United States Patent

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[72] Inventors **Wilfred Richard Scheller**
New Cumberland;
Winfield Warren Loose, Harrisburg, both of Pa.

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[73] Assignee **AMP Incorporated**
Harrisburg, Pa.

[54] **PRINTED CIRCUIT BOARD CONNECTOR**
9 Claims, 5 Drawing Figs.

[52] **U.S. Cl.** ..... **339/17 C,** 339/220 R
[51] **Int. Cl.** **H01r 9/08,** H05k 1/00
[50] **Field of Search** 339/17, 220

[56] **References Cited**

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Primary Examiner—Marvin A. Champion
Assistant Examiner—Terrell P. Lewis
Attorneys—Curtis, Morris and Safford, Marshall M. Holcombe, William Hintze, William J. Keating, Frederick W. Raring, John R. Hopkins, Adrian J. La Rue and Jay L. Seitchik

ABSTRACT: A female U-shaped electrical connector for staking to printed circuit boards capable of forming disconnect terminations between printed circuitry and a male tab (or blade) connector where the sides of the "U" are bowed inwardly to form a spring wipe-contact with any tab connector inserted therebetween and where the female connector extends through the board and is clinched in position thereon without piercing the printed circuitry so as to bring the free ends of the "U" into positive electrical contact with the printed circuitry.

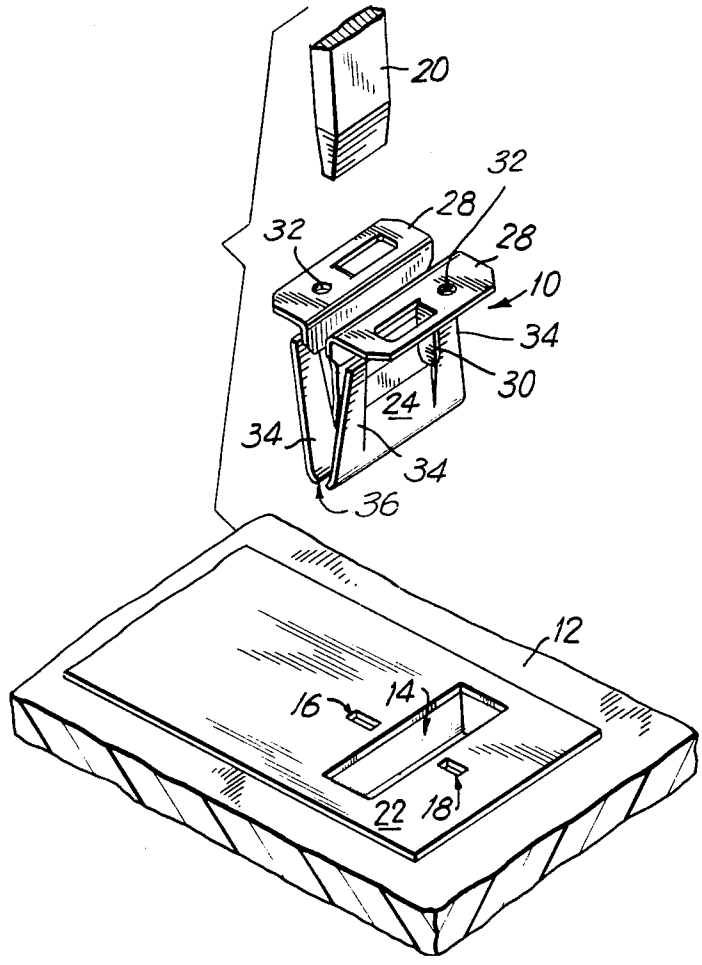


FIG. 1

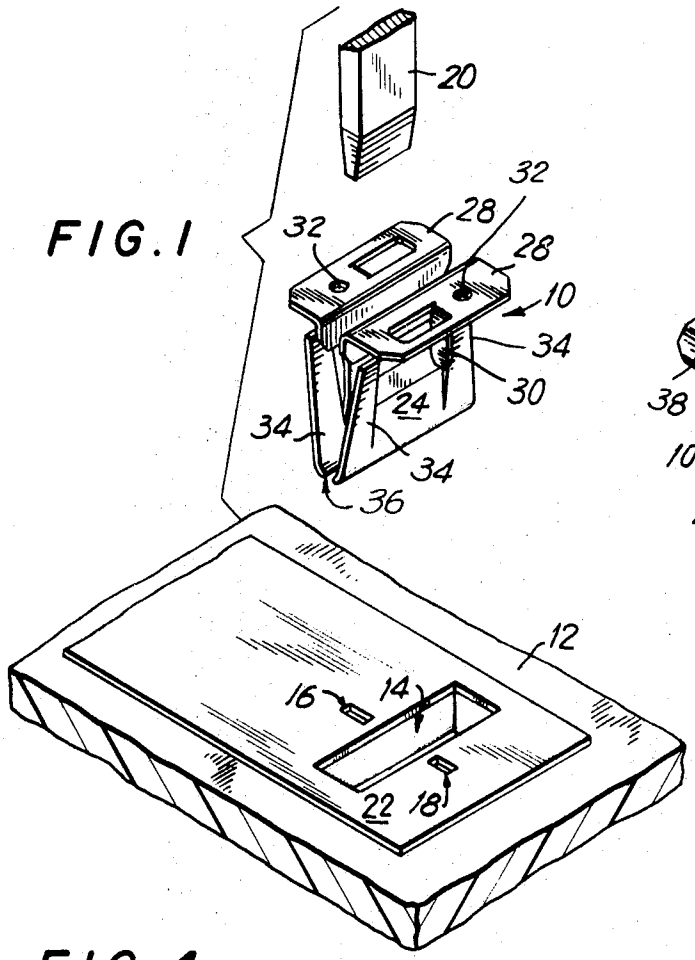


FIG. 2

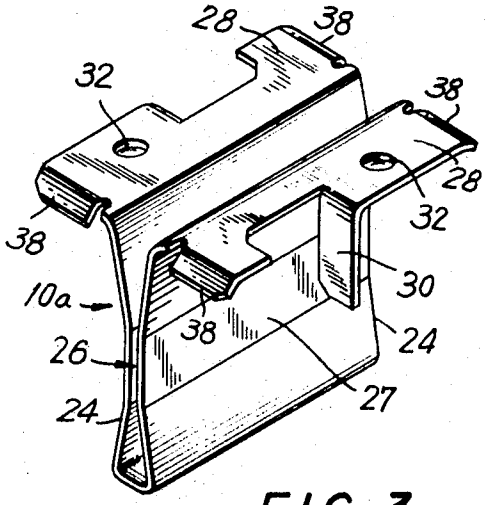


FIG. 3

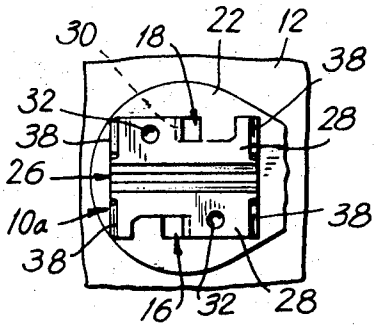


FIG. 4

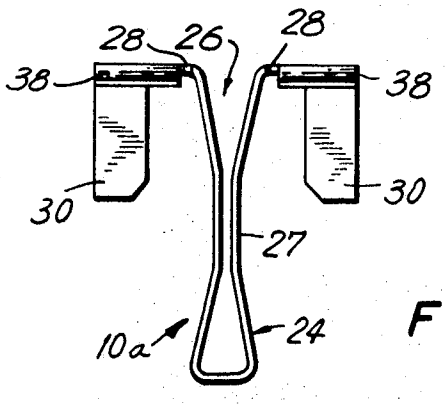
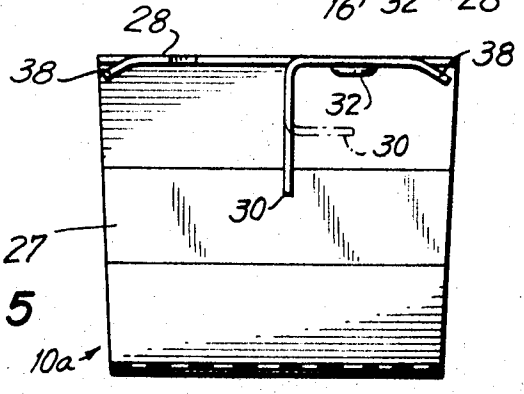


FIG. 5



INVENTORS
WILFRED R. SCHELLER
WINFIELD W. LOOSE
BY
Curais, Morris & Safford
ATTORNEY

PRINTED CIRCUIT BOARD CONNECTOR

This invention relates to connectors and assemblies for terminating a tab connector to a printed circuit board.

With all of the many advantages of printed circuitry, one of the continuing limitations has been the difficulty of obtaining a simple, reliable, electrical connection, particularly which can be repeatedly disconnected for use with removable components. U.S. Pat. Nos. 2,972,727 and 3,114,586 are illustrative of some earlier developments to meet this problem. The latter patent, although a simplification over the earliest developments in this area, still retains the significant drawback of requiring soldering to complete the electrical connection. The former patent, although an improvement, was found to loosen in service causing "intermittents" sufficient to constitute a total failure for many intended uses. The cause of this failure would appear to be the utilization of sharp serrations biting down into the conductive lamina of the printed circuit board during installation when the female contact is "staked," i.e., clinched, in place. The sharp points of the serrations formed areas of high stress which under vibration in service would loosen and sometimes be accompanied by a complete piercing of the copper lamina, delamination, and/or deformation of the insulating board beneath. Because the downwardly extending sharp serrations dug into the lamina during the staking operation, they prevented the formation of an adequate spring grip which might otherwise have absorbed and compensated for the effects of vibration. Finally, the leverage of the component tabs in the female connector would tend to work against the anchored serrations and open them up; thus, further contributing to the loosening of such connectors.

It is an object of the present invention to provide a female tab connector for use with printed circuitry which overcomes the above-mentioned problems.

It is a further object of the present invention to provide a female tab connector for printed circuit boards which through a simple mechanical application makes a positive and effective electrical connection with the conductive lamina without pealing, piercing, or otherwise damaging or destroying the lamina and which withstands substantial vibrations and mechanical shock without affecting the integrity of the connection.

According to a preferred embodiment of the present invention a printed circuit board female connector is stamped from a flat stock of conductive metal, formed into a general U-shape with the sides of the "U" bowed inwardly to form a restricted spring contact area and with the free ends of the "U" being bent outwardly, generally at right angles, to overlie and make contact with the conductive lamina of the printed circuit board adjacent the rectangular hole in which this female connector is mounted. The free ends have tongues lanced therefrom which extend through respective small holes in the printed circuit board which specifically accommodate these tongues. The tongues are folded over on the other side of the printed circuit board, thereby clinching the female connector in place. Applicants have discovered that a positive contact between the free ends of the connector and the conductive lamina of the printed circuitry can be obtained if a portion of these free ends extend downwardly into resilient engagement with the lamina. These downwardly extending portions may take the form of a hemispherical dimple, angled ears, or other similar devices of relatively abrupt configuration, i.e. closely approximating lines or points, for obtaining a positive resilient contact. It should be noted that in these preferred embodiments the downwardly extending portions are formed so that they may indent the lamina, but do not sharply pierce it. This enables the present invention to be used even on printed circuitry having considerably thinner and more fragile lamina. Alternatively, according to the present invention one may provide a downwardly extending portion which resiliently pierces the lamina making a positive pressure contact therewith, so long as the means for gripping and fastening the connector in place on the printed circuit board does not pierce the lamina. This ensures that the vibrations and shock to the connector are absorbed by the nonpiercing gripping element, such as the above-mentioned tongues.

In the broader aspects of this invention, the gripping function of the lanced tongues may be replaced by some other suitable structures.

Other objects, advantages, 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 is shown and described preferred 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 in order that others skilled in the art may more fully understand the invention and the principles thereof and the manner of applying it in practical use so that they may modify it in various forms, each as may be best suited to the conditions of a particular use.

In the drawings:

FIG. 1 is an isometric view of a preferred embodiment of the present invention showing a female connector, its cooperative tab connector, and the appropriately slotted printed circuit board, all prior to assembly;

FIG. 2 is a view similar to FIG. 1 of a modified preferred embodiment of the female connector;

FIG. 3 is a plan view of the connector in FIG. 2 staked to the printed circuit board;

FIG. 4 is an end elevation of the embodiment in FIG. 2; and

FIG. 5 is a side elevation of the embodiment in FIG. 2.

In FIG. 1 a female connector is illustrated positioned over a printed circuit board **12**, which has cutouts **14**, **16**, and **18** to accommodate the connector **10**. The tab connector **20** is illustrated aligned with the female connector **10** with which it meets to form a disconnect termination. The printed circuit board **12** includes the printed circuitry formed of a thin copper lamina **22**.

Connector **10** has a generally U-shaped body with the sides **24** bent inwardly toward each other to define a restricted internal spacing **26**. The inwardly bowed sides **24** in forming the spacing **26** are advantageously parallel throughout a substantial portion of their midsection **27**. This provides for a greater potential area for making electrical wipe contact with the tab **20** when inserted therebetween. Connector **10** is made from a resilient strip of conductive metal so that the inwardly bowed sides exert a spring pressure against the tab **20** upon insertion, thus insuring a good electrical wipe contact. The free ends **28** of the sides **24** are preferably bent outwardly at right angles so as to overlie the printed circuitry **22** upon insertion in the board **12**. These pads, or members, **28** preferably have tongues **30** lanced or struck out from them and bent downwardly to pass through the respective holes **16** and **18** positioned to accommodate them. These tongues **30** are long enough to pass completely through the board **12** and extend therebeyond, so that the free ends of the tongues **30** may be folded over to clinch the members **28** in place, thus, securely positioning the connector **10**.

The members **28** have a downwardly extending portion to insure positive engagement with the conductive lamina **22**. In the connector **10** illustrated in FIG. **1** this portion takes the form of a hemispherical dimple **32**. This dimple is advantageously positioned adjacent the tongue **30**, so that an effective amount of the resilient pressure exerted during the staking operation installing the connector **10** on the board **12** is retained after the removal of the applicator dies due to the continued gripping action of the clinched tongues.

In the staking operation it may be advantageous to have the connector **10** loosely secured on the board **12** prior to the actual clinching of the tongues **30**. This can be accomplished by providing four locking legs **34** which are cut out from the edges of the sides **24** and bowed slightly outwardly so that opposing pairs of legs are spread at their upper ends by an amount wider than the width of hole **14**. Thus, upon insertion of the connector **10** into the holes **14**, **16**, and **18**, the legs **30** are biased inwardly until they clear the board **12** at which point they snap outwardly catching behind the board **12** and locking the connector **10** in place.

The V-groove **36** in either end of the base of the connector **10** serves as a guide in conjunction with the applicator tool in feeding the connector **10** into the hole **14**.

FIGS. **2** to **5** show a slightly modified embodiment **10***a* of a connector made according to the present invention. In this embodiment, the locking legs **34** were omitted as being unnecessary since the applicator tool can positively position and stake the connector **10***a* in a single operation, thereby obviating the need for such legs **34**. Applicants have found the phenolic resin boards which are commonly used in printed circuitry have a tendency to crack or break between the hole **14** and the holes **16** and **18**, if the spacing therebetween is made too small. Therefore, to insure a positive anchoring and yet not make the members **28** of the connector **10***a* too large, the applicants found that they could lance the tongues **30** out from the edge of these members **28** without affecting the effectiveness of the resulting electrical contact. This both saved on excessive material costs and enhanced circuit density by keeping the members **28** to a reasonably small size.

To further enhance the positive electrical connection and its reliability, the connector **10***a* has the further feature of having the four side edges of the members **28** bent downwardly at approximately a 30° angle to form ears **38**. The members **28**, being formed from the same resilient strip of conductive metal as the spring sides **24**, serve to function with their ears **38** as spring contacts bearing on lamina **22**. A similar saving in size and material has been made by the elimination of the legs **34**, or conversely an increase in the effective area of the contact between the male tab connector **20** and the contact midsection **27** of the sides **24**.

In FIG. **3** the connector **10***a* is shown staked to the printed circuit board **12**. In FIG. **5**, the connector **10***a* is shown prior to assembly with the board **22** and the tongue **30** is also shown in dotted outline in the position which it would assume after clinching. FIG. **5** also shows a slight taper in the outline of the connector **10***a* which facilitates in the insertion of the connector **10***a* in the board **22**.

It should be noted that connectors of the type described in this application are particularly desirable in installations subject to occasional mechanical shock or even continual vibration. For example, several of these connectors **10** could be mounted in a printed circuit board in a polarized relationship for use in receiving and mounting the tab prongs of an electrical component used in an automobile.

A typical connector **10***a* might have overall dimensions of approximately one-half inch with the spacing **26** being about 0.02 inch and with the tongue being 0.17 inch long. This is designed for use with a printed circuit board one-sixteenth of an inch thick. For such a board, the spacing between the hole **14** and the holes **16** and **18** should be at least 0.07 inch. The width of hole **14** illustrated in FIG. **1** is about 0.50 inch. The square holes **16** and **18** are 0.9 inch on a side. The flat metal stock from which the connector is made is advantageously of a **04** hard brass about 0.015 inch thick.

We claim:

1. A female printed circuit tab connector comprising a generally U-shaped body made from a springlike conductive material, the sides of said U-shaped body each having a portion bent inwardly towards each other to define a restricted internal spacing for making a spring wipe contact with a tab inserted therebetween, the free ends of said U-shaped body forming flat members bent outwardly at substantially right angles to said body and said members having at least portions extending downwardly each in a nonpiercing relatively abrupt contact configuration, one portion being a dimple, another portion being ears bent downwardly at the opposing free sides of said member, gripping means for fixing said connector to a printed circuit board with said downwardly extending portion of said free ends being constructed and positioned relative to said gripping means to press into a positive engagement with at least one conductive surface of such a printed circuit board.

2. A connector as claimed in claim **1** wherein said gripping means is a tongue lanced out from each of said members long enough to extend through a printed circuit board and be securely clinched behind said board.

3. A connector as claimed in claim **2** further comprising four locking legs formed from each edge of the sides of said U-shaped body and being slightly outwardly sprung.

4. A female printed circuit tab connector comprising a generally U-shaped body made from a springlike conductive material, the sides of said U-shaped body each having a portion bent inwardly towards each other to define a restricted internal spacing for making a spring wipe contact with a tab inserted therebetween, the free ends of said U-shaped body forming flat members bent outwardly at substantially right angles to said body and said members having at least a portion extending downwardly in a nonpiercing relatively abrupt contact configuration, said downwardly extending portion of said members being an ear formed from a portion of said member bent downwardly, gripping means for fixing said connector to a printed circuit board with said downwardly extending portion of said free ends being constructed and positioned relative to said gripping means to press into a positive engagement with at least one conductive surface of such a printed circuit board.

5. A connector as claimed in claim **4** wherein said gripping means is a tongue lanced out from each of said members long enough to extend through a printed circuit board and be securely clinched behind said board.

6. A connector assembly comprising a female connector having a generally U-shaped body, the sides of said U-shaped body each having a portion bent inwardly towards each other to define opposed internal contact areas for making a spring wipe contact with a male connector adapted to be inserted therebetween, a printed circuit board having a hole therethrough to accommodate the body of said female connector and smaller tongue holes spaced from said body hole sufficiently to assure a firm base therebetween, a conductive lamina affixed to one side of said board adjacent said holes, said U-shaped body extending through said hole, the free ends of said U-shaped body being formed outwardly with portions extending downwardly to engage said lamina in a nonpiercing relatively abrupt electrical contact configuration, and a tongue lanced out from each of said free ends extending through said tongue holes and clinched to the board on the side opposite said free ends to fix said female connector onto said board and press said downwardly extending portions into positive engagement with said lamina.

7. A connector as claimed in claim **6** wherein said downwardly extending portion is a dimple adjacent the joinder of each of said tongues to said free ends which forms a pressure contact with said lamina.

8. A connector as claimed in claim **6** wherein said free ends have portions of their edges bent downwardly forming spring contacts bearing against said lamina.

9. A connector as claimed in claim **7** wherein said free ends have portions of their edges bent downwardly forming spring contacts bearing against said lamina.