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Iantorno

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[54] **CONDUCTIVE TERMINAL FOR FLEXIBLE CIRCUIT BOARDS**

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[52] **U.S. Cl.** ..... **339/220 R,** 339/276 R, 85/72

[51] **Int. Cl.** **H01r 9/08**

[58] **Field of Search** ..... 339/220, 221, 278 U, 276; 85/72

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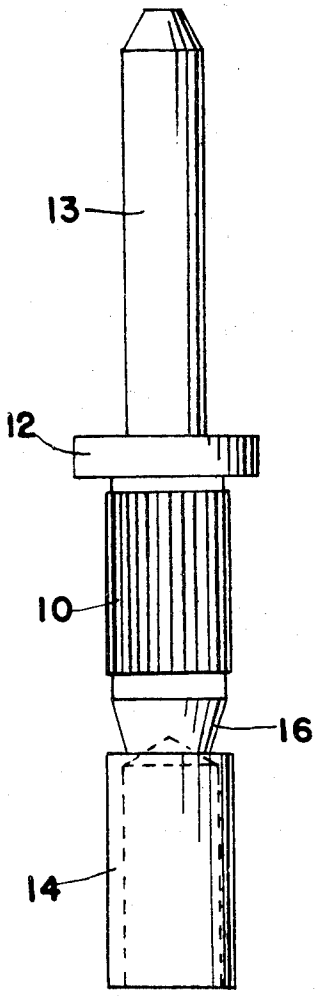
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Primary Examiner—Roy D. Frazier
Assistant Examiner—Robert A. Hafer
Attorney, Agent, or Firm—James M. Heilman; William O. Heilman; Anthony J. Casella

[57] **ABSTRACT**

A miniature conductive terminal designed for use with flexible materials. The terminal is made of a single piece of metal, such as brass, and includes a cylindrical shaft mounted within a hole in the circuit material, and a terminal rod or female contact for connection to a circuit or testing means. A hollow cylindrical ferrule is joined to the shaft by a break-away shear section. When the terminal is riveted to one or more stacked circuits, the ferrule is broken away from the shaft and forced over the shaft's outer surface to apply a clamping pressure against one side of the stack.

8 Claims, 8 Drawing Figures



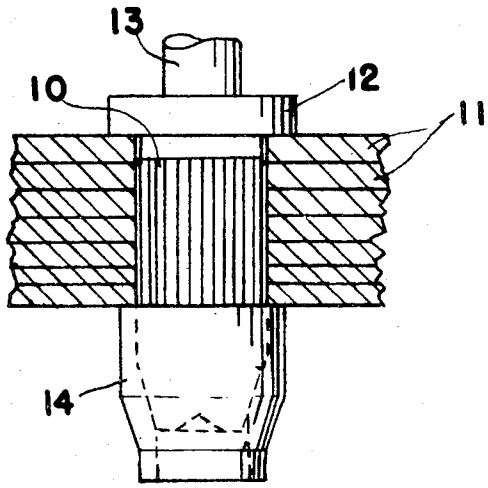


FIG. 1

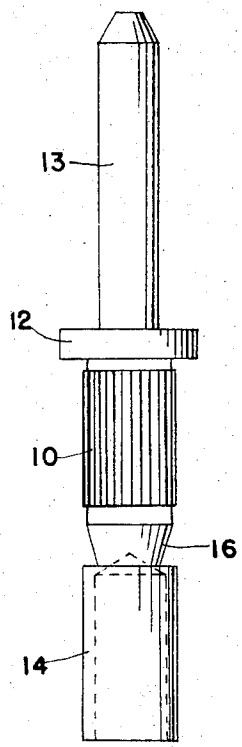


FIG 2

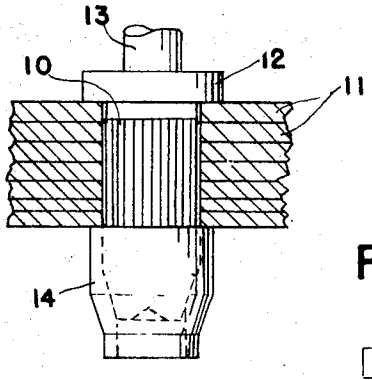


FIG. 3

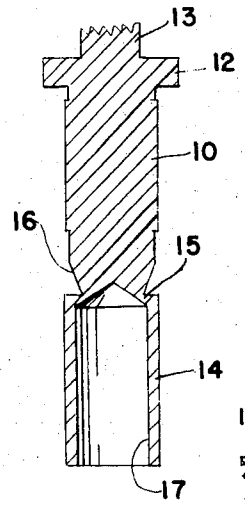


FIG. 4

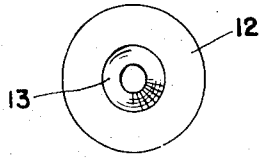


FIG 6

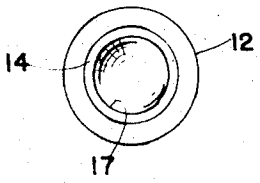


FIG. 5

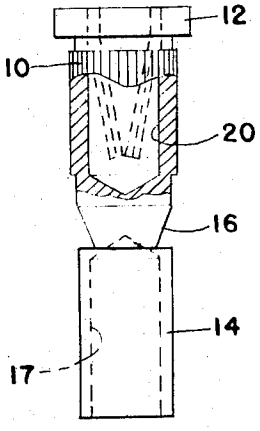


FIG. 7

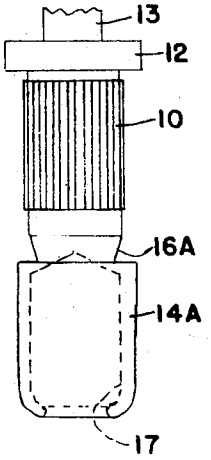
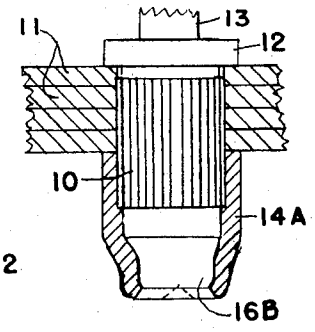


FIG. 8



CONDUCTIVE TERMINAL FOR FLEXIBLE CIRCUIT BOARDS

BACKGROUND OF THE INVENTION

The advent of flexible circuits has produced new problems in mounting terminals and test points. Some of the available types include simple pins press-fitted into drilled holes, self-piercing stamped parts, and eyelets. The basic problem is the securing means. The terminal described herein reduces the complexity and cost of installation while providing a reliable electrical conduction to the flexible circuit or circuitry to which it is attached.

The present invention is a single piece construction item when manufactured and separates into two joined pieces only when secured to a panel. It can be made in very small sizes and arranged for installation in multiple array on small circuit layouts.

One of the features of the invention is the small space required by the terminal when applied to miniaturized electrical/electronic circuits.

Another feature of the invention is the use of a single piece to form two cooperating pieces when the terminal is attached to one or a stack of circuits.

Another feature of the invention is that it permits the use of a simple flat metal tool to attach the terminal. No special equipment is required.

SUMMARY

The metal terminal includes a cylindrical shaft for mounting within a hole formed in one or a multiple of layers of insulator sheets. A shoulder is formed on one end of the shaft with the other end of the shaft extending beyond the layers of circuits. A terminal post for connection to a circuit component is formed integral with the shoulder and extends in axial alignment with the shaft. A hollow cylindrical ferrule is also formed integral with the shaft and is joined to it by a diminished shear section so under axial pressure it breaks away from the spreader cone and is forced over the shaft against one side of the stack.

Additional details of the invention will be disclosed in the following description, taken in connection with the accompanying drawings.

BRIEF DESCRIPTION OF THE FIGURES

FIG. **1** is a side view of the terminal before being attached to an insulator board.

FIG. **2** is a partial side view of the terminal after being riveted to a stack of circuits.

FIG. **3** is a cross sectional view of the lower portion of the unattached terminal.

FIG. **4** is an end view of the terminal taken from the rod end.

FIG. **5** is a cross sectional view of an alternate form of the terminal formed with a cavity instead of a post and containing a female spring contact.

FIG. **6** is an end view of the terminal taken from the ferrule end.

FIG. **7** is a side view of an alternate form of the conductive terminal wherein the ferrule is formed with a turned over edge.

FIG. **8** is a cross sectional view of the terminal shown in FIG. **7** after the riveting operation.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now to the figures, the terminal comprises a shaft **10** for insertion into one or more layers **11** of insulation. A shoulder **12** is formed at one end of the shaft **10** for locating against one side of the stack. A terminal post **13** is formed integral with the shoulder **12** and extends away from it in axial alignment. The terminal post is used as an electrical termination or tiepoint for one or more circuit components. At the other end of shaft **10** is a ferrule **14** also formed integral with the shaft **10** and joined to the shaft by a diminished section **15** adjoining a spreader cone **16.** The ferrule **14** is hollow as indicated in FIG. **3** and has an inside surface **17** with a diameter which is slightly less than the diameter of the shaft **10.** The diminished section **15** forms a breakaway portion which is fractured when the terminal is attached to a board.

The cylindrical surface of the shaft **10** may be smooth but it is preferably knurled as indicated in the drawings. A knurl consisting of ridges formed parallel to the shaft axis permits grounding out on circuit pad in the various layers of stacked circuitry.

An alternate form of the invention is shown in FIG. **5** where the post **13** is replaced by a cylindrical cavity **20** formed in the shaft **10** and in axial alignment therewith. This cavity is for receiving a test plug, or circuit component lead.

Another alternate form of the invention is shown in FIGS. **7** and **8** where the ferrule end is rolled inward providing a rounded end for easy entrance into mounting holes.

The riveting operation is simple but positive. The terminal is first entered into a hole in an insulator panel or into a hole in a stack of circuits as shown in FIG. **2.** Then a hammer or other blunt tool is used to strike a sharp blow on the lower end of the ferrule **14** and the ferrule is driven onto the lower end of the shaft **10.** It is not necessary to complete the action with a single blow, and several hits may be applied to insure that the ferrule **14** is snug against the lower side of the panel. Overdriving the ferrule **14** permits the riveting tool to spread the end of diminished section **15** increasing resistance to removal.

One type of terminal which has operated with good results had the following characteristics:

Diameter of post 13	= .040 inches
Diameter of shoulder 12	= .093 inches
Diameter of shaft 10	= .062 inches
Outside diameter of ferrule 14	= .064 inches
Inside diameter of ferrule 14	= .042 inches

After setting the ferrule against a surface more than 10 pounds pull was required to dislodge the ferrule. Terminals can be made of brass, copper or a variety of other metals. As indicated in the table above, the inside diameter of the ferrule is made about 0.020 inches smaller than the outside diameter of the shaft. This inside diameter may vary with different materials but it is usually about 30 percent less than the shaft diameter.

The embodiments of the invention, in which an exclusive property or priviledge is claimed, are defined as follows:

1. A conductive metal terminal for mounting within a hole formed in an insulator comprising an integral construction of:

a cylindrical shaft for mounting within said hole formed in the insulator and extending beyond one side thereof;

a shoulder formed integrally with one end of said shaft for limiting against the other side of the insulator;

a terminal post, for connection to a circuit component, formed integrally with the shoulder and extending in axial alignment with said shaft;

a spreader cone formed integrally with the opposite end of said shaft, said spreader cone being of a truncated conical configuration with its greater diameter end formed integrally with the shaft and being substantially equal in diameter with the diameter of said shaft, while the opposite end of said spreader cone is of smaller diameter than the diameter of said shaft; and

a hollow cylindrical ferrule integrally formed with said spreader cone and connected to the smaller diameter portion of said spreader cone, with the outer diameter of said hollow ferrule being substantially equal to the diameter of the shaft and the larger diameter of the spreader cone, while the internal diameter of said hollow ferrule is substantially equal to the smaller diameter of said spreader cone, such that the integral portion of the terminal connecting said spreader cone to the hollow ferrule defines a diminished shear section whereby, after said shaft is inserted into the hole and said shoulder abuts the insulator, an axial mechanical force may be applied to the terminal to cause shearing of the diminished shear section and radial expansion of the ferrule as it is forced over the spreader cone so as to form a pressure contact for mounting the terminal within the hole of the insulator.

2. A conductive metal terminal as in claim **1** wherein the conductive metal is brass.

3. A conductive metal terminal as in claim **1** wherein said metal is copper.

4. A conductive metal terminal as in claim **1** wherein a knurled surface is formed on said cylindrical shaft.

5. A conductive metal terminal for mounting within a hole formed in an insulator comprising an integral construction of:

a cylindrical shaft for mounting within said hole formed in the insulator and extending beyond one side thereof, said shaft formed with a cylindrical cavity for receiving a circuit plug and a plurality of spring fingers disposed within said cavity for resilient contact therewith;

a shoulder formed integrally with one end of said shaft for limiting against the other side of the insulator;

a spreader cone formed integral with the opposite end of said shaft, said spreader cone being of a truncated conical configuration, with its greater diameter end formed integrally with the shaft and being substantially equal in diameter with the diameter of the shaft, and the opposite end of said spreader cone is of smaller diameter than said shaft; and

a hollow cylindrical ferrule integrally formed with said spreader cone and connected to the smaller diameter portion of said spreader cone, with the outer diameter of said hollow ferrule being substantially equal to the diameter of the shaft and the larger diameter of the spreader cone, while the internal diameter of said hollow ferrule is substantially equal to the smaller diameter of said spreader cone, such that the integral portion of the terminal connecting said spreader cone to the hollow ferrule defines a diminished shear section whereby, after said shaft is inserted into the hole and said shoulder abuts the insulator, an axial mechanical force may be applied to the terminal to cause shearing of the diminished shear section and radial expansion of the ferrule as it is forced over a spreader cone so as to form a pressure contact for mounting the terminal within the hole of the insulator.

6. A conductive metal terminal as in claim **5** wherein said conductive metal is brass.

7. A conductive metal terminal as in claim **5** wherein said conductive metal is copper.

8. A conductive metal terminal as in claim **5** wherein a knurled surface is formed on said cylindrical shaft.

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