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(54) Press-fit connection pin.

(57) A connection pin is pressed into through-metallized bore (46) in a printed circuit board (44). The connection pin is preferably of slightly conical external shape and has a recess (30) which extends in its longitudinal direction and which is open at one side. The provision of the recess makes the press-in portion (14) of the pin somewhat resilient. The press-in portion is divided into a plurality of portions of different external shapes. In spite of a high level of resiliency and a sufficiently high pressing pressure, metallization and tinning of the board bores are not scraped off and the formation of cuttings is prevented.

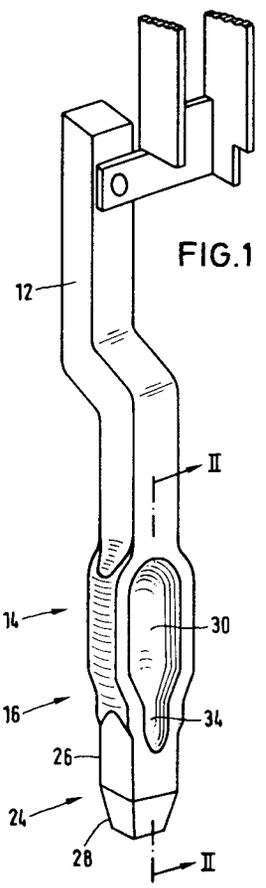

FIG.1

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FIELD OF THE INVENTION:

The invention concerns a connection pin for insertion into a through-metallized bore in a printed circuit board.

BACKGROUND OF THE INVENTION:

Connection pins of the press-fit kind are known for what is referred to as the solder-free connection procedure. In a known connection pin (German patent specification No. 2,937,883) the press-in portion is cylindrical and the introduction portion is conical. That means that the outside diameter of that known connection pin increases to its full dimension without a transition in the plane between the introduction and the press-in portions. That further means that, when the connection pin is pressed into the bore in a printed circuit board, the connection pin suddenly enlarges the bore as soon as its press-in portion reaches the upper edge of the bore. The compacting effect on the material of the printed circuit board, which occurs in that situation, does not cause any further risk. It happens, however, that the metallization of the bore may be scraped off and fine cuttings or slivers formed. Some time afterwards, such slivers may come out of the bore and give rise to unacceptable short-circuits. There is also the danger of the conductive layers or conductor tracks in a multi-layer printed circuit board being deformed. The recess which is provided in the known connection pin in the press-in portion thereof does not in any way alter that situation. It enhances the resiliency of the press-in portion and permits the limbs defining same to move towards each other when the press-in portion is pressed into the bore. However, it does not have any influence on the resiliency of the connection pin in the plane thereof between the introduction and the press-in portions. The connection pin remains stiff there. In a further known connection pin (U.S. Patent No. 4,776,807) the press-in portion has three protrusions which are spaced around its periphery. As a result it no longer bears against the inside of the bore, with the entire periphery of the press-in portion, but only along three vertical extending lines. The risk of cuttings being formed and the danger of excessive deformation of the material of the printed circuit board may still occur.

SUMMARY OF THE INVENTION:

Taking that state of the art as its basic starting point, the invention is based on the problem of designing a connection pin so that, when it is pushed into a printed circuit board, cuttings are not scraped off the metallization of the bore, nor is the material of the printed circuit board excessively deformed. In a connection pin of the kind set forth in the opening part of this specification, in accordance with the invention, the solution to that problem is achieved in that the press-in portion is preferably of an outside diameter which slightly decreases conically in a downward direction. At the lower end of the press-in portion there is a transition region to the introduction portion. The transition region has a first portion of decreasing outside diameter, an adjoining second portion of constant outside diameter, and an adjoining third portion of a diameter which decreases to the outside diameter of the introduction portion. The result of such configuration of the press-in portion is that, when the press-in portion is pushed into the printed circuit board, the material thereof is only gradually compressed and thus uniformly deformed. In that way the inner layers and conductor tracks of multi-layer printed circuit boards tend not to be damaged. The same purpose is served by the transition region between the introduction and the press-in portions. With its three portions with first an increasing outside diameter, then a uniform outside diameter and finally an increasing outside diameter, as viewed in the direction from the introduction up to the press-in portion, it further provides that, after initial compacting, during the insertion of the second portion with a uniform outside diameter, the material of the printed circuit board settles and experiences further compacting only upon insertion of the further portion with an outside diameter which again increases. Such gradual expansion of the bore of the printed circuit board also means that the metallization thereof is treated carefully. The metallization is gradually pressed radially outwardly into the material of the printed circuit board, without cuttings being formed in that situation. That means that the material surrounding the bore, and the metallization thereof, are only compacted when the connection pin is pressed into position, without being deformed or forming cuttings.

The outside diameter of the press-in portion desirably has a conicity of 0.5°. The press-in portion itself is of C-shaped cross-section. The ends of the limbs of the C-shape, which embrace the recess, are rounded off. Desirably they are rounded off both on their inward and on their outward sides. That avoids excessive pressing pressures which could occur at ends which converge in a point. That arrangement likewise prevents cuttings from being scraped off the metallization upon a rotary movement of the connection pin.

The limbs of the C-shape are of a wall thickness which increases towards their ends. In that arrangement the inward and outward sides of the ends of the limbs of the C-shape both desirably extend slightly outwardly with an increase in wall thickness. That means that the C-shape is narrower

and is thus particularly flexible in its central region between its two limbs. That enhances the resiliency of the press-in portion when it is pushed into the printed circuit board.

BRIEF DESCRIPTION OF THE DRAWINGS:

The invention will now be described in further detail by way of the example of the embodiment illustrated in the drawing in which:

Figure 1 is a perspective view of the connection pin.

Figure 2 is a view in longitudinal section of part of the connection pin, taken along section line II - II in Fig. 1.

Figure 3 is a side view of the lower region of the connection pin of Fig. 2.

Figure 4 is a view in longitudinal section showing the lower region of the connection pin inserted into a part of a printed circuit board.

Figure 5 is a view in cross-section taken along section line V - V in Fig. 4.

Figure 6 is a view in cross-section taken along section line VI - VI in Fig. 4.

Figure 7 is a view in cross-section taken along section line VII - VII in Fig. 4.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS:

Figure 1 shows the connection pin with its connection portion 12, its press-in portion 14 and a transition region 16 comprising first, second and third portions 18, 20 and 22, and with its introduction portion 24. The introduction portion 24 is divided into a square portion 26 and a tip 28. A recess 30 is disposed within the press-in portion 14, recess 30 having an upper portion 32 and a lower portion 34. The shape of those two portions 32 and 34 corresponds to the shape of the outside walls enclosing them.

As illustrated, the press-in portion 14 is of substantially C-shape. The two limbs of the C-shape are identified by reference numeral 36 in Figs. 5 through 7. The ends 38 thereof have rounded configurations 40 at their outward sides and rounded configurations 42 at their inward sides. The printed circuit board, into the numerous bores in which connection pins are pressed, is seen in part in Figs. 4 through 7 and is identified by reference numeral 44. The bore for receiving the connection pin 12 is identified by reference numeral 46. Metallization 48 is provided on the inside wall thereof. The press-in portion 14 does not bear against the metallization 48 or the bore 46 with the whole of its outside wall, but only at some locations. The contact points are identified by reference numeral 50.

The connection pin is made from a square starting metallic material with a cross-section of for example 1 mm^2. In the final condition the outside diameter of the press-in portion 14 is more than the inside diameter of a bore 46.

The connection pins may be urged into the metallized bores in a printed circuit board by a robot under the control of a computer, with a force of about 10 kg. Firstly, the tip 28 and then the square portion 26 pass into the bore 46. The latter is still not touched. In the further movement of the connection pin, the third portion 22 then encounters, with its diameter which increases in an upward direction, the top edge of the bore 46. The bore 46 is gradually enlarged in the further movement of the connection pin. The second portion 20 then passes with its uniform diameter into the bore 46. In further movement, the material of the printed circuit board can settle and is not subjected to further deformation. Finally, the first portion 18 passes with its diameter which increases again, into the bore 46. The bore 46 is further enlarged. When the upper end of the first portion 18 reaches the upper edge of the bore 46, the speed at which the latter is enlarged has reached a maximum. In further movement of the connection pin the press-in portion 14 passes into the bore 46. The conicity of 0.5° of the outside wall thereof is below the conicity of the first portion 18. Therefore, when the press-in portion 14 is passed into the bore 46, the bore is enlarged over a longer period of time, but to a lesser degree per unit of time. That means that the material of the printed circuit board including the conductor tracks or conductive layers disposed therein is neither damaged nor irregularly deformed. When the press-in portion 14 is pressed into the bore 46, the limbs 36 of the C-shape also move towards each other. That also provides careful treatment for the material of the printed circuit board 44 and the metallization 48.

Figures 4 through 7 show how the press-in portion 14 bears against the inside of the bore 46 or the metallization 48 thereof. As a result of the thickening at the ends 38 of the limbs 36 of the C-shape and the resulting relative weakening in the central region which joins the limbs, the press-in portion 14 contracts radially inwardly approximately at the halfway position in the height of the bore 46. Figure 4 shows this condition. The press-in portion 14 bears against the metallization 48 of the bore 46 only a short distance below the upper edge and a short distance above the lower edge of the bore. Figure 4 also shows this condition. The press-in portion 14 is constricted at its center. That phenomenon is referred to as a guitar effect. In the two planes in which the press-in portion 14 bears against the metallization 48, there is no line contact but only point contact. Figure 4 and in particular

Figures 5 and 7 show this situation. The press-in portion 14 only bears against the metallization 46 at three contact points 50. At the halfway position in terms of the height of the bore 46, because of the guitar effect, it even bears against the metallization 48 only at two contact points 50. That is clearly shown in Figure 6. However, the contact of the press-in portion 14 at three respective contact points 50 in a lower plane and an upper plane respectively is sufficient for the entire connection pin to be held in the bore 46 in such a way that it cannot tilt or turn. In that respect it is to be noted that the two ends 38 of the limbs 36 are urged constantly outwardly against the metallization 48 as a result of the resiliency of the press-in portion 14.

The true scope of the invention is set forth in the claims appended hereto.

Claims

1. A connection pin for insertion to a through-metallized bore in a printed circuit board comprising, in sequential order, a connection portion, a press-in portion, a transition region and an introduction portion, said introduction portion adapted to be inserted initially into said through-metallized bore, said transition region comprising three distinct sections, a first section adjoining said press-in portion of decreasing outer dimension, a second section adjoining said first section of substantially constant outer dimension and a third section of decreasing outer dimension adjoining said second section and said introduction portion.

2. A connection pin according to claim 1, wherein said press-in portion comprises an outer dimension gradually decreasing in a direction toward the transition region.

3. A connection pin according to claim 2, wherein said press-in portion has a generally cylindrical outer configuration.

4. A connection pin according to claim 3, wherein said outer configuration of said press-in portion tapers downwardly toward said transition region approximately 0.5 degrees.

5. A connection pin according to claim 2, wherein said press-in portion is generally of C-shaped cross-section, defined by a pair of end limbs with a recess extending therebetween.

6. A connection pin according to claim 3, wherein said introduction portion is of cross-section different from the cross-section of said press-in portion.

7. A connection pin according to claim 6, wherein said cross-section of said introduction portion is substantially rectangular.

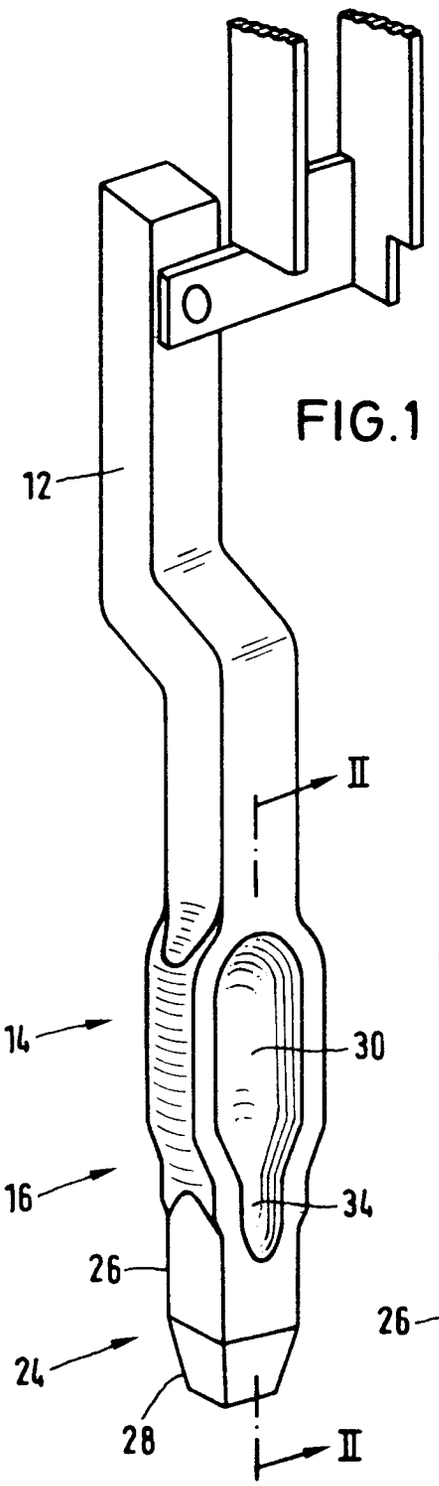

FIG.1

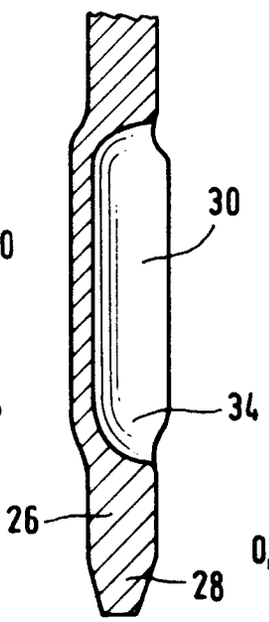

FIG.2

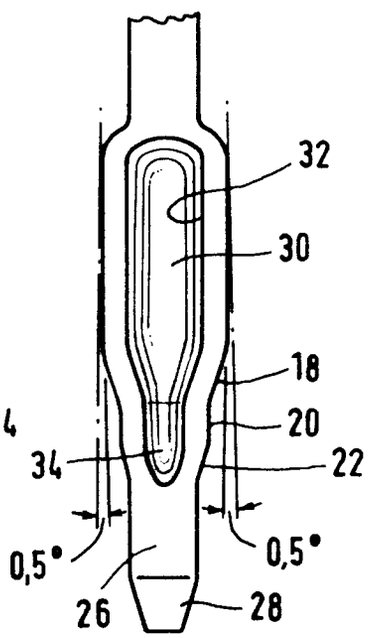

FIG.3

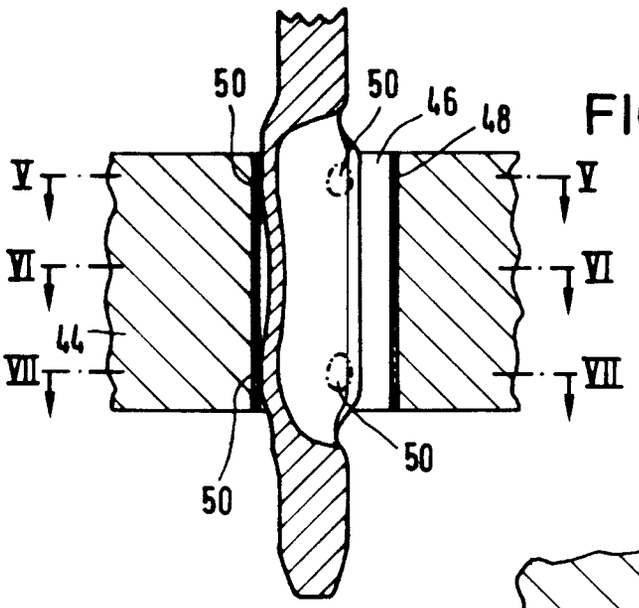

FIG.4

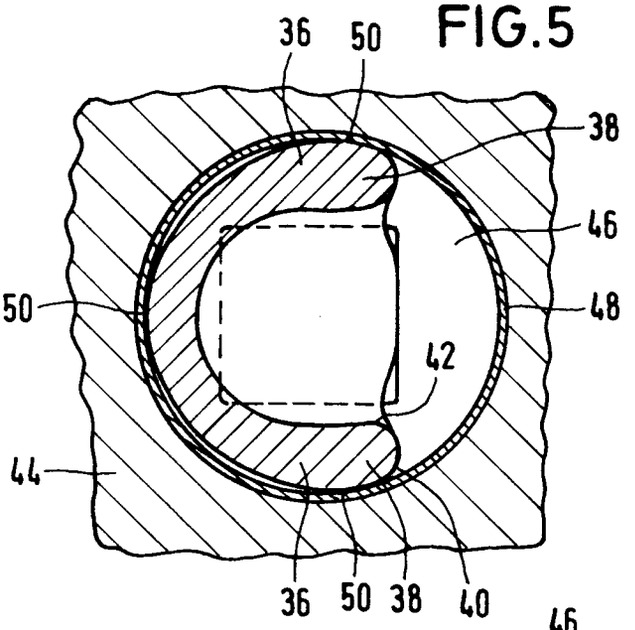

FIG.5

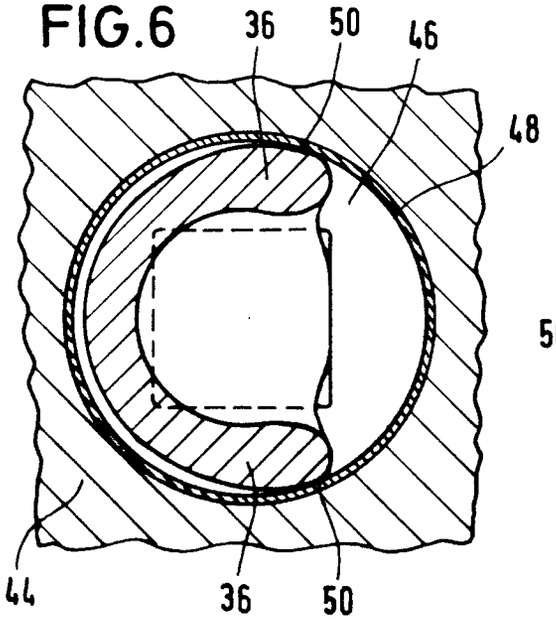

FIG.6

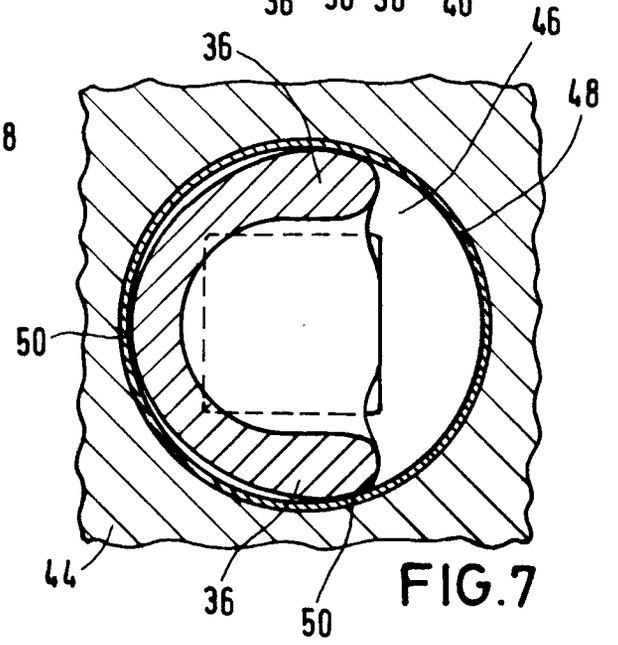

FIG.7

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EUROPEAN SEARCH REPORT

Application Number

EP 91 25 0319

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.5)
X	EP-A-0 225 400 (BURNDY ELECTRA N.V.) * abstract; figure 2 *	1-3,5-7	H01R9/09
X	WO-A-8 604 743 (NORTH AMERICAN SPECIALTIES CORP) * page 4, line 8 - line 28; figure 1 *	1-3,5,6	
D,A	US-A-4 776 807 (TRINER ET AL.) * abstract * * column 4, line 3 - line 19; figures 9,10 *	1-3,5-7	
A	EP-A-0 257 746 (AMP INCORPORATED) * column 8, line 33 - line 37; figure 8A *	1-3,6,7	

TECHNICAL FIELDS SEARCHED (Int. Cl.5)

H01R

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	28 FEBRUARY 1992	KOHLER J.W.

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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