

# PATENT SPECIFICATION

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## (54) AN ELECTRICAL CONNECTOR

- (71) We, HEWLETT-PACKARD COMPANY, of 1501 Page Mill Road, Palo Alto, California, United States of America, a corporation organized and existing under the laws of the State of California, United States of America, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method it is to be performed, to be particularly described in and by the following statement:—
- This invention is concerned with improvements in or relating to electrical connectors and is especially concerned with connectors for printed circuit boards.
- Typically electro-mechanical connections between electrical components such as printed circuit boards, integrated circuits, or individual electronic components have been accomplished in two ways: conductive wires or plug-in receptacles. Unfortunately, both of these methods suffer from many disadvantages. Soldering individual wires is expensive, time-consuming and makes re-work difficult. Plug-in receptacles, while allowing easy disassembly, are also relatively time-consuming to install and therefore expensive. The soldered connections between the receptacle and the printed circuit board make changing receptacles difficult, and because the receptacles are bulky in comparison to common subminiature components, they reduce assembly packing density.
- It is an object of the present invention to provide an improved electrical connector.
- It is another object of the present invention to provide an improved electrical connector assembly.
- The present invention provides a connector suitable for mechanically and electrically coupling to a device having an aperture with a conductive surface therein, the connector comprising a base; a first member having first and second ends and joined at the first end to the base; a second member having first and second ends and joined at
- [Price 33p]

the first end to the base, at least one of the first and second members being flexible relative to the other; a guide tip joined to the second end of the first member whereby the combined length of the first member and the guide tip is greater than the length of the second member, and the guide tip extends over the second member for guiding the second ends of both the first and second members into said hole.

Preferably the base has regions of first and second widths, the second width being greater than the first; the first end of the first member is joined to the base at the region of second width; the first end of the second member is joined to the base at the region of second width; the second ends of the first and second members are separated to allow at least one of the second ends to be displaced toward the other; the guide tip has regions of first and second width, the second width being greater than the first, and the second end of the first member is joined to the guide tip at the region of second width; and the base, the first member, the second member, and the guide tip are the same thickness.

The present invention further provides a connector assembly comprising a plurality of connectors according to the invention wherein at least one removable tab means is attached to each of the connectors for maintaining alignment of the connectors in their assembled relationship.

Preferably the removable tab means includes two parallel strips of material; and each connector is orthogonally attached at one end to one strip and at another end to the other strip.

Preferably the plurality of connectors and the removable tab means are coplanar and are made from a single piece of material.

There now follows a detailed description which is to be read with reference to the accompanying drawings of connectors and

connector assemblies according to the invention; it is to be clearly understood that these connectors and assemblies have been selected for description to illustrate the invention by way of example and not by way of limitation.

In the drawings:

Fig. 1. is a view of one preferred embodiment according to the invention showing the connectors and the removable tabs.

Fig. 2 is a view of a connector according to the invention in place between two printed circuit boards.

Fig. 3 is a view of another connector according to the invention in place between two printed circuit boards.

Fig. 4 shows another embodiment according to the invention having connectors encapsulated in an electrical component.

Fig. 5 is a view of several of the connectors according to the invention attached to leads from an integrated circuit.

Fig. 1 shows an assembly of connectors according to the invention for electrically or mechanically connecting two components, here printed circuit boards. Removable tabs 11, 12 maintain the desired alignment of a plurality of electrical connectors 20, 20', 20'' . . . 20<sup>n</sup>, where n may be any desired number. Each of the connectors includes a base 15, a supportive member 16, a flexible contact member 17, and a guide tip 18.

The separation between adjacent connectors may be made to correspond to the separation between holes drilled into the printed circuit board. To install a plurality of the connectors between two printed circuit boards one removable tab connecting the ends of the plurality of connectors is broken off by bending it away from the plane of the connectors, i.e. perpendicular to the surface shown in Fig. 1. The ends of the connectors are then inserted into the holes on the first of the two printed circuit boards to be connected. The other tab is then removed and the second printed circuit board mated to the connectors. If a more permanent connection is desired the connectors may be soldered to either or both of the printed circuit boards.

Fig. 2 shows a view of one of the connectors in place between two printed circuit boards 21, 22. This assembly is created in the following manner: the base 15 of the connector is inserted into a plated-through hole 19 in the lower printed circuit board 21. The upper printed circuit board 22 having a plated-through hole 23 is then pressed down over the guide tip 18 and is held in that position by means, not shown in Fig. 2, such as a screw. Because the contact member 17 is compressed by the sides of the hole 23 toward the supportive member 16, a good electrical contact between the connector and

the printed circuit board hole 23 is maintained.

Fig. 3 shows another connector according to the invention in place between two printed circuit boards. In this embodiment the connector functions as a mechanical support for the upper circuit board 22 and provides electrical contact between the plated-through holes 19, 23 of the two circuit boards 21, 22. The mechanical support is achieved by the formation of shoulders 24, 25 in the connector. This allows the connector to be inserted into the lower printed circuit board 21 only to a certain depth before resting upon the shoulder 25. The shoulder 24 prevents the upper printed circuit board 22 from sliding down the connector.

Fig. 4 is a top view of a typical sub-miniature component prior to encapsuation. An integrated circuit 40 is shown with associated leads 41 and connectors 42 according to the invention. The connectors 42 are attached to a removable tab 43 which maintains the alignment of the connectors 42 until the assembly is encapsulated. The broken line 44 shows the region of the assembly which is encapsulated. Following this process the removable tab 43 is separated from each of the connector at location 45. For connections to a printed circuit board each of the connectors 42 is bent perpendicular to the surface as shown in Fig. 4, for example, between the connector 42 and the surface of the encapsulation 44.

Fig. 5 is a perspective view of an electrical component 50 such as an integrated circuit and a plurality of connectors 52 according to the invention. These connectors are encapsulated within the component and may be connected to elements, for example, within the integrated circuit. They allow the component to be plugged directly into plated-through holes in a printed circuit board. During the process of the encapsulation the connectors may be held in alignment by removable tabs as discussed earlier.

#### WHAT WE CLAIM IS:—

1. A connector suitable for mechanically and electrically coupling to a device having an aperture with a conductive surface therein, the connector comprising a base; a first member having first and second ends and joined at the first end to the base; a second member having first and second ends and joined at the first end to the base, at least one of the first and second members being flexible relative to the other; a guide tip joined to the second end of the first member whereby the combined length of the first member and the guide tip is greater than the length of the second member, and the guide tip extends over the second



connector assemblies according to the invention; it is to be clearly understood that these connectors and assemblies have been selected for description to illustrate the invention by way of example and not by way of limitation.

In the drawings:

Fig. 1 is a view of one preferred embodiment according to the invention showing the connectors and the removable tabs.

Fig. 2 is a view of a connector according to the invention in place between two printed circuit boards.

Fig. 3 is a view of another connector according to the invention in place between two printed circuit boards.

Fig. 4 shows another embodiment according to the invention having connectors encapsulated in an electrical component.

Fig. 5 is a view of several of the connectors according to the invention attached to leads from an integrated circuit.

Fig. 1 shows an assembly of connectors according to the invention for electrically or mechanically connecting two components, here printed circuit boards. Removable tabs 11, 12 maintain the desired alignment of a plurality of electrical connectors 20, 20', 20'' . . . 20<sup>n</sup>, where n may be any desired number. Each of the connectors includes a base 15, a supportive member 16, a flexible contact member 17, and a guide tip 18.

The separation between adjacent connectors may be made to correspond to the separation between holes drilled into the printed circuit board. To install a plurality of the connectors between two printed circuit boards one removable tab connecting the ends of the plurality of connectors is broken off by bending it away from the plane of the connectors, i.e. perpendicular to the surface shown in Fig. 1. The ends of the connectors are then inserted into the holes on the first of the two printed circuit boards to be connected. The other tab is then removed and the second printed circuit board mated to the connectors. If a more permanent connection is desired the connectors may be soldered to either or both of the printed circuit boards.

Fig. 2 shows a view of one of the connectors in place between two printed circuit boards 21, 22. This assembly is created in the following manner: the base 15 of the connector is inserted into a plated-through hole 19 in the lower printed circuit board 21. The upper printed circuit board 22 having a plated-through hole 23 is then pressed down over the guide tip 18 and is held in that position by means, not shown in Fig. 2, such as a screw. Because the contact member 17 is compressed by the sides of the hole 23 toward the supportive member 16, a good electrical contact between the connector and

the printed circuit board hole 23 is maintained.

Fig. 3 shows another connector according to the invention in place between two printed circuit boards. In this embodiment the connector functions as a mechanical support for the upper circuit board 22 and provides electrical contact between the plated-through holes 19, 23 of the two circuit boards 21, 22. The mechanical support is achieved by the formation of shoulders 24, 25 in the connector. This allows the connector to be inserted into the lower printed circuit board 21 only to a certain depth before resting upon the shoulder 25. The shoulder 24 prevents the upper printed circuit board 22 from sliding down the connector.

Fig. 4 is a top view of a typical sub-miniature component prior to encapsulation. An integrated circuit 40 is shown with associated leads 41 and connectors 42 according to the invention. The connectors 42 are attached to a removable tab 43 which maintains the alignment of the connectors 42 until the assembly is encapsulated. The broken line 44 shows the region of the assembly which is encapsulated. Following this process the removable tab 43 is separated from each of the connector at location 45. For connections to a printed circuit board each of the connectors 42 is bent perpendicular to the surface as shown in Fig. 4, for example, between the connector 42 and the surface of the encapsulation 44.

Fig. 5 is a perspective view of an electrical component 50 such as an integrated circuit and a plurality of connectors 52 according to the invention. These connectors are encapsulated within the component and may be connected to elements, for example, within the integrated circuit. They allow the component to be plugged directly into plated-through holes in a printed circuit board. During the process of the encapsulation the connectors may be held in alignment by removable tabs as discussed earlier.

#### WHAT WE CLAIM IS:—

1. A connector suitable for mechanically and electrically coupling to a device having an aperture with a conductive surface therein, the connector comprising a base; a first member having first and second ends and joined at the first end to the base; a second member having first and second ends and joined at the first end to the base, at least one of the first and second members being flexible relative to the other; a guide tip joined to the second end of the first member whereby the combined length of the first member and the guide tip is greater than the length of the second member, and the guide tip extends over the second



member for guiding the second ends of both the first and second members into said hole.

2. A connector as in claim 1 wherein the base has regions of first and second widths, the second width being greater than the first; the first end of the first member is joined to the base at the region of second width; the first end of the second member is joined to the base at the region of second width; the second ends of the first and second members are separated to allow at least one of the second ends to be displaced toward the other; the guide tip has regions of first and second width, the second width being greater than the first, and the second end of the first member is joined to the guide tip at the region of second width; and the base, the first member, the second member, and the guide tip are the same thickness.

3. A connector assembly comprising a plurality of connectors according to either one of claims 1 and 2 wherein at least one removable tab means is attached to each of the connectors for maintaining alignment

of the connectors in their assembled relationship.

4. A connector assembly according to claim 3 wherein the removable tab means includes two parallel strips of material; and each connector is orthogonally attached at one end to one strip and at another end to the other strip.

5. A connector assembly according to either one of claims 3 and 4 wherein the plurality of connectors and the removable tab means are coplanar and are made from a single piece of material.

6. A connector according to claim 1 substantially as hereinbefore described with reference to the accompanying drawings.

7. A connector assembly according to claim 3 substantially as hereinbefore described with reference to the accompanying drawings.

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