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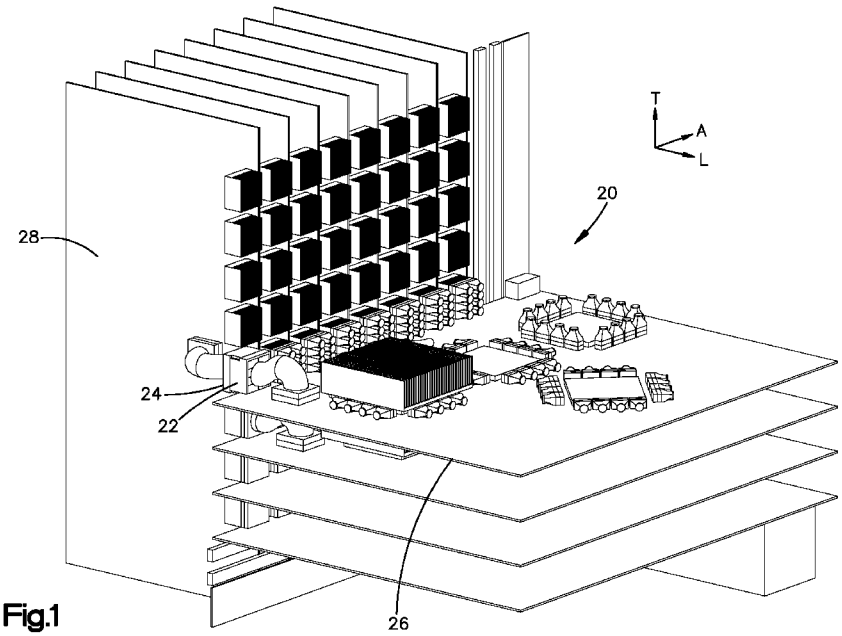

Fig.1

(57) Abstract: Shielded electrical connectors are described herein. An electrical connector can include a connector housing. The electrical connector can further include at least one electrical connector supported by the connector housing. The electrical connector can further include an electrical shield that at least partially surrounds the at least one electrical contact, where the electrical connector is configured to transmit data signals along the at least one electrical contact. The electrical connector can be configured to mate with a corresponding electrical connector having another electrical shield. When the electrical connector and the corresponding connector are partially seated, the data signals can experience crosstalk interference levels that are approximately the level of crosstalk interference the data signals experience when the electrical connector and the corresponding electrical connector are fully seated.

WO 2025/080907 A1

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SHIELDED ELECTRICAL CABLE CONNECTOR

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This claims priority to U.S. Patent Application Serial No. 63/590,291 filed October 13, 2023, the disclosure of which is hereby incorporated by reference as if set forth in its entirety herein.

BACKGROUND

[0002] Electrical connectors include electrical contacts that mount to respective electrical components, and mate with each other to communicate signals between the electrical components. The electrical contacts typically include electrical signal contacts that carry the signals, and grounds that shield the various contacts from each other. Nevertheless the signal contacts are so closely spaced that undesirable interference, or "cross talk," occurs between the adjacent signal contacts. Cross talk occurs when one signal contact induces electrical interference in an adjacent signal contact due to intermingling electrical fields, thereby compromising signal integrity. With electronic device communications becoming more prevalent, the reduction of cross talk becomes a significant factor in connector design.

[0003] Further, electrical connectors can in some cases be a part of an electrical connector system. For example, an electrical connector system can include a plurality of connectors mounted to a substrate, such as a printed circuit board (PCB), where the plurality of connectors are configured to mate with another plurality of corresponding connectors mounted to another substrate. In some cases, mating each connector of the system may be difficult. For example, one of the substrates may be warped, such that some of the electrical connectors are fully mated (e.g., seated), whereas other connectors are partially seated. The partially seated connectors may be exposed to greater levels of cross talk interference, which may cause signal degradation for the connector system.

SUMMARY

[0004] In accordance with one aspect of the present disclosure, an electrical connector can include a connector housing. The electrical connector can further include at least one electrical connector supported by the connector housing. The electrical connector can further include an electrical shield that at least partially surrounds the at least one

electrical contact, where the electrical connector is configured to transmit data signals along the at least one electrical contact. The electrical connector can be configured to mate with a corresponding electrical connector having another electrical shield. When the electrical connector and the corresponding connector are partially seated, the data signals can experience crosstalk interference levels that are approximately the level of crosstalk interference the data signals experience when the electrical connector and the corresponding electrical connector are fully seated.

BRIEF DESCRIPTION OF THE DRAWINGS

[0005] Fig. 1 is a perspective view of an electrical connector system according to the present disclosure, including a first electrical connector and a second electrical connector;

[0006] Fig. 2A is a perspective view of the first electrical connector of Fig. 1, showing a first mating interface of the first electrical connector;

[0007] Fig. 2B is a perspective view of the first electrical connector of Fig. 2A;

[0008] Fig. 2C is a perspective view of the first electrical connector of Fig. 2, with the shroud removed;

[0009] Fig. 2D is a perspective view of the first electrical connector of Fig. 2, with the shroud and housing removed;

[0010] Fig. 2E is a perspective view of the first electrical connector of Fig. 2, with the shroud and housing removed;

[0011] Fig. 3 is a perspective view of the second electrical connector of Fig. 1, showing a second mating interface of the second electrical connector configured to mate with the first mating interface of Fig. 2;

[0012] Fig. 4 is a perspective view of the first electrical connector and the second electrical connector of Fig. 1, shown fully mated;

[0013] Fig. 5 is a perspective view of the first electrical connector and the second electrical connector of Fig. 4, with the respective shroud and housing removed;

[0014] Fig. 6 is a perspective view of a first contact assembly disposed in a first contact assembly of the first electrical connector of Fig. 2A;

[0015] Fig. 7 is a perspective view of a first contact assembly disposed in a first contact assembly of the first electrical connector of Fig. 2A;

[0016] Fig. 8 is a perspective view of a first contact assembly disposed in a first contact assembly of the first electrical connector of Fig. 2A, with the first electrical shield removed;

[0017] Fig. 9A is a top perspective view of an electrical contact of a first contact assembly of the first electrical connector of Fig. 2A;

[0018] Fig. 9B is a top perspective view of an electrical contact of a first contact assembly of the first electrical connector of Fig. 2A;

[0019] Fig. 9C is a side perspective view of an electrical contact of a first contact assembly of the first electrical connector of Fig. 2A;

[0020] Fig. 9D is a bottom perspective view of an electrical contact of a first contact assembly of the first electrical connector of Fig. 2A;

[0021] Fig. 9E is a front perspective view of an electrical contact of a first contact assembly of the first electrical connector of Fig. 2A;

[0022] Fig. 10A is a top perspective view of an electrical contact of a first contact assembly of the first electrical connector of Fig. 2A;

[0023] Fig. 10B is a top perspective view of an electrical contact of a first contact assembly of the first electrical connector of Fig. 2A;

[0024] Fig. 10C is a side perspective view of an electrical contact of a first contact assembly of the first electrical connector of Fig. 2A;

[0025] Fig. 10D is a bottom perspective view of an electrical contact of a first contact assembly of the first electrical connector of Fig. 2A;

[0026] Fig. 10E is a front perspective view of an electrical contact of a first contact assembly of the first electrical connector of Fig. 2A;

[0027] Fig. 11A is a front view of a first electrical shield of a first contact assembly of the first electrical connector of Fig. 2A;

[0028] Fig. 11B is a side view of a first electrical shield of a first contact assembly of the first electrical connector of Fig. 2A;

[0029] Fig. 11C is a perspective side view of a first electrical shield of a first contact assembly of the first electrical connector of Fig. 2A;

[0030] Fig. 12 is a perspective view of the second electrical connector of Fig. 3;

[0031] Fig. 13A is a perspective view of the second electrical connector of Fig. 3, with the housing removed;

[0032] Fig. 13B is a perspective view of the second electrical connector of Fig. 3, with the housing removed;

[0033] Fig. 14 is perspective view of a second contact assembly disposed in a second contact assembly of the second electrical connector of Fig. 3;

[0034] Fig. 15 is perspective view of a second contact assembly disposed in a second contact assembly of the second electrical connector of Fig. 3, with the second electrical shield removed;

[0035] Fig. 16 is perspective view of a second contact assembly disposed in a second contact assembly of the second electrical connector of Fig. 3, with the second electrical shield and the second dielectric sleeve removed;

[0036] Fig. 17A is a top perspective view of an electrical contact of a second contact assembly of the second electrical connector of Fig. 3;

[0037] Fig. 17B is a top perspective view of an electrical contact of a second contact assembly of the second electrical connector of Fig. 3;

[0038] Fig. 17C is a side perspective view of an electrical contact of a second contact assembly of the second electrical connector of Fig. 3;

[0039] Fig. 17D is a bottom perspective view of an electrical contact of a second contact assembly of the second electrical connector of Fig. 3;

[0040] Fig. 17E is a front perspective view of an electrical contact of a second contact assembly of the second electrical connector of Fig. 3;

[0041] Fig. 18A is a top perspective view of an electrical contact of a second contact assembly of the second electrical connector of Fig. 3;

[0042] Fig. 18B is a top perspective view of an electrical contact of a second contact assembly of the second electrical connector of Fig. 3;

[0043] Fig. 18C is a side perspective view of an electrical contact of a second contact assembly of the second electrical connector of Fig. 3;

[0044] Fig. 18D is a bottom perspective view of an electrical contact of a second contact assembly of the second electrical connector of Fig. 3;

[0045] Fig. 18E is a front perspective view of an electrical contact of a second contact assembly of the second electrical connector of Fig. 3;

[0046] Fig. 19A is a back view of a second electrical shield of the second electrical connector of Fig. 3;

[0047] Fig. 19B is a top perspective view of a second electrical shield of the second electrical connector of Fig. 3;

[0048] Fig. 19C is a side view of a second electrical shield of the second electrical connector of Fig. 3;

[0049] Fig. 19D is a bottom perspective view of a second electrical shield of the second electrical connector of Fig. 3;

[0050] Fig. 19E is a front view of a second electrical shield of the second electrical connector of Fig. 3;

[0051] Fig. 20A is a cross-sectional view of a first electrical shield and set of first electrical contacts of the first electrical connector of Fig. 2A partially seated with a second electrical shield and corresponding set of second electrical contacts of the second electrical connector of Fig. 3;

[0052] Fig. 20B is a cross-sectional view of a first electrical shield and set of first electrical contacts of the first electrical connector of Fig. 2A partially seated with a second electrical shield and corresponding set of second electrical contacts of the second electrical connector of Fig. 3;

[0053] Fig. 20C is a cross-sectional view of a first electrical shield and set of first electrical contacts of the first electrical connector of Fig. 2A partially seated with a second electrical shield and corresponding set of second electrical contacts of the second electrical connector of Fig. 3;

[0054] Fig. 20D is a cross-sectional view of a first electrical shield and set of first electrical contacts of the first electrical connector of Fig. 2A partially seated with a second electrical shield and corresponding set of second electrical contacts of the second electrical connector of Fig. 3;

[0055] Fig. 20E is a cross-sectional view of a first electrical shield and set of first electrical contacts of the first electrical connector of Fig. 2A partially seated with a second electrical shield and corresponding set of second electrical contacts of the second electrical connector of Fig. 3;

[0056] Fig. 21A is a top perspective view of a first electrical shield and set of first electrical contacts of the first electrical connector of Fig. 2A partially seated with a second electrical shield and corresponding set of second electrical contacts of the second electrical connector of Fig. 3;

[0057] Fig. 21B is a bottom perspective view of a first electrical shield and set of first electrical contacts of the first electrical connector of Fig. 2A partially seated with a second electrical shield and corresponding set of second electrical contacts of the second electrical connector of Fig. 3;

[0058] Fig. 21C is a side view of a first electrical shield and set of first electrical contacts of the first electrical connector of Fig. 2A partially seated with a second electrical shield and corresponding set of second electrical contacts of the second electrical connector of Fig. 3;

[0059] Fig. 21D is a face view of a first electrical shield and set of first electrical contacts of the first electrical connector of Fig. 2A partially seated with a second electrical shield and corresponding set of second electrical contacts of the second electrical connector of Fig. 3;

[0060] Fig. 21E is a face view of a first electrical shield and set of first electrical contacts of the first electrical connector of Fig. 2A partially seated with a second electrical shield and corresponding set of second electrical contacts of the second electrical connector of Fig. 3;

[0061] Fig. 22A is a cross-sectional view of a first electrical shield and set of first electrical contacts of the first electrical connector of Fig. 2A fully seated with a second electrical shield and corresponding set of second electrical contacts of the second electrical connector of Fig. 3;

[0062] Fig. 22B is a cross-sectional view of a first electrical shield and set of first electrical contacts of the first electrical connector of Fig. 2A fully seated with a second electrical shield and corresponding set of second electrical contacts of the second electrical connector of Fig. 3;

[0063] Fig. 23A is a top perspective view of a first electrical shield and set of first electrical contacts of the first electrical connector of Fig. 2A fully seated with a second electrical shield and corresponding set of second electrical contacts of the second electrical connector of Fig. 3;

[0064] Fig. 23B is a bottom perspective view of a first electrical shield and set of first electrical contacts of the first electrical connector of Fig. 2A fully seated with a second electrical shield and corresponding set of second electrical contacts of the second electrical connector of Fig. 3;

[0065] Fig. 23C is a top view of a first electrical shield and set of first electrical contacts of the first electrical connector of Fig. 2A fully seated with a second electrical shield and corresponding set of second electrical contacts of the second electrical connector of Fig. 3;

[0066] Fig. 23D is a side view of a first electrical shield and set of first electrical contacts of the first electrical connector of Fig. 2A fully seated with a second electrical shield and corresponding set of second electrical contacts of the second electrical connector of Fig. 3;

[0067] Fig. 23E is a face view of a first electrical shield and set of first electrical contacts of the first electrical connector of Fig. 2A fully seated with a second electrical shield and corresponding set of second electrical contacts of the second electrical connector of Fig. 3;

[0068] Fig. 24 is a perspective view of the first electrical connector of Fig. 2A and the second electrical connector of Fig. 3 mated to each other, with a top portion of the first and second contact assemblies removed;

[0069] Fig. 25 is a cross-section view of the first electrical connector of Fig. 2A and the second electrical connector of Fig. 3 fully mated to one another;

[0070] Fig. 26 is a perspective view of the first electrical connector of Fig. 2A and the second electrical connector of Fig. 3 partially mated to one another;

[0071] Fig. 27 is a perspective view of the first electrical connector of Fig. 2A and the second electrical connector of Fig. 3 partially mated to one another, with respective shrouds and housings removed;

[0072] Fig. 28 is a perspective view of the first electrical connector of Fig. 2A and the second electrical connector of Fig. 3 partially seated to one another, with respective shrouds, housings, and top portions of the first and second contact assemblies, removed;

[0073] Fig. 29A is a perspective view of another embodiment of a first electrical connector and a second electrical connector fully seated to each other;

[0074] Fig. 29B is a perspective view of the first electrical connector and the second electrical connector of Fig. 29A partially mated to each other;

[0075] Fig. 30 is a perspective view of a mating interface of the first electrical connector of Fig. 29A;

[0076] Fig. 31 is a perspective view of a mating interface of the second electrical connector of Fig. 29A;

[0077] Fig. 32 is a perspective view of a first electrical shield including portions of metallic glass;

[0078] Fig. 33 is a perspective view of a second electrical shield including portions of metallic glass;

[0079] Fig. 34 is a side view of metallic glass having a compressive force applied; and

[0080] Fig. 35 is side view of metallic glass having a compressive force applied.

DETAILED DESCRIPTION

[0081] Referring to Fig. 1, a connector system 20 constructed in accordance with one embodiment includes at least one first electrical connector 22 and a complementary at least one second electrical connector 24. The electrical connector system 20 can further include at least one first substrate 26, such as a plurality of first substrates 26. The connector system 20 can further include at least one second substrate 28, such as a plurality of second substrates 28. The first and second substrates 26 and 28 can be, for example, printed circuit boards (PCBs). The second electrical connectors 24 can be configured to attach to respective ones of the second substrates 28. When the first electrical connectors 24 are attached to the first substrates, and the second electrical connectors 24 are attached to the second substrates, the first and second electrical connectors are configured to mate to each other such that the first substrates 26 are oriented along respective first planes, and the second substrates 28 are oriented along respective second planes. In Figs. 1A and 1B, the electrical connector system 20 is shown as an orthogonal connector system, and the first planes can be substantially orthogonal to the second planes. However, the electrical connector system 20 can also be a vertical connector system, where the first planes and the second planes are substantially parallel to each other, or a right-angle connector system, where the first planes and the second planes are substantially perpendicular to each other.

[0082] In one example, the electrical connector system 20 can include first arrays of first electrical connectors 22 that are each configured to be placed in electrical communication with a common one of the first substrates 26 (e.g., via attaching). Likewise, the electrical connector system 20 can include second arrays of second electrical connectors

24 that are each configured to be placed in electrical communication with a common one of the second substrates 28.

[0083] In an electrical connector system such as the electrical connector system 20, a mating force is applied to the arrays of first and second electrical connectors 22 and 24 so as to cause respective pairs of the electrical connectors 22 and 24 to mate with each other. However, the present inventors recognize that it is possible that the mating force will not be applied equally to each connector of the arrays. This while some of the respective pairs of first and second electrical connectors 22 and 24 may fully mate with each other such that the respective connector housings are fully seated against each other, other pairs of the first and second electrical connectors 22 and 24 may not. In other words, the mating force applied to the other pairs may not be sufficient to cause the respective connector housings to fully seat against each other. However, as will be described in more detail below, the electrical contacts and electrical shields of the first and second electrical connectors 22 and 24 are constructed to reliably physically and electrically contact each other even so as to mate the first and second electrical connectors 22 and 24 even when the respective connector housings are not fully seated against each other.

[0084] Referring to Figs. 2A-2E, the first electrical connector 22 can include a first connector housing 38 and a plurality of first electrical contacts 60 supported by the first connector housing 38. The first electrical connector 22 can further include a plurality of first electrical shields 56 supported by the first connector housing 38. The first electrical shields 56 provide electrical shielding to the first electrical contacts 60. As will be described in more detail below, each first electrical shield 56 can surround at least a portion of at least one first electrical contact 60 such as a pair of electrical contacts 60. A set of at least one electrical contact 60 and the electrical shield 56 surrounding the set of at least one electrical contact 60 can be referred to as a first electrical contact assembly 40. The set of at least one electrical contact 60 can include a single electrical contact 60 or a pair of electrical contacts 60, or any number of electrical contacts 60 as desired. The first connector housing 38 can include a first housing body 49 and a first outer shroud 37 (shown in Fig. 2C). In some examples, the first outer shroud 37 can be separate from the first housing body 49. For instance, the first outer shroud 37 can be electrically insulative, and can be made from any suitable plastic or other electrically insulative material. The first housing body 49 can be electrically conductive, and for example can be made of a metal. In other examples, the first outer shroud 37 can be

monolithic with the first housing body 49. The first housing body 49 can support the first electrical contact assembly 40, and the first outer shroud 37 can provide guidance when mating the first electrical connector 22 to the second electrical connector 24 in a predetermined relative orientation. The first electrical connector 22 can define a first mating interface 41 that engages a complementary second mating interface 43 of the second electrical connector 24 (see Fig. 3) when the first and second electrical connectors 22 and 24 are mated to each other. The first mating interface 41 can be for example, a distal or forward end of the first connector housing 38, which can be defined by either or both of the first housing body 49 and the shroud 37. The mating interface can be defined by a first mating surface. The first mating surface can further define a mating plane, which can be substantially perpendicular to a mating direction of the first electrical connector 22, where the mating direction can extend along the longitudinal direction L.

[0085] The first electrical connector 22 is configured to be mated with the second electrical connector in a mating direction, which can be oriented along the longitudinal direction L. The first electrical contact assemblies 40 can be arranged along respective rows that are oriented along a lateral direction A that is perpendicular to the longitudinal direction L. The rows can be adjacent each other along a transverse direction T that is perpendicular to each of the longitudinal direction L and the lateral direction A. The outer shroud 37 can be oriented in a plane defined by the transverse direction T and the lateral direction A. Further, the outer shroud 37 can surround a rear portion of the housing body 49, and can extend out from the housing body 49 in a rearward or unmate direction that is opposite the mating direction.

[0086] The housing body 49 can extend out from the outer shroud 37 in the mating direction, and can define the first mating interface 41 of the first electrical connector. In one example, the first electrical contact assemblies 40 can be recessed with respect to the front end of the housing body 49. It should be appreciated, on other examples, that the first electrical contact assemblies 40 can alternatively extend out from the front end of the housing body 49 in the mating direction. The first housing body 49, and thus the first connector housing 38, can define an inner frame oriented along a plane that includes the transverse direction T and the lateral direction A, thereby forming a cavity. The first housing body 49 can support the first electrical contact assemblies 40 in the first housing body cavity. Further,

the first housing body 49 can be dimensioned to be partially disposed in the cavity defined by the outer shroud 37.

[0087] As described above, the first electrical contact assemblies 40 can be arranged along respective rows that are oriented along a lateral direction A. In this regard, the first electrical connector can include a plurality of first contact array housings 51 that support respective arrays of the contact assemblies 40 so as to define a plurality of contact arrays 52 (shown in Fig. 2D and 2E). The arrays of the contact assemblies 40 can be linear arrays. The contact array housings 51 that can be oriented along the lateral direction A, and arrays of the first electrical contact assemblies 40 supported by respective ones of the contact array housings 51. The contact array housings 51 can be oriented along a row direction, which can be defined by the lateral direction A. Thus, the contact array housings 51 can be referred to as row assembly housings. In one example, the contact array housings 51 and the respective arrays of first electrical contact assemblies 40 can be referred to as first leadframes, and the contact array housings 51 can be referred to as first leadframe housings. Each contact array housing 51 can define a plurality of cavities spaced from each other along the lateral direction. Ones of the array of first electrical contact assemblies 40 can be supported by the respective contact array housing 51 in a corresponding one of the cavities. The first electrical connector 22 can include a plurality of first contact arrays 52 adjacent each other along the transverse direction T. However, one skilled in the art will understand that the first contact arrays 52 can include different configurations. For example, the first contact arrays 52 can instead be columnar, and thus can be oriented along the transverse direction T. In another example, the first contact arrays 52 can form a single block assembly including a single contact array housing 51, or multiple block arrays 52 including a plurality of housings 51 arranged in any manner as desired. In one example, the first electrical contact assemblies 40 can be recessed with respect to the front end of the contact array housings 51. It should be appreciated, on other examples, that the first electrical contact assemblies 40 can alternatively extend out from the front end of the respective contact array housings 51 in the mating direction as desired. The electrical contacts 60 can be stamped and formed, or can be deep drawn or machine screwed.

[0088] Each contact array housing 51 can be electrically conductive, such as metallic, as desired. Each contact array housing 51 can be in mechanical contact, and thus electrical contact, with the first electrical shields 56, thereby electrically commoning the first

electrical shields 56 of each contact array 52. Further, adjacent ones of the contact array housings 51 can be in mechanical contact, and thus electrical contact, with each other, thereby electrically commoning all first electrical shields 56 and all contact array housings 51 together. While the first electrical contact assemblies 40 are supported by the first connector housing 38 indirectly via the contact array housings 51 or other intermediate structure in one example, it should be appreciated that the first electrical contact assemblies 40 can alternatively be supported directly by the first connector housing 38 as desired.

[0089] With continuing reference to Figs. 2A-2E, the first electrical contacts 60 can be coupled, or configured to be coupled to, a first electrical cable 70. In particular, the first electrical cables can be mounted to respective ones or pairs of the first electrical contacts 60. The first electrical cable 70 can include at least one electrical wire conductor that can transfer electrical signals. When the first electrical cables 70 are configured as twinaxial cables, the first electrical cables 70 each includes two electrical wire conductors. When the first electrical cables 70 are configured as coaxial cables, the first electrical cables 70 each includes a single wire conductor. The at least one wire conductor can extend through an inner dielectric, which can be surrounded by an electrical shield, which in turn is surrounded by an outer dielectric jacket. Mounting portions of the electrical conductors of the first electrical cable 70 can be exposed, such as with respect to the inner dielectric, electrical shield, or outer jacket of the cable. A mounting portion of each of the first electrical contacts can be mounted to a respective mounting portion of the electrical conductor of the first electrical cables 70. The set of first electrical contacts 60 can be electrically conductive, and can be configured to transmit electrical signals between the first electrical cable 70 and the respective mating portions of the first electrical contacts 60 that mate with the second electrical contacts 62 of the second electrical connector 24.

[0090] Adjacent ones of the first electrical contacts 60 can define differential signal pairs. The mounting portions of the first electrical contacts 60 of the differential signal pairs can be mounted to the first and second electrical conductors of a respective one of the electrical cables 70. Further, the first electrical contacts 60 of each differential signal pair can be surrounded or at least partially surrounded by a respective one of the first electrical shields 56. Examples of the mounting portions of the set of first electrical connectors 60 can be seen in Figs. 7 and 8 (e.g., mounting portion 64b). Alternatively, the first electrical contacts 60 can be single-ended. Adjacent pairs of first electrical contacts 60 arranged along the lateral

direction A can be spaced from each other a center-to-center distance from 1.8 mm to 2.4 mm, such as 1.8 mm, 1.9 mm, 2.0 mm, 2.1 mm, and 2.2 mm, and ranges of 0.1 mm therebetween. Adjacent rows of electrical contacts 60 can be spaced from each other along the transverse direction T a center-to-center distance from 1.6 mm to 2.4 mm, including 1.6 mm, 1.7 mm, 1.8 mm, 1.9 mm, 2.0 mm, 2.1 mm, 2.2 mm, 2.3 mm, and 2.4 mm, and ranges of 0.1 mm therebetween.

[0091] Referring now to Fig. 3, the second electrical connector 24 can include a second connector housing 39 and a plurality of second electrical contacts 62 supported by the second connector housing 39. The second electrical connector 24 can further include a plurality of second electrical shields 58 that are supported by the second connector housing 39. The second electrical shields 58 provide electrical shielding to the second electrical contacts 62. As will be described in more detail below, each second electrical shield 58 can surround at least a portion of at least one of the second electrical contact 62 such as a pair of second electrical contacts 62. A set of at least one second electrical contact 62 and second electrical shield 58 surrounding the at least one second electrical contact 62 can be referred to as a second electrical contact assembly 42. The set of at least one second electrical contact 62 can be configured as a single second electrical contact 62, a pair of second electrical contacts 62, or any number of second electrical contacts 62 as desired. The second connector housing 39 can include a second housing body 57 and a second outer shroud 59. In some examples, the second outer shroud 59 can be monolithic with the second housing body 57. The second housing body 57 can support the second electrical contact assembly 42, and the second outer shroud 59 can provide guidance when mating the second electrical connector 24 to the first electrical connector 22. The second connector housing 39 can define a second mating interface 43 that engages the complementary first mating interface 41 of the first electrical connector 22 (see Fig. 2A) when the first and second electrical connectors 22 and 24 are mated to each other. The second mating interface 43 can be, for example, a distal end of the second housing 39, and can be defined by a second mating surface. The second mating surface can further define a second mating plane, which can be substantially perpendicular to a mating direction of the second electrical connector 24, where the mating direction can be defined by the longitudinal direction L.

[0092] The second electrical connector 24 is configured to be mated with the first electrical connector 22 in a respective mating direction, which can be oriented along the

longitudinal direction L. The second electrical contact assemblies 42 can be arranged along respective rows that are oriented along a lateral direction A that is perpendicular to the longitudinal direction L. The rows can be adjacent each other along a transverse direction T that is perpendicular to each of the longitudinal direction L and the lateral direction A. The second outer shroud 59 can be oriented in a plane defined by the transverse direction T and the lateral direction A. Further, the second outer shroud 59 can extend forward in the mating direction from the housing body 49. The second outer shroud 59, and thus the second connector housing 39, can surround respective mating portions of the second electrical contact assemblies 42, which can be cantilevered in some examples.

[0093] As described above, the second electrical contact assemblies 42 can be arranged along respective rows that are oriented along a lateral direction A. In this regard, the second electrical connector 24 can include a plurality of second contact arrays 54 including a plurality of contact array housings 61 and respective ones of the second electrical contact assemblies 44 supported by each of the contact array housings 61. The arrays of the contact assemblies 44 can be linear arrays. The contact array housings 61 can be oriented along the lateral direction A. In one example, the second contact array housings 61 and the respective arrays of second electrical contact assemblies 42 can be referred to as second leadframes, and the second contact array housings 61 can be referred to as leadframe housings. Each second contact array housing 61 can define a plurality of cavities spaced from each other along the lateral direction A. Ones of the array of first electrical contact assemblies 42 can be supported by the respective contact array housing 61 in a corresponding one of the cavities. The second electrical connector 24 can include a plurality of second contact arrays 54 adjacent each other along the transverse direction T. However, one skilled in the art will understand that the second contact arrays 54 can include different configurations. For example, the second contact arrays 54 can instead be columnar, and thus can be oriented along the transverse direction T. In another example, the second contact arrays 54 can form a single block assembly including a single hosing 61, or multiple block assemblies including a plurality of housing 61 arranged in any manner as desired. Each contact array housing 61 can be electrically conductive, such as metallic, as desired. Each contact array housing 61 can be in mechanical contact, and thus electrical contact, with the second electrical shields 58, thereby electrically commoning the second electrical shields 58 of each second electrical contact array 54. Further, adjacent ones of the contact array

housings 61 can be in mechanical contact, and thus electrical contact, with each other, thereby electrically commoning all second electrical shields 58 and all second contact array housings 61 together. A first electrical contact assembly 40 can be disposed in each cavity formed by a first contact array 52. The cavities of the first contact arrays 52 can extend along the longitudinal (L) direction. A first contact assembly 40 can include a set of at least one first electrical contact 60, a first electrical shield 56, and a first dielectric sleeve 66 that supports the at least one first electrical contact 60. In some cases, the first contact assembly 40 can include a mounting portion of an electrical cable 70.

[0094] Referring now to Figs. 2A-4, the first and second electrical connectors can be mated to each other, so as to cause the first electrical contacts 60 to mate with respective ones of the second electrical contacts 62. In particular, when the first and second electrical connectors 22 and 24 are mated to each other, mating portions of the first electrical contacts 60 physically contact respective mating portions of the second electrical contacts 62. Further, as will be described in more detail below, the first electrical shields 56 contact respective ones of the second electrical shields 58, thereby providing electrical shielding of both the mating portions of the first electrical contacts 60, the mating portions of the second electrical contacts 62, and respective interfaces at mating locations of the first and second electrical contacts 60 and 62. As shown in Fig. 4, the first and second electrical connectors 22 and 24 can mate until they are fully seated. Thus, the respective first and second connector housings 38 and 39 can abut each other. As will be described in more detail below, each of the first and second electrical connectors 22 and 24 can be configured to mate with each other even when the first and second connectors 22 and 24 are not fully seated.

[0095] The first and second connectors 22 and 24 can be keyed to only mate with each other in a predetermined orientation relative to each other. In particular, one of the first and second electrical connectors 22 and 24 can include a protrusion, and the other of the first and second electrical connectors 22 and 24 can define a recess configured to receive the protrusion only when the first and second electrical connectors 22 and 24 are in the predetermined orientation. In one example, the first connector housing 38, and in particular the housing body 49 (see Fig. 2A) can include a projection 44 that extends along the mating direction. Likewise, the second electrical connector 24 can define a recess 46 sized to receive the projection 44 when the first electrical connector 22 mates with the second electrical connector 24 when the first and second electrical connectors 22 and 24 are in the

predetermined orientation. The projection 44 interferes with the second connector housing 39 to prevent the first and second electrical connectors 22 and 24 from mating with each other when the first and second electrical connectors 22 and 24 are not in the predetermined relative orientation. The first electrical connector 22 and the second electrical connector 24 can define other key features for limiting mating orientations between the respective electrical connectors. For example, as shown in Figs. 7 and 8, the electrical connectors can define a second projection 48 and a second recess 50.

[0096] Fig. 5 shows the first and second electrical connectors of Fig. 4 with the first and second housings 38 and 39, and the outer shroud 37 removed, thereby showing the first and second contact arrays 52 and 54. The first contact array 52 can be disposed internal to the first housing 38, such that the first housing 38 surrounds the first contact arrays 52. Further, the first connector housing 38 can support the first contact arrays 52. The first contact array housings 51 can further define the first mating interface 41. The first contact array housings 51 can be electrically conductive. Similarly, the second contact array 54 can be disposed internal to the second housing 39, such that the second housing 39 surrounds the second contact arrays 54. Further, the second connector housing 39 can support the second contact arrays 54. The second contact housings 61 can further define the second mating interface 43. The second contact housings 61 can be electrically conductive. In one example, when the first and second electrical connectors 22 and 24 are fully seated with one another, the mating interface of the first contact array housing 51 can contact the mating interface of the second contact array housing 61.

[0097] Referring now to Figs. 6-8, the first contact array housings 51 can define a plurality of channels 63 that are elongate along the longitudinal direction. The first contact assemblies 40 can be disposed in respective ones of the channels 63. Fig. 6 depicts one of the first contact assemblies 40 disposed within a respective channel 63 of one of the first contact array housings 51. A top half of the first contact array housing 51 in Fig. 6 is removed, thereby providing a view of disposed components along the mating direction. Fig. 7 depicts the first contact assembly 40 disposed within a cavity of the first contact array 52, but with a sleeve 66 shown removed. Fig. 8 depicts a first contact assembly 40 disposed within a cavity of the first contact array 52, with the sleeve 66 and the first electrical shield 56 shown removed to better illustrate the mounting portions of the first electrical contacts 60 shown coupled to the first electrical cables 70.

[0098] In one example, each of the channels 63 can be configured to house a respective one of the first electrical shields 56. The first electrical shields 56 can be elongate along the longitudinal direction L. For instance, the first electrical shields can surround a respective central axis that is oriented along the longitudinal direction L The first electrical shields 56 can be supported by the first contact array housings 51 in respective ones of the channels 63. For instance, the first electrical shields 56 can be directly supported by, and thus can contact, the first contact array housings 51 in respective ones of the channels 63. The first electrical shield 56 can be electrically conductive. The first electrical shield 56 can surround, or partially surround, at least one first electrical contact 60 such as a pair of first electrical contacts 60 as described above. In particular, the first electrical shield 56 can extend along the longitudinal direction L, and can define a cavity that also extends along the longitudinal direction L. At least a portion of the electrical contacts 60 can be disposed within the cavity of the first electrical shield 56. Otherwise stated, the first electrical shields 56 can surround at least a portion of an overall length of the electrical contacts 60. For example, the first electrical contacts 60 can extend a length along the longitudinal direction L, which is greater than the length of the first electrical shield 56 along the longitudinal direction L. Thus, the first electrical contacts 60 can extend out from the first electrical shields 56, in particular in a rearward direction that is opposite the mating direction of the first electrical connector 22.

[0099] With continuing reference to Figs. 6-8, the first electrical contacts 60 can be surrounded by respective ones of the first electrical shields 56. As shown at Fig. 6, each first contact array 52 can include a first dielectric sleeve 66 supported in the first array housing 51 The at least one electrical contact 60 of each contact assembly 40 can be supported by the first dielectric sleeve 66, which in turn is supported in one of the channels 63 of the first array housing 51. Each first dielectric sleeve 66 can be elongate along the longitudinal direction L and can surround a portion of the first electrical contacts 60 of the respective first contact array 40. For example, the dielectric sleeve 66 can extend along the longitudinal direction L between the first electrical shield 56 and the mounting portions of the first electrical contacts 60. Thus, the first dielectric sleeve 66 can be exposed from the first electrical shield 56. In some cases, the first electrical shield 56 and the first dielectric sleeve 66 can overlap, such that a portion of the first electrical shield 56 surrounds, or partially surrounds, a portion of the first dielectric sleeve 66. The first dielectric sleeve 66 can be insert molded over the first

electrical contacts 60 in one example. In another example, the first electrical contacts 60 can be stitched into the first dielectric sleeves 66. The mounting portions of the first electrical contacts 60 can extend out form the first dielectric sleeve 66 so as to be placed in physical and electrical contact with respective ones of the electrical conductors of the first electrical cables 70.

[00100] In some examples, such as shown in Figs. 6-8, the electrical contacts 60 of each first electrical contact assembly 40 can include a male contact and female contact. The male contacts can have mating portions 68a that are configured to be received in complementary mating portions of the second electrical connector 24. The female contacts have mating portions 68b that are configured to receive complementary mating portions of the second electrical connector. In one example, the mating portions 68a of the male contacts can be configured as pins, and the mating portions 68b of the female contacts can define receptacles configured as sockets that receive respective ones of the pins. Thus, in this example, a pair of first electrical contacts 60 can be configured to mate to a corresponding pair of firs electrical contacts. Respective ones of the pair of first electrical contacts 60 can define a pin and socket at their respective mating ends, and respective ones of the pair of second electrical contacts can define a socket and pin. In one example, the pairs can define differential signal pairs. The sockets of the first and second pairs are configured to receive the pins of the first and second pairs. It should therefore be appreciated that the electrical connector can include first and second contact types that are alternatingly arranged. For instance, they can be alternatingly arranged along the lateral direction A. The first contact type can have mating ends defined by pins that are configured to be received in corresponding sockets of a mated electrical connector, and the second contact types can have mating ends defined by sockets configured to receive respective pins of a mated electrical connector. As is appreciated from the description herein, at least one or more up to all of the pairs of first and second contact types can be at least partially surrounded by an electrical shield. In some examples, the electrical shield can be configured as any electrical shield described herein, but any suitable electrical shield is envisioned.

[00101] In some cases, the mating portions 68a and 68b can be disposed within the cavity of the first contact array 52, such that the corresponding second set of electrical contacts 62 are disposed within the first electrical shield 56 when partially seated and fully seated. As shown, the mating portions of the electrical contacts do not extend beyond the

respective first electrical shields 56 in the mating direction. For instance, the mating portions of the electrical contacts 60 can be recessed with respect to the front ends of the respective first electrical shields 56 in the rearward direction of the first electrical connector 22.

[00102] The first electrical shields 56 surround respective sets of first electrical contacts 60, but the individual ones of the set of first electrical contacts 60 are not individually shielded by individual dedicated shields.

[00103] Figs. 9A-9E show various perspective views of a first electrical contact 60a of the set of first electrical contacts 60 of the electrical contact assembly 40. The electrical contact 60a can define a mounting portion 64a and the mating portion 68a opposite the mounting portion 64a. The mating portion 68a can be configured to be mated with a mating portion of a corresponding electrical contact. For example, the first electrical contact 60a can be a male electrical contact. The mating portion 68a of the electrical contact 60a can be configured to be inserted into a corresponding female contact so as to mate the electrical contacts. In some cases, the electrical contact 60a can be formed from a sheet of metal, such as by stamping or lasing. The mating portion 68a can then be crimped or rolled to form a cylindrical, or post, end (along the mating direction). The mounting portion 64a can be configured to contact a first electrical conductor of an electrical cable. The mounting portion 64 can be crimped, soldered, or can otherwise contact the exposed wire conductor of the electrical cable.

[00104] Figs. 10A-10E show various perspective views of a second electrical contact 60b of the set of first electrical contacts 60 of the electrical contact assembly 40. The second electrical contact 60b can define a mounting portion 64b and a mating portion 68b opposite the mounting portion 64b. The electrical contact 60b can be configured to mate with a mating portion of a corresponding electrical contact. For example, the electrical contact 60b can be a female electrical contact. The mating portion 68b of the electrical contact 60b can be configured to receive a corresponding male contact so as to mate the electrical contacts. In some examples, the electrical contact 60b can be formed from a sheet of metal, such as by stamping or lasing. The mating portion 68b can then be crimped or rolled to form a cylindrical, or receptacle, end (along the mating direction). The mating portion 68b can also define one or more tapered fingers72 that extend forward from a body of the electrical contact 60b that extends from the mating portion 68b to the mounting portion 64b. At least a portion of the tapered fingers 72 can be tapered toward each other and the longitudinal axis of

the mating portion 68b as they extend in the forward mating direction, and thus away from the respective mounting 64b. In some examples, the free distal end 74 of the tapered fingers 72 can flare away from the longitudinal axis of the electrical contact 60b. The flaring can guide a mating portion of a complementary electrical contact to enter the cavity formed by the mating portion 68b. The tapered fingers 72 can apply a normal force against the received mating portion of the complementary electrical contact. Thus, even if a mating portion of the corresponding electrical contact is not fully seated, and is instead partially seated, with the second electrical contact 60b, the electrical contacts can still be in electronic communication with one another due to the contact with the tapered fingers 72. The female second electrical contacts 62 can include any number of fingers 72 as desired. In one example, the female second electrical contacts 62 can include three fingers 72 spaced circumferentially 120 degrees apart.

[00105] The second mounting portion 64b can be configured to contact the second electrical conductor of the electrical cable. The mounting portion 64b can be crimped, soldered, or can otherwise contact the exposed wire conductor of the electrical cable. The first and second electrical contacts 60a and 60b can alternatively be included in separate electrical contact assemblies 40, each configured to be mounted to respective electrical conductors of different coaxial cables. The mating portions 68a-68b and the mounting portions 64a-64b can be opposite each other along the longitudinal direction L, such that the first electrical connector 22 is configured as a vertical connector. Alternatively, the first electrical connector 22 can be configured as a right-angle connector whereby the mating portions 68a-68b are oriented perpendicular with respect to the mounting portions 64a-64b.

[00106] The mating portions of the male and female electrical contacts of the first electrical contacts 60 can terminate at respective ends that are coplanar with each other along a plane that is oriented perpendicular to the central axes of the respective electrical contacts, when the fingers defined by the female contacts are straightened to extend only along the longitudinal direction L. Thus, in one example, the mating portions of the male and female electrical contacts of the first electrical contacts 60 can terminate at respective ends that are coplanar with each other along a plane that is oriented perpendicular to the central axes of the respective electrical contacts when the fingers defined by the female contacts are straightened to extend only along the longitudinal direction L.

[00107] Fig. 11A-11C show different views of the first electrical shield 56. The first electrical shield 56, in some cases, can have a first shield body that is generally cylindrical in shape, and can be elongate along a central axis that is oriented along the longitudinal direction L. The first electrical shield 56 can be annular so as to define a channel or partial channel along the longitudinal direction L. The first electrical shield 56 can be formed of a single sheet of material, such as a sheet of electrically conductive material, which can be rolled or wrapped to form the cylindrical shape shown in Fig. 11A-11C. In some cases, there can be a gap defined between adjacent terminal circumferential edges 76 and 78 of the first electrical shield 56. The gap, if it exists, can be oriented along the longitudinal direction L. Thus, the first electrical shield 56, in some cases, can partially form a channel. In some other cases, the first electrical shield 56 can be circumferentially continuous, such that the adjacent edges 76 and 78 and the gap therebetween are not present. This can be accomplished, in some cases, by rolling the sheet of electrical material to contact the adjacent edges 76 and 78, and/or to couple the adjacent edges 76 and 78 via soldering, welding, and the like. Whether the gap exists or not, the first electrical shield 56 can be said to surround or substantially surround the set of first electrical contacts 60. Thus, a path that extends along the first electrical shield 56 can extend around an entirety of the set of first electrical contacts 60. In some examples, the edges 76 and 78 can prevent the path from extending entirely around the set of first electrical contacts. In such an example, the path can extend between 85% and 100%, such as between 90% and 100%, such as between 95% and 100% of a path that extends around an entirety of the set of first electrical contacts.

[00108] The first electrical shield 56 can further define one or more tabs 80. The tabs 80 can extend into the channel formed by the first electrical shield 56. The tabs 80 can each extend from a respective first location 82 of the first shield body to a free second end 84 opposite the first location. The second end 84 can be disposed within the channel defined by the first shield body. In some cases, the tabs 80 can be monolithic with the first shield body. Alternatively, the tabs 80 can be coupled to the first shield body of the first electrical shield 56.

[00109] The tabs 80 can be flexible along the radial direction of the first electrical shield 56. The radial direction can be oriented perpendicular to the central axis of the first shield body. For example, the tabs 80 can be biased to extend into the channel of the first electrical shield 56. Thus, the tabs 80 can extend into the channel when in a first state.

During operation when a complementary electrical shield of a corresponding electrical connector is received in the channel, the tabs 80 can ride along a surface, such as an outer surface, of the complementary shield, which can cause the tabs 80 flex radially outward toward the first shield body of the first electrical shield 56 and away from the central longitudinal axis of the first electrical shield 56.

[00110] For example, the second electrical shield 58 of the second electrical connector 24 (see Fig. 3) can be configured to be inserted in the first electrical shield 56 when the first electrical connector 22 is mated with the second electrical connector 24. The second electrical shield 58 can translate through the channel of the first electrical shield 56 along the longitudinal direction L. As the second electrical shield 58 is inserted into the first electrical shield 56, the second electrical shield 58 can be brought into contact with respective contact surfaces of the tabs 80, which can cause the second end 84 of at least one of the tabs 80 to deflect towards the first shield body of the first electrical shield 56 (e.g., away from the central longitudinal axis of the first electrical shield 56). Because the tabs 80 are resiliently flexible, deflection of the tabs 80 causes the tabs 80 to apply a force against the second electrical shield 58, thereby maintaining contact between the first and second electrical shields 56 and 58. Because the first and second electrical shields 56 and 58 are electrically conductive, the first and second electrical shields can be in electronic communication with each other when the first and second electrical connectors 22 and 24 are mated to each other. Components of the second electrical connector 24, including the second electrical shield 58 and the second set of electrical contacts 62, will be described in more detail below. When the tabs 80 deflect outwardly, an inner diameter of the first electrical shield defied by the tabs 80 expands, while an outer cross-sectional dimension defined by the first shield body remains constant. In this regard, as shown in Fig. 6, the shield body can be captured in the channel of the contact array housing 51 and thus prevented from expanding. Accordingly, it can be said that the tabs 80 deflect outwardly while the size and shape of the shield body remains constant.

[00111] In some examples, the tabs 80 can include a middle portion 86 that extends from the first shield body to the second end. The middle portions 86 extend radially inward toward the central longitudinal axis of the first electrical shield 56 as they extend in the rearward direction opposite the mating direction of the first electrical connector 22. Thus, the middle portions 86 can extend in a combination of radial and longitudinal directions of the

first electrical shield 56. The contact surface can be defined by the second end 84, and can extend substantially along the longitudinal direction L. Thus, that the second end 84 can define a non-perpendicular angle with respect to the middle portion 86. The contact surface of the second end 84 can be substantially planar or planar in a plane that is defined by the longitudinal direction L and the lateral direction A. Alternatively, the contact surface of the second end 84 can be oriented along the longitudinal direction L, and can be concave as it extends along the lateral direction A. In one example, a midline of the contact surface can be configured to contact the second electrical shield 58. The midline can extend along the contact surface along longitudinal direction L, and can bisect the contact surface with respect to the lateral direction A. While the contact surfaces can be defined by the ends 84 of the tabs in one example, it should be appreciated that the contact surfaces can alternatively be defined at any location along the respective lengths of the tabs.

[00112] In some examples, the middle portion 86 can include a first arm 88a and a second arm 88b that is spaced from the first arm. The first and second arms 88a and 88b can originate from respective first and second locations 82a and 82b of the first shield body. The first and second locations 82a and 82b can be spaced from each other, for instance circumferentially. The term circumferential applies herein both to cylindrical shapes and to non-cylindrical shapes, and refers to a direction in a plane that is oriented perpendicular to the central longitudinal axis of the first electrical shield 56. The first arm 88a and the second arm 88b can converge toward each other as they extend from the respective first and second locations 82a and 82b to the second end 84, such that the first arm 88a and the second arm 88b terminate at the second end 84.

[00113] In some cases, the first electrical shield 56 can include a plurality of tabs 80 that extend along the longitudinal direction of the first electrical shield 56. The tabs 80 can be arranged in a plurality of circumferentially spaced columns, whereby the tabs 80 of each column are spaced from each other along the longitudinal direction L. For example, the first electrical shield 56 can define respective planes along the first shield body of the first electrical shield 56 that extends in the longitudinal direction and tangential or coextensive with any location along the first shield body of the first electrical shield. The first electrical shield 56 can include a plurality of tabs 80 spaced longitudinally from each other along the planes so as to define the columns. For example, Fig. 11C shows columns of tabs 80 spaced from each other along the longitudinal direction L.

[00114] In some cases, the tabs 80 of each of the columns of tabs 80 can be partially nested within each other. For example, Fig.11B shows a top view of a plurality of tabs 80 disposed along the longitudinal direction of the first electrical shield 62. The plurality of tabs 80 can include a first tab 80a and a second tab 80b that is immediately adjacent the first tab 80a, such that no tabs are disposed between the first and second tabs 80a and 80b with respect to the longitudinal direction L. As shown, respective footprints of the first and second tabs 80a and 80b can overlap each other along a direction that is perpendicular to the central longitudinal axis of the first electrical shield 56. Further, the second ends 84 of the first and second tabs 80a and 80b can be aligned with each other along the longitudinal direction L. Thus, at least two, such as at least three, such as at least four, such as at least five of the aligned second ends 84 can lie on a common line. The common line can be oriented along the longitudinal direction L. In some examples, the second end 84 of the first tab 80a can be aligned with the middle portion of the second tab 80b along the longitudinal direction L. Further, as seen in Fig. 11B, the contact surfaces of the second ends 84 of the plurality of tabs 80 can be coplanar with each other. In some examples, the second ends 84 of the tabs 80 can all be oriented in the same direction. Further, in some examples, the tabs 80 including the second ends can be identical to each other.

[00115] In some examples, the first electrical shield 56 can also define one or more apertures 92. The apertures 92 can be defined by void space previously occupied by material of the first electrical shield 56 that defines the tabs 80. For example, as shown in Fig. 11B, each aperture 92 can define the first and second arms and second end of the first tab 80a. Likewise, the tabs 80 can be formed from the first shield body of the first electrical shield 56, and thus can define an aperture 93 when the respective tab 80 extends into the channel. For example, a tab 80 can be formed, in part, by stamping the first shield body of the first electrical shield 56, and thus the tab 80 can be stamped and formed from the material of the first shield body. This can further facilitate the actuation of the tab 80 when deflected away from the longitudinal axis of the first electrical shield 56, such as when the tab 80 contacts the second electrical shield 56 as the second electrical shield 56 is received in the channel of the first electrical shield 56. The electrical contacts 62 can be stamped and formed, or can be deep drawn or machine screwed.

[00116] In some examples, the tabs 80 of all of the columns 81 can be aligned with each other in respective planes that are oriented perpendicular to the longitudinal direction L.

In some cases, the columns of tabs 80 can be circumferentially spaced from each other. For example, Fig. 11A shows a first group of tabs 81a that define a first column of tabs, and a second group of tabs 81b that define a second column of tabs. The first group of tabs 81a can include one or more tabs 80 that are circumferentially coplanar with each other, such as the tabs 80 shown in Fig. 11B or 11C (the group of tabs 81 of Fig. 11C). Likewise, the second group of tabs 81b can include on or more tabs 80 that are circumferentially coplanar with each other. The first group of tabs 81a and the second group of tabs 81b can be circumferentially spaced from each other. Thus, in some cases, when the second electrical shield 58 is received in the first electrical shield 56 in the rearward direction of the first electrical connector 22, the second electrical shield 58 can contact at least a first tab of the first group of tabs 81a, and a first tab of a second group of tabs 81b. In one example, the second electrical shield 58 can contact at least a first tab of all groups or columns of tabs 80. The first electrical shield 56 can include any number of columns of tabs 81 as desired that can be circumferentially spaced from each other. Thus, the column of tabs 81 can be spaced from each other in a plane that is oriented perpendicular to the longitudinal direction L The first electrical shield 56 can include any number of columns of tabs as desired, including one column, two columns, three columns, and four columns.

[00117] While Fig. 11A shows four groups or columns of tabs 81, where each group is spaced circumferentially apart equidistantly with respect to adjacent groups of tabs, one skilled in the art will understand that variations in the number of groups of tabs can be implemented with the first electrical shield 56. For example, the first electrical shield 56 can include a single group of tabs 81. In another example, the first electrical shield 56 can include two groups of tabs 81 (e.g., spaced 180 degrees apart). In another example, the first electrical shield 56 can define three groups of tabs (e.g., spaced 120 degree apart). In another example, the first electrical shield 56 can define five groups of tabs 80, and so forth.

[00118] Likewise, while Fig. 11B shows five tabs 80 as part of a group of tabs 81, one skilled in the art will understand that a number of tabs within each group can vary. For example, a group of tabs can include one tab, two tabs, three tabs, four tabs, five tabs, six tabs, seven tabs, eight tabs, nine tabs, ten tabs, and so forth. Further, the number of tabs can be the same for each group, or can vary across groups of tabs. For example, a first group of tabs can include three tabs, whereas a second group of tabs can include five tabs, and the like.

The tabs and the second electrical shield 58 can thus contact each other at locations spaced about the mating portions of the surrounded first and second electrical contacts when mated.

[00119] As will be described in more detail below, more tabs can contact the second electrical shield 58 when the first and second connectors 22 and 24 are mated and fully seated with each other compared to when the first and second electrical connectors 22 and 24 are mated and partially seated. For instance, all of the tabs can contact the second electrical shield when the first and second connectors 22 and 24 are mated to each other and fully seated. At least one tab of each column, such as two tabs of each column, or any number less than all of the tabs of each column can contact the second electrical shield when the first and second connectors 22 and 24 are mated with each other but partially seated. When partially seated, the first and second connectors 22 and 24 can be responsive to additional mating forces that can bring the connectors 22 and 24 toward each other. However, as described above, it is contemplated in some examples that the first and second connectors 22 and 24 do not receive a mating force sufficient to cause the first and second electrical connectors 22 and 24 to become fully seated.

[00120] In some cases, in lieu of tabs formed or defined by the first electrical shield 56, or in addition to the tabs, the first electrical shield 56 can be formed of metallic glass, or can be attached to metallic glass at opposed ends of the metallic glass. The first electrical shield 56 can be configured to receive the second electrical shield 58, and the shape of the first electrical shield 56 can conform to the shape of the inserted second electrical shield 58 so as to contact the second electrical shield about the mating portions of the surrounded first and second electrical contacts when mated to each other. An electrical connector can include a ground shield or plate or plane or trace or electrical conductor that is either formed of metallic or attached to metallic glass. The ground shield or plate or plane or trace or electrical conductor can be formed of metallic glass or can be attached to metallic glass such that when the shield or plate or plane or trace or electrical conductor is compressed, the metallic glass defines undulations that define physical contact surfaces of the first electrical shield 56 that contact the second electrical shield 58 in the manner described above with respect to the tabs 80. It is appreciated that increasing compressive forces applied to the metallic glass can correspondingly increase the number of undulations and resulting contact surfaces of the first shield. Thus, a radially inner surface of the first electrical shield 56 can be defined by metallic glass.

[00121] Referring to Fig. 32, the first electrical shield 56 can include one or more portions of metallic glass disposed or defining an outer surface of the first electrical shield 56, which can be a radially outer surface. In some cases, each portion of metallic glass can extend along the longitudinal direction of the first electrical shield 56. Each portion of metallic glass can be spaced circumferentially apart from other respective portions of metallic glass. For example, Fig. 32 shows the first electrical shield 56 having three portions of metallic glass 302a, 302b, and 302c, that extend along the longitudinal direction and are circumferentially spaced from each other. However, one skilled in the art will understand that any number of portions of metallic glass can be disposed or define the outer surface of the first electrical shield 56, including one, two three, four, five, six, seven, eight, nine, ten, etc. Additionally, one skilled in the art will understand the dimensions of the portion of metallic glass can also vary, for example the dimension of the portion of metallic glass extending along the circumferential direction of the first electrical shield 56 can vary. Without being bound by theory, a segment of metallic glass can be fixed at both opposed ends, such as fixed to an electrical ground or an electrical reference or an electrically grounded shield. A fixation distance between the opposed ends of the metallic glass can be less than a length of the segment of metallic glass. This arrangement can create slack or play, or an arc defined by the segment of metallic glass. The metallic glass can have room to compress without also expanding in length or overall length. Alternatively, the segment or portion of metallic glass 302a can be attached to an electrical ground or an electrical reference or an electrically grounded shield by one edge. This can form a type of seal or wipe between two mating objects, one of which carries or defines the portion of metallic glass 302a.

[00122] During operation, when the second electrical shield 58 is inserted into the first electrical shield 56, the second electrical shield 58, can apply a compressive force against the metallic glass of the first electrical shield 56, thereby causing the metallic glass of the first electrical shield 56 to define the undulations. shown in Figs. 34 and 35. Fig. 34 shows the portion of metallic glass 302a with a number of undulations caused by applying a first compressive force to the metallic glass. Fig. 35 shows a greater number of undulations of the portion of metallic glass 302a, which can be caused by applying a second compressive force that is greater than the first compressive force applied to the portion of metallic glass 302a. The undulations can define contact surfaces of the first electrical shield 56 that contact the second electrical shield. For example, the segment or portion of metallic glass 302a can

initially contact another article or structure at only a small number of physical contact points, such as one physical contact point. The number of physical contact points can increase as a function of force and a lessening separation distance between the article that carries the portion of metallic glass 302a and the compression article. Stated another way, a portion of metallic glass 302a can be attached to or be carried by any one or more of an electrical ground, an electrical ground conductor, an electrical reference, an electrically grounded trace, and an electrically grounded shield. The portion of metallic glass 302a can initially physically contact another article at any one of only one physical point of contact at a first force, a first separation distance between the article (such as an electrical ground) and a the corresponding compression article, or both. At a second force greater than the first force or at a second separation distance that is less than the first separation distance, the portion of metallic glass 302a can physically contact another article with at least two physical points of contact, at least three physical points of contact, at least four physical points of contact, at least five physical points of contact, at least six physical points of contact, at least seven physical points of contact, at least eight physical points of contact, and/or more than eight physical points of contact. Without being bound by theory, it is believed that even though unplated metallic glass or unplated amorphous metal is not as electrically conductive as copper or silver or gold. An example of a metallic glass or amorphous metal is VITRELOY 105, which can contain 52.5 percent zirconium, 5 percent titanium, 5 percent copper, 14.6 percent copper, 10 aluminum. Other compounds with greater electrical conductivity can also be used, such as more copper laden metallic glass or amorphous metal, as VITERLOY 105 has electrical conductivity below copper, silver or gold. However, zirconium metallic glass or amorphous metal can be well-suited for electrical grounding applications due to its high elastic yielding. Instead of taking a permanent set, it creates more and more ground paths as it is deflected and constrained.

[00123] Alternatively or additionally, the second electrical shield 58 can be made from metallic glass or can be attached to metallic glass for instance at opposed ends of the metallic glass. Thus, the radially outer surface of the second electrical shield can be defined by metallic glass. The second electrical shield 58 can define an annulus. As the second electrical shield is radially compressed (i.e., along a plane that is oriented perpendicular to the longitudinal direction L), the outer wall of the second electrical shield 58 can become increasingly undulated, which correspondingly increases a number of outer contact surfaces

of the second electrical shield 58 that contact the radially inner surface of the first electrical shield 56 when the first and second electrical shields 56 and 58 mate with each other. Thus, the first and second complementary electrical shields 56 and 58 can be in physical contact with each other at the contact regions, in the manner described above with respect to the tabs 80. However, because the second electrical shield 58 define the contact surfaces, the first electrical shield 56 can be substantially tubular and sized to fit over the second electrical shield so that it applies a radially compressive force to the second electrical shield 58, thereby defining the contact regions.

[00124] Referring to Fig. 33, the second electrical shield 58 can include one or more portions of metallic glass disposed or defining an outer surface, which can be a radially outer surface, of the second electrical shield 58. In some cases, each portion of metallic glass can extend along the longitudinal direction of the second electrical shield 58. Each portion of metallic glass can be spaced circumferentially apart from other respective portions of metallic glass. For example, Fig. 33 shows the first electrical shield having three portions of metallic glass 302d, 302e, and 302f, that extend along the longitudinal direction and are circumferentially spaced from each other. However, one skilled in the art will understand that any number of portions of metallic glass can be disposed or define the outer surface of the second electrical shield 58, including one, two three, four, five, six, seven, eight, nine, ten, etc. Additionally, one skilled in the art will understand the dimensions of the portion of metallic glass can also vary, for example the dimension of the portion of metallic glass extending along the circumferential direction of the second electrical shield 58 can vary. When the second electrical shield 58 is inserted into the first electrical shield 56, the first electrical shield 56 can apply the compressive force to the second electrical shield 58, which is applied to the one or more portions of metallic glass of the second electrical shield 58 thereby causing the second electrical shield 58 to define the undulations that define the contact surfaces of the second electrical shield 58 with the first electrical shield 56. An electrical connector or transceiver cage can include one or more of an electrically conductive housing and an electrically non-conductive housing. An electrical ground or electrical reference that includes or is formed from or carries an amorphous metal or amorphous metal alloy or a metallic glass can be carried by one or more of the electrical connector, the transceiver cage, the electrical ground, the electrical reference, and a ground plane of a printed circuit board. The amorphous metal or amorphous metal alloy or metallic glass can

be a portion of metallic glass 302d, 302e, 302f that is physically attached, electrically connected or both to the one or more of the electrical ground or electrical reference. The amorphous metal or amorphous metal alloy or metallic glass, such as a portion of metallic glass 302d, 302e, 302f, can be attached to the electrical ground or electrical reference at one end, at both opposed ends or along at least one edge. The amorphous metal or amorphous metal alloy or metallic glass, such as the portion of metallic glass 302d, 302e, 302f, can be compressible or compressed without changing an overall physical length of the respective portion of metallic glass 302d, 302e, 302f. The amorphous metal or amorphous metal alloy or metallic glass, such as the portion of metallic glass 302d, 302e, 302f, can be compressible or compressed without changing an overall physical length of the respective portion of metallic glass 302d, 302e, 302f and simultaneously forming a plurality of physical points of contacts, such as any one or more of greater than one, two, greater than two, three, greater than three, four, greater than four, five, greater than five, six, greater than six, seven, greater than seven, eight, and greater than eight.

[00125] With respect to transceiver cages, it is appreciated that transceiver cage can have an opening at its inner end that is sized to receive an electrical connector, that is mounted to the underlying substrate, as the cage is mounted to the underlying substrate. Thus, when the cage is mounted to the substrate, a gap can exist between the connector and the transceiver cage. It is recognized that metallic glass can at least partially fill or substantially completely fill or otherwise be disposed in the gap. For instance, the metallic glass can be disposed at one or more up to all of the substrate, the transceiver cage, and the electrical connector housing. The compression of the transceiver cage onto the underlying substrate (which can be a printed circuit board), can be applied to the metallic glass and cause the metallic glass to at least partially seal the gap and provide electrical shielding. Further still, the cage can be inserted through an opening in a panel. The metallic glass can at least partially fill or substantially completely fill or otherwise be disposed in a panel gap between the panel and the cage. Either or both of the panel and the transceiver cage can include metallic glass, such that when the transceiver is inserted into the opening of the panel, the metallic glass is compressed in the gap between the panel and the cage, which can cause the metallic glass to at least partially seal the gap and provide electrical shielding.

[00126] Referring again to Figs. 6-8, the first electrical shield 56 can be supported by the first array housing 51. The first array housing 51 can be electrically conductive as

described above, and the first electrical shield 56 can be electrically conductive. Thus, the first array housing 51 and the first electrical shield 56 can be said to be in electrical communication with each other. Likewise, the set of first electrical contacts 60 can be mounted to a wire conductor of a first electrical cable 70. The set of first electrical contacts 60 can be supported by the dielectric sleeve 66 that, in turn, is supported by the first contact array housing 51. As the wire conductor can be electrically conductive, and the set of first electrical contacts 60 can be electrically conductive, the wire conductor(s) of the first electrical cable 70 and the respective ones of the set of first electrical contacts 60 can be said to be in electrical communication with each other. Further, a portion of the set of first electrical contact 60 can be disposed within the channel defined by the first electrical shield 56. However, the set of first electrical contacts 60, and the wire conductor(s) of the first electrical cable 70, can be physically spaced from the first electrical shield 56 and the first contact array 52. Thus, the set of first electrical contacts 60 and the wire conductor(s) of the first electrical cable 70 can be said to be electrically isolated from the first electrical shield 56 and the first contact array 52.

[00127] The second electrical connector 22 will now be further described with reference to Figs. 12-13B. The second electrical connector 24 can include the second connector housing 39, which can define a frame that is oriented along the transverse direction T and the lateral direction A, thereby forming cavity which the internal components of the second electrical connector 24 can be disposed. The second connector housing 39 can be electrically insulative, and can be composed of, for example, plastic. The second housing 39 can support other internal components of the second electrical connector 24. As described above with respect to Fig. 3, the second connector housing 39 can support a plurality of second electrical contact assemblies 42. In particular, the second electrical connector 22 can include a plurality of second contact arrays 54 that include a plurality of second contact array housings 61 and arrays of second contact assemblies 42 supported in respective ones of the second contact array housings 61.

[00128] The second connector housing 39 can also support a plurality of second electrical cables 94 that extends through the housing 39 so as to be mounted to respective second electrical contacts 62. The electrical cables 94 can be configured as twinaxial cables, or can be configured as coaxial cables as described above with respect to the first electrical connector 22. Adjacent ones of the second electrical contacts 62 along the lateral direction A

can define differential signal pairs. Alternatively, the second electrical contacts 62 can be single-ended. Alternatively, the first electrical contacts 60 can be single-ended. Adjacent pairs of second electrical contacts 62 arranged along the lateral direction A can be spaced from each other a center-to-center distance from 1.8 mm to 2.4 mm, such as 1.8 mm, 1.9 mm, 2.0 mm, 2.1 mm, and 2.2 mm, and ranges of 0.1 mm therebetween. Adjacent rows of electrical contacts 62 can be spaced from each other along the transverse direction T a center-to-center distance from 1.6 mm to 2.4 mm, including 1.6 mm, 1.7 mm, 1.8 mm, 1.9 mm, 2.0 mm, 2.1 mm, 2.2 mm, 2.3 mm, and 2.4 mm, and ranges of 0.1 mm therebetween.

[00129] Fig. 14 depicts a second contact assembly 42 disposed within a cavity of the second contact array 54. The top half of the second contact array 54 in Fig. 14 is removed, thereby providing a view of disposed components along the mating direction. Fig. 15 depicts a second contact assembly 42 disposed within a cavity of the second contact array 54, with the second electrical shield 58 removed. Fig. 16 depicts a second contact assembly 42 disposed within a cavity of the second contact array 54, with the second electrical shield 58 and second dielectric sleeve 96 removed.

[00130] The plurality of second contact arrays 54 can be supported by the second connector housing 39. The second contact arrays can be dimensioned such that the second contact array housings 61 can be oriented and elongate in rows along the lateral direction A. The second contact array housing 61 can define a plurality of channels that are elongate along the longitudinal direction L. A number of second contact arrays 54 can be stacked in the transverse direction. However, one skilled in the art will understand that the second contact arrays 54 can include different configurations. For example, the second contact arrays 54 can instead be columnar, and thus oriented in columns along the transverse direction T. In another example, the second contact arrays 54 can form a single block assembly, or multiple block assemblies. Further, the second contact array housings 61 can be electrically conductive, and can be composed of, for example, a metal.

[00131] A respective one of the second contact assemblies 42 can be disposed in each channel formed by a second contact array housing 61. The channels of the second contact array housings 61 can be oriented along the longitudinal direction L. Each second contact assembly 42 can include a set of at least one second electrical contact 62, a second electrical shield 58, and a second dielectric sleeve 96 that supports the at least one second electrical contact 62.

[00132] Each channel of the second contact array housing 61 can house and retain a respective one of the second electrical shields 58. The second electrical shield 58 can be oriented along the longitudinal direction L. The second electrical shield 58 can be electrically conductive. The second electrical shield 58 can surround, or partially surround the set of at least one of the second electrical contacts 62, which can be configured as a pair of the second electrical contacts 62. In particular, the second electrical shield 58 can surround or partially surround the at least one of the second electrical contacts 62 in a plane that is perpendicular to the longitudinal direction L, which includes the mating direction of the second electrical connector 24. The second electrical contacts 62 can extend along the mating direction, and can be electrically conductive.

[00133] The second electrical shield 58 can surround, or partially surround, a set of second electrical contacts 62 so as to provide electrical shielding to the second electrical contacts 62. The second electrical shield 58 can extend along a central longitudinal axis that is oriented along the longitudinal direction L, and can define a cavity that also extends along the longitudinal direction L. The second set of electrical contacts 62 can be at least partially disposed within the cavity formed by the second electrical shield 58. For example, the set of second electrical contacts 62 can have a length along the longitudinal direction L that is greater than the length of the second electrical shield 58. Thus, the set of second electrical contacts 62 can extend out of the cavity of the second electrical shield 58.

[00134] The second contact array housing 61 can define at least one channel such as a plurality of channels that extend along the longitudinal direction L. Each channel can support a respective second electrical contact assembly 42. Thus, each channel can support a second electrical shield 58. The second electrical shield 58 can be oriented along the longitudinal direction L. The second electrical shield 58 can be electrically conductive. The second electrical shield 58 can surround, or partially surround, the set of second electrical contacts 62 that can be supported in the channel of the second contact array housing 61. The second electrical contacts 62 can extend along the longitudinal direction L, and can be electrically conductive.

[00135] The set of second electrical contacts 62 can be coupled, or configured to be coupled to, a second electrical cable 94. The second electrical cable 94 can include wire conductors that can transfer electrical signals. In some cases, the second electrical cable 94 can have different physical dimensions compared to the first electrical cable 70. For

example, the second electrical cable 94 can be a larger-gauged electrical cable compared to the first electrical cable 70. The electrical cables 70 and 94 can be sized as desired. For instance, the first electrical cables 70 can have a wire gauge from 26 to 34, such as 27. In another example, the wire gauge of the first electrical cables 70 can be 33. Similarly, the second electrical cables 94 can have a wire gauge from 26 to 34, such as 27. In another example, the wire gauge of the second electrical cables 94 can be 33. Thus, in one specific example, the wire gauge of the first electrical cables 70 can be 27 and the wire gauge of the second electrical cables 94 can be 33. In another specific example, the wire gauge of the first electrical cables 70 can be 33 and the wire gauge of the second electrical cables 94 can be 27. In one example, one end of the electrical cables 70 can be mounted to the first electrical contacts 60 as described above. The other end of the electrical cables 70 can be mounted to or adjacent a substrate, such as a PCB, having an integrated circuit such as an application-specific integrated circuit mounted thereto. Similarly, in one example, one end of the electrical cables 94 can be mounted to the second electrical contacts 62 as described above. The other end of the electrical cables 94 can be mounted to or adjacent a substrate, such as a PCB, having an integrated circuit such as an application-specific integrated circuit mounted thereto.

[00136] Mounting portions of the first electrical cable 94 can be exposed, such as with respect to insulation or exterior wrapping of the cable. A mounting portion of each of the set of second electrical contacts 62 can be mounted to a respective mounting portion of the second electrical cable 94. For example, as shown in Fig. 16, the second electrical cable 94 can be a coaxial cable having two wire conductors. Thus, each of the two wire conductors can be mounted to a respective second electrical contacts 62. Examples of the mounting portions of the set of second electrical connectors 62 can be seen in Fig. 16.

[00137] The channel of the second contact array housing 61 can also support a second dielectric sleeve 96 that, in turn, supports the at least one second electrical contact 62 of the second set. The second dielectric sleeve 96 can extend along the longitudinal direction L. The set of second electrical contacts 62 can extend through the second dielectric sleeve and out of the second dielectric sleeve 96 in the mating direction and into the cavity defined by the second electrical shield 58. The set of second electrical contacts 62 can extend from the second dielectric sleeve 96 in the rearward direction so as to mount to respective ones of the second electrical cables. Thus, the second dielectric sleeve 96 can be disposed between

the second electrical shield 58 and the mounting portions of the second electrical contacts 62. Thus, a portion of the second dielectric sleeve 96 can be spaced from the second electrical shield 58 along the rearward direction. In some cases, the second electrical shield 58 and the second dielectric sleeve 96 can overlap, such that a portion of the second electrical shield 58 surrounds, or partially surrounds, a portion of the second dielectric sleeve 96. In some cases, the second dielectric sleeve 96 can be, in its entirety, disposed within the second electrical shield 58. The second dielectric sleeve 96 can be insert molded over the respective set of second electrical contacts 62. Alternatively, the set of second electrical contacts can be stitched into the second dielectric sleeve 96. In some examples, the second connector array housings 61 can define an aperture 98. The aperture 98 can receive legs of a clip 99 that supports the second dielectric sleeve 96. For instance, the second dielectric sleeve 96 can extend through the clip 99. The clip 99 can be disposed adjacent the second electrical shield 58. In some examples, the clip 99 can abut the rear and of the second electrical shield 58.

[00138] The set of second electrical contacts 62 can be electrically conductive, and can be configured to transmit electrical signals between the second electrical cable 94 and respective mating portions. The set of second electrical contacts 62 have mounting portions 100a and 100b that are configured to physically and electrically contact respective electrical wire conductors of the second electrical cables 94, and mating portions 100a and 100b that are configured to mate with respective mating portions of the first electrical contacts 60 of the first electrical connector 22. In some cases, such as shown in Figs. 14-16, the set of second electrical contacts 62 can include male and female contacts. The male contacts have mating portions configured to be inserted into female mating portions of the first electrical contacts 60. The female contact have mating portions configured to receive mating portions of male electrical contacts of the first electrical connector 22. The mating portions of the male electrical contacts can be configured as posts, and the mating portions of the female electrical contacts can be configured as receptacles. Likewise, in this example, the set of second electrical contacts 62 can be configured to mate to corresponding receptacle and post contacts of a set of the first electrical contacts 60 of the first electrical connector 22. In some cases, the mating portions 102a, 102b can be exposed from the cavity of the second contact array 54, such that the second set of electrical contacts 62 are disposed within the first electrical shield 56 when partially seated and fully seated. Further, the mating portions 102a, 102b can extend, along the mating direction, and away from the second contact array 54. For example,

the mating portions 102a, 102b can be cantilevered from the second dielectric sleeve 96, and in turn cantilevered from the second contact array 54. This can allow for the mating portions 102a, 102b to enter the corresponding first electrical shield 56 when the first and second electrical connectors 22, 24 are partially or fully seated. As shown, the mating portions of the electrical contacts 62 do not extend beyond the respective second electrical shields 58 in the mating direction. For instance, the mating portions of the electrical contacts 62 can be recessed with respect to the front ends of the respective second electrical shields 58 in the rearward direction of the second electrical connector 24. The second electrical shields 58 can be solid along an entirety of their respective lengths, whereas the first electrical shields 56 can be porous. The second electrical shields 58 can be deep drawn. The electrically conductive components described herein can be metal, or plastic coated with an electrically conductive material such as metal. The second electrical shields surround respective sets of second electrical contacts 62, but the individual ones of the set of electrical contacts 62 are not individually shielded by individual dedicated shields.

[00139] It should be appreciated that when the first and second electrical connectors 22 and 24 are unmated, the first electrical shields 56 surround the mating portions of respective sets of first electrical contacts 60 (see Figs. 6-8), and the second electrical shields 58 surround the mating portions of respective sets of second electrical contacts 62 (see Figs. 14-16). When the first and second electrical connectors 22 and 24 are mated, the first electrical shields 56 surround the mating portions of respective sets of the second electrical contacts 62 that mate with the first electrical contacts 60 that are surrounded by the respective first electrical shields 56. Similarly, when the first and second electrical connectors 22 and 24 are mated, the second electrical shields 58 surround the mating portions of respective sets of the first electrical contacts 60 that mate with the second electrical contacts 62 that are surrounded by the respective second electrical shields 58.

[00140] Figs. 17A-17E show various perspective views of an electrical contact 62a of the set of second electrical contacts 62. The electrical contact 62a can define a mounting portion 100a and a mating portion 102a. The electrical contact 62a can be configured to mate with a mating portion of a corresponding electrical contact. For example, the electrical contact 62a can be a female electrical contact. The mating portion 102a of the electrical contact 62a can be configured to receive a corresponding male contact, such as the mating portion 68a of an electrical contact 60a of the set of first electrical contacts 60. In some

cases, the electrical contact 62a can be formed from a sheet of metal, such as by stamping or lasing. The mating portion 102a can then be crimped or rolled to form a cylindrical, or receptacle, end (along the mating direction). The mating portion 102a can also define one or more tapered fingers 104. The tapered fingers 104 can extend along the length of the electrical contact 62a. The width of a tapered finger 104 can taper distally away from the respective mounting portion 100a. Further, the tapered fingers 104 can be biased to angle inwards towards the longitudinal axis of the electrical contact 62a. In some cases, the distal end 106 of a tapered finger can flare away from the longitudinal axis of the electrical contact 62a. The flaring can allow for a mating portion of a corresponding electrical contact to enter the cavity formed by the mating portion 102a, whereas the biased angling of the tapered fingers 104 can allow for contact between the inserted, corresponding electrical contact and the mating portion at least at the distal end 74 of the mating portion 68b. Thus, even if a mating portion of the corresponding electrical contact is not fully seated, and is instead partially seated, with the second electrical contact 62a, the electrical contacts can still be in electrical communication with one another due to the contact with the tapered fingers 104.

[00141] The mounting portion 64b of the second electrical contact 60b can likewise be crimped to adjust the height of the mounting portion 64b with respect to the mating portion 68b. The mating portion 68a can then be mounted to the exposed wire conductor of an electrical cable, such as by soldering or crimping.

[00142] Figs. 18A-18E show various perspective views of an electrical contact 62b of the set of second electrical contacts 62. The electrical contact 62b can define a mounting portion 100b and a mating portion 102b. The mating portion 102b can be configured to be mated with a mating portion of a corresponding electrical contact. For example, the electrical contact 62b can be a male electrical contact. The mating portion 102b of the electrical contact 62b can be configured to be inserted into a corresponding female contact, such as the electrical contact 60b of the set of first electrical contacts 60 of the first electrical connector 22. In some cases, the electrical contact 62b can be formed from a sheet of metal, such as by punching or lasing. The mating portion 102b can then be crimped or rolled to form a cylindrical, or post, end (along the mating direction). The mounting portion 100b can likewise be crimped to adjust the height of the mounting portion 100b with respect to the mating portion 102b. The mating portion 102b can then be mounted to the exposed wire conductor of an electrical cable, such as by soldering or crimping.

[00143] The mating portions of the male and female electrical contacts of the second electrical contacts 62 can terminate at respective ends that are coplanar with each other along a plane that is oriented perpendicular to the central axes of the respective electrical contacts, when the fingers defined by the female contacts are straightened to extend only along the longitudinal direction L. Thus, in one example, the mating portions of the male and female electrical contacts of the second electrical contacts 62 can terminate at respective ends that are coplanar with each other along a plane that is oriented perpendicular to the central axes of the respective electrical contacts when the fingers defined by the female contacts are straightened to extend only along the longitudinal direction L.

[00144] Figs. 19A-19E show various perspective views of the second electrical shield 58. The second electrical shield 58 can, in some cases, be generally cylindrical in shape, extending along the mating direction of the second electrical connector 24. The second electrical shield 58 can thus define a channel or partial channel along the longitudinal direction of the second electrical shield 58. The second electrical shield 58 can be formed of a single sheet of material, such as a sheet of electrically conductive material, which can be rolled or wrapped to form the cylindrical shape shown in Figs. 19A-19E.

[00145] The second electrical shield 58 can be dimensioned such that the second electrical shield 58 can be inserted into the first electrical shield 56 along the mating directions. For example, the first electrical shield 56 can define a channel along the mating direction of the first electrical connector 22. The channel can include a diameter that is approximate to, or approximately larger than, an outer diameter of the second electrical shield 58.

[00146] The second electrical shield 58 can define a mating portion 108 and a mounting portion 110. The mating portion 108 can be configured to be inserted into a corresponding first electrical shield 56. In some cases, the mating portion 108 can be beveled, and curved towards the longitudinal axis of the second electrical shield 58. In some cases, the mounting portion 110 can be flanged. In some cases, the second contact array 54 can define a circumferential ridge perpendicular to the mating direction of the second connector 24, where the flanged mounting portion 110 can be disposed.

[00147] The second electrical shield 58 can be configured for the set of second electrical contacts 62 to be partially disposed within the channel of the second electrical shield 58. For example, turning back to Fig. 14, the set of second electrical contacts 62 can be

disposed within the channel of the second electrical shield 58, such that mating portions 102 of the set of second electrical contacts 62 are disposed approximate to the mating portion 108 of the second electrical shield 58. In some cases, the mating portions 102 of the set of second electrical contacts 62 can remain within the channel of the second electrical shield 58.

[00148] Turning back to Fig. 14, the second electrical shield 58 can be supported by the second contact array 54. As the second contact array 54 can be electrically conductive, and the second electrical shield 58 can be electrically conductive, the second contact array 54 and the second electrical shield 58 can be said to be in electrical communication with each other. Likewise, the set of second electrical contacts 62 can be mounted to a wire conductor of a second electrical cable 94. The set of second electrical contacts 62 can be supported by the second dielectric sleeve 96. As the wire conductor can be electrically conductive, and the set of second electrical contacts 62 can be electrically conductive, the wire conductor(s) of the second electrical cable 94 and the set of second electrical contacts 62 can be said to be in electrical communication with each other. Further, a portion of the set of second electrical contacts 62 can be disposed within the channel defined by the second electrical shield 58. However, the set of second electrical contacts 62, and the wire conductor(s) of the second electrical cable 94, can be physically isolated from the second electrical shield 58 and the second contact array 54. Thus, the set of second electrical contacts 62 and the wire conductor(s) of the second electrical cable 94 can be said to be electrically isolated from the second electrical shield 58 and the second contact array 54.

[00149] The first electrical connector 22 can be configured to mate to the second electrical connector 24. For example, the first mating interface 41 of the first electrical connector 22 can be configured to mate to the second mating interface 43 of the second connector 24. The first mating interface 41 can define a first mating plane, and the second mating interface 43 can define a second mating plane. The mating planes can be perpendicular to the mating direction of the corresponding electrical connector 22, 24. Thus, when mating or mated, the mating planes can be parallel with one another.

[00150] When mating, a second electrical shield 58 of the second electrical connector 24 can insert into a channel of a corresponding first electrical shield 56. The first electrical shield 56 can include one or more tabs 80 that extend inward towards the longitudinal axis of the first electrical shield 56. The second electrical shield 58, while

entering the first electrical shield 56, can contact the one or more tabs 80 of the first electrical shield 56.

[00151] Figs. 20A-20E show examples where the second electrical shield 58 is partially inserted into the first electrical shield 56. In this example, the first electrical shield 56 can include at least three groups of tabs 81a, 81b, and 81c. The second electrical shield 58 can contact first tabs of the respective groups of tabs, then second tabs of the respective groups of tabs, and so forth, as the second electrical shield continues to be inserted into the first electrical shield 56. In some cases, the mating portion 108 of the second electrical shield 58 can be beveled, which can facilitate the flexing of a tab 80 away from the longitudinal axis when in contact with the mating portion 108. The tabs 80 in contact with the second electrical shield 58 can flex away from the longitudinal axis of the first electrical shield 56, and can remain in contact with the second electrical shield 58 as the second electrical shield 58 continues to be inserted into the first electrical shield 56. Other tabs 80 that are not in contact with the second electrical shield 58 can remain extended into the channel of the first electrical shield 56.

[00152] Likewise, the set of first electrical contacts 60 and the set of second electrical contacts 62 can be partially seated, or fully seated, when the second electrical shield is inserted into the first electrical shield 56. For example, the set of first electrical contacts 60 can include a male electrical contact and a female contact. The set of second electrical contacts 62 can include a female electrical contact configured to mate to the male electrical contact of the first set of electrical contacts 60, and a male electrical contact configured to mate to the female electrical contact of the set of first electrical contacts 60. When the second electrical shield 58 is inserted into the first electrical shield 56, the set of first electrical contacts 60 can likewise mate to the set of second electrical contacts 62.

[00153] In some cases, the set of first electrical contacts 60 and the set of second electrical contacts can be positioned such that they are fully seated. For example, the set of first electrical contacts 60 can be fully seated with respect to the set of second set of electrical contacts 62 such that, when mated, the set of first electrical contacts cannot travel further along the mating direction with respect to the set of second electrical contacts 62. To continue the example with respect to male and female electrical contacts, for fully seated, a female electrical contact cannot receive any additional portion of the mating portion of the respective male electrical contact. Likewise, for a male electrical contact, for fully seated, the mating

portion of the male electrical contact cannot be further received by the mating portion of the respective female electrical contact.

[00154] In some cases, for fully seated, a portion of mating portion of an electrical contact can be mated to a respective corresponding electrical contact. For example, 10 percent, 20 percent, 30 percent, 40 percent, 50 percent, 60 percent, 70 percent, 80 percent, 90 percent, and the like, of a length of the mating portion of an electrical contact can be mated to a corresponding electrical contact, can result in fully seated electrical contact. In other cases, for fully seated, a portion of an electrical contact can be mated to a respective corresponding electrical contact. For example, 10 percent, 20 percent, 30 percent, 40 percent, 50 percent, 60 percent, 70 percent, 80 percent, 90 percent, and the like, of a length of an electrical contact can be mated to a corresponding electrical contact, which can result in fully seated electrical contact.

[00155] In some cases, fully seated can be in relation to the insertion or mating of the second electrical shield 58 to the first electrical shield 56. For example, for fully seated, a portion of the first electrical shield 56 can receive the second electrical shield 58. For example, 10 percent, 20 percent, 30 percent, 40 percent, 50 percent, 60 percent, 70 percent, 80 percent, 90 percent, and the like, of a length of the first electrical shield 56 can receive the second electrical shield 58. In another example, for fully seated, a portion of the second electrical shield 58 can be inserted into the first electrical shield 56. For example, 10 percent, 20 percent, 30 percent, 40 percent, 50 percent, 60 percent, 70 percent, 80 percent, 90 percent, and the like, of a length of the second electrical shield 58 can be inserted into the first electrical shield 56. It is further appreciated that when the first and second electrical connectors 22 and 24 are fully seated, the first and second shields 56 and 58 do not abut or contact each other so as to prevent further movement of the first and second electrical connectors 22 and 24 in their respective mating directions.

[00156] It is recognized that when the first and second electrical connectors 22 and 24 are mated and partially seated, the tabs 80 extend into the channel defined by the first shield body of the first electrical shield 56, thereby providing better impedance control with respect to an example where the channel of the first shield body of the first electrical shield 56 included only air. When the tabs 80 extend into the channel of the first shield body of the first electrical shield 56, the tabs 80 add metal to the channel.

[00157] In some cases, the first electrical shield 56 can be fully seated with the second electrical shield when the first and second electrical connectors 22 and 24 are mated and fully seated. When the first electrical shield is fully seated, all of the tabs 80 of the first electrical shield 56 can physically contact the second electrical shield 58. When the first and second electrical connectors 22 and 24 are partially seated (see Figs. 20A-20E), a some of the tabs 80 less than all of the tabs of the first electrical shield 56 can be in physical contact with the second electrical shield 58 in some examples. Thus, some of the tabs 80 are removed from physical contact with the second electrical shield 58. For instance, at least one of the tabs 80 of the first electrical shield 56 can be removed from contact with the second electrical shield 58. In other examples, at least two of the tabs 80 of the first electrical shield 56 can be removed from contact with the second electrical shield 58. In still other examples, at least one less than all of the tabs 80 of each of the columns 81 (see Figs. 11A-C) can be removed from contact with the second electrical shield 58. For instance, at least two less than all of the tabs 80 of each of the columns 81 can be removed from contact with the second electrical shield 58. For instance, at least three less than all of the tabs 80 of each of the columns 81 can be removed from contact with the second electrical shield 58. For instance, at least four less than all of the tabs 80 of each of the columns 81 can be removed from contact with the second electrical shield 58.

[00158] As the first and second electrical connectors 22 and 24 become increasingly unshielded but still mated, the first and second electrical shields 56 and 58 can become correspondingly increasingly unseated, whereby an increasing number of the tabs 80 less than all of the tabs 80 are removed from physical contact with the second electrical shield 58. When the first and second shields are partially seated, 10 percent, 20 percent, 30 percent, 40 percent, 50 percent, 60 percent, 70 percent, 80 percent, 90 percent, and the like, of the number of tabs 80 of the first electrical shield can be in physical contact with the second electrical shield 58. In some examples, wherein the first and second shields 56 and 58 are fully seated, all of the tabs 80 of the first electrical shield 56 can be in contact with the second electrical shield 58. Figs. 21A-21E and 22A-22B show examples of a first electrical shield 56, and corresponding set of first electrical contacts 60 being fully seated with a second electrical shield 58 and set of second electrical contacts 62.

[00159] Referring now to Figs. 20A-20E and 23A-23E, and as described above, the first and second electrical connectors can be partially unseated but mated to each other,

whereby at least a portion of mating portion of an electrical contact of the first electrical connector can be mated to a respective corresponding electrical contact. For example, when the first and second electrical connectors are mated but unseated, 10 percent, 20 percent, 30 percent, 40 percent, 50 percent, 60 percent, 70 percent, 80 percent, 90 percent, and percentage ranges therebetween, of a length of the mating portion of an electrical contact can be mated to a corresponding electrical contact, can result in a partially seated electrical contact. In other cases, for partially seated, a portion of an electrical contact can be mated to a respective corresponding electrical contact. Thus, it can also be said that the electrical contacts can likewise be referred to as partially seated but still mated.

[00160] Both when the electrical connectors 22 and 24 are partially seated and fully seated, the first electrical shield 56 can surround overlapped regions of the mating portions of the mated set of electrical contacts along an entirety of the lengths of the overlapped regions along the longitudinal direction L. In this regard, it is appreciated that when a female mating portion receives a male mating portion along the longitudinal direction L, the mating portions overlap each other with respect to a plane that is perpendicular to the longitudinal direction L, thereby defining the overlapped region. Similarly, both when the electrical connectors 22 and 24 are partially seated and fully seated, the second electrical shield 58 can surround the overlapped regions of the mating portions of the mated set of electrical contacts along an entirety of the lengths of the overlapped regions along the longitudinal direction L.

[00161] In some cases, partially seated can be in relation to the insertion or mating of the second electrical shield 58 to the first electrical shield 56. For example, for partially seated, a portion of the first electrical shield 56 can receive the second electrical shield 58. For example, 10 percent, 20 percent, 30 percent, 40 percent, 50 percent, 60 percent, 70 percent, 80 percent, 90 percent, and the like, of a length of the first electrical shield 56 can receive the second electrical shield 58. In another example, for partially seated, a portion of the second electrical shield 58 can be inserted into the first electrical shield 56. For example, 10 percent, 20 percent, 30 percent, 40 percent, 50 percent, 60 percent, 70 percent, 80 percent, 90 percent, and the like, of a length of the second electrical shield 58 can be inserted into the first electrical shield 56.

[00162] In some cases, partially seated can be in relation to a number of tabs 80 of the first electrical shield 56 the second electrical shield 58 contacts when inserted. The number of tabs can be a portion of the tabs of the first electrical shield. For example, for fully

seated, 10 percent, 20 percent, 30 percent, 40 percent, 50 percent, 60 percent, 70 percent, 80 percent, 90 percent, and the like, of the number of tabs 80 of the first electrical shield can be in contact with the second electrical shield 58. In some cases, for partially seated, a minimum number of tabs 80 of the first electrical shield 56 can be in contact with the second electrical shield 58. In one example, such as that shown in Fig. 20A, partially seated can be where the second electrical shield 58 contacts two tabs of a group of tabs 81. Continuing this example, the first electrical shield can include groups of tabs 81, where each group can include five tabs 80. For partially seated, the second electrical shield 58 can be inserted into the first electrical shield 56 sufficiently enough to contact two tabs 81 for a group of tabs 81.

[00163] In some cases, partially seated can be in relation to a relative distance between the mating interface of the first electrical connector 22 and the mating interface of the second electrical connector. For example, when fully seated, no gap may exist between the respective interfaces (e.g., along the mating direction). For partially seated connectors, a gap from 1 mm to 5 mm can exist between the mating interface of the first electrical connector 22 and the mating interface of the second electrical connector 24, such as of 1 mm, 1.1 mm, 1.2 mm, 1.3 mm, 1.4 mm, 1.5 mm, 1.6 mm, 1.7 mm, 1.8 mm, 1.9 mm, 2.0 mm, 2.1 mm, 2.2 mm, 2.3 mm, 2.4 mm, 2.5 mm, 2.6 mm, 2.7 mm, 2.8 mm, 2.9 mm, 3.0 mm, 3.1 mm, 3.2 mm, 3.3 mm, 3.4 mm, 3.5 mm, 3.6 mm, 3.7 mm, 3.8 mm, 3.9 mm, 4.0 mm, 4.1 mm, 4.2 mm, 4.3 mm, 4.4 mm, 4.5 mm, 4.6 mm, 4.7 mm, 4.8 mm, 4.9 mm, 5.0 mm and the like.

[00164] When a first electrical shield 56 is fully seated with a second electrical shield 58, and/or a set of first electrical contacts 62 are fully seated with a set of second electrical contacts 62, the components of the first electrical connector 22 and the second electrical connector 24 can facilitate a mitigation of crosstalk interference. For example, when fully seated, the set of first electrical contacts 60 can be in electrical communication with the set of second electrical contacts 62. Likewise, as the set of first electrical contacts 62 are mounted to a first electrical cable 70, and the set of second electrical contacts 62 can be mounted to a second electrical cable 94, it can be said that the first electrical cable 70 and the second electrical cable 94 are in electrical communication with each other.

[00165] Further, when the first electrical shield 56 is fully seated with the second electrical shield 58, the first electrical shield 56 and the second electrical shield 58 can mitigate the crosstalk interference experienced by the set of first electrical contacts 60 and the set of second electrical contacts 62. For example, the first electrical shield 56 can be in

electrical communication with the second electrical shield 58. Additionally, the first electrical shield 56 can be electrical communication with the first contact array 52, and the second contact assembly can be in electrical communication with the second contact array 54, the first and second contact assembly can be in electrical communication with each other. This can create a grounding effect between the first and second electrical shields 56 and 58, which can minimize crosstalk interference experienced by the set of first and second electrical contacts 60 and 62. For example, the set of first and second electrical contacts 60, 62, when fully seated, can experience no worse than: -80 dB, -79 dB, -78 dB, -77 dB, -76 dB, -75 dB, -74 dB, -73 dB, -72 dB, -71 dB, -70 dB, -69 dB, -68 dB, -67 dB, -66 dB, -65 dB, -64dB, -63 dB, -62dB, -61dB, -60dB and the like of crosstalk interference levels when transmitting signals at data transfer speeds of 224 gigabits/second at frequencies up to 80 GHz, for instance up to 60 GHz, for instance up to 56 GHz, such as up to 50 GHz, both when the electrical connectors 22 and 24 are fully seated and mated, and when the electrical connectors 22 and 24 are partially seated and mated.

[00166] When the first electrical shield 56 is partially seated with the second electrical shield 58, the first electrical shield 56 and the second electrical shield 58 can mitigate the crosstalk interference experienced by the sets of first and second electrical contacts 60 and 62, such that the levels of crosstalk interference levels experienced by the set of first and second electrical contacts 60 and 62 when partially seated substantially approximate the crosstalk interference levels of the sets of first and second electrical contact 60 and 62 when fully seated. For example, the crosstalk interference levels experienced by the sets of first and second electrical contacts 60 and 62 can be 5 percent, 10 percent, 15 percent, 20 percent, 25 percent and the like, within the crosstalk interference levels experienced wen the sets of first and second electrical contacts 60 and 62 are fully seated.

[00167] The first and second electrical connectors 22 and 24 can each include a plurality of sets of first and second electrical contacts 60 and 62, respectively. For example, turning back to Fig. 2A, the first electrical connector 22 can define a plurality of rows of sets of first electrical contacts 60, and a plurality of columns of sets of first electrical contacts 60. Likewise, as shown in Fig. 12, the second electrical connector 24 can define a plurality of rows of sets of second electrical contacts 62, and a plurality of columns of sets of second electrical contacts 62. Each set of second of second electrical contacts 62 can be configured to mate to a respective set of first electrical contacts 60 of the first electrical connector 22.

Additionally, each set of the first electrical contacts 60 can be surrounded, or partially surrounded by a first electrical shield 56, and each set of the second electrical contacts 62 can be surrounded by, or partially surrounded by, a second electrical shield 58. Fig. 24 shows a row of electrical contacts of a first electrical connector being fully seated with a row of electrical contacts of a second electrical connector. Fig. 25 shows a cross sectional view of a first electrical connector 22 being fully seated to a second electrical connector 24 (e.g., showing a column of sets of first and second electrical contacts and first and second electrical shields.

[00168] The mitigation of crosstalk interference by the electrical connectors described herein can be beneficial in situations where the electrical connectors are partially seated to one another. For example, returning to Fig. 1, a row of first electrical connectors 22 can be mounted to a first substrate 26, such as along an edge of the first substrate 26. A row of second electrical connectors 24 can be mounted to a second substrate 28, such as along an edge of the second substrate 28. There may be situations where the first or second substrate becomes warped, such as due to thermal degradation. In this type of situation, some of the first and second electrical connectors 22 and 24 can be fully seated, whereas other first and second electrical connectors 22 and 24 can be partially seated. For example, in some cases the first and second electrical connectors mounted closer to the center of an edge of a substrate can be partially seated, while first and second electrical connectors further away from the center of a substrate edge can be fully seated. The electrical connectors that are partially seated can still maintain a level of crosstalk interference for the respective electrical contacts as electrical connectors that are fully seated. Fig. 26 shows partially seated electrical connectors. Fig. 27 shows partially seated electrical connectors, where the housings of the electrical connectors are removed. Fig. 28 shows partially seated electrical connectors with the housing and contact assembly removed.

[00169] Additionally, there may be situations where some electrical contacts of a particular electrical connector that are fully seated, and other electrical contacts that are partially seated (e.g., in cases where the mating interface of an electrical connector is warped). The electrical connectors that are partially seated can still maintain a level of crosstalk interference for the respective electrical contacts as electrical connectors that are fully seated.

[00170] One skilled in the art will understand that certain features of the electrical connectors described herein can vary. For example, Figs. 29A and 29B show a first and second electrical connector 22, 24 each having a respective connector housing that can include an outer shroud with various fingers along the respective mating interface. The fingers can facilitate mating between the first and second electrical connector in limited orientations. Fig. 29A shows the first and second electrical connectors 22, 24 fully seated, and Fig. 29B shows the first and second electrical connectors 22, 24 partially seated.

[00171] Similarly, the first and second connectors 22, 24 can include first electrical shields and/or second electrical shields 56, 58. For example, Figs. 30 and 31 show mating interfaces of a first and second electrical connector 22, 24, respectively. The first electrical connector 22 can include second rows of sets of second electrical contacts and respective second electrical shields. The first electrical connector 22 can also include first rows of sets of first electrical contacts and respective first electrical shields. In some cases, these first and second rows can alternate along the mating interface. Similarly, second electrical connector 24 can include first rows of sets of first electrical contacts and respective first electrical shields. The second electrical connector 24 can also include second rows of sets of second electrical contacts and respective second electrical shields. In some cases, these first and second rows can alternate along the mating interface. One skilled in the art will understand that the electrical connectors are not limited to such rows, and a combination of sets of first and second electrical contacts can vary with different rows or other different configurations.

[00172] Assemblies can include first and second pluralities of electrical cables are mounted to the first and second cable connectors, respectively. The first and second cable connectors can mate with each other to place ones of the first plurality of electrical cables in electrical communication with respective ones of the second plurality of electrical cables (known as a cable-to-cable assembly).

[00173] In still other applications, the electrical connectors of the assembly includes first and second board connectors that are mounted to first and second substrates that can be configured as printed circuit boards. The first and second board connectors can mate with each other to place the first and second printed circuit boards in electrical communication with each other (known as a board-to-board assembly). The first and second board connectors can be referred to as mezzanine connectors.

[00174] The assemblies can be configured for high density board-to-board cable systems, and/or on-package cable systems. The electrical connectors may include Pulse Amplitude Modulation 4-level (PAM4) connectors, and may support, for example, 224 Gbps data speeds.

[00175] While systems and methods have been described in connection with the various embodiments of the various figures, it will be appreciated by those skilled in the art that changes could be made to the embodiments without departing from the broad inventive concept thereof. It is understood, therefore, that this disclosure is not limited to the particular embodiments disclosed, and it is intended to cover modifications within the spirit and scope of the present disclosure as defined by the claims.

What is claimed:

1. An electrical connector comprising:
a connector housing;
at least one electrical contact supported by the connector housing; and
an electrical shield that at least partially surrounds the at least one electrical contact, wherein the electrical connector is configured to transmit data signals along the at least one electrical contact.

2. The electrical connector of claim 1, wherein the electrical shield is configured to limit a crosstalk interference level experienced by the at least one electrical contact when mated to a respective other electrical contact.

3. The electrical connector of any one of the preceding claims, wherein the data signals along the at least one electrical contact have data transfer speeds of 224 gigabits per second with no worse than -60 dB of crosstalk at frequencies up to 60 GHz.

4. The electrical connector of any one of the preceding claims, wherein the data signals along the at least one electrical contact have data transfer speeds of 224 gigabits per second with no worse than -80 dB of crosstalk at frequencies up to 60 GHz.

5. The electrical connector of any one of the preceding claims, wherein a level of crosstalk interference experienced by the data signals when the electrical connector is partially seated with a complementary electrical connector is substantially approximate to a level of crosstalk interference experienced by the data signals when the electrical connector is fully seated with the complementary electrical connector.

6. The electrical connector of claim 5, wherein partially seated comprises the electrical shield mated at least 10 percent of a length of the electrical shield.

7. The electrical connector of any one of claims 5 to 6, wherein partially seated comprises the electrical shield mated at least 20 percent of a length of the electrical shield.

8. The electrical connector of any one of the preceding claims, wherein the at least one electrical contact is configured to mate to a complementary at least one electrical contact of a complementary electrical connector when the electrical connector is mated with the complementary electrical connector.

9. The electrical connector of claim 8, wherein the electrical shield is configured to maintain contact with a complementary electrical shield that at least partially surrounds the complementary at least one electrical contact when the electrical connector and the complementary electrical connector are partially seated.

10. The electrical connector of any one of claims 8 to 9, wherein partially seated comprises the electrical shield mated at least 10 percent of a length of the electrical shield.

11. The electrical connector of any one of claims 8 to 10, wherein partially seated comprises the electrical shield mated at least 20 percent of a length of the electrical shield.

12. The electrical connector of any one of the preceding claims, wherein the electrical shield comprises a first electrical shield configured to receive the complementary electrical shield.

13. The electrical connector of any one of the preceding claims, wherein the electrical shield defines one or more tabs extending towards a longitudinal axis of the electrical shield.

14. The electrical connector of claim 13, wherein the one or more tabs each define a distal end, wherein each distal end are planar along a plane that is parallel to a reference plane defined by the longitudinal axis of the electrical shield.

15. The electrical connector of any one of claims 13 to 14, wherein the one or more tabs each define a pair of arms, wherein each arm of the pair originate at different circumferential positions relative to the other arm of the pair, and wherein each arm of the pair converge to form a distal end.

16. The electrical connector of any one of claims 13 to 15, wherein the one or more tabs form a group of tabs, and wherein the one or more tabs define columns of tabs along a direction of the longitudinal axis of the electrical shield.

17. The electrical connector of any one of claims 13 to 16, wherein a tab of the one or more tabs is nested in an adjacent tab of the one or more tabs.

18. The electrical connector of any one of claims 13 to 17, wherein the one or more tabs are configured to contact a complementary electrical shield of a complementary electrical connector when the electrical connector is fully seated to the complementary electrical connector.

19. The electrical connector of any one of claims 13 to 18, wherein each tab of the one or more tabs are configured to flex away from the longitudinal axis of the electrical shield when in contact with a complementary electrical shield of a complementary electrical connector.

20. The electrical connector of any one of claims 13 to 19, wherein the one or more tabs are stamped from the electrical shield so as to define stamped sections.

21. The electrical connector of claim 20, wherein each stamped section of the electrical shield defines a V-shaped aperture.

22. The electrical connector of any one of claims 20 to 21, wherein at least one of the stamped sections of the shield is nested within another stamped section of the shield along a direction of the longitudinal axis of the electrical shield.

23. The electrical connector of any one of claims 13 to 22, wherein the electrical shield is configured to be in physical contact with a second electrical shield of a complementary electrical connector when the electrical connector is mated with the complementary electrical connector.

24. The electrical connector of claim 23, wherein all of the tabs of the electrical shield are configured to physical contact the second electrical shield when the electrical connector is mated with the complementary electrical connector.

25. The electrical connector of any one of claims 23 to 24, wherein a number of the tabs less than all of the tabs are configured to remain in physical contact with the second electrical shield when the electrical connector and the complementary electrical connector are partially unseated.

26. The electrical connector of claim 25, wherein at least one of the tabs is removed from physical contact with the second electrical shield when the electrical connector and the complementary electrical connector are partially unseated.

27. The electrical connector of claim 26, wherein at least two of the tabs is removed from physical contact with the second electrical shield when the electrical connector and the complementary electrical connector are partially unseated.

28. The electrical connector of any one of claims 18 to 27, wherein a level of crosstalk interference experienced by the data signals when the electrical connector is partially seated with a complementary electrical connector is substantially approximate to a level of crosstalk interference experienced by the data signals when the electrical connector is fully seated with the complementary electrical connector, and wherein partially seated comprises at least a tab of the one or more tabs contacting the complementary electrical shield, at least two tabs of one or more tabs contacting the complementary electrical shield, at least three tabs of the one or more tabs contacting the complementary electrical shield, or at least four tabs of the one or more tabs contacting the electrical shield.

29. The electrical connector of any one of the preceding claims, wherein the at least one electrical contact defines a mating portion configured to mate with a complementary at least one electrical contact, and another end configured to be electrically coupled to an electrical cable.

30. The electrical connector of any one of the preceding claims, wherein the at least one electrical contact comprises a first electrical contact and a second electrical contact, and wherein the complementary at least one electrical contact comprises a third electrical contact and a fourth electrical contact, and wherein the first electrical contact is configured to mate with the third electrical contact, and the second electrical contact is configured to mate with the fourth electrical contact.

31. The electrical connector of claim 30, wherein each of the first electrical contact and the second electrical contact defines a mating portion configured to mate with a complementary electrical contact, and another end configured to be coupled to an electrical cable.

32. The electrical connector of claim 31, wherein the electrical cable comprises a cable having a first conductive core and a second conductive core, and wherein the another end of the first electrical contact is configured to be coupled to the first conductive core, and the another end of the second electrical contact is configured to be coupled to the second conductive core.

33. The electrical connector of any one of claims 31 to 32, wherein the electrical cable comprises a multi-core electrical cable.

34. The electrical connector of any one of claims 31 to 33, wherein the electrical cable comprises a coaxial electrical cable.

35. The electrical connector of any one of claims 31 to 34, wherein the first electrical contact comprises a male electrical contact configured to seat within the third electrical contact, and wherein the second electrical contact comprises a female electrical contact configured to accept the fourth electrical contact.

36. The electrical connector of any one of claims 31 to 35, wherein the first electrical contact comprises a socket, and the second electrical contact comprises a pin.

37. The electrical connector of any one of the preceding claims, further comprising a dielectric sleeve extending along a mating direction and surrounding a portion of the at least one electrical contact.

38. The electrical connector of claim 37, wherein the portion of the electrical contact is not surrounded by the electrical shield.

39. The electrical connector of any one of the preceding claims, wherein the electrical connector housing defines a cavity along a mating direction of the electrical connector, and wherein a portion of the at least one electrical contact and a portion of the electrical shield are disposed within the cavity.

40. The electrical connector of claim 39, wherein a mating portion of the at least one electrical contact is exposed from the cavity.

41. The electrical connector of any one of claims 39 to 40, wherein the connector housing defines a mating surface, and wherein the connector housing is configured to contact a complementary mating surface of a complementary housing of a complementary electrical connector when fully seated.

42. The electrical connector of any one of the preceding claims, wherein the connector housing is electrically conductive, and is in electrical communication with the electrical shield.

43. The electrical connector of claim 42, wherein the connector housing is in electrical communication, via the electrical shield, with the complementary electrical connector when partially seated or fully seated.

44. The connector of any one of the preceding claims, wherein the electrical shield comprises a sleeve, and wherein the sleeve is configured to insert into a complementary electrical shield of a complementary electrical connector when mated.

45. The electrical connector of any one of the preceding claims, wherein the shield surrounds an entirety of the at least one electrical contact.

46. The electrical connector of any one of the preceding claims, further comprising:

a plurality of the at least one electrical contacts supported by the connector housing; and

a plurality of electrical shields, wherein each electrical shield of the plurality of electrical shields at least partially surrounds a respective at least one electrical contact of the plurality of the at least one electrical contacts, wherein the electrical connector is configured to transmit data signals along the plurality of the at least one electrical contacts.

47. An electrical connector system, comprising:

at least one electrical connector of any one of the preceding claims; and

a substrate, wherein each of the at least one electrical connector is mounted to the substrate.

48. The electrical connector system of claim 47, wherein the electrical connector system comprises an orthogonal electrical connector system.

49. An electrical connector comprising:

a connector housing; and

a plurality of electrical contacts supported by the connector housing, wherein the electrical contacts define mating portions configured to mate with complementary electrical contacts of a mated connector,

wherein the plurality of electrical contacts comprise pairs of first and second types of contacts, wherein the mating portions of the first types of contacts define pins, and the mating portions of the second types of contacts define sockets.

50. The electrical connector of claim 49, wherein the first and second types of contacts are alternatingly arranged along a row of the electrical connector.

51. The electrical connector of claim 50, wherein the first and second types of contacts are alternatingly arranged along multiple rows of the electrical connector.

52. The electrical connector of any one of claims 49 to 51, wherein the pairs define differential signal pairs.

53. The electrical connector of any one of claims 49 to 52, further comprising an electrical shield that surrounds a corresponding one of the pairs.

54. An electrical ground for an electrical connector, wherein the electrical ground either comprises metallic glass or is attached to metallic glass.

55. The electrical ground of claim 54, wherein the metallic glass is attached at its opposed ends to the electrical ground.

56. The electrical ground of any one of claims 54 to 55, wherein the electrical ground comprises a shield configured to mate with a complementary electrical shield, wherein the electrical shield is configured to surround at least one electrical contact, wherein the electrical shield is configured to be inserted in the complementary electrical shield, which applies a compressive force against the electrical shield, thereby causing the electrical shield to define undulations that, in turn, define contact surfaces against the complementary electrical shield.

57. The electrical ground of any one of claims 54 to 55, wherein the electrical ground comprises a shield configured to mate with a complementary electrical shield, wherein the electrical shield is configured to surround at least one electrical contact, wherein the electrical shield is configured to receive a complementary electrical shield, which applies a compressive force against the electrical shield, thereby causing the electrical shield to define undulations that, in turn, define contact surfaces against the complementary electrical shield.

58. An electrical connector comprising:

a housing; and

an electrical ground or electrical reference that includes or carries an amorphous metal or amorphous metal alloy.

59. An electrical connector comprising:

a housing; and

an electrical ground or electrical reference that includes or carries a metallic glass.

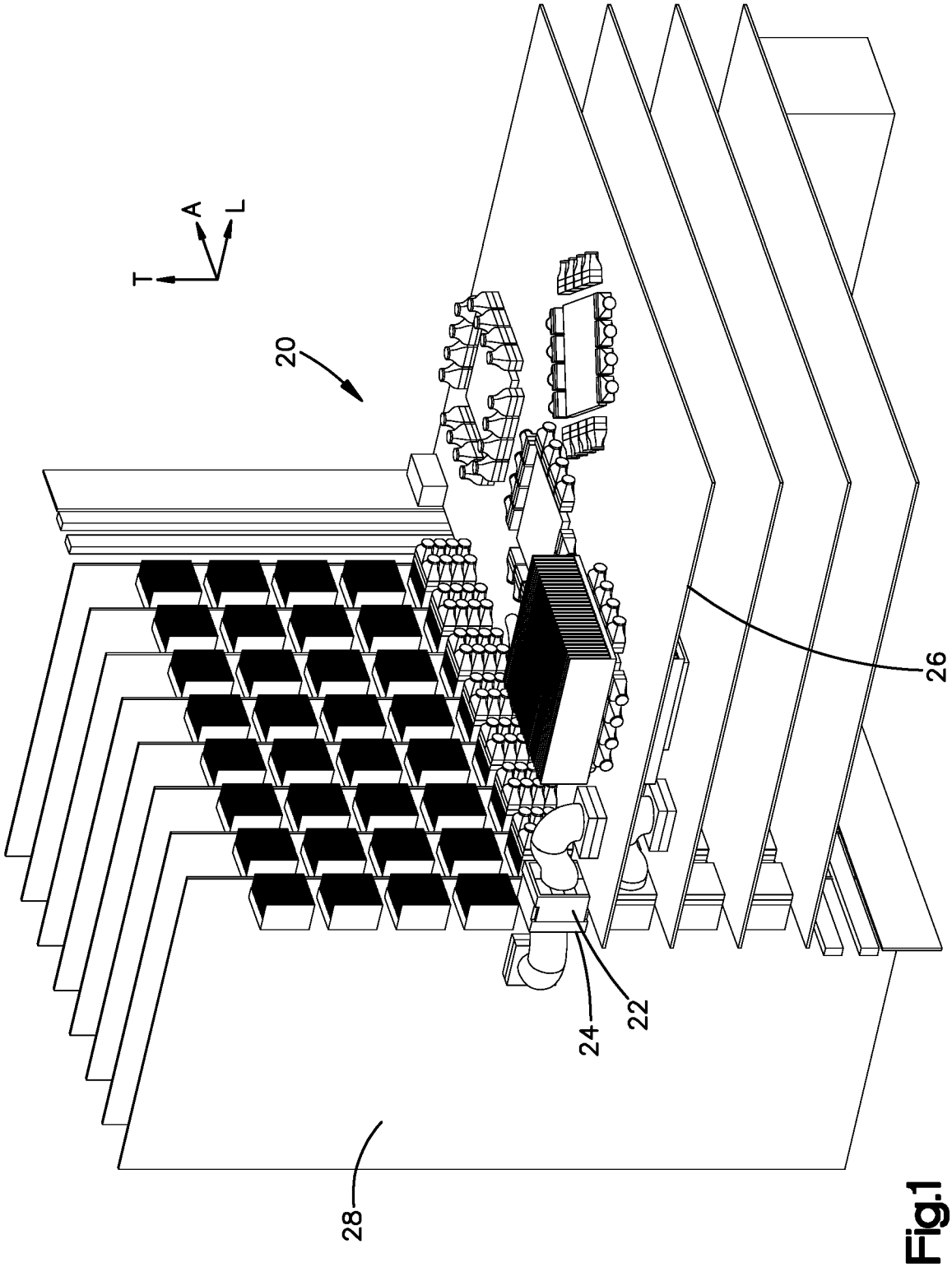

Fig.1

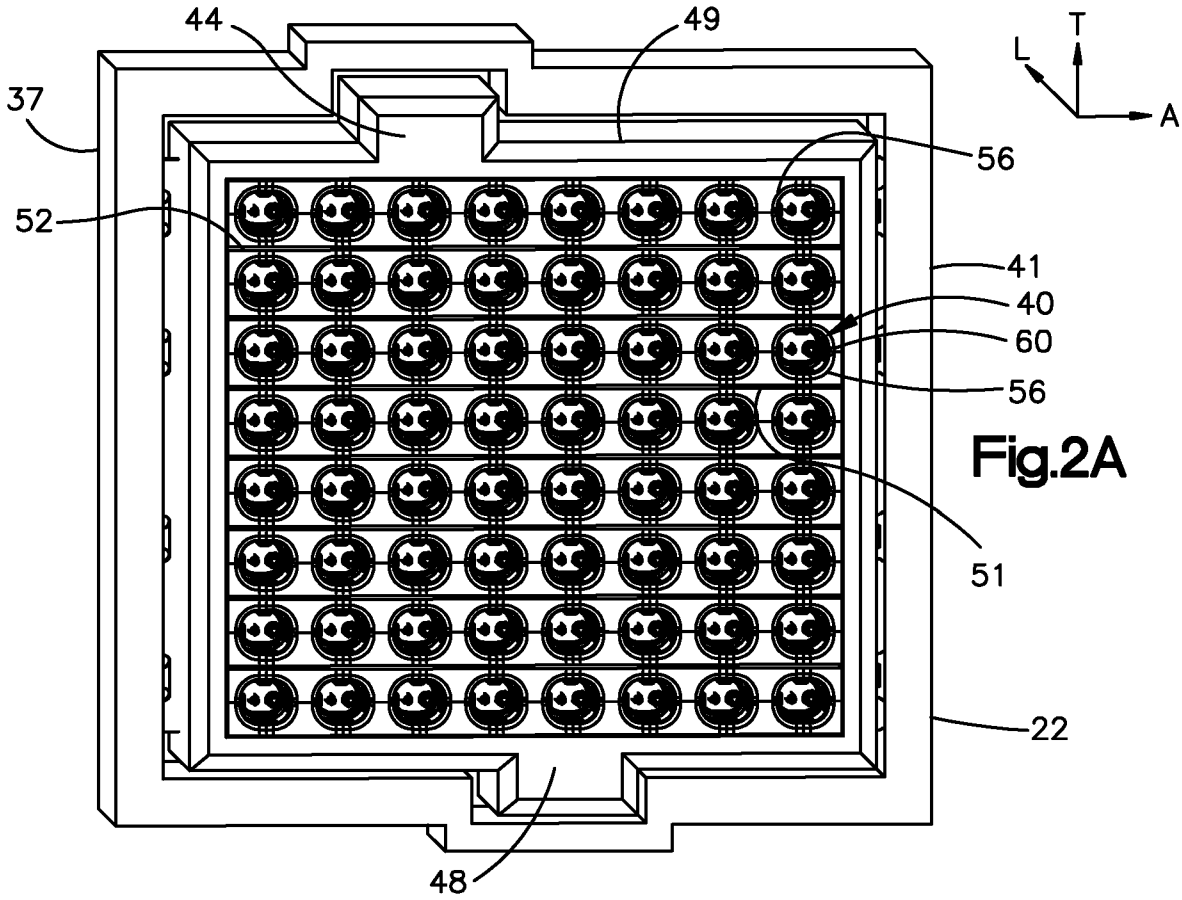

Fig.2A

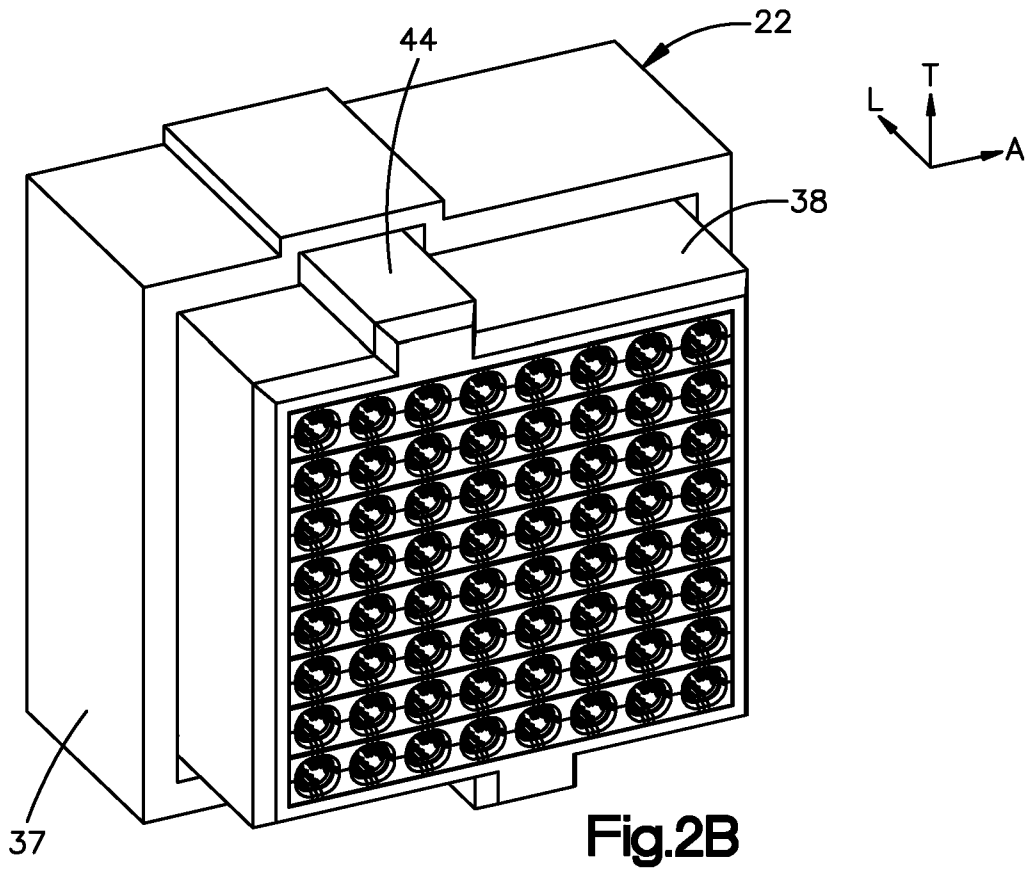

Fig.2B

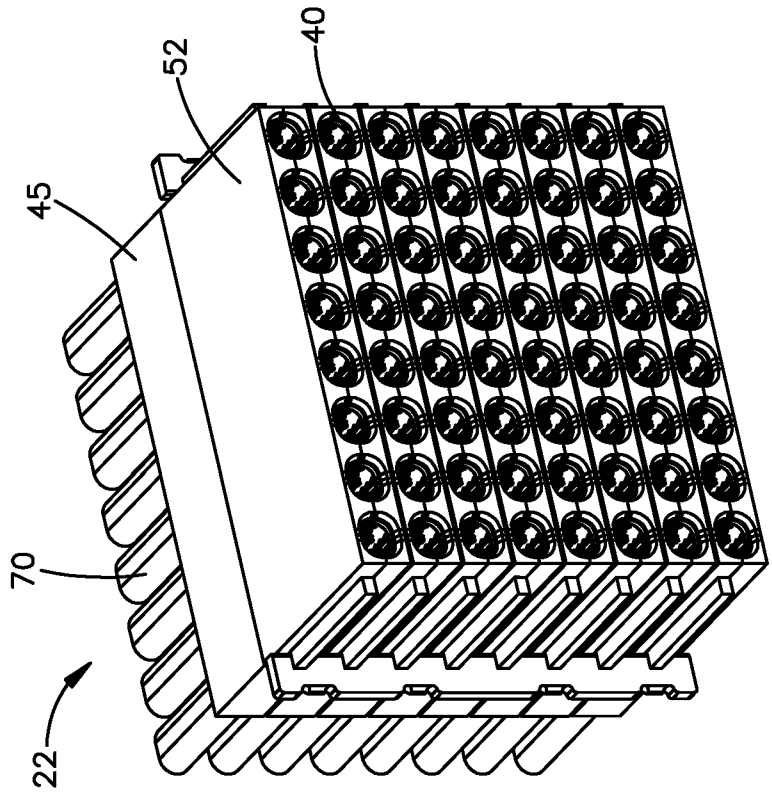

Fig.2D

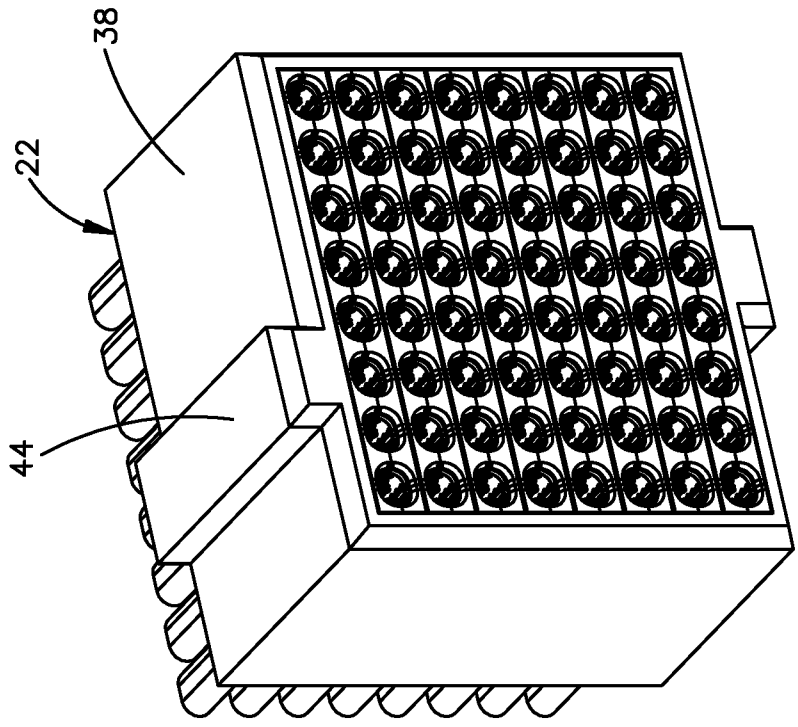

Fig.2C

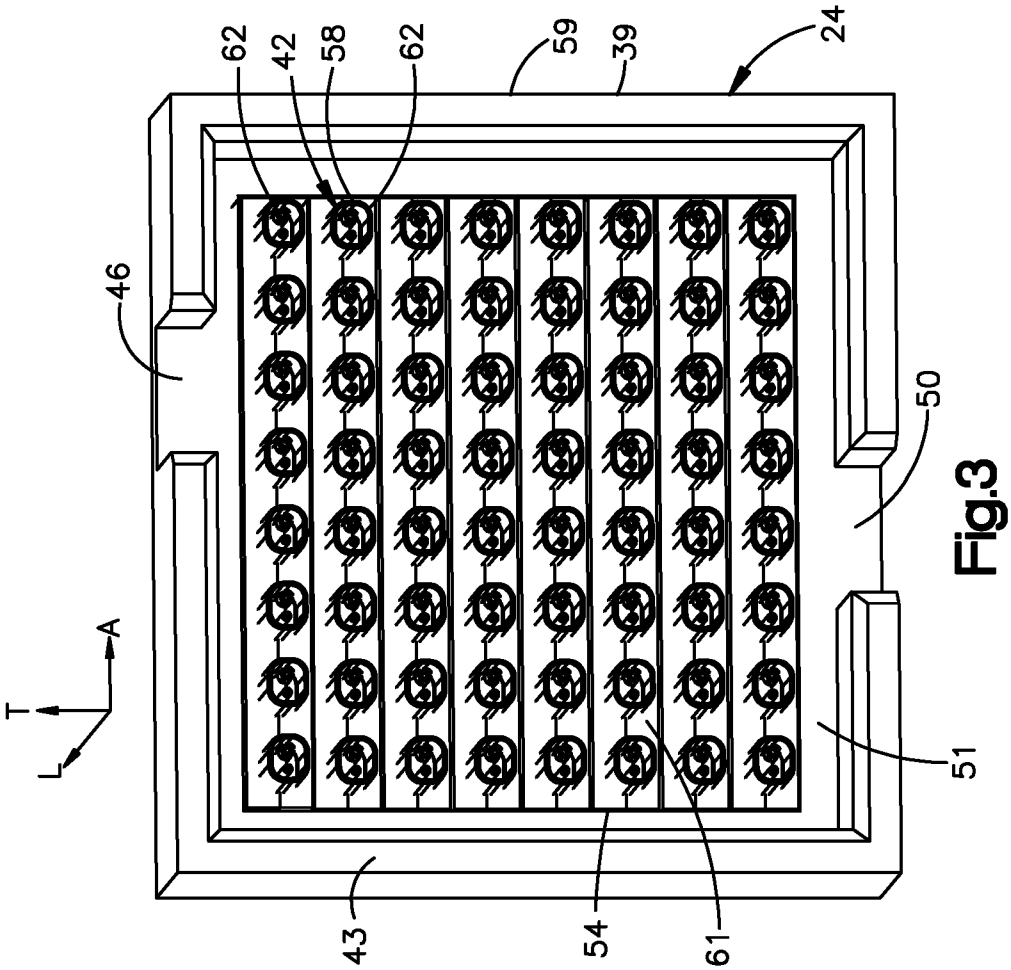

Fig.3

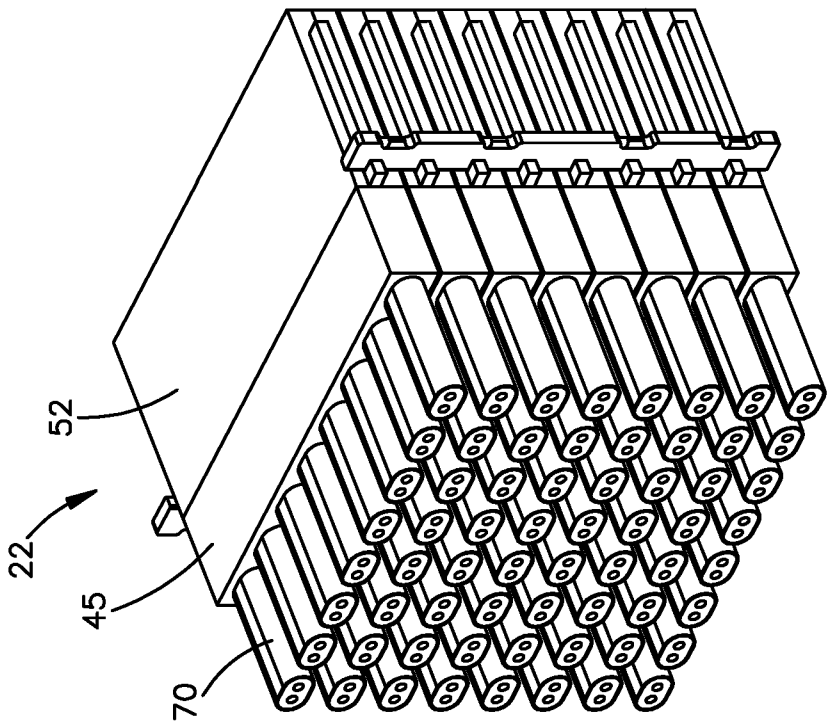

Fig.2E

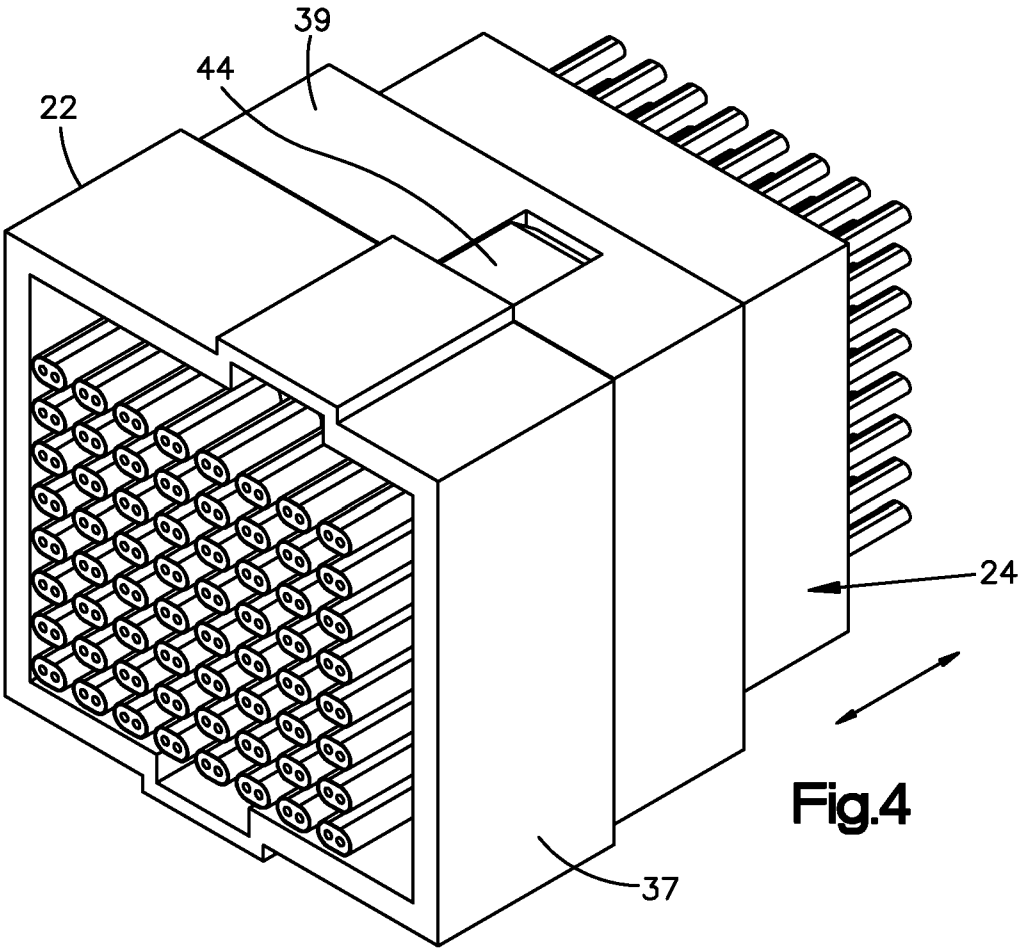

Fig.4

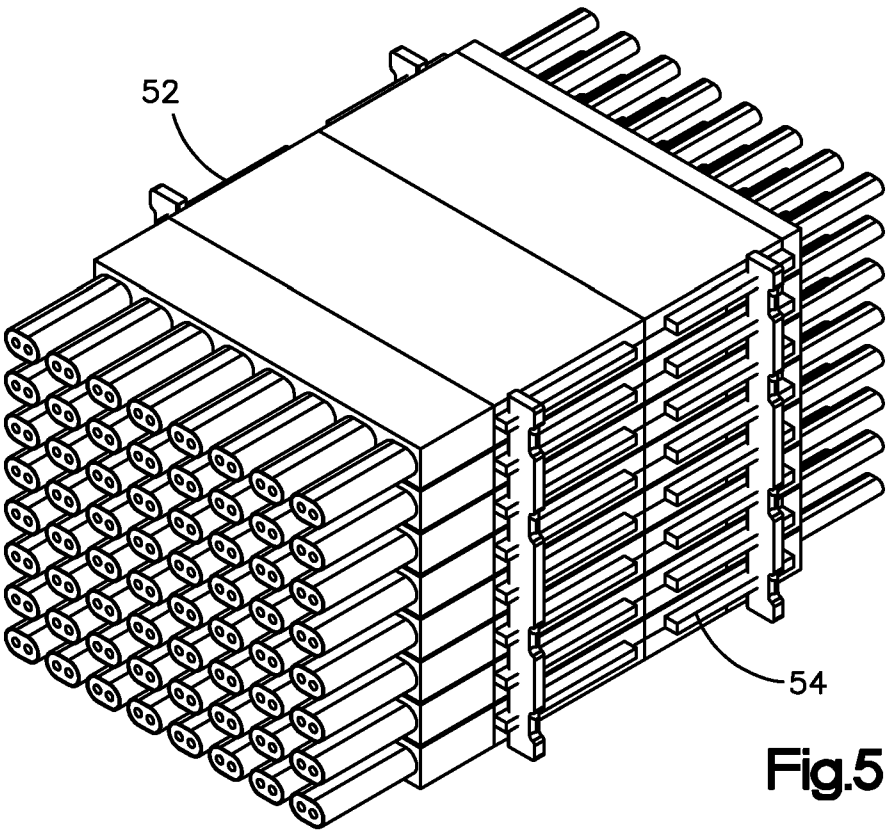

Fig.5

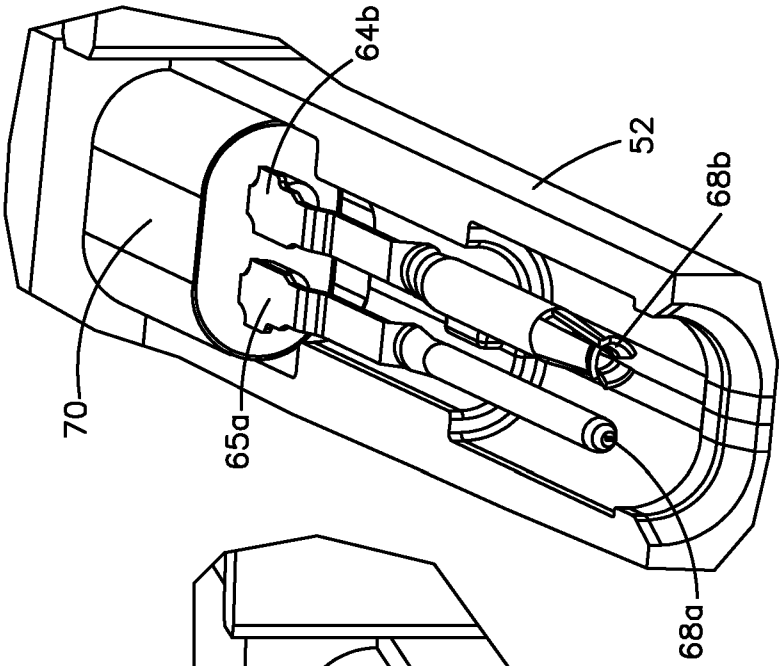

Fig.8

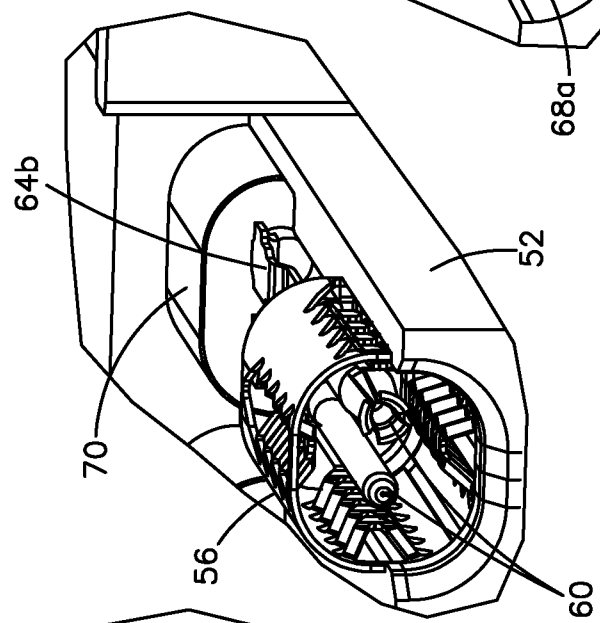

Fig.7

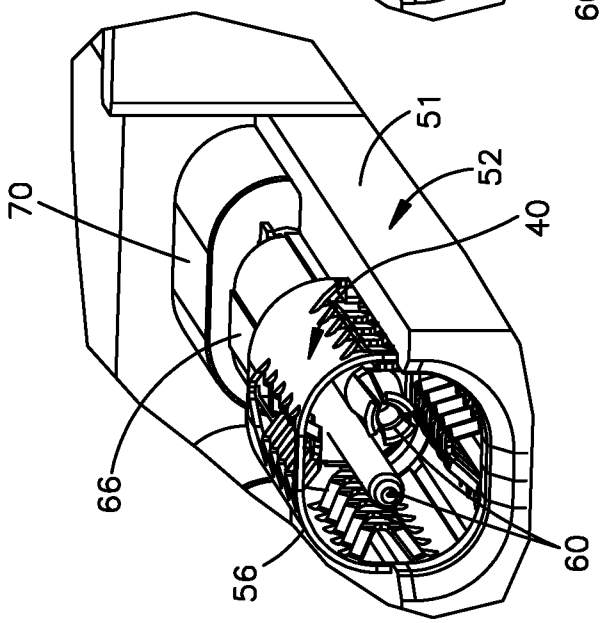

Fig.6

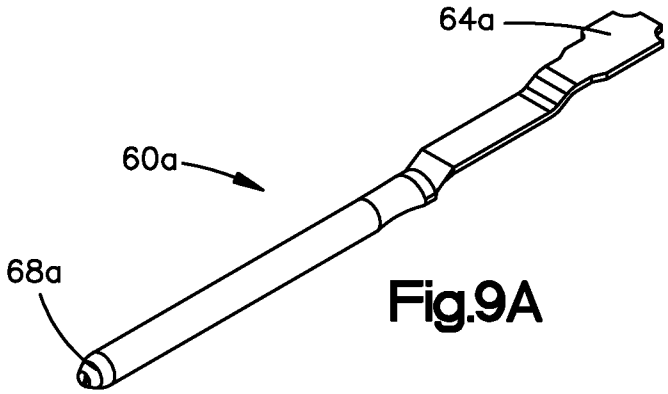

Fig.9A

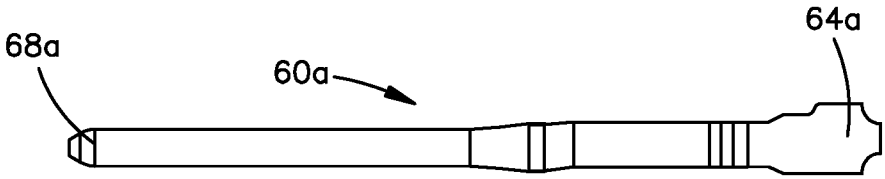

Fig.9B

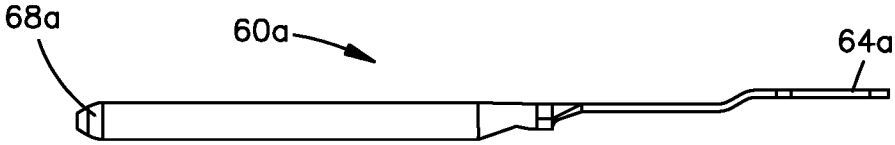

Fig.9C

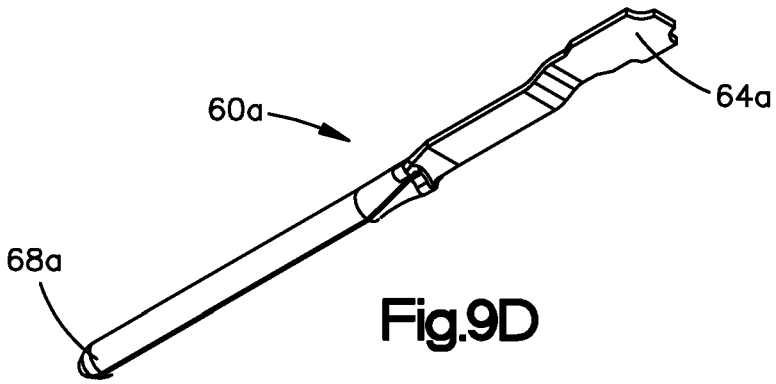

Fig.9D

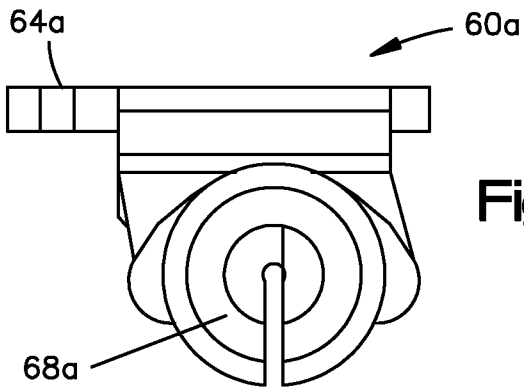

Fig.9E

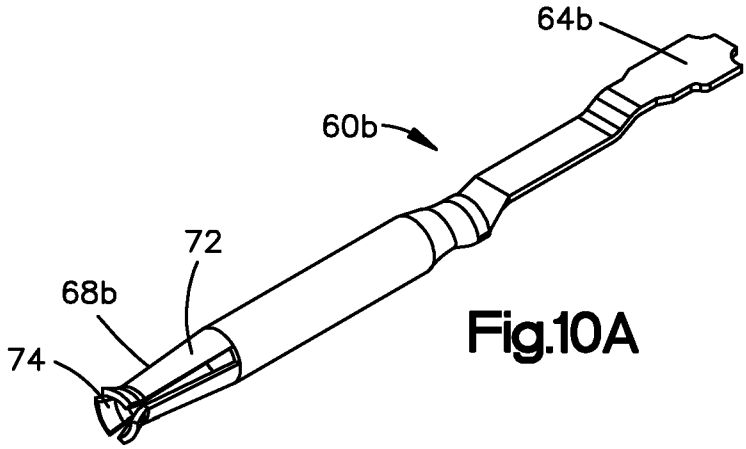

Fig.10A

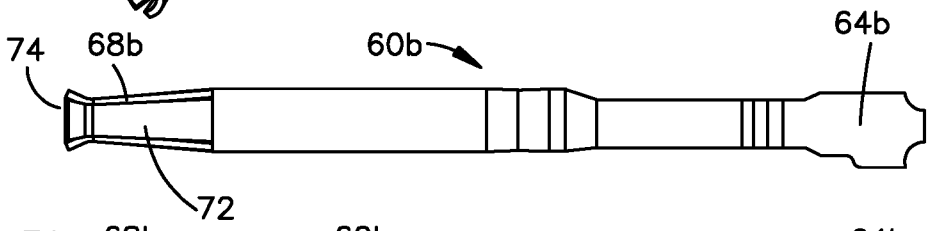

Fig.10B

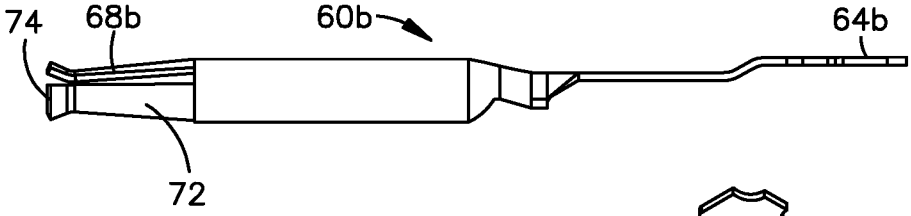

Fig.10C

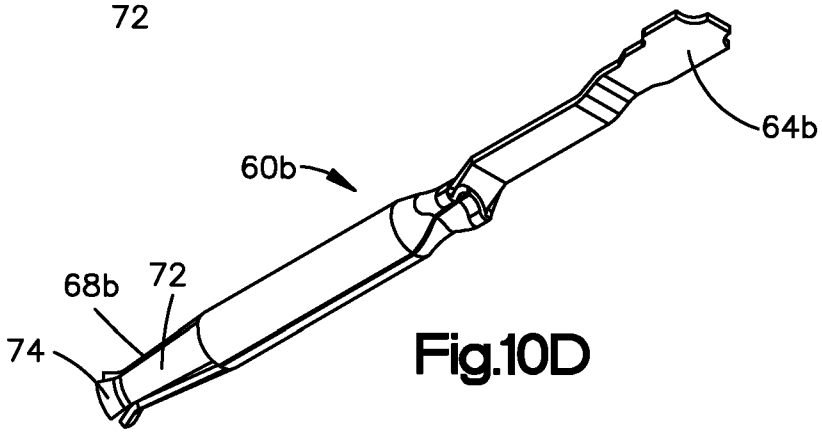

Fig.10D

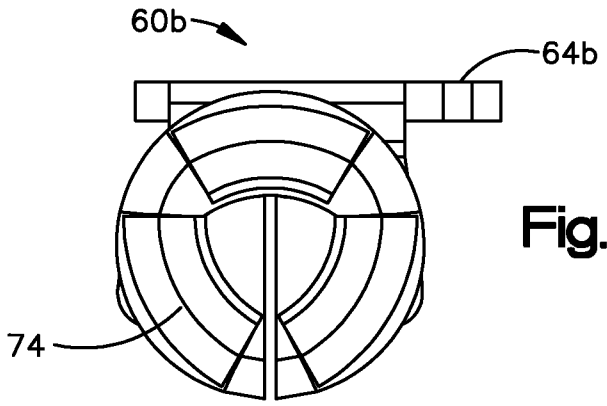

Fig.10E

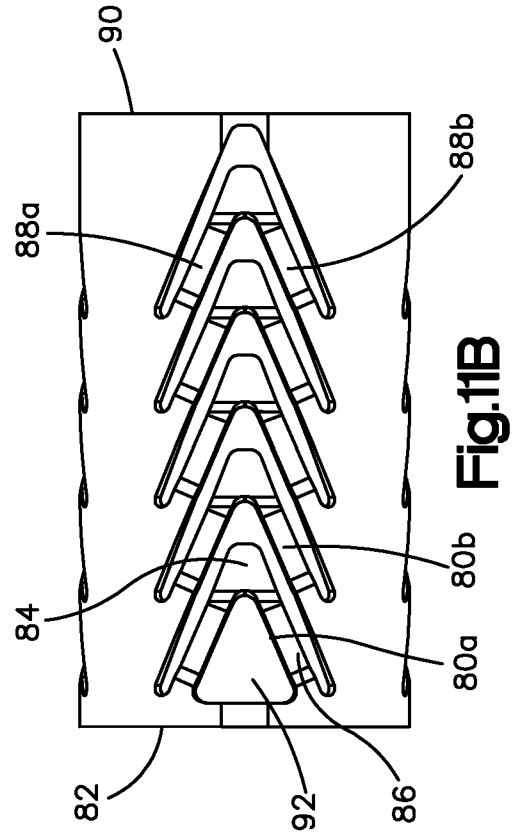

Fig.11B

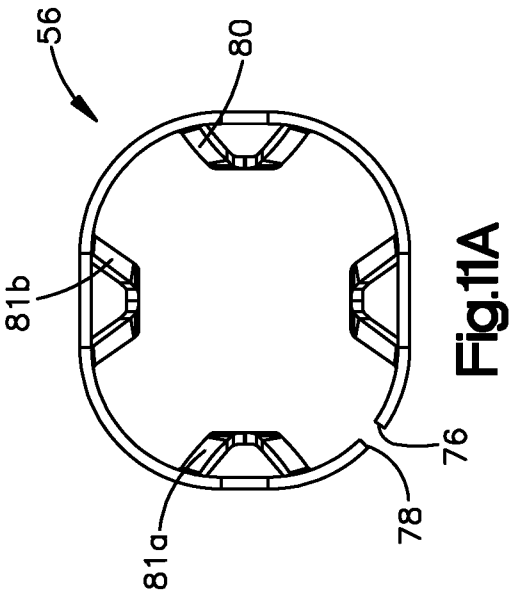

Fig.11A

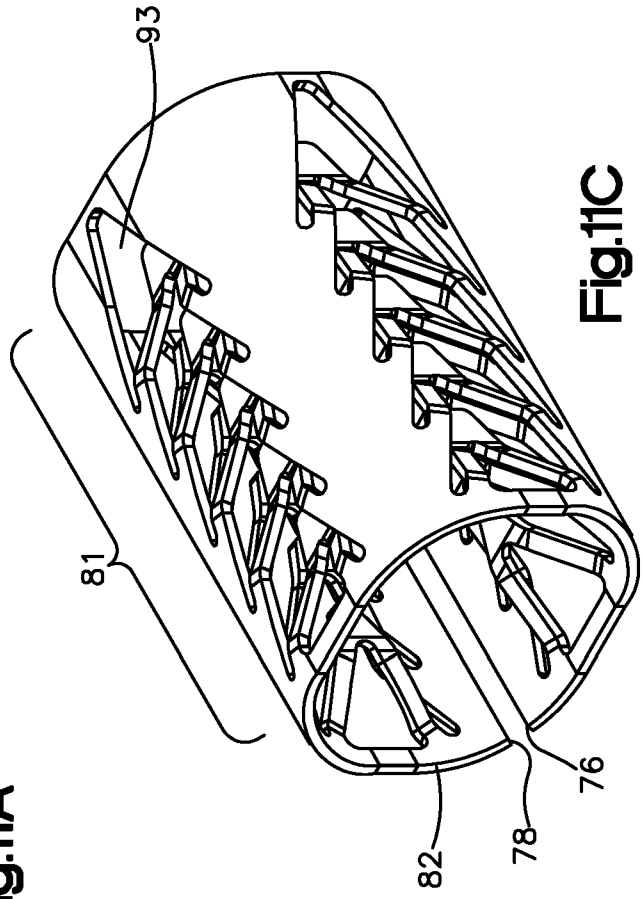

Fig.11C

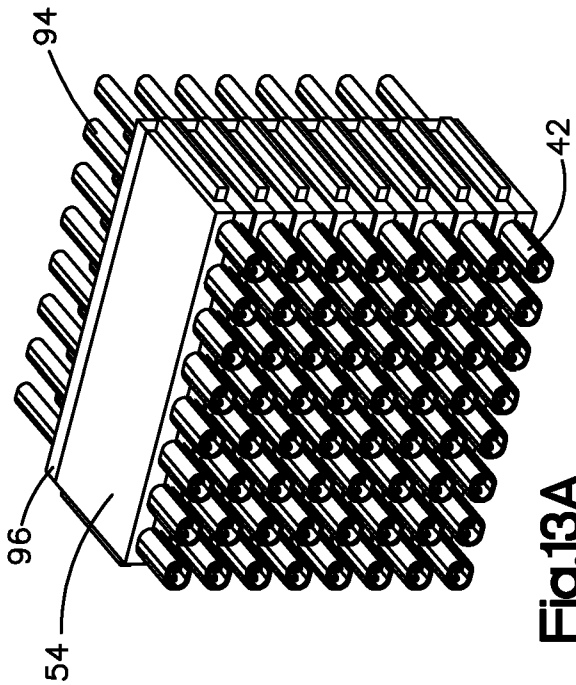

Fig.13A

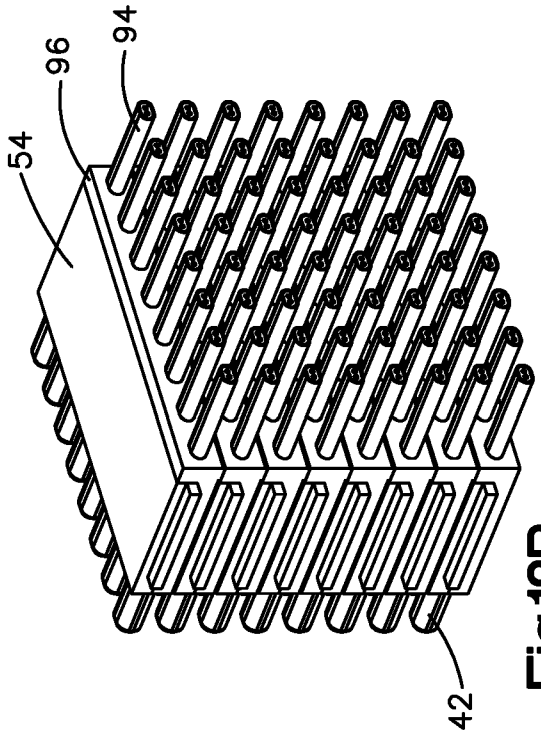

Fig.13B

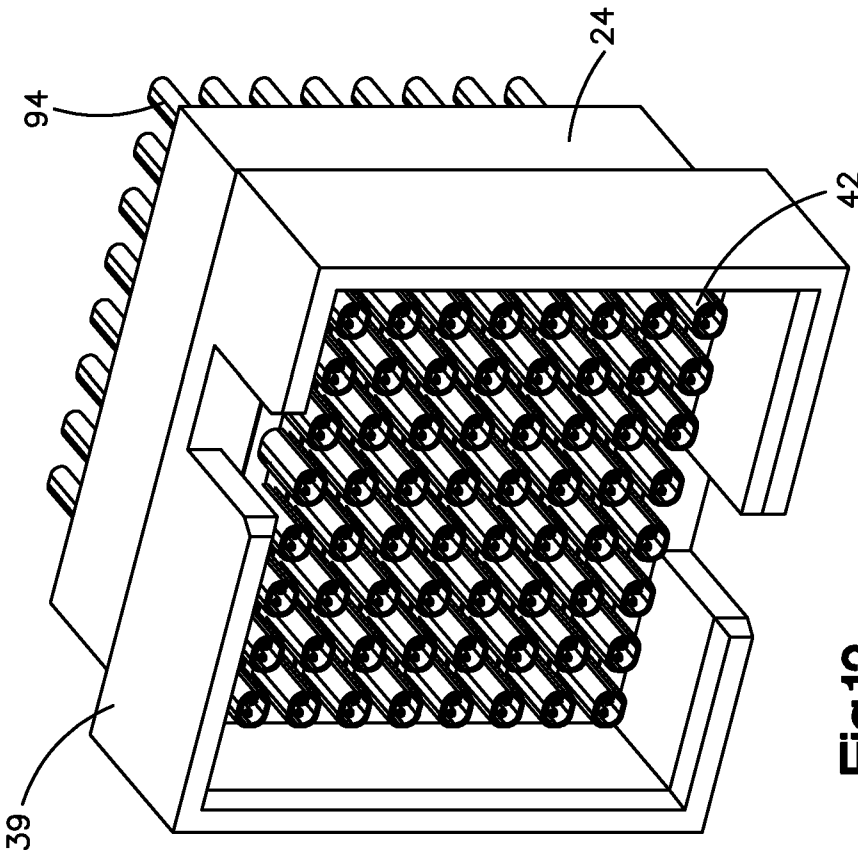

Fig.12

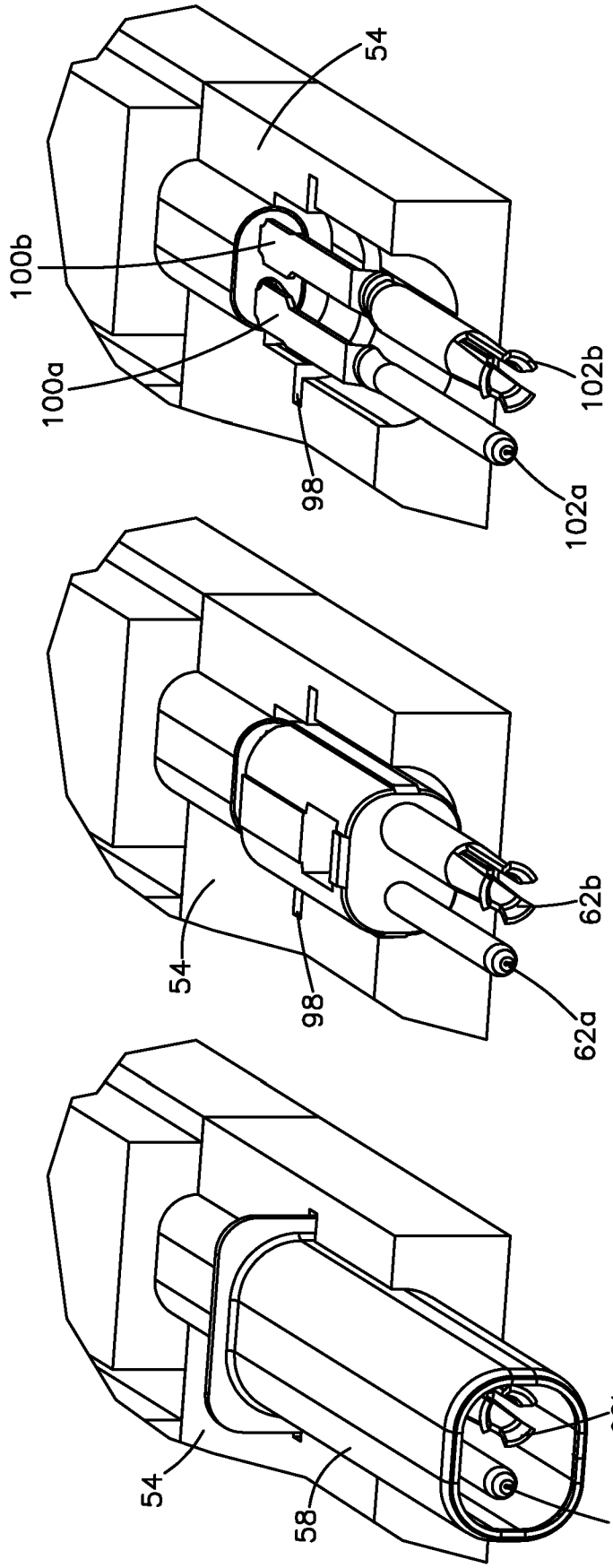

Fig.16

Fig.15

Fig.14

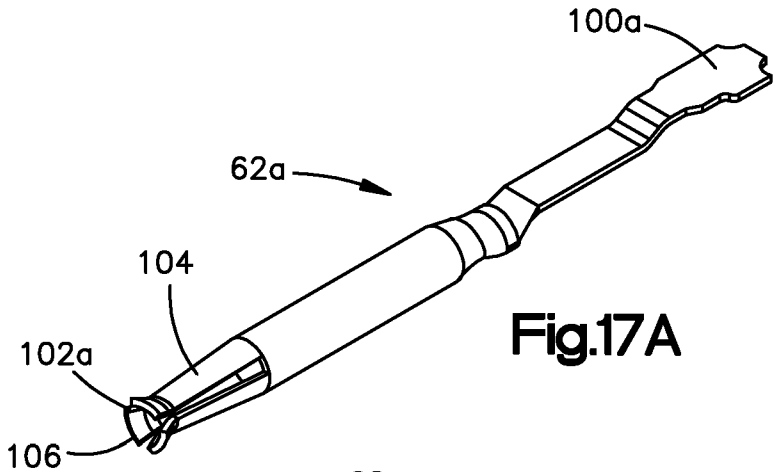

Fig.17A

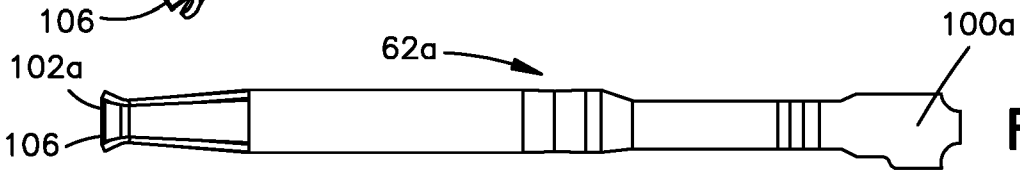

Fig.17B

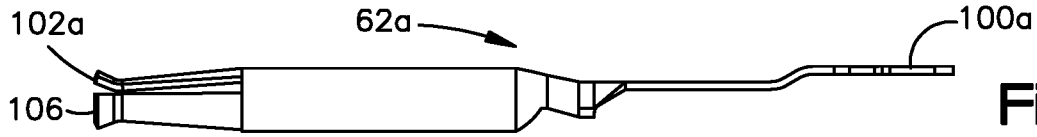

Fig.17C

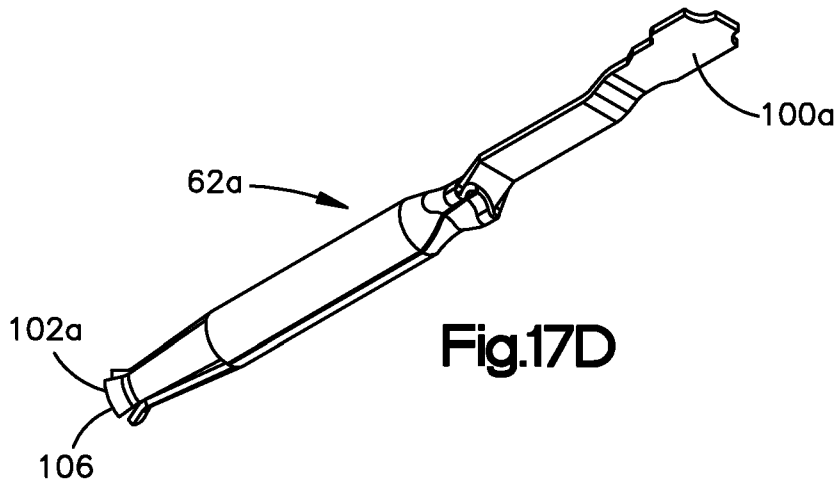

Fig.17D

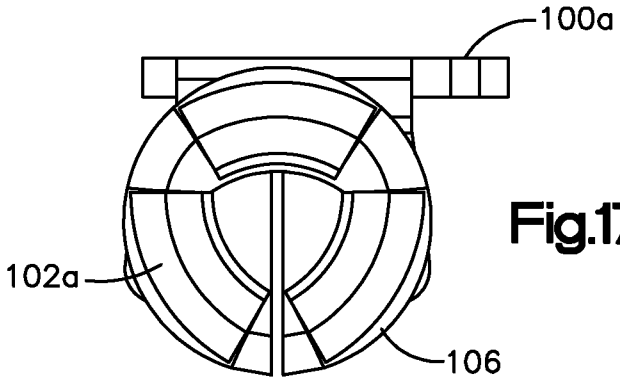

Fig.17E

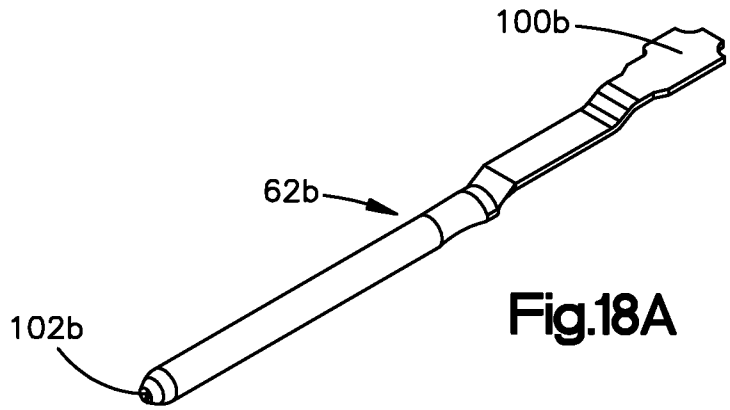

Fig.18A

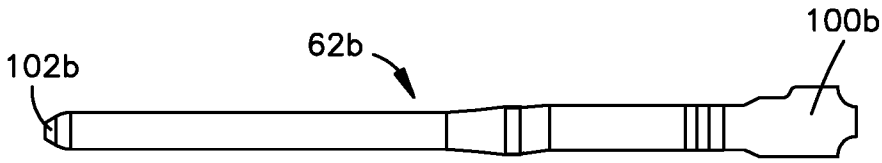

Fig.18B

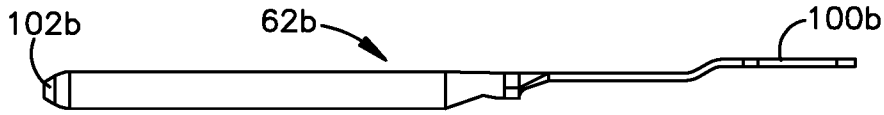

Fig.18C

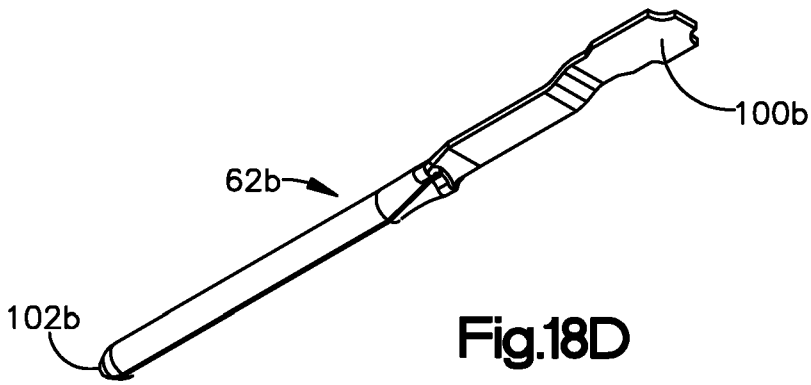

Fig.18D

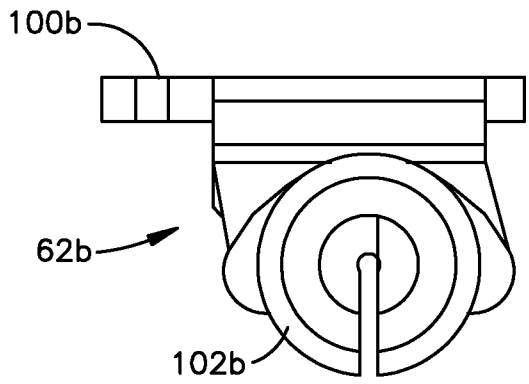

Fig.18E

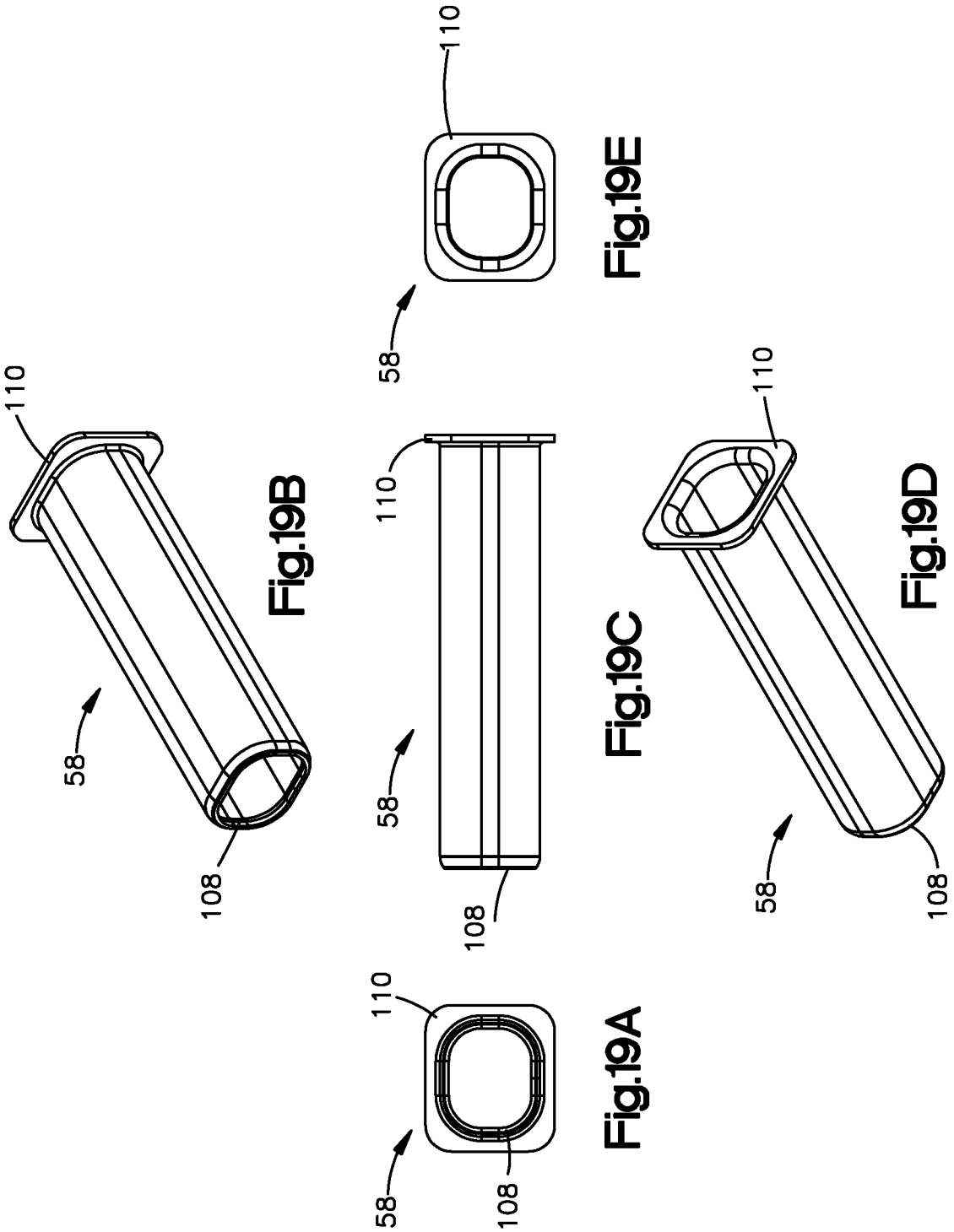

Fig.19B Fig.19E Fig.19C Fig.19D Fig.19A

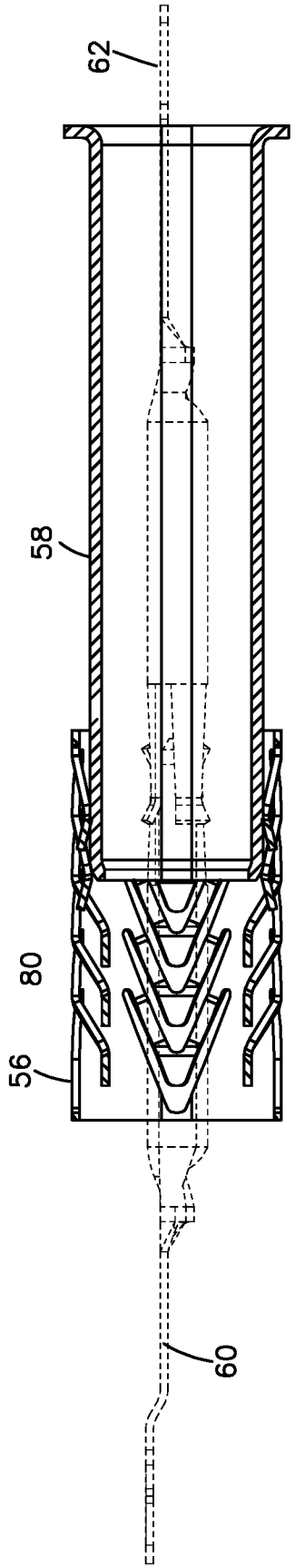

Fig.20A

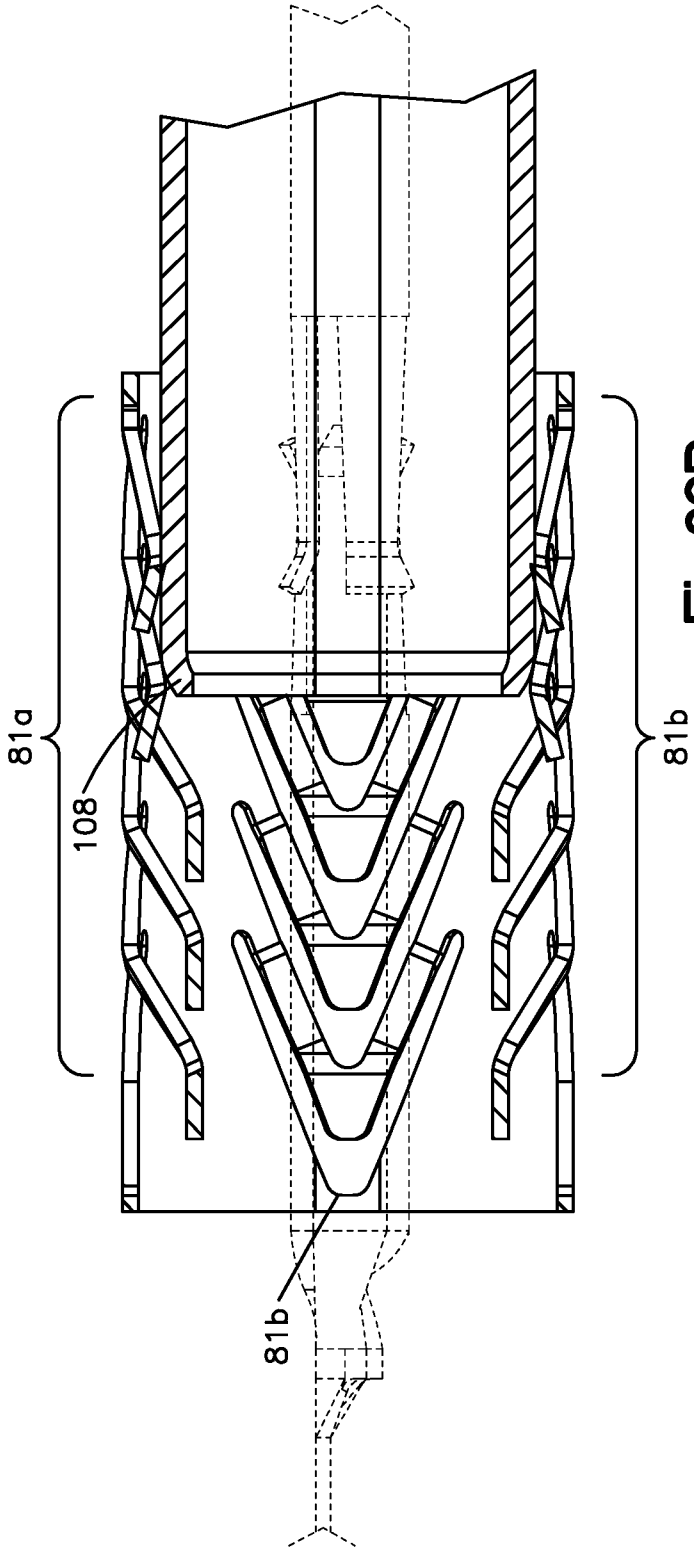

Fig.20B

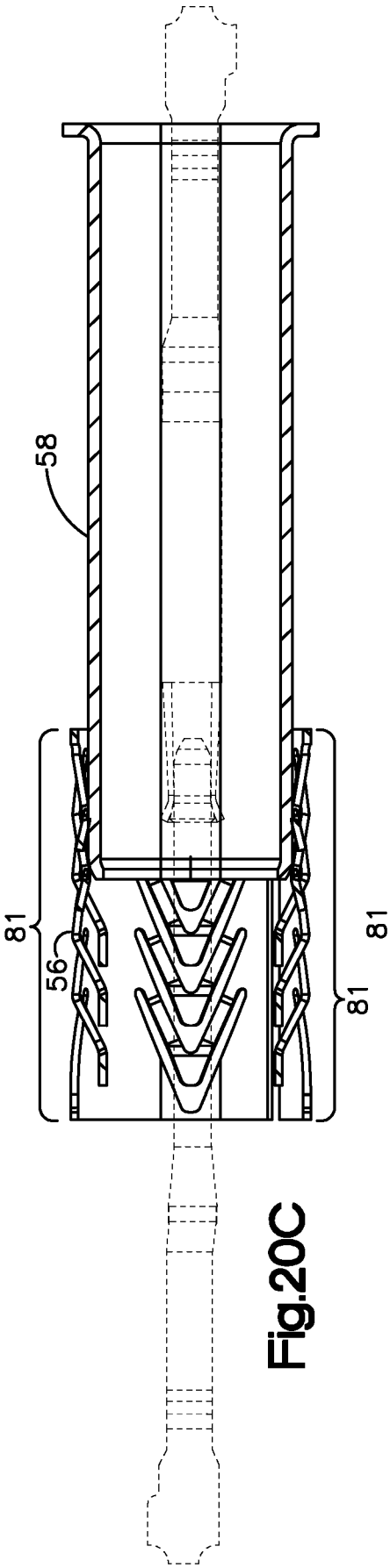

Fig.20C

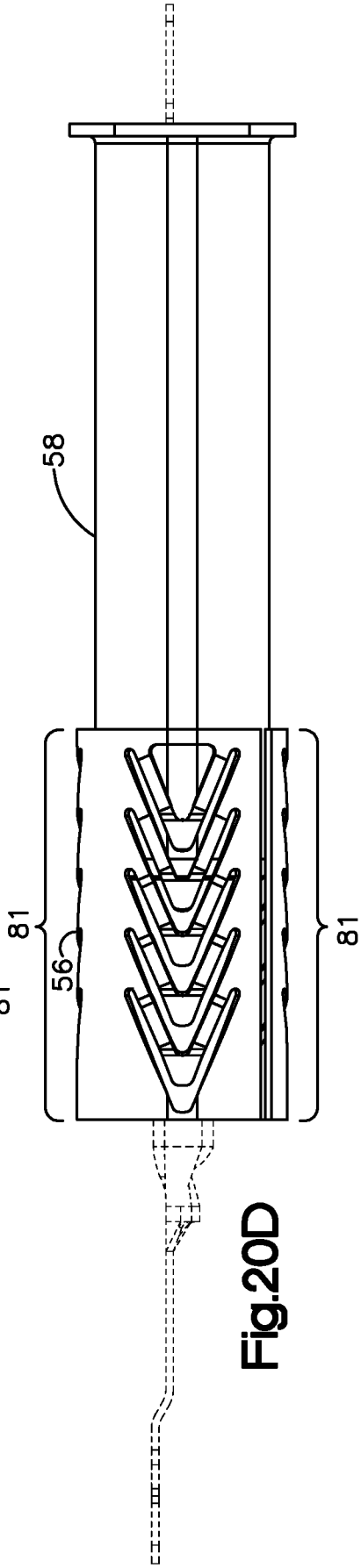

Fig.20D

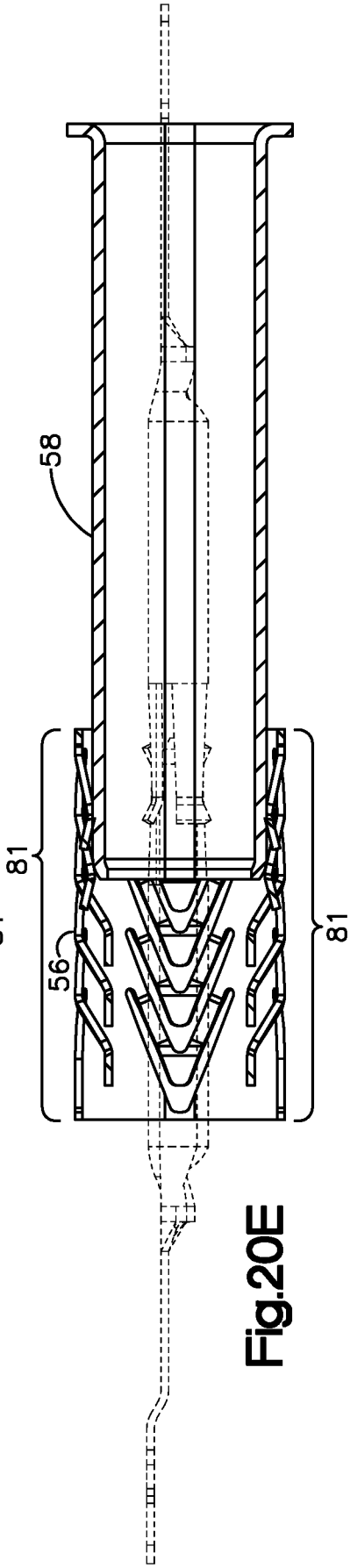

Fig.20E

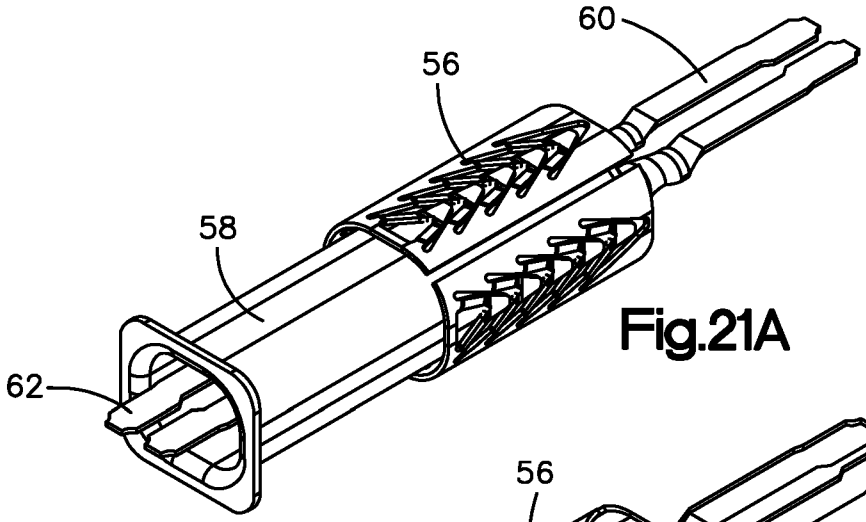

Fig.21A

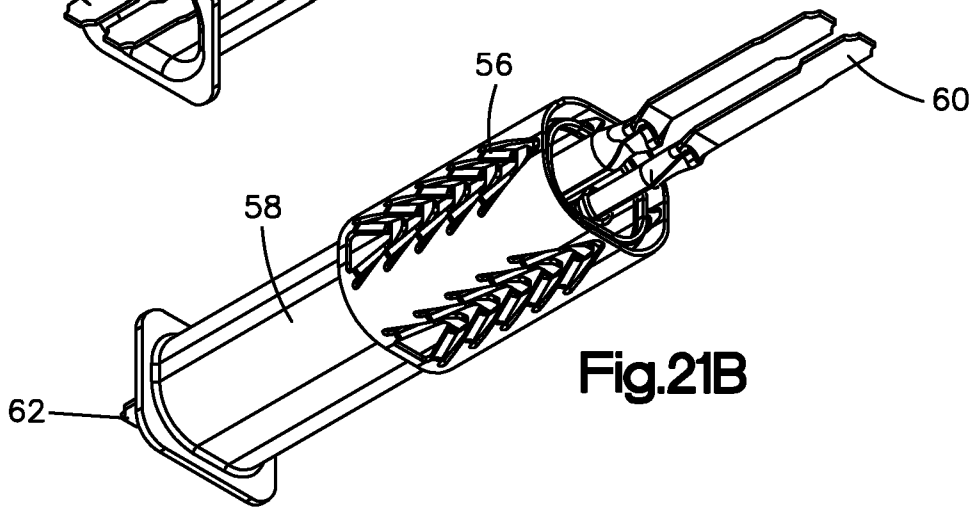

Fig.21B

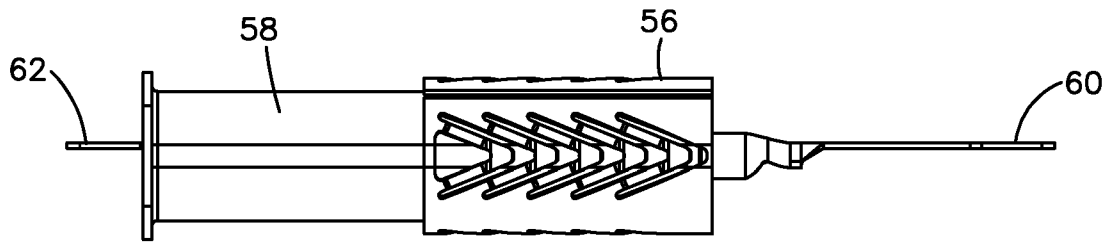

Fig.21C

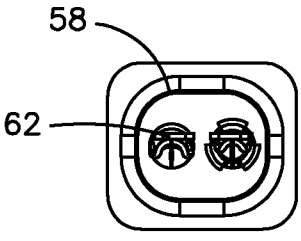

Fig.21D

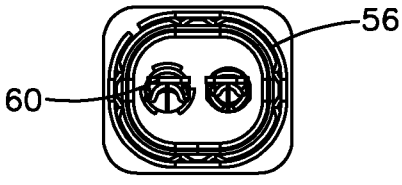

Fig.21E

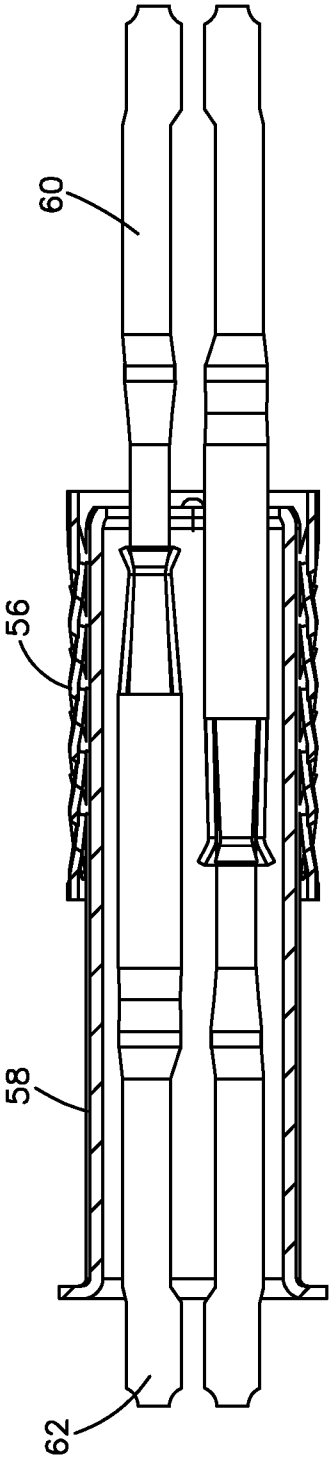

Fig.22A

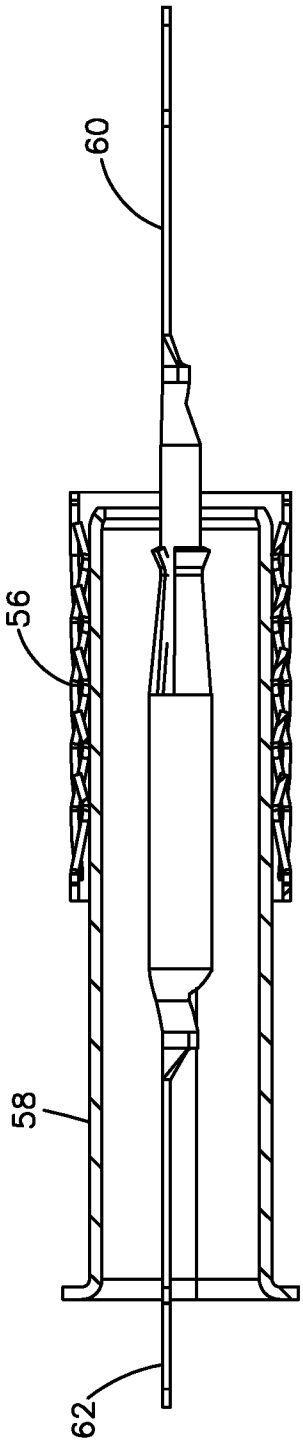

Fig.22B

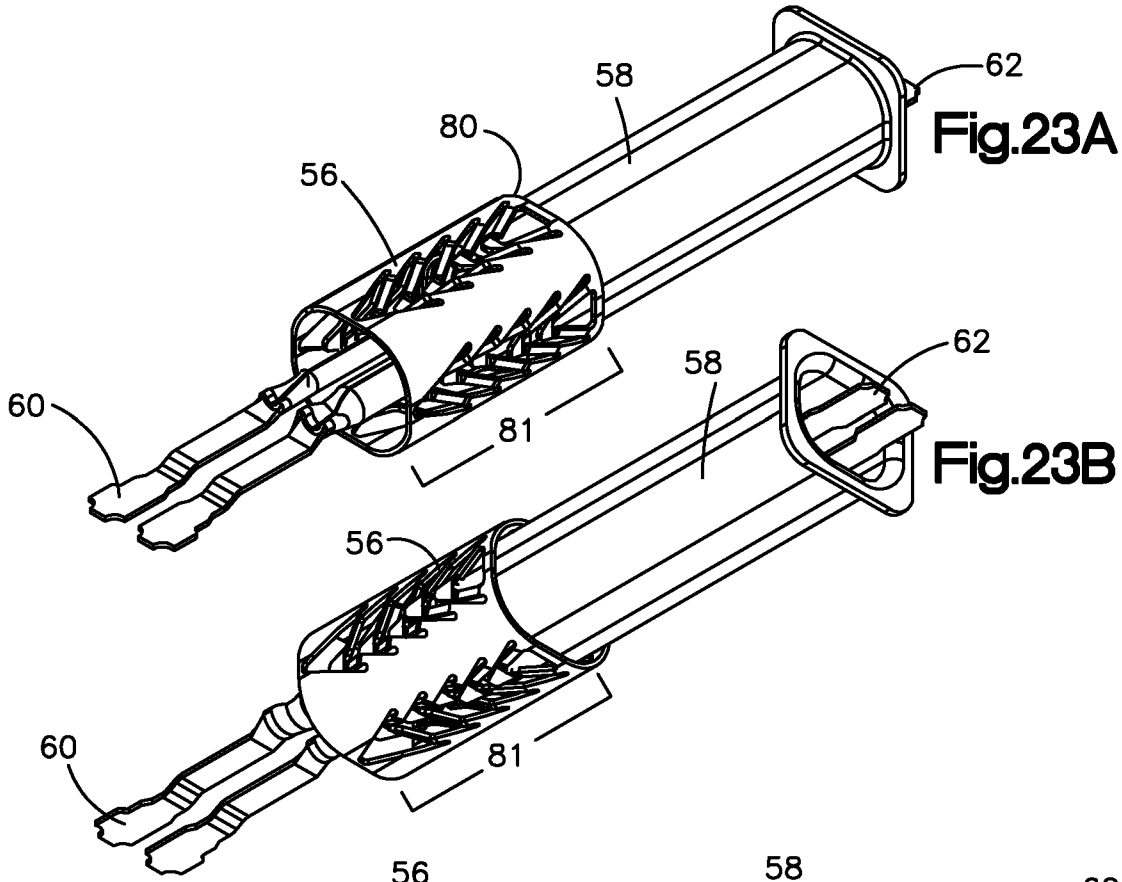

Fig.23A

Fig.23B

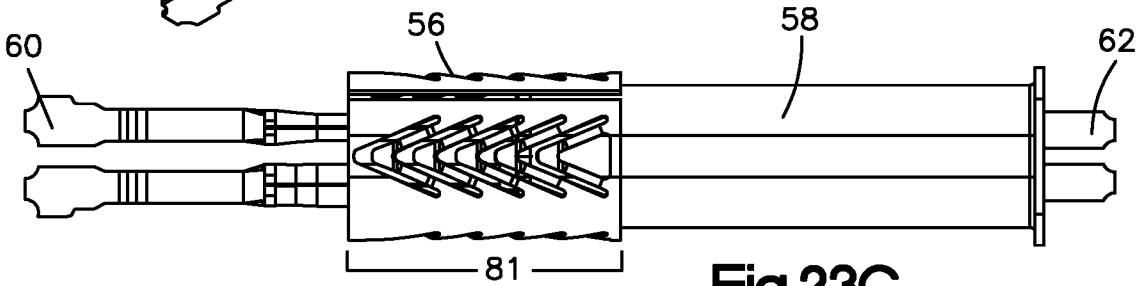

Fig.23C

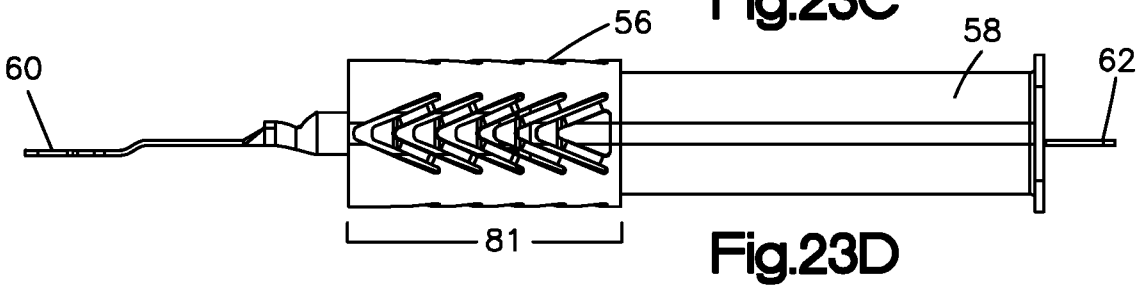

Fig.23D

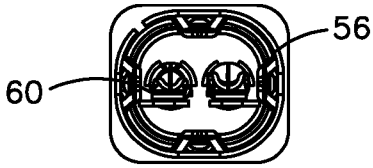

Fig.23E

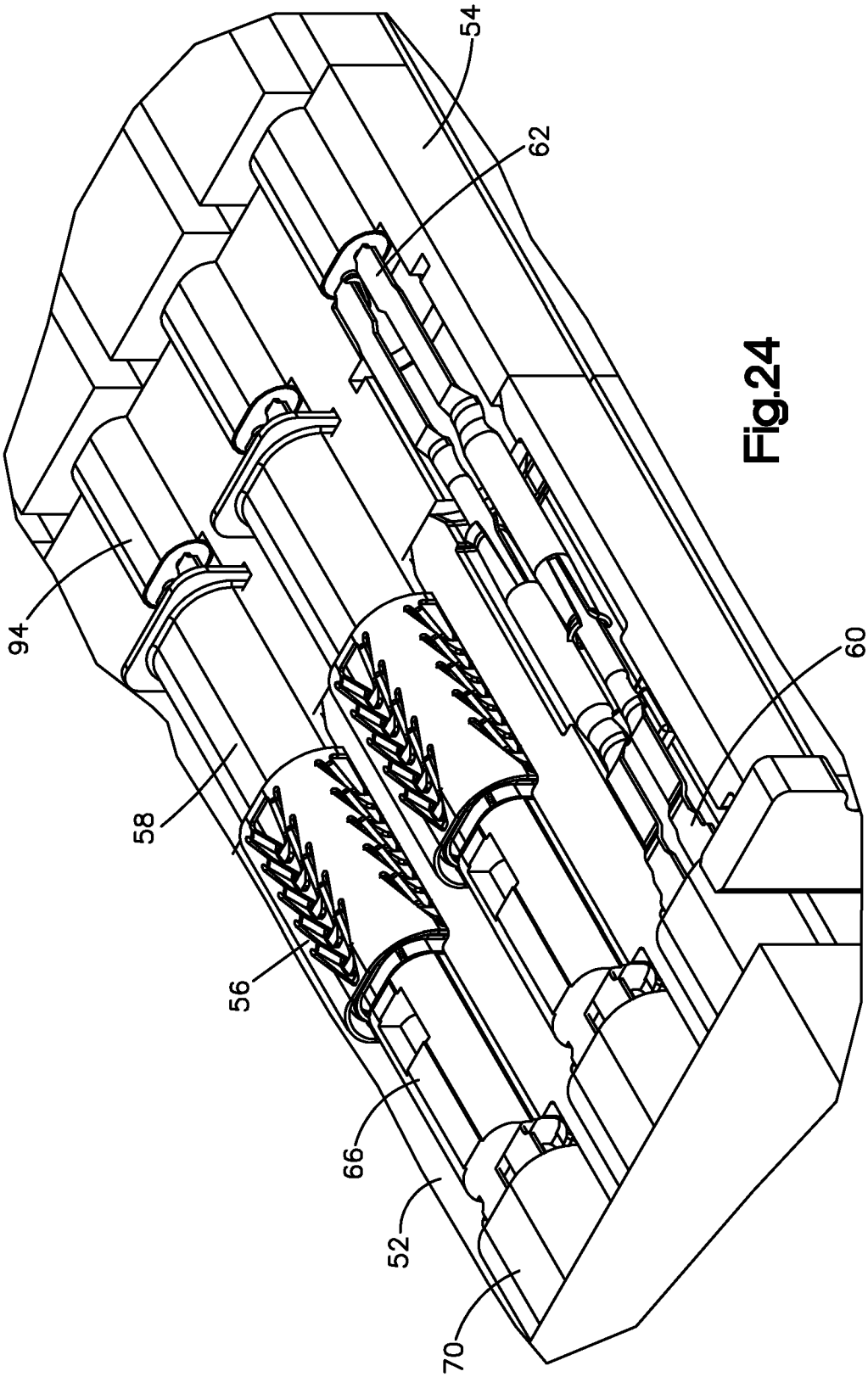

Fig.24

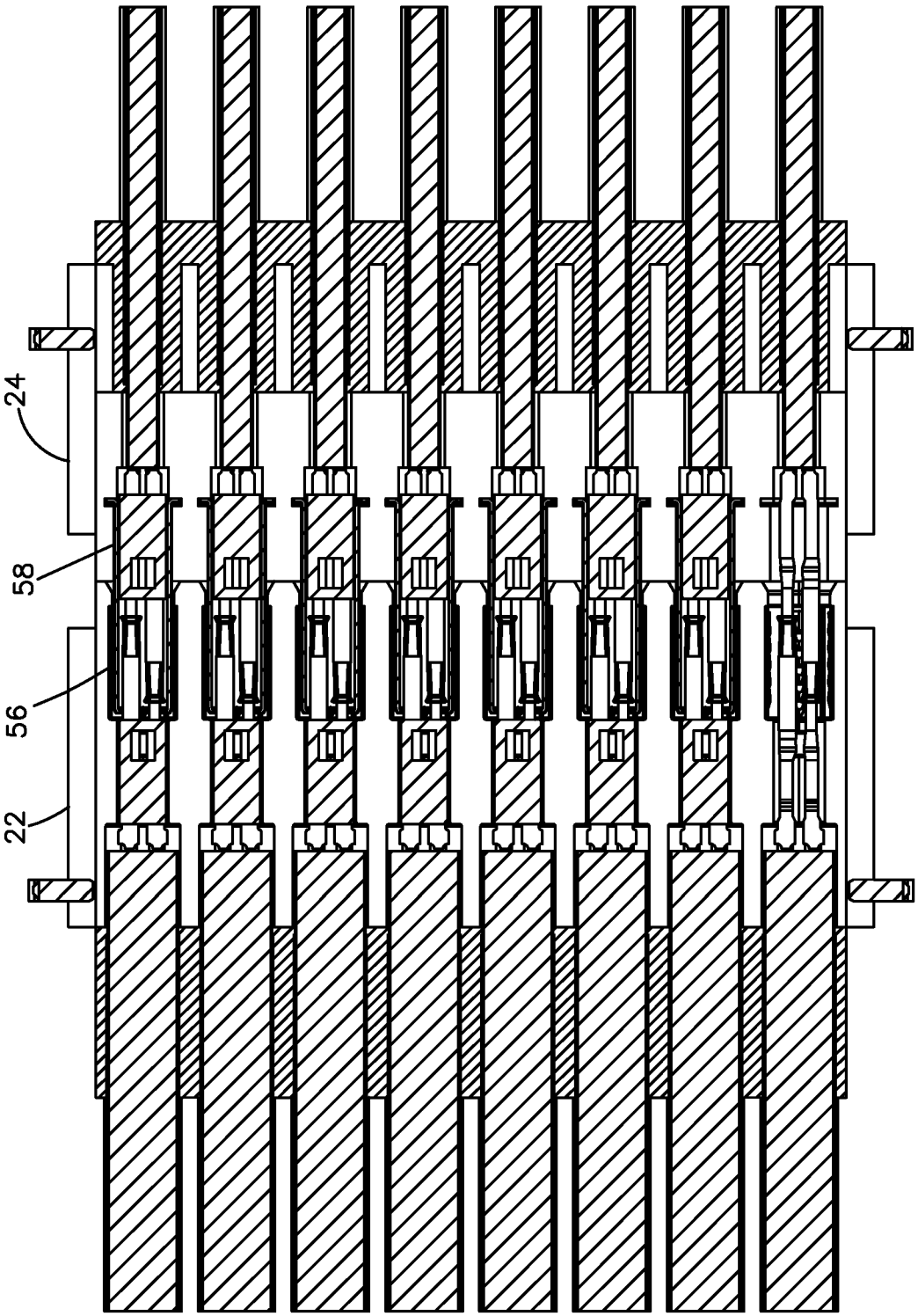

Fig.25

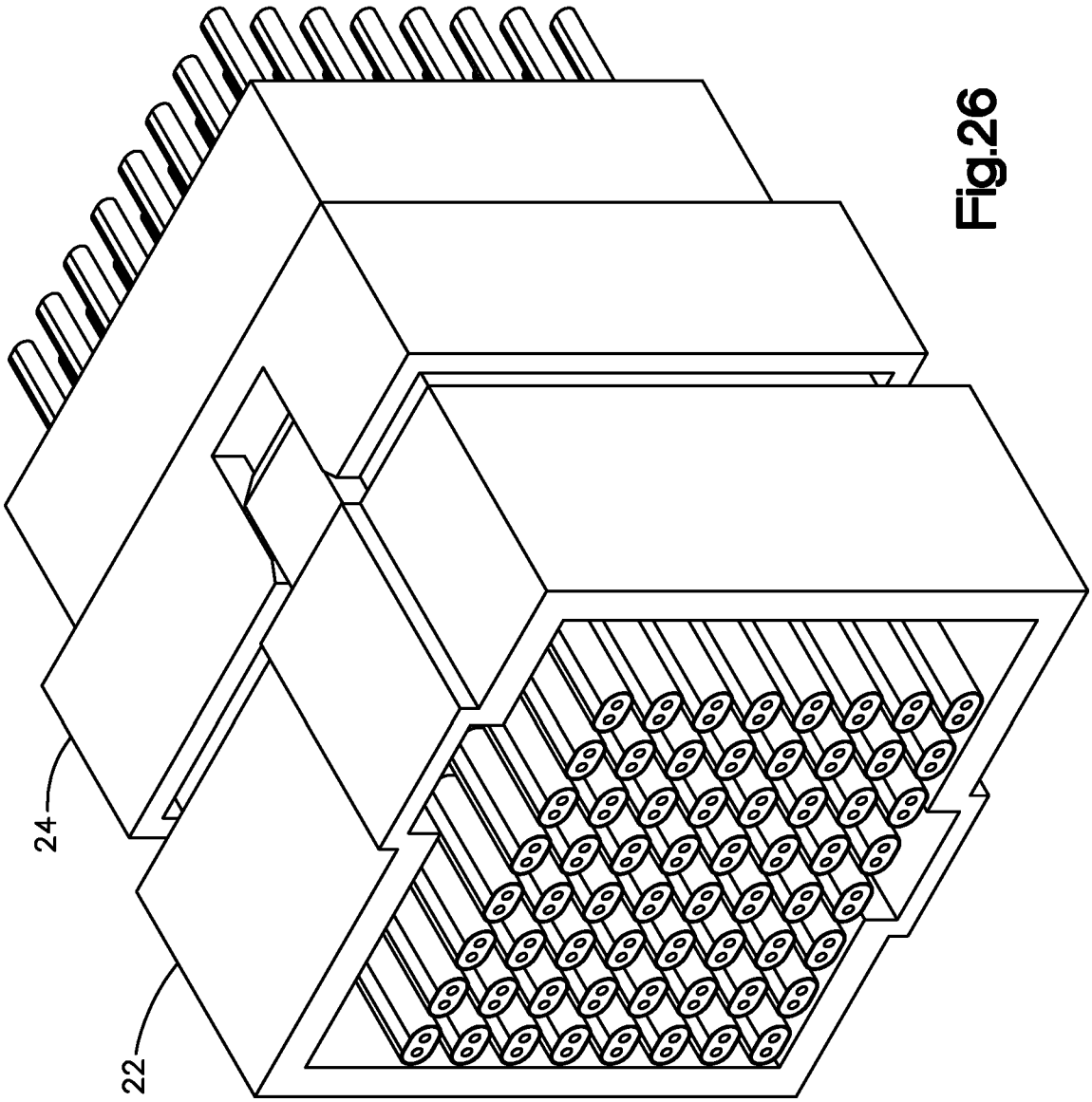

Fig.26

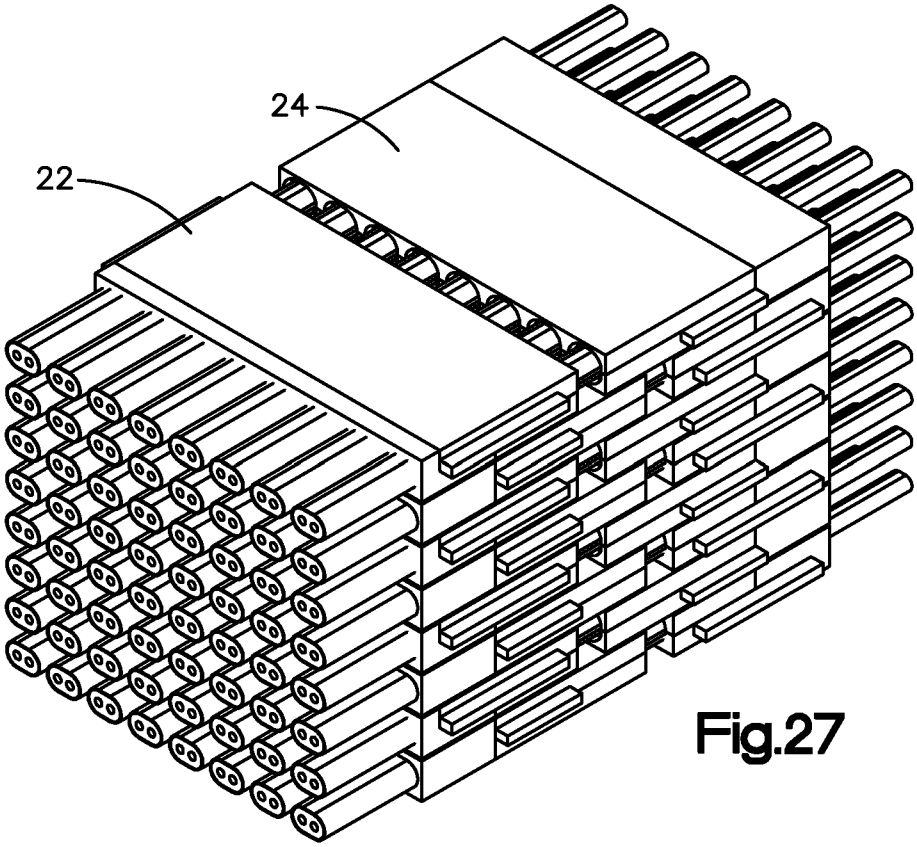

Fig.27

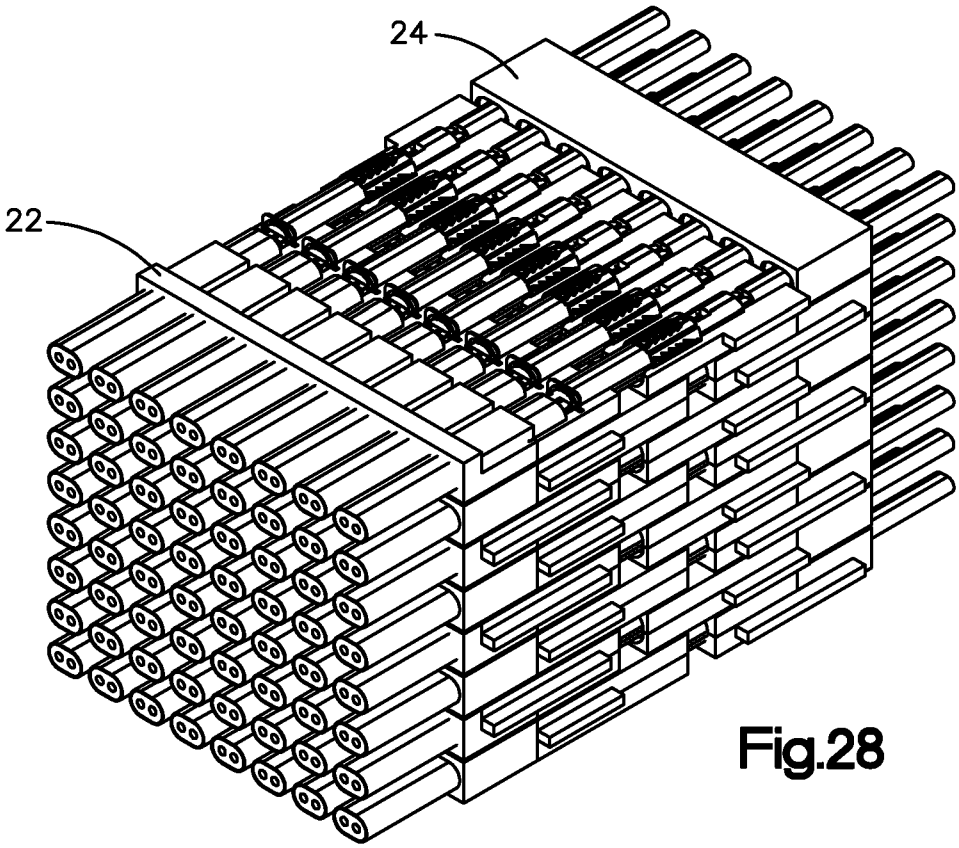

Fig.28

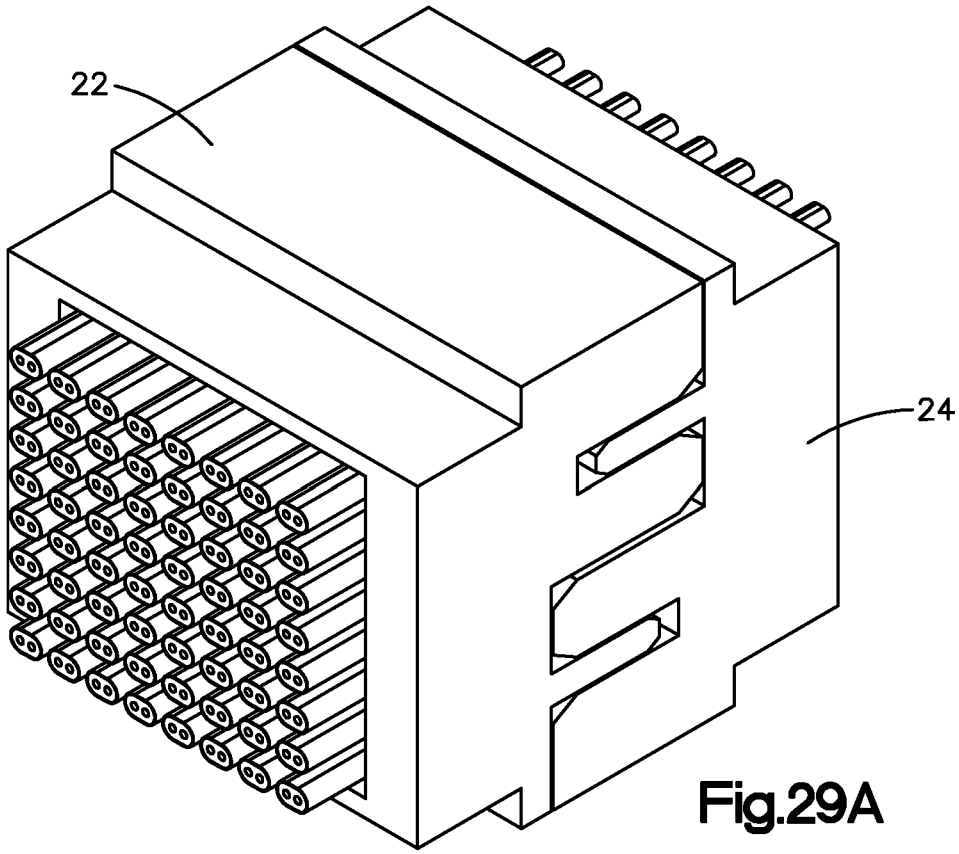

Fig.29A

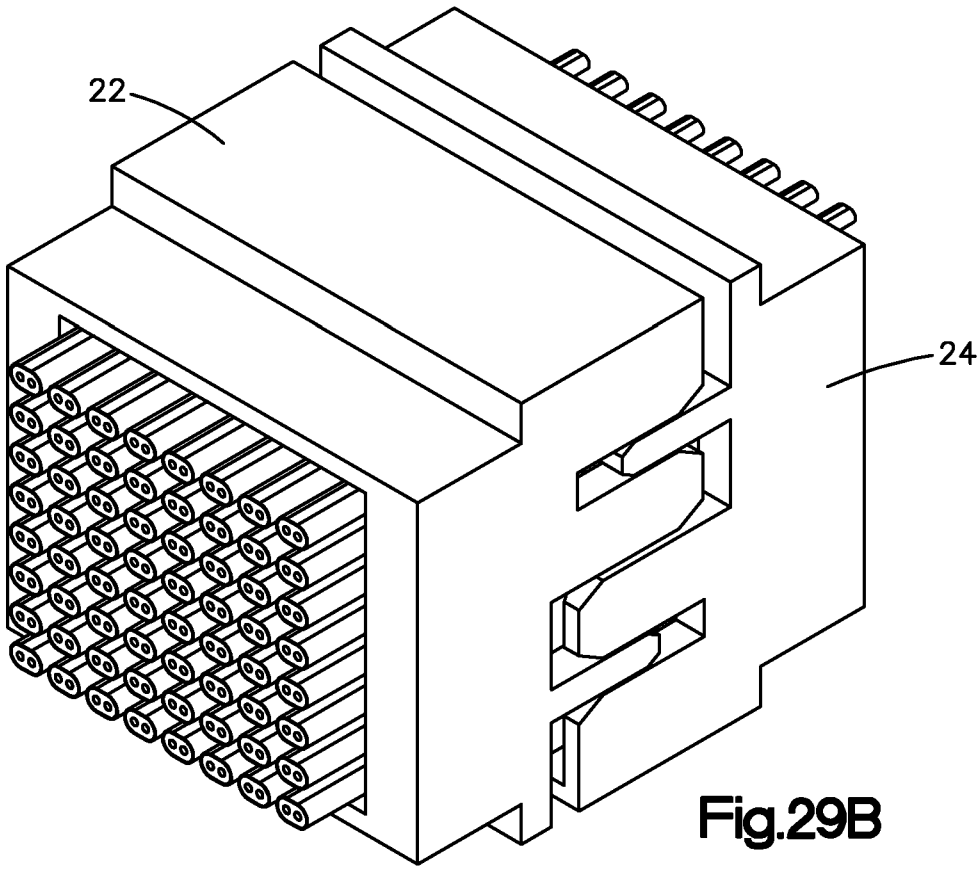

Fig.29B

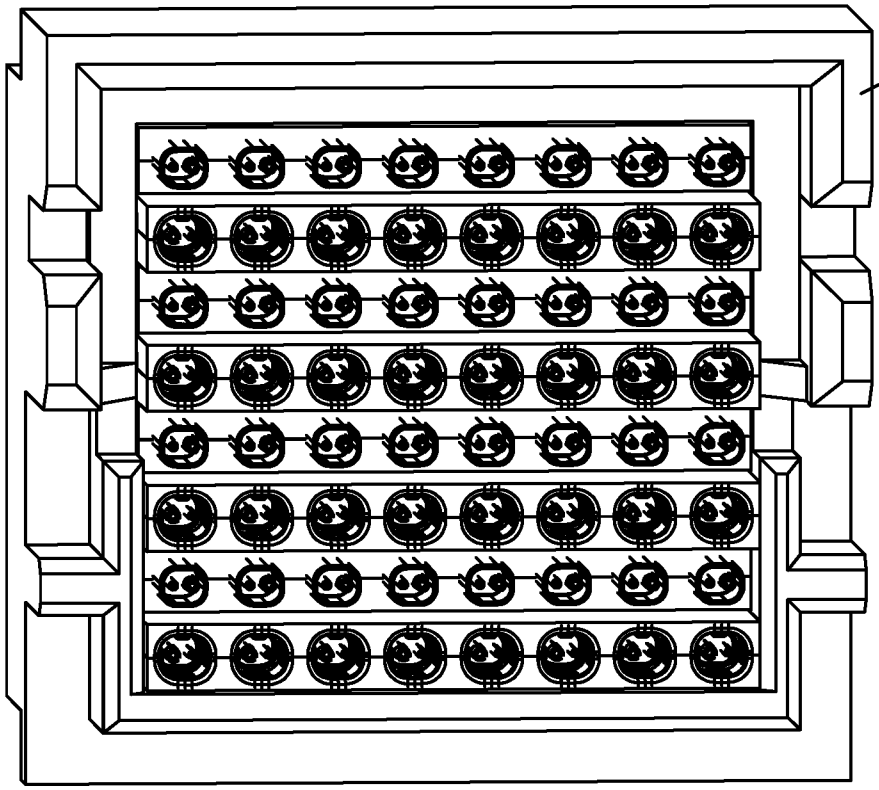

Fig.30

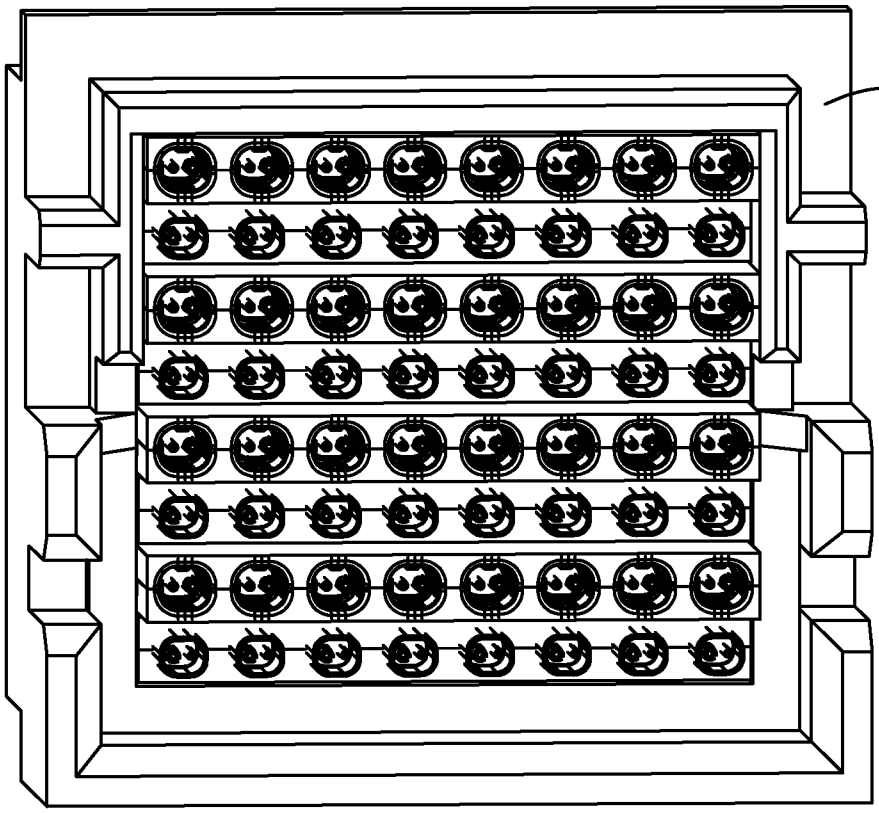

Fig.31

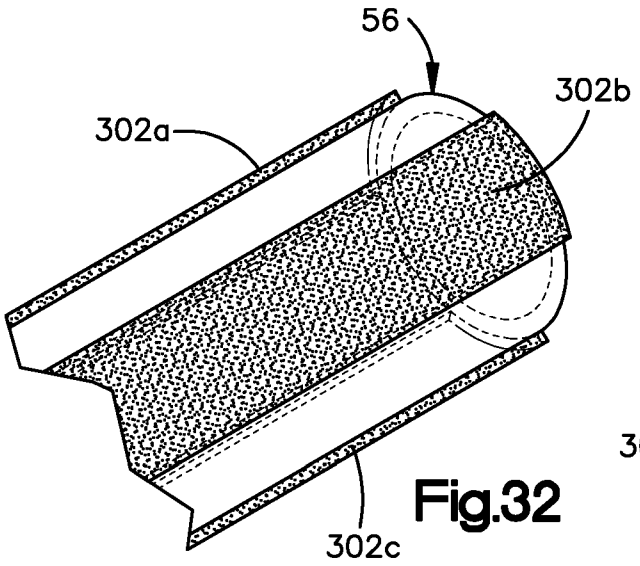

Fig.32

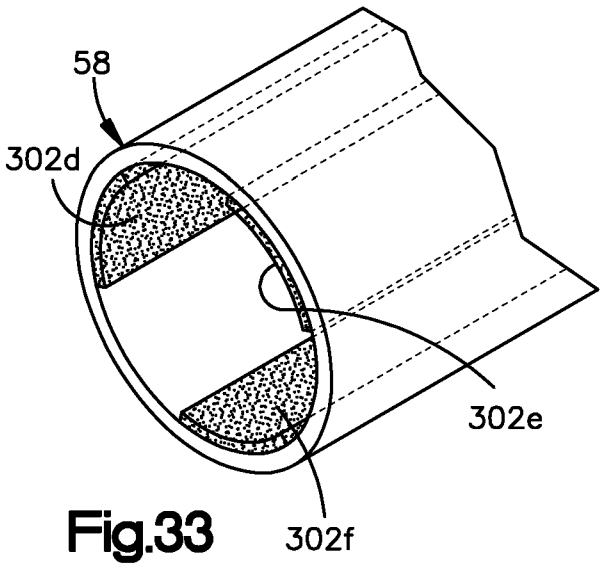

Fig.33

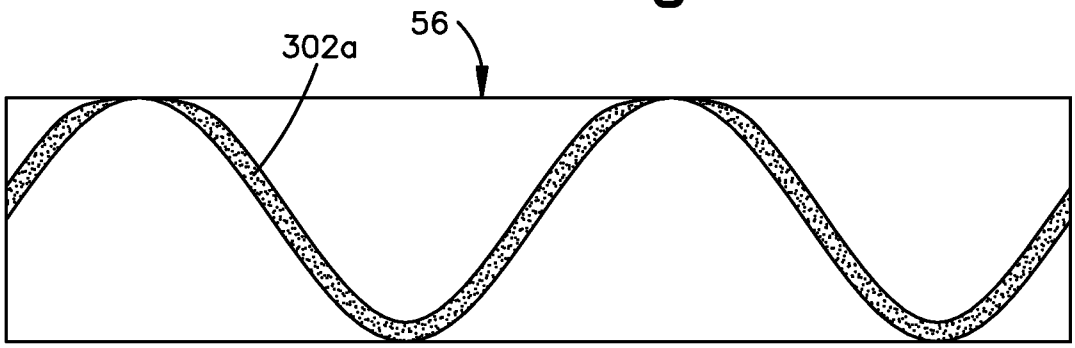

Fig.34

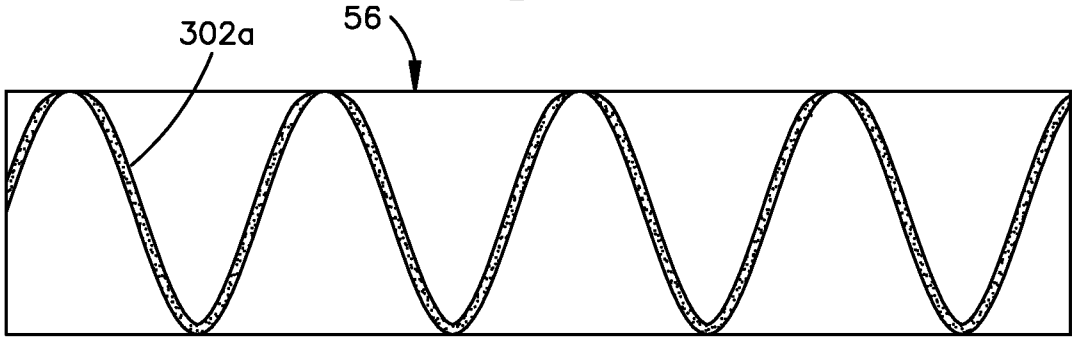

Fig.35

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2024/050868

A. CLASSIFICATION OF SUBJECT MATTER

H01R 13/6581(2011.01)i; **H01R 13/652**(2006.01)i; **H01R 12/75**(2011.01)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)

H01R 13/6581(2011.01); C22C 45/02(2006.01); C23C 30/00(2006.01); G02B 6/00(2006.01); H01R 13/424(2006.01); H01R 13/428(2006.01); H01R 13/6587(2011.01); H01R 13/6599(2011.01); H01R 4/48(2006.01); H05K 1/18(2006.01)

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
Japanese utility models and applications for utility models

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

eKOMPASS(KIPO internal) & Keywords: connector, contact, shield, ground, metallic glass

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2022-0224060 A1 (SAMTEC, INC.) 14 July 2022 (2022-07-14) paragraphs [0011]-[0206], claims 1, 5 and figure 5	1-3,49-52
Y		54-59
Y	JP 2011-094199 A (FURUKAWA ELECTRIC CO., LTD.) 12 May 2011 (2011-05-12) paragraph [0045] and figures 1-2	54-59
A	US 2016-0149318 A1 (UNID CO., LTD. et al.) 26 May 2016 (2016-05-26) claims 1-40	1-3,49-52,54-59
A	US 9899758 B1 (DELPHI TECHNOLOGIES, INC.) 20 February 2018 (2018-02-20) claims 1-14	1-3,49-52,54-59
A	US 2010-0182798 A1 (CHEN-JUNG CHEN et al.) 22 July 2010 (2010-07-22) claims 1-19	1-3,49-52,54-59

☐ 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
"D" document cited by the applicant in the international application
"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 another 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
31 January 2025	**31 January 2025**

Name and mailing address of the ISA/KR	Authorized officer
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INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2024/050868

Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. ☑ Claims Nos.: **6,9,14,21,24,26-27,31-32,38,40,43,48**
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

Claims 6,9,14,21,24,26-27,31-32,38,40,43,48 are unclear, because they refer to multiple dependent claims which do not comply with PCT Rule 6.4(a).

3. ☑ Claims Nos.: **4-5,7-8,10-13,15-20,22-23,25,28-30,33-37,39,41-42,44-47,53**
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/US2024/050868

Patent document cited in search report	Publication date (day/month/year)	Patent family member(s)	Publication date (day/month/year)
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		US 8206019 B2	26 June 2012