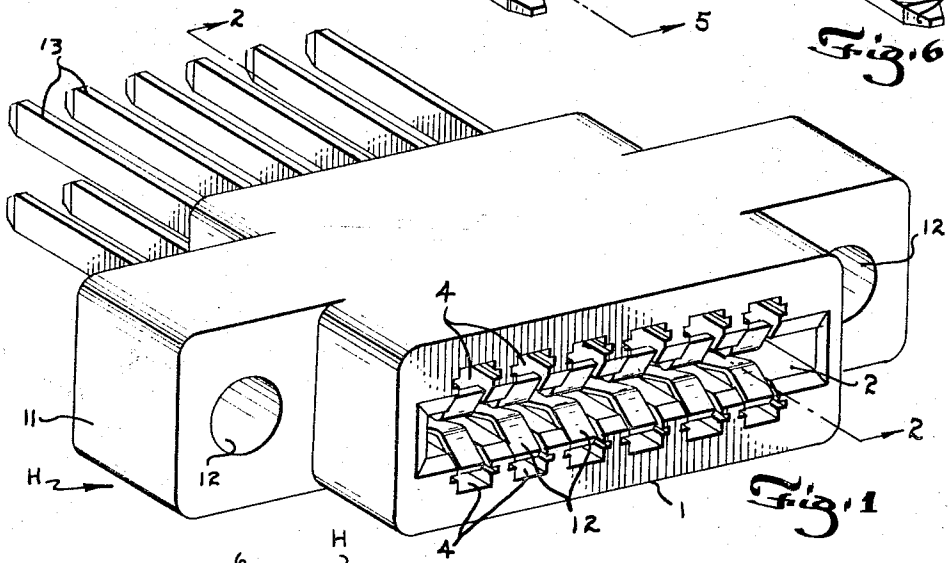
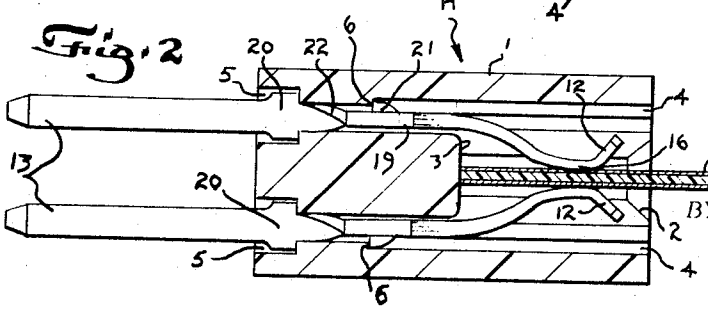


Fig. 1

Fig. 2



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United States Patent Office 3,348,191 Patented Oct. 17, 1967

3,348,191

ELECTRICAL CONNECTOR ELEMENTS

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Continuation of application Ser. No. 349,565, Mar. 5, 1964. This application Feb. 3, 1967, Ser. No. 613,966
9 Claims. (Cl. 339—176)

This application is a continuation of application Ser. No. 349,565, filed Mar. 5, 1964, in the name of Robert John Kinkaid, and now abandoned.

This invention relates to electrical connector elements and particularly electrical connector elements for use with printed circuit boards.

Heretofore, electrical connector elements used in conjunction with printed circuit boards have been disposed in insulated receptacle housing members in various ways, e.g., frictionally pushing them in position in the housing members, utilizing stop members on the electrical connector elements that engage abutments in the housing members, etc. The wire-receiving sections of the connector elements have to withstand a certain maximum force of insertion when applying conductors thereon. This force of insertion has been determined to be no less than thirty pounds. Another problem has been the fact that the wire-receiving sections have been susceptible to torque. A further problem has been the proneness of the wire-receiving sections to short each other due to their close disposition.

It has been found that these electrical connector elements have not proved satisfactory because they are incapable of withstanding the maximum force of insertion of electrical leads on the wire-receiving sections thereof.

It is, therefore, a primary object of the present invention to provide electrical connector elements that when placed in a housing member are capable of withstanding more than the maximum insertion force when electrical leads are applied to the wire-receiving sections thereof.

It is another object of the present invention to provide electrical connector elements which are stable for all types of application of conductor means thereon.

A further object of the present invention is to provide electrical connector elements that may be used with any type of application of conductor means thereon.

An additional object of the present invention is the provision of the wire-receiving sections of the connector elements being disposed in a manner to provide a more desirable disposition of the conductor means with respect thereto.

Other objects and attainments of the present invention will become apparent to those skilled in the art upon a reading of the following detailed description when taken in conjunction with the drawings in which there are shown and described illustrative embodiments of the invention; it is to be understood, however, that these embodiments are not intended to be exhaustive nor limiting of the invention but are given for purposes of illustration and principles thereof and the manner of applying them in practical use so that they may modify them in various forms, each as may be best suited to the conditions of a particular use.

In the drawings:

FIGURE 1 is a perspective view of a housing member having the electrical connector elements disposed therein;

FIGURE 2 is a cross-sectional view taken along lines 2—2 of FIGURE 1;

FIGURE 3 is a rear view of FIGURE 1 with the top row empty and the bottom row containing connector elements therein;

FIGURE 4 is a fragmentary perspective view of the connector elements during formation;

FIGURE 5 is a view taken along lines 5—5 of FIGURE 4;

FIGURE 6 is a perspective view of a finished connector element ready for insertion in the housing member; and

FIGURE 7 is a perspective view of an alternative embodiment of the connector element.

Turning now to the drawings, there is shown in FIGURES 1–3 a housing member H in which the electrical connector elements E are disposed. Housing member H is preferably molded from plastic material, such as, nylon, polypropylene, Bakelite, etc., and has a main body section **1**, the front end of which contains a rectangularly shaped opening **2** in which a printed circuit board PC is to be disposed. Opening **2** extends to an inner rear wall **3** against which the edge of the printed circuit board engages to limit its movement within the opening. Each side and end of opening **2** has an inclined surface to facilitate the insertion of a printed circuit board thereinto.

Each side of opening **2** has a number of diametrical T-shaped passageways **4** which are evenly spaced and parallel with respect to each other. These T-shaped configurations become configurations of a cross at rear wall **3** and continue this configuration to where coaxial recesses **5** are located in the rear wall of the housing member. About midway between wall **3** and the inner end of recesses **5**, the outer legs of the cross-shaped section of the passageways extending away from the longitudinal axis of the housing member are provided with abutting surfaces **6** as illustrated in FIGURE 2.

As can be seen from FIGURE 3, each recess **5** has surfaces **7**, **8**, **9** and **10** which extend from the inner end of the recess to the outer end thereof. Surfaces **7** and **9** are equally spaced from the vertical plane passing through the axis of the recess and are parallel thereto. Surfaces **8** and **10** are equally spaced from the horizontal plane passing through the recess axis and are parallel thereto.

Projections **11** extend from the sides of housing member H and contain apertures **12** therethrough in order to define a means to secure the housing member to a mounting member (not shown). Of course, other means may be utilized to secure the housing member to a mounting member which are conventional in the art and need not be propounded.

Turning now to FIGURES 4–6, there is illustrated electrical connector element E to be inserted into passageways **4** of the housing member and secured therein. The electrical connector element comprises an engaging section **12**, a wire-receiving section **13**, and a securing section **14**.

As illustrated in FIGURE 4, the connector elements are preferably stamped from suitable metallic stock in a progressive die means which has the proper hardness to withstand the forces of insertion to be applied to wire-receiving section **13** when conductor means are applied and connected thereto, has the proper spring qualities to make excellent electrical connection with the circuit paths of the printed circuit board, as well as applying retentive pressure on the printed circuit board to maintain it in position and has the proper electrical conductivity to provide excellent electrical conductance. FIGURES 4 and 5 illustrate partial completion of the connector elements and FIGURE 6 illustrates the complete element.

As illustrated in FIGURE 5, one side of section **12** tapers from securing section **14** to a point about midway of section **12** and the remainder of this section then has the same thickness. The reason for this is to provide an excellent spring effect to section **12** in the form of a long cantilever beam.

As can be discerned from FIGURE 6, section **12** has a configuration similar to that of a section taken from the center of a spoon. Outer end **15** of section **12** is turned upwardly to facilitate engagement with the printed circuit board. Contact section **16** has a rearwardly inclined

surface as indicated in FIGURE 2. Both end **15** and section **16**, when in normal position in the housing member, are located out of the plane in which sections **13** and **14** are disposed. Sections **12** have sufficient movement in their respective passageways to provide for normal tolerance when engaging any printed circuit board.

Edges **17** from end **15** to a point beyond contact section **16** toward securing section **14** are rounded so that contact section **16** is slightly convex in this area which eliminates sharp edges that could gouge, scratch or scrape circuit path of the printed circuit board as well as providing excellent mechanical connection on the contact portion of the circuit paths.

Wire-receiving section **13** is rectangular in configuration. Outer end **18** is tapered to facilitate in one respect the insertion of the elements within passageways **4** of the housing member. The sides merge into section **14** with a slight radius.

Securing section **14** is divided into two portions, a stabilizing portion **19** and a locking portion **20**. Portion **19** is rectangularly shaped and has projection **21** extending outwardly from the outer surface thereof. Portion **22** interconnects portions **19** and **20** and has a width about one-half that of the widths of portions **19** and **20**.

In assembly each connector element is inserted within a passageway **4** of the housing member with projection **21** coming to rest against abutting surface **6**; then wire-receiving section **13** is rotated 90° against surfaces **7** and **9** in recess **5** which causes portion **22** to assume a twisted configuration between portions **19** and **20** which tightens element E in the passageway between surface **6** and recess **5** and completely secures it therewithin so as to withstand an insertion force in excess of the maximum amount. The surface of projection **21** in engagement with surface **6** is located about midway of portion **19** which provides a sufficient amount of portion **19** engaging the side sections of the cross configuration and extending toward section **12** to stabilize the connector element within its passageway.

As can be discerned, wire-receiving section **13** is normally disposed with respect to engaging section **12** which facilitates access to section **13** when applying a conductor means thereon as well as providing a more desirable disposition of the conductor means between the wire-receiving sections. While section **13** has been established as being rotated 90° with respect to section **14**, other angular dispositions between 0° and 90° may be effective in some aspects.

The conductor means can be applied to wire-receiving section **13** according to any of the ways conventional in the art, such as, welding, soldering, wire wrap, etc. When using wire wrap techniques, surfaces **7** and **9** prevent any torque from moving portion **20** out of position.

Another type of technique for the application of a conductor means to wire-receiving section **13** may be utilized in the manner disclosed in U.S. Patents 3,249,992 and 3,243,757, which apply an insertion force of about thirty pounds during the connecting operation.

FIGURE 7 illustrates an alternative embodiment of the connector element. In this embodiment, connector element E′ is similar to that of FIGURE 6 in every respect except that wire-receiving post or section **13′** has a substantially square cross-sectional configuration. Diametrical sides of section **13′** have been subjected to a coining operation during formation of the connector element in order to form section **13** into its square-shaped configuration and to provide channels **23** (only one being shown) therein. After connector element E′ has been secured in housing member H in the same manner as connector element E, the sides containing channels **23** are disposed in planes normal to the plane containing contact engaging surface **16**. The same techniques for applying conductor means to the post as outlined above, may be used. In case the techniques outlined in the above-mentioned U.S. patents were used, the bare wire portion of the conductor means would be disposed in one channel while the edges of the connector elements disclosed therein would be disposed in the other channel.

As was pointed out hereinabove, section **12** from section **14** defines a long cantilever beam which provides excellent spring characteristics thereto in order to withstand numerous insertions and removals of printed circuit boards therein, provides a frictional fit connection for printed circuit boards to accept wide variations in thickness of the insulation body of the printed circuit board and to overcome plastic creep to the insulation under load and provides mechanical stability under vibration or externally imposed stresses on the lead-in wires connected to sections **13** as well as excellent electrical continuity.

While the present invention has been disclosed in conjunction with a housing member containing only one opening in which two parallel rows of electrical connector elements are disposed, it is obvious that the housing member may be provided with only a single row of electrical connector elements. Also, the housing member could be provided with a number of openings each of which contains at least one row of electrical connector elements instead of the single opening as illustrated.

It should be pointed out that the principles of the present invention are applicable to other types of electrical connector elements other than those with regard to printed circuit boards. The positive securing of electrical connector elements having a contact engaging configuration other than that disclosed can be utilized in accordance with connector elements used for other purposes, e.g., the connector elements in the stationary plugboard of a plugboard assembly as disclosed in U.S. Patent No. 2,927,295. It is also contemplated that the connector element could have a securing section as described with wire-receiving sections **13** extending outwardly from each end and secured in an opening of a mounting panel in the manner described above so as to receive conductor means on each wire-receiving section on both sides of the mounting panel. Other variations of the same theme can be enumerated but are deemed unnecessary as well as superfluous.

As can be discerned, there has been disclosed a unique and simple solution to providing electrical connector elements disposed in a mounting means which are capable of withstanding insertion forces on the wire-receiving sections thereof in excess of those conventionally utilized.

It will, therefore, be appreciated that the aforementioned and other desirable objects have been achieved; however, it should be emphasized that the particular embodiments of the invention, which are shown and described herein, are intended as merely illustrated and not as restrictive of the invention.

I claim:

1. In combination, a housing member having an opening in one surface to receive a printed circuit board, at least one row of passageways disposed in one side of said opening and extending through said housing member in an equally spaced and parallel manner, an electrical connector element defining an elongated metallic member disposed in each passageway and including a contact section, securing section and conductor-receiving section, said contact section being disposed in said opening and defining a curved contact-engaging surface for engaging a circuit path on said printed circuit board, said securing section including a stabilizing portion and a locking portion spaced therefrom and both portions interconnected by a portion having a width less than the width of said stabilizing and locking portions, said housing member having a recess in which said locking portion is disposed, said recess including surfaces on opposite sides of a plane containing the longitudinal axis of each passageway, said surfaces being equally spaced from and parallel to said plane, said locking portion being twisted with respect to said stabilizing portion so that said locking portion engages said surfaces and the twist being located in said interconnecting portion within the passageway thereby

locking said connector element within the passageway, said conductor-receiving section extending outwardly from said housing member to receive conductor means thereon.

2. The combination of claim 1 wherein said stabilizing portion includes a projection engaging an abutting surface in said passageway to limit the inner movement of said connector element therewithin.

3. The combination of claim 1 wherein said locking portion is twisted about 90°.

4. The combination of claim 1 wherein said contact section from said stabilizing portion defines a cantilever beam and said contact-engaging surface being disposed in a plane substantially parallel to another plane in which said securing section is disposed.

5. The combination of claim 1 wherein said conductor-receiving section has a rectangular cross-sectional configuration.

6. The combination of claim 1 wherein said conductor-receiving section has a square cross-sectional configuration with diametrical sides thereof being provided with channel therein.

7. An electrical connector comprising a dielectric housing having at least one passageway extending therethrough and locking surfaces, said passageway including a first section and a second section, said first section having a cross section smaller than a cross section of said second section, and stop surfaces being disposed adjacent said first section and being disposed on opposite sides of a plane containing a longitudinal axis of said passageway; an electrical terminal having a contact section, securing section and conductor-receiving section; said securing section including a stabilizing portion, locking portion and an interconnecting portion connecting said stabilizing and locking portions; means on said electrical terminal and in said passageway to limit movement of said electrical terminal in said passageway in one direction; said locking portion twisted with respect to said stabilizing portion with said locking portion in engagement with said locking surfaces and stop surfaces of said housing to limit movement of said electrical terminal in said passageway in another direction and to limit the twist of said locking portion; the twist being located in said interconnecting portion within said first section; and means in said passageway and on said stabilizing portion stabilizing said electrical terminal in said passageway.

8. An electrical connector according to claim 7 wherein said locking surfaces and stop surfaces are located in a recess in said passage.

9. An electrical connector comprising, in combination, a dielectric mounting member and an electrical terminal member; said terminal member including a stabilizing section and a conductor-receiving section; said mounting member having an opening extending therethrough and locking surfaces and stop surfaces thereon, said opening being provided with a first section and a second section; said stabilizing section being disposed in said first section and said first section having a cross-sectional configuration conforming to the cross-sectional configuration of said stabilizing section; said stop and locking surfaces being disposed in said second section and said stop surfaces being disposed on opposite sides of a plane containing a longitudinal axis of said opening; means on said contact member and in said opening to limit movement of said contact member in said opening in one direction; said conductor-receiving section being twisted with respect to said stabilizing section with said conductor-receiving section being disposed adjacent said stop surfaces thereby defining stops limiting the degree of twisting of said conductor-receiving section and whereby a portion of said conductor-receiving section is disposed adjacent said locking surfaces thereby locking said contact member within said opening.

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