United States Patent [19]

Kunkle et al.

[11] **3,846,741**

[45] **Nov. 5, 1974**

[54] **CIRCUIT BOARD POST TYPE TERMINAL**

[75] Inventors: **John Philip Kunkle,** Harrisburg; **Ronald Bruce Barnes,** Camp Hill, both of Pa.

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

[22] Filed: **Sept. 25, 1973**

[21] Appl. No.: **400,469**

[52] **U.S. Cl.**..... **339/221 R,** 339/217 S, 339/252 R

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

[58] **Field of Search**..... 339/217 R, 217 S, 220, 339/221, 276 R, 276 T, 252 R, 252 P, 17 R, 17 L

[56] **References Cited**

UNITED STATES PATENTS

2,329,460	9/1943	Ebert	339/221 M
3,027,538	3/1962	Deakin	339/195
3,040,291	6/1962	Schweitzer et al.	339/217 S
3,360,767	12/1967	Brown et al.	339/17 L

FOREIGN PATENTS OR APPLICATIONS

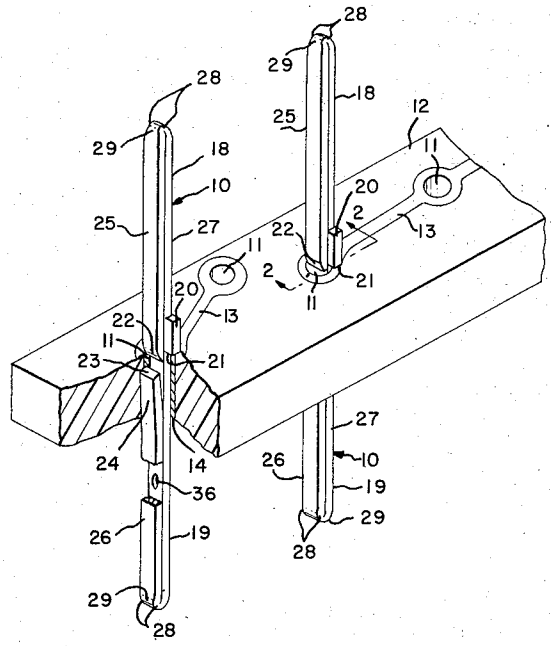
12,822	6/1909	Great Britain	339/252 P

Primary Examiner—Roy D. Frazier
Assistant Examiner—Robert A. Hafer
Attorney, Agent, or Firm—AMP Incorporated

[57] **ABSTRACT**

A printed circuit board post type terminal formed of a single strip of rectangularly cross-sectioned conductive metal and having an inherent resiliency. The strip of metal is folded back on itself from each end over a center portion and with at least one end flared away from the center portion to form a spring-like element which is inserted into a printed circuit board hole and grips the walls of said hole to provide good mechanical support and good electrical contact. An insert position stop shoulder side projection formed on at least one side of each terminal post provides for accurate and uniform insertion of the post terminals through a printed circuit board.

13 Claims, 9 Drawing Figures



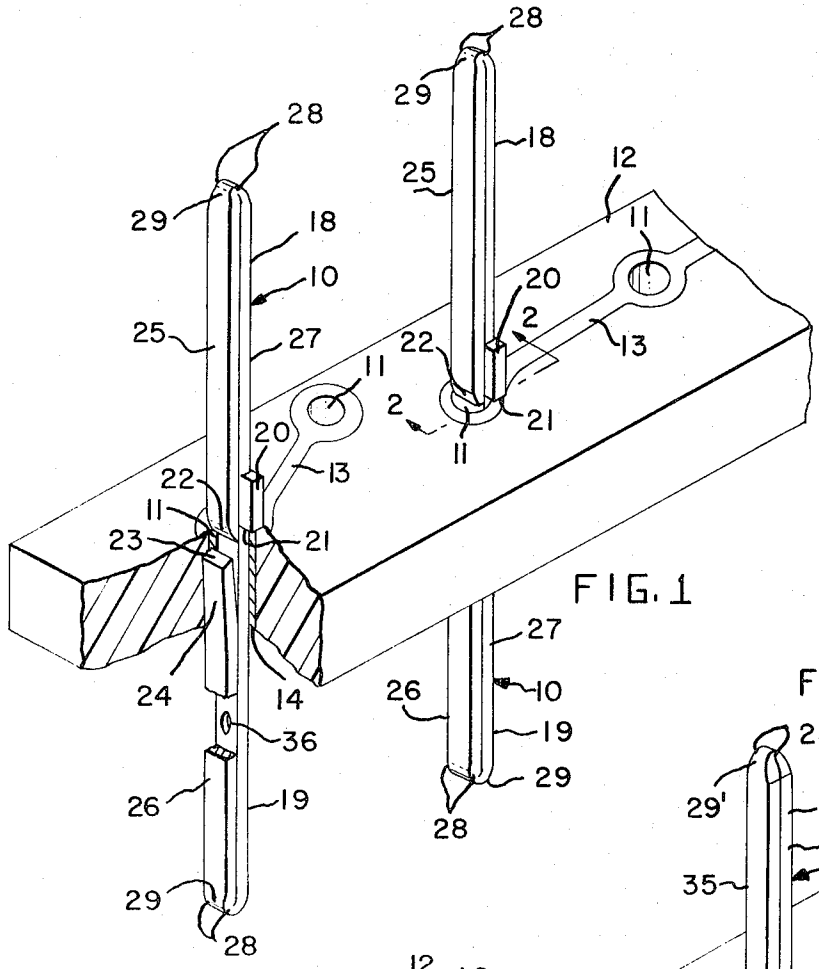


FIG. 1

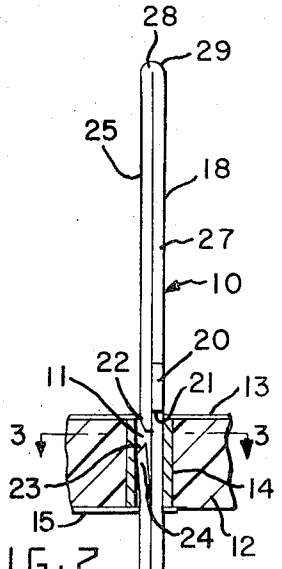


FIG. 2

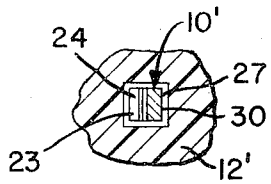


FIG. 4

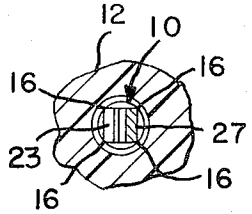


FIG. 3

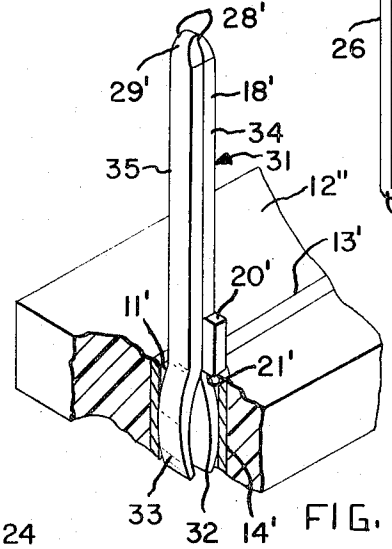


FIG. 6

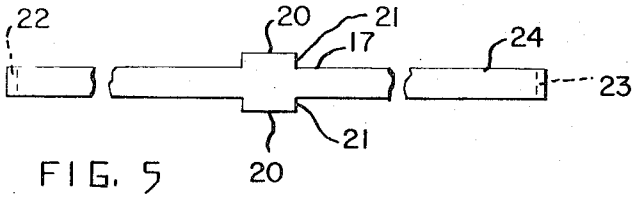


FIG. 5

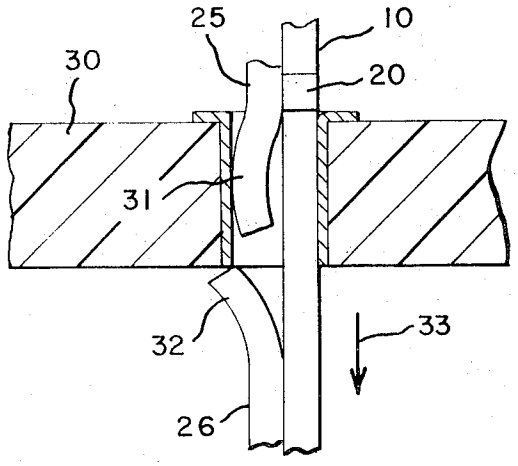


FIG. 7

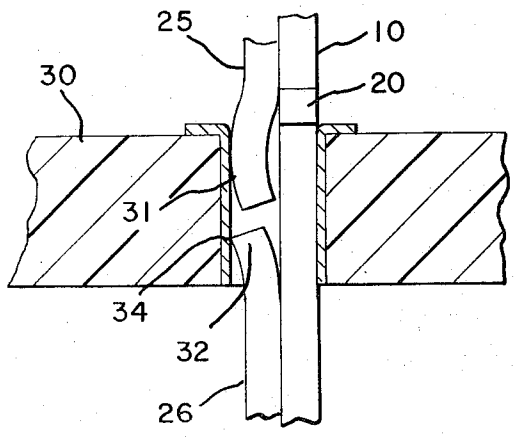


FIG. 8

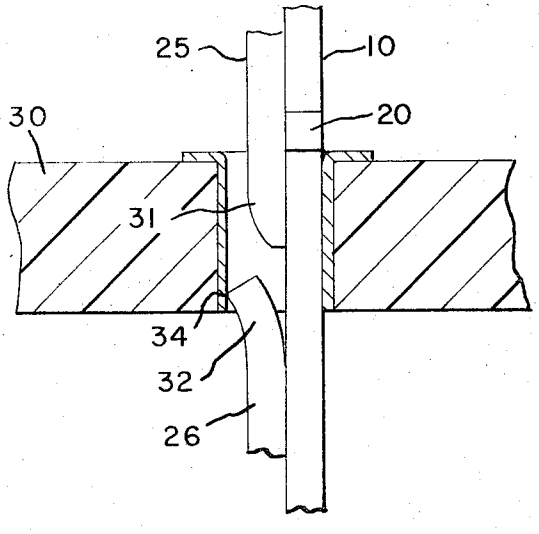


FIG. 9

CIRCUIT BOARD POST TYPE TERMINAL

This invention relates in general to printed circuit board terminals, and in particular, to post type terminals formed from a metal strip and with an integrally formed spring for in-place holding, and further with an integral stop shoulder locating said terminal in a hole in the printed circuit board.

Drilled-through terminal insert holes in printed circuit boards are commonly plated with thin metallic films which require snugly fitted post type terminals for consistent electrically conductive contact and for durable upright rigidity so that lead wires can be firmly attached. Post type terminals of circular cross-section configuration do not uniformly fit snugly because plated holes cannot be obtained with a sufficiently uniform close diameter tolerance and where the fit is overly snug, rupturing of the metallic film plating often occurs. Structural weakness and poor electrical connections often occur when circular cross-section post type terminals are split and spread for spring holding in the inserted portion of the terminal. Other solutions to the conductive contact and upright rigidity requirements, such as soldering, for example, result in undesirable additions in manufacturing costs and assembly time.

It is therefore, a principal object of this invention to provide a post type terminal with good electrical contact between the terminal and the metal plated through hole in a printed circuit board.

Another object of the invention is to provide a durable and rigid upright terminal post mountable with consistent snug fitting in holes in printed circuit boards.

A further object is to minimize terminal post mounting costs by providing a terminal post construction that can be inexpensively manufactured and assembled in a printed circuit board in a minimum amount of time.

In accordance with one form of the invention there is provided a formed strip of electrically conductive metallic material with folded-over ends, and with one end being shaped to form an integral, inherently resilient spring insert portion. An integral stop shoulder is provided on one side of the terminal posts for determining the depth of insertion of the post into a circuit board plated through insert hole. Further in some forms of the invention, when the terminal post stop shoulder is in registry contact with the surface of a circuit board, both ends of the formed terminal post are retained within a plated through hole. In other forms of the invention only one end is retained within the hole.

Specific embodiments representing what presently are regarded as the best modes of carrying out the invention are illustrated in the accompanying drawings:

In the drawings:

FIG. **1** represents a perspective view of a portion of a printed circuit board, partially sectioned and having a plurality of plated through terminal insert holes and interconnecting metallic film electric current paths, with some insert holes having post type terminals inserted;

FIG. **2,** a side evaluation view of an inserted post type terminal shown with a portion of a circuit board, in cross-section taken along line **2—2** of FIG. **1**;

FIG. **3,** a top plan view in section through a terminal post mounting plated through round hole of the circuit board of FIGS. **1** and **2** taken along line **3—3** of FIG. **2**;

FIG. **4,** a top plan view in section through a portion of a circuit board similar to FIG. **3,** showing, however, mounting detail of a terminal post mounted in a rectangular hole;

FIG. **5,** a plan view of a terminal post stamped blank prior to opposite ends being form bent back upon itself;

FIG. **6,** a perspective view of a printed circuit board, partially cut away and sectioned, and having a plated through hole holding an alternate embodiment of a folded over terminal post with spring bowed ends in the plated through hole;

FIG. **7,** another form of the invention in which one of the ends of one of the folded over portions functions as a latching element;

FIG. **8,** still another form of the invention in which the end of one of the folded over portions acts as a spring element and the end of the other folded over portion functions as a secondary supporting member as well as to provide good electrical contact; and

FIG. **9,** still another form of the invention in which an end of one of the folded over members is shaped and positioned to penetrate into the side of the circuit board hole to form both a good electrical contact and a good mechanical support. Referring to the drawings:

Two folded over post type terminals **10** are shown inserted through two holes of a plurality of plated through holes **11** in circuit board **12** which has a portion broken away and which is sectioned to show the detail of a terminal post **10** mounted in a plated through hole **11.** Some holes **11** are interconnected via printed metal circuit paths **13** and some are not, for various circuit designs purposes, as required. In any event, the plated through holes **11** have walls **14** of a conductive material which is generally a metal plating built up to a significant thickness, and which often is the electrically conductive path from circuitry **13** on one side of the board to circuitry **15** on the other side of the board **12** (See FIG. **2**). With the integrity of such through hole circuit paths being of considerable importance and with a good electrical connection between the plating of a plated through hole and a terminal post inserted therein being required, it is important that the through hole plating walls **14** not be ruptured in such a manner as to break conductive paths. Such conductive paths are maintained intact with the posts of the present invention.

More specifically the post **10** of the present invention has a rectangularly shaped cross-sectional area whereas the plated through holes such as hole **11** of FIG. **1** are circular in shape. The corners of the rectangularly shaped posts **10** will cut into the walls of the hole to form right angle grooves or indentations therein, such as indentations **16** of FIG. **3.** Due to the spring-like action of the flared out portion **24** of pin **10,** as shown in FIG. **1,** the effective cross-sectional area of post **10** will vary in accordance with hole size. The amount of spring force is sufficient, however, to cause the corners of the post **10** to cut into the walls of the hole, and more specifically to cut through the solder plating on the walls and make contact with the firmer copper plating underneath the solder. Thus, when resoldering occurs, the post **10** will remain firmly fixed in the hole since the copper does not flow during the solder reflow. Accord-

ingly, it can be seen that both good electrical contact and good mechanical support is obtained through the plated through hole when post **10** is inserted therethrough.

For relatively large terminal posts there are some advantages in utilizing square plated through holes in the printed circuit board, as shown in the cross section partial plan view of circuit board **12'** in FIG. **4.** Such advantages stem largely from the fact that more surface contact between a square post and a square hole can be obtained than between a square post and a round hole. The formation of very small square holes, however, is difficult to obtain without considerable expense. Accordingly, since most holes in printed circuit boards must be quite small a circular configuration is most frequently employed.

Regardless of size, the terminal posts **10** and **10'** are formed from a stamped blank **17** of electrically conductive spring metal as shown in FIG. **5,** that is generally twice as wide as it is thick through most of its length. Thus when the end portions thereof are folded back on itself around a center portion **27,** substantially square upper and lower terminal post extensions **18** and **19,** respectively, are formed. The terminal post blank **17** is also formed with side projections **20** which are positioned adjacent the center portion of the blank length so as to form a side projection from the upper terminal post extension **18.** These side projections **20** form bottom shoulders **21** that seat upon the surface of the printed circuit board and function as stops that determine the depth of insertion of terminal post **10** into the circuit board plated through hole.

The end portions of stamped blank **17** of FIG. **5** is provided with bevel tapers **22** and **23** respectively, on the same side of blank **17** and at each end thereof. The bevel taper **23** portion of blank **17** is bent back on itself to form lower terminal post extension **19** and the end of the bevel taper **23** portion is bent outwardly as shown in FIG. **1** to form a flat spring end **24** extending out and away from the center section **27** of terminal post **10.** Each terminal post **10** is installed in place by inserting the lower terminal post extension **19** into a plated through hole **11** and sliding it downward through the hole until the bottom shoulders **21** of the side projections **20** of that terminal post abut against the upper surface of the circuit board **12.** As the flat spring **24** enters a hole **11,** it accommodates itself to the hole within reasonable limits and will adjust to a considerable range of hole sizes. When the end portions of blank **17** are folded over to form terminal post extensions **18** and **19,** the metal in the end bends is cold worked so that the folded back portions **25** and **26,** respectively, are in contiguous engagement with the back portion **27** of a terminal post **10,** other than for the flat spring **24** portion of the terminal post. The folded over portions **25** and **26** can be welded to the back center portion **27** by spot welding the smooth inner surfaces of the folded over portions and the center portion together or by forming dimples, such as dimple **36** on one of said smooth inner surfaces and then using a flat welding surface to perform the welding. Further, the lateral corners of the outer ends of the terminal post extensions **18** and **19** can be beveled **28** after the portions **25** and **26** are folded back. The bevel surfaces **28** combined with the rounded ends **29** facilitate entrance of terminal post extensions **18** and **19** into connector box sockets generally available on the market (not shown), and also facilitate insertion of terminal post extensions **19** into a plated through holes **11** for installation of terminal posts **10** in board **12.**

The folded back portions **25** and **26** are so folded back on back portion **27** that the flat spring **24** and bevel taper **23** are substantially contained within a plated through hole **11** when shoulders **21** are seated upon the upper surface of a circuit board **12.** It should be noted that the bevel taper **22** of folded back portion **25** can extend into a plated through hole **11** when the post **10** is installed in place with the shoulder **21** seated on a circuit board, to thereby help prevent undesired spreading of folded back portion **25** from contiguous contact with back portion **27,** and further to block solder which might flow up through the hole.

With a larger terminal post **10'** inserted into a rectangular plated through hole **30** in a circuit board **12',** as partially shown in FIG. **4,** the enhanced structural mounting advantages and good electrical connection between the terminal post and plating of the hole are much the same as with the terminal post **10** mountings in round plated through holes **11,** except for the corner conforming indentations **16** thereof. Various structural parts of terminal post **30,** substantially the same, other than for size, as with the terminal posts **10,** are numbered the same.

Referring now to the embodiment of FIG. **6** a terminal post extension **18'** extends upwards only from a base mounting within cylindrical plated through hole **11',** with plated metal wall **14'** in circuit board **12''** connected to typical printed metal circuitry **13'.** The base mounting comprises a pair of opposite bowed spring ends **32** and **33** extending from sides **34** and **35,** respectively. The side **34** has a projection **20'** formed thereon with an indexing bottom shoulder **21'** that seats on the face of board **12''** when the terminal post **31** is fully inserted. The spring ends **32** and **33** are formed to bow outwardly from each other where they join terminal post sides **34** and **35,** and then to turn in again toward each other at their ends to facilitate easy insertion into the hole **11'.** During entry into said hole **11'** the bowed ends **32** and **33** will cut corner grooves in the plating similar to the grooves **16** of FIG. **3.** The groove cutting effect combined with the index seating of shoulder **21'** and the spring compression of bowed ends **32** and **33** in the hole **11'** results in a firm mounting of the terminal post **31** and in a reliable electrical contact between the post and the plating of hole **11'.** Here, just as with terminal posts **10,** the beveled surfaces **28'** and the rounded end **29'** facilitate the insertion of post **31** into box sockets (not shown). Further, the square shape of the terminal post extension **18'** and the extensions **18** and **19** of terminal posts **10** with right angle sharp corners is ideal for wire wrap connections.

Referring now to FIG. **7** the end **31** of folded over portion **25** acts as a spring-like element against the sides of the hole in printed circuit board **30.** The end **32** of the folded over portion **26** functions as a latch to prevent the terminal **10** from being unintentionally withdrawn from the board **30.** The pin **10** is inserted initially in the direction of arrow **33.** The stop **20** seats upon the top surface of printed circuit board **30.**

In FIG. **8** there is shown a modification of the structure of FIG. **7** wherein the end **32** of folded over portion **26** is formed with a relatively sharp point **34** which digs into the side of the hole in printed circuit board **30**

to provide additional mechanical support and good electrical contact. The end **31** of folded over portion **25** acts as a spring in the same manner as end **31** in FIG. 7

In relatively thin circuit boards wherein there is insufficient thickness to support both a spring member and a penetrating member such as ends **31** and **32** of FIG. **8,** only a penetrating member is employed. Such a structure is shown in FIG. **9** wherein the sharp point of end **32** of folded over member **26** penetrates into the wall of the hole in printed circuit board **30.**

Whereas this invention is herein illustrated and described with respect to several embodiments hereof, it should be noted that various changes may be made without departing from the spirit or scope of the invention.

What is claimed is:

1. A terminal post inserted in a hole in a circuit board and comprising an electrically conductive metal strip having first and second ends and folded over onto itself at first and second fold points about the center portion of said metal strip so that the said first and second ends are facing and adjacent to each other but separated by a distance less than the thickness of said circuit board, and stop means affixed to said terminal post and constructed to seat upon the insertion side surface of said circuit board when said terminal post is fully inserted in said hole to position a given end of said metal strip within said hole, one of said ends of said metal strip being positioned and shaped to penetrate into the wall of said hole when said terminal post is fully inserted therein to provide good electrical and mechanical contact with said wall and to inhibit withdrawal of said terminal post from said hole.

2. The combination of a circuit board having a plated-through hole formed therein, and a terminal post formed from an electrically conductive single metal strip and mounted in said plated-through hole of said circuit board, said terminal post comprising:

a terminal post elongated back portion with a side projection presenting a stop shoulder for register positioning on one of said circuit board surfaces; and

said metal strip folded over on itself at the extremities of said elongated back portion, said fold over portions extending towards each other and forming a front portion;

said front fold-over portion and said back portion being in side-by-side contiguous engagement to form a desired overall terminal post of rectangular cross-section; and one of said fold over portions forming

spring means on that portion of said terminal post which is inserted in said circuit board hole.

3. The combination of claim **2,** with said front fold-over portion being a first fold-over portion which combines with said back portion to form upper terminal post extension;

a second fold-over portion which is also a front fold over portion and which combines with said back portion to form a lower terminal post extension;

said upper and lower terminal post extensions extending, respectively, up from said one of said circuit board surfaces and down from the other of said circuit board surfaces when the terminal post is fully inserted in a plated-through hole.

4. The combination of claim **3,** wherein said spring means is an integrally formed resilient spring end portion of said second fold-over portion of the terminal post.

5. The combination of claim **4,** wherein said spring means is a flat spring end portion extending out and away from said back portion.

6. The combination of claim **5,** wherein said first fold-over portion extends below the stop shoulder of said side projection and into a hole in said circuit board when said terminal post is fully inserted in place in the circuit board hole.

7. The combination of claim **5,** wherein the rectangular cross-section of the combined terminal post back and folded over portions is substantially square; and with the terminal post sized to cut corner-conforming identations in the plating of said circuit board plated-through hole to receive and retain said terminal post.

8. The combination of claim **7,** wherein the end termination of said flat spring end portion is angled to facilitate removal of the terminal post from a plated-through hole;

and wherein said spring means resiliently engages the wall of a plated-through hole to provide for repeated insertion of a terminal post in a previously used hole to provide both proper support and good electrical contact between the terminal post and the plating of the plated-through hole.

9. The combination of claim **2,** with oppositely positioned bowed-out spring extensions from said terminal post back portion and said front fold-over portion extending from said side-by-side contiguous engagement between said terminal post front and back portions adjacent the level of said stop shoulder.

10. The combination of claim **9,** wherein said oppositely positioned bowed-out spring extensions are formed to turn in toward each other at the bottom ends;

and with the bottom ends of said spring extensions being spaced close together to facilitate easy entry into a circular plated-through hole and then to come together while in the hole to provide an increased spring force of the bowed portions of said spring means upon the sides of said plated-through hole.

11. In combination, a circuit board having apertures therein, and a terminal post inserted in an aperture in said circuit board with said terminal post comprising:

an electrically conductive metal strip having first and second ends and folded over onto itself at first and second fold points about the center portion of said metal strip so that the said first and second ends are facing and adjacent to each other but separated by a distance less than the thickness of said circuit board;

a given one of said ends being flared away from said center portion of said metal strip to provide a gripping action against the wall of said aperture in said circuit board when inserted therein; and

stop means affixed to said terminal post and constructed to seat upon the insertion side surface of said circuit board when said terminal post is fully inserted in said hole to position said given end of said strip within said hole.

12. A combination in accordance with claim 11 in which the other end of said metal strip is flared away from said center portion of said metal strip and which abuts against the intersection of said aperture and the other surface of said circuit board when said terminal post is fully inserted in said aperture to prevent withdrawal of said terminal post from said aperture.

13. A combination in accordance with claim 11 in which the other end of said metal strip is flared away from said center portion of said metal strip and which is positioned and shaped to penetrate into the wall of said aperture when said terminal post is fully inserted therein to provide good electrical and mechanical contact with said wall and to inhibit withdrawal of said terminal post from said aperture.

* * * * *