



- (51) **International Patent Classification:**
H01R 24/38 (2011.01) *H01R 13/639* (2006.01)
- (21) **International Application Number:**
PCT/US2014/061681
- (22) **International Filing Date:**
22 October 2014 (22.10.2014)
- (25) **Filing Language:** English
- (26) **Publication Language:** English
- (30) **Priority Data:**
61/895,912 25 October 2013 (25.10.2013) US
- (71) **Applicant (for all designated States except BR, CA, MX, US):** FCI ASIA PTE. LTD [SG/SG]; 159 Kampong Ampat, #04-01/04 KA Place, Singapore 368328 (SG).
- (71) **Applicant (for BR, CA, MX, US only):** FCI AMERICAS TECHNOLOGY LLC [US/US]; 502 East John Street, Carson City, Nevada 89706 (US).
- (72) **Inventors:** ZEREBILOV, Arkady; c/o FCI USA LLC, 825 Old Trail Road, Etters, Pennsylvania 17319 (US). SCHOLENO, Michael; c/o FCI USA LLC, 825 Old Trail Road, Etters, Pennsylvania 17319 (US). LORD, Hung Wei; c/o FCI USA LLC, 825 Old Trail Road, Etters, Pennsylvania 17319 (US). GARMAN, Joshua A.; c/o FCI USA LLC, 825 Old Trail Road, Etters, Pennsylvania 17319 (US). GROSS, Charles M.; c/o FCI USA LLC, 825 Old Trail Road, Etters, Pennsylvania 17319 (US). ELLISON,

Jason J.; c/o FCI USA LLC, 825 Old Trail Road, Etters, Pennsylvania 17319 (US).

(74) **Agent:** GEIBEL, Dean E.; Fci Usa Llc, 825 Old Trail Road, Etters, Pennsylvania 17319 (US).

(81) **Designated States** (unless otherwise indicated, for every kind of national protection available): AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IR, IS, JP, KE, KG, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) **Designated States** (unless otherwise indicated, for every kind of regional protection available): ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, ST, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, KM, ML, MR, NE, SN, TD, TG).

Published:

— with international search report (Art. 21(3))

(54) **Title:** ELECTRICAL CABLE CONNECTOR

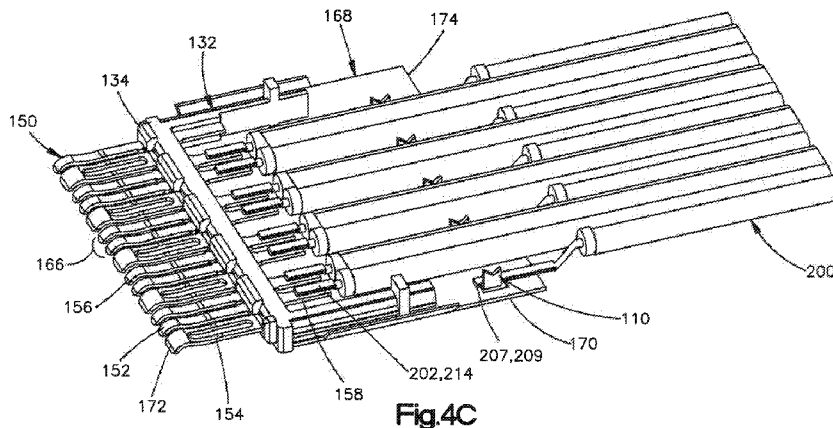


Fig.4C

(57) **Abstract:** Embodiments of an electrical connector assembly are disclosed. The electrical connector assembly can include an electrical connector having a connector housing and a leadframe supported by the connector housing. The leadframe includes an electrically conductive ground plate that includes a drain wire connection tabs that can attach to drain wires of respective electrical cables. The electrical connector assembly can further include a cable clip that supports the plurality of cables. The electrical connector assembly can further include a cable guide that directs the plurality of cables through the cable clip along a desired direction.

WO 2015/061390 A1

ELECTRICAL CABLE CONNECTOR

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This claims the benefit of U.S. Patent Application Serial No. 61/895,912 filed on October 25, 2013, the disclosure of which is hereby incorporated by reference as if set forth in its entirety herein.

BACKGROUND

[0002] Electrical connectors include dielectric or electrically insulative connector housings, and a plurality of electrical contacts supported by the housing. The electrical contacts define mating ends that are configured to mate with a complementary electrical connector. The mounting ends are configured to be mounted to a complementary electrical component. In some applications, the mounting ends are configured to be placed in communication with conductive cables that include electrical signal conductors and drain wires.

SUMMARY

[0003] In accordance with one embodiment, an electrical connector includes an electrically insulative connector housing, and a leadframe supported by the connector housing. The leadframe includes an electrically insulative leadframe housing and a plurality of electrical signal contacts supported by the leadframe housing. The electrical connector can further include an electrically conductive ground plate positioned adjacent to the leadframe housing, the ground plate including an electrically conductive plate body and a drain wire connection tab that projects out from the plate body. The electrical connector can be configured to receive at least one electrical cable such that signal conductors of the electrical cable are attached to the signal contacts and a drain wire of the electrical cable is mechanically attached to the drain wire connection tab, thereby placing the drain wire in electrical communication with the ground plate.

BRIEF DESCRIPTION OF THE DRAWINGS

[0004] The foregoing summary, as well as the following detailed description of example embodiments of the application, will be better understood when read in conjunction with the appended drawings, in which there is shown in the drawings example embodiments for the purposes of illustration. It should be understood, however, that the application is not limited to the precise arrangements and instrumentalities shown. In the drawings:

[0005] Fig. 1 is an exploded perspective view of an electrical connector system constructed in accordance with one embodiment, including a first electrical connector and a second electrical connector;

[0006] Fig. 2 is an end elevation view of an electrical cable configured to be placed in electrical communication with the first electrical connector;

[0007] Fig. 3 is an exploded perspective view of a leadframe assembly and a plurality of electrical cables illustrated in Fig. 2 configured to be placed in electrical communication with the leadframe assembly;

[0008] Fig. 4A is a perspective view of a portion of a leadframe assembly including a plurality of electrical signal contacts supported by a leadframe housing in accordance with one embodiment;

[0009] Fig. 4B is a perspective view of a portion of the leadframe assembly illustrated in Fig. 4A, but further including a plurality of electrical cables having electrical signal conductors mounted to respective ones of the signal contacts;

[0010] Fig. 4C is a perspective view of a portion of the leadframe assembly illustrated in Fig. 4B, but including a ground plate;

[0011] Fig. 4D is a perspective view of a portion of the leadframe assembly illustrated in Fig. 4C, but including a termination housing;

[0012] Fig. 4E is a perspective view of the leadframe assembly illustrated in Fig. 4D, further including a strain relief housing;

[0013] Fig. 5A is a perspective view of a ground plate constructed in accordance with an alternative embodiment;

[0014] Fig. 5B is a perspective view of a leadframe assembly constructed in accordance with an alternative embodiment;

[0015] Fig. 6A is a perspective view of a portion of a leadframe assembly constructed in accordance with an alternative embodiment, including a leadframe housing and a plurality of electrical signal contacts supported by the leadframe housing;

[0016] Fig. 6B is a perspective view of a portion of the leadframe assembly illustrated in Fig. 6A, but including a plurality of electrical cables having electrical signal conductors mounted to respective ones of the electrical signal contacts;

[0017] Fig. 6C is a perspective view of a portion of the leadframe assembly illustrated in Fig. 6B, but including a ground plate constructed in accordance with one embodiment;

[0018] Fig. 6D is a perspective view of a portion of the leadframe assembly illustrated in Fig. 6C, but including a termination housing;

[0019] Fig. 6E is a perspective view of the leadframe assembly illustrated in Fig. 6D, but including a termination housing;

[0020] Fig. 7A is a perspective view of a conventional cable bundle;

[0021] Fig. 7B is another perspective view of a conventional cable bundle;

[0022] Fig. 7C is another perspective view of a conventional cable bundle;

[0023] Fig. 8A is a perspective view of a cable bundle attached to a cable clip constructed in accordance with one embodiment;

[0024] Fig. 8B is a top plan view of a cable bundle attached to the cable clip illustrated in Fig. 8A;

[0025] Fig. 8C is a side elevation view of the cable bundle attached to the cable clip as illustrated in Fig. 8B

[0026] Fig. 8D is a top plan view of a plurality of wires of the cable bundle illustrated in Fig. 8B, shown with the outer sheath removed;

[0027] Fig. 8E is a side elevation view of the plurality of wires of the cable bundle illustrated in Fig. 8B, shown with the outer sheath removed

[0028] Fig. 8F is a top plan view of a conventional cable bundle, shown with the outer sheath removed;

[0029] Fig. 8G is a top plan view of a cable bundle arranged as when attached to the cable clip constructed in accordance with one embodiment, shown with the outer sheath removed;

[0030] Fig. 9A is an exploded perspective view of the cable clip illustrated in Fig. 8A;

[0031] Fig. 9B is a perspective view of the cable clip illustrated in Fig. 9A;

[0032] Fig. 10A is a perspective view of a cable guide that includes a guide body and the cable clip supported by the guide body;

[0033] Fig. 10B is a perspective view of the cable guide illustrated in Fig. 10A, but showing the cable clip exploded;

[0034] Fig. 10C is another perspective view of the cable guide illustrated in Fig. 10A;

[0035] Fig. 10D is a perspective view of the cable guide as illustrated in Fig. 10A, but including a slot for a band attachment; and

[0036] Fig. 10E is a perspective view of the cable guide illustrated in Fig. 10D, but showing the band attached.

DETAILED DESCRIPTION

[0037] For convenience, the same or equivalent elements in the various embodiments illustrated in the drawings have been identified with the same reference numerals. Referring initially to Fig. 1, an electrical connector system 20 constructed in accordance with one embodiment can include a first electrical connector assembly 22 and a second or complementary electrical connector assembly 24. The first electrical connector assembly 22 is configured to be mated with the second or complementary electrical connector assembly 24 in a mating direction M that is along a longitudinal direction L. The first electrical connector assembly 22 can include a first electrical connector 100 and at least one first electrical component such as at least one electrical cable 200, including a plurality of electrical cables 200. The complementary electrical assembly 24 can include a complementary or second electrical connector 300 and a second electrical component such as a substrate 400 that can be configured as a printed circuit board.

[0038] The first and second electrical connectors 100 and 300 can be configured to be mated with each other so as to establish an electrical connection between the first and second electrical connectors 100 and 300, and thus between the first and complementary electrical connector assemblies 22 and 24, respectively. The first electrical connector 100 can be configured to be mounted to the plurality of electrical cables 200 so as to place the first electrical connector 100 in electrical communication with the plurality of electrical cables 200. Similarly, the second electrical connector 300 can be configured to be mounted to the substrate 400 so as to establish an electrical connection between second electrical connector 300 and the substrate 400. Thus, the electrical cables 200 can be placed in electrical communication with the substrate 400 when the first and second electrical connectors 100 and 300 are mounted to the electrical cables 200 and the substrate 400, respectively, and mated to each other.

[0039] The substrate 400 can be provided as a backplane, midplane, daughtercard, or the like. The electrical cables 200 can include as signal conductors and at least one drain, power cables, optical cables, or any suitable alternatively constructed conductive cables. As illustrated in Fig. 2, each of the electrical cables 200 include at least one signal carrying conductor 202,

such as a pair of signal carrying conductors 202, and an electrically insulative layer 204 that surrounds each of the pair of signal carrying conductors 202. The electrically insulative layers 204 of each cable can reduce the crosstalk imparted by one of the conductors 202 of the cable 200 to the other of the conductors 202 of the cable 200. Each of the cables 200 can further include an electrically conductive ground jacket 206 that surrounds both of the respective insulative layer 204 of the cable 200. The ground jacket 206 can be connected to a respective ground plane of a complementary electrical component to which the cable 200 is mounted. For example, in accordance with the illustrated embodiment, the ground jacket 206 of each of the plurality of cables 200 can be placed into electrical communication with an electrically conductive ground plate 168 of the first electrical connector 100, as described in more detail below. For instance, in accordance with certain embodiments, the ground jacket 206 can carry a drain wire 207 (see Fig. 3) that, in turn, is connected to a ground contact 154 of the first electrical connector 100. Each of the cables 200 can further include an outer layer 208 that is electrically insulative and surrounds the respective ground jacket 206. Thus, each of the electrical cables 200 defines an outer electrically insulative layer that surrounds at least one or more up to all of the signal conductors 202, the ground jacket 206, and the drain wire 207. Respective exposed ends 214 of the conductors 202 can be exposed and configured to attach to respective mounting ends of signal contacts, and a portion of the drain wires 207 can be exposed and configured to attach to respective mounting ends of ground contacts. The exposed portions of the drain wires 207 can be recessed with respect to the exposed ends 214 of the conductors 202. The outer layer 208 can reduce the crosstalk imparted by the respective cable 200 to another one of the plurality of cables 200. The insulative layer 204 and the outer layer 208 can be constructed of any suitable dielectric material, such as plastic. The conductors 202 can be constructed of any suitable electrically conductive material, such as copper.

[0040] With continuing reference to Fig. 1, the first electrical connector assembly 22 can be referred to as an electrical cable assembly, including the first electrical connector 100 that can be referred to as a cable connector configured to be mounted to the plurality of electrical cables 200 so as to place the first electrical connector 100 in electrical communication with each of the plurality of electrical cables 200. The first electrical connector 100 can include a dielectric or electrically insulative connector housing 106 and a plurality of electrical contacts 150 that are supported by the connector housing 106. The plurality of electrical contacts 150 can include a plurality of signal contacts 152 and a plurality of ground contacts 154.

[0041] Referring also to Fig. 3, in accordance with one embodiment, the first electrical

connector 100 can include a plurality of leadframe assemblies 130 that are supported by the connector housing 106. Each of the leadframe assemblies 130 can include a dielectric or electrically insulative leadframe housing 132 and respective ones of the plurality of the electrical contacts 150 supported by the leadframe housing 132. Thus, it can be said that the electrical contacts 150 are supported by both the respective leadframe housing 132 and the connector housing 106. For instance, a plurality of signal contacts 152 can be supported by the leadframe housing 132 so as to define a leadframe 133.

[0042] In accordance with the illustrated embodiment, the first electrical connector 100 is constructed as a vertical electrical connector. In particular, the connector housing 106 defines a mating interface 102 that is configured to engage a complementary mating interface of the second electrical connector 300 when the first and second electrical connectors 100 and 300 mate with each other. The connector housing 106 further defines a mounting interface 104 that is configured to engage the electrical cables 200 when the first electrical connector 100 is mounted to the electrical cables 200. The mating interface 102 can be oriented parallel to the mounting interface 104. Further, the electrical contacts 150 include electrical signal contacts 152 and ground contacts 154. The electrical signal contacts 152 define respective mating ends 156 that are configured to mate with complementary mating ends of electrical contacts of the second electrical connector 300, and respective mounting ends 158 that are configured to be placed in electrical communication with, for instance mounted to, respective ones of the conductors 202 of the electrical cables 200. The mating ends 156 are oriented parallel to the mounting ends 158, such that the electrical signal contacts 152 can be referred to as vertical contacts. Alternatively, the first electrical connector 100 can be configured as a right-angle electrical connector whereby the mating interface 102 and the mounting interface 104 are oriented perpendicular with respect to each other, and the mating ends 156 and the mounting ends 258 are oriented perpendicular to each other.

[0043] Each of the ground contacts 154 can define respective ground mating ends 172 that extend along or parallel to the mating interface 102, and ground mounting ends 174 that extend along or parallel to the mounting interface 104 and can be in electrical communication with the ground mating ends 172. Thus, it can be said that the electrical contacts 150 can define mating ends, which can include the mating ends 156 of the electrical signal contacts 152 and the ground mating ends 172, and the electrical contacts 150 can further define mounting ends, which can include the mounting ends 158 of the electrical signal contacts 152 and the ground mounting ends 174. Each ground contact 154, including the ground mating ends 172 and the ground

mounting ends 174, can be defined by a ground plate 168 of the respective leadframe assembly 130. The ground plate 168 can be positioned adjacent to the leadframe housing 132. For instance, the ground plate 168 can be supported by the leadframe housing 132. The ground plate 168 can be electrically conductive as desired, and can reduce crosstalk between the electrical signal contacts 152 of adjacent leadframe assemblies 130. Thus, the ground plate 168 can be said to define a crosstalk shield. Alternatively, the ground mating ends 172 and ground mounting ends 174 can be defined by individual ground contacts as desired. Thus, reference herein to one or more components of a ground contact can refer to components of one of the ground plates 168, or can refer to components of individual ground contacts. Furthermore, reference to a ground contact can refer to a ground plate 168 or an individual ground contact having a single ground mating end 172 and a single ground mounting end 174. It should be further appreciated that the mating ends 156 and the ground mating ends 172 can be configured as receptacle contacts. The first electrical connector 100 can be constructed in accordance with any suitable embodiment as desired. For instance, the first electrical connector 100 can be configured as described in U.S. Patent Application Serial No. 13/836,610 filed March 15, 2013, the disclosure of which is hereby incorporated by reference as if set forth in its entirety herein.

[0044] As illustrated in Figs. 3 and 4A-4B, the leadframe housing 132 can be overmolded onto the respective ones of the electrical contacts 150, such as the signal contacts 152 so as to define an insert molded leadframe assembly (IMLA). Alternatively, respective ones of the electrical contacts 150, such as the signal contacts 152, can be stitched into the leadframe housing 132 or otherwise supported by the leadframe housing 132 as desired. Respective ones of the plurality of electrical contacts 150 of each of the leadframe assemblies 130 can be arranged along a column direction, which extends along a transverse direction T that is perpendicular to the longitudinal direction L. Adjacent ones of the leadframe assemblies 130 can be spaced along a row direction that is perpendicular to the column direction. For instance, the row direction can extend along a lateral direction A that is perpendicular to both the longitudinal direction L and the transverse direction T.

[0045] The electrical signal contacts 152 and ground contacts 154 can be arranged in any manner as desired. For instance, adjacent signal contacts 152 can define differential signal pairs 166 or single ended signal contacts as desired. One or more of the ground contacts 154 can be disposed between adjacent pairs of differential signal pairs 166. For instance, when ground plate 168 is supported by the leadframe housing 132, the signal contacts 152 and the ground contacts 154 can be said to be supported by the leadframe housing 132. When the electrical

contacts 150 are supported by respective leadframe housings 132, adjacent signal contacts 152, for instance along the column direction, can define differential signal pairs 166. The leadframe assemblies 130 can include ground contacts 154 disposed between adjacent pairs of differential signal pairs 166 along the column direction. When the first electrical connector 100 is mounted to the electrical cables 200, the signal contacts 152 are placed in electrical communication with the conductors 202 as illustrated in Fig. 4B, and the ground contacts 154 are placed in electrical communication with the drain wire 207, as illustrated in Fig. 4C. Thus, the ground contacts 154 can further be placed in electrical communication with the ground jacket 206 .

[0046] Referring again to Figs. 3 and 4A-4B, each leadframe assembly 130 includes a plurality of signal contacts 152 that are supported by the leadframe housing 132 and a ground contact 154 configured as the electrically conductive ground plate 168. The signal contacts 152 can be overmolded by the dielectric leadframe housing 132 such that the leadframe assemblies 130 are configured as insert molded leadframe assemblies (IMLAs), or the signal contacts 152 can be stitched into or otherwise supported by the leadframe housing 132. The ground plate 168 can be attached to the dielectric leadframe housing 132 (see Fig. 4C). The signal contacts 152, including the mating ends 156 and the mounting ends 158, of each leadframe assembly 130 are spaced from each other along the column direction. The leadframe assemblies 130 can be spaced along the lateral direction A in the connector housing 106.

[0047] The leadframe housing 132 includes a housing body 134 that defines a front wall 136 that defines extends along the lateral direction A and defines opposed first and second ends that are spaced apart from each other along the lateral direction A. The front wall 136 can be configured to at least partially support the respective signal contacts 152 of the leadframe assembly 130. For example, in accordance with the illustrated embodiment, the signal contacts 152 are supported by the front wall 136 such that the signal contacts 152 are disposed between the first and second ends of the front wall 136. Furthermore, the front wall 136 is disposed between the mating ends 156 and the mounting ends 158. The leadframe 133 can be configured such that the plurality of mating ends 156 extend from the leadframe housing 132 along the longitudinal direction L, and in the mating direction M.

[0048] The leadframe housing 132 can further define first and second attachment arm 138 and 140, respectively, that extend rearward from the front wall 136 along the longitudinal direction L. The first and second attachment arm 138 and 140 can operate as attachment locations for at least one or both of the ground plate 168 and an electrically conductive termination housing 190. The leadframe housing 132 can alternatively or additionally include

any suitable attachment locations as desired. The termination housing 190 can be a metal, and die cast, in accordance with one embodiment, or made from any suitable alternative material, for instance a lossy material that can be electrically conductive or nonconductive as desired, and made from any suitable method as desired. The first attachment arm 138 can be disposed closer to the first end of the front wall 136 than to the second end, for example substantially at the first end. Similarly, the second attachment arm 140 can be disposed closer to the second end of the front wall 136 than to the first end, for example substantially at the second end.

[0049] Each cable 200 can define an end 212 that can be configured such that respective portions of each of the signal carrying conductors 202 are exposed, the exposed portion of each signal carrying conductor 202 defining a respective exposed signal conductor end 214. Respective portions of the insulative and outer layers 204 and 208, respectively, and the ground jacket 206 of each cable 200 (see Fig. 2) can be removed from the respective signal carrying conductors 202 at the end 212 so as to expose the signal conductors ends 214. The respective portions of the insulative and outer layers 204 and 208, respectively, and the ground jacket 206 of each cable 200 can be removed such that each signal conductor end 214 extends outward from the insulative and outer layers 204 and 208, respectively, and the ground jacket 206 along the longitudinal direction L. Alternatively, the plurality of cables 200 can be manufactured such that the respective signal carrying conductors 202 extend longitudinally outward from the insulative and outer layers 204 and 208, respectively, and the ground jacket 206 at the end 212 of each cable 200, so as to expose the conductor ends 214. Additionally, a portion of the outer layer 208 rearward of the conductor end 216 of each cable 200 can be removed, thereby defining a respective exposed portion 209 of the drain wire 207 of each cable 200. Alternatively, the plurality of cables 200 can be manufactured with at least a portion of the outer layer 208 removed so as to define the exposed portions 209 of the drain wires 207.

[0050] As illustrated in Fig. 4B, the electrical connector 100 is configured to receive at least one electrical cable 200 such that signal conductors 202 of the electrical cable 200 are attached to one of the signal contacts 152, for instance to the mounting end 158. The drain wire 207 of the electrical cable 200 is mechanically attached to the ground plate 168 as illustrated in Fig. 4C. For instance, each of the electrical cables 200 can have an end 212 that defines an exposed end 214 of the conductors 202 that is configured to be mounted or otherwise attached to the signal contacts 152, and thus to the leadframe 133. The drain wires 207 can have an exposed portion 209 that is configured to be mounted or otherwise attached to the ground contact 154,

and in particular the ground plate 168, so as to place the ground jacket 206 in electrical communication with the ground plate 168.

[0051] Referring again to Figs. 1-4B, the signal contacts 152 define respective mating ends 156 that are arranged along, and are thus parallel with, the mating interface 102, and mounting ends 158 that are arranged along, and are thus parallel with, the mounting interface 104. The mating end 156 of each signal contact 152 can be constructed as a receptacle mating end that defines a curved tip 164. The signal contacts 152 can be arranged in pairs 166, which can define edge-coupled differential signal pairs. Any suitable dielectric material, such as air or plastic, may be used to isolate the signal contacts 152 from one another. The mounting ends 158 can be provided as cable conductor mounting ends, each mounting end 158 configured to be placed in electrical communication with a signal conductor end 214 of a respective one of the plurality of cables 200.

[0052] Referring now to Figs. 3 and 4C in particular, the ground plate 168 includes the electrically conductive plate body 170. The plate body 170 can be a metallic plate body. The plate body 170 can be substantially planar as illustrated, or can define any suitable shape and size as desired. The ground plate 168 can be configured such that the plurality of ground mating ends 172 extend from the plate body 170, for instance forward from the plate body 170 along the longitudinal direction L, and in the mating direction M. The ground mating ends 172 can be monolithic with the plate body 170 as illustrated. The ground mounting ends 174 can be defined by the ground plate body 170, and thus can be continuous with each other along the transverse direction T. As described above, the ground plate 168 can be said to define a crosstalk shield, such that the plate body 170 can define a metallic shield body. The ground mating ends 172 are aligned along the transverse direction T. Each ground mating end 172 can be constructed as a receptacle ground mating end that defines a curved tip 180. The plate body 170 defines a first plate body surface that can define an inner surface 170a and an opposed second plate body surface that can define a second or outer surface 170b of the body of the ground plate 168. The outer surface 170b is spaced from the inner surface 170a, along the lateral direction A. The inner surface 170a faces the plurality of cables 200 when the ground plate 168 is attached to the leadframe housing 132. The ground plate 168 can further include opposed first and second side walls that are spaced apart from each other along the transverse direction T such that the leadframe housing 132 can be received between the first and second side walls in an interference fit, for example by pressing the leadframe housing 132 toward the ground plate 168 such that the leadframe housing 132 snaps into place between the first and second side walls. Each of the first

and second side walls can include a wing that extends outwardly from the ground plate body 170 along the transverse direction T, the wings configured to be supported by the connector housing 106 when the leadframe assembly 130 is inserted into and mounted to the connector housing 106. The ground plate 168 can be formed from any suitable electrically conductive material. For instance, the ground plate 168 can be formed from a metal.

[0053] Because the mating ends 156 of the signal contacts 152 and the ground mating ends 172 of the ground plate 168 are provided as receptacle mating ends and receptacle ground mating ends, respectively, the first electrical connector 100 can be referred to as a receptacle connector as illustrated. In accordance with the illustrated embodiment, each ground plate 168 can define a plurality of signal pairs 166, which can define differential signal pairs, and an extra single signal contact 142 reserved. For instance, the ground plate 168 can define five ground mating ends 172 and nine signal contacts 152. The nine signal contacts 152 can include four pairs 166 of signal contacts 152 configured as edge-coupled differential signal pairs, with the ninth signal contact 152 reserved. The ground mating ends 172 and the mating ends 156 of the signal contacts 152 of each leadframe assembly 130 can be arranged in a column that extends along the column direction. Thus, the ground mating ends 172 are aligned with the mating ends 156 of the signal contacts 152 when the ground plate 168 is positioned adjacent to the leadframe housing 132. In accordance with one embodiment, the ground mating ends 172 are aligned with the mating ends 156 of the signal contacts 152 when the ground plate 168 is supported by the leadframe housing 132. The differential signal pairs 166 can be disposed between successive ground mating ends 172, and the extra ninth signal contact 152 can be disposed adjacent one of the ground mating ends 172 at the end of the column.

[0054] Each of the plurality of leadframe assemblies 130 can include a plurality of first leadframe assemblies 130 provided in accordance with a first configuration and a plurality of second leadframe assemblies 130 provided in accordance with a second configuration. The termination housing 190 or other component of the leadframe assembly 130 can include a first indicator, such as an "A" to identify one of the first plurality of leadframe assemblies 130, and a second indicator such as a "B" to identify one of the second plurality of leadframe assemblies 130. In accordance with the first configuration, the extra signal contact 152 of the first leadframe assembly 130 is disposed at an upper end of the column of electrical contacts 150. In accordance with the second configuration, the extra signal contact 152 of the second leadframe assembly 130 is disposed at a lower end of the column of electrical contacts 150. It should be appreciated that the respective leadframe housings 132 of the first and second leadframe assemblies 130 can be

constructed substantially similarly but with structural differences accounting for the respective configurations of electrical contacts 150 within the first and second leadframe assemblies 130 and for the configurations of the respective ground plates 168. It should further be appreciated the illustrated ground plate 168 is configured for use with the first leadframe assembly 130, and that the ground plate 168 configured for use with the second leadframe assembly 130 may define the ground mating ends 172 at locations along the plate body 170 that are different from those of the ground plate 168 configured for use with the first leadframe assembly 130.

[0055] With continuing reference to Figs. 3 and 4C, the ground plate 168 includes the metallic plate body 170 and a plurality of drain wire connection tabs 110 that project out from the plate body 170, for instance at the ground mounting end 174. The drain wire connection tabs 110 are configured to attach to respective ones of the exposed portions of the drain wires 207, such that the plate body 170 places the attached drain wires 207 in electrical communication with each other. The first electrical connector 100 is configured to receive the electrical cables 200 such that signal conductors 202 of the electrical cable are attached to the signal contacts 152 and the drain wires 207 are mechanically attached to respective ones of the drain wire connection tab 110. The drain wire connection tab 110 includes a tab body 112 having a proximal end 112a that is attached to the plate body 170 and a free distal end 112b opposite the proximal end 112a, the free distal end 112b spaced from the proximal end 112a, for instance along the lateral direction A. The drain wire connection tabs 110 can be configured as a crimp member that is movable with respect to the plate body 170 such that the free distal end 112b moves toward the plate body 170, thereby capturing the exposed portion 209 of the drain wire 207 in electrical communication with the ground plate 168. For instance, the tab body 112 can be placed adjacent the tab body 112, and the tab body 112 can be bent toward the plate body 170 so as to capture the exposed portion 209 of the drain wire between the tab body 112 and the plate body 170. Alternatively, the tab body 112 can be crimped about the drain wire 207. Alternatively still, the exposed portions 209 of the drain wires 207 can be attached, for instance soldered or welded, to the drain wire connection tab 110 so as to place the drain wires 207 in electrical connection with the ground plate 168 and each other.

[0056] The drain wire connection tab 110 can be cut out from the plate body 170 so as to define an aperture 116 that extends through the plate body 170. The drain wire connection tab 110 can then be bent so as to project out from the plate body 170 such that the drain wire connection tab 110 defines the proximal end 112a and the free distal end 112b. The drain wire connection tab 110 can be attached to the plate body 170 at an interface 114. The interface 114

can be elongate along the mating direction M, and thus substantially parallel to the ground mating ends 172.

[0057] Referring now also to Fig. 4D, the leadframe assembly 130, and thus the electrical connector 100, can further include the termination housing 190 that is configured to secure to the leadframe housing 132 so as to capture the exposed portions of the outer insulative layer of the electrical cables 200 between the ground plate 168 and the termination housing 190. The termination housing 190 can further be configured to isolate each of the electrical cables 200 from the others of the electrical cables 200. The termination housing 190 can be electrically conductive, and includes an electrically conductive body 192 that can be configured to attach to the ground plate 168. In accordance with one embodiment, the electrically conductive body 192 is metallic. The termination housing 190 can cover at least a portion of a first side of the leadframe assembly 130 such that the signal contacts 152 are disposed between the ground plate 168 and the termination housing 190. The termination housing 190 can further include a second portion that covers at least a portion of a second side of the leadframe assembly 130 that is opposite the first side. The first and second portions of the termination housing 190 can be attached to each other so as to capture the ground plate 168 between the first and second portions. For instance, the first and second portions of the termination housing 190 can be welded, soldered, clipped, or otherwise attached to each other. The signal conductors 202 attach to the mounting ends 158 at a location, and the termination housing 190 can cover and substantially encapsulate the location. For instance, the exposed portions of the signal conductors 202 can be soldered, welded, or otherwise attached to respective ones of the mounting ends 158 in any manner as desired. In accordance with one embodiment, the termination housing 190 can secure the ground plate 168 to the leadframe housing 132.

[0058] With continuing reference to Figs. 3 and 4E, the leadframe assembly 130, and thus the electrical connector 100, further includes a dielectric or electrically insulative strain relief housing 120 that encapsulates at least a connection location between the drain wire 207 and drain wire connection tab 110. For instance, the strain relief housing 120 can encapsulate the exposed portion of the drain wire and an entirety of the ground plate 168 that extends out from the termination housing 190. Thus, the strain relief housing 120 further encapsulates the drain wire connection tabs 110. Further, the strain relief housing 120 can surround at least a length of the outer electrically insulative layer of the electrical cables 200. In accordance with one embodiment, the strain relief housing 120 is overmolded onto the cables 200, the exposed portions 209 of the drain wires 207, the drain wire connection tabs 110, and the ground mounting

end 174. Accordingly, a tensile load applied to the electrical cables 200, and in particular to the outer insulative layer, at a location outside the strain relief housing 120 will be absorbed by the strain relief housing 120, and will not be transferred to the attachment locations of either the drain wires 107 and the ground plate 168, or the signal conductors 202 and the signal contacts 152.

[0059] Referring now to Fig. 5A, it should be appreciated that the drain wire connection tabs 110 can be constructed in accordance with any alternative embodiment suitable to facilitate attachment of the drain wires 207 to the ground plate 168. For instance, the tab body 112 can include a pair of uprights 113 that extend out from the plate body 170, and a crossbar 115 that extends between the uprights 113, from one of the uprights to the other of the uprights at a location spaced from the plate body 170. Thus, the crossbar 115 can define the free distal end 112b. The crossbar 115 can extend substantially parallel to the plate body 170, or in any other direction as desired. Thus, the interface 114 can be elongate between the uprights 113, and thus along a direction that is angularly offset with respect to the mating direction M. For instance, the interface 114 can be elongate along a direction that is perpendicular to the mating direction M. Further, the drain wire connection tab 110 illustrated in Fig. 5A defines an opening 117 that extends through the tab body 112. For instance, the opening 117 can be defined between the uprights 113, and further between the crossbar 115 and the plate body 170. The opening 117 can be sized to receive the exposed portion 209 of the drain wire 207, such that the tab body 112 can be bent toward the plate body 170 so as to capture the exposed portion 209 of the drain wire between the tab body 112 and the plate body 170. Alternatively, the tab body 112 can be crimped about the drain wire 207. Alternatively still, the drain wire 207 can extend through the opening 117 and can contact the drain wire connection tab 110 without bending the tab 110 with respect to the plate body 170. For instance, the drain wire 207 can be bent as it extends through the opening so as to maintain contact with the drain wire connection tab 110. Thus, the strain relief housing 120 can be overmolded onto both the drain wire connection tabs 110 and the exposed portions 209 of the drain wires 207, thereby securing the drain wires 207 in contact with the respective drain wire connection tabs 110 either with or without first crimping the drain wire connection tabs 110 about the drain wires 207, or first bending the drain wire connection tabs 110 so as to capture the drain wires 207 between the drain wire connection tabs 110 and the plate body 170.

[0060] Because the drain wire connection tab 110 can be cut, for instance punched or stamped, from the plate body 170, the ground plate 168 can define an aperture 116 that extends

through the plate body 170. The aperture 116 can be sized and shaped substantially equal to the size and shape of the drain wire connection tab 110, or the aperture 116 can be expanded by removing additional material from the plate body 170. In accordance with one embodiment, the plate body 170 can define a projection 119 that at least partially defines the aperture 116 and can be equal in size and shape to the opening 117 that extends through the tab body 112. Thus, if it is desired to attach the exposed portion 209 of the drain wire 207 directly to the plate body 170, the exposed portion 209 can be attached (for instance, soldered, welded, or the like) to the projection 119. If it is desired to attach the drain wire 207 directly to the plate body 170, the drain wire connection tab can be removed.

[0061] Referring now to Fig. 5B, and as described above, the ground contacts 154 can be discrete ground contacts that are separate from each other, and include a ground contact body that defines their own ground mating end 172 and ground mounting end 174. Thus, the ground contacts 154 can be non-monolithic with respect to each other, and the ground mounting ends 174 can be spaced from each other along the transverse direction T. The ground contacts 154 and the signal contacts 152 can be supported by the leadframe housing 132. The ground contacts 154 and the signal contacts 152 can, for instance, be overmolded by the leadframe housing 132. Thus, the leadframe assembly 130 can include the leadframe housing 132, and the signal contacts 152 and ground contacts 154 that are all supported by the leadframe housing 132. The signal contacts 152 and ground contacts 154 can be overmolded by the leadframe housing 132 such that the leadframe is an insert molded leadframe, and the leadframe assembly 130 is an insert molded leadframe assembly. The exposed portions 209 of the drain wires 207 can be attached, for instance soldered, welded, or otherwise attached, to the mounting ends 174. The ground plate 168 can be supported adjacent the leadframe assembly 130, and in particular adjacent the leadframe housing 132. For instance, the ground plate 168 can be attached to the leadframe housing 132. When the ground plate 168 is supported adjacent, or attached to, the leadframe housing 132, the ground contacts 154 are placed in electrical contact with the ground plate 168, while the signal contacts 152 are spaced from the ground plate 168. For instance, each of the ground contacts 154 can include contact tabs 175 that project out from the ground contact body toward the ground plate 168 so as to make contact with the ground plate 168 when the ground plate 168 is supported adjacent the leadframe housing 132. Thus, the contact tabs 175 make contact with the ground plate 168 when the ground plate 168 is attached to the leadframe housing 132. Because the contact tabs 175 contact the ground plate 168, the ground contacts 154 are placed in electrical contact with the ground plate 168 and each other.

[0062] The contact tabs 175 can be cut, for instance punched or stamped, from the ground contact body, for instance at a location proximate to the mounting end 174. Thus, the ground contacts 154 can define an opening that extends through the ground contact body that defines a location of the ground contact body from which the contact tabs 175 were cut. The exposed portions 209 of the drain wires 207 can be attached to the mounting ends at a location that is spaced from the openings in a direction opposite the mating direction. As illustrated in Figs. 3 and 4D, the termination housing 190 is configured to secure to the leadframe housing 132 so as to capture the exposed portions of the outer insulative layer of the electrical cables 200, and in particular the conductors 202 and the drain wires 207, between the ground plate 168 and the termination housing 190. The termination housing 190 can further be configured to isolate each of the electrical cables 200 from the others of the electrical cables 200. The termination housing 190 can be electrically conductive, and includes an electrically conductive body 192 that can be configured to attach to the ground plate 168. In accordance with one embodiment, the electrically conductive body 192 is metallic. The electrically conductive body 192 can alternatively be made from a conductive lossy material. Alternatively, the body 192 of the termination housing can be made from a nonconductive material, such as a nonconductive plastic. The termination housing 190 can cover at least a portion of a first side of the leadframe assembly 130, such that the signal contacts 152 and ground contacts are disposed between the ground plate 168 and the termination housing 190. The termination housing 190 can further include a second portion that covers at least a portion of a second side of the leadframe assembly 130, and in particular the ground plate 168, that is opposite the first side, in the manner described above with respect to Figs. 3 and 4D.

[0063] Referring now to Figs. 6A-6E, the leadframe assembly 130 can be constructed substantially as described above with respect to Figs. 4A-E. The leadframe housing 132 can include a protective shroud 135 that surrounds the signal contacts 152 when the signal contacts 152 are supported by the leadframe housing 132, and further surrounds the ground mating end 172 when the ground plate 168 is supported by the leadframe 133. The shroud 135 can be removed from the housing body 134 prior to placing the electrical connector 100 in use. Further, as illustrated in Figs. 6C-6E, the exposed portions 209 of the drain wires 207 can extend through respective ones of the openings 117 so as to make contact with the respective drain wire connection tabs 110, and thus be placed in electrical communication with the ground plate 168 and each other. In accordance with the illustrated embodiment, the drain wire connection tab can be devoid of the crossbar 115 of Fig. 5A, so that the drain wires 207 can be inserted into the

respective openings 117 between the uprights 113 along a direction toward the ground plate so as to contact the uprights 113. For instance, the uprights 113 can be spaced from each other a distance substantially equal to or slightly less than a cross-sectional dimension of the respective drain wire 207. Thus, the strain relief housing 120 can be overmolded onto both the drain wire connection tabs 110 and the exposed portions 209 of the drain wires 207, thereby securing the drain wires 207 in contact with the respective drain wire connection tabs 110 without first crimping the drain wire connection tabs 110 about the drain wires 207, or first bending the drain wire connection tabs 110 so as to capture the drain wires 207 between the drain wire connection tabs 110 and the plate body 170. In accordance with another embodiment, each of the drain wire connection tabs 110 can further include an anti-backout tab that projects into the opening 117 and is angled forward along the mating direction as it extends into the opening. Thus, the anti-backout tab can be angled so as to allow the exposed portion 209 of the drain wire 207 to be inserted through the opening 117 along the mating direction, and prevent the drain wire 207 from being removed from the opening 117 in a direction opposite the mating direction. In particular, the anti-backout tab can bite into the drain wire 207 when a tensile force is applied to the drain wire 207 in the direction that is opposite the mating direction.

[0064] As illustrated in Fig. 1, the electrical connector system 20 is illustrated in accordance with one embodiment whereby the first and second electrical connectors 100 and 300 are configured to mate with each other in a shroud that extends through a panel. The second electrical connector 300 can be configured as a right angle connector so as to place the respective substrate in electrical connection with the cables 200. The first electrical connector 100 can include one or more guidance member, including an asymmetric guidance member that projects from the connector housing 106 along the mating direction. The guidance member can be rotated along an axis that extends along the longitudinal direction so as to position the asymmetric guidance member in one of a number of orientations in order to mate the first electrical connector with the second electrical connector 300.

[0065] The second electrical connector 300 can include a first dielectric or electrically insulative connector housing 302 and at least one electrical contact 304 such as a plurality of first electrical contacts 304 that are supported by the connector housing 302. In accordance with one embodiment, the second electrical connector 300 can include a plurality of leadframe assemblies that are supported by the connector housing 302. Each of the leadframe assemblies can include a dielectric or electrically insulative leadframe housing and respective ones of the plurality of the electrical contacts 304 supported by the leadframe housing. Thus, it can be said that the

electrical contacts 304 are supported by both the respective leadframe housing and the connector housing 302. For instance, the leadframe housing can be overmolded onto the respective ones of the electrical contacts 304 so as to define an insert molded leadframe assembly (IMLA), or the electrical contacts 304 can be stitched into the leadframe housing or otherwise supported by the leadframe housing. The respective ones of the plurality of electrical contacts 304 of each of the leadframe assemblies can be arranged along a column direction, which extends along a transverse direction T that is perpendicular to the longitudinal direction L. Adjacent ones of the leadframe assemblies can be spaced along a row direction that is perpendicular to the column direction. For instance, the row direction can extend along a lateral direction A that is perpendicular to both the longitudinal direction L and the transverse direction T.

[0066] In accordance with the illustrated embodiment, the second electrical connector 300 is constructed as a vertical electrical connector. In particular, the connector housing 302 defines a mating interface 306 that is configured to engage a complementary mating interface of the first electrical connector 100 when the first and second electrical connectors 100 and 300 mate with each other. The connector housing 302 further defines a mounting interface that is configured to engage the substrate 400 when the second electrical connector 300 is mounted to the substrate 400. Further, the electrical contacts 304 define respective mating ends that are configured to mate with complementary mating ends of electrical contacts of the first electrical connector 100, and respective mounting ends that are configured to be mounted to the substrate 400. The mating ends of the electrical contacts 304 are oriented parallel to the mounting ends, such that the electrical contacts 304 can be referred to as vertical electrical contacts.

Alternatively, the second electrical connector 300 can be configured as a right-angle electrical connector whereby the mating interface 306 and the mounting interface of the connector housing 302 are oriented perpendicular with respect to each other, and the mating ends and the mounting ends of the electrical contacts 304 are oriented perpendicular to each other. It should be further appreciated that the mating ends of the electrical contacts 304 can be configured as receptacle contacts.

[0067] The second electrical connector 300 can be constructed in accordance with any suitable embodiment as desired. For instance, the second electrical connector can be constructed as described in U.S. Patent Application Serial No. 13/836,610 filed March 15, 2013, the disclosure of which is hereby incorporated by reference as if set forth in its entirety herein. For instance, the electrical contacts 304 can include a plurality of signal contacts and ground contacts arranged in any manner as desired. For instance, adjacent signal contacts can define differential

signal pairs or single ended signal contacts as desired. For instance, each of the ground contacts of the second electrical connector 300 can define respective ground mating ends and ground mounting ends in electrical communication with the ground mating ends. Furthermore, each of the signal contacts of the second electrical connector 300 can define respective mating ends and mounting ends in electrical communication with the mating ends. Thus, it can be said that the mating ends of the electrical contacts 150 can define mating ends, which can include the mating ends of the electrical signal contacts and the ground mating ends, and the electrical contacts 1350 can further define mounting ends, which can include the mounting ends of the electrical signal contacts and the ground mounting ends. Because the mating ends of the signal contacts and the ground mating ends of the ground plate are provided as receptacle mating ends and receptacle ground mating ends, respectively, the second electrical connector 300 can be referred to as a receptacle connector. Each ground contact, including the ground mating ends and the ground mounting ends, can be defined by a ground plate of the respective leadframe assembly. The ground plate can be electrically conductive as desired. Alternatively, the ground mating ends and ground mounting ends can be defined by individual ground contacts as desired, and the ground plate can be devoid of ground mating ends and ground mounting ends. Thus, reference herein to one or more components of a ground contact can refer to components of one of the ground plates, or can refer to components of individual ground contacts. Furthermore, reference to a ground contact can refer to a ground plate or an individual ground contact having a single ground mating end and a single ground mounting end.

[0068] One or more ground contacts can be disposed between adjacent pairs of differential signal pairs. For instance, when the electrical contacts 304 are supported by respective leadframe housings, adjacent signal contacts, for instance along the column direction, can define differential signal pairs. The leadframe assemblies can include ground contacts disposed between adjacent pairs of differential signal pairs along the column direction. When the second electrical connector 300 is mounted to the substrate 400 along a mounting direction, the electrical contacts 304 are placed in electrical communication with electrical traces of the first substrate 400.

[0069] Referring now to Figs. 7A-7C and 8F, the present disclosure recognizes that conventional cable bundles 199 include a plurality of electrical cables bundled in an outer sheath 201 that contains a respective one of the bundles 119 of electrical cables. The cables of the cable bundle 199 are configured to be attached to an electrical connector 205 in any manner as desired. The electrical connector 205 can be mounted onto a panel 203, such that the cable bundle 199

extends out from the panel 203. Cable bundles 199 typically have a height H and a width W that is perpendicular to the height and substantially equal to the height. For instance, when the electrical connector 205 is attached to the cable bundle 199 and mounted to the panel 203, it is often desired to bend the cable bundles 199 so as to route them to a desired location. However, it has been found that the height H causes the cable bundles 199 to define a large bend radius R, which causes the cable bundles 199 to extend out from the panel 203 a distance that can either occupy valuable real estate in the cabinet, or can be greater than the permissible distance inside the cabinet, particularly when the cable bundles 199 are stacked on top of each other. As illustrated, the width W extends along a direction that is parallel to the face of the panel 203, and the height is perpendicular to the width W. At certain locations along the length of the cable bundle 199, the height can extend along a direction that intersects the panel 203, for instance substantially perpendicular to the face of the panel 203.

[0070] As illustrated in Figs. 8A-E and 8G, a cable assembly 500 constructed in accordance with one embodiment can include a cable bundle 502 that includes a plurality of electrical cables 200 (see Fig. 1) and an outer sheath 506 that surrounds the electrical cables 200. The electrical cables 200 can be attached to an electrical connector in any manner as desired, for instance as described above with respect to the first electrical connector 100. The conventional cable bundle 199 (see Fig. 7C) can define a height H1 that has been measured to be 23mm. The cable assembly 500 can include a cable clip 508 that includes a clip body 510 and an opening 512 that extends through the clip body 510. The opening 512 can have any size and shape as desired, and in accordance with the illustrated embodiment defines a height H2 that is less than the height H1 of the conventional cable bundle 199. For instance, the height H2 can be approximately 10mm, though it should be appreciated that the height H2 can be any distance as desired, depending for instance on the number of electrical cables of the cable bundle 502. It is recognized that by decreasing the height of the cable bundle 502 with respect to the prior art, the bend radius of the cable bundle 502 is reduced with respect to the bend radius of the conventional cable bundle 199, and that the bending force that causes the cable bundle 502 to bend along the bend radius is also reduced. Accordingly, a plurality of cable bundles 502 can be stacked on top of each other within the space permitted by the cabinet. For instance, the cable clips 508 of adjacent cable assemblies 500 can be stacked onto each other.

[0071] The cable bundles 502 can define a height H3 at locations spaced from the cable clip 508. The height H3 is greater than the height H2 in the opening 512 of the cable clip 508, and can be substantially equal to the height H1 of the conventional cable bundle 199. However,

because the cable clip 508 can be located at the bend radius, the reduced height H2 provides for a reduced bend radius with respect to the prior art, and reduced bending force. It should be appreciated that because the height H2 increases gradually to the increased height H3 at locations increasingly away from the cable clip 508, the bend radius can intersect the cable clip 508, or the cable clip 508 can be disposed adjacent, and thus spaced from, the bend radius. Thus, the height of the opening can be defined along the bend radius, or can be coplanar with the bend radius.

[0072] It is recognized that the cable clip 508 applies a compressive force to the cable bundle 502 that decreases the height, and accordingly causes the cables 200 of the cable bundle 502 to fan or spread out along the width, thereby increasing the width W2 to a width greater than the width W1 of the conventional cable bundle 199, shown in Fig. 8F. However, the increased width W2 is measured along a direction that is substantially perpendicular to the bend radius. The cable bundles 502 can define a width W3 at locations spaced from the cable clip 508. The width W3 is less than the width W2 at the opening 512 cable clip 508, and can be substantially equal to the width W1 of the conventional cable bundle 199. Fig. 8D and 8G illustrate the dimensions of the cables 200 with the outer sheath 506 removed to illustrate the compression of the cables 200 along the height and expansion of the cables 200 along the width when the cable clip 508 is attached. It should be appreciated that because the cable clip 508 surrounds the outer sheath 506 of the cable bundle 502, the cable clip 508 further surrounds the individual cables 200 as well. Alternatively, the cable bundle 502 can be devoid of the outer sheath 506, and the cable clip 508 can surround the individual cables 200 directly.

[0073] Thus, a method can be provided for managing a plurality of electrical cables 200. The method can include the steps of attaching the plurality of electrical cables 200 to the electrical connector 100 (see Fig. 1), such that the electrical cables 200 extend out from the electrical connector 100. The method can further include the step of securing the cable clip 508 onto the plurality of electrical cables 200 such that the electrical cables 200 extend through the opening 512 of the cable clip 508. The opening has a height and a width that is perpendicular to the height and greater than the height. The method can further include the step of bending the electrical cables about a bend radius that is substantially coplanar with the height. For instance, the bend radius can be substantially parallel to the height, and can define the height in accordance with certain embodiments. Thus, the height can be measured along the bend radius. The securing step can include the step of causing the cables 200 to expand away from each other along the width and to compress against each other along the height. The securing step can be performed before or after the attaching step. As will be described below with respect to Figs.

10A-10E, the bending step can further include directing the cables 200 along a cable guide 530 that defines the bend radius. The cable guide 530 can define a guide body 532 and the cable clip 508 that is supported by the guide body 532.

[0074] The method can further include the step of 1) attaching a second plurality of electrical cables to a second electrical connector, such that the second plurality of electrical cables extend out from the second electrical connector, 2) securing a second cable clip onto the second plurality of electrical cables such that the second plurality of electrical cables extend through a second opening of the second cable clip, the second opening having a height and a width that is perpendicular to the height and greater than the height, 3) bending the second plurality of electrical cables about a second bend radius that is substantially coplanar with the height of the second opening, and 4) stacking the cable clips onto each other along a direction that defines the respective heights.

[0075] Referring now to Figs. 8A-9B, the cable clip 508 includes the clip body 510 and the opening 512 that extends through the clip body 510. The opening 512 has a height that is less than the height of the plurality of electrical cables 200, for instance of the bundle 502 of electrical cables 200, and a width greater than the width of the plurality of electrical cables 200, for instance of the bundle 502 of electrical cables 200. The opening 512 can be sized such that when the plurality of electrical cables 200 extends through the opening 512, the height of the electrical cables 200 is decreased to the height of the opening 512, and the width of the plurality of electrical cables 200 is increased to the width of the opening 512. A cable assembly can include the cable clip 508 and the plurality of electrical cables 200. The width W_2 of the opening 512 is greater than the height H_2 of the opening, and can be less than any multiple of the height H_2 of the opening 512, for instance less than five times the height H_2 of the opening 512. In accordance with one embodiment, the width W_2 can be greater than three times the height H_2 of the opening 512 and less than four times the height H_2 of the opening 512. For instance, the width can be approximately 37 mm and the height can be approximately 10 mm.

[0076] The cable clip can include 508 a first component 514 defining a first portion 512a of the opening 512, and a second component 516 that defines a second portion 512b of the opening 512. The first and second components 514 and 516 are configured to be attached to each other about the plurality of electrical cables 200, for instance the cable bundle 502, to define the opening 512 such that the plurality of electrical cables 200 extends through the opening 512. The first and second components 514 and 516 can be hermaphroditic with each other. For instance, each of the first and second components 514 and 516 includes a body 518, and a pair of

legs 520 that extend out from the body 518. Each body 518 of the first and second components 514 and 516 can define a pair of recesses 522 that are sized to receive protrusions 524 of each of the pair of legs 520 of the other of the first and second components 514 and 516, thereby attaching the first and second components 514 and 516 to each other. It should be appreciated, of course, that the first and second components 514 and 516 can be attached to each other in accordance with any embodiment as desired. The first and second components 514 and 516, including the respective body 518 and legs 520, define respective inner surfaces 521 that, in combination, define the opening 512 of the cable clip 508 when the first and second components 514 and 516 are attached to each other. .

[0077] Referring now also to Figs. 10A-10E, the cable assembly can further include a cable guide 530 that includes a guide body 532 and the cable clip 508 that is supported by the guide body 532. For instance, at least one of the first and second components, such as the first component 514, can be monolithic with the guide body 532. The guide body 532 defines a guide surface 534 that can be curved. For instance, the guide surface 534 can be convex. The guide surface 534 can define a bend radius R . Alternatively, the guide surface 534 can define any sized and shaped curvature as desired. The opening 512 of the cable clip 508 can be operatively aligned with the guide surface 534 such that when the plurality of cables extends along the guide surface 534, the plurality of cables further extends through the opening 512. The guide surface 534 can include a base 535a and a pair of side walls 535b that extend out from the base, such that the supported plurality of cables 200 are disposed between the side walls. Accordingly, the base 535a and the side walls 535b can cooperate to define the guide surface 534. The bundle 502 of electrical cables 200 can be supported by the base 535a at a location between the side walls 535b, so as to extend through the opening 512. The cable guide 530 can further include a slot 538 that extends into an outer surface of the guide body 532 that is opposite the guide surface 534. The slot 538 can be defined by both the base 535a and each of the pair of side walls 535b. The slot 538 can extend into the outer surface toward the guide surface 534, but can terminate prior to reaching the guide surface 534. The cable assembly can further include a band 541 that is configured to extend about the cable guide 530 in the slot 538 further extend about and the plurality of cables 200 so as to secure the plurality of cables 200 to the cable guide 530. The band 541 can include any suitable mounting apparatus 543 that is configured to be mounted onto the panel. In accordance with the illustrated embodiment, the guide surface 534 defines a first end 534a and a second end 534b that is opposite the first end 534a. The guide surface 534 can be configured such that the first end 534a is oriented perpendicular to the second end 534b. The

cable clip 508 can be supported by the guide body 532 at the second end 534b of the guide surface 534. The cable guide 530 is configured to be supported adjacent to the electrical connector 100 at a location proximate to the first end 534a of the guide surface 534

[0078] The foregoing description is provided for the purpose of explanation and is not to be construed as limiting the invention. While various embodiments have been described with reference to preferred embodiments or preferred methods, it is understood that the words which have been used herein are words of description and illustration, rather than words of limitation. Furthermore, although the embodiments have been described herein with reference to particular structure, methods, and embodiments, the invention is not intended to be limited to the particulars disclosed herein. For instance, it should be appreciated that structure and methods described in association with one embodiment are equally applicable to all other embodiments described herein unless otherwise indicated. Those skilled in the relevant art, having the benefit of the teachings of this specification, may effect numerous modifications to the invention as described herein, and changes may be made without departing from the spirit and scope of the invention, for instance as set forth by the appended claims.

What is Claimed:

1. An electrical connector comprising:
an electrically insulative connector housing; and
a leadframe supported by the connector housing, the leadframe including an electrically insulative leadframe housing and a plurality of electrical signal contacts supported by the leadframe housing; and
an electrically conductive ground plate positioned adjacent to the leadframe housing, the ground plate including an electrically conductive plate body and a drain wire connection tab that projects out from the plate body;
wherein the electrical connector is configured to receive at least one electrical cable such that at least one signal conductor of the electrical cable is attached to a corresponding at least one of the signal contacts, and a drain wire of the electrical cable is mechanically attached to the drain wire connection tab, thereby placing the drain wire in electrical communication with the ground plate.
2. The electrical connector as recited in claim 1, wherein the plate body is substantially planar.
3. The electrical connector as recited in any one of the preceding claims, wherein the ground plate further comprises a plurality of ground mating ends that extend from the plate body.
4. The electrical connector as recited in claim 3, wherein the ground plate further comprises a plurality of ground mating ends are monolithic with the plate body.
5. The electrical connector as recited in any one of the preceding claims, wherein the ground plate is supported by the leadframe housing.
6. The electrical connector as recited in any one of the preceding claims, wherein the drain wire connection tab defines a tab body having a proximal end that is attached to the ground plate and a free distal end opposite the proximal end, the free distal end spaced from the proximal end.
7. The electrical connector as recited in claim 6, wherein the drain wire connection tab comprises a crimp member movable with respect to the plate body such that the free distal end moves toward the plate body, thereby capturing the drain wire in electrical communication with the ground plate.

8. The electrical connector as recited in any one of the preceding claims, configured to mate with a complementary electrical connector along a mating direction, wherein the drain wire connection tab is attached to the plate body at an interface that is elongate along the mating direction.
9. The electrical connector as recited in any one of claims 1-7, configured to mate with a complementary electrical connector along a mating direction, wherein the drain wire connection tab is attached to the plate body at an interface that is elongate along a direction that is angularly offset with respect to the mating direction.
10. The electrical connector as recited in claim 9, wherein the direction is perpendicular to the mating direction.
11. The electrical connector as recited in any one of the preceding claims, wherein the drain wire connection tab is cut out from the plate body.
12. The electrical connector as recited in any one of the preceding claims, wherein the drain wire connection tab includes a tab body and an opening that extends through the tab body, the opening sized to receive the drain wire.
13. The electrical connector as recited in claim 12, configured to mate with a complementary electrical connector along a mating direction, wherein the opening extends through the tab body along the mating direction.
14. The electrical connector as recited in any one of claims 12 to 13, wherein the opening is sized to maintain connection between the tab body and the drain wire, when the drain wire extends through the opening, without bending the tab body toward the plate body.
15. The electrical connector as recited in any one of the preceding claims, wherein the drain wire connection tab comprises an anti-backout tab that projects into the opening so as to allow insertion of the drain wire through the opening in a mating direction, but prevents the drain wire from being removed from the opening in a direction opposite the mating direction.
16. The electrical connector as recited in any one of the preceding claims, further comprising a strain relief housing that surrounds at least a connection location between the drain wire and drain wire connection tab.

17. The electrical connector as recited in any one of the preceding claims, wherein the at least one electrical cable includes an outer electrically insulative layer that surrounds at least one or both of the signal conductors and the drain wire, and the strain relief housing further surrounds at least a length of the outer electrically insulative layer.
18. The electrical connector as recited in any one of claims 16 to 17, wherein the strain relief housing is overmolded onto the connection location and the outer electrically insulative layer.
19. An electrical connector assembly as recited in any one of the preceding claims, further comprising the at least one electrical cable, wherein the signal conductors of the electrical cable are attached to the signal contacts and a drain wire of the electrical cable is mechanically attached to the drain wire connection tab.
20. The electrical connector assembly as recited in claim 19, further comprising a strain relief housing that is overmolded onto at least a connection location between the drain wire and the drain wire connection tab.
21. The electrical connector assembly as recited in any one of claims 19 to 20, further comprising a plurality of electrical cables that are attached to the electrical connector, and a cable clip having an opening that receives the electrical cables, wherein the electrical cables extend out from the connector and are bent about a bend radius, the opening defines a height along the bend radius and a width that is perpendicular to the height, and the width is greater than the height.
22. The electrical connector assembly as recited in claim 21, wherein the width is greater than the height, and less than five times the height.
23. A leadframe assembly comprising:
a leadframe supported by the connector housing, the leadframe including an electrically insulative leadframe housing and a plurality of electrical signal contacts supported by the leadframe housing;
a plurality of electrical signal contacts supported by the leadframe housing; and
an electrically conductive ground plate positioned adjacent to the leadframe housing, the ground plate including an electrically conductive plate body and a crimp member that projects out from the plate body;

wherein the leadframe assembly is configured to receive at least one electrical cable such that at least one signal conductor of the electrical cable is attached to a corresponding at least one of the signal contacts, and a drain wire of the electrical cable is mechanically attached to the crimp member, thereby placing the drain wire in electrical communication with the electrically conductive ground plate.

24. The leadframe assembly as recited in claim 23, wherein the plate body is substantially planar.

25. The leadframe assembly as recited in any one of claims 23 to 24, wherein the ground plate further comprises a plurality of ground mating ends that extend from the plate body.

26. The leadframe assembly as recited in claim 25, wherein the ground plate further comprises a plurality of ground mating ends are monolithic with the plate body.

27. The leadframe assembly as recited in any one of claims 23 to 26, wherein the ground plate is supported by the leadframe housing.

28. The leadframe assembly as recited in any one of claims 23 to 27, wherein the drain wire connection tab defines a tab body having a proximal end that is attached to the ground plate and a free distal end opposite the proximal end, the free distal end spaced from the proximal end.

29. The leadframe assembly as recited in claim 28, wherein the drain wire connection tab comprises a crimp member movable with respect to the plate body such that the free distal end moves toward the plate body, thereby capturing the drain wire in electrical communication with the ground plate.

30. The leadframe assembly as recited in any one of claims 23 to 29, configured to mate with a complementary electrical connector along a mating direction, wherein the drain wire connection tab is attached to the plate body at an interface that is elongate along the mating direction.

31. The leadframe assembly as recited in any one of claims 23 to 30, configured to mate with a complementary electrical connector along a mating direction, wherein the drain wire connection tab is attached to the plate body at an interface that is elongate along a direction that is angularly offset with respect to the mating direction.

32. The leadframe assembly as recited in claim 31, wherein the direction is perpendicular to the mating direction.
33. The leadframe assembly as recited in any one of claims 23 to 32, wherein the drain wire connection tab is cut out from the plate body.
34. The leadframe assembly as recited in any one of claims 23 to 33, wherein the drain wire connection tab includes a tab body and an opening that extends through the tab body, the opening sized to receive the drain wire.
35. The leadframe assembly as recited in claim 34, configured to mate with a complementary electrical connector along a mating direction, wherein the opening extends through the tab body along the mating direction.
36. The leadframe assembly as recited in any one of claims 34 to 35, wherein the opening is sized to maintain connection between the tab body and the drain wire, when the drain wire extends through the opening, without bending the tab body toward the plate body.
37. The leadframe assembly as recited in any one of claims 34 to 36, wherein the drain wire connection tab comprises an anti-backout tab that projects into the opening so as to allow insertion of the drain wire through the opening in a mating direction, but prevents the drain wire from being removed from the opening in a direction opposite the mating direction.
38. The leadframe assembly as recited in any one of claims 23 to 37, further comprising a strain relief housing that surrounds at least a connection location between the drain wire and drain wire connection tab.
39. The leadframe assembly as recited in any one of claims 23 to 38, wherein the at least one electrical cable includes an outer electrically insulative layer that surrounds at least one or both of the signal conductors and the drain wire, and the strain relief housing further surrounds at least a length of the outer electrically insulative layer.
40. The leadframe assembly as recited in any one of claims 38 to 39, wherein the strain relief housing is overmolded onto the connection location and the outer electrically insulative layer.
41. An electrical connector comprising:
an electrically insulative connector housing; and

a leadframe supported by the connector housing, the leadframe including an electrically insulative leadframe housing and a plurality of electrical signal contacts and ground contacts supported by the leadframe housing; and

an electrically conductive ground plate positioned adjacent to the leadframe housing such that the ground contacts are in electrical contact with the ground plate and the electrical signal contacts are spaced from the ground plate,

wherein the electrical connector is configured to receive at least one electrical cable such that at least one signal conductor of the electrical cable is attached to a corresponding at least one of the signal contacts, and a drain wire of the electrical cable is attached to a corresponding one of the ground contacts, thereby placing the drain wire in electrical communication with the ground plate.

42. The electrical connector as recited in claim 41, wherein the ground contacts comprise a ground contact tab that projects toward the ground plate and contacts the ground plate.

43. The electrical connector as recited in claim 42, wherein each of the ground contacts includes a ground contact body that defines a ground mating end and a ground mounting end, and the ground contact tab is cut from the ground contact body.

44. The electrical connector as recited in claim 43, configured to mate with a complementary electrical connector along a mating direction, wherein the corresponding one of the ground contacts is configured to attach to the drain wire.

45. The electrical connector as recited in any one of claims 41 to 44, wherein ground plate is substantially planar.

46. The electrical connector as recited in any one of claims 41 to 45, wherein the ground plate is supported by the leadframe housing.

47. An electrical connector assembly as recited in any one of claims 41 to 46, further comprising the at least one electrical cable, wherein the at least one signal conductor of the electrical cable are attached to the corresponding one of the signal contacts and the drain wire of the electrical cable is mechanically attached to a corresponding one of the ground contacts.

48. The electrical connector assembly as recited in any one of claims 41 to 47, further comprising a plurality of electrical cables that are attached to the electrical connector, and a cable

clip having an opening that receives the electrical cables, wherein the electrical cables extend out from the connector and are bent about a bend radius, the opening defines a height along the bend radius and a width that is perpendicular to the height, and the width is greater than the height.

49. The electrical connector assembly as recited in claim 48, wherein the width is greater than the height, and less than five times the height.

50. A leadframe assembly comprising:

a leadframe supported by the connector housing, the leadframe including an electrically insulative leadframe housing and a plurality of electrical signal contacts and ground contacts supported by the leadframe housing; and

an electrically conductive ground plate positioned adjacent to the leadframe housing such that the ground contacts are in electrical contact with the ground plate and the electrical signal contacts are spaced from the ground plate,

wherein the electrical connector is configured to receive at least one electrical cable such that at least one signal conductor of the electrical cable is attached to a corresponding at least one of the signal contacts, and a drain wire of the electrical cable is attached to a corresponding one of the ground contacts, thereby placing the drain wire in electrical communication with the ground plate.

51. The leadframe assembly as recited in claim 50, wherein the ground contacts comprise a ground contact tab that projects toward the ground plate and contacts the ground plate.

52. The leadframe assembly as recited in claim 51, wherein each of the ground contacts includes a ground contact body that defines a ground mating end and a ground mounting end, and the ground contact tab is cut from the ground contact body.

53. The leadframe assembly as recited in claim 52, configured to mate with a complementary electrical connector along a mating direction, wherein the corresponding one of the ground contacts is configured to attach to the drain wire.

54. The leadframe assembly as recited in any one of claims 50 to 53, wherein ground plate is substantially planar.

55. The leadframe assembly as recited in any one of claims 50 to 54, wherein the ground plate is supported by the leadframe housing.

56. A method of managing a plurality of electrical cables comprising the steps of:
attaching a plurality of electrical cables to an electrical connector, such that the electrical cables extend out from the electrical connector;
securing a cable clip onto the plurality of electrical cables such that the electrical cables extend through an opening of the cable clip, the opening having a height and a width that is perpendicular to the height and greater than the height; and
bending the electrical cables about a bend radius that is substantially coplanar with the height.
57. The method as recited in claim 56, wherein the height is measured along the bend radius.
58. The method as recited in any one of claims 56 to 57, wherein the securing step comprises the step of causing the cables to expand away from each other along the width and to compress against each other along the height.
59. The method as recited in any one of claims 56 to 58, wherein the securing step is performed before the attaching step.
60. The method as recited in any one of claims 56 to 58, wherein the securing step is performed after the attaching step.
61. The method as recited in any one of claims 56 to 60, wherein the bending step further comprises directing the cables along a cable guide that defines the radius, the cable guide defining a guide body and the cable clip supported by the guide body.
62. The method as recited in any one of claims 56 to 61, further comprising the steps of:
attaching a second plurality of electrical cables to a second electrical connector, such that the second plurality of electrical cables extends out from the second electrical connector;
securing a second cable clip onto the second plurality of electrical cables such that the second plurality of electrical cables extend through a second opening of the second cable clip, the second opening having a height and a width that is perpendicular to the height and greater than the height;
bending the second plurality of electrical cables about a second bend radius that is substantially coplanar with the height of the second opening; and

stacking the cable clips onto each other along a direction that defines the respective heights.

63. A cable assembly comprising:

a plurality of electrical cables including at least one electrical conductor and an electrically insulative outer sheath that surrounds the at least one electrical conductor, the electrical conductor configured to be placed in electrical communication with an electrical connector, the plurality of electrical cables defining a height and a width perpendicular to the height;

a cable clip comprising a clip body and an opening that extends through a clip body, the opening having a height less than the height of the plurality of electrical cables, and a width greater than the width of the plurality of electrical cables,

wherein the opening is sized such that when the plurality of electrical cables extend through the opening, the height of the electrical cables is decreased to the height of the opening, and the width of the plurality of electrical cables is increased to the width of the opening.

64. The cable assembly as recited in claim 63, wherein the cable clip comprises a first component defining a first portion of the opening, and a second component that defines a second portion of the opening, the first and second components configured to be attached to each other about the plurality of electrical cables to define the opening such that the plurality of electrical cables extends through the opening.

65. The cable assembly as recited in any one of claims 63 to 64, wherein the width of the opening is greater than the height of the opening, and less than five times the height of the opening.

66. The cable assembly as recited in any one of claims 63 to 65, wherein the width of the opening is greater than three times the height of the opening and less than four times the height of the opening.

67. The cable assembly as recited in any one of claims 64 to 66, wherein the first and second components are hermaphroditic with each other.

68. The cable assembly as recited in any one of claims 64 to 67, wherein each of the first and second components comprises a body and a pair of legs that extend out from the body, each body

of the first and second components defining a pair of recesses sized to receive protrusions of the pair of legs of the other of the first and second components, thereby attaching the first and second components to each other.

69. The cable assembly as recited in any one of claims 64 to 67, wherein the body and legs of the first and second components define respective inner surfaces that, in combination, define the opening of the cable clip.

70. The cable assembly as recited in any one of claims 63 to 69, further comprising a cable guide having a guide surface that defines a bend radius, the cable guide further including the cable clip, the opening operatively aligned with the guide surface such that when the plurality of cables extends along the guide surface, the plurality of cables further extends through the opening.

71. The cable assembly as recited in claim 70, wherein the guide surface is curved.

72. The cable assembly as recited in claim 71, wherein the curved guide surface is defined by a bend radius, and the height of the opening is coplanar with the bend radius.

73. The cable assembly as recited in claim 72, wherein the curved guide surface is defined by a bend radius, and the height of the opening is parallel with the bend radius.

74. The cable assembly as recited in claim 73, wherein the curved guide surface is defined by a bend radius, and the height of the opening is defined by the bend radius.

75. The cable assembly as recited in any one of claims 63 to 74, wherein the cable guide includes a guide body that defines the guide surface, and the first component is monolithic with the guide body.

76. The cable assembly as recited in any one of claims 70 to 75, further comprising a band that is configured to extend about the cable guide and the plurality of cables so as to secure the plurality of cables to the cable guide.

77. An electrical connector assembly comprising the leadframe assembly as recited in any one of claims 23 to 40 and 50 to 55, and the cable assembly as recited in any one of claims 53 to 76, wherein the drain wire of the plurality of electrical cables are attached to the ground plate.

78. An electrical connector comprising a connector housing, and a plurality of the leadframe assemblies as recited in any one of claims 23 to 40 and 50 to 55, and the cable assembly as recited in any one of claims 53 to 77.

79. A cable guide comprising:

a guide body defining a guide surface configured to support a plurality of electrical cables; and

a cable clip supported by the guide body, the cable clip comprising a clip body and an opening that extends through a clip body, the opening having a height and a width that is perpendicular to the height and greater than the height,

wherein the opening is in operable communication with the guide surface such that the guide surface directs the supported plurality of electrical cables to extend through the opening.

80. The cable guide as recited in claim 79, wherein the opening is sized such that when the plurality of electrical cables extend through the opening, the height of the electrical cables is decreased to the height of the opening, and the width of the plurality of electrical cables is increased to the width of the opening.

81. The cable guide as recited in any one of claims 79 to 80, wherein the cable clip comprises a first component defining a first portion of the opening, and a second component that defines a second portion of the opening, the first and second components configured to be attached to each other about the plurality of electrical cables to define the opening such that the plurality of electrical cables extends through the opening.

82. The cable guide as recited in claim 81, wherein the first component is monolithic with the guide body.

83. The cable guide as recited in any one of claims 79 to 82, wherein the width of the opening is greater than the height of the opening, and less than five times the height of the opening.

84. The cable guide as recited in any one of claims 79 to 83, wherein the width of the opening is greater than three times the height of the opening and less than four times the height of the opening.

85. The cable guide as recited in any one of claims 79 to 84, wherein the first and second components are hermaphroditic with each other.

86. The cable guide as recited in any one of claims 81 to 85, wherein each of the first and second components comprises a body and a pair of legs that extend out from the body, each body of the first and second components defining a pair of recesses sized to receive protrusions of the pair of legs of the other of the first and second components, thereby attaching the first and second components to each other.

87. The cable guide as recited in any one of claims 81 to 86, wherein the body and legs of the first and second components define respective inner surfaces that, in combination, define the opening of the cable clip.

88. The cable guide as recited in any one of claims 79 to 87, wherein the guide surface is curved.

89. The cable guide as recited in claim 88, wherein the curved guide surface is defined by a bend radius, and the height of the opening is coplanar with the bend radius.

90. The cable assembly as recited in claim 88, wherein the curved guide surface is defined by a bend radius, and the height of the opening is parallel with the bend radius.

91. The cable assembly as recited in claim 88, wherein the curved guide surface is defined by a bend radius, and the height of the opening is defined by the bend radius.

92. The cable guide as recited in any one of claims 79 to 91, wherein the guide surface defines a first end and a second end that is oriented substantially perpendicular to the first end, and the cable clip is supported at the second end.

93. The cable guide as recited in claim 92, wherein the cable guide is configured to be supported adjacent to an electrical connector proximate to the first end of the guide surface.

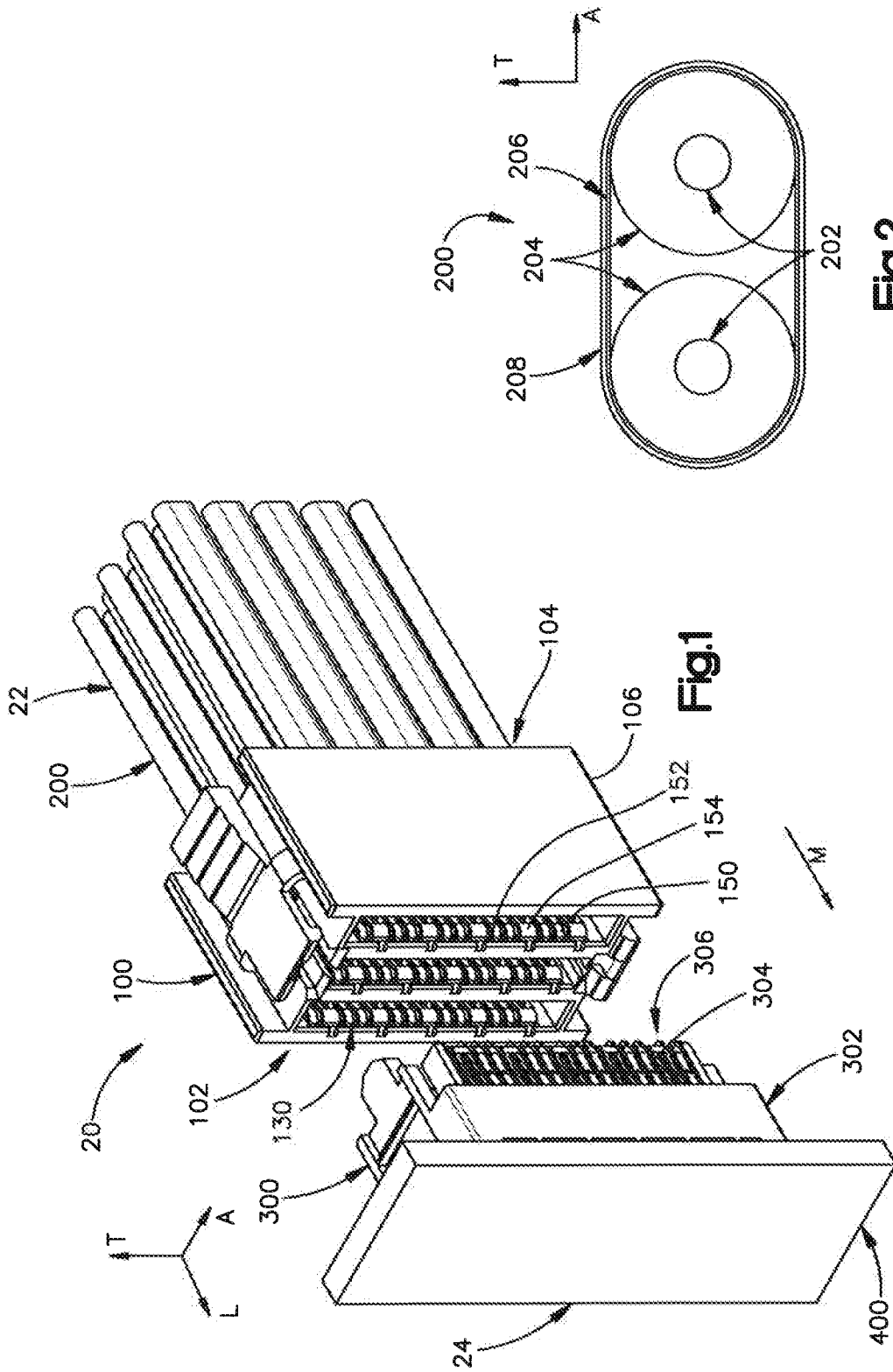


Fig.2

Fig.1

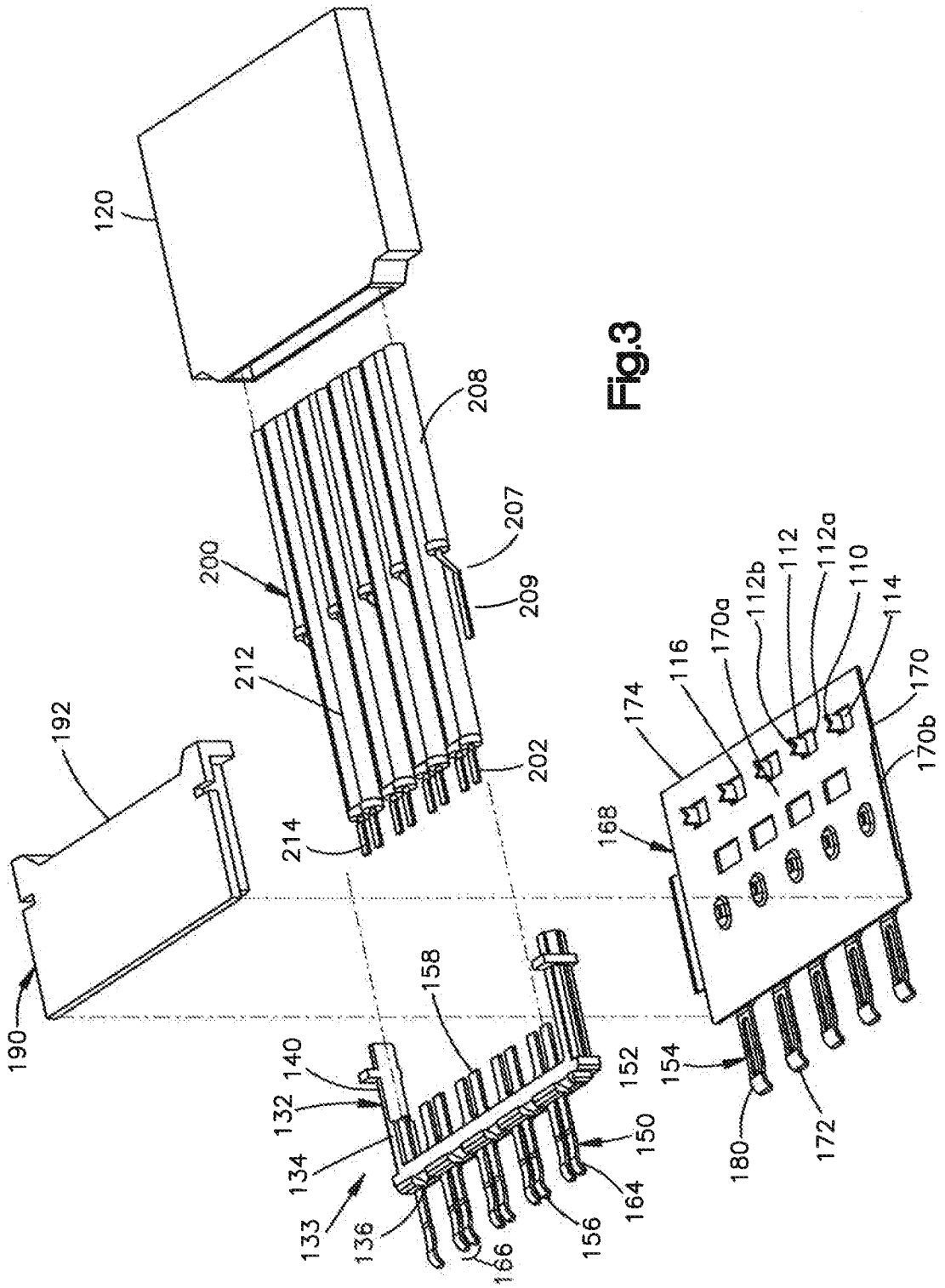


Fig.3

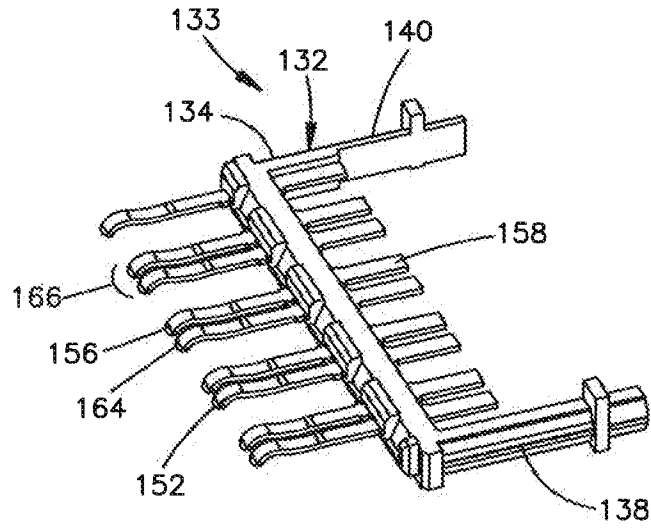


Fig.4A

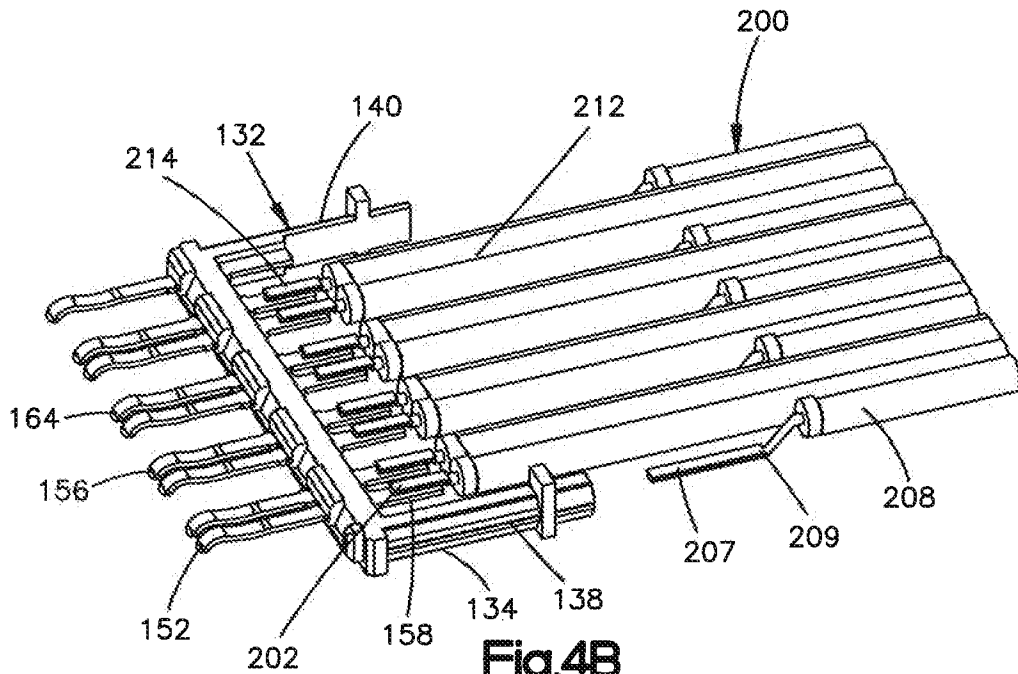


Fig.4B

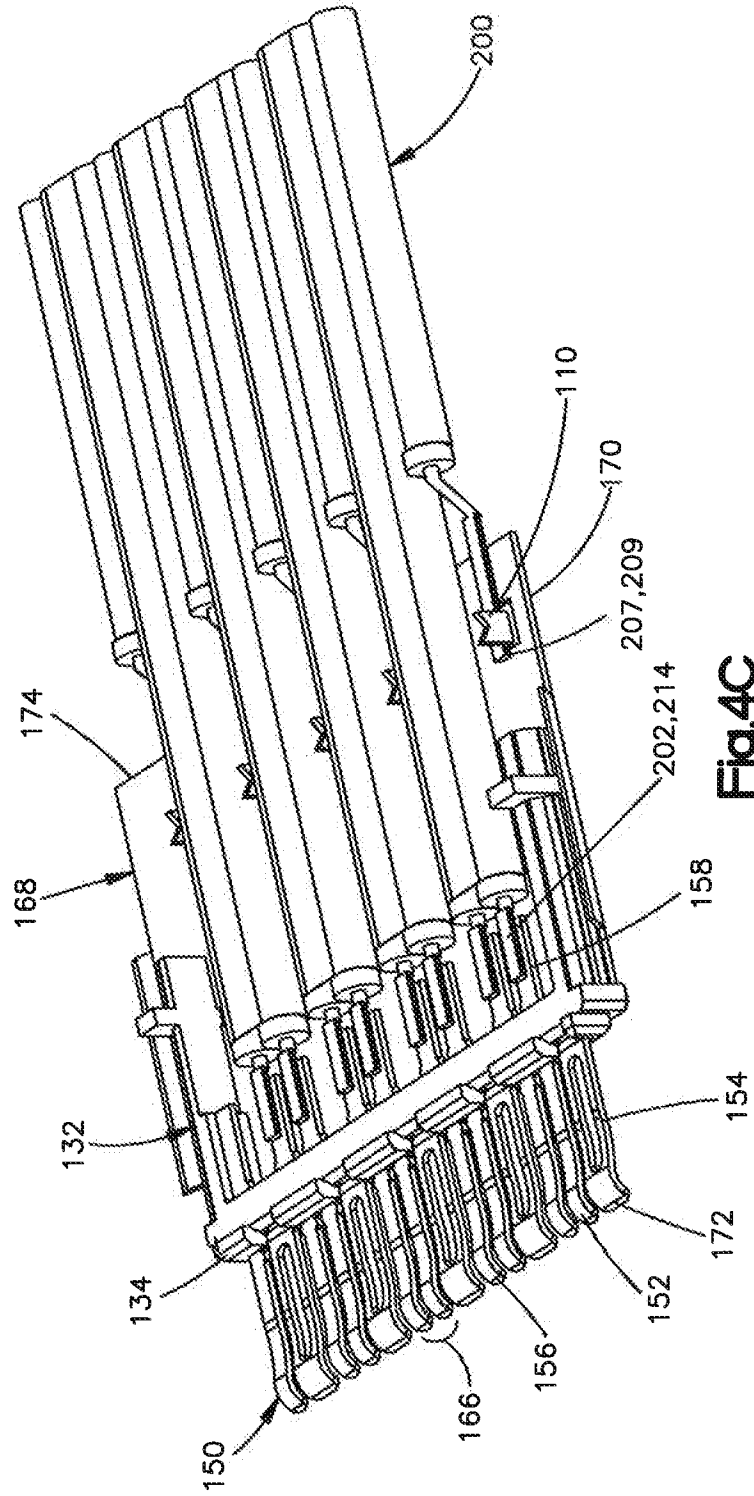
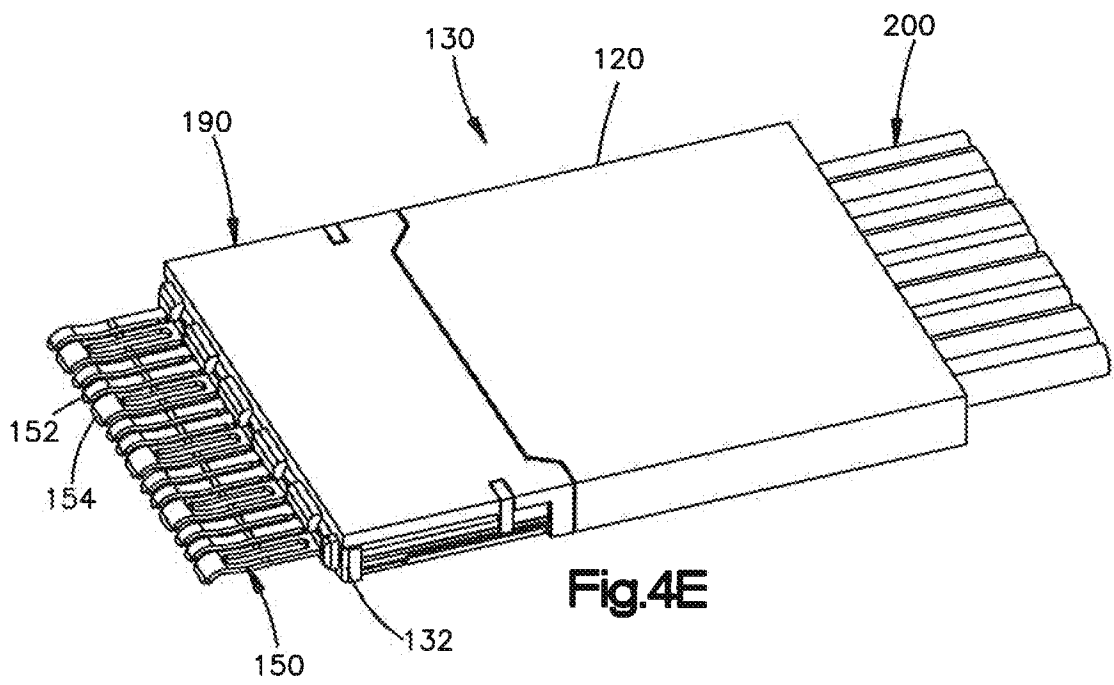
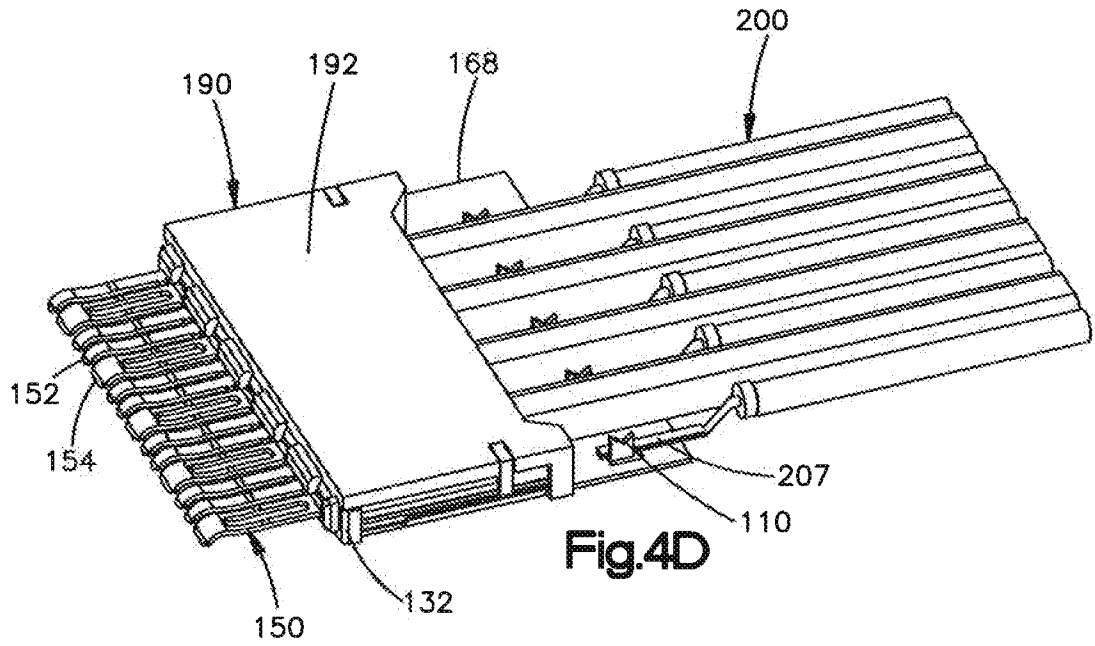


Fig.4C



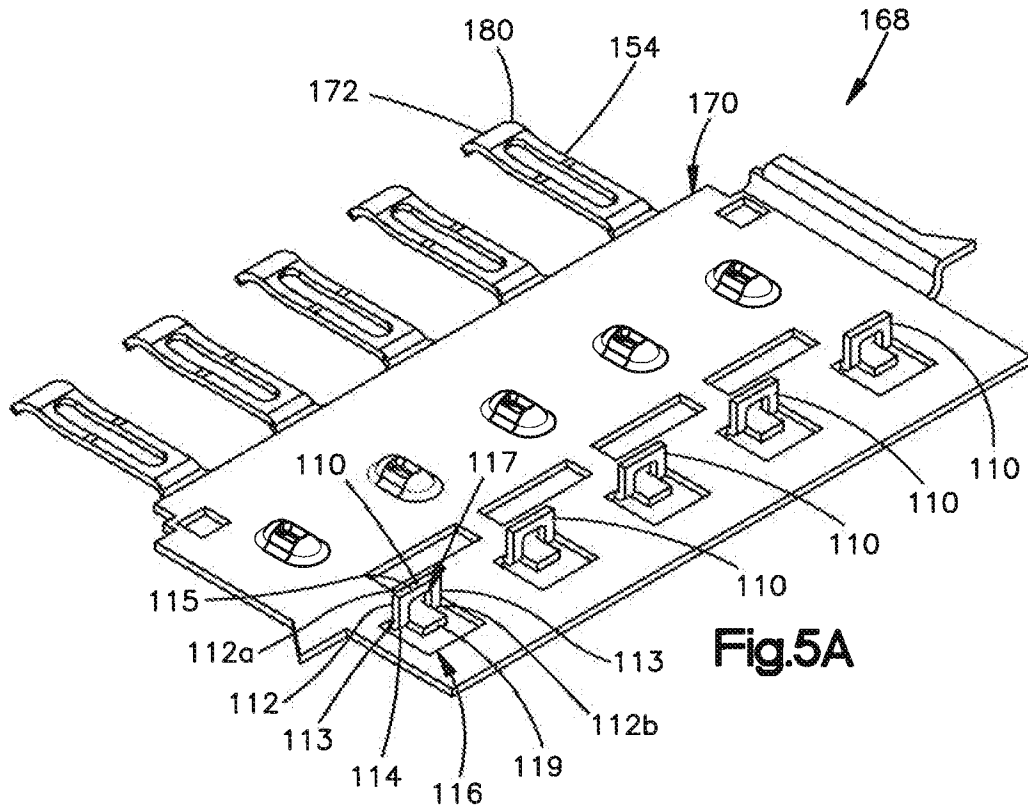


Fig.5A

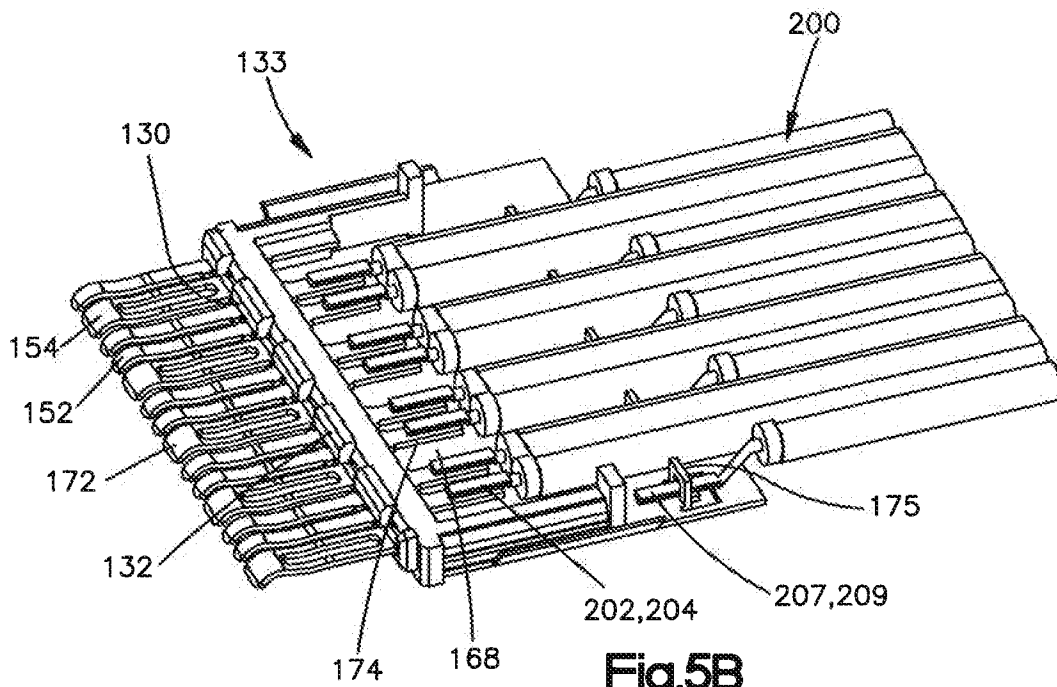
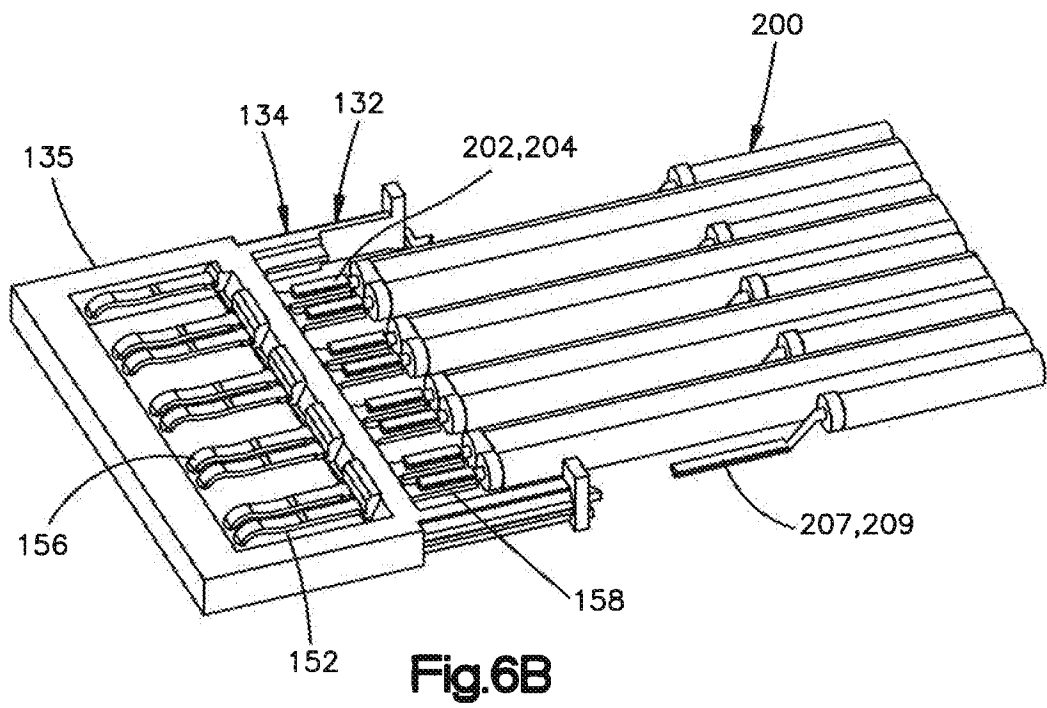
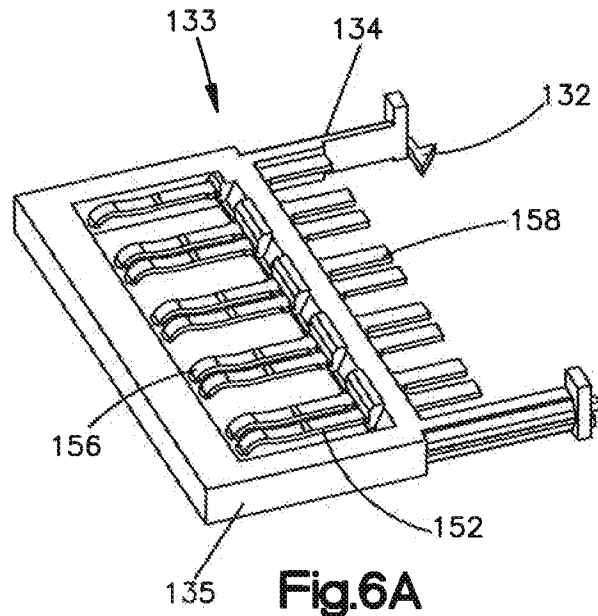


Fig.5B



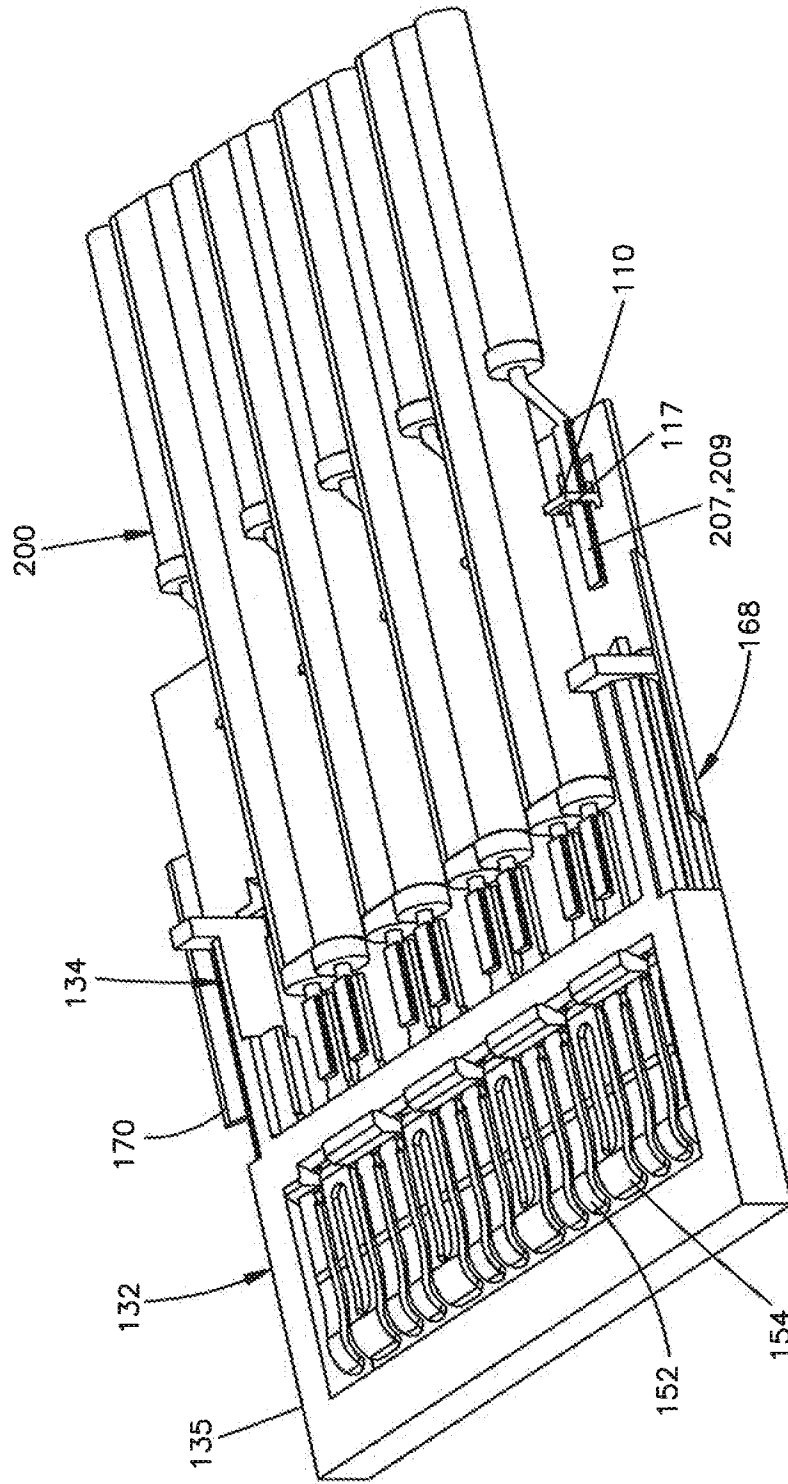
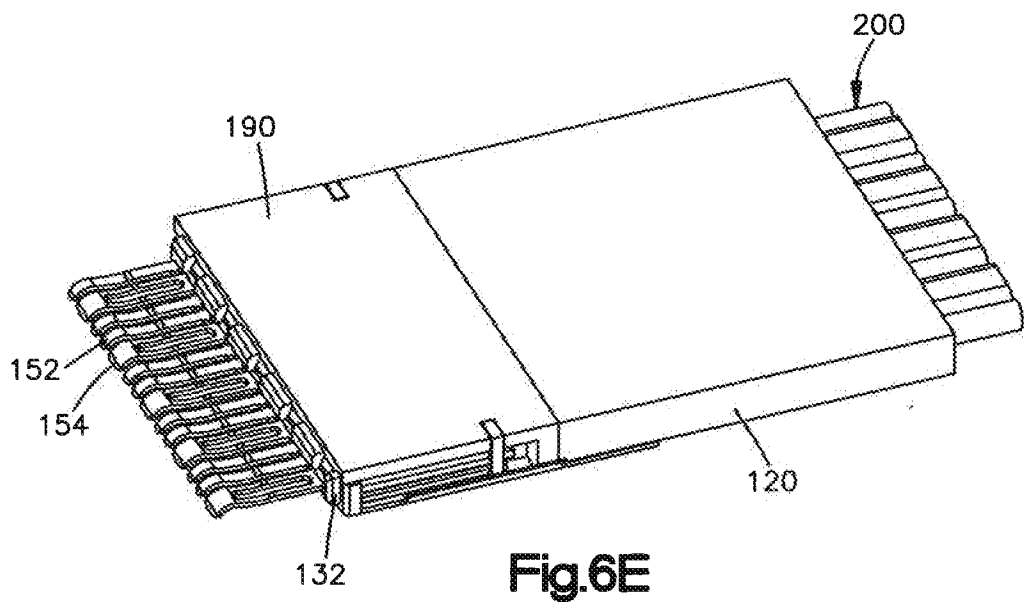
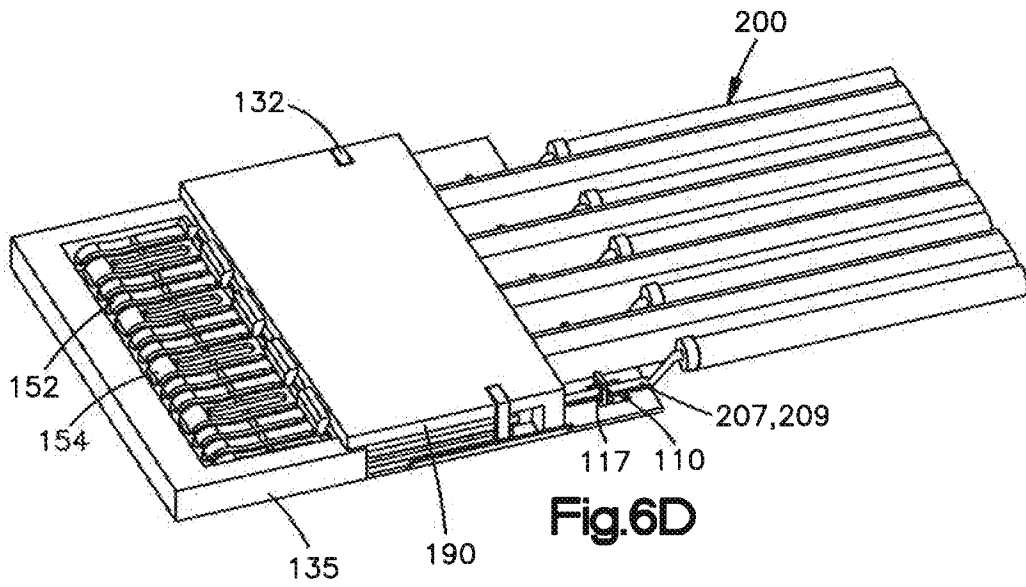


Fig.6C



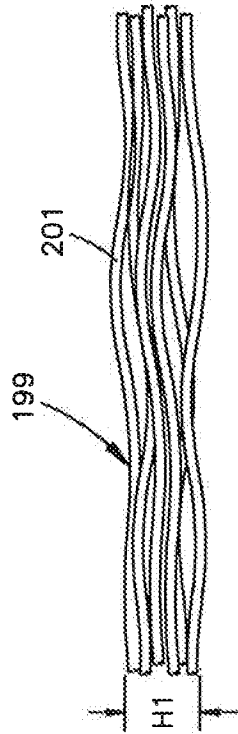


Fig. 7C
PRIOR ART

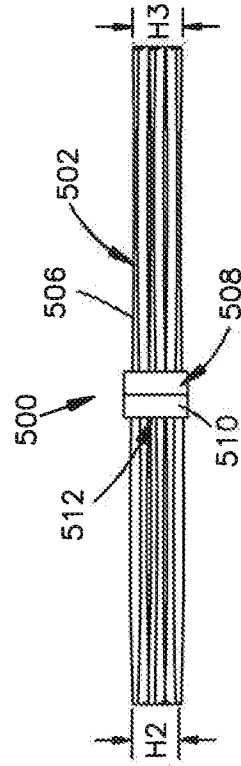


Fig. 8A

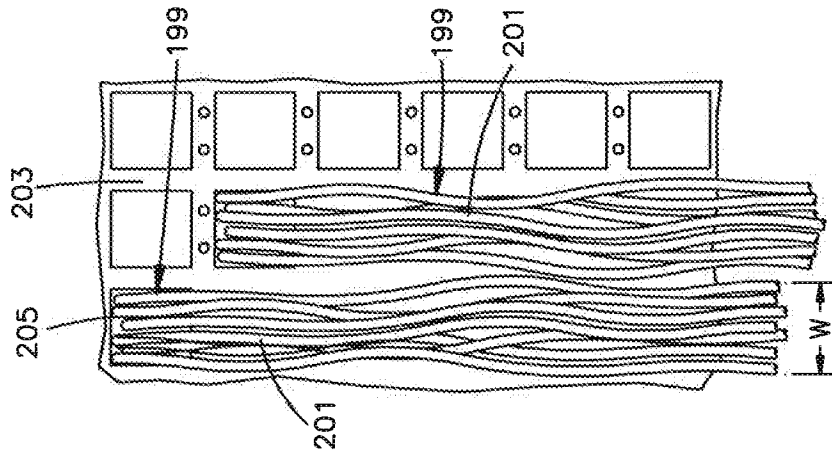


Fig. 7B
PRIOR ART

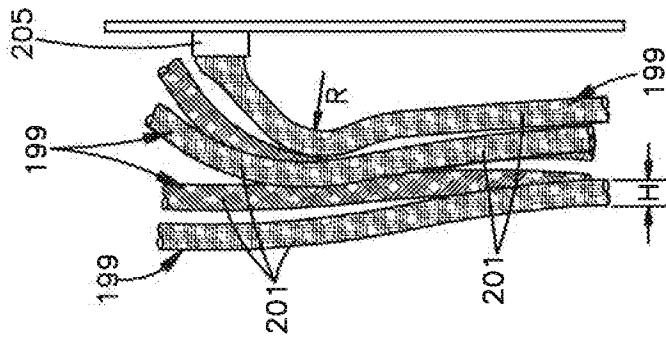


Fig. 7A
PRIOR ART

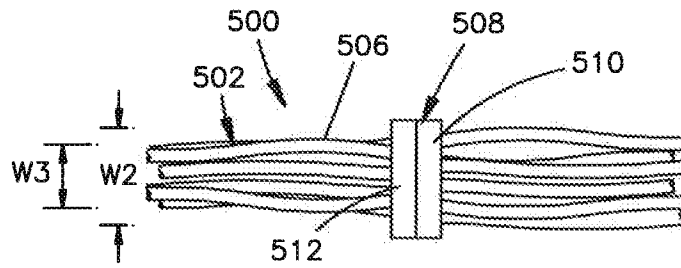


Fig. 8B

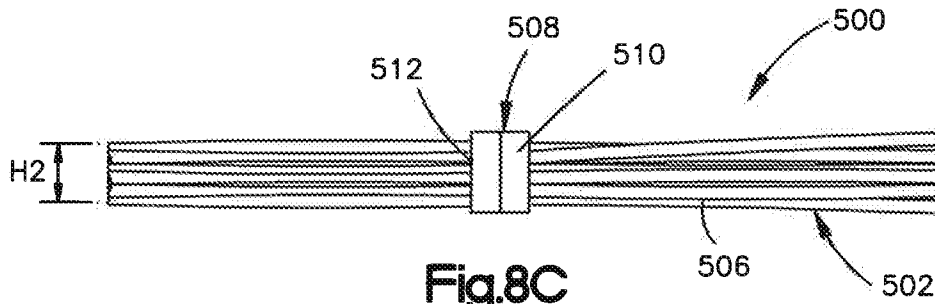


Fig. 8C

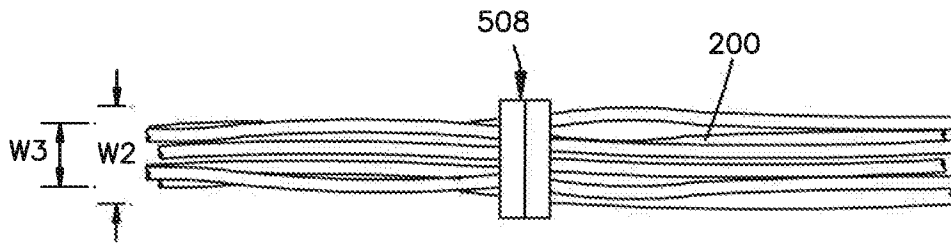


Fig. 8D

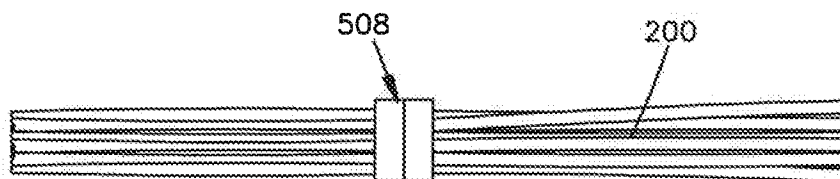


Fig. 8E

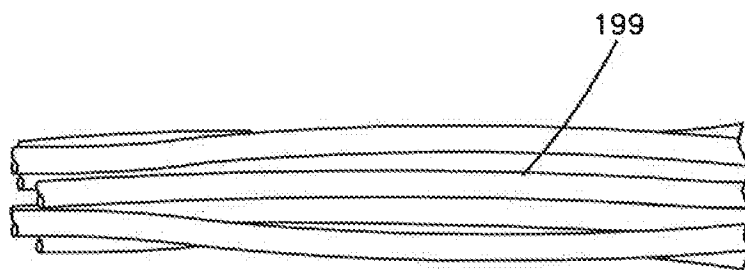


Fig.8F
PRIOR ART

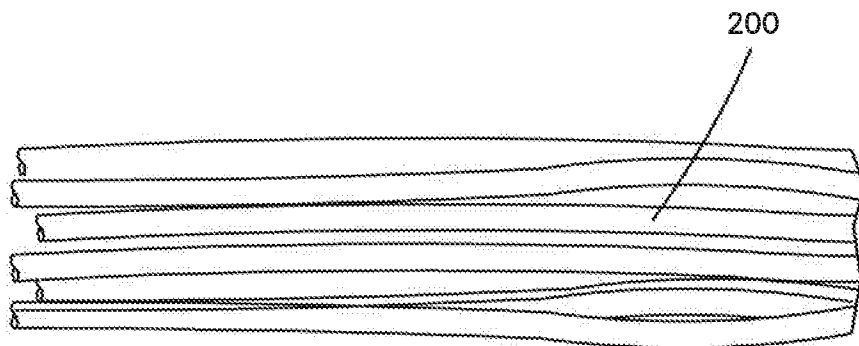
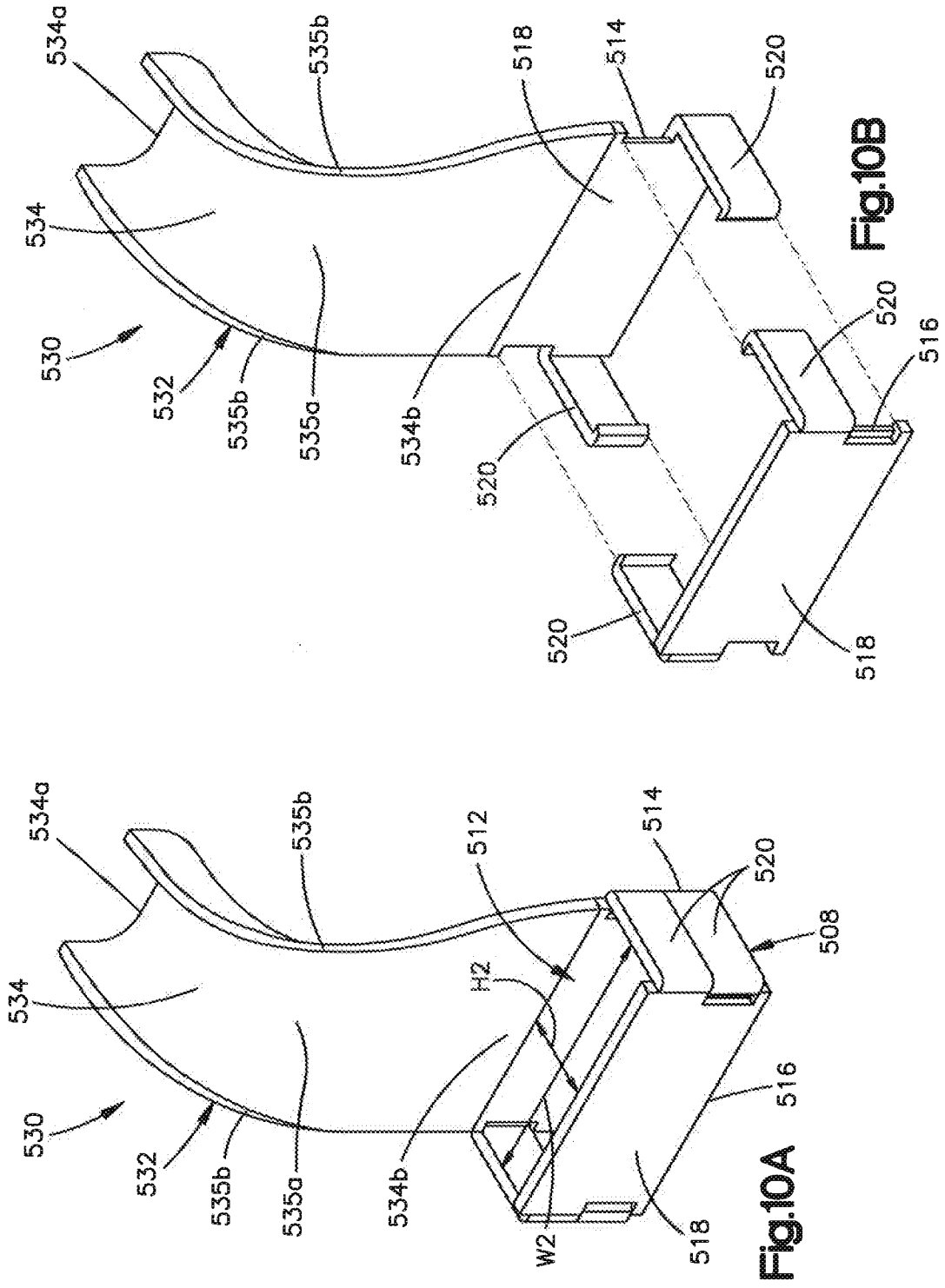


Fig.8G



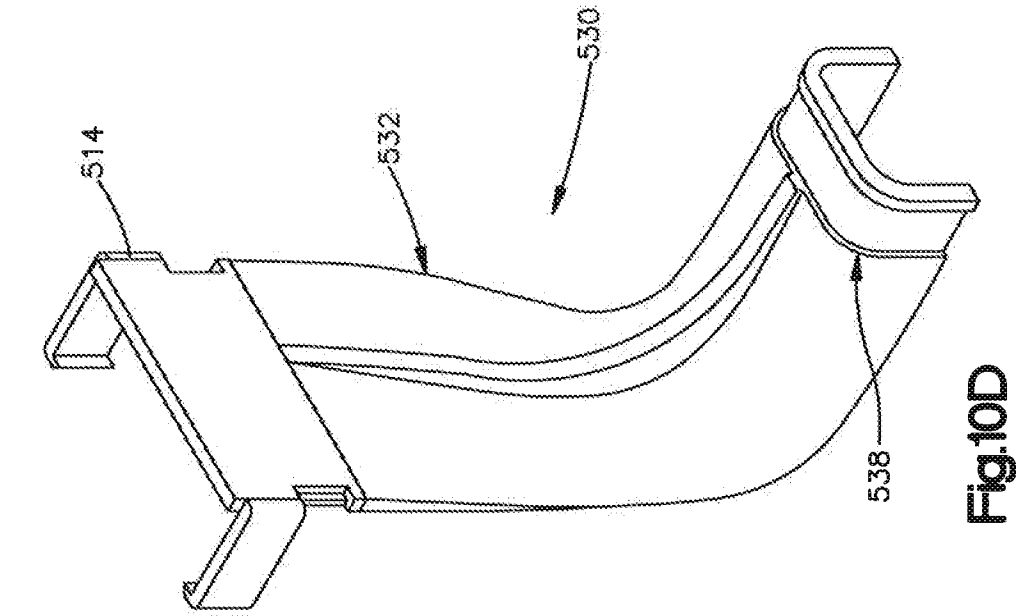


Fig. 10D

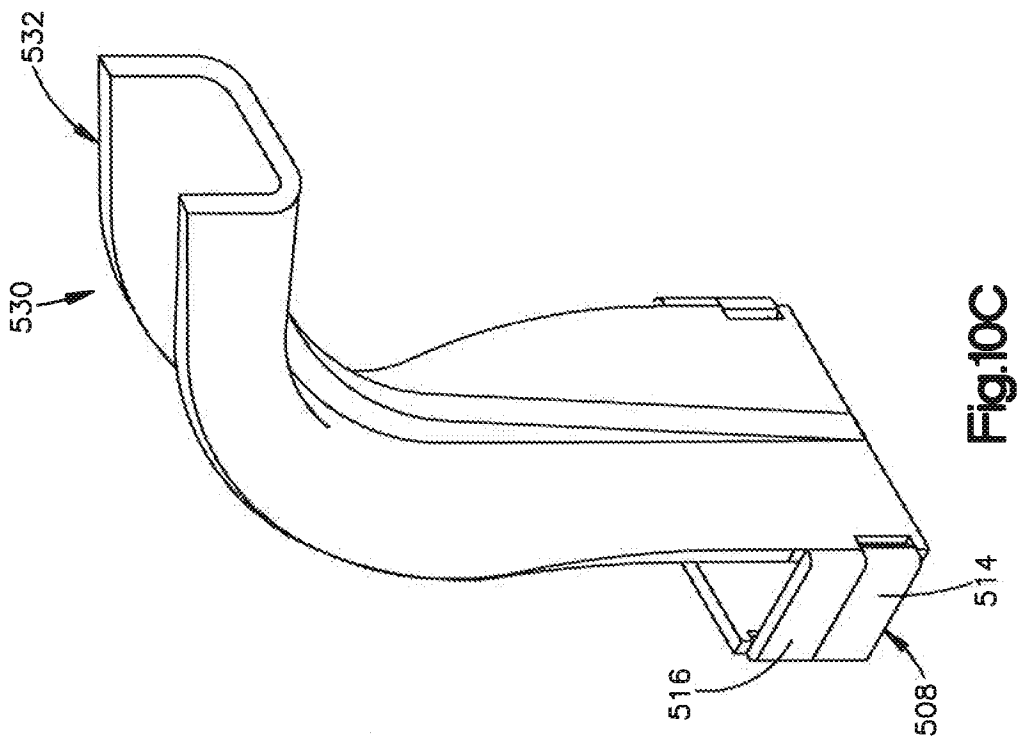
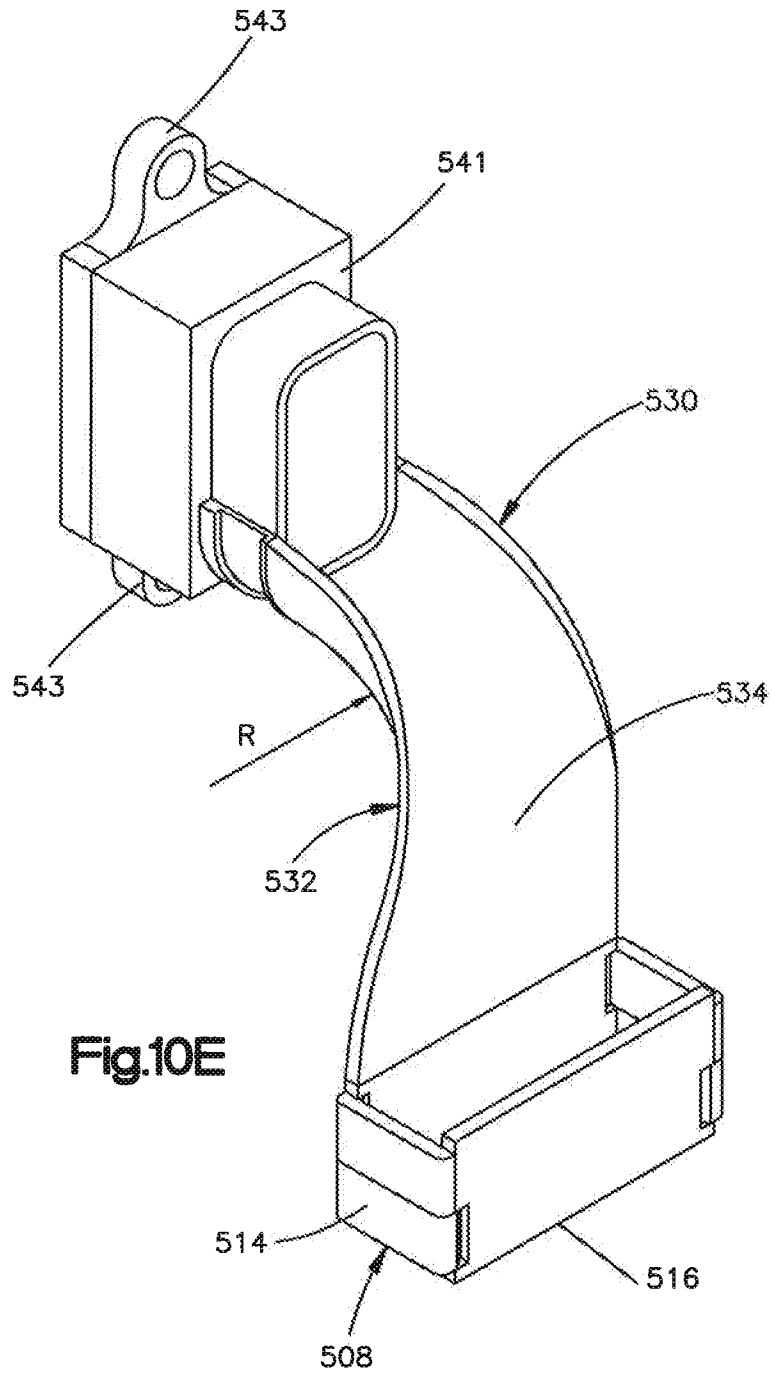


Fig. 10C



INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2014/061681**A. CLASSIFICATION OF SUBJECT MATTER****H01R 24/38(2011.01)i, H01R 13/639(2006.01)i**

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

H01R 24/38; H01R 13/648; H01R 43/00; H01B 7/00; G02B 6/38; H01R 13/639

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, cable, lead frame, tab, clip, bend, guide

C. DOCUMENTS CONSIDERED TO BE RELEVANT

| Category* | Citation of document, with indication, where appropriate, of the relevant passages | Relevant to claim No. |
|-----------|---|---|
| X | US 2013-0130547 A1 (JEFFREY STEWART SIMPSON et al.) 23 May 2013 See paragraphs [0022]-[0038], [0043]-[0057], claims 1-5 and figures 1-2, 5-10. | 41,50 |
| Y | | 1-4, 23-26, 42-45 ,51-54 |
| A | | 56-58, 63-65, 79-82 |
| Y | US 2013-0149899 A1 (NEIL FRANKLIN SCHROLL et al.) 13 June 2013 See paragraphs [0023]-[0027], [0059], claims 1-7 and figures 2, 10. | 1-4, 23-26, 42-45 ,51-54 |
| Y | US 2009-0188716 A1 (AYAKO NAGASE) 30 July 2009 See paragraphs [0052]-[0056], claims 1, 5 and figures 3-7. | 56-58, 63-65, 79-82 |
| Y | EP 0997756 A2 (SIECOR OPERATIONS, LLC.) 03 May 2000 See paragraphs [0009]-[0017], claim 2 and figures 1-4. | 56-58, 63-65, 79-82 |
| A | US 2007-0287332 A1 (W. ANDREW GORDON et al.) 13 December 2007 See paragraphs [0036]-[0038], [0045]-[0046], claim 1 and figures 4, 6. | 1-4, 23-26, 41-45 ,50-54, 56-58, 63-65 ,79-82 |

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

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of 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

26 January 2015 (26.01.2015)

Date of mailing of the international search report

27 January 2015 (27.01.2015)

Name and mailing address of the ISA/KR

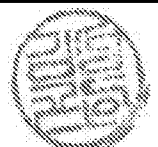
International Application Division
Korean Intellectual Property Office
189 Cheongsu-ro, Seo-gu, Daejeon Metropolitan City, 302-701,
Republic of Korea

Facsimile No. ++82 42 472 3473

Authorized officer

KIM, Sung Gon

Telephone No. +82-42-481-8746



INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

PCT/US2014/061681

| Patent document cited in search report | Publication date | Patent family member(s) | Publication date |
|--|------------------|---|--|
| US 2013-0130547 A1 | 23/05/2013 | CN 103178408 A TW 201334318 A US 8475208 B2 | 26/06/2013 16/08/2013 02/07/2013 |
| US 2013-0149899 A1 | 13/06/2013 | CN 103999292 A EP 2789054 A1 TW 201334316 A US 8845365 B2 WO 2013-085735 A1 | 20/08/2014 15/10/2014 16/08/2013 30/09/2014 13/06/2013 |
| US 2009-0188716 A1 | 30/07/2009 | CN 101132728 A EP 1854396 A1 EP 1854396 A4 JP 2006-239170 A JP 4477524 B2 WO 2006-093223 A1 | 27/02/2008 14/11/2007 05/05/2010 14/09/2006 09/06/2010 08/09/2006 |
| EP 0997756 A2 | 03/05/2000 | EP 0997756 A3 US 6134370 A | 30/05/2001 17/10/2000 |
| US 2007-0287332 A1 | 13/12/2007 | AU 2005-255867 A1 AU 2005-255867 B2 AU 2005-255867 C1 CN 100539323 C CN 101015094 A EP 2005536 A2 US 2005-0277335 A1 US 2006-0205277 A1 US 7083472 B2 US 7249974 B2 US 7510439 B2 WO 2005-124940 A2 WO 2005-124940 A3 | 29/12/2005 20/05/2010 14/10/2010 09/09/2009 08/08/2007 24/12/2008 15/12/2005 14/09/2006 01/08/2006 31/07/2007 31/03/2009 29/12/2005 04/05/2006 |

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.: 7,10,13,20,22,29,32,35,49,71-74,89-91,93
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 7, 10, 13, 20, 22, 29, 32, 35, 49, 71-74, 89-91 and 93 are unclear because they refer respectively to claims 6, 9, 12, 19, 21, 28, 31, 34, 48, 70, 88 and 92 directly or indirectly which do not comply with PCT Rule 6.4(a).

3. Claims Nos.: see extra page
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

1. Claims 1-4, 23-26, 41-45 and 50-54 are directed to a leadframe assembly.
2. Claims 56-58, 63-65 and 79-82 are directed to a cable clip.

1. As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.

2. As all searchable claims could be searched without effort justifying an additional fees, this Authority did not invite payment of any additional fees.

3. As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:

4. No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

- The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.
- The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.
- No protest accompanied the payment of additional search fees.

Continuation of Box No. II

3. Claims Nos.:5-6,8-9,11-12,14-19,21,27-28,30-31,33-34,36-40,46-48,55,59-62,66-70,75-78,83-88,92 because they dependent claims are not drafted in accordance with second and third sentences of Rule 6.4(a)