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Ljubijankic et al.

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(54) **ELECTRICAL CONNECTOR WAFER ASSEMBLY**

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H01R 13/62	(2006.01)
H01R 43/24	(2006.01)
H01R 13/405	(2006.01)

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CPC ***H01R 13/6471*** (2013.01); ***H01R 13/405*** (2013.01); ***H01R 13/502*** (2013.01); ***H01R 13/62*** (2013.01); ***H01R 43/24*** (2013.01)

(58) **Field of Classification Search**
CPC H01R 13/658; H01R 13/6594; H01R 13/502; H01R 13/40; H01R 13/405; H01R 13/514; H01R 9/03; H01R 9/0512; H01R 43/24; H01R 24/40; H01R 24/86
See application file for complete search history.

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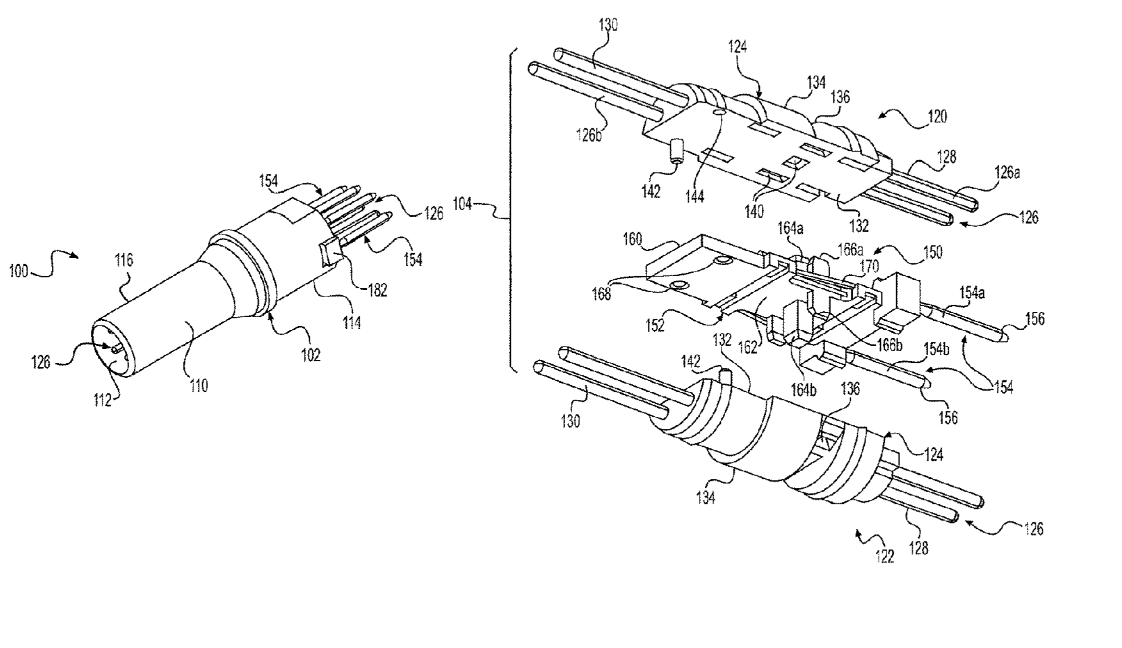
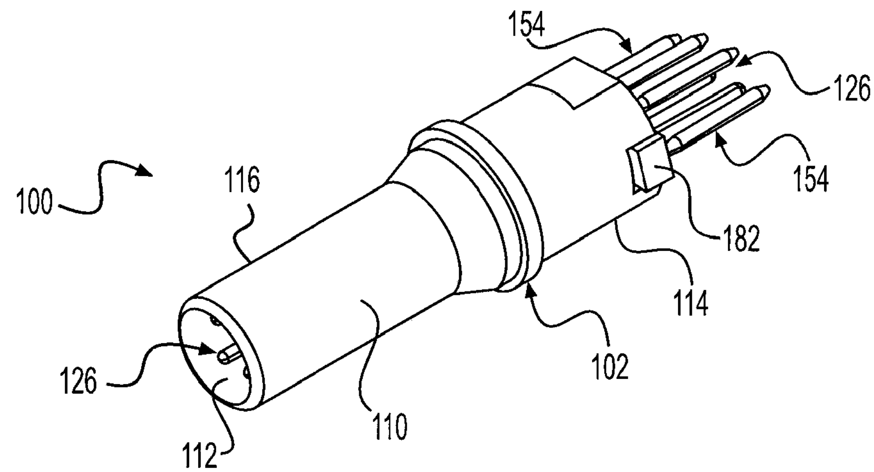
(57) **ABSTRACT**

An electrical connector, and method of assembly, that has a conductive connector shell and a contact subassembly received therein. The contact subassembly has first and second signal wafers and a ground wafer sandwiched between the signal wafers. Each of the signal wafers includes one or more signal contacts and a dielectric wafer body formed around the signal contacts such that the tail and mating ends of the signal contacts are outside of the wafer body. The ground wafer includes one or more ground contacts and a dielectric wafer body formed around the ground contacts such that the tail ends of the ground contacts are outside of the wafer body of the ground wafer.

30 Claims, 4 Drawing Sheets

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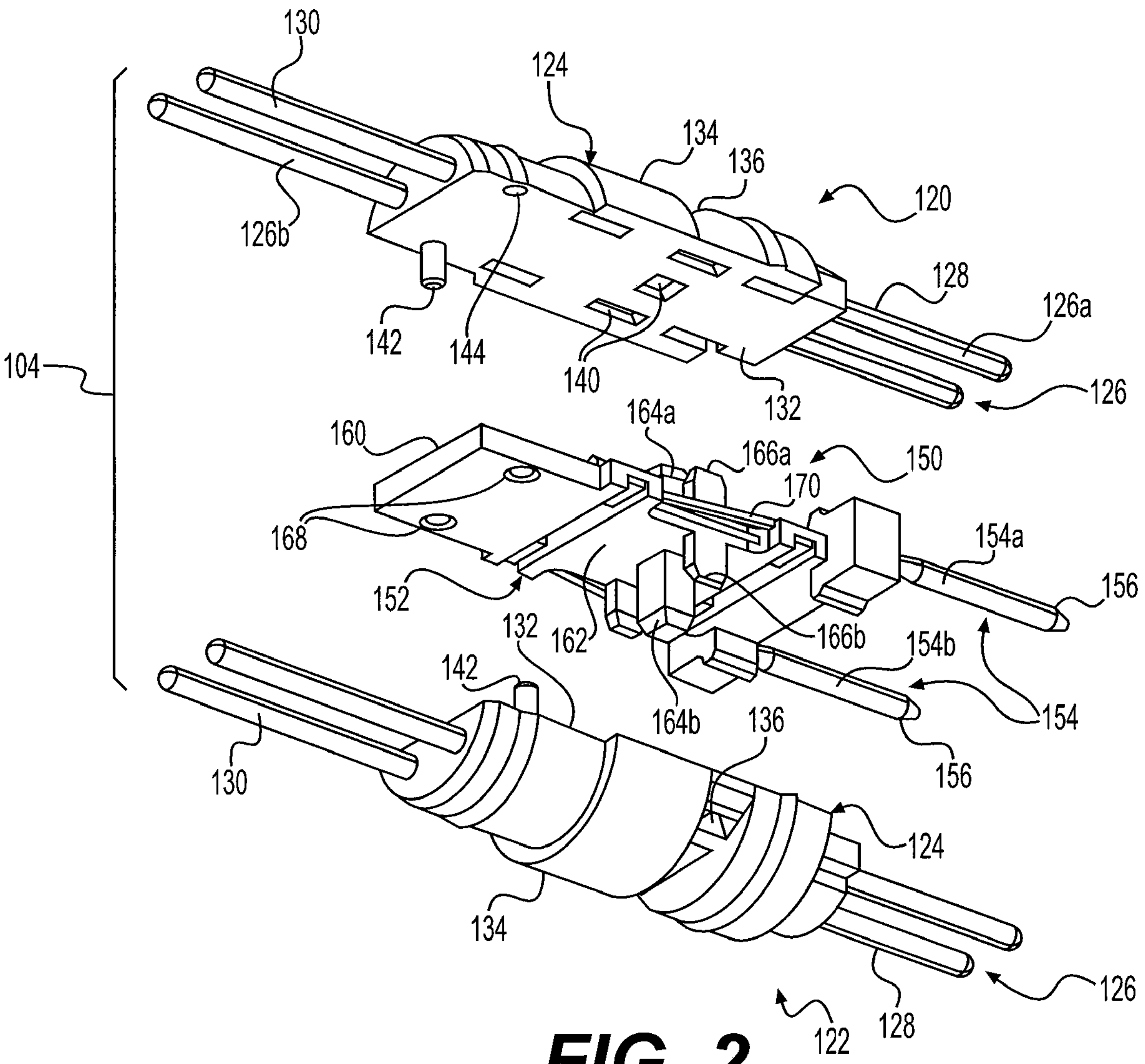
126
154
182
114
102
100
116
126
112
110

FIG. 1


130
124
134
136
120
126b
128
126a
142
144
140
132
126
104
160
164a
166a
150
170
168
154a
156
152
132
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166b
154b
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154
164b
136
130
156
124
134
126
122
128

FIG. 2

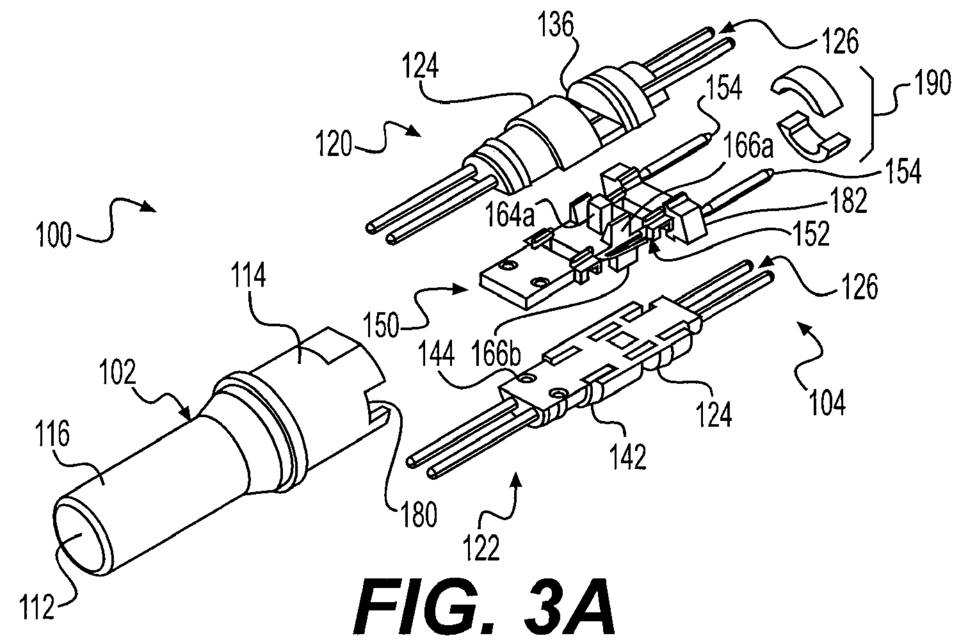

FIG. 3A

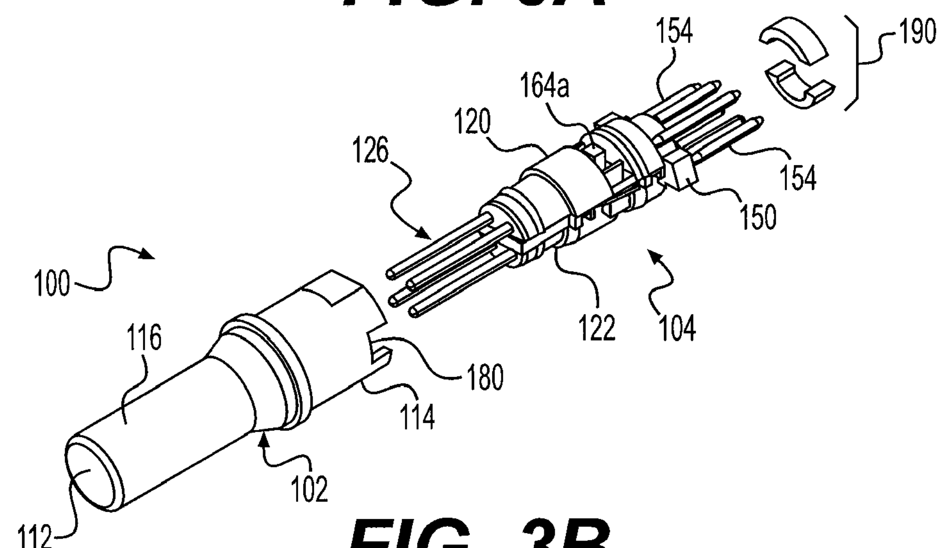

FIG. 3B

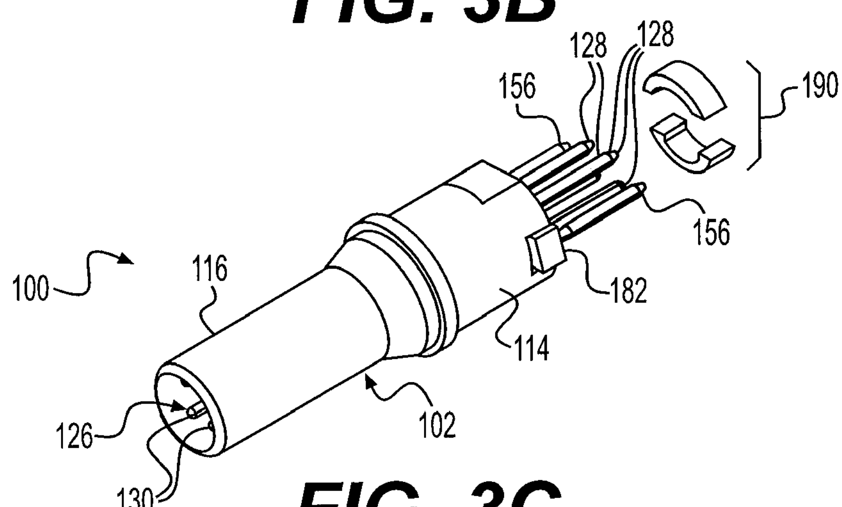

FIG. 3C

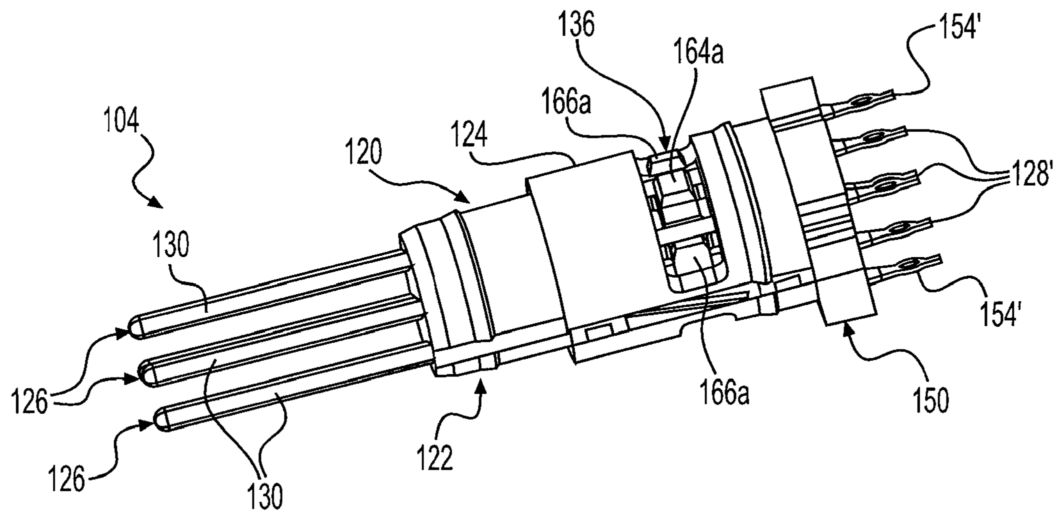
104
136
164a
154'
166a
124
120
128'
130
154'
126
166a
150
126
130
122

FIG. 4A

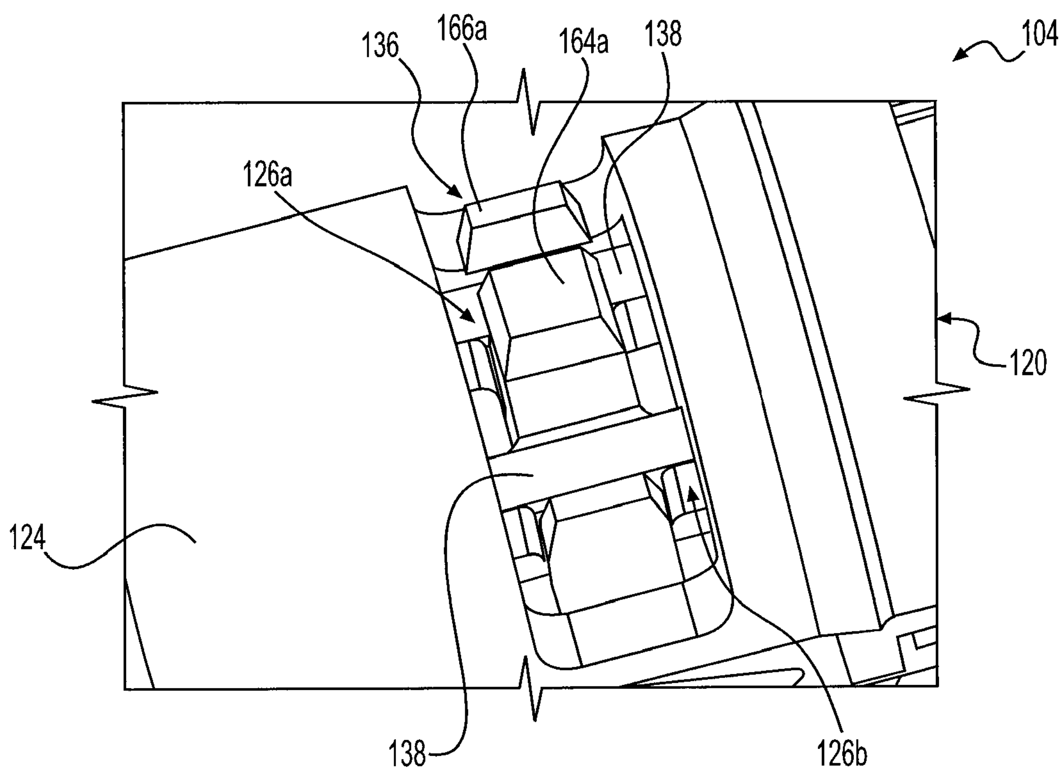
136
166a
164a
138
104
126a
120
124
138
126b

FIG. 4B

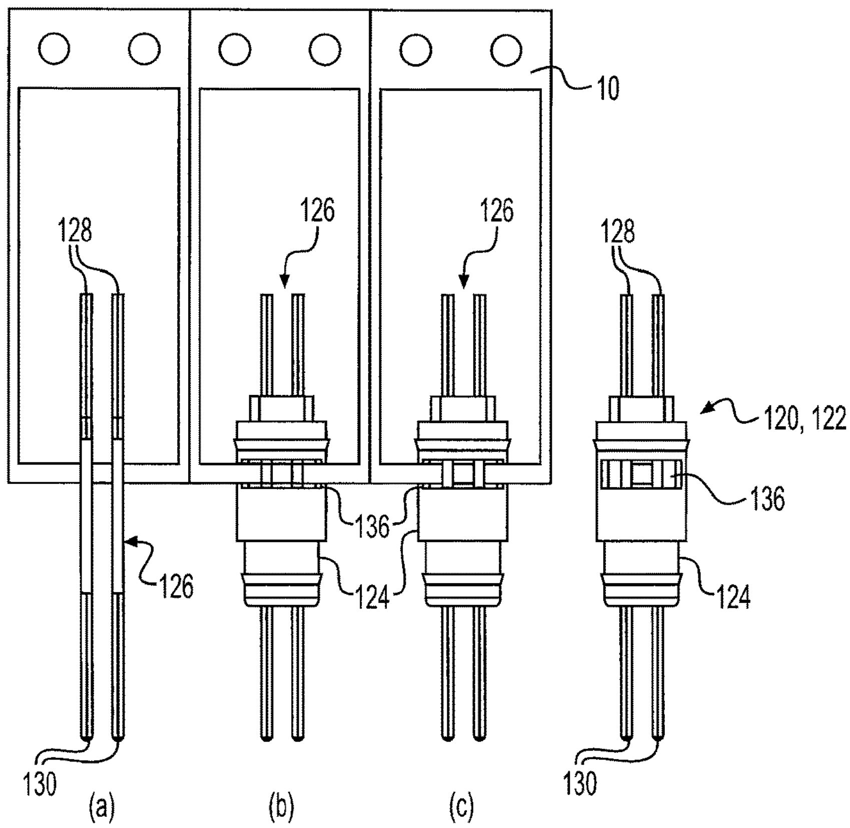
10
128
126
126
128
120, 122
136
136
126
124
124
130
130
(a)
(b)
(c)

FIG. 5

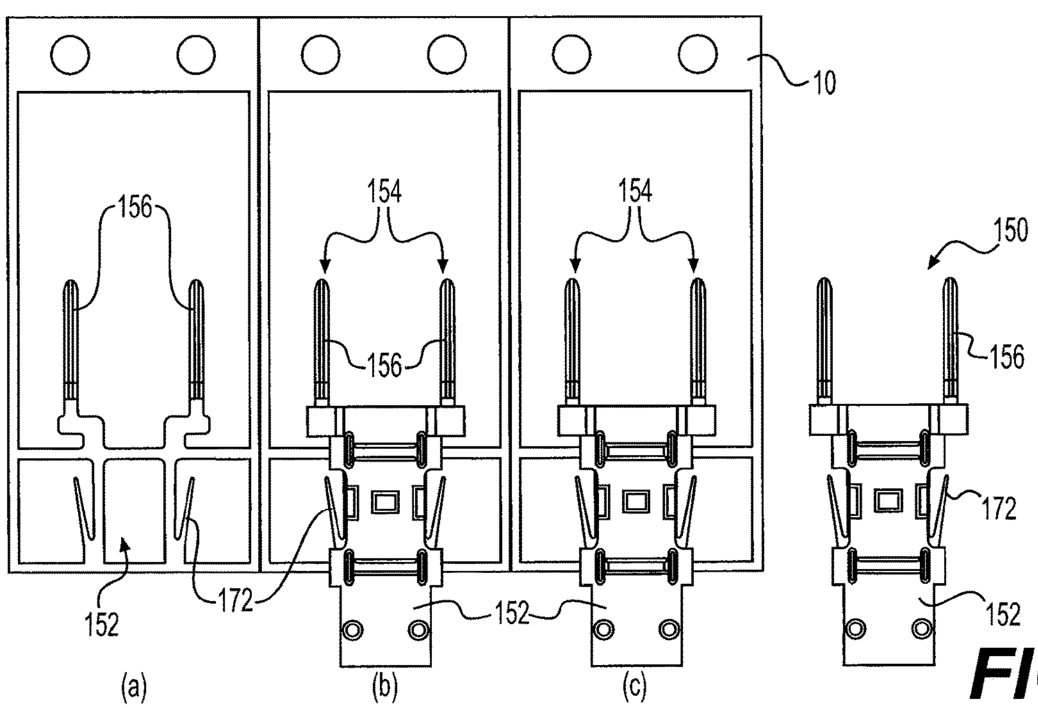
10
156
154
154
150
156
156
172
172
152
152
152
(a)
(b)
(c)

FIG. 6

ELECTRICAL CONNECTOR WAFER ASSEMBLY

FIELD OF THE INVENTION

The present invention relates to an electrical connector, and method of efficiently assembling the same, with high electrical performance at a low manufacturing cost.

BACKGROUND

High speed electrical connectors, such as a Twinax or Quadrax connector, transmit high speed signals at low losses. Such high speed electrical connectors may be used for transmitting and receiving various types of data, for example, for defense and commercial applications. In certain applications, these high speed electrical connectors mount to a printed circuit board and electrical connect with the circuit traces thereof. The machining of these high speed data connectors, however, is costly time consuming, particularly due to the high cycle time. Therefore, a need exists for a high speed data connector that is less expensive to manufacture while also providing high electrical performance.

SUMMARY

Accordingly, the present invention may provide an electrical connector that comprises a conductive connector shell that has a mating interface end and an opposite board engagement end. and a contact subassembly received in the connector shell. The contact subassembly comprises first and second signal wafers and a ground wafer separate from the first and second signal wafers and the ground wafer is sandwiched between the first and second signal wafers. Each of the first and second signal wafers may include one or more signal contacts that has a tail end and an opposite mating end, and a dielectric wafer body formed around the one or more signal contacts such that the tail and mating ends of the one or more signal contacts are outside of the wafer body. The tail end of the one or more signal contacts may extend through and beyond the board engagement end of the connector shell and the mating end of the one more signal contacts may extend toward the mating interface end of the connector shell. The ground wafer may include one or more ground contacts and a dielectric wafer body formed around the one or more ground contacts such that a tail end of the one or more ground contacts is outside of the wafer body of the ground wafer and may extend through and beyond the board engagement end of the connector shell.

In certain embodiments, the wafer body of the first and second signal wafers forms an overmold around the one or more signal contacts such that the one or more signal contacts are integral with the wafer body of the first and second signal wafers; the wafer body of the ground wafer forms an overmold around the one or more ground contacts such that the one or more ground contacts are integral with the wafer body of the ground wafer; the one or more ground contacts of the ground wafer are in electrical continuity with the connector shell; the wafer body of the ground wafer includes a conductive continuity member in contact with the one or more ground contacts and the connector shell to provide the electrical continuity; and/or the continuity member is a spring arm extending from one or more of the ground contacts supported by the wafer body of the ground wafer.

In other embodiments, each of the wafer bodies of the first and second signal wafers has a locating member configured to couple with the wafer body of the ground wafer; each of the wafer bodies of the first and second signal wafers has an engagement member configured to engage the locating member of the other signal wafer; the location member is a post and the engagement member is a hole sized to receive the post; wherein the wafer body of the ground wafer has first and second opposing faces facing the first and second signal wafers, respectively, and at least the first opposing face has at least one isolation extension extending through the wafer body of the first signal wafer adjacent to the one or more signal contacts of the first signal wafer; the wafer body of the first signal wafer has a window disposed therein that exposes a portion of the one or more signal contacts therein and receives the isolation extension from the ground wafer; the isolation extension of the ground wafer extends from a middle portion of the first opposing face, and another isolation extension extends from an edge portion of the first opposing face, the another isolation extension extends through the window adjacent to the one or more signal contacts of the first signal wafer; and/or the connector shell includes at least one notch at the board engagement end thereof that is configured to receive a portion of the wafer body of the ground wafer.

The present invention may also provide an electrical connector that comprises a conductive connector shell that has a mating interface end and an opposite board engagement end and a contact subassembly received in the connector shell. The contact subassembly may comprise first and second signal wafers and a ground wafer separate from the first and second signal wafers, and the ground wafer is sandwiched between the first and second wafers. Each of the first and second signal wafers may include a plurality signal contacts that each have a tail end and an opposite mating end, and a dielectric wafer body overmolded around the signal contacts such that the signal contacts are integral with the wafer body, the signal contacts are laterally spaced from one another, and the tail and mating ends of the signal contacts are outside of the wafer body. The tail ends extend through and beyond the board engagement end of the connector shell and the mating ends extend toward the mating interface end of the connector shell. The ground wafer may include a plurality of ground contacts and a dielectric wafer body overmolded around the ground contacts such that the ground contacts are integral with the wafer body of the ground wafer, the ground contacts are laterally spaced from one another, and a tail end of each of the ground contacts is outside of the wafer body of the ground wafer and extends through and beyond the board engagement end of the connector shell. The ground contacts may be in electrical continuity with the connector shell.

In some embodiments, the wafer body of the ground wafer has first and second opposing faces facing the first and second signal wafers, respectively, and each of the first and second opposing faces has at least one isolation extension extending through the wafer body of the first and second signal wafers, respectively, adjacent to one or more of the signal contacts; the wafer body of each of the first and second signal wafers has a window disposed therein that exposes a portion of each of the signal contacts therein and receives the isolation extension from the first and second opposing faces, respectively, of the ground wafer; each of the wafer bodies of the first and second signal wafers has a locating member configured to couple with the wafer body of the ground wafer and engage the wafer body of the other signal wafer; and/or the wafer body of the ground wafer includes a conductive continuity member in contact with at least one of the ground contacts and an inner surface of the connector shell to provide the electrical continuity.

The present invention may yet further provide a method of assembling an electrical connector that comprises the steps of engaging first and second signal wafers together and sandwiching a ground wafer therebetween, thereby creating a contact subassembly, wherein each of the first and second signal wafers includes one or more signal contacts and a dielectric wafer body formed around the signal contacts and the ground wafer includes one or more ground contacts and a dielectric wafer body formed around the ground contacts; inserting the contact subassembly into a conductive connector shell, such that tail ends of the signal contacts and tail ends of the ground contacts extend through and beyond a board engagement end of the connector shell and mating ends of the signal contacts extend toward a mating end of the connector shell; and attaching the contact subassembly to the connector shell.

In certain embodiments, the method further comprises the step of overmolding the wafer bodies around the one or more signal contacts of the first and second signal wafers, respectively, and overmolding the wafer body of the ground wafer around the one or more ground contacts prior to the step of creating the contact subassembly; the method further comprises the step of stamping the signal contacts and plating the mating ends thereof prior to the step of overmolding the wafer bodies around the signal contacts and stamping and plating the one or more ground contacts prior to the step of overmolding the wafer body of the ground wafer around the one or more ground contacts; and/or the step of attaching the contact subassembly to the connector shell includes adhering the contact subassembly to an inside of the connector shell.

In some embodiments of the method, after the step of inserting the contact subassembly into the connector shell, electrical continuity may established between the one or more ground contacts and the connector shell; may further comprise the step of locating the first and second signal wafers with respect to one another and the ground wafer when creating the contact subassembly; and/or may further comprising the step of electrically isolating the signal contacts of each of the first and second wafers, prior to creating the contact subassembly.

BRIEF DESCRIPTION OF THE DRAWINGS

A more complete appreciation of the invention and many of the attendant advantages thereof will be readily obtained as the same becomes better understood by reference to the following detailed description when considered in connection with the accompanying drawing figures:

FIG. **1** is a perspective view of an electrical connector according to an exemplary embodiment of the present invention;

FIG. **2** is an exploded perspective view of a contact subassembly of the electrical connector illustrated in FIG. **1**;

FIGS. **3A-3C** are perspective views of exemplary steps for assembling the electrical connector illustrated in FIG. **1**;

FIGS. **4A** and **4B** are perspective and enlarged views, respectively, of the assembled contact subassembly of the electrical connector;

FIG. **5** is a plan view of exemplary steps for making a signal wafer of the electrical connector illustrated in FIG. **1**; and

FIG. **6** is a plan view of exemplary steps for making a ground wafer of the electrical connector illustrated in FIG. **1**.

DETAILED DESCRIPTION

Referring to the figures, the present invention relates to an electrical connector **100** designed to be less expensive and more efficient to manufacture than traditional electrical connectors, while also providing high electrical performance, such as when used for high speed data transmission. The design of electrical connector **100** also improves electrical performance, including impedance tuning of its contacts, which is particularly important for high date rate transfer, for example. Electrical connector **100** generally comprises a conductive connector shell **102** and a contact subassembly **104** received in the shell **102**. Contact subassembly **104** is configured to be received in the shell **102** such that grounding/electrical continuity is established therebetween while also electrically isolating the signal contacts of the subassembly **104** to improve electrical performance.

As seen in FIG. **1**, connector shell **102** may be a generally cylindrical housing **110** with an inner surface **112** defining a receiving area for the contact subassembly **104**. Housing **110** has a mating interface end **116** for connecting to a mating cable receptacle connector or to a receptacle connector also terminated to the board and an opposite board engagement end **114** for connecting to a printed circuit board.

Contact subassembly **104** may comprise first and second signal wafers **120** and **122** with a ground wafer **150** sandwiched therebetween, as best seen in FIGS. **2** and **3**B. Each of the signal wafers **120** and **122** may comprise a dielectric wafer body **124** and one or more signal contacts **126**. In a preferred embodiment, wafer body **124** is formed around the signal contacts **126**. For example, the wafer body **124** may be overmolded onto and over the signal contacts **126** such that the signal contacts **126** become integral with wafer body **124**, that is they cannot be readily separated from wafer body **124** without destroying the wafer body **124**. Each signal contact **126** has a tail end **128** and an opposite mating end **130**. When forming wafer body **124** around the signal contacts **126**, e.g. by overmolding, the tail ends **128** and the opposite mating ends **130** may be left uncovered or outside of wafer body **124**. In one embodiment, wafer body **124** is formed around two signal contacts **126***a* and **126***b* (FIG. **2**) that may be oriented such that they can be laterally spaced from and substantially parallel to one another.

Each wafer body **124** has an inner surface **132** facing ground wafer **150** and an outer surface **134**. In one embodiment, the inner surface **132** is substantially flat and the outer surface **134** is rounded or curved such that the cross-sectional shape of wafer body **124** is generally semi-circular. A window **136** may be formed in the outer surface **134** of the wafer body **124**, thereby exposing a portion **138** of each signal contact **126**, as seen in FIGS. **4**A and **4**B. Inner surface **132** of wafer body **124** may have one or more openings **140** (FIG. **2**) in communication with window **136**.

Each wafer body **124** of the first and second signal wafers **120** and **122** may have one or more locating members **142** configured to couple with the ground wafer **150**. Each wafer body **124** may also have an engagement member **144** configured to engage the other signal wafer **120** or **122**. In one embodiment, the engagement members **144** may be configured to engage the locating members **142** of the other signal wafer **120** or **122**. For example, the location member **142** of the wafer body of the first signal wafer **120** can engage the engagement member **144** of the wafer body **124** of the second signal wafer **122**, and vise-versa. The location and engagement members **142** and **144** act to properly locate and position the signal wafers **120** and **122** along with the ground wafer **150** when creating contact subassembly **104**. In one embodiment, each locating member **142** is a post extending from the inner surface **132** of wafer body **124** and each engagement member **144** is a corresponding hole in the inner surface **132** that can receive the post.

Ground wafer **150** may comprise a dielectric wafer body **152** and one or more ground contacts **154**. In a preferred embodiment, wafer body **152** is formed around the ground contacts **154** that are spaced from one another similar to the wafer body **124** of the signal wafers **120** and **122**. Wafer body **152** may be overmolded onto the ground contacts **154** such that the ground contacts **154** become integral with wafer body **152**. Each ground contact **154** has a tail end **156** extending from wafer body **152**. That is, when forming wafer body **152** around the ground contacts **154**, e.g. by overmolding, the tail ends **156** may be left uncovered or outside of wafer body **152**. In one embodiment, wafer body **152** is formed around two ground contacts **154***a* and **154***b* (FIG. **2**) that may be oriented such that they can be laterally spaced from and substantially parallel to one another. In one embodiment, ground contacts **154***a* and **154***b* are laterally spaced from one another for a distance greater than the distance between signal contacts **126***a* and **126***b*. The contacts **126***a* and **126***b* may be arranged as a standard Quadrax, for example, such that the differential pair are diagonally opposite one another with the ground contact **154***a* and **154***b* therebetween. In another embodiment, a ground plate may be provided between the ground contacts **154***a* and **154***b*, thereby allowing for a split pair Quadrax where the differential pair is separated by the ground contacts **154***a* and **154***b* and the ground plate.

Tail ends **128** of the signal contacts **126** and the tail ends **156** of the ground contacts **154** may be configured to engage a printed circuit board mechanically and electrically, such as by soldering them to the board or by configuring the tail ends **128'** and **156'** as press-fit pins (FIG. **4**A) that press fit into the board.

Wafer body **152** of ground wafer **150** has first and second opposing faces **160** and **162** facing the inner surfaces **132** of first and second signal wafers **120** and **122**, respectively. Each of the opposing faces **160** and **162** may have at least one isolation extension **164***a* and **164***b*. Each isolation extension **164***a* and **164***b* may be sized and configured to extend through one of the openings **140** in the signal wafers' inner surfaces **132** and into window **136**. In a preferred embodiment, each isolation extension **164***a* and **164***b* is positioned near or adjacent to the exposed portions **138** of the signal contacts **126**, as seen in FIG. 4B. For example, each isolation extension **164***a* and **164***b* may by positioned on a middle portion of wafer body **152** and extend between the signal contacts **126***a* and **126***b* of the first and second signal wafers **120** and **122**, respectively, to assist with electrical isolation of the signal contacts. Because air is a dielectric, window **136** also assists with the electrical isolation of the signal contacts **126**. Isolation extensions **164***a* and **164***b*, by virtue of extending into the windows **136** of signal wafers **120** and **122**, respectively, may also assist with locating and positioning of the signal and ground wafers. One or more through bores **168** may be provided in wafer body **152** that are positioned therein to be generally aligned with and receive the locating members **142** of signal wafers **120** and **122** when assembled into contact subassembly **104**.

Additional or secondary isolation extensions **166***a* and **166***b* may also be provided on the opposing faces **160** and **162** of the ground wafer body **152**. These isolation extensions **166***a* and **166***b* may also extend through one of the openings **140** in the signal wafers and into their respective windows **136** such that the isolation extensions **166***a* and **166***b* are near or adjacent at least one of the signal contacts **126**. For example, the isolation extensions **166***a* and **166***b* (FIGS. **2** and **3**A) may be positioned at or near an edge of wafer body **152** such that they are outside of the signal contacts **126***a* and **126***b*, thereby further electrically isolating the signal contacts.

In a preferred embodiment, the ground contacts **154** may be in electrical continuity with the connector shell **102**, thereby establishing a grounding path through electrical connector **100**. One or more conductive continuity members **170** may be provided in the ground wafer body **154** that electrically connects the connector shell **102** and the ground contacts **154**. Continuity member **170** may be, for example, a spring arm **172**, that is preferably formed integrally with each ground contact **154** (FIG. **6**). The spring arm **172** is designed to bias outwardly and make contact with connector shell **102**, such as the inner surface **112** of shell **102**.

As seen in FIGS. **3**A-3C, to assemble electrical connector **100**, the contact subassembly **104** is first created or assembled and then inserted into the connector shell **102**. Connector shell **102** may include one or more notches **180** at its board engagement end **114** thereof that are configured to receive one or more abutment portions **182** that extend from the wafer body **152** of the ground wafer **150**. That is, contact subassembly **104** may be inserted into the board engagement end **114** of connector shell **102** until abutment portions **182** are received in and abut against the notches **180**.

Creating contact subassembly **104** generally involves engaging first and second signal wafers **120** and **122** together and sandwiching ground wafer **150** between the inner surfaces **132** of the signal wafers **120** and **122**. Signal wafers **120** and **122** may be engaged by, for example, inserting the respective locating members **142**, such as a post, on the signal wafer body inner surfaces **132** thereof, into the respective engagement members **144**, such as a corresponding hole, in the signal wafer body inner surfaces **132** thereof. Those locating members **142** may also extend through the through bores **168** of the wafer body **152** of ground wafer **150** for proper positioning and alignment of the wafers **120**, **122**, and **150** when assembling together.

Isolation extensions **164***a* and **164***b* and isolation extensions **166***a* and **166***b* may extend into respective windows **136** of the first and second signal wafers **120** and **122**, and adjacent to the exposed portions **138** of the signal contacts **126**. In a preferred embodiment, each of the signal contacts **126** is located between at least two isolation extensions of ground wafer **150**, such as between middle isolation extension **164***a* and outer isolation extension **166***a*, as seen in FIG. 4B, for electrically isolating the signal contacts **126**.

Once contact subassembly **104** is assembled, it can be inserted into conductive connector shell **102**, preferably through its board engagement end **114**, such that tail ends **128** of the signal contacts **126** and tail ends **156** of the ground contacts **154** extend through and beyond the shell's board engagement end **114** and mating ends **130** of the signal contacts **126** extend toward mating interface end **116** of connector shell **102**. Also, ground spring arm **172**, which extends outwardly from the wafer body **152** of ground wafer **152**, engages the connector shell's inner surface **112** to establish electrical continuity between contact subassembly **104** and shell **102**. Contact subassembly **104** may then be attached to connector shell **102**, such as by applying an adhesive or epoxy **190** between contact subassembly **104** and the inner surface **112** of connector shell **102**.

As seen in FIG. **5**, each signal wafer **120** and **122** may be made, for example, by (a) stamping one or more contacts **126** such that they are laterally spaced and generally parallel to one another and plating the mating ends **130** of each contact **126**; (b) overmolding the dielectric wafer body **124** around and over the mid-portions of the contacts **126**, leaving the window **136** in each wafer body; and (c) cutting and removing the carrier strip **10** from the overmolded wafer body **124**. Stamping of the contacts **126** allows for impedance tuning. That is because when signal contacts transition from being in open air to residing in an insulator or dielectric, such as plastic, the impedance changes, thus resulting an impedance mismatch. The stamped contacts **126** are inherently more adaptable for impedance tuning (addressing impedance mismatch) than the conventional machined contacts. For example, the contacts **126** inside the dielectric wafer body **124** can be moved closer or further away from ground wafer **150** without changing the cross-section of the individual contacts. Also, the contacts **126** inside of wafer body **124** can be moved closer to, or further apart from each other, as needed. Conventional machined contacts cannot be moved.

As seen in FIG. **6**, ground wafer **150** is formed in a manner similar to signal wafers **120** and **122**, including (a) stamping one or more ground contacts **154**; (b) overmolding the dielectric wafer body **152** around and over the ground contacts **154** leaving the contacts' tail ends **156** uncovered and the grounding spring arms **172** exposed; and (c) cutting and removing the carrier strip **10** from the overmolded wafer body **152**.

While particular embodiments have been chosen to illustrate the invention, it will be understood by those skilled in the art that various changes and modifications can be made therein without departing from the scope of the invention as defined in the appended claims. For example, although electrical connector **100** is shown as having its contacts in Quadrax arrangement, the present invention contemplates over connector types, such as one or more straight pin contacts, twinax, coax, parallel array contacts or any other type of electrical contacts, suitable for carrying a variety of signal types.

What is claimed is:

1. An electrical connector, comprising:

a conductive connector shell having a receiving area, a mating interface end, and a board engagement end; and

a contact subassembly received in the receiving area of the connector shell such that the contact subassembly is generally enclosed by the connector shell, the contact subassembly comprising,

first and second signal wafers and a ground wafer separate from the first and second signal wafers, the ground wafer being sandwiched between the first and second signal wafers,

each of the first and second signal wafers including one or more signal contacts that has a tail end and an opposite mating end, and a dielectric wafer body formed around the one or more signal contacts such that the tail and mating ends of the one or more signal contacts extend beyond the wafer body with the tail end of the one or more signal contacts extending through and beyond the board engagement end of the connector shell and the mating end of the one more signal contacts extending toward the mating interface end of the connector shell,

the ground wafer including one or more ground contacts and a dielectric wafer body formed around the one or more ground contacts such that a tail end of the one or more ground contacts extends beyond the wafer body of the ground wafer and the board engagement end of the connector shell, and

wherein the connector shell includes at least one notch at the board engagement end thereof that is configured to receive a portion of the wafer body of the ground wafer.

2. An electrical connector, comprising:

a conductive connector shell having a receiving area, a mating interface end, and a board engagement end; and

a contact subassembly received in the receiving area of the connector shell such that the contact subassembly is generally enclosed by the connector shell, the contact subassembly comprising,

first and second signal wafers and a ground wafer separate from the first and second signal wafers, the ground wafer being sandwiched between the first and second signal wafers,

each of the first and second signal wafers including one or more signal contacts that has a tail end and an opposite mating end, and a dielectric wafer body formed around the one or more signal contacts such that the tail and mating ends of the one or more signal contacts extend beyond the wafer body with the tail end of the one or more signal contacts extending through and beyond the board engagement end of the connector shell and the mating end of the one more signal contacts extending toward the mating interface end of the connector shell,

both signal wafer dielectric wafer bodies substantially mirror each other in that they have a definitively non-planar outer surface and a substantially planar inner surface which faces the ground wafer, and

the ground wafer including one or more ground contacts and a dielectric wafer body formed around the one or more ground contacts such that a tail end of the one or more ground contacts extends beyond the wafer body of the ground wafer and the board engagement end of the connector shell.

3. The electrical connector of claim **2**, wherein the wafer body of the first and second signal wafers forms an overmold around the one or more signal contacts such that the one or more signal contacts are integral with the wafer body of the first and second signal wafers.

4. The electrical connector of claim **2**, wherein the wafer body of the ground wafer forms an overmold around the one or more ground contacts such that the one or more ground contacts are integral with the wafer body of the ground wafer.

5. The electrical connector of claim **2**, wherein the connector shell includes at least one notch at the board engagement end thereof that is configured to receive a portion of the wafer body of the ground wafer.

6. The electrical connector of claim **2**, wherein the first and second signal wafers are substantially the same.

7. The electrical connector of claim **2**, wherein the connector shell is substantially cylindrical.

8. The electrical connector of claim **2**, wherein the mating and tail ends of each signal contact are axially aligned.

9. The electrical connector of claim **2**, wherein both the first and second signal wafers are directly coupled to the ground wafer.

10. The electrical connector of claim **2**, wherein the one or more ground contacts of the ground wafer are in electrical continuity with the connector shell.

11. The electrical connector of claim **10**, wherein the wafer body of the ground wafer includes a conductive continuity member in contact with the one or more ground contacts and the connector shell to provide the electrical continuity.

12. The electrical connector of claim **11**, wherein the continuity member is a spring arm extending from one or more of the ground contacts supported by the wafer body of the ground wafer.

13. The electrical connector of claim **2**, wherein each of the wafer bodies of the first and second signal wafers has a locating member configured to couple with the wafer body of the ground wafer.

14. The electrical connector of claim **13**, wherein each of the wafer bodies of the first and second signal wafers has an engagement member configured to engage the locating member of the other signal wafer.

15. The electrical connector of claim **14**, wherein the location member is a post and the engagement member is a hole sized to receive the post.

16. The electrical connector of claim **2**, wherein the wafer body of the ground wafer has first and second opposing faces facing the first and second signal wafers, respectively, and at least the first opposing face has at least one isolation extension extending through the wafer body of the first signal wafer adjacent to the one or more signal contacts of the first signal wafer.

17. The electrical connector of claim **16**, wherein the wafer body of the first signal wafer has a window disposed therein that exposes a portion of the one or more signal contacts therein and receives the isolation extension from the ground wafer.

18. The electrical connector of claim **17**, wherein the isolation extension of the ground wafer extends from a middle portion of the first opposing face, and another isolation extension extends from an edge portion of the first opposing face, the another isolation extension extends through the window adjacent to the one or more signal contacts of the first signal wafer.

19. An electrical connector, comprising:

a conductive connector shell having a mating interface end and an opposite board engagement end; and

a contact subassembly received in a receiving area of the connector shell, such that the contact subassembly is generally enclosed by connector shell, the contact subassembly comprising,

first and second signal wafers and a ground wafer separate from the first and second signal wafers, the ground wafer being sandwiched between the first and second wafers,

each of the first and second signal wafers including a plurality signal contacts that each have a tail end and an opposite mating end, and a dielectric wafer body overmolded around the signal contacts such that the signal contacts are integral with the wafer body, the signal contacts are laterally spaced from one another, and the tail and mating ends of the signal contacts extend beyond the wafer body, with the tail ends extending through and beyond the board engagement end of the connector shell and the mating ends extending toward the mating interface end of the connector shell,

both signal wafer dielectric wafer bodies substantially mirror each other in that they have a definitively non-planar outer surface and a substantially planar inner surface which faces the ground wafer, and

the ground wafer including a plurality of ground contacts and a dielectric wafer body overmolded around the ground contacts such that the ground contacts are integral with the wafer body of the ground wafer, the ground contacts are laterally spaced from one another, and a tail end of each of the ground contacts extends beyond the wafer body of the ground wafer and the board engagement end of the connector shell wherein the ground contacts are in electrical continuity with the connector shell.

20. The electrical connector of claim **19**, wherein each of the wafer bodies of the first and second signal wafers has a locating member configured to couple with the wafer body of the ground wafer and engage the wafer body of the other signal wafer.

21. The electrical connector of claim **19**, wherein the wafer body of the ground wafer includes a conductive continuity member in contact with at least one of the ground contacts and an inner surface of the connector shell to provide the electrical continuity.

22. The electrical connector of claim **19**, wherein the wafer body of the ground wafer has first and second opposing faces facing the first and second signal wafers, respectively, and each of the first and second opposing faces has at least one isolation extension extending through the wafer body of the first and second signal wafers, respectively, adjacent to one or more of the signal contacts.

23. The electrical connector of claim **22**, wherein the wafer body of each of the first and second signal wafers has a window disposed therein that exposes a portion of each of the signal contacts therein and receives the isolation extension from the first and second opposing faces, respectively, of the ground wafer.

24. A method of assembling an electrical connector, comprising the steps of

engaging first and second signal wafers together, each of the first and second signal wafers engaging a ground wafer and sandwiching the ground wafer therebetween, thereby creating a contact subassembly, wherein each of the first and second signal wafers includes one or more signal contacts and a dielectric wafer body formed around the signal contacts and the ground wafer includes one or more ground contacts and a dielectric wafer body formed around the ground contacts, and wherein both signal wafer dielectric wafer bodies substantially mirror each other in that they have a definitively non-planar outer surface and a substantially planar inner surface which faces the ground wafer;

inserting the contact subassembly into a receiving area of a conductive connector shell, such that the connector shell generally encloses the contact subassembly and tail ends of the signal contacts and tail ends of the ground contacts extend through and beyond a board engagement end of the connector shell and mating ends of the signal contacts extend toward a mating end of the connector shell; and

attaching the contact subassembly to the connector shell.

25. The method of claim **24**, wherein the step of attaching the contact subassembly to the connector shell includes adhering the contact subassembly to an inside of the connector shell.

26. The method of claim **24**, wherein after the step of inserting the contact subassembly into the connector shell, establishing electrical continuity between the one or more ground contacts and the connector shell.

27. The method of claim **24**, further comprising the step of locating the first and second signal wafers with respect to one another and the ground wafer when creating the contact subassembly.

28. The method of claim **24**, further comprising the step of electrically isolating the signal contacts of each of the first and second wafers, prior to creating the contact subassembly.

29. The method of claim **24**, further comprising the step of overmolding the wafer bodies around the one or more signal contacts of the first and second signal wafers, respectively, and overmolding the wafer body of the ground wafer around the one or more ground contacts prior to the step of creating the contact subassembly.

30. The method of claim **29**, further comprising the step of stamping the signal contacts and plating the mating ends thereof prior to the step of overmolding the wafer bodies around the signal contacts and stamping and plating the one or more ground contacts prior to the step of overmolding the wafer body of the ground wafer around the one or more ground contacts.

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