(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 0 949 724 A2

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
13.10.1999 Bulletin 1999/41

(51) Int Cl.[6]: **H01R 23/72**

(21) Application number: **99302747.3**

(22) Date of filing: **08.04.1999**

(84) Designated Contracting States:
AT BE CH CY DE DK ES FI FR GB GR IE IT LI LU MC NL PT SE
Designated Extension States:
AL LT LV MK RO SI

(30) Priority: **08.04.1998 JP 9637398**

(71) Applicant: **THE WHITAKER CORPORATION**
Wilmington, Delaware 19808 (US)

(72) Inventors:
- **Goto, Kikuo**
  Yamato, Kanagawa 242-0014 (JP)
- **Kimura, Takao**
  Fujisawa, Kanagawa 251-0047 (JP)

(74) Representative: **Johnstone, Douglas Ian et al**
Baron & Warren,
18 South End
Kensington, London W8 5BU (GB)

(54) Electrical connector

(57) Electrical connector (1) with an insulating housing (10), and electrical contacts (20) which are fastened to the housing (10), for electrically connecting a first circuit board (30) and a substantially parallel second circuit board (40). The contacts (20) have cantilever contact sections (22) which extend from fastening sections (21) cast in the housing (10) into openings between housing partition walls (10a), and which resiliently engage an undersurface of the first circuit board (30) with arcuate surfaces stamped and formed from a metal plate. The cantilever contact sections (22) are bent from the fastening sections (21) and have supporting-point members (24) which bear on the second circuit board (40) when the cantilever contact sections (22) are flexed by contact with the first circuit board (30). The connector (1) has a low profile and provides high contact pressure between the contacts (20) and the circuit boards (30, 40).

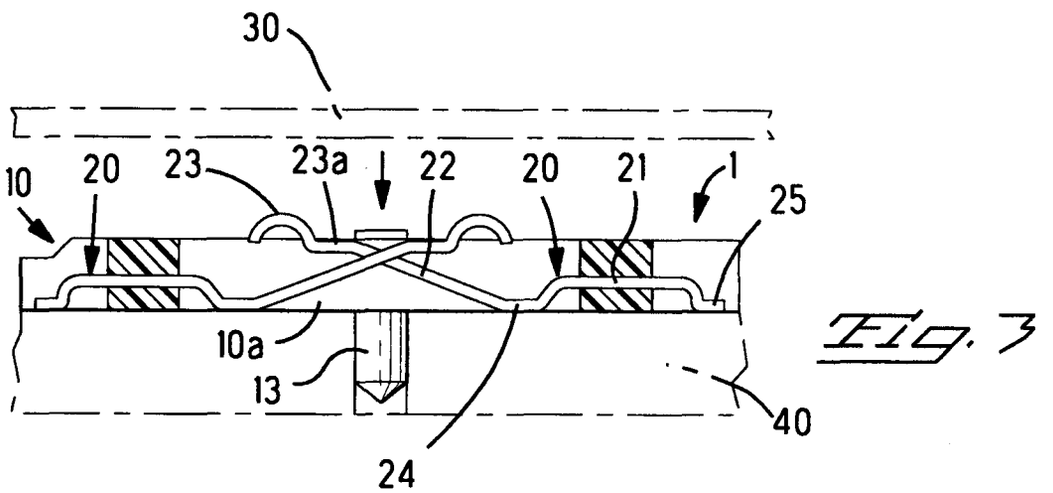


Fig. 3

EP 0 949 724 A2

Description

[0001] The present invention relates to an electrical connector which has electrical contacts that electrically connect a first circuit board such as card-mounting flexible printed circuits (FPC's) or integrated circuits, or a printed circuit board, and a second circuit board such as a printed circuit board, which is disposed substantially parallel to the first circuit board.

[0002] For example, electrical connector 100 shown in Figures 4A and 4B is known as an electrical card connector, which electrically connects electronic memory cards on which integrated circuits are mounted and printed circuit boards, which are disposed substantially parallel to the electronic memory cards as disclosed in Japanese Patent Application No. 63-155392. Electrical card connector 100 is equipped with an insulating housing 110, which has a plurality of openings 111 arranged in two rows, and a plurality of electrical contacts 120, which are fastened to housing 110 in two rows. Electrical contacts 120 electrically connect an electronic memory card (not shown) and a printed circuit board (not shown) that are disposed substantially parallel to each other. The respective contacts 120 are formed by stamping and forming a metal plate. Each contact 120 is equipped with a fastening section 121 fastened to the housing 110, a cantilever contact section 122, which extends into and across the corresponding opening 111 of the housing 110 from the fastening section 121, and which has an arcuate contact member 123 that electrically engages with a flat surface of a conductive pad on an undersurface of the electronic memory card, and a tine section 124, which extends to the outside of the housing 110 from the fastening section 121 and is electrically connected to the printed circuit board by soldering. Posts 112 are provided on housing 110 to position the electrical card connector 100 on the printed circuit board.

[0003] Connector 200 shown in Figures 5A and 5B is known as a surface-mount electrical connector which electrically connects IC chips with printed circuit boards that are disposed substantially parallel to the IC chips as disclosed in Japanese Patent Application No. 6-85342. Surface-mount electrical connector 200 is equipped with an insulating housing 210, and a plurality of electrical contacts 220 which are secured to housing 210 in a single row, and which electrically connect an IC chip (not shown) and a printed circuit board (not shown) that are disposed substantially parallel to each other. The respective contacts 220 are formed by the stamping of a metal plate. Each contact 220 is equipped with a base section 221 which has a press-fitting projection 222 that is press-fit into the housing 210 from beneath, a resilient contact section 223 which extends into the housing 210 from the base section 221, and which has an arcuate contact member 224 that engages with a conductive pad on the undersurface of the IC chip, and a tine section 225 which extends to the outside of the housing 210 from the base section 221, and which is connected to the printed circuit board by soldering. In Figure 5B, a post 211 which is used to position the surface-mount electrical connector 200 on the printed circuit board.

[0004] In the electrical card connector 100 shown in Figures 4A and 4B, the contact members 123 of the contact sections 122 of the contacts 120 are arranged so that the contact members 123 engage the conductive pads on the undersurface of the electronic memory card with arcuate surfaces; accordingly, the electrical engagement is smoothly accomplished, and the height of the connector 100 in the vertical direction is lowered. However, since the free length of each contact section 122 from the fixed end of the fastening section 121 of the contact 120 with the housing 110 to the contact member 123 is long, and since the contact section 122 flexes in the direction of thickness, sufficient contact pressure may not be achieved when the electronic memory card engages the contact member 123.

[0005] On the other hand, in the case of the surface-mount electrical connector 200 shown in Figures 5A and 5B, the contact members 224 of the contact sections 223 of the contacts 220 engage the undersurface of the IC chip with a shear surface, and the contact sections 223 flex in the direction perpendicular to the direction of thickness; accordingly, a sufficiently large contact pressure can be obtained when the IC chip engages the contact members 224. However, since the width of the stamped arcuate surface of each contact 220 extends in the vertical direction, there are limits to how far the vertical height of the connector 200 can be lowered.

[0006] Accordingly, the object of the present invention is to provide an electrical connector which electrically connects circuit boards that are disposed substantially parallel to each other, and which also makes it possible to lower the height of the connector as a whole, and to increase the contact pressure on the circuit boards.

[0007] The electrical connector of the present invention is equipped with an insulating housing, and electrical contacts which have fastening sections that are fastened to the housing, and which electrically connect a first circuit board and a second circuit board that are disposed substantially parallel to each other, the contacts have cantilever contact sections which extend from the fastening sections, and which resiliently engage an undersurface of the first circuit board with arcuate surfaces stamped and formed from a metal plate, and the cantilever contact sections have supporting-point members which are bent from the fastening sections and engage the surface of the second circuit board, and which act as supporting points when flexed by the first circuit board during engagement therewith. The supporting-point members are movable on the second circuit board.

[0008] An electrical connector for interconnecting conductive pads on a first circuit board with conductive pads on a second circuit board comprises a dielectric housing, electrical contacts having fastening sections secured in the housing, tine sections for electrical en-

gagement with the conductive pads on the second circuit board, and cantilever contact sections extending from the fastening sections for electrical engagement with the conductive pads on the first circuit board wherein the cantilever contact sections include supporting-point members for engaging the second circuit board and acting as supporting points when the cantilever contact sections are flexed by engagement with the first circuit board.

[0009] An embodiment of the present invention will now be described by way of example with reference to the accompanying drawings in which:

[0010] Figures 1A and 1B show the electrical connector of the present invention; Figure 1A is a top plan view, and Figure 1B is a front view thereof.

[0011] Figure 2 is a left-side view of the electrical connector shown in Figure 1.

[0012] Figure 3 is a cross-sectional view taken along line 3-3 in Figure 1. In Figure 3, the first and second circuit boards that are connected to each other by the electrical connector are indicated by broken lines.

[0013] Figures 4A and 4B show a conventional electrical card connector; Figure 4A is a top plan view, and Figure 4B is cross-sectional view taken along line 4B-4B in Figure 4A.

[0014] Figures 5A and 5B show a conventional surface-mount connector; Figure 5A is a top plan view, and Figure 5B is a cross-sectional view taken along line 5B-5B in Figure 5A; however, in Figure 5B, the electrical contacts are not shown in cross-section.

[0015] In Figures 1 through 3, electrical connector 1 is equipped with an insulating housing 10, and a plurality of electrical contacts 20 which are fastened to housing 10 in two rows, and which electrically connect a first circuit board 30 and second circuit board 40 that are disposed substantially parallel to each other. In the present embodiment, the first circuit board 30 is an FPC (Flexible Printed Circuit) and the second circuit board 40 is a printed circuit board; however, these circuit boards may also be other types of circuit boards, such as cards mounting integrated circuits thereon.

[0016] The housing 10 is formed substantially into the shape of a rectangular parallelepiped which extends in the direction of length, forming of the housing being accomplished by molding from an insulating resin material. A plurality of openings 11, which are arranged at a uniform pitch in a single row along the direction of length, are located in roughly a central portion of the housing 10. Positioning posts 13, which are used when the electrical connector 1 is attached to the second circuit board 40, are in the form of downward protrusions at both ends of the housing 10 with respect to the direction of length. Partition walls 10a, which delineate the openings 11, are provided in order to insulate the contacts 20 in the direction of the contact row. Furthermore, cut-outs 12, which are used to ascertain visually or by means of an automatic inspection device whether or not tine sections 25 of the plurality of contacts 20 (described later) are properly soldered to the conductive pads of the second circuit board 40, are located in both side walls of the housing 10 with respect to the direction perpendicular to the direction of length.

[0017] Furthermore, the contacts 20 of the respective rows are arranged at a uniform pitch along the direction of length of the housing 10, and pairs of mutually facing contacts 20 of different rows are disposed inside the respective openings 11 of the housing 10. The respective electrical contacts 20 are formed by stamping and forming a metal plate; each contact is equipped with a fastening section 21, which is fastened to the housing 10 by insert molding, a cantilever contact section 22, which extends into the opening 11 of the housing 10 from the fastening section 21, and a tine section 25, which extends to the outside of the housing 10 from the fastening section 21 and which is fastened by soldering to a conductive pad on the second circuit board 40. The cantilever contact section 22 has a supporting-point member 24, which is bent from the fastening section 21 and engages a surface of the second circuit board 40 and which acts as a supporting point when the cantilever contact section is flexed by the first circuit board 30. Furthermore, the cantilever contact section 22 extends upward at an inclination toward the inside of the corresponding opening 11 from the supporting-point member 24, and it is bent so that it is parallel to the second circuit board 40. A contact member 23, which electrically engages a conductive pad formed on an undersurface of the first circuit board 30 is a continuation of a parallel part 23a of the cantilever contact section 22 that is parallel to the second circuit board 40. Parallel section 23a is provided in order to prevent buckling of the cantilever contact section 22 when the conductive pad on the first circuit board 30 engages the contact member 23. The contact member 23 electrically engages the conductive pad of the first circuit board 30 with an arcuate surface, and the supporting-point member 24 engages the second circuit board 40 with a smooth surface; furthermore, the tine section 25 is connected by soldering of a smooth surface to the conductive pad on the second circuit board 40. The supporting-point member 24 is not fastened to the surface of the second circuit board 40, and it can move slightly with respect to the second circuit board 40 in the direction of length of the housing 10 and in the direction perpendicular to the direction of length of the housing 10.

[0018] The cantilever contact sections 22 of pairs of mutually facing contacts 20 of different rows extend toward each other, and they are positioned inside the respective openings 11. The pitch between the cantilever contact sections 22 of the pairs of contacts 20 is smaller than the pitch between the contacts 20 of the respective rows. Furthermore, the tine sections 25 of pairs of mutually facing contacts 20 of different rows are connected by soldering to respective conductive pads on the second circuit board 40, and the contact members 23 engage respective conductive pads on the undersurface

of the first circuit board 30. Accordingly, the respective conductive pads of the first circuit board 30 make a two-point contact, so that the reliability of electrical engagement is increased compared to the case of a single-point engagement.

[0019] When the first circuit board 30 is placed on the electrical connector 1 from above and the conductive pads on the undersurface of the first circuit board 30 are caused to electrically engage the respective contact members 23 of the contacts 20 (as shown in Figure 3) after the respective tine sections 25 of the contacts 20 have been electrically connected by soldering to conductive pads on the second circuit board 40, the respective conductive pads of the first and second circuit boards 30, 40 are electrically connected to each other via the respective pairs of contacts. In this case, the cantilever contact sections 22 of the respective contacts 20 flex downward with the supporting-point members 24 as supporting points. Each cantilever contact section 22 flexes not at the end where the contact 20 is fastened to the housing 10, but rather at the supporting-point member 24 as a supporting point; accordingly, the contact pressure with respect to the first circuit board 30 is sufficiently large. Furthermore, since the contact members 23 of the contacts 20 engage the conductive pads of the first circuit board 30 with arcuate surfaces, the overall height of the electrical connector 1 can be lowered. Moreover, since the supporting-point members 24 are not fastened to the surface of the second circuit board 40, but they are instead movable with respect thereto, the bending stress of the contacts 20 at the supporting-point members 24 when the first circuit board 30 engages the contact members 23 is small compared to that in a case where the supporting-point members 24 are fixed, so that there is little possibility of deformation of the contacts 20 due to bending.

[0020] In the electrical connector described above, the contacts have cantilever contact sections which extend upward within the housing from fastening sections, and which resiliently engage the undersurface of the first circuit board with arcuate surfaces stamped and formed from a metal plate. Furthermore, the cantilever contact sections are bent from the fastening sections so that they engage the second surface board, and have supporting-point members which act as supporting points when the contact members are flexed by the first circuit board. Accordingly, when the first circuit board engages the cantilever contact sections, the cantilever contact sections of the respective contacts flex downward with the supporting-point members as supporting points, so that the contact pressure with respect to the first circuit board is sufficiently large. Furthermore, since the cantilever contact sections engage the first circuit board with arcuate surfaces stamped from a metal plate, the height of the electrical connector as a whole can be lowered.

[0021] Furthermore, in the electrical connector of the present invention, the supporting-point members are movable on the surface of the second circuit board. Accordingly, the bending stress of the contacts at the supporting-point members when the first circuit board engages the cantilever contact sections is small compared to that in a case where the supporting-point members are fixed, so that there is little possibility of deformation of the contacts due to bending.

Claims

1. An electrical connector (1) for interconnecting conductive pads on a first circuit board (30) with conductive pads on a second circuit board (40) comprising a dielectric housing (10), electrical contacts (20) having fastening sections (21) secured in the housing, tine sections (25) for electrical engagement with the conductive pads on the second circuit board (40), and cantilever contact sections (22) extending from the fastening sections for electrical engagement with the conductive pads on the first circuit board (30), wherein the cantilever contact sections (22) include supporting-point members (24) for engaging the second circuit board (40) and acting as supporting points when the cantilever contact sections are flexed by engagement with the first circuit board (30).

2. An electrical connector according to claim 1, wherein the supporting-point members (24) are movable relative to the second circuit board (40).

3. An electrical connector according to claim 1 or 2, wherein the supporting-point members (24) engage the conductive pads on the second circuit board (40).

4. An electrical connector according to any preceding claim wherein free ends (23) of said cantilever contact sections (22) are arcuate-shaped extending above an upper surface of the housing.

5. An electrical connector according to claim 4 wherein parallel sections (23a) are disposed in the cantilever contact sections (22) adjacent the free ends (23).

6. An electrical connector according to any preceding claim wherein said housing (10) has a rectangular shape and includes a plurality of openings (10a) arranged at a uniform pitch along a length of the housing, said electrical contacts (20) are arranged in rows along sides of the housing with the cantilever contact sections (22) of one of the contact rows extending across respective openings (10a) toward the other of the contact rows and the cantilever contact sections (22) of the other of the contact rows extending across the respective openings toward the one of the contact rows so that a pair of canti-

lever contact sections are disposed within each of the openings in a crosswise manner.

7. An electrical connector according to any preceding claim wherein the tine sections (25) are disposed in cut-outs in each side of the housing.

8. An electrical connector according to any preceding claim wherein the tine sections (25) and the supporting-point members (24) are disposed in a plane of a bottom surface of said housing (10).

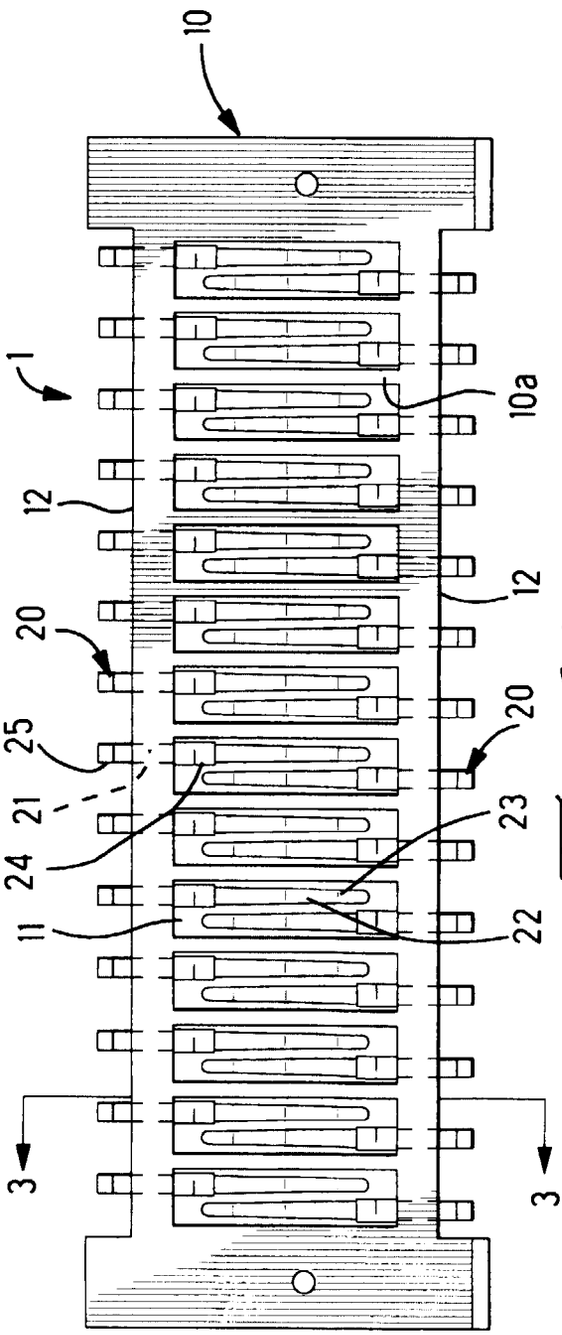


FIG. 1A

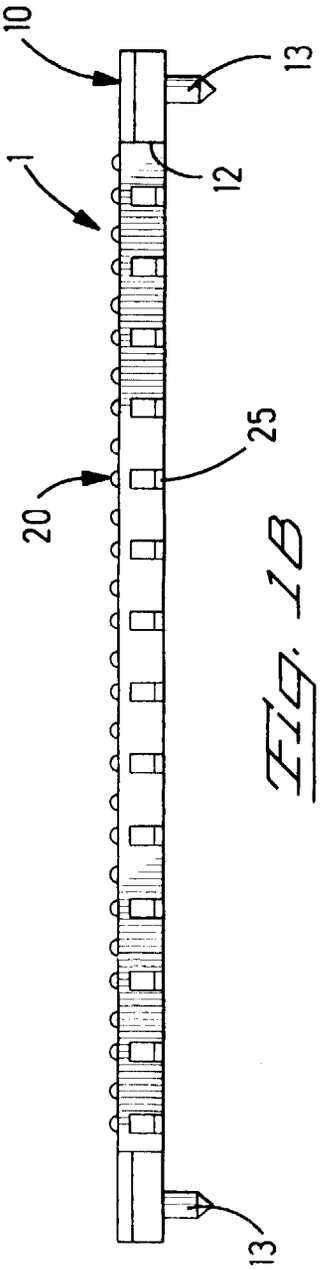
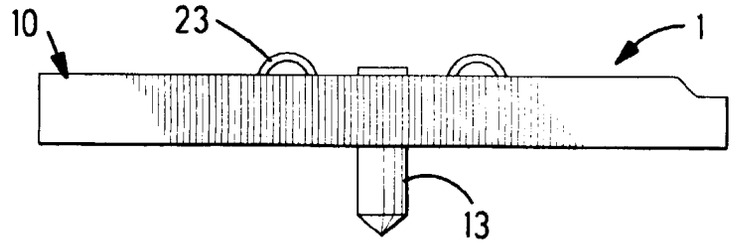


FIG. 1B

Fig. 2



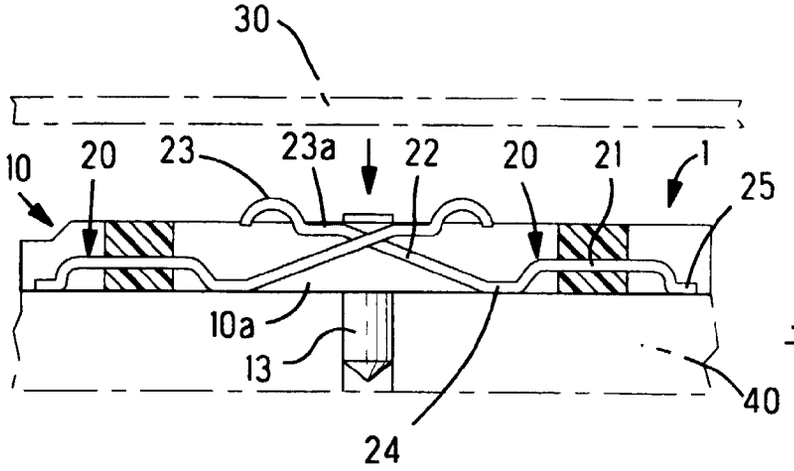
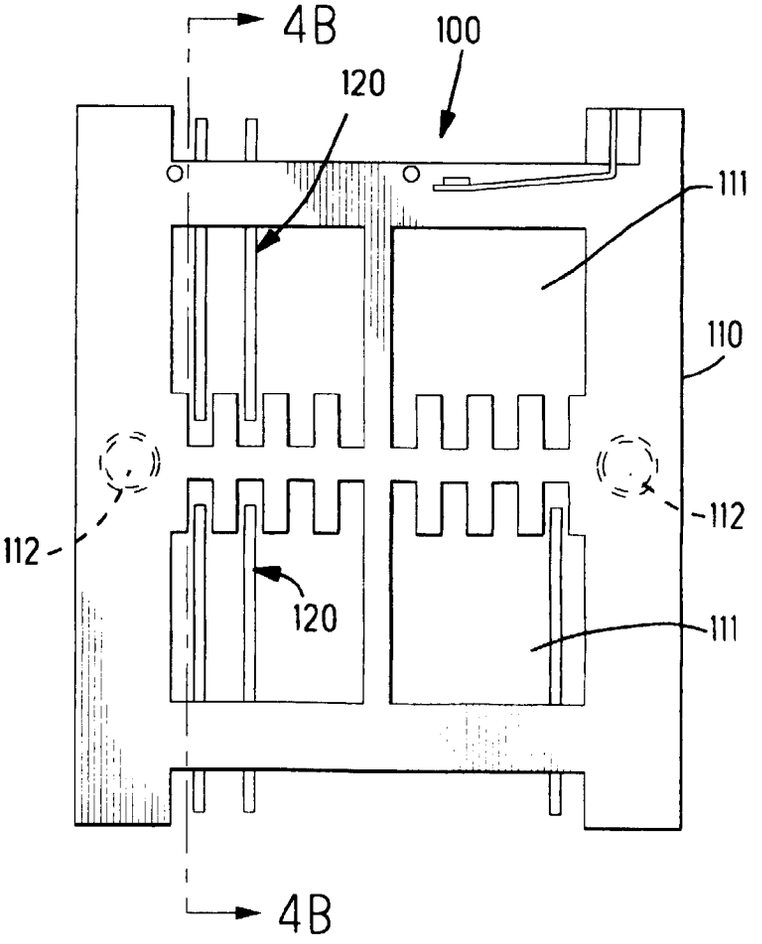


Fig. 3

Fig. 4A



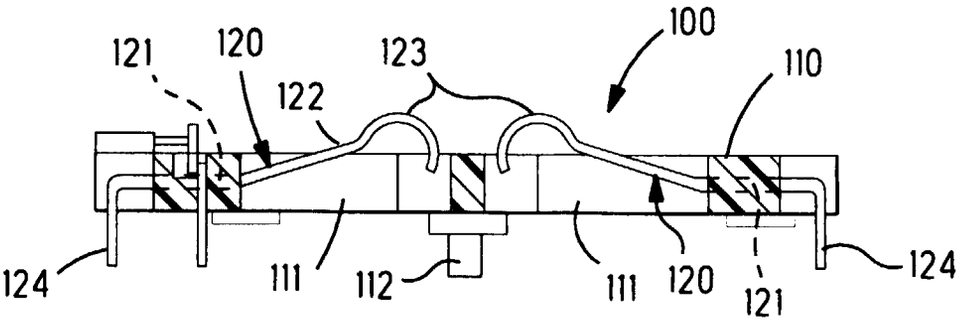


Fig. 4B

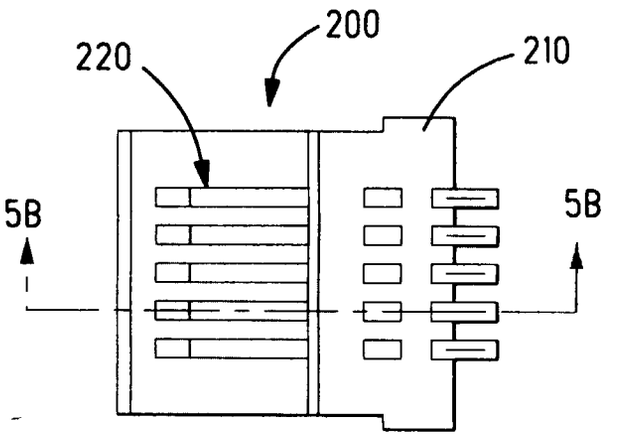


Fig. 5A

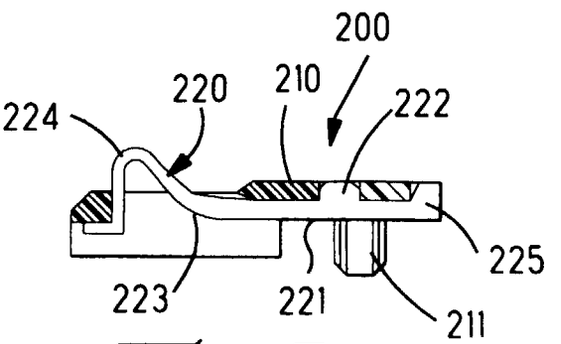


Fig. 5B