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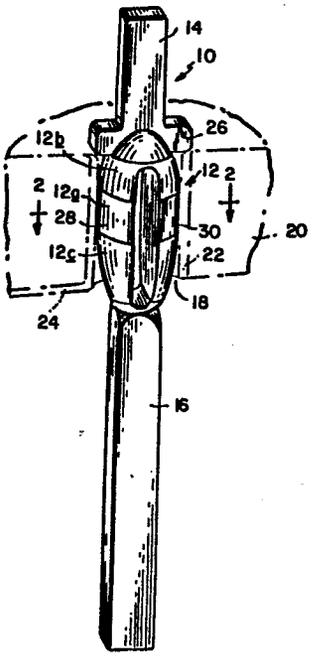
(54) Press-fit pin for circuit board connection.

(57) This invention relates to a press-fit pin (10) for insertion into a hole having a conductive surface (22).

This pin comprises a contact section (12) for engagement with the surface to provide electrical contact therewith and further to provide a retention force maintaining said pin in the hole. The contact section comprises a pair of elongated beams (28-30) extending in the longitudinal direction of the pin, each beam having a generally C-shaped cross section with the C's opened toward each other.



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Background of the Invention

This invention relates to the solderless connection of contact pins to printed circuit boards. More specifically it relates to press-fit pins that are inserted into plated-through holes to make contacts with conductive surface layers in such holes thereby providingconnections to printed circuit conductors terminating in the surface layers. The pin that is provided by the invention has a compliant contact section that engages a surface layer in a plated-through hole at multiple circumferential locations that are symmetrical with respect to each other. It provides both reliable electrical contact and precise orienting of the pin for external connection of various circuit elements thereto.

Prior to the present invention the contact pin in widest use has been configured with a contact section whose cross section is square and which defines a circumscribed circle somewhat larger in diameter than the plated-through hole into which the pin is to be inserted. When the pin is inserted into the hole, the edges of the contact section essentially coin the interior surface of the hole, thereby making a tight fit therein. Pins of this type are characterized by a relatively high insertion force. Moreover in order to provide both reliable electrical contact and a reasonable limit to the

insertion force, the difference between the diameter of the hole and the diameter of the circumscribing circle of the pin must be closely controlled. This in turn means that both the pin and the hole have to be made with relatively close tolerances. Moreover, if repair of the circuit board requires removal of the pin, the pin must be replaced with a larger pin to ensure reliable electrical contact in the hole. This, of course, requires the stocking of pins of various cross sections.

The deficiencies of the square pin are largely overcome by pins having radially compliant contact sections. These sections are larger than the holes into which the pins are to be inserted and when the pins are inserted into the holes, the contact sections are therefore squeezed inwardly. The resulting outwardly-directed spring forces of these contact sections maintain electrical contacts between the pins and the plated surfaces of the holes. They also provide sufficient frictional forces to retain the pins in the holes. Because of their compliant nature, the contact sections adjust themselves to a relatively wide range of holediameters, thereby easing the tolerance requirements for both the pins and the holes. Moreover, the pins can be removed and replaced without seriously damaging the surfaces of the holes.

However, while radially compliant pins can, in principle, overcome all the deficiencies of the non-compliant pins, none of the prior compliant pin designs that we are aware of overcomes all of the deficiencies. Thus some provide adequate retention forces but unduly damage the surface of the hole so that replacement of the pins is difficult. With other designs there is minimal hole damage but retention forces are inadequate or the insertion forces are difficult to control. Moreover some designs provide non-symmetrical retention forces so that the pins tend to cock or splay. This makes it difficult to make external connections to the pins by devices such as automatic wire wrap machinery, which requires a fair degree of precision in the locations of the ends of the pins.

Summary of the Invention

The principle object of the invention therefore is to provide a press-fit pin having a compliant contact section which makes reliable contact with the conductive surface of a plated hole, has a moderate insertion force and a relatively strong retention force. A further object of the invention is to provide a pin, having the above characteristics, which causes relatively little damage to a plated hole upon insertion and therefore can be replaced by a pin of the same type and size.

Yet another object of the invention is to provide a pin which can be used with a relatively wide range of hole diameters while retaining the foregoing characteristics.

Yet another object of the invention is to provide a pin having the foregoing characteristics and which retains a desired orientation with respect to a printed circuit board into which it is inserted.

A pin embodying the invention has a compliant contact section comprising a pair of longitudinally extending beams whose cross sections are in the form of opposed C's. The radius of curvature of each of these C-sections is greater than that of the hole into which the pin is to be inserted and the ends of the arms of the C's fit a circle having a larger diameter than that of the hole. Accordingly, when the pin is inserted into the hole, the ends of the two arms of each C are forced toward each other. Also the compliant sections bend so that the C's are forced toward each other. With this arrangement the contact section has six circumferentially spaced areas of contact with the conductive surface of the hole. Moreover, the pin can be removed and replaced by a pin of the same size, while retaining the desired reliability of electrical contact.

Brief Description of the Drawings

FIG. 1 is a perspective view of a press-fit pin embodying the invention, showing the pin in position in a plated-through hole in a printed circuit board;

FIG. 2 is a section on line 2-2 of FIG. 1, through the contact section of the pin; and

FIG. 3 is a schematic representation showing the contact between pin and the plated surface of the hole.

Detailed Description of the Preferred Embodiments

As shown in FIG. 1, a press-fit pin embodying the invention and generally indicated at 10 comprises a contact section 12, connected at one end to a head section 14 and at the other end to a tail section 16. The pin 10 is shown in position in a hole 18 in a circuit board fragmentarily shown at 20. The hole 18 has a conductive surface layer 22, connected to a conductor 24 formed in a conventional manner on the board 20.

The pin 10 is inserted into the board 10 with a downward motion (FIG. 1). Specifically, the insertion force is provided by a suitable tool that presses down on ears 26 on the head section 14. The downward movement continues until the ears 26 seat against the circuit board 20. During insertion, the contact section 12 is squeezed inwardly by the inner surface of the hole 12 as described below. The resulting outward force exerted by

the contact section provides both reliable electrical contact with the surface layer 22 of the hole 18 and a friction force that serves to retain the pin 10 in the hole. The illustrated tail section 16 is suitable for a wire wrap connection to an external conductor.

As seen in FIG. 1, the contact section 12 has a mid portion 12a and upper and lower tapered portions 12b and 12c. The portion 12a, which is cylindrical in shape, provides the contact, described above, with the conductive layer 22. The tapered portions are tapered to accommodate the narrower head section 14 and tail section 16 to the wider contact portion 12a. The lower tapered portion 12c also serves as a guide which, on insertion, provides a smooth transition to the larger diameter of the contact portion, so as to minimize damage to the surface layer 22.

With reference to both Figs. 1 and 2, the contact section 12 comprises a pair of longitudinally extending beams 28 and 30. At least the mid portion of each beam has the shape of a truncated "C" in cross section, with the C's facing each other. In the unstressed condition of the contact section 12, the outer surfaces of the C's have a radius of curvature which is greater than that of the inner surface of the hole 18. Moreover, the ends 28a, 28b, 30a and 38b of the C's define a circumscribing circle whose radius is greater than that of the hole 18.

Also, the central portions 28C and 30C of the C's are spaced apart by a distance greater than the diameter of the hole 18.

Accordingly, when the pin 10 is inserted into the hole 18, the C ends 28a, 28b, 30a and 30b contact the conductive layer 18 and are electrically forced inwardly thereby. Also the beams 28 and 30 bend inwardly so that the distance between the central portions 28C and 30C conforms to the diameter of the hole 18.

For ease of illustration, FIG. 2 shows the C's in continuous contact with the conductive layer 22. Actually, reliable electrical contact will generally take place only at the ends 28a, 28b, 30a and 30b and the central portions 28c and 30c of the C's, as shown in FIG. 3. This is because the forces exerted by the contact section 12 on the conductive layer 22 are applied primarily at these points. In any case, with six areas of contact, the pin provides a reliable electrical connection with the conductive layer 22. Moreover, since the contact areas are symetrically disposed, there is no tendency of the pin to splay and thus the tail section 16 is assured of a predetermined, usually perpendicular, orientation with respect to the board 20.

Thus we have described a novel press-fit contact pin having a compliant contact section which can accommodate a relatively wide range of hole diameters in providing

reliable electrical contact with a conductive surface of a hole. Moreover, the pin is readily inserted into a hole and yet, at the same time, it provides sufficient retention force. Furthermore, the pin is readily removed with minimal damage to the conductive layer in the hole and it provides a pre-determined orientation with respect to the circuit board into which it is inserted.

CLAIMS

1. A press-fit pin for insertion into a hole having a conductive surface, said pin comprising a contact section for engagement with said surface to provide electrical contact therewith and further to provide a retention force maintaining said pin in said hole, said contact section comprising a pair of elongated beams extending in the longitudinal direction of said pin, each beam having a generally C-shaped cross section with the C's opened toward each other.

2. A press-fit pin for insertion into a hole have a conductive surface and having a radius in a pre-determined range of radii, said pin having a contact section for engagement with said surface to provide electrical contact with said surface and further to provide a retention force to maintain the pin in the hole, said contact section comprising a pair of elongated beams extending in the longitudinal direction of said pin, each beam having a contact portion generally C-shaped in cross section, with the C's of the two beams facing each other, each of said C's having an outer radius of curvature that is greater than the largest **radius in said pre-determined range, the circle defined by the ends of said C's having a greater radius than the largest radius in said pre-determined range, whereby when said contact section is inserted into said hole said beams flex inwardly toward each other and each beam bends around a longitudinal axis so that the ends of the C of the beam move inwardly toward each other.**

3. The pin defined in Claim 2 further including a head section and tail section, said contact section being disposedintermediate said head and tail sections, said tail section having a cross section sufficiently small to clear said hole, said contact section having a generally cylindrical contact portion for engagement with said hole surface and a tapered portion interconnecting said contact portion and said tail section to provide a gradual transition in diameter between said tail section and said contact portion

1.1

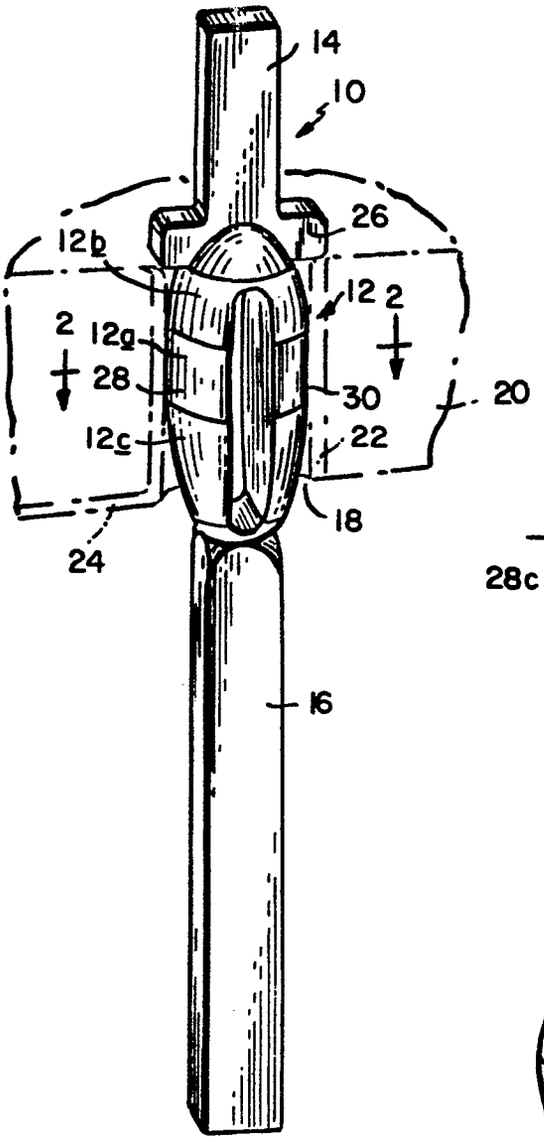

FIG. 1

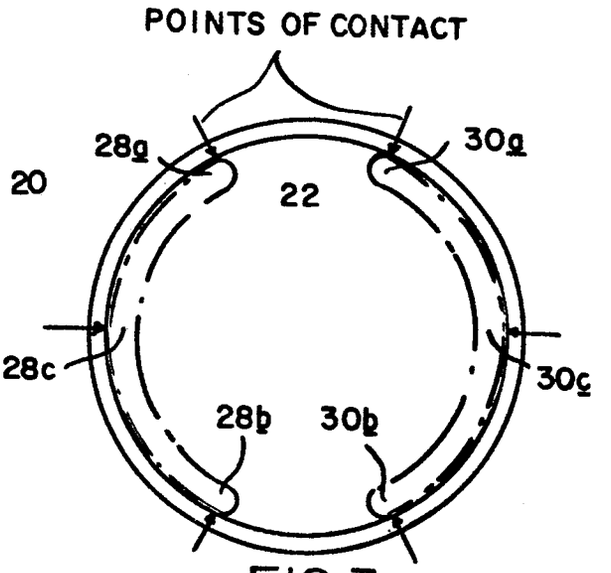

FIG. 3

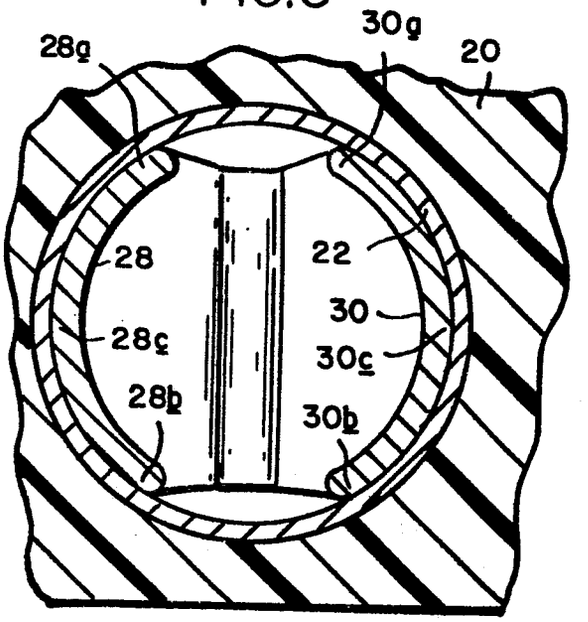

FIG. 2

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Application number

EP 87 40 0213

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EUROPEAN SEARCH REPORT

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.4)
X	DE-A-1 615 681 (AMP) * page 8, lines 13-22; page 10, lines 12-16; figures 5, 5A, 9 *	1	H 01 R 9/09
X	DE-U-7 615 027 (SIEMENS) * page 4, lines 10-19, 28-30; figures 1-6 *	1	
A	* page 5, lines 5-8; figures 1-6 *	2-3	
X	EP-A-0 102 786 (MINNESOTA MINING AND MANUFACTURING CO.) * page 3, lines 12-21, page 5, lines 16-22; figure 5 *	1	
A	GB-A-2 161 035 (SMITH INDUSTRIES) * page 2, lines 72-76; figure 2 *	3	TECHNICAL FIELDS SEARCHED (Int. Cl.4) H 01 R 9/00 H 01 R 13/00 H 01 R 43/00

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
BERLIN	24-04-1987	LEOUFFRE M.

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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E : earlier patent document, but published on, or after the filing date
D : document cited in the application
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