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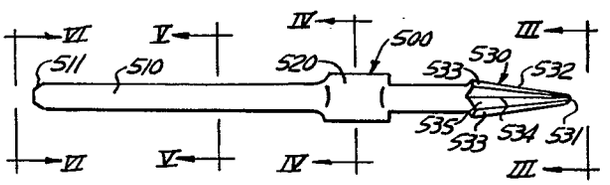
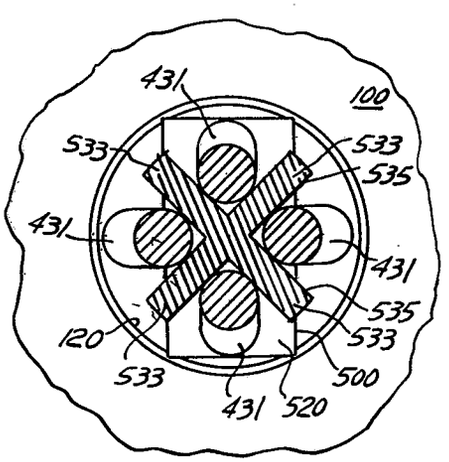
(54) Electrical pin-type contact.

(57) First and second electrical contacts are arranged to be electrically interconnected. The first contact (400) includes a mateable brushtype portion (430). The second contact (500) is pin-type and includes a tapered nose section designed to penetrate the brush to mate, the tapered nose section having a plurality of V-shaped grooves (534) disposed circumferentially therearound and which extend linearly rearwardly from the apex and radially outwardly from the nose axis. Each groove guidingly receives one of the conductive brush wires (431) and forces the wire to spread radially outward during mating engagement. The nose section may be convoluted wherein the grooves spiral rearwardly from the apex.





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ELECTRICAL PIN-TYPE CONTACT

This invention relates to electrical interconnections between printed circuit boards and more particularly to mating between a brush-type contact and a pin-type contact.

In some applications where compactness of packaging is important, a plurality of individual printed circuit boards containing one or more electronic circuits are designed to be mounted perpendicularly to a larger printed circuit board, the former being referred to as daughter-boards and the latter being referred to as a mother-board. Flexibility in circuit design, fabrication and ease of maintenance has been achieved in prior art designs by providing the mother-board with card edge connectors having an elongated opening that an edge of each daughter-board plugs into. In these connectors a nose section of each of a plurality of contacts include a pair of resilient tines which are designed to spread apart and slidably engage conductive pads located along the edge of the daughter-board. These contacts typically have tail portions which project through the mother-board and are of rectangular configuration to permit a programmed back panel wiring technique to be used to permit a solderless termination to effect the necessary interconnections between circuits on the individual boards. One solderless interconnection approach includes having the mother-board provided with a plurality of conductively plated through holes for interference fitment by squared edges of a contact such as described in U.S. Patent 3 530 422 filed March 25, 1968 and entitled "Connector and Method for Attaching same to Printed Circuit Board". While suitable for the purposes intended, the flexible tines, if exposed, could become bent or deformed and typically must be enclosed.

As the number of contacts increase, the force required to mate contact pairs increases considerably. A user normally desires a contact-to-contact mating requiring low mating forces. With conventional pin and socket contacts, a reduction in the normal force at the contact interface results in an increase in contact resistance and hence is not suitable in

most dry circuit applications. A hermaphroditic brush-type contact disclosed in U.S. Patent 3 725 844 filed March 15, 1971 and entitled "Hermaphroditic Electrical Contact" meets the low mating force requirement without sacrificing performance. A disadvantage of using the brush-type contact is the spacing required between contacts. A brush-to-brush interconnection has been designed on 1,25 mm centers, but the housing molding is complicated and contact installation is tedious. A mating between the brush-type contact and a tapered pin-type contact is disclosed in U.S. Patent Application S.N. 928 923 filed July 28, 1978 and entitled "Electrical Connector". However and although providing an acceptable interconnection, only one line of contact is achieved between each conductive wire of the brush and the surface of the pin and a possibility exists that if the brush consists of a small number of spreadable wires (e.g. two) that each wire can laterally skew and diminish contact with the surface.

Accordingly, a more desirable pin-type contact would be one that provides a low mating force to interconnect with a brush-type contact and that increases the pin-to-brush-wire contact surface.

To this end, the invention proposes an electrical pin-type contact for electrically interconnecting a brush-type contact of the type having a plurality of straight electrically conductive wires assembled into a bunch, each wire being secured at the rear ends so that the forward ends are adapted to be spread upon mating with the pin contact, characterized in that said pin contact comprises a tapered nose section, a tail section and a body which interconnects the nose and tail sections, said nose section being characterized by a frusto-conical shape having a central axis, an apex and a body portion of increasing cross-section axially rearwardly from said apex, said body portion including a plurality of concave grooves extending axially rearwardly from said apex and radially outwardly from the central axis, each groove being adapted to receive on of said conductive wires when the two contacts are interconnected, the nose section of the pin-type contact penetrating into the bunch of electrically conductive wires thereby speading the wires into one respective groove to make the electrical interconnection.

In accordance with the present invention, an electrical pin-type contact comprises a frusto-conical shaped male nose section for mating with a brush-like contact, a generally rectangular shaped body section adapted to interference fit within one of an array of plated apertures disposed on a mother-board and a tail section for wire wrapping to complete another off-board electrical interconnection. Ine one embodiment the nose section is

"cruciform" in shape and defined by four circumferentially disposed V-shaped grooves which extend linearly axially rearwardly from a central apex. The male nose section is adapted to be forcibly inserted into the brush and mate which the forward end portions of each of the brush wires, each brush wire being biased to make at least two contacts with the walls defining each respective V-groove.

An advantage of the frusto-conical contact is maintenance of contact forces to assure a good electrical contact without an increase in mating forces.

Another advantage is provision of a contact having a mateable portion which is rugged and not easily susceptible to beaking.

Still another advantage of the present contact is that, when placed in an array, forms a rigid mounting surface.

Other objects and advantages of the present invention will become apparent to the reader in view of the following detailed description and the claims accompanying the drawings wherein :

- Figure 1 is an exploded perspective view of an electrical connector assembly according to the present invention ;

- Figure 2 is a side view of an electrical pin-type contact according to the invention and as shown in the electrical connector assembly of Figure 1 ;

- Figure 3 is a front end view of the contact shown in Figure 2 ;

- Figure 4 is a section view of the contact looking rearwardly along lines IV-IV of Figure 2 ;

- Figure 5 is a section view of the contact lloking rearwardly along lines V-V of Figure 2 ;

- Figure 6 is a rear end view of the contact shown in Figure 2 ;

- Figure 7 is a partial view in section of an electrical interconnection between the pin-type contact of Figure 1 and a brush-type contact ;

- Figure 8 is a plan view in section of the mated contacts taken along lines VIII-VIII of Figure 7 ;

- Figure 9 is a side view of an alternate electrical pin contact according to this invention.

Referring now to the drawings, Figure 1 shown an exploded view in perspective of an electrical connector assembly 700 according to the present invention and includes a mother-board 100, a plurality of daughter-boards 200 (only one being shown) and a connector housing 300 secured to the daughter-board and positioning a plurality of first electrical contacts 400

for mating with a plurality of second electrical contacts 500.

The mother-board and the daughter-board both include predetermined electrical circuit paths (not shown) which may be electrically interconnected. The mother-board 100 includes a first plurality of through apertures 110 plated with a coating of electrically conductive material 120, the apertures being disposed in an array and sized to receive one of the second electrical contacts 500, the conductive material 120 being in communication with one or more of the electrical circuit paths on the mother-board.

The daughter-board 200 includes a second plurality of through apertures 210 and a pair of latch openings 220 and 230, each of the second apertures being disposed in an array and sized to receive a portion of one of the first electrical contacts 400, the second apertures 210 being in communication with one or more of the electrical circuit paths on the daughter-board.

The connector housing 300 is molded of insulative material and includes a top surface 301, a bottom surface 302, a plurality of cavities 310 designed to receive the first electrical contacts 400 and extending between the surfaces and a pair of latch members 320 and 330, each respective latch member being sized to be received by the latch openings 220 and 230 whereby the housing is mounted to the daughter-board. The connector housing 300 orients the first electrical contacts 400 with the second electrical contacts 500 and with the circuitry on the daughter-board 200 circuitry.

Each of the first electrical contacts 400 includes a holder 420, a tail section 410 extending rearwardly from the holder and a mateable brush-type portion 430 extending forwardly of the holder, the brush being formed by a plurality of straight electrically conductive wires 431 being closely clustered together or arranged in a bundle, each wire 431 being provided with an acutely angled forward end. The angled forward ends of the brush would be disposed somewhat rearwarly of the bottom surface 302 of the housing 300. The forward end portion of each wire is adapted to spread radially (i.e. blossom) outwardly upon mating with the second electrical contact 500. Since electrical redundancy (increasing the number of wires and the wire contact surface) improves performance, as few as two and as many seven wires could work to advantage. Preferably, the brush would comprise four wires 431. Three wires could also be advantageous in some applications. The tail section 410 is bent about 90° to the axis of the

wires 431 and fitted through respective of the second apertures 210 extending through the daughter-board 200.

Preferably and in accordance with the present invention, the second electrical contacts 500 are pin-type and comprise a formed nose section 530, a tail section 510 and a body section 420 which interconnects the nose and tail sections. Each tail section 510 is designed to be interference fit within one of the first apertures 110 on the mother-board 100.

Figure 2 shows the second electrical contact 500 in detail. The nose section 530 is frusto-conical shaped and characterized by a tapered hub portion 532 having a central axis and a central apex 531, the hub portion 532 extending axially rearwardly of said central apex and having increasing radial cross-section. The hub portion has a taper having an included angle of 60° or less.

Figure 3 shows a front end view of the nose section 530 looking at the central apex 531. The hub portion 532 includes a plurality of ribs 533 circumferentially disposed about the nose, each pair of adjacent ribs 533 defining concave grooves 534 extending axially rearwardly from the apex 531 and radially outwardly from the central axis. Each groove is 534 substantially V-shaped in cross-section and defines a "cruciform" shaped male member for penetrating the brush. Each groove has a cross-section of substantially uniform width and depth rearwardly of the apex.

Figure 4 shows the body section 520 as having a generally rectangular cross-section with squared corners 521 and inwardly curved portions 522. An otherwise uniform square shaft of metal stock is swaged to provide the rectangular shape and inwardly curved portions.

Figure 5 shows the tail section 510 as having a generally square cross-section which advantageously can be used for wire wrap interconnections.

Figure 6 shows an end view of the contact tail section and includes chamfered surfaces 511.

Figure 7 shows the first (brush-type) contact 400 mounted in the cavity 310 of the housing 300, the second (pin-type) contact 500 interference fit in the plated through aperture 120 of the mother-board 100 and the forward portions of the two contacts mated. A forward end portion of one of the brush wires 431 is shown received in one of the V-shaped grooves 534.

Figure 8 shows the body section 520 of the second (pin-type) contact 500 being received in the plated aperture 120 of the mother-board 100 and each of four brush wires 430a being spread radially outward by the nose section 530. Each of the four squared corners 521 of the contact body

section 520 have been interference fit within the aperture 110, thereby staking the contact 500 therein and scoring the plating 120, this scoring electrically connecting the contact 500 with circuitry on the mother-board. Staked fitment of each of the pin-type contacts 500 offers an adequate restraint that will not allow the contacts to withdraw due to disengagement forces imposed by removal of the daughter-board. Each groove 534 is sized to receive one conductive wire 430a of the brush contact when the first and second contacts are mated, the nose section penetrating into the bunch to mate therewith and make contact with the wires, the wires spreading (blossoming) radially outwardly. Each groove includes two walls 535 which provide two contact surfaces. Accordingly, each conductive wire is tangent to and biased to contact the groove walls along two contact lines.

Figure 9 shows an alternate embodiment of the first contact according to the invention and wherein a nose section 600 includes a plurality of convoluted ribs 633 defining V-shaped grooves 634 which spiral axially rearwardly from a central apex 631.

Although both contacts 500, 600 are shown as having a slightly rounded central apex, in some applications, a sharp pointed tip portion may be desirable. Further, the grooves may be "fluted" or semi-circular, thereby increasing the contact surface area engaging each of the brush wires.

CLAIMS

1. An electrical pin-type contact (500) for electrically interconnecting a brush-type contact (400) of the type having a plurality of straight electrically conductive wires (431) assembled into a bunch, each wire (431) being secured at the rear ends so that the forward ends are adapted to be spread upon mating with the pin contact, characterized in that said pin contact comprises a tapered nose section (530), a tail section (510), and a body (520) which interconnects the nose and tail sections, said nose section being characterized by a frusto-conical shape having a central axis, an apex (531) and a body portion of increasing cross-section axially rearwardly from said apex, said body portion including a plurality of concave grooves (534) extending axially rearwardly from said apex and radially outwardly from the central axis, each groove being adapted to receive one of said conductive wires when the two contacts are interconnected, the nose section of the pin-type contact penetrating into the bunch of electrically conductive wires thereby spreading the wires into one respective groove to make the electrical interconnection.

2. An electrical pin-ype contact according to claim 1, characterized in that said brush-type contact (400) includes at least four wires and the pin-type electrical contact (500) includes at least four grooves (534) extending rearwardly from the apex (531).

3. An electrical pin-type contact according to claim 1 or 2, characterized in that the apex (531) terminates in a point.

4. An electrical pin-type contact according to claim 1 or 2, characterized in that the body portion (530) has a taper having an included angle of 60° or less.

5. An electrical pin-type contact according to claim 1 or 2, wherein each of said grooves (534) has a cross-section of substantially uniform width and depth rearwardly of the apex (531).

6. An electrical pin-type contact according to claim 5, characterized in that the grooves (534) rearwardly of the apex (531) defines a nose section having a cruciform shaped transverse cross-section.

7. An electrical pin-type contact according to claim 5, wherein each of said grooves (534) spiral axially and radially rearwardly from the apex.

8. An electrical pin-type contact according to claim 6 or 7, characterized in that each of the grooves (534) are V-shaped.

9. An electrical pin-type contact according to claim 8, characterized in that each groove has a pair of opposing walls (535), the surfaces

of the walls presenting each wire forward portion with two lines of contact.

10. An electrical pin-type contact according to claim 1 or 2, characterized in that said groove (534) is arcuate in cross-section and substantially of the same size as the diameter of each conductive wire (431), thereby providing a contact surface to continuously contact the presented forward portion of the conductive wire.

FIG. 1

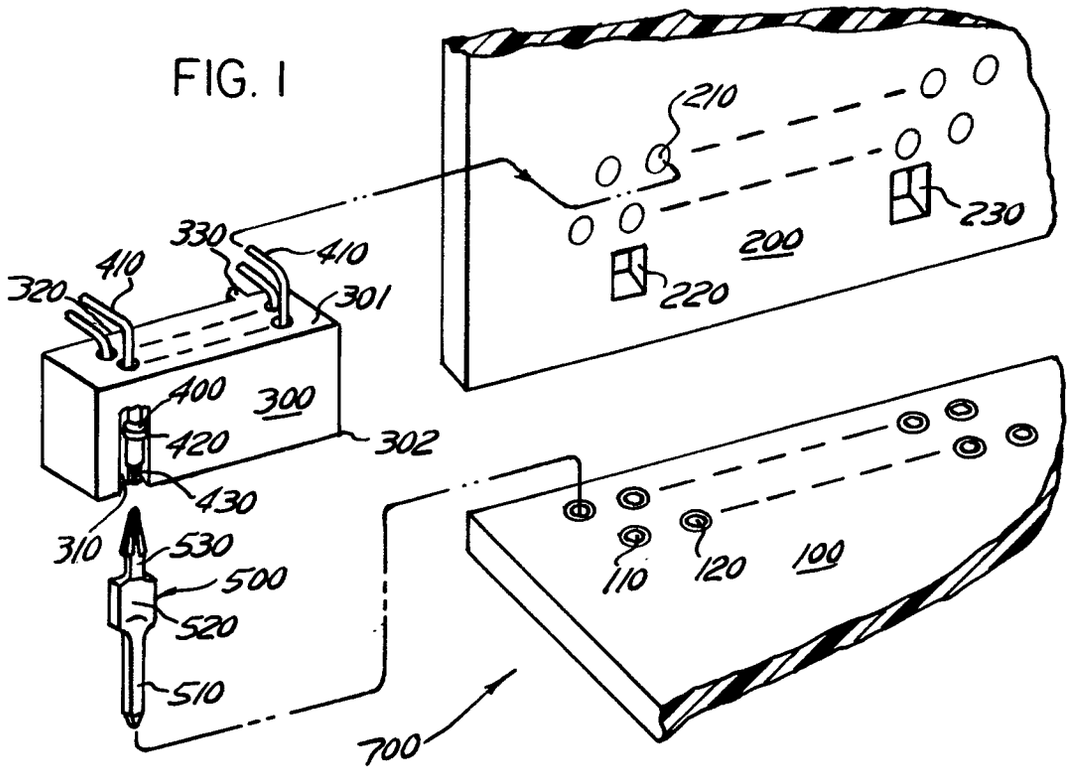


FIG. 2

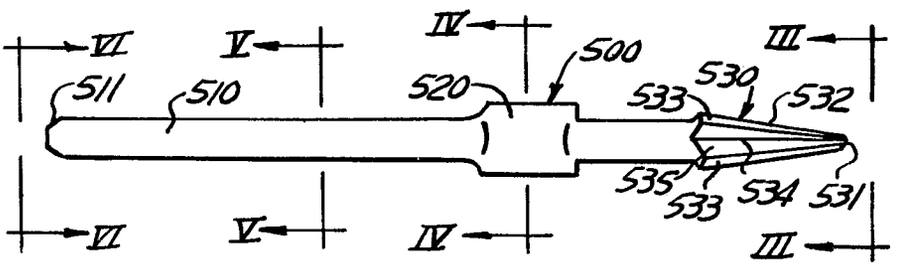


FIG. 6

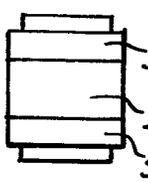


FIG. 5

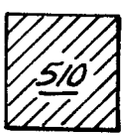


FIG. 4

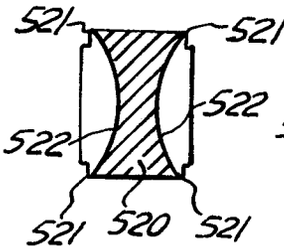


FIG. 3

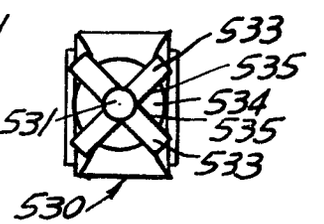


FIG.7

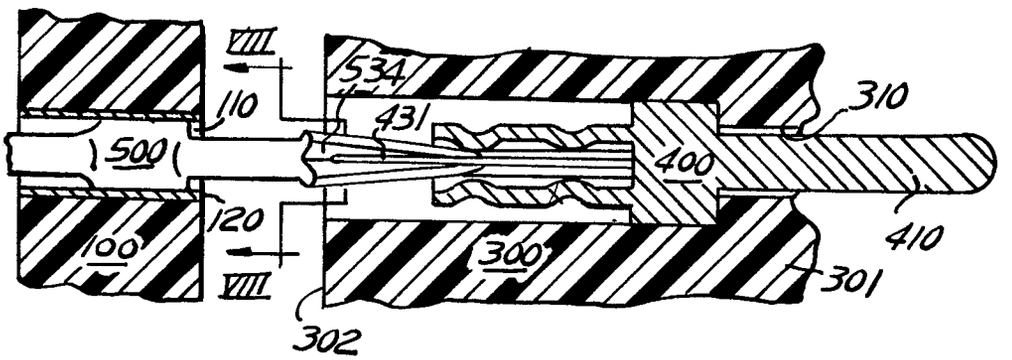


FIG.8

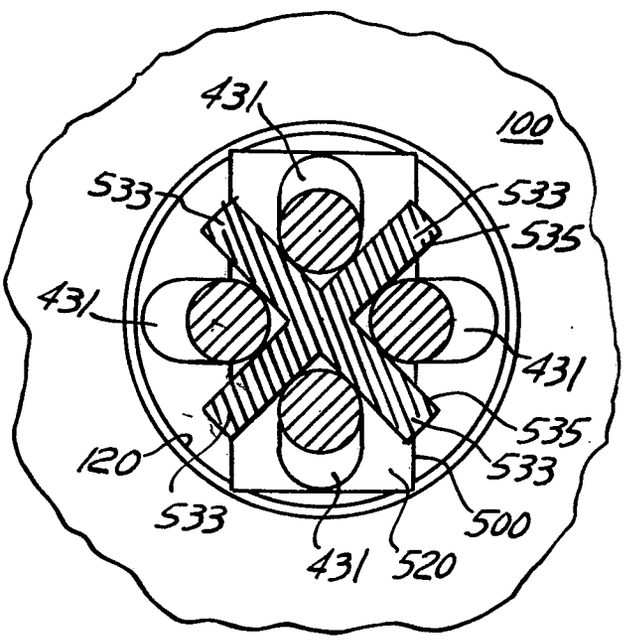
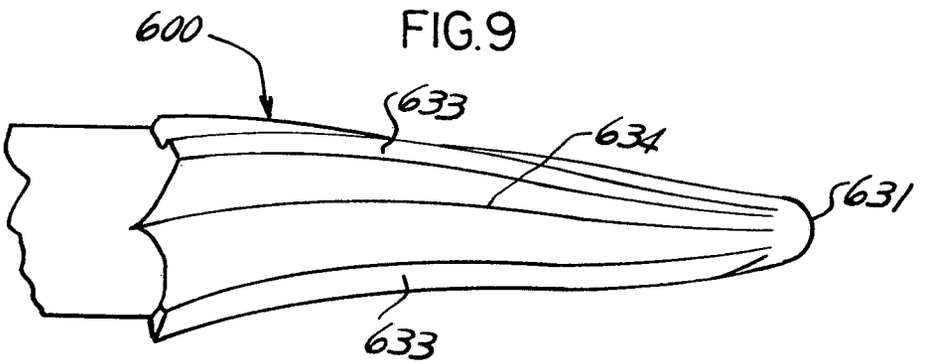


FIG.9



European Patent Office

EUROPEAN SEARCH REPORT

Application number 0043749

EP 81 40 0992

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim
AD	GB - A - 2 026 786 (BENDIX CORP.) * Figures 1,4; page 2, lines 10-36 *	1-4
AD	US - A - 3 725 844 (BENDIX CORP.) * Figures 1,2,4; column 3, lines 43-47; column 4, lines 33-46 *	1
A	US - A - 3 157 455 (NIPPON ELECTRIC COMP.) * Figure 1a; column 1, lines 46-51 *	7
A	FR - A - 2 438 352 (BENDIX CORP.) * Figure 5; page 4, lines 10-31 *	1

CLASSIFICATION OF THE APPLICATION (Int. Cl.³)

H 01 R 13/33

TECHNICAL FIELDS SEARCHED (Int. Cl.³)

H 01 R 13/33
9/09

CATEGORY OF CITED DOCUMENTS

X: particularly relevant
A: technological background
O: non-written disclosure
P: intermediate document
T: theory or principle underlying the invention
E: conflicting application
D: document cited in the application
L: citation for other reasons

&: member of the same patent family, corresponding document

X The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	09-10-1981	WAERN

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