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(54) Compliant pin.

(57) The disclosure relates to a compliant pin that effects a resilient interference fit within a complementary aperture of a printed circuit board. The pin utilizes an improved three beam configuration that optimizes electrical continuity, load distribution and mechanical stability, yet minimizes insertion force. The compliant pin exhibits contact wiping upon insertion and an anti-torque characteristic after insertion.

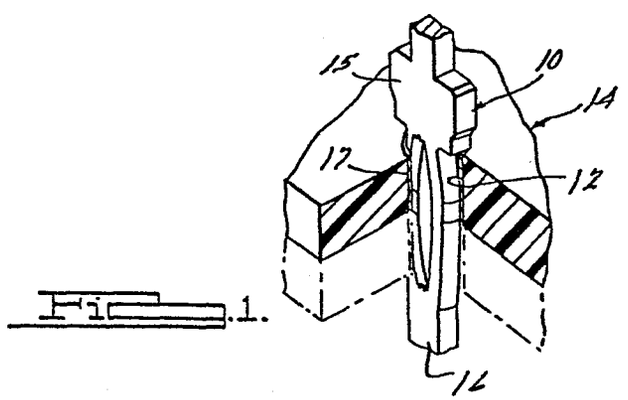

Fig. 1.

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COMPLIANT PIN

BACKGROUND OF THE INVENTION

Compliant pins are used to facilitate an electrical connection between, for example, printed circuit boards and associated circuitry. Such pin connectors generally utilize a split wall or twin beams that are radially contractable upon insertion of the pin into an aperture thereby to provide a positive electrical and mechanical connection to the circuit board. An example of a compliant pin heretofore known and used is found in U. S. Patent Re. 29,513.

It is desirable that a compliant pin effect resilient engagement with the circuit board so that contact pressure is maintained yet be capable of insertion into the circuit board in a high density array without requiring excessive installation force. Yet another desirable feature of a compliant pin is that it exhibit contact wiping upon insertion into the circuit board yet be resilient to torque applied to the pin in order to preclude an electrical short circuit between adjacent pins and scoring of the aperture in the circuit board.

The problem with pins of conventional design is that in order to meet the force requirements incident to insertion, retention and torque, such known pins are relatively stiff. As a result, the aperture in the printed circuit board often complies more than the pin. This results in significant hole deformation, both electrical and mechanical damage to the circuit

board, and ultimate compromise of the integrity of the electrical circuit.

SUMMARY OF THE INVENTION

A compliant pin in accordance with the instant invention solves the aforesaid problem by utilizing a shank portion that is split into three beams that are seated in an aperture in a printed circuit board or other mounting member. The pin has conventional wire-wrap, solder or mechanical terminations extending above and below the circuit board, of any desired configuration. Upon insertion of the pin into the mounting aperture of the circuit board, the three beams engage the aperture walls and maintain a resilient bias thereon. The resilient bias of the flexed beams against the walls of the aperture, ensures secure mechanical mounting as well as positive electrical contact with the conductive plating internally of the aperture. In accordance with one feature, flexure of an intermediate beam of the pin results in torsion of the outer beams to effect contact wiping and insure good electrical contact. The intermediate beam also functions as an anti-torque element to stabilize the rotational position of the pin within the aperture in the circuit board.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 is a perspective exploded view of a compliant pin in accordance with the instant invention mounted on a conventional printed circuit board;

Figure 2 is an elevational view of the compliant pin of Figure 1, partly broken away;

Figure 3 is a side elevational view of the pin of Figure 2; and

Figure 4 is a cross-sectional view of the compliant pin taken substantially along the line 4-4 of Figure 2 and shown in relation to a maximum and minimum diameter aperture in a circuit board.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT OF THE INVENTION

As seen in Figure 1, a compliant pin 10, in accordance with a constructed embodiment of the instant invention, is preferably fabricated from a single piece of flat metal or other conductive material and adapted to be press fit into an aperture 12 in a printed circuit board 14. The pin 10 is adapted to be electrically connected to conductors of any desired configuration at an upper terminal or head portion 15 and a lower terminal or tail portion 16 thereof (not shown), as well as to be electrically connected to conductive plating 17 within the aperture 12 in the circuit board 14. A minimum thickness circuit board 14 is illustrated in solid lines, the dashed lines indicating the degree of penetration of the pin 10 in a maximum thickness circuit board.

As shown in detail in Figures 2 and 3, the head portion 15 of the pin 10 has shoulders 18 and 19 thereon that limit penetration of the pin 10 into the circuit board 14. A shank portion of the pin 10 comprises an intermediate beam 20 disposed between two

outboard beams 22 and 24. The beams 20, 22 and 24 are disposed in a generally triangular array thereby to mount the pin 10 within the aperture 12 in the circuit board 14. Arcuate sidewall edges 26, 28 and 30 on the beams 20, 22 and 24, respectively, engage the conductive sidewall 17 of the mounting aperture 12 in the board 14. The beams 20, 22 and 24 are bent radially outwardly so that the edge portions 26, 28 and 30 lie in and define a circle of predetermined diameter greater than the maximum diameter of the aperture 12 in the circuit board 14. Thus, the beams 20, 22 and 24 provide for both mechanical attachment of the pin 10 to the circuit board 14 and electrical contact with a desired printed circuit thereon.

As best seen in Figure 4 of the drawing, the intermediate beam 20 is displaced radially to the left and out of the plane of the beams 22 and 24. The beams 22 and 24 are displaced radially outwardly relative to one another and to the beam 20 whereby the beams 20, 22 and 24 are disposed in a generally triangular array.

The beams 20, 22 and 24 are provided with arcuate edge surfaces 26, 28 and 30, the radii of development thereof R_1, R_2 and R_3, respectively, being equal to the radius R_4 of a minimum aperture A_{min}. Thus, when the pin 10 is inserted into a minimum aperture A_{min} in the circuit board 14, the beams 20, 22 and 24 will be radially inwardly contracted to the extent that the arcuate edge portions 26, 28 and 30 thereon, respectively, are concentric with the inner surface of the aperture A_{min}.

It is to be noted that the beams 20, 22 and 24 are initially expanded, as seen in Figure 4 of the drawings, to a circle having a radius R_6 which is greater than the radius R_5 of a maximum size aperture A_{max}. When the beams 20, 22 and 24 contract radially inwardly into an aperture A_{max}, the arcuate edge surfaces 26, 28 and 30 thereon make line contact with the periphery of the aperture A_{max}.

From the foregoing it should be apparent that the arcuate edge portions 26, 28 and 30 of the beams 20, 22 and 24, respectively, never engage the aperture 12 of the circuit board 14 in a manner that brings the circumferentially spaced side corners 32-34, 36-38, and 40-42 thereof into biting contact with the apertures A_{max} or A_{min}. The aforesaid relationship precludes scoring of the aperture 12 and compromise of circuit board 14 integrity.

In accordance with another feature of the invention, the entire pin 10 is moved radially to the right as seen in Figure 4, upon insertion into the circuit board 14 by a radial force F_1. Concomitantly, the beams 22 and 24 are biased radially inwardly under the influence of radial forces F_2 and F_3, resolution of the aforesaid forces resulting in the beam 22 being subjected to a counterclockwise torsional moment TM_{CC} while the beam 24 is subjected to a clockwise torsional moment TM_C. The aforesaid torsional moments TM_{CC} and TM_C effect contact wiping between the edge surfaces 28 and 30 on the beams 22, 24, respectively, and the electrically conductive surface 17 of the aperture 12

in the circuit board 14.

In accordance with yet another feature of the instant invention, the pin 10 is stabilized against rotation by the intermediate beam 20 since it essentially floats between the beams 22 and 24 thereby to provide a counter torque to any twisting moment applied to the upper terminal or head portion 15 or lower terminal or tail portion 16 of the pin 10. This anti-torque feature results in maintenance of a desired orientation for the upper and lower terminal portions 15 and 16 of the pin 10 on the circuit board 14 to ensure electrical spacing between adjacent pins.

While the preferred embodiment of the invention has been disclosed, it should be appreciated that the invention is susceptible of modification without departing from the scope of the following claims.

CLAIMS

1. A compliant pin for acceptance in a complementary aperture in a mounting device comprising a head portion having means thereon for positioning said pin relative to said mounting device, a tail portion spaced from said head portion, and an intermediate portion comprising three resilient beams circumferentially spaced from one another about a central axis and disposed in a generally triangular array.

2. A compliant pin in accordance with claim 1 wherein said beams have arcuate edge portions lying in a circle generated about said axis.

3. A compliant pin in accordance with claim 1 wherein two of said beams lie in a common diametrical plane and an intermediate beam is displaced radially at an angle of ninety degrees to said plane.

4. A compliant pin in accordance with claim 1 wherein said aperture is circular and said edge portions lie in a circle having a diameter relatively larger than said aperture.

5. A compliant pin in accordance with claim 2 wherein the radius of generation of said arcuate edge portions is equal to or less than the radius of said aperture.

6. A compliant pin in accordance with claim 1 wherein said pin is movable radially relative to said aperture upon insertion thereinto.

7. A compliant pin in accordance with claim 3 wherein said two beams move circumferentially toward said intermediate beam, respectively, upon insertion of said pin into said aperture to effect contact wiping therewith.

8. A compliant pin in accordance with claim 3 wherein said intermediate beam is attached solely to said head and tail portions thereby to stabilize said pin against rotation in said aperture.

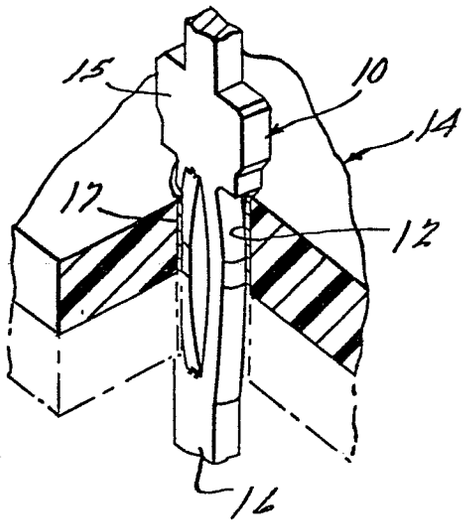

Fig.1.

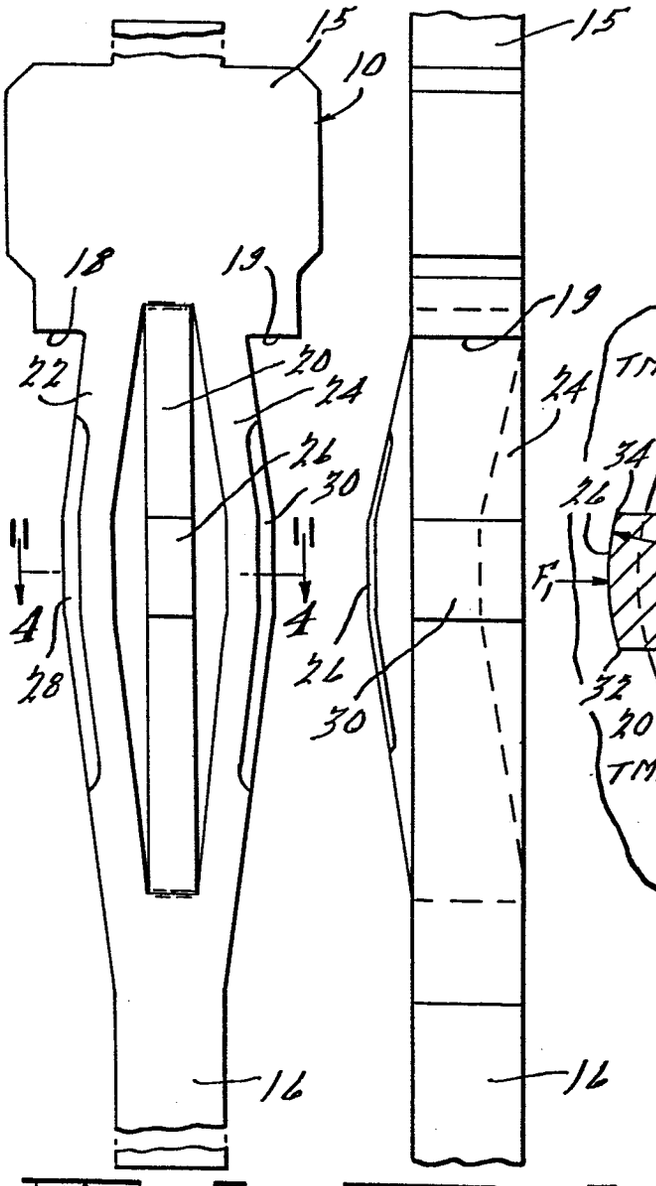

Fig.2.

Fig.3.

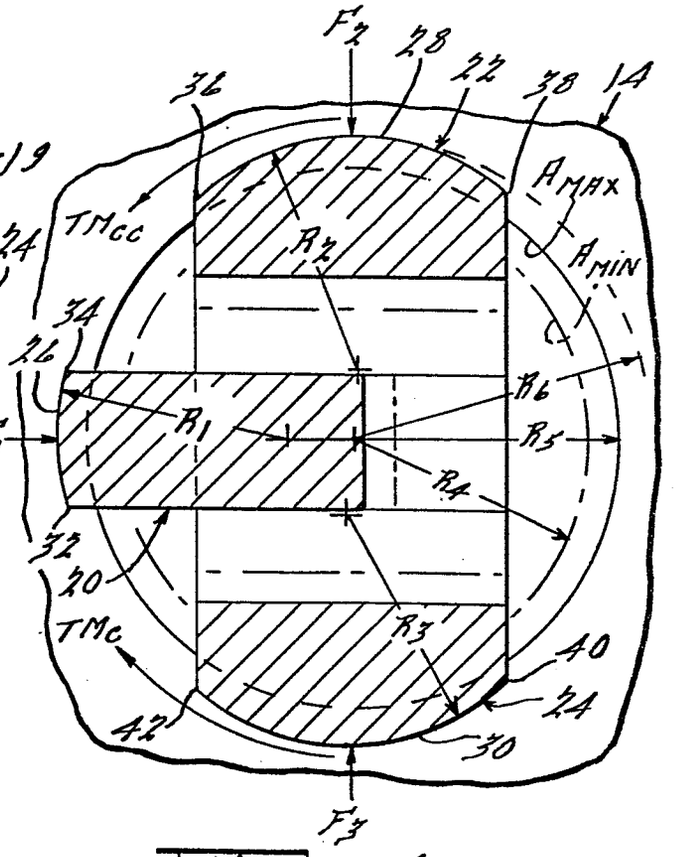

Fig.4.