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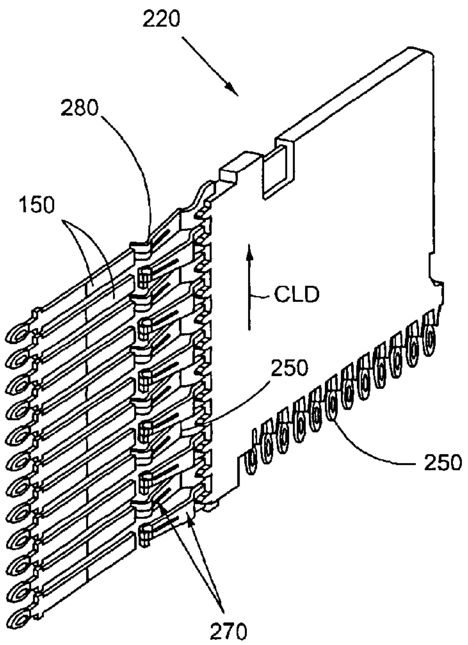

(57) **Abstract:** An electrical connector may include a first connector with electrically-conductive contacts. The contacts may have blade-shaped mating ends, and may be arranged in a centerline. The electrical connector may include a second connector with electrically-conductive receptacle contacts, which may also be arranged in a centerline. The connectors may be mated such that the mating portion of a first contact in the second connector may physically contact of a corresponding blade-shaped mating end of a contact in the first connector.

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SHIELDLESS, HIGH-SPEED, LOW-CROSS-TALK ELECTRICAL CONNECTOR

BACKGROUND

[0001] Electrical connectors provide signal connections between electronic devices using electrically-conductive contacts. In some applications, an electrical connector provides a connectable interface between one or more substrates, e.g., printed circuit boards. Such an electrical connector may include a header connector mounted to a first substrate and a complementary receptacle connector mounted to a second substrate. Typically, a first plurality of contacts in the header connector are adapted to mate with a corresponding plurality of contacts in a receptacle connector.

[0002] Undesirable electrical signal interference between differential signal pairs of electrical contacts increases as signal density increases, particularly in electrical connectors that are devoid of metallic crosstalk shields. Signal density is important because silicon chips are subject to heat constraints as clock speeds increase. One way to achieve more signal throughput, despite the limitations of silicon-based chips, is to operate several chips and their respective transmission paths in parallel at the same time. This solution requires more backpanel, midplane, and daughter card space allocated to electrical connectors.

[0003] Therefore, there is a need for an orthogonal differential signal electrical connector with balanced mating characteristics that occupies a minimum amount of substrate space yet still operates above four Gigabits/sec with six percent or less of worst case, multi-active crosstalk in the absence of metallic crosstalk shields.

SUMMARY

[0004] An electrical connector comprising may include a plurality of electrically isolated electrical contacts arranged at least partially coincident along a common centerline, wherein adjacent, alternating contacts deflect in opposite directions by corresponding blade contacts of a mating connector. An electrical connector may also include a plurality of electrically isolated electrical contacts arranged at least partially

coincident along a common centerline, wherein at least two of the plurality of electrically isolated electrical contacts each define a mating end that deflects in a first direction transverse to the common centerline by corresponding blade contacts of a mating connector. At least one of the plurality of electrically isolated electrical contacts is adjacent to one of the at least two of the plurality of electrically isolated electrical contacts and defines a respective mating end that deflects in a second direction transverse to the common centerline and opposite to the first direction by a corresponding blade contact of the mating connector. At least one of the plurality of electrically isolated electrical contacts may include two adjacent electrically isolated electrical contacts. At least two of the plurality of electrically isolated electrical contacts may be adjacent to each other and the at least two of the plurality of electrically isolated electrical contacts may each deflect in the first direction. The at least one of the plurality of electrically isolated electrical contacts may include two adjacent electrically isolated electrical contacts. The at least two of the plurality of electrically isolated electrical contacts may include at least three electrically isolated electrical contacts that are adjacent to each other and that each define a mating end that deflects in a first direction transverse to the common centerline by corresponding blade contacts of a mating connector. The at least one of the plurality of electrically isolated electrical contacts could also include three adjacent electrically isolated electrical contacts. The at least two of the plurality of electrically isolated electrical contacts may include at least four electrically isolated electrical contacts that are adjacent to each other and that each define a mating end that deflects in a first direction transverse to the common centerline by corresponding blade contacts of a mating connector. The at least one of the plurality of electrically isolated electrical contacts may include four adjacent electrically isolated electrical contacts.

[0005] An electrical connector may also include an array of electrical contacts with adjacent electrical contacts in the array paired into differential signal pairs along respective centerlines. The differential signal pairs may be separated from each other along the respective centerlines by a ground contact, wherein the electrical connector is devoid of metallic plates and comprises more than eighty-two differential signal pairs per inch of card edge, one of the more than eighty-two differential signal pairs is a victim differential signal pair, and differential signals with rise times of 70 picoseconds in eight aggressor differential signal pairs closest in distance to the victim differential signal pair produce no more than six percent worst-case, multi-active cross talk on the victim differential signal pair. The adjacent electrical contacts that define a differential signal pair may be separated by a first distance and the differential signal pair may be separated from the ground contact by a second distance that is greater than the first distance. The second distance may be approximately 1.5 times greater than the first distance, two times greater than the first distance, or greater than two times greater than the first distance. Each electrical contact in the array of electrical contacts may include a receptacle mating portion. The receptacle mating portions in the array of electrical contacts may be circumscribed within an imaginary perimeter of about 400 square millimeters or less. Each electrical contact in the array of electrical contacts may include a receptacle compliant portion and the receptacle compliant portions in the array of electrical contacts may be circumscribed within an imaginary perimeter of about 400 square millimeters or less. The electrical connector may extend no more than 20 mm from a mounting surface of a substrate. A pitch may be defined between each of the centerlines of the contacts arranged in the first direction. The pitch between each of the centerlines may be approximately 1.2 mm to 1.8 mm.

[0006] An electrical connector may include a first electrical contact and a second electrical contact positioned at least partially along a first centerline. The first electrical contact may be adjacent to the second electrical contact, wherein the first electrical contact defines a tail end that jogs in a first direction away from the first centerline. The second electrical contact defines a tail end that jogs in a second direction opposite the first direction. A third electrical contact and a fourth electrical contact may be positioned at least partially along a second centerline that is adjacent to the first centerline. The third electrical contact may be adjacent to the fourth electrical contact, wherein the third electrical contact defines a tail end that jogs in a second direction and the fourth electrical contact defines a tail end that jogs in the first direction. The tail ends of the first and second electrical contacts may be in an orientation that is the mirror image of the tail ends of the third and fourth electrical contacts. The first and second electrical contacts may form a differential signal pair, and the third and fourth electrical contacts may form a differential signal pair. The electrical connector may further comprise a ground contact adjacent to the second electrical contact along the first centerline.

[0007] A substrate may include a first electrical via and a second electrical via positioned at least partially along a first centerline. The first electrical via may be adjacent to the second electrical via. The first electrical via may jog in a first direction away from the first centerline and the second electrical via may jog in a second direction opposite the first direction. A third electrical via and a fourth electrical via may be positioned at least partially along a second centerline that is adjacent to the first centerline. The third electrical via may be adjacent to the fourth electrical via. The third electrical via may jog in a second direction and the fourth electrical via may jog in the first direction. The first and second electrical vias are preferably in an orientation that is a mirror image of third and fourth electrical vias.

[0008] An electrical connector may comprise a differential signal pair comprising a first electrical contact retained in a dielectric housing and a second electrical contact retained in the housing adjacent to the first signal contact, wherein the first electrical contact has a first length in the first direction, the second signal contact has a second length in the first direction, the first length being less than the second length, and an electrical signal in the second signal contact propagates through the second length longer than the electrical signal in the first signal contact propagates through the first length to correct skew from a mating differential signal pair in a mating right angle connector.

BRIEF DESCRIPTION OF THE DRAWINGS

[0009] Figs. 1A and 1B depict a vertical header connector and right-angle receptacle connector.

[0010] Fig. 1C depicts a right angle receptacle housing that accepts receptacle insert molded leadframe assemblies (IMLA) with six differential signal pairs and related ground contacts per centerline.

[0011] Fig. 1D depicts a vertical header connector with six differential signal pairs and related ground contacts per centerline.

[0012] Fig. 2 depicts a vertical header connector and right-angle receptacle connector mounted to respective substrates.

[0013] Fig. 3 depicts an orthogonal connector footprint and electrical contacts positioned on the orthogonal footprint.

[0014] Figs. 4A and 4B are front and isometric views, respectively, of a right-angle receptacle connector with a receptacle housing.

[0015] Figs. 5A and 5B are front and isometric views, respectively, of a right-angle receptacle connector without a receptacle housing.

[0016] Figs. 6A and 6B are top and side views, respectively, of a four differential signal pair IMLA for a right-angle receptacle connector.

[0017] Figs. 7A and 7B are front and isometric views, respectively, of a receptacle housing.

[0018] Figs. 8A and 8B depict an IMLA being received into a receptacle housing.

[0019] Fig. 9 is a side view of the mated electrical connectors depicted in FIGs. 1A and 1B.

[0020] Figs. 10A and 10B depict an array of electrical contacts mating with a first embodiment receptacle IMLA.

[0021] Figs. 11A and 11B depict an array of electrical contacts mating with a second embodiment receptacle IMLA.

[0022] Figs. 12A and 12B depict an array of electrical contacts mating with a third embodiment receptacle IMLA.

[0023] Figs. 13A and 13B depict an array of electrical contacts mating with a fourth embodiment receptacle IMLA.

[0024] Fig. 14 depicts a mated right angle receptacle IMLA with plastic dielectric material removed.

[0025] Fig. 15 is a detailed view of a portion of the right angle receptacle IMLA of FIG. 14.

[0026] Fig. 16 depicts a header IMLA and a right angle receptacle IMLA.

[0027] Fig. 17 depicts an array of electrical contacts mating with right angle electrical contacts.

DETAILED DESCRIPTION

[0028] Figs. 1A and 1B depict a first electrical connector 110 and a second electrical connector 210. As shown, the first electrical connector 110 may be a vertical header connector. That is, the first electrical connector 110 may define mating and mounting regions that are parallel to one another. The second electrical connector 210 may be a right-angle connector, or some other suitable mating connector that mates with first electrical connector 110. That is, the second electrical connector 210 may define mating and mounting regions that are perpendicular to one another. Though the embodiments depicted herein show a vertical header connector and a right-angle receptacle connector, it should be understood that either the first or second electrical connectors 110, 210 could be a vertical connector or a right-angle connector, either the first or second electrical connectors 110, 210 could be a header connector or a receptacle connector, and both of the first and second electrical connectors 110, 210 can be mezzanine connectors.

[0029] The first and second electrical connectors 110 and 210 may be shieldless high-speed electrical connectors, i.e., connectors that operate without metallic crosstalk plates at data transfer rates at or above four Gigabits/sec, and typically anywhere at or between 6.25 through 12.5 Gigabits/sec or more (about 80 through 35 picosecond rise times) with acceptable worst-case, multi-active crosstalk on a victim pair of no more than six percent. Worst case, multi-active crosstalk may be determined by the sum of the absolute values of six or eight aggressor differential signal pairs (Fig. 3) that are closest to the victim differential signal pair. Rise time ≈ 0.35/bandwidth, where bandwidth is approximately equal to one-half of the data transfer rate. Each differential signal pair may have a differential impedance of approximately 85 to 100 Ohms, plus or minus 10 percent. The differential impedance may be matched to the impedance of a system, such as a printed circuit board or integrated circuit, for example, to which the connectors may be attached. The connectors 110 and 210 may have an insertion loss of approximately -1 dB or less up to about a five-Gigahertz operating frequency and of approximately -2 dB or less up to about a ten-Gigahertz operating frequency.

[0030] Referring again to Figs. 1A and 1B, the first electrical connector 110 may include a header housing 120 that carries electrical contacts 130. The electrical contacts 130 include a header mating portion 150 and a header compliant portion 140. Each of the header mating portions 150 may define a respective first broadside and a respective second broadside opposite the first broadside. Header compliant portions 140 may be press-fit tails, surface mount tails, or fusible elements such as solder balls. The electrical contacts 130 may be insert molded prior to attachment to the header housing 120 or stitched into the header housing 120. Each of the electrical contacts 130 may have a material thickness approximately equal to its respective height, although the height may be greater than the material thickness. For example, the electrical contacts 130 may have a material thickness of about 0.1 mm to 0.45 mm and a contact height of about 0.1 mm to 0.9 mm. In an edge coupled arrangement along centerline CL1, the adjacent electrical contacts 130 that define a differential signal pair may be equally spaced or unevenly spaced from an adjacent ground contact. For example, the spacing between a first differential signal contact and a second adjacent differential signal contact may be approximately 1.2 to 4 times less than the spacing between the second differential signal contact and an adjacent ground contact. As shown in Fig. 1D, a uniform X-direction centerline pitch CL1, CL2, CL3 of about 1 mm to 2 mm is desired and an approximate 1 mm to 1.5 mm Y-direction centerline pitch CLA, CLB is desired, with 1.2 mm, 1.3mm, or 1.4 mm preferred. The spacing between adjacent electrical contacts 130 may correspond to the dielectric material between the electrical contacts 130. For example, electrical contacts 130 may be spaced more closely to one another where the dielectric material is air, than they might be where the dielectric material is a plastic.

[0031] With continuing reference to Figs. 1A and 1B, second electrical connector 210 includes insert molded leadframe assemblies (IMLA) 220 that are carried by a receptacle housing 240. Each IMLA 220 carries electrical contacts, such as right angle electrical contacts 250. Any suitable dielectric material, such as air or plastic, may be used to isolate the right angle electrical contacts 250 from one another. The right angle electrical contacts 250 include a receptacle mating portion 270 and a receptacle compliant portion 260. The receptacle compliant portions 260 may be similar to the header compliant portions 140 and may include press-fit tails, surface mount tails, or fusible elements such as solder balls. The right angle electrical contacts 250 may have a material thickness of about 0.1 mm to 0.5 mm and a contact height of about 0.1 mm to 0.9 mm. The contact height may vary over the overall length of the right angle electrical contacts 250, such that the mating ends 280 of the right angle electrical contacts 250 have a height of about 0.9 mm and an adjacent lead portion 255 (Fig. 14) narrows to a height of about 0.2 mm. In general, a ratio of mating end 280 height to lead portion 255 (Fig. 14) height may be about five. The second electrical connector 210 also may include an IMLA organizer 230 that may be electrically insulated or electrically conductive. An electrically conductive IMLA organizer 230 may be electrically connected to electrically conductive portions of the IMLAs 220 via slits 280 defined in the IMLA organizer 230 or any other suitable connection.

[0032] The first and second electrical connectors 110, 210 in Figs. 1A and 1B may include four differential signal pairs and interleaved ground contacts positioned edge-to-edge along centerline CL1. However, any number of differential signal pairs can extend along centerline CL1. For example, two, three, four, five, six, or more differential signal pairs are possible, with or without interleaved ground contacts. A differential signal pair positioned along a centerline adjacent to centerline CL1 may be offset from a differential signal pair positioned along centerline CL2. Referring again to Fig. 1A, second electrical connector 210 has a depth D of less than 46 mm, preferably about 35 mm, when the second electrical connector 210 includes IMLAs 220 having eighteen right angle electrical contacts 250.

[0033] Fig. 1C depicts a receptacle housing 240A that is configured to receive twelve IMLAs 220 (Figs. 6A, 6B), each having six differential pairs and interleaved ground contacts positioned edge-to-edge along a common respective centerline CL1, CL2, CL3. This is approximately eighteen right angle electrical contacts per IMLA, with six right angle electrical contacts individually positioned/interleaved between the differential signal pairs dedicated to ground. In this embodiment, the differential signal pairs and interleaved ground contacts of each IMLA extend along respective centerlines CL1, CL2, CL3, etc. in the Y direction and the centerlines CL1, CL2, CL3 are spaced apart in the X direction. A receptacle mating region is defined by all of the receptacle mating portions 270 (Fig. 1A) that populate the X by Y area when the IMLAs are attached to the receptacle header 240A. The centerline spacing between differential pairs on centerlines CL1, CL2, and CL3 may be about 1 mm to 4 mm, with 1.5 mm or 1.8 mm centerline spacing preferred.

[0034] With continuing reference to Fig. 1C, the receptacle mating region of a second electrical connector 210 configured with twelve IMLAs 220 each comprising six differential pairs and interleaved ground contacts positioned edge-to-edge is approximately 20 mm to 25 mm in length in the X direction by approximately 20 mm to 27 mm in length in the Y direction. For example, a 20 mm by 20 mm receptacle mating region in this embodiment includes approximately two hundred and sixteen individual receptacle mating portions which can be paired into about seventy-two differential signal pairs. The number of differential signal pairs per inch of card edge, measured in the X direction, may be approximately eighty-four to eighty-five (more than eighty-two) when the differential signal pairs are on 1.8 mm centerlines CL1, CL2, CL3 and approximately 101 to 102 when the differential signal pairs are on 1.5 mm centerlines CL1, CL2, CL3. The height or Y direction length and the depth D (Fig. 1A) preferably stays constant regardless of the centerline spacing or the total number of IMLAs added or omitted.

[0035] Fig. 1D shows a first electrical connector 110A with electrical contacts 130 arranged into six differential signal pairs S+, S- and interleaved ground contacts G per centerline CL1, CL2, CL3. First electrical connector 110A can mate with the receptacle housing 240A shown in Fig. 1C.

[0036] As shown in Fig. 2, a header mating region the first electrical connector 110 is defined by an imaginary square or rectangular perimeter P1 that intersects electrical contacts 1, 2, 3, 4 and includes the header mating portions 150 circumscribed by imaginary perimeter P1. Although four centerlines CL1, CL2, CL3, CL4 of twelve contacts are shown in Fig. 2, for a total of four differential signal pairs and four interleaved ground contacts per centerline, the header mating region can be expanded in total area by adding more centerlines of electrical contacts or more electrical contacts 130 in the Y direction. For four differential signal pairs and interleaved ground contacts per centerline, the number of differential signal pairs per inch of card edge or X direction is approximately fifty-six at a 1.8 mm centerline spacing and approximately sixty-eight at a 1.5 mm centerline spacing. The card pitch between daughter cards stacked in series on a back panel or midplane is less than 25 mm, and is preferably about 18 mm or less. For five differential signal pairs and interleaved ground contacts per centerline, the number of differential signal pairs per inch of card edge X is approximately seventy-one differential signal pairs at a 1.8 mm centerline spacing and approximately eight-five pairs at a 1.5 mm centerline spacing. The card pitch is less than 25 mm, and is preferably about 21 mm. For six differential signal pairs and interleaved ground contacts per centerline, the number of differential signal pairs per inch is the same as discussed above. The card pitch is less than 35 mm, and is preferably about 25 mm or less. An electrical connector with three differential signal pairs and interleaved grounds per centerline fits within a 15 mm card pitch.

[0037] In general, the card pitch increases by about 3 mm for each differential signal pair and adjacent ground contact added along a respective centerline in the Y direction and decreases by roughly the same amount when a differential signal pair and adjacent ground contact are omitted. Differential signal pairs per inch of card edge increases by about fourteen to seventeen differential signal pairs for every differential signal pair added to the centerline or omitted from the centerline, assuming the centerline spacing and the number of centerlines remain constant.

[0038] With continuing reference to Fig. 2, a receptacle footprint of the second electrical connector 210 is defined by an imaginary square or rectangular perimeter P2 that passes through receptacle compliant portion tails 5, 6, 7, and 8 and circumscribes receptacle compliant portions 260 within the P2 perimeter. The receptacle footprint of the second electrical connector is preferably about 20 mm by 20 mm for a six differential signal pair connector. A non-orthogonal header footprint of a mating six pair first electrical connector 110 is also preferably about 20 mm by 20 mm. As shown in Fig. 2, the first electrical connector 110 may be mounted to a first substrate 105 such as a backplane or midplane. The second electrical connector 210 may be mounted to a second substrate 205 such as a daughter card.

[0039] Fig. 3 is a front view of a connector and corresponding via footprint, such as the first electrical connector 110A (Fig. 1D) mounted onto the first substrate 105. The header housing 120 hidden in Fig. 3 for clarity. The first electrical connector 110A includes electrical contacts 130 arranged along centerlines, as described above and each header compliant portion 140 may include a respective tail portion 265. However, the header compliant portions 140 and the corresponding footprint on the first substrate 105 are both arranged for shared via orthogonal mounting through the first substrate 105, such as a backplane or midplane. Tail portions 265 of a differential signal pair 275 and the corresponding substrate via may jog in opposite directions with respect to one another. That is, one tail portion and via of the differential signal pair 275 may jog in the X direction, and a second tail portion and via of a second contact of the differential signal pair 275 may jog in the X- direction. The ground contacts G adjacent to the differential signal pair may or may not jog with respect to the centerline CL1.

[0040] More specifically, the tail portions 265 of the differential signal pairs 275 positioned along centerline CL1 may have a tail and corresponding via orientation that is reversed from the tail and corresponding via orientation of tail portions 265 of differential signal pairs 285 positioned along an adjacent centerline CL2. Thus, the tail portion 265 and corresponding via of a first contact of a first differential signal pair 275 positioned along first centerline CL1 may jog in the X- direction. A tail portion 265 and corresponding via of a corresponding first contact of a second differential signal pair 285 in a second centerline CL2 may jog in the X direction. Further, the tail portion 265 and corresponding via of a second contact of the first differential signal pair 275 positioned along the first centerline CL1 may jog in the X direction, and a tail portion 265 and corresponding via of a second contact of the second differential signal pair 285 in the second centerline may jog in the X-direction. Thus, the tail portions 265 and respective vias positioned along a first centerline CL1 may jog in a pattern reverse to the pattern of the tail portions 265 and respective vias of the terminal ends of contacts positioned along centerline CL2. This pattern can repeat for the remaining centerlines.

[0041] The substrate via footprint and corresponding first electrical connector 110A shown in Fig. 3 provides for at least six differential signal pairs 275, 285 positioned along each of the eleven centerlines CL1, CL2, CL3, etc. Each of the centerlines additionally may include respective ground contacts/vias G disposed between signal pairs of the centerline. The substrate may define a centerline pitch Pc between adjacent centerlines CL1, CL2. The centerline pitch Pc of the substrate may be one and a half times the via or electrical contact 130 spacing within a respective centerline, for example. The first electrical connector 110 and vias preferably have a square or rectangular footprint defined by an imaginary perimeter P3 that passes through 1A, 1B, 1C, 1D and circumscribes the header compliant portions 140 or interior vias. Differential signal pairs A can be possible aggressor pairs and differential signal pair V can be a possible victim differential signal pair.

[0042] Figs. 4A and 4B are front views of the second electrical connector 210 shown in Figs. 1A and 1B.

[0043] Figs. 5A and 5B are front and isometric views, respectively, of the second electrical connector 210 shown in Figs. 1A and 1B without the receptacle housing 240. As best seen without the receptacle housing 240, the receptacle mating portions 270 of the right angle electrical contacts 250 may define lead portions 290 and mating ends 280. The mating ends 280 may be offset from the centerline CL1 to fully accept respective header mating portions 150 of electrical contacts 130. That is, each mating end 280 may be offset in a direction that is perpendicular to the direction along which the centerline CL1 extends. Alternate mating ends 280 may be offset in alternating directions. That is, mating end 280 of a first one of the right angle electrical contacts 250 may be offset from centerline CL1 in a first direction that is perpendicular to centerline CL1, and the mating end 280 of an adjacent right angle electrical contact 250 positioned along the same centerline CL1 may be offset from the centerline CL1 in a second direction that is opposite the first direction. The mating ends 280 may bend toward the centerline CL1. Thus, the mating ends 280 of the right angle electrical contacts 250 may be adapted to engage blade-shaped header mating portions 150 (Fig. 1) of the first electrical contacts 130 from the first electrical connector 110, which, as described above, may be aligned along a centerline coincident with the centerline CL1 shown in Fig. 5A.

[0044] Figs. 6A and 6B are top and side views, respectively, of an IMLA 220. As shown in Fig. 6B, each leadframe contact 250 may define a lead portion 255 (Fig. 14) that extends between the receptacle mating portion 270 and the receptacle compliant portions 260. The right angle electrical contacts 250 may define one or more angles. Ideally, lengths of the right angle electrical contacts 250 that form a differential signal pair 295 should vary by about 2 mm or less so that the signal skew is less than 10 picoseconds. IMLAs 220 may also include a respective tab 330 that may be defined in a recess 340 in plastic dielectric material 301 or otherwise exposed. For example, the dielectric material 310 may have a respective top surface 350 thereof. The recess 340 may be defined in the top surface 350 of the dielectric material 310 such that the tab 330 is exposed in the recess 340.

[0045] As shown in Fig. 6B, the dielectric material 310 may include one or more protrusions 320. Each protrusion 320 may be an optional keying feature that extends from the dielectric material 310 in a direction in which the IMLA 220 is received into a cavity 380 (Fig. 7B) the receptacle housing 240 (Fig. 7B). It should be understood that the IMLA 220 could have cavities that accept protrusions similar to protrusions 320 that extend from the receptacle housing 240 to minimize relative motion perpendicular to the mating direction.

[0046] Figs. 7A and 7B are front and isometric views, respectively, of the receptacle housing 240. As shown in Fig. 9A, the receptacle housing 240 may define one or more mating windows 360, one or more mating cavities 370, and one or more cavities 380. The receptacle housing 240 may further include walls 390 that separate adjacent right angle electrical contacts 250 (Fig. 1A) along a centerline to prevent electrical shorting. Each of the mating windows 360 may receive, as shown in Fig. 8A, a blade-shaped header mating portion 150 of a corresponding first electrical contact 130 from the first electrical connector 110 when the first electrical connector 110 and the second electrical connector 210 are mated.

[0047] Referring again to Figs. 8A and 8B, a receptacle mating portion 270 of a corresponding right angle electrical contact 250 from the second electrical connector 210 (Fig. 1A) may extend into each of the mating cavities 370 and may pre-load the offset mating ends 280. The mating cavities 370 may be offset from one another to accommodate the offset mating ends 280 of right angle electrical contacts 250. Each of the cavities 380 may receive a respective protrusion 320 (Fig. 6B). The receptacle housing 240 may include latches 400 to secure the IMLAs 220, shown in Figs. 6A and 6B, into the receptacle housing 240.

[0048] A plurality of IMLAs 220 may be arranged in the receptacle housing 240 such that each of the IMLAs 220 is adjacent to another IMLA 220 on at least one side. For example, the mating portions 270 of the right angle electrical contacts 250 may be received into the mating cavities 370. The IMLAs 220 may be received into the mating cavities 370 until each of the respective protrusions 320 is inserted into a corresponding cavity 380. The IMLA organizer 230 (Fig. 9) may then be assembled to the IMLAs 220 to complete the assembly of the second electrical connector 210.

[0049] Fig. 9 is a side view of the mated electrical first and second electrical connectors 110, 210 shown in Figs. 1A and 1B. As shown, each of the respective slots 280 that may be defined in a curved portion 410 of the IMLA organizer 230 may receive a respective tab 330 from the recess 340 in IMLAs 220. For example, each of the tabs 330 may define a first side and a second side opposite of the first side.

[0050] Figs. 10A-15B depict an array of first electrical contacts 130 mating and receptacle mating portions 270 of right angle electrical contacts 250. Each of the blade-shaped header mating portions 150 of the first electrical contacts 130 from the first electrical connector 110 (Fig. 1A) may mate with a corresponding mating end 280 of a right angle electrical contact 250 IMLA 220 from the second electrical connector 210 (Fig. 1A). Each of the mating ends 280 may contact a respective header mating portion 150 in at least one place, and preferably at least two places.

[0051] As shown in Figs. 10A and 10B, the first broadsides of the blade-shaped header mounting portions 150 of the first electrical contacts 130 may define a first plane in a centerline direction CLD. The second broadsides of the blade-shaped header mounting portions 150 of the first electrical contacts 130 may define a second plane that may be offset from and parallel to the first plane. Some of the mating ends 280 of the receptacle mating portions 270 may physically contact the first broadside of a corresponding blade-shaped header mating portion 150, but not second broadside of the same blade-shaped header mating portion 150. The other mating ends 280 may physically contact the second broadside of a corresponding header mating portion 150, but not the first opposed broadside. Thus, a more balanced net force may be produced when the first and second electrical connectors 110, 210 are mated.

[0052] Figs. 11A and 11B are similar to Figs. 10A and 10B. The IMLA 220A carries right angle electrical contacts 250. However, in this embodiment two adjacent mating ends 280 contact a respective first broadside of two adjacent header mating portions 150 and two other adjacent mating ends 280 contact a respective second broadside of two other adjacent header mating portions 150.

[0053] Figs. 12A and 12B are similar to Figs. 10A and 10B. The IMLA 220B carries right angle electrical contacts 250. However, in this embodiment three adjacent mating ends 280 contact a respective first broadside of three adjacent header mating portions 150 and three other adjacent mating ends 280 contact a respective second broadside of three other adjacent header mating portions 150.

[0054] Figs. 13A and 13B are similar to Figs. 10A and 10B. The IMLA 220C carries right angle electrical contacts 250. However, in this embodiment four adjacent mating ends 280 contact a respective first broadside of four adjacent header mating portions 150 and four other adjacent mating ends 280 contact a respective second broadside of four other adjacent header mating portions 150.

[0055] It should be understood that although Figs. 10A through 13B embodiments show adjacent mating ends 280 physically contacting opposite broadsides of corresponding header mating portions 150 the header mating portions 150.

[0056] Fig. 14 shows a plurality of right angle electrical contacts 250 with plastic dielectric material removed for clarity. The right angle electrical contacts 250 may include a plurality of differential signal pairs 420 and one or more electrically-conductive ground contacts 450. Each right angle electrical contact 250 may define a lead portion 255 that extends between the receptacle mating portion 270 and the receptacle compliant portion 260. Where the second electrical connector 210 is a right-angle connector, the lead portions 255 may define one or more angles. Each lead portion 255 may have a respective length, L-r. The right angle electrical contacts 250 may have different lengths, as shown, which may result in signal skew. Ideally, the lengths L-r of right angle electrical contacts 250 that form a differential signal pair 420 should vary by about 1mm or less so that the signal skew is less than 10 picoseconds.

[0057] Portion 460 is shown in greater detail in Fig. 15. Fig. 15 is a detailed view of the differential signal pair 420 and a ground contact 450 shown in Fig. 14. As shown in Fig. 15, each of the differential signal pairs 420 may include a first signal contact 430 and a second signal contact 440. The first and second signal contacts 430, 440 may be spaced apart by a distance D1 such that the first and second signal contacts 430, 440 are tightly electrically coupled to one another. The gap between the first signal contact 430 and the second signal contact 440, in plastic, may be about 0.2 to 0.8 mm depending on the height and material thickness of the contacts. A gap of about 0.25 mm to 0.4 mm is preferred. In air, the gap may be less. The adjacent ground contact 450 may be spaced apart by a distance D2 from the differential signal pair within the IMLA 220. The distance D2 may be approximately 1.5 to 4 times the distance D1. The D2 distance between the second signal contact 440 and the ground contact 450, may be approximately 0.3 to 0.8 mm in plastic. A D2 distance of about 0.4 mm is preferred. In air, the values may be smaller. As discussed above, the height or width of the first signal contact 430 and the second signal contact 440 may be approximately equal to the material thickness, although it may be greater than a material thickness. For example, the height may vary between about 0.1 mm to 0.9 mm.

[0058] The ground contact 450 may be similar in dimensions to the first and second signal contacts 430, 440 to optimize spacing between signals contacts and grounds to produce an electrical connector with a differential signal pair density greater than eighty-two differential signal pairs per inch of card edge, and a stacked card pitch distance of less than about 35 mm or 31 mm (about 25 mm preferred), and a back panel to rear connector length of less than about 37 mm (about 35 mm preferred). In addition, a second electrical connector with right angle electrical contacts and more than eighty-two differential pairs per inch of card edge and the associated interleaved ground contacts 450 rises less than 20 mm from a daughter card mounting surface and only occupies about 400 square millimeters of daughter card surface area.

[0059] Fig. 16 shows that the electrical contacts 130 of the first electrical connector 110 may have an insert molded housing 480 adjacent to the header mating portions 150. The insert molded housing 480 may hold electrical contacts 130 of differing electrical and physical lengths.

[0060] Fig. 17 depicts the array of electrical contacts 130 and the IMLA 220 in Fig. 16 without the insert molded housing 480. The electrical contacts 130 may define a respective header lead portions 135 between each of the header compliant portions 140 and each of the header mating portions 150. The header lead portions 135 of adjacent contacts may vary in length. For example, a first electrical contact 470 may have a header lead portion 135 with a first physical and electrical length L1 and a second electrical contact 480 adjacent to the first electrical contact 470 may have a header lead portion 135 of a second physical and electrical length L2. In an example embodiment, the first length L1 may be less than the second length L2 to correct for skew in third and fourth electrical contacts 490 and 500.

[0061] For example, third electrical contact 490 may have a third physical and electrical length L3 and a fourth electrical contact 500 adjacent to the third electrical contact 490 may have a fourth physical and electrical length. In an example embodiment, the fourth physical and electrical length may be less than the third length. The third electrical contact 490 may be mated to the first electrical contact 470 and the fourth electrical contact 500 may be mated with the second electrical contact 480 such that the summation of the first physical and electrical length and the third physical and electrical length may be approximately equal to the summation of the second physical and electrical length and the fourth physical and electrical length. That is, the total electrical length between two contacts in a differential signal pair may be corrected for skew.

What is Claimed:

1. An electrical connector comprising:

a plurality of electrically isolated electrical contacts arranged at least partially coincident along a common centerline, wherein adjacent, alternating contacts deflect in opposite directions by corresponding blade contacts of a mating connector.

2. An electrical connector comprising:

a plurality of electrically isolated electrical contacts arranged at least partially coincident along a common centerline, wherein at least two of the plurality of electrically isolated electrical contacts each define a mating end that deflects in a first direction transverse to the common centerline by the corresponding blade contacts of the mating connector, at least one of the plurality of electrically isolated electrical contacts is adjacent to one of the at least two of the plurality of electrically isolated electrical contacts and defines a respective mating end deflects in a second direction transverse to the common centerline and opposite to the first direction by a corresponding blade contact of the mating connector, and at least one of the plurality of electrically isolated electrical contacts comprises two adjacent electrically isolated electrical contacts that deflect in opposite directions.

3. The electrical connector as claimed in claim 2, wherein the at least two of the plurality of electrically isolated electrical contacts are adjacent to each other and the at least two of the plurality of electrically isolated electrical contacts each deflect in the first direction.

4. The electrical connector as claimed in claim 3, wherein the at least one of the plurality of electrically isolated electrical contacts comprises two adjacent electrically isolated electrical contacts.

5. The electrical connector as claimed in claim 2, wherein the at least two of the plurality of electrically isolated electrical contacts comprises at least three electrically isolated electrical contacts that are adjacent to each other and that each define a mating

end that deflects in a first direction transverse to the common centerline by corresponding blade contacts of a mating connector.

6. The electrical connector as claimed in claim 5, wherein the at least one of the plurality of electrically isolated electrical contacts comprises three adjacent electrically isolated electrical contacts.

7. The electrical connector as claimed in claim 2, wherein the at least two of the plurality of electrically isolated electrical contacts comprises at least four electrically isolated electrical contacts that are adjacent to each other and that each define a mating end that deflects in a first direction transverse to the common centerline by corresponding blade contacts of a mating connector.

8. The electrical connector as claimed in claim 7, wherein the at least one of the plurality of electrically isolated electrical contacts comprises four adjacent electrically isolated electrical contacts.

9. An electrical connector comprising:

an array of electrical contacts with adjacent electrical contacts in the array paired into differential signal pairs along respective centerlines, the differential signal pairs separated from each other along the respective centerlines by a ground contact,

wherein the electrical connector is devoid of metallic plates and comprises more than eighty-two differential signal pairs per inch of card edge, one of the more than eight-two differential signal pairs is a victim differential signal pair, and differential signals with rise times of 70 picoseconds in eight aggressor differential signal pairs closest in distance to the victim differential signal pair produce no more than six percent worst-case, multi-active cross talk on the victim differential signal pair.

10. The electrical connector as claimed in claim 9, wherein the adjacent electrical contacts that define a differential signal pair are separated by a first distance and the differential signal pair is separated from the ground contact by a second distance that is greater than the first distance.

11. The electrical connector as claimed in claim 10, wherein the second distance is approximately 1.5 times greater than the first distance.

12. The electrical connector as claimed in claim 10, wherein the second distance is approximately two times greater than the first distance.

13. The electrical connector as claimed in claim 10, wherein the second distance is greater than two times greater than the first distance.

14. The electrical connector as claimed in claim 9, wherein each electrical contact in the array of electrical contacts comprises a receptacle mating portion and the receptacle mating portions in the array of electrical contacts are circumscribed within an imaginary perimeter of about 400 square millimeters or less.

15. The electrical connector as claimed in claim 9, wherein each electrical contact in the array of electrical contacts comprises a receptacle compliant portion and the receptacle compliant portions in the array of electrical contacts are circumscribed within an imaginary perimeter of about 400 square millimeters or less.

16. The electrical connector as claimed in claim 9, wherein the electrical connector extends no more than 20 mm from a mounting surface of a substrate.

17. The electrical connector as claimed in claim 9, wherein a pitch is defined between each of the centerlines of the contacts arranged in the first direction.

18. The electrical connector as claimed in claim 17, wherein the pitch between each of the centerlines is approximately 1.2 mm to 1.8 mm.

19. An electrical connector, comprising:

a first electrical contact and a second electrical contact positioned at least partially along a first centerline, the first electrical contact adjacent to the second electrical contact, wherein the first electrical contact defines a tail end that jogs in a first direction away from the first centerline and the second electrical contact defines a tail end that jogs in a second direction opposite the first direction; and

a third electrical contact and a fourth electrical contact positioned at least partially along a second centerline that is adjacent to the first centerline, the third electrical contact adjacent to the fourth electrical contact, wherein the third electrical contact defines a tail end that jogs in a second direction and the fourth electrical contact defines a tail end that jogs in the first direction,

wherein the tail ends of the first and second electrical contacts are in an orientation that is the mirror image of the tail ends of the third and fourth electrical contacts.

20. The electrical connector as claimed in claim 19, wherein the first and second electrical contacts form a differential signal pair, and wherein the third and fourth electrical contacts form a differential signal pair.

21. The electrical connector as claimed in claim 19, further comprising a ground contact adjacent to the second electrical along the first centerline.

22. A substrate comprising:

a first electrical via and a second electrical via positioned at least partially along a first centerline, the first electrical via adjacent to the second electrical via, wherein the first electrical via jogs in a first direction away from the first centerline and the second electrical via jogs in a second direction opposite the first direction; and

a third electrical via and a fourth electrical via positioned at least partially along a second centerline that is adjacent to the first centerline, the third electrical via adjacent to the fourth electrical via, wherein the third electrical via jogs in a second direction and the fourth electrical via jogs in the first direction,

wherein the first and second electrical vias are in an orientation that is a mirror image of third and fourth electrical vias.

23. An electrical connector comprising:

a differential signal pair comprising a first electrical contact retained in a dielectric housing and a second electrical contact retained in the housing adjacent to the first signal contact,

wherein (i) the first electrical contact has a first length in the first direction, (ii) the second signal contact has a second length in the first direction, (iii) the first length being less than the second length, and (iv) an electrical signal in the second signal contact propagates through the second length longer than the electrical signal in the first signal contact propagates through the first length to correct skew from a mating differential signal pair in a mating right angle connector.

24. The electrical connector as claimed in claim 23, wherein the electrical connector is devoid of metallic plates.

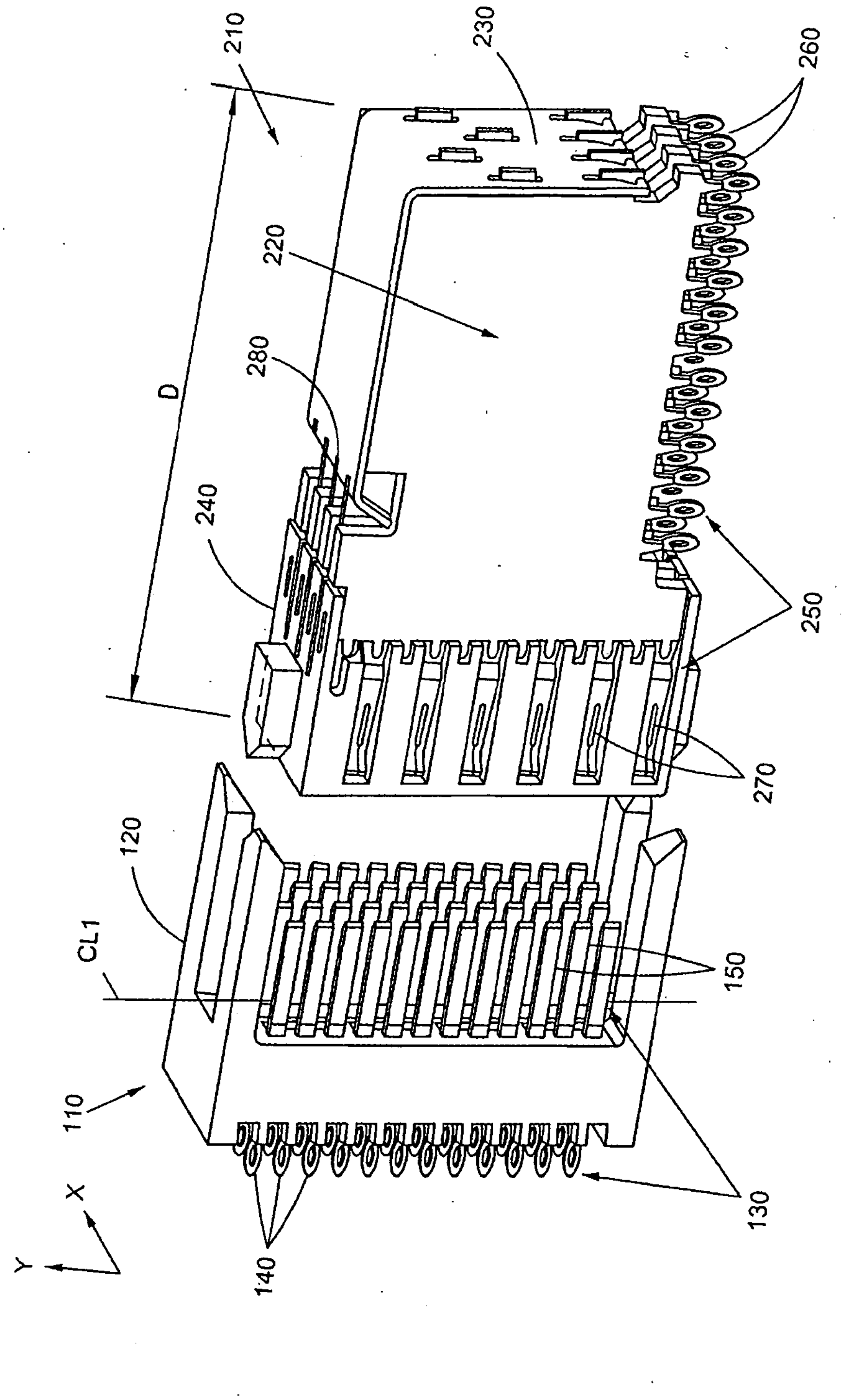


Fig. 1A

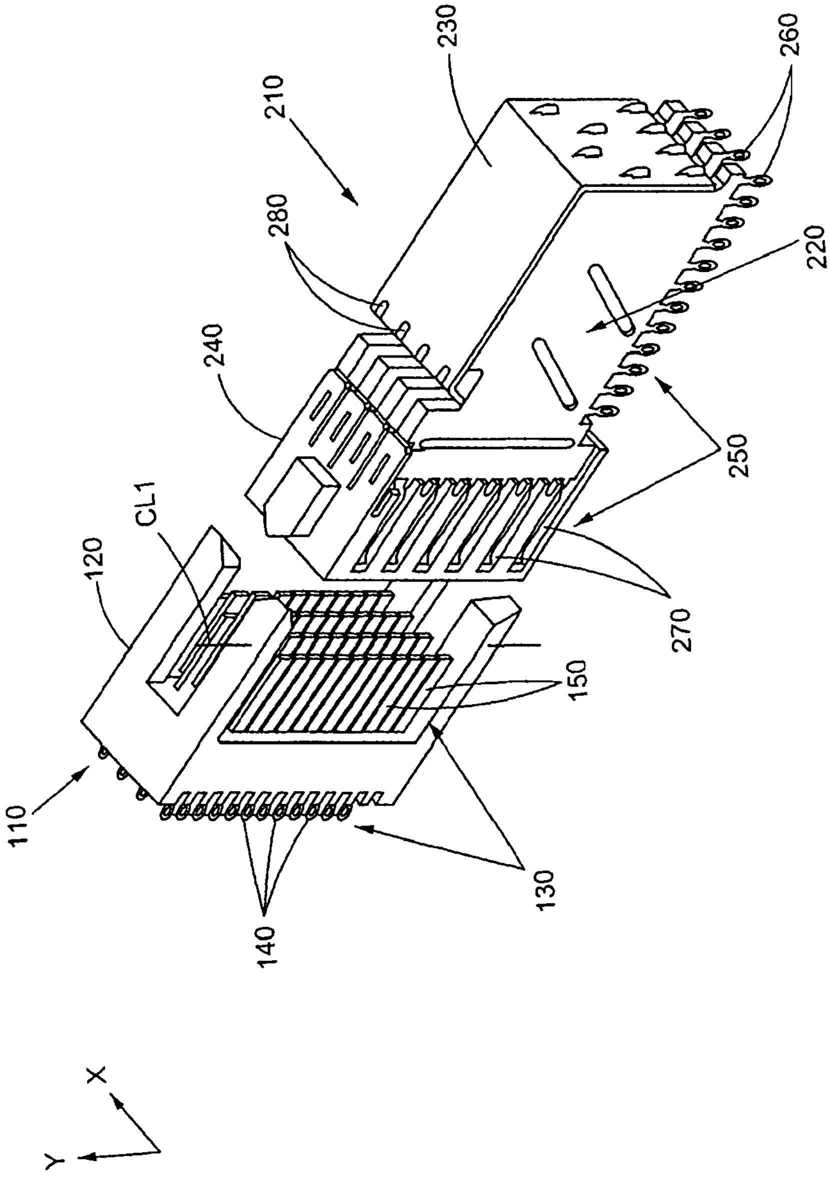


Fig. 1B

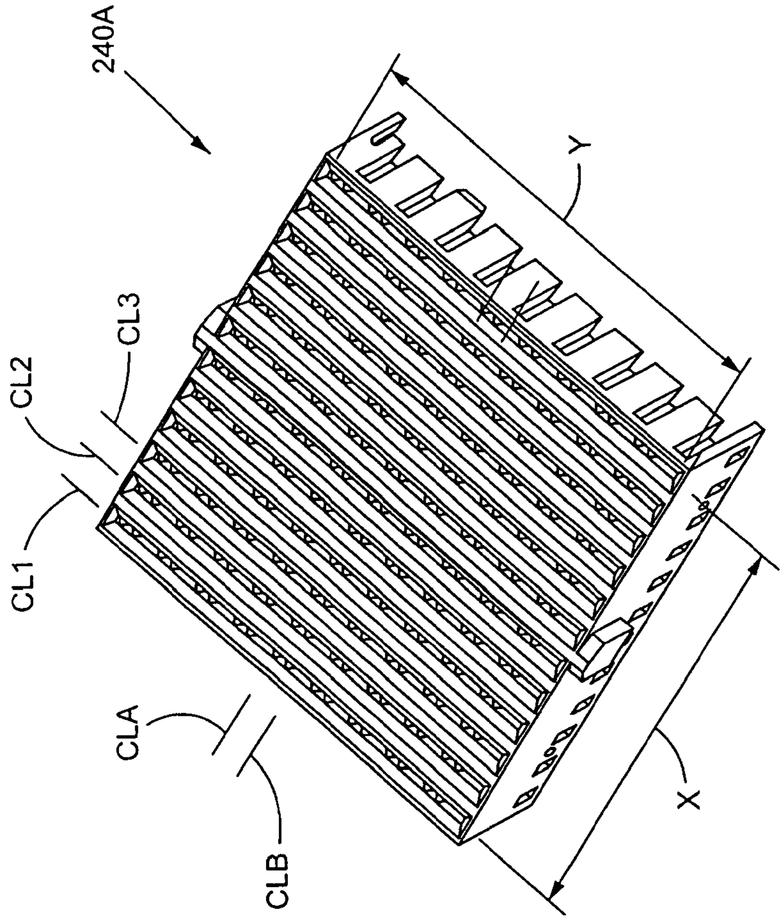


Fig. 1C

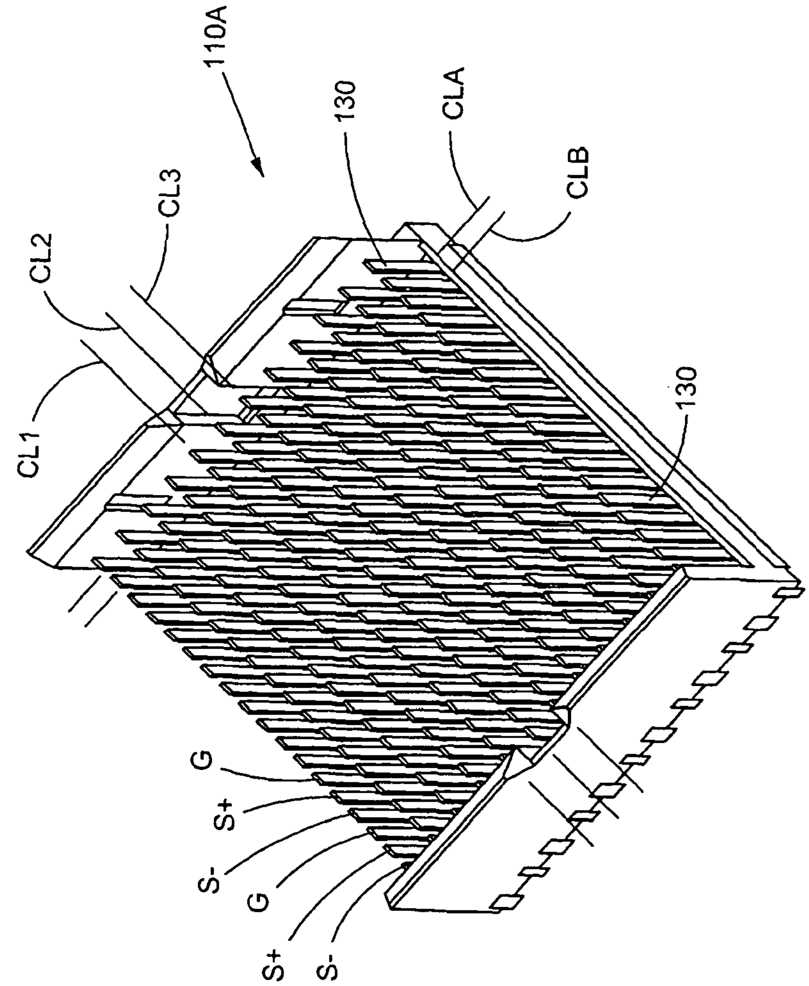


Fig. 1D

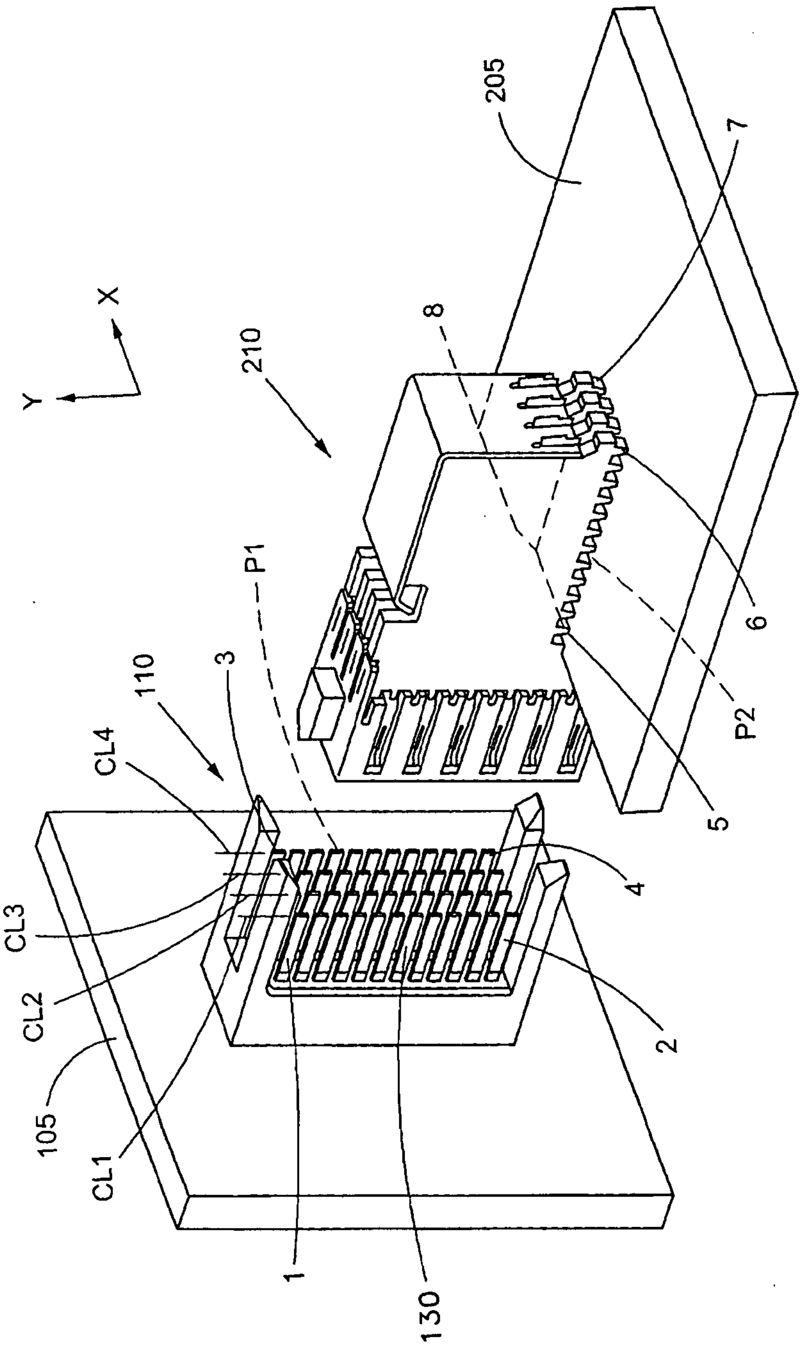
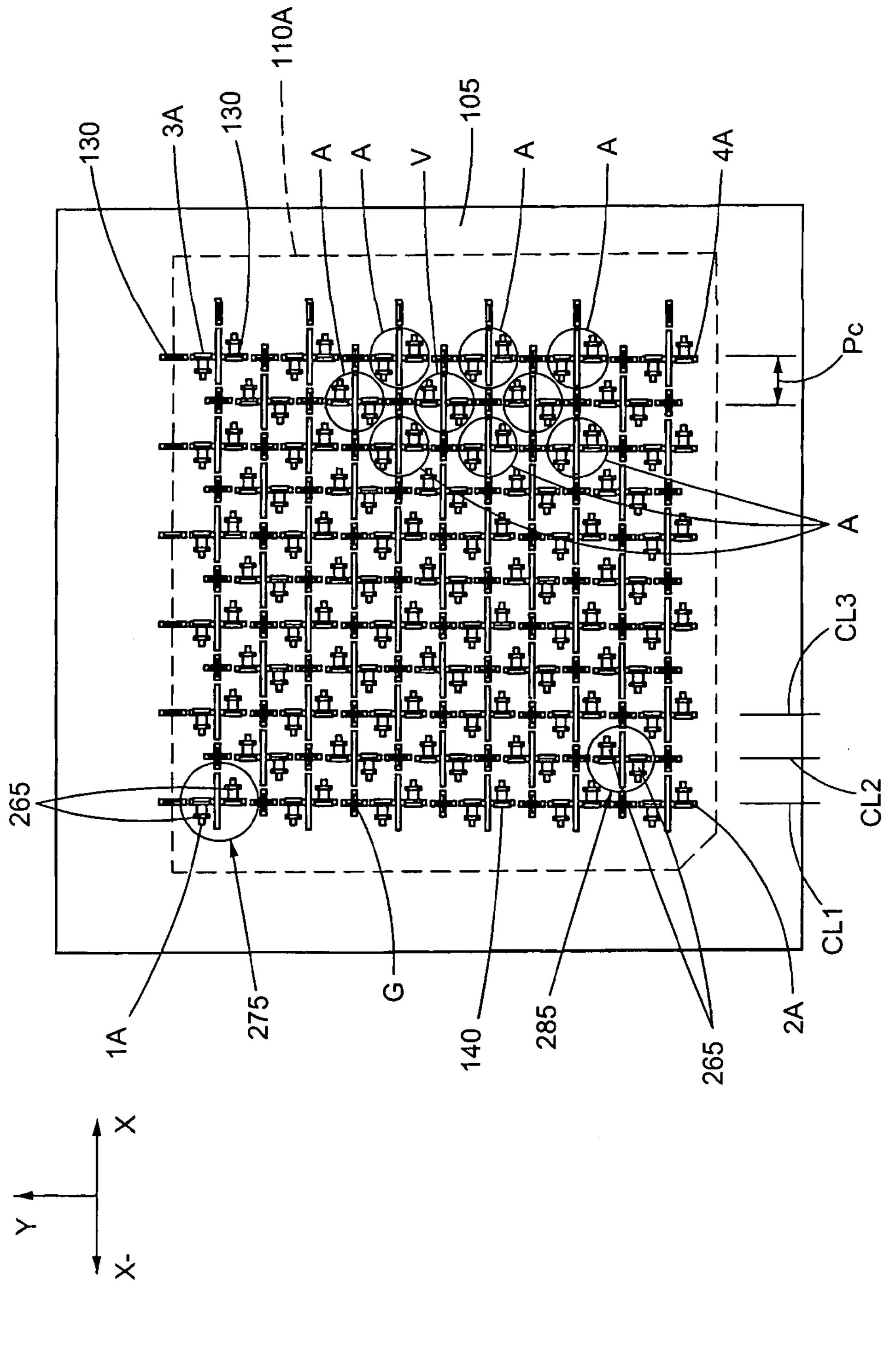


Fig. 2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X-

Fig. 3

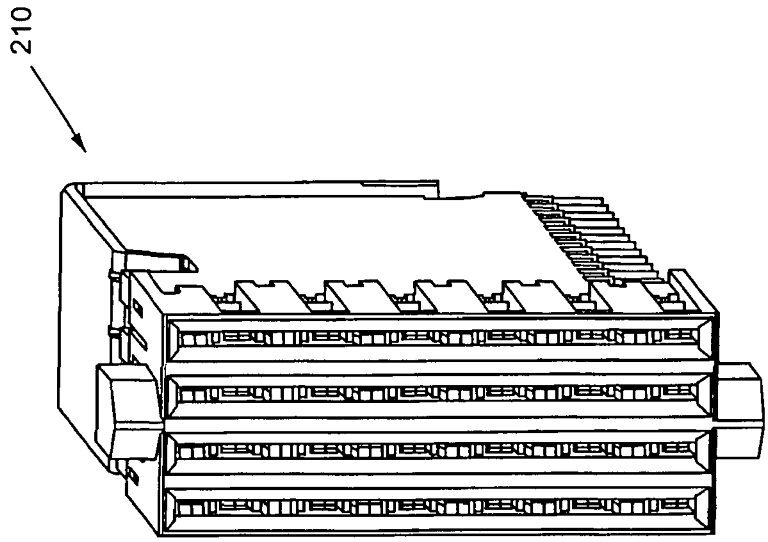


Fig. 4B

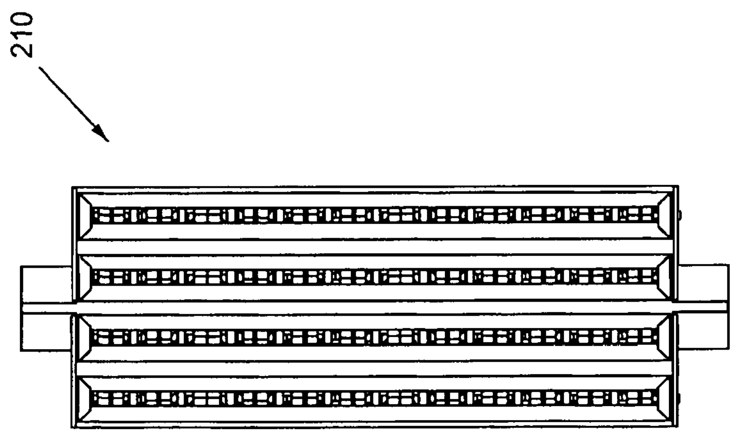


Fig. 4A

SUBSTITUTE SHEET (RULE 26)

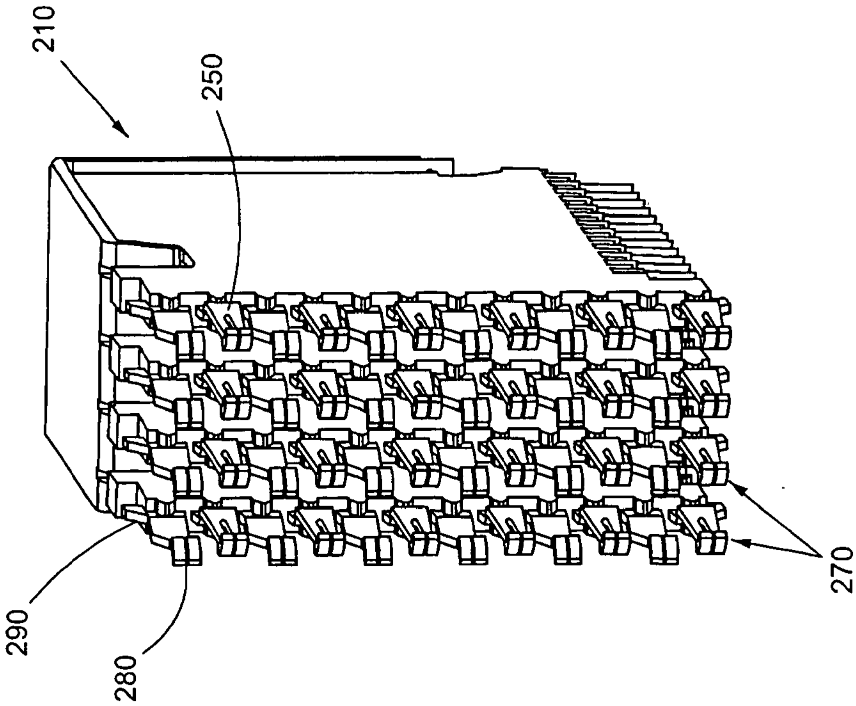
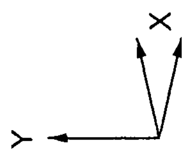


Fig. 5B



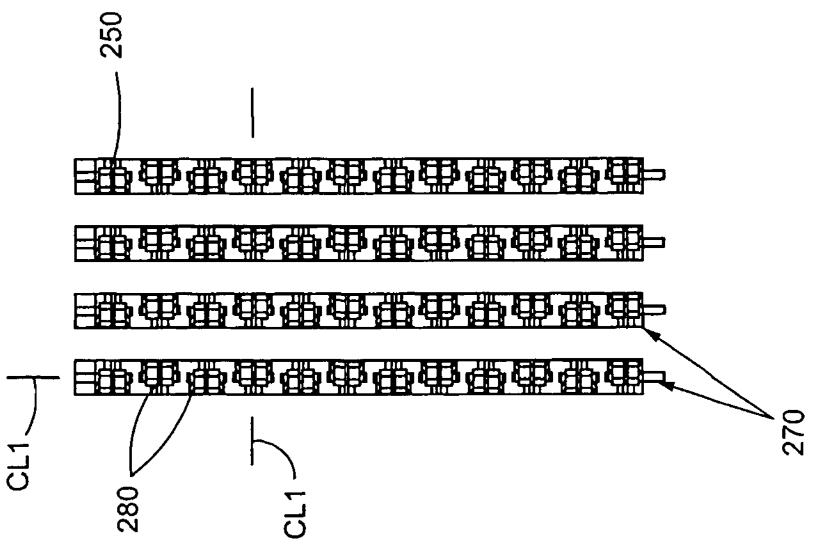


Fig. 5A

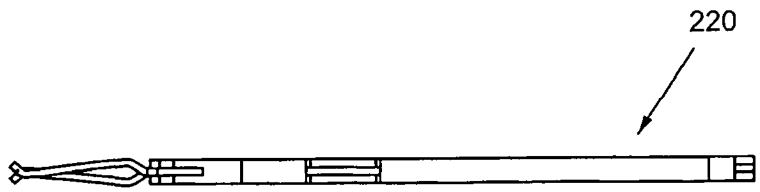


Fig. 6A

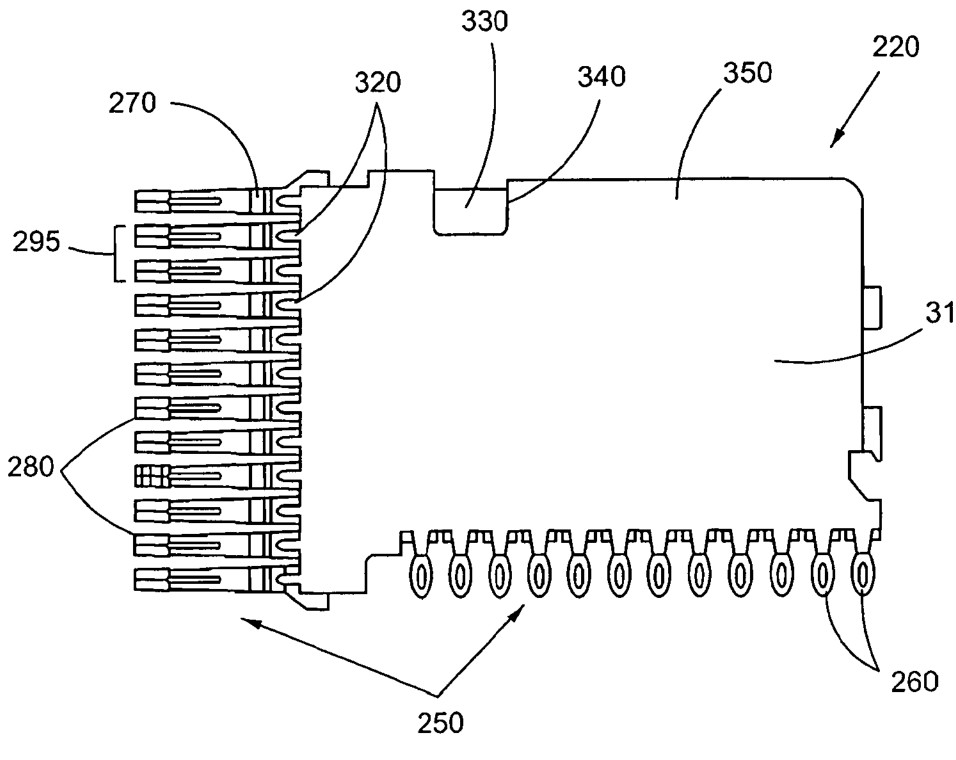


Fig. 6B

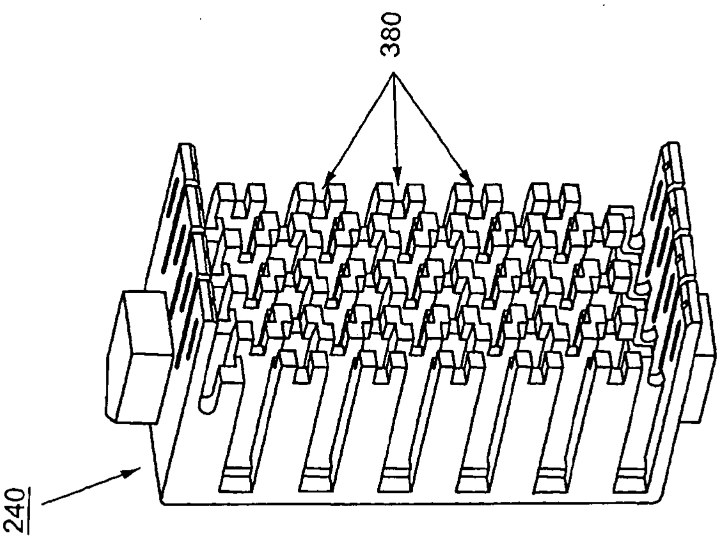


Fig. 7B

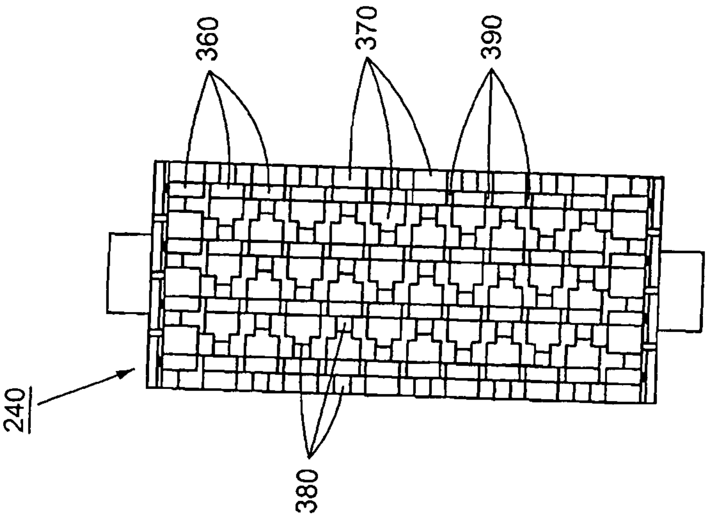


Fig. 7A

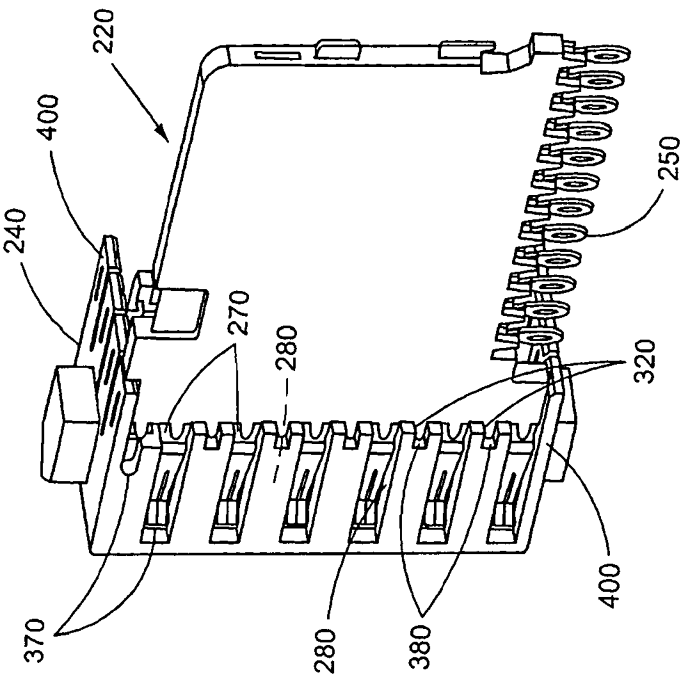

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Fig. 8B

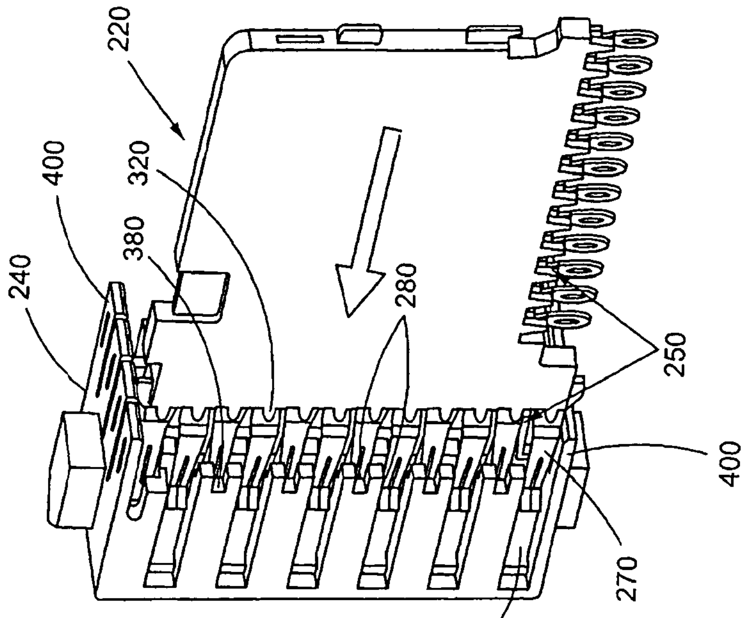
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Fig. 8A

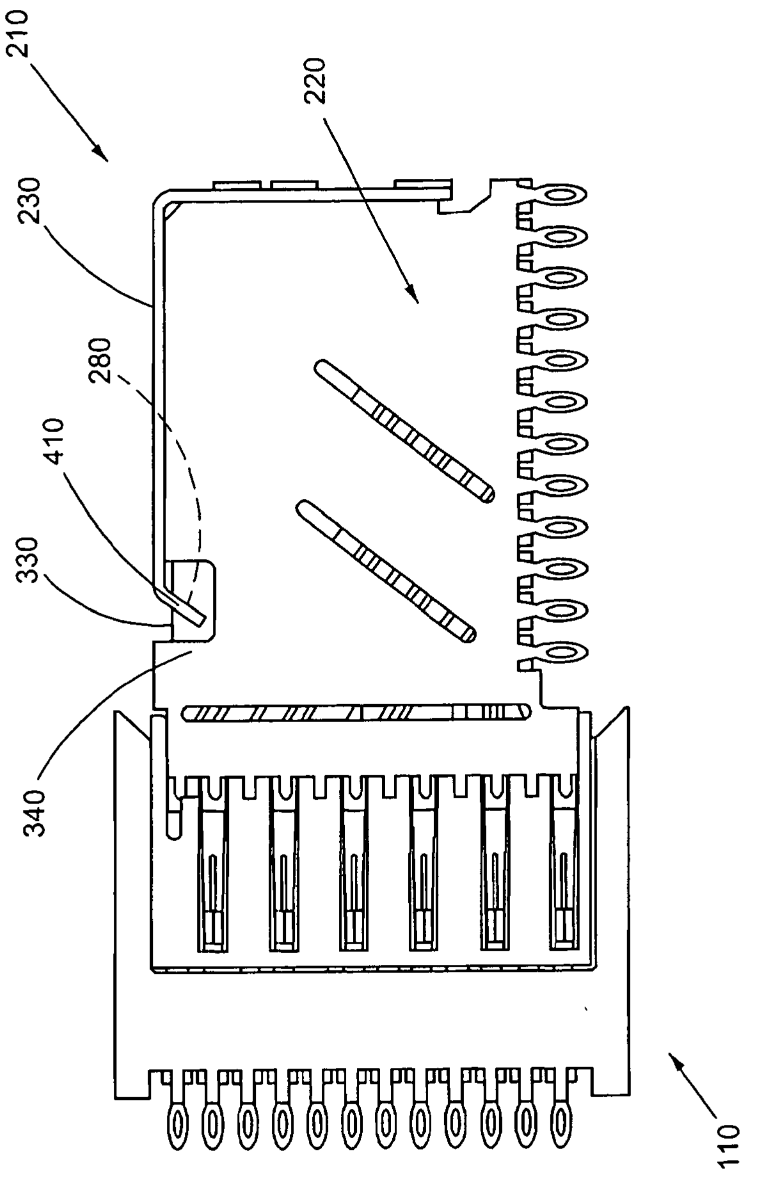

Fig. 9

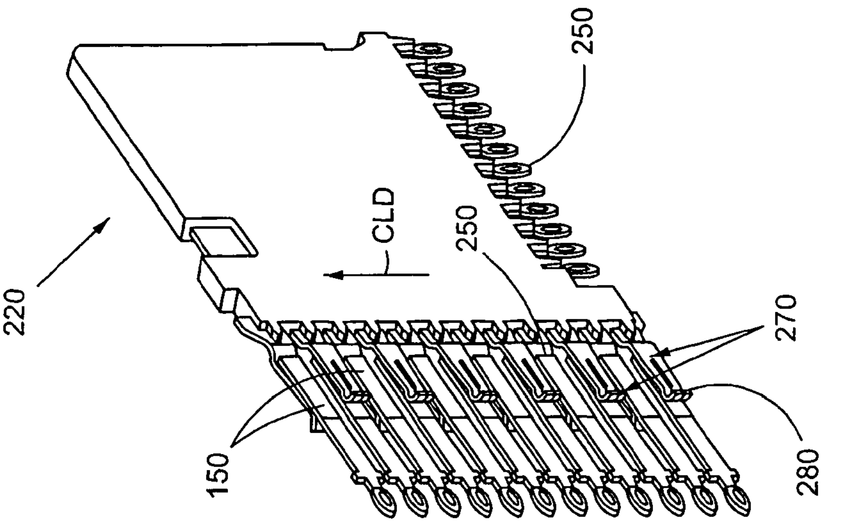

Fig. 10B

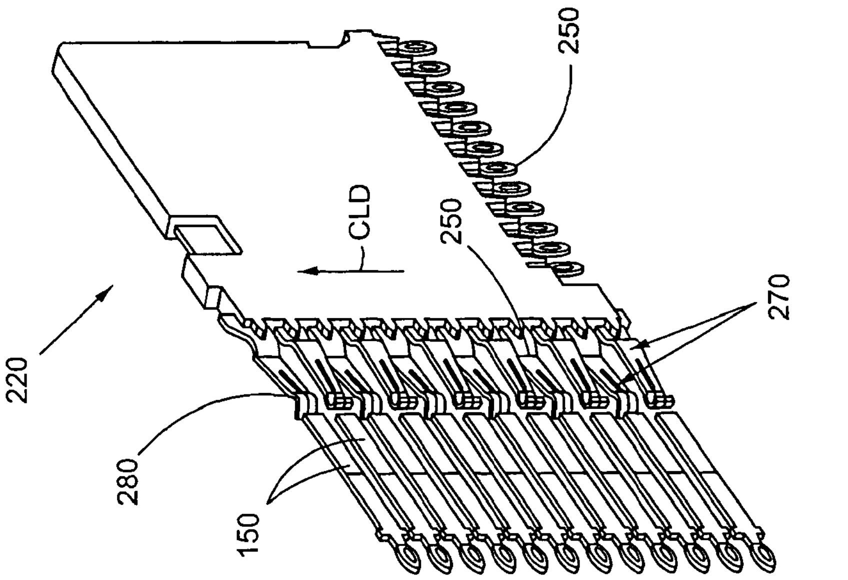

Fig. 10A

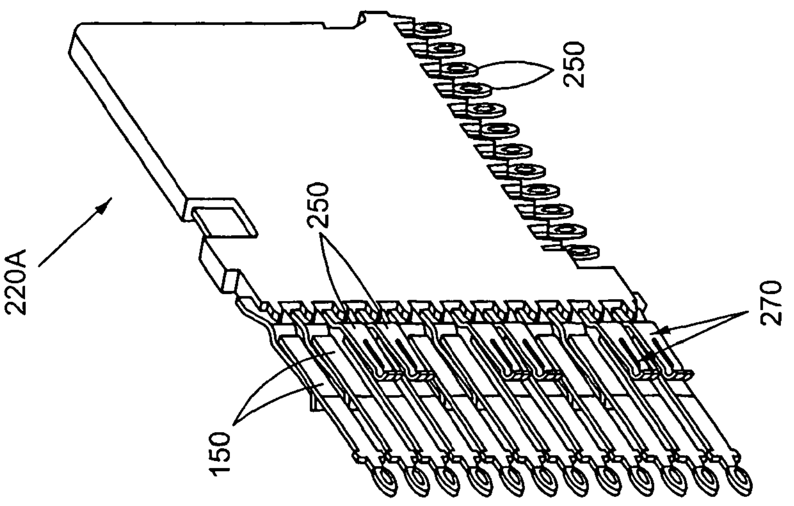

Fig. 11B

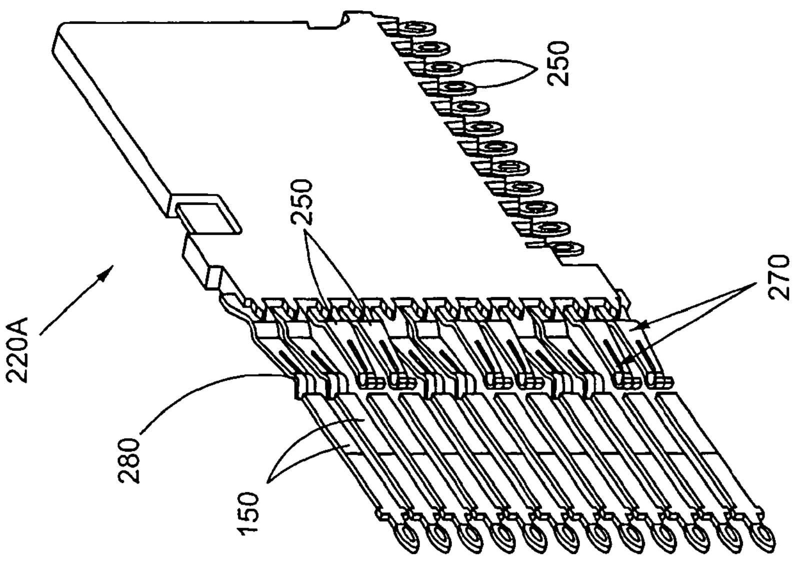

Fig. 11A

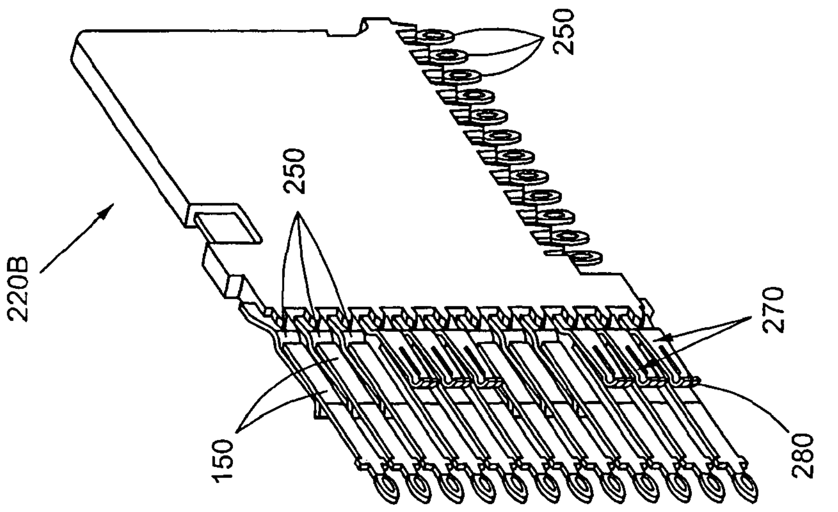

Fig. 12B

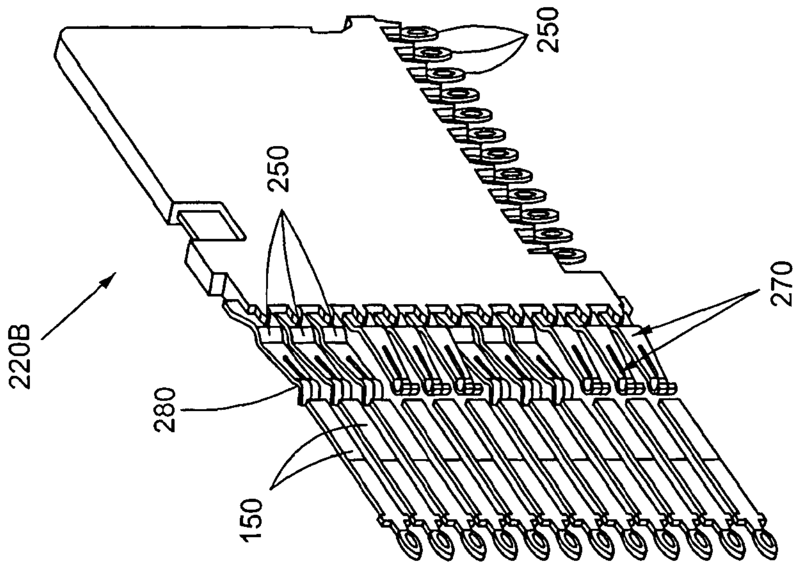

Fig. 12A

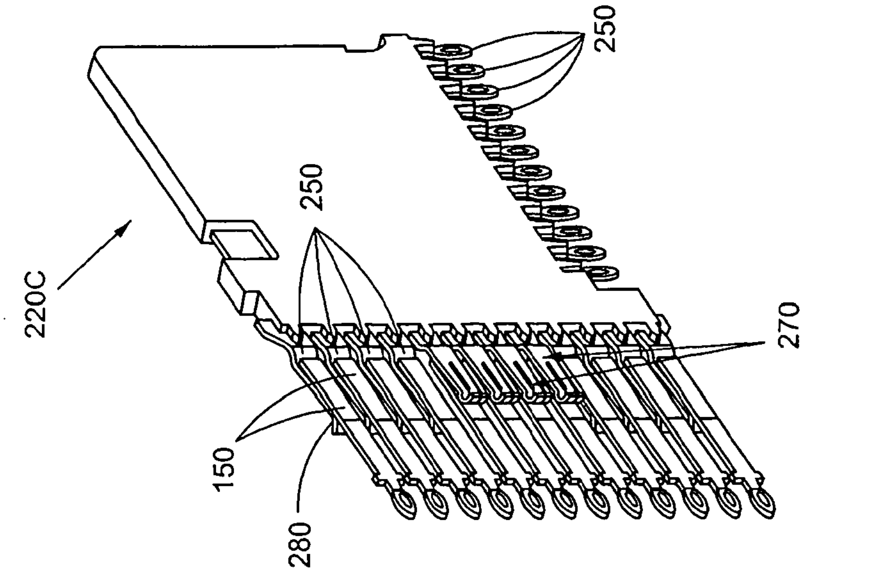

Fig. 13B

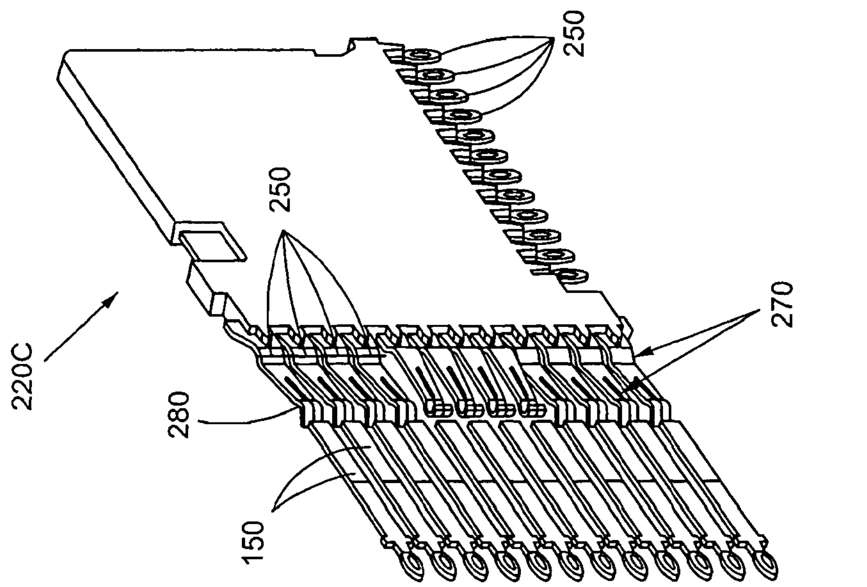

Fig. 13A

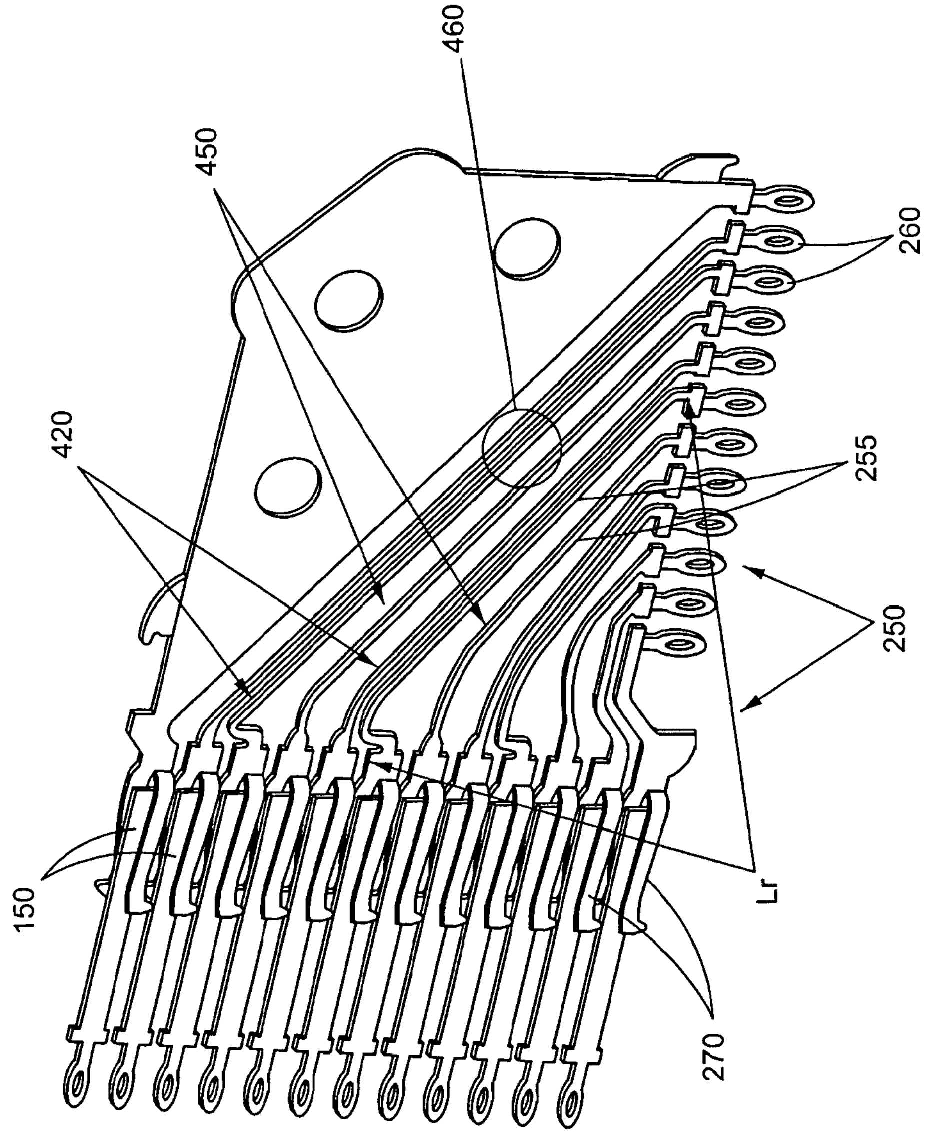

Fig. 14

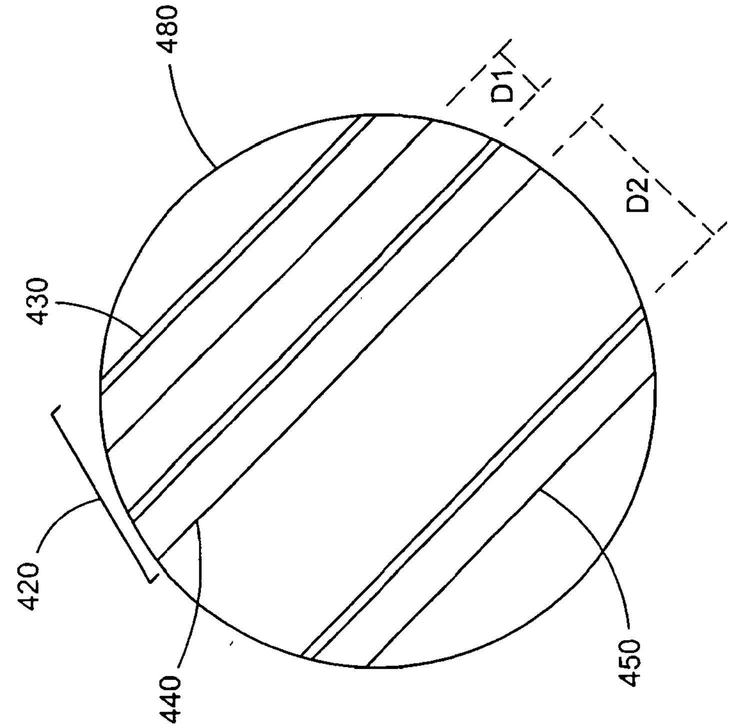

Fig. 15

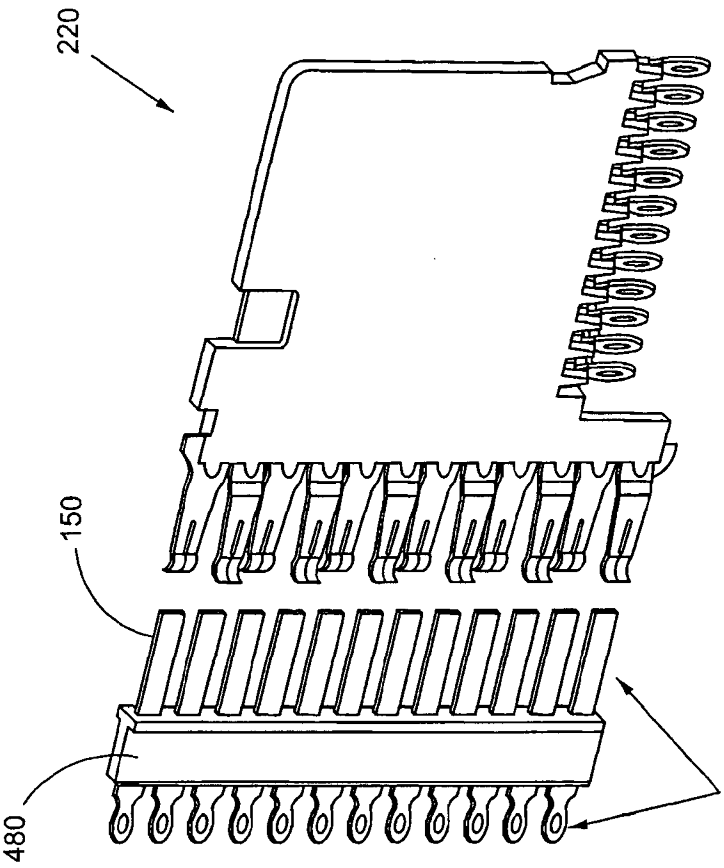

Fig. 16

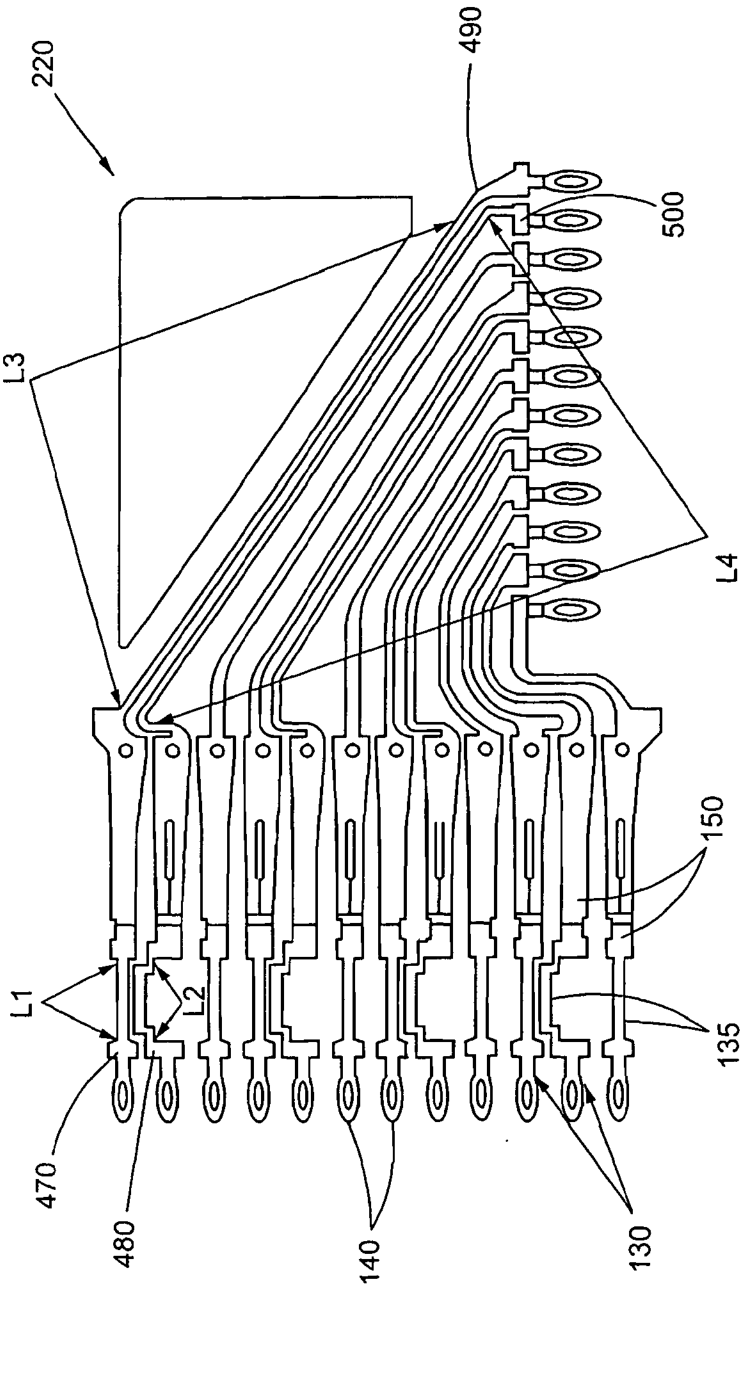

Fig. 17

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2007/025910

A. CLASSIFICATION OF SUBJECT MATTER

H01R 31/02(2006.01)i

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 8 : H01R

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
Korean Utility models and applications for Utility models since 1975
Japanese Utility models and applications for Utility models since 1975

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
eKIPASS(KIPO internal, Keyword: " electrical, connector, speed, crosstalk and the similar terms")

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 2006-0068610 A1(Belopolsky) 30 March 2006 See abstract, Figs 1-2d; [0025]-[0032]	1-24
A	US 2002-0039857 A1(Naito et al.) 4 April 2002 See abstract, Figs 10-16; [0039]-[0055]	1-24
A	US 6464529 B1(Jensen et al.) 15 October 2002 See abstract, Figs 11-15; Column 17, line 63 - Column 18, line 19	1-24
A	EP 0635910 B1(Molex Incorporated) 21 June 2000 See abstract, Figs 1, 2; [0017]-[0023]	1-24

☐ Further documents are listed in the continuation of Box C. ☒ See patent family annex.

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" earlier application or patent but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents,such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
26 MAY 2008 (26.05.2008)	**26 MAY 2008 (26.05.2008)**

Name and mailing address of the ISA/KR	Authorized officer
Korean Intellectual Property Office Government Complex-Daejeon, 139 Seonsa-ro, Seo-gu, Daejeon 302-701, Republic of Korea	KIM, Ki Wan
Facsimile No. 82-42-472-7140	Telephone No. 82-42-481-5682

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/US2007/025910

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2006-0068610 A1	30.03.2006	US2006068610AA	30.03.2006
US 2002-0039857 A1	04.04.2002	CN1205698C	01.06.2005
		CN1353476A	12.06.2002
		DE60104256C0	19.08.2004
		EP01193799A2	03.04.2002
		EP01193799A3	15.05.2002
		EP01193799B1	14.07.2004
		EP1193799A2	03.04.2002
		EP1193799B1	14.07.2004
		EP1193799A3	15.05.2002
		JP2001345151A2	14.12.2001
		JP3678990B2	03.08.2005
		KR1020020025737A	04.04.2002
		KR2002025737A	04.04.2002
		TW540187B	01.07.2003
		TW540187A	01.07.2003
		US2002039857AA	04.04.2002
		US6561849BB	13.05.2003
US 6464529 B1	15.10.2002	AT193164E	15.06.2000
		AT259548E	15.02.2004
		AU2001257104B2	07.11.2001
		AU200157104A1	07.11.2001
		AU200157104A5	07.11.2001
		AU6203394A1	26.09.1994
		AU8088898A1	15.10.1998
		CA2157279AA	15.09.1994
		CA2157279C	10.08.2004
		CA2157279C	15.09.1994
		CA2405101AA	01.11.2001
		CA2405101A1	01.11.2001
		DE60102010C0	18.03.2004
		DE60102010T2	09.12.2004
		DE69424536C0	21.06.2000
		DE69424536T2	15.02.2001
		DK28193A0	12.03.1993
		DK688472T3	09.10.2000
		EP01275177B1	11.02.2004
		EP0688472A1	27.12.1995
		EP1275177A1	15.01.2003
		EP1275177B1	11.02.2004
		EP688472A1	27.12.1995
		EP688472B1	17.05.2000
		ES2149261T3	01.11.2000
		ES2211802T3	16.07.2004
		JP08507406	06.08.1996
		JP3414737B2	09.06.2003
		JP8507406T2	06.08.1996

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

PCT/US2007/025910

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
		NZ260078A	24.06.1997
		US2003186591A1	02.10.2003
		US2003186591AA	02.10.2003
		US6113418A	05.09.2000
		US6464529B1	15.10.2002
		US6464529BA	15.10.2002
		WO0182418A1	01.11.2001
		WO200182418A1	01.11.2001
		WO9421007A1	15.09.1994
EP 0635910 B1	21.06.2000	EP1104473A2	06.06.2001
		EP1351813A1	15.10.2003
		EP1409786A1	21.04.2004
		EP635910A2	25.01.1995
		EP635910A3	26.06.1996
		EP635910B1	21.06.2000