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(54) **ELECTRICAL CONNECTOR WITH ESD PROTECTION**

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(Under 37 CFR 1.47)

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Filed: **Nov. 15, 2007**

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H01R 13/60 (2006.01)
H01R 13/66 (2006.01)

(52) **U.S. Cl.**
USPC **439/541.5**

(58) **Field of Classification Search**
USPC 439/541.5, 79, 660, 676
See application file for complete search history.

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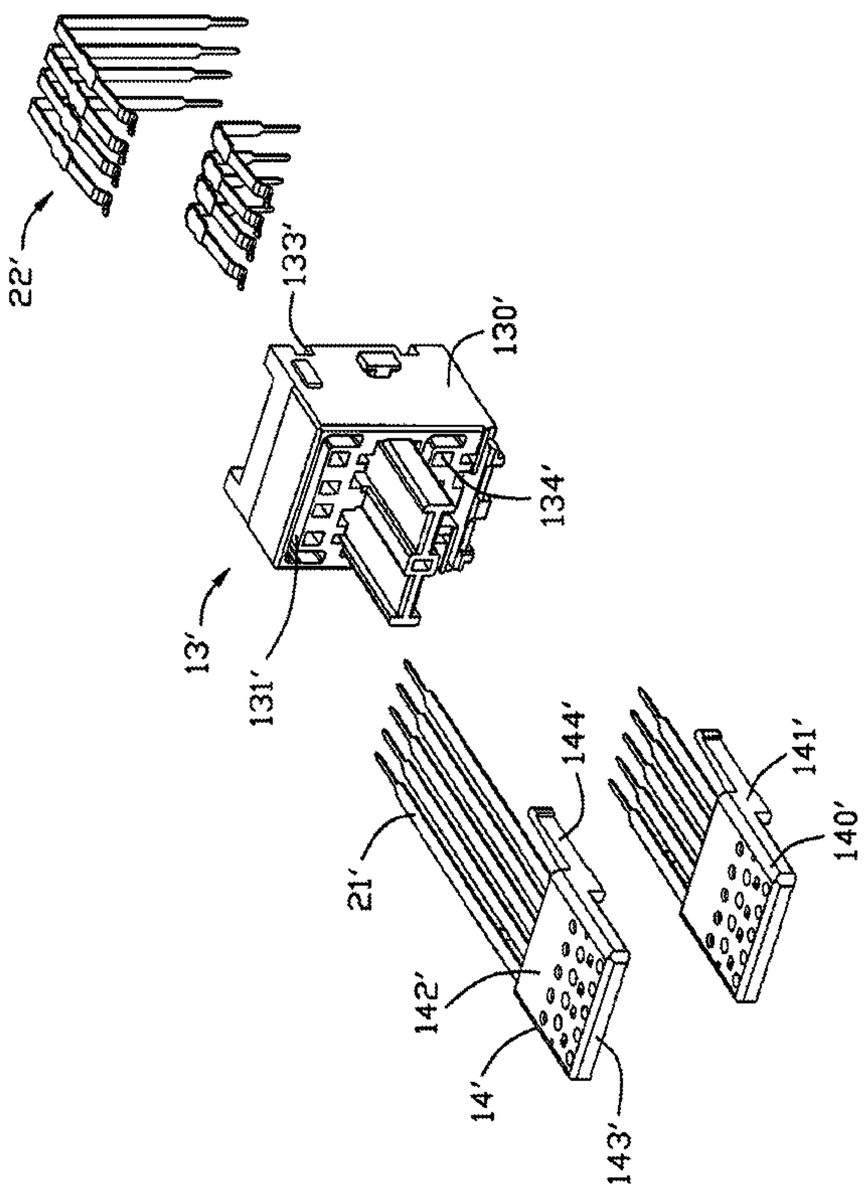
(57) **ABSTRACT**

An electrical connector (**100**) for receiving a mating plug (**200**) having an insulative housing (**10**), a set of first contacts (**21**), and a set of second contacts (**22**). The insulative housing includes a base portion (**13**), a wafer (**14**), and a latch mechanism fastened the wafer to the base portion. The electrical contacts are attached to the insulative housing and each has a contact section (**214**, **222**) connecting with the plug and a mounting section (**213**, **224**) extending out of the insulative housing. The contact sections of the first contacts are staggered with the contact sections of the second contacts along a mating direction of the electrical connector, and wherein the contact sections of the first contacts are closed to a front edge of the wafer.

19 Claims, 18 Drawing Sheets



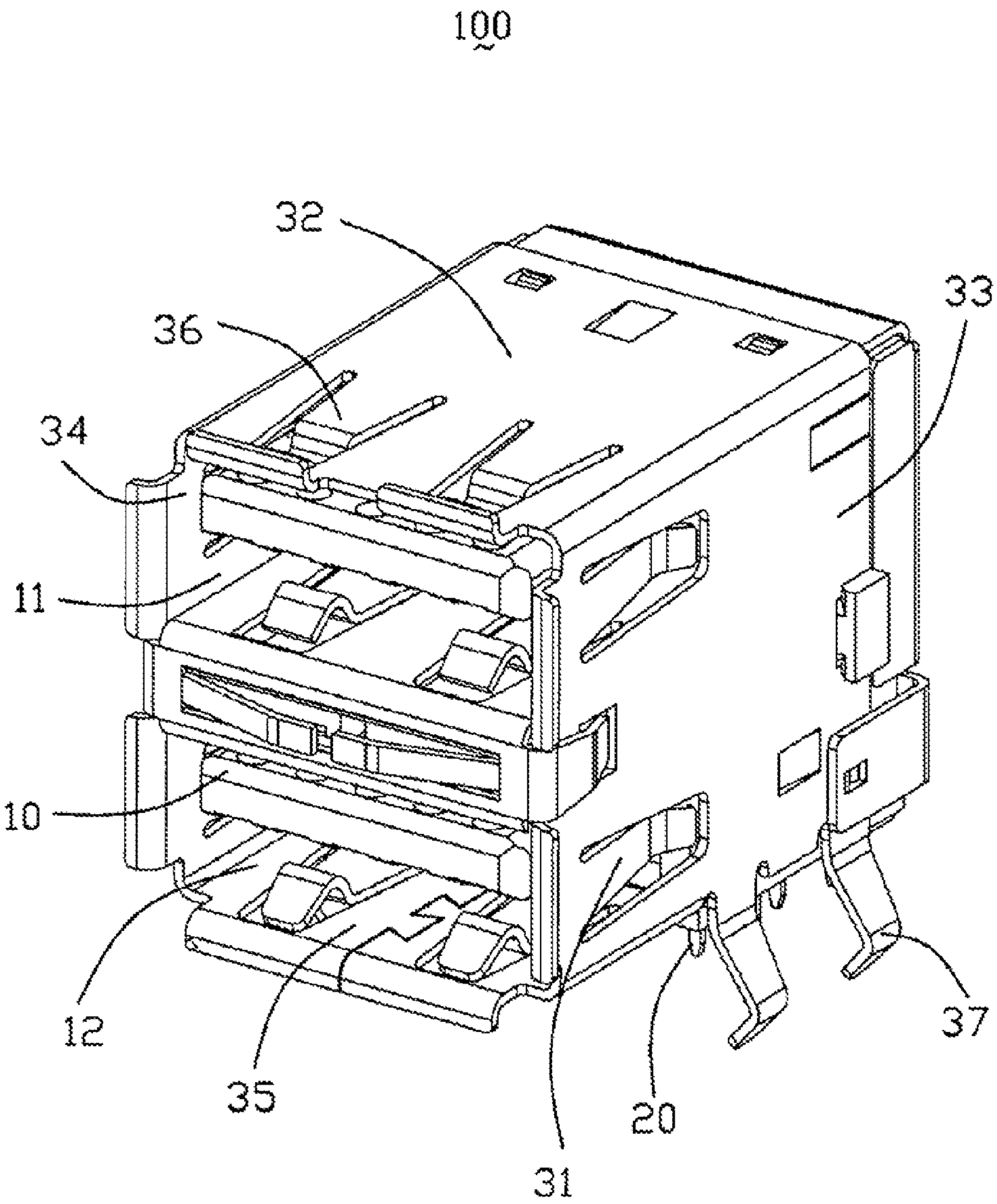


FIG. 1

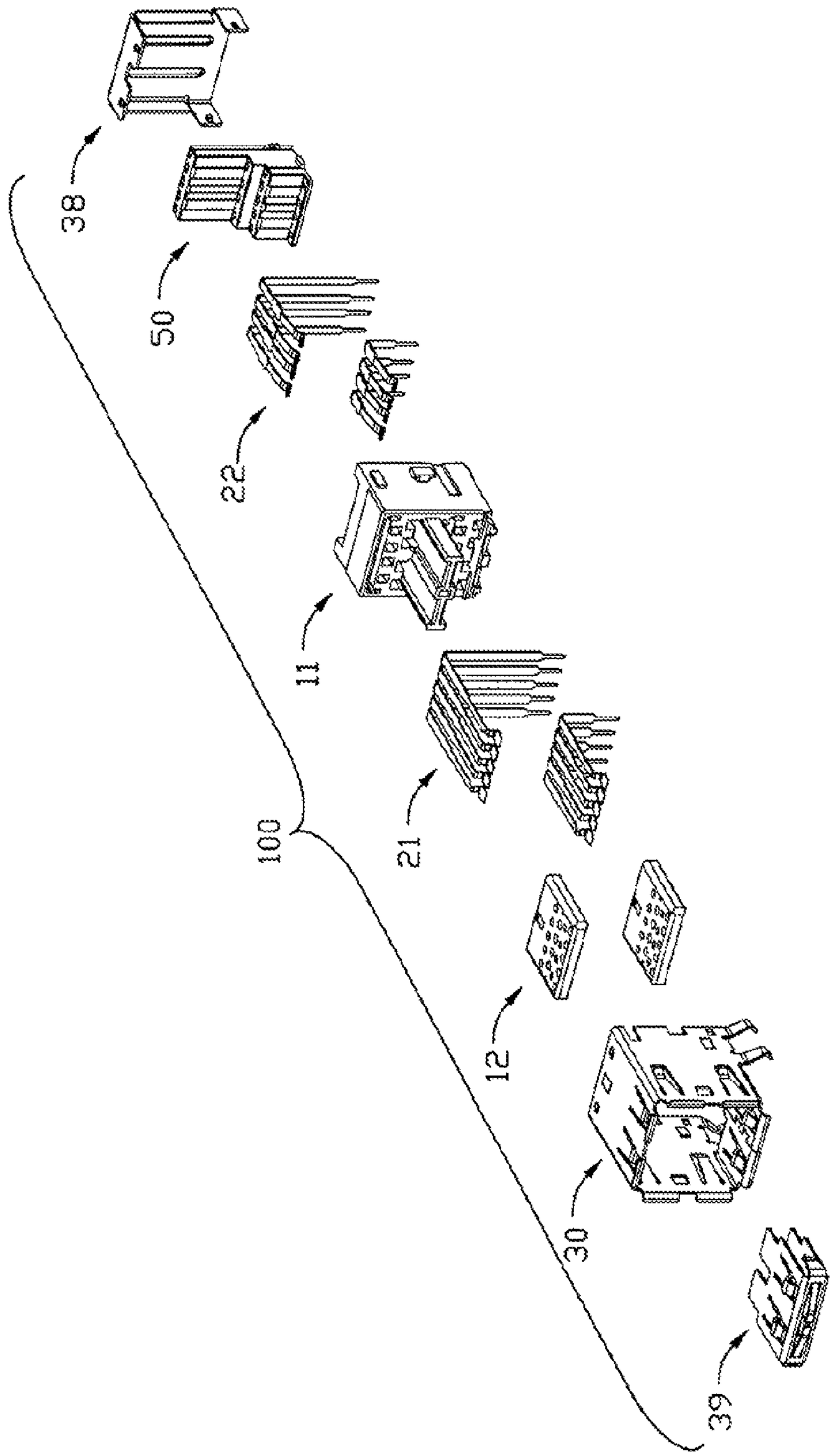


FIG. 2

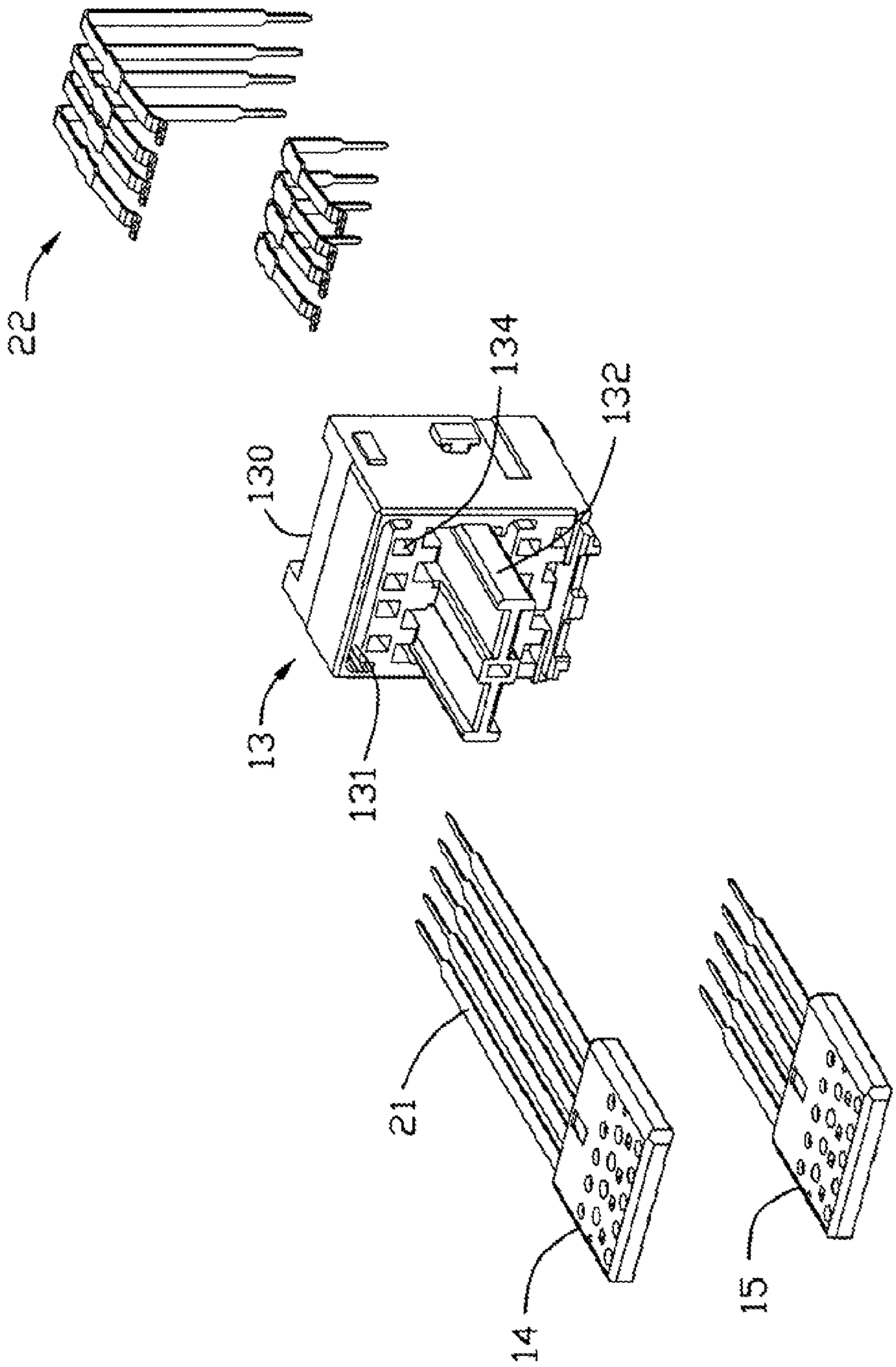


FIG. 3

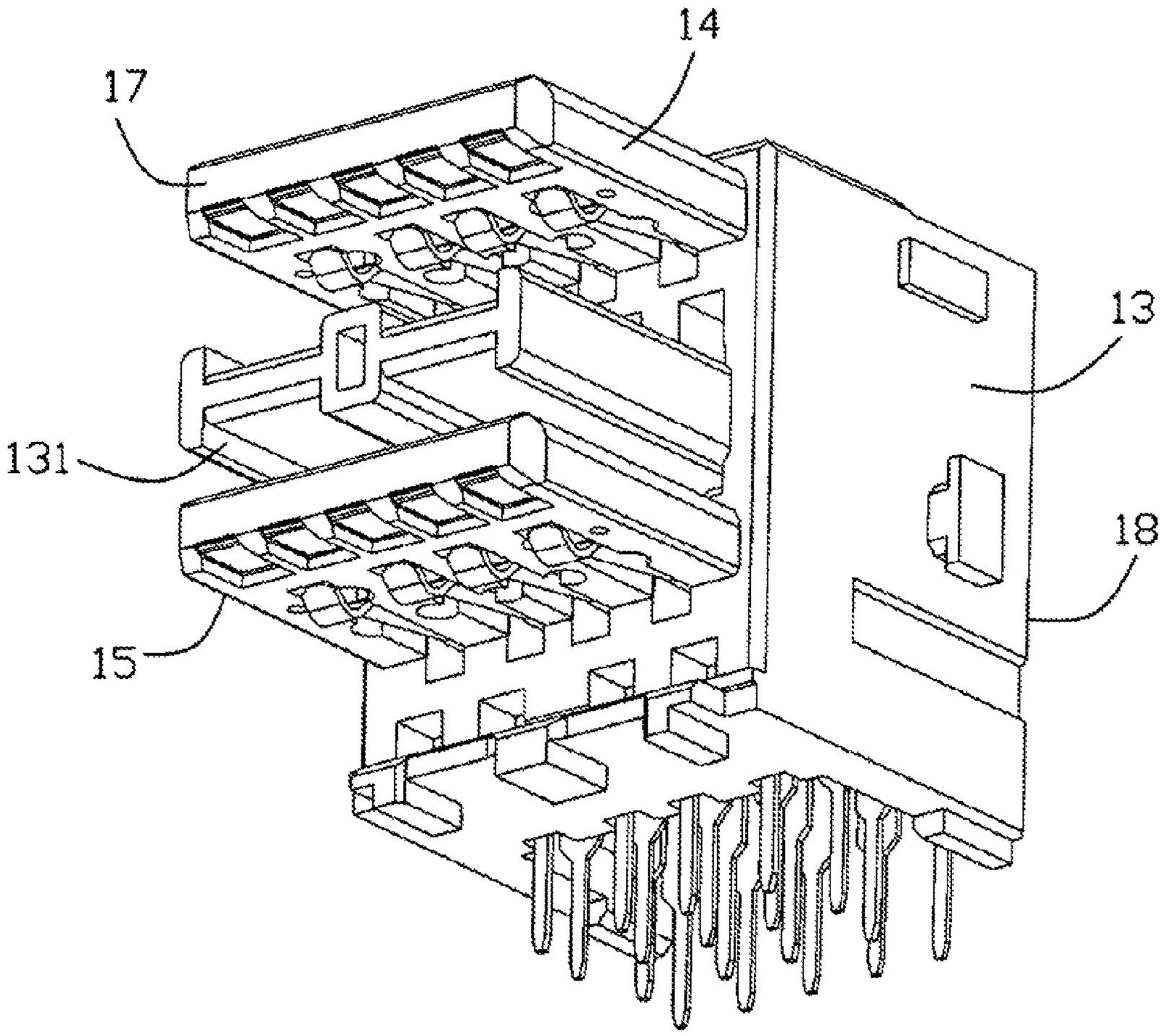


FIG. 4

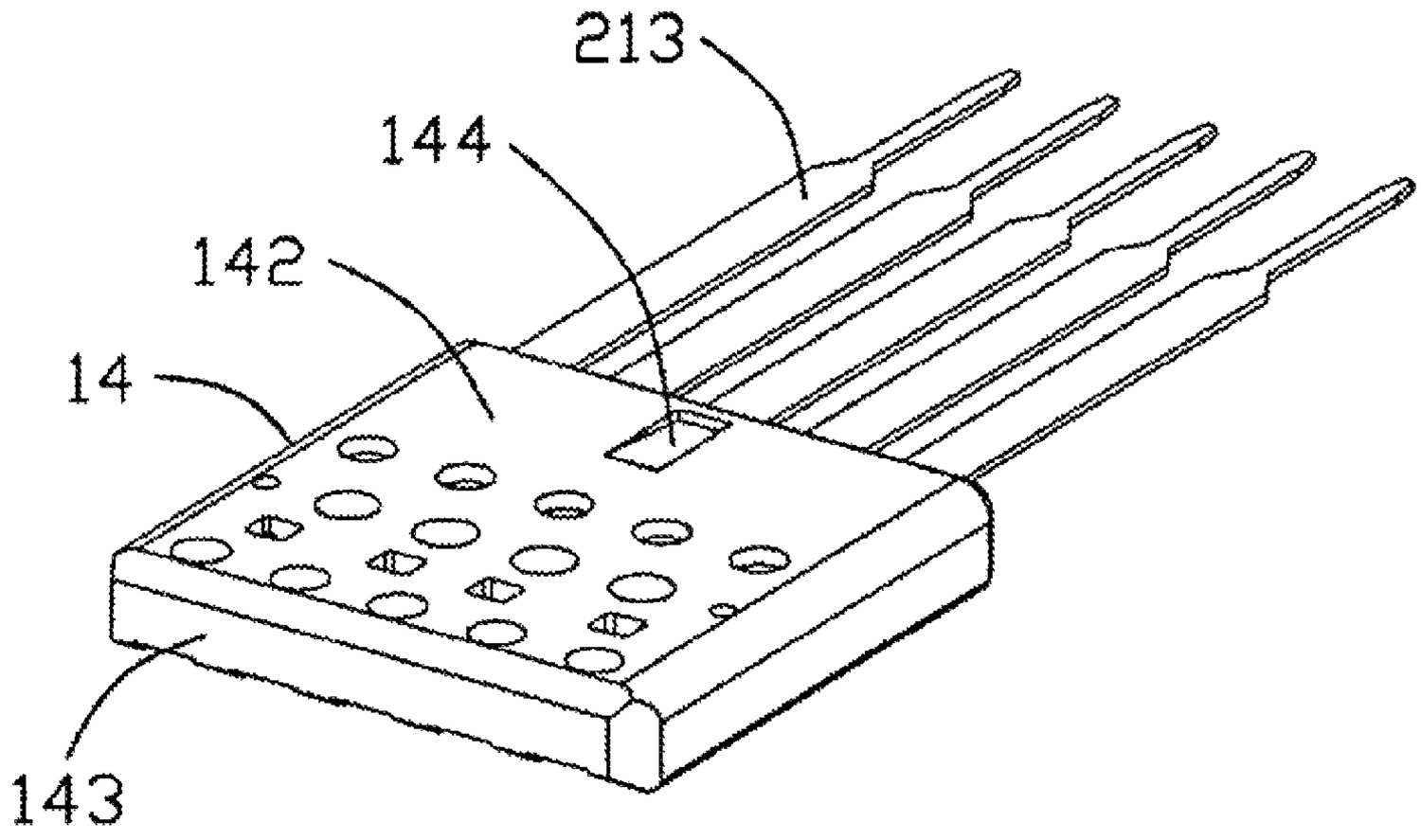


FIG. 5

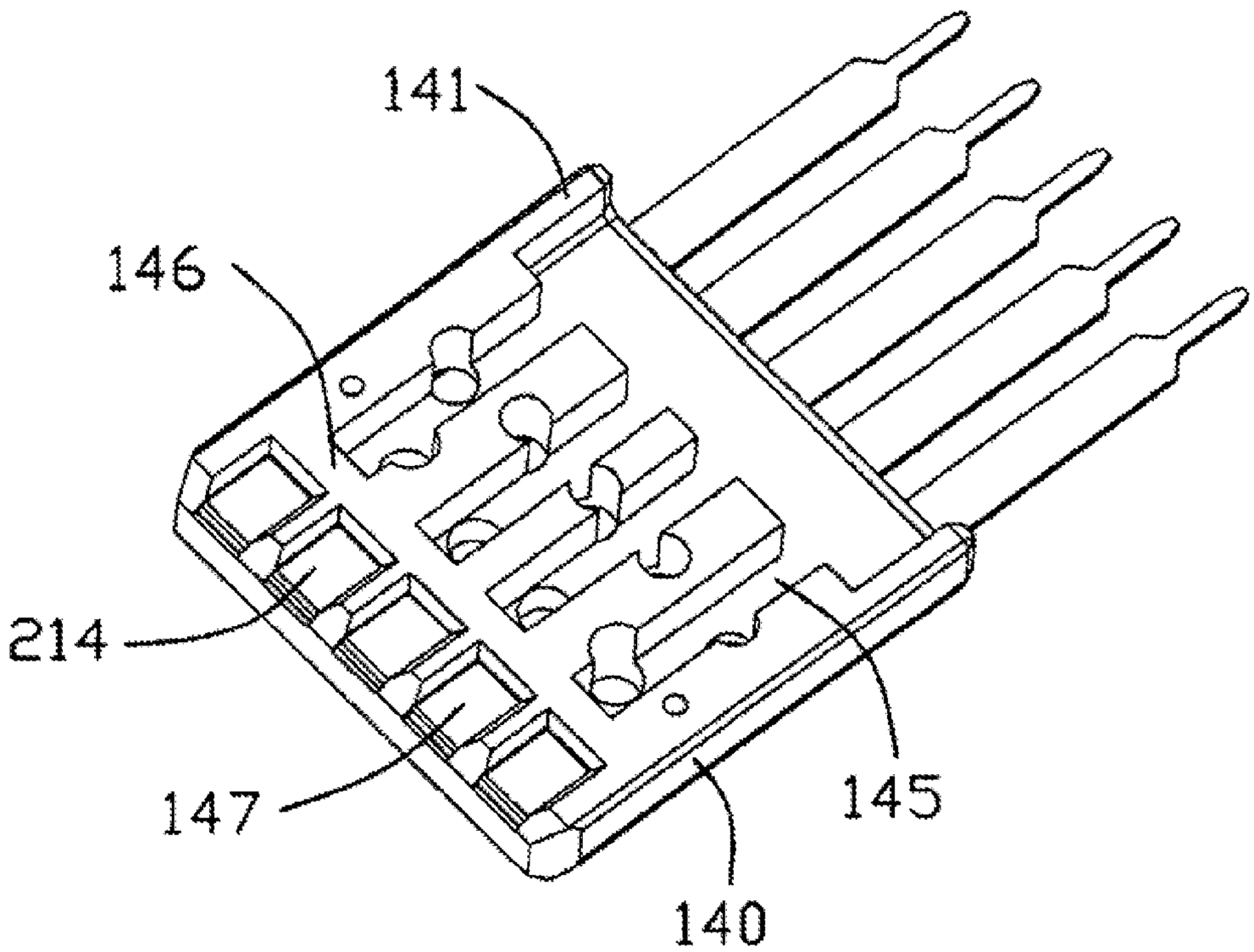


FIG. 6

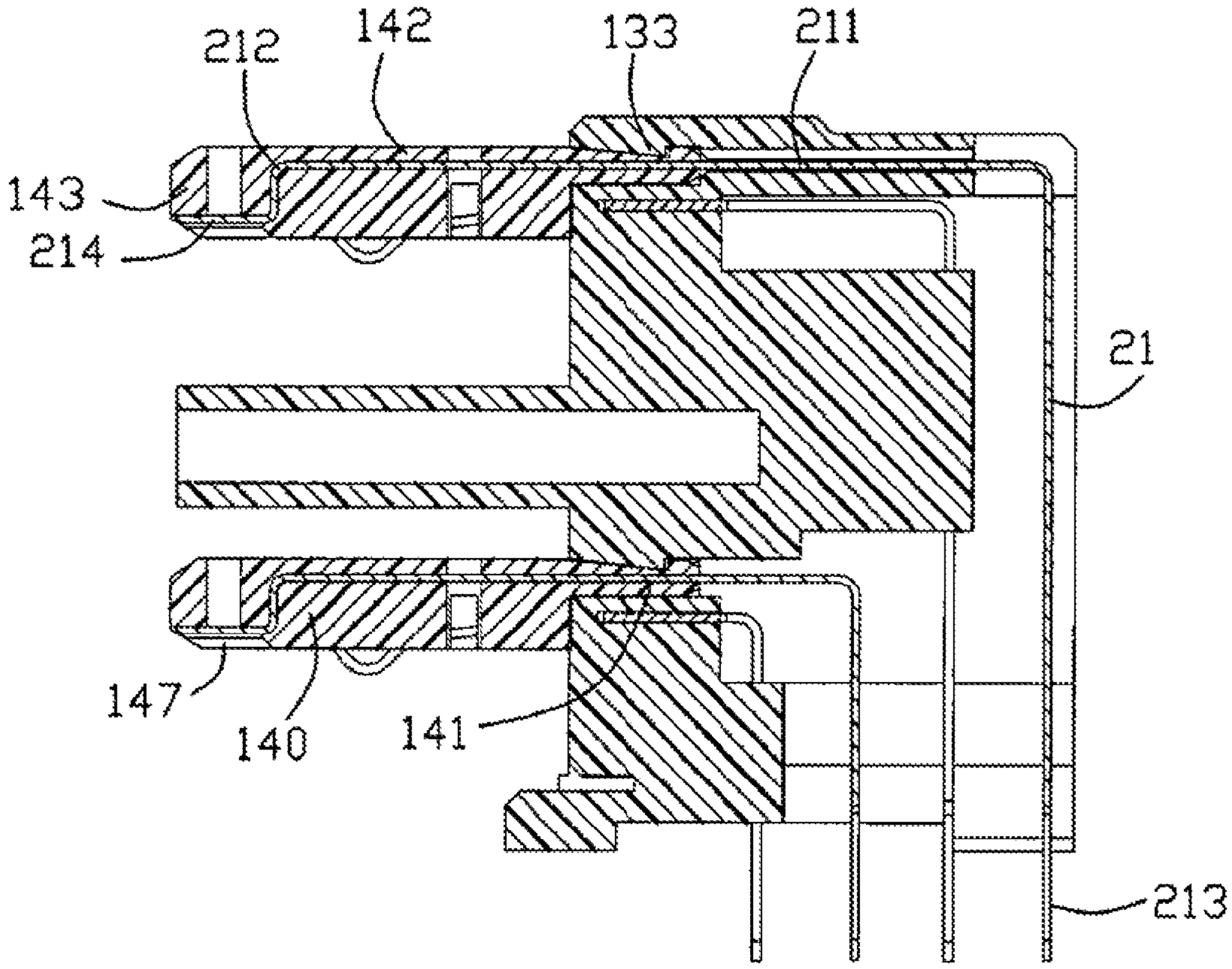


FIG. 7

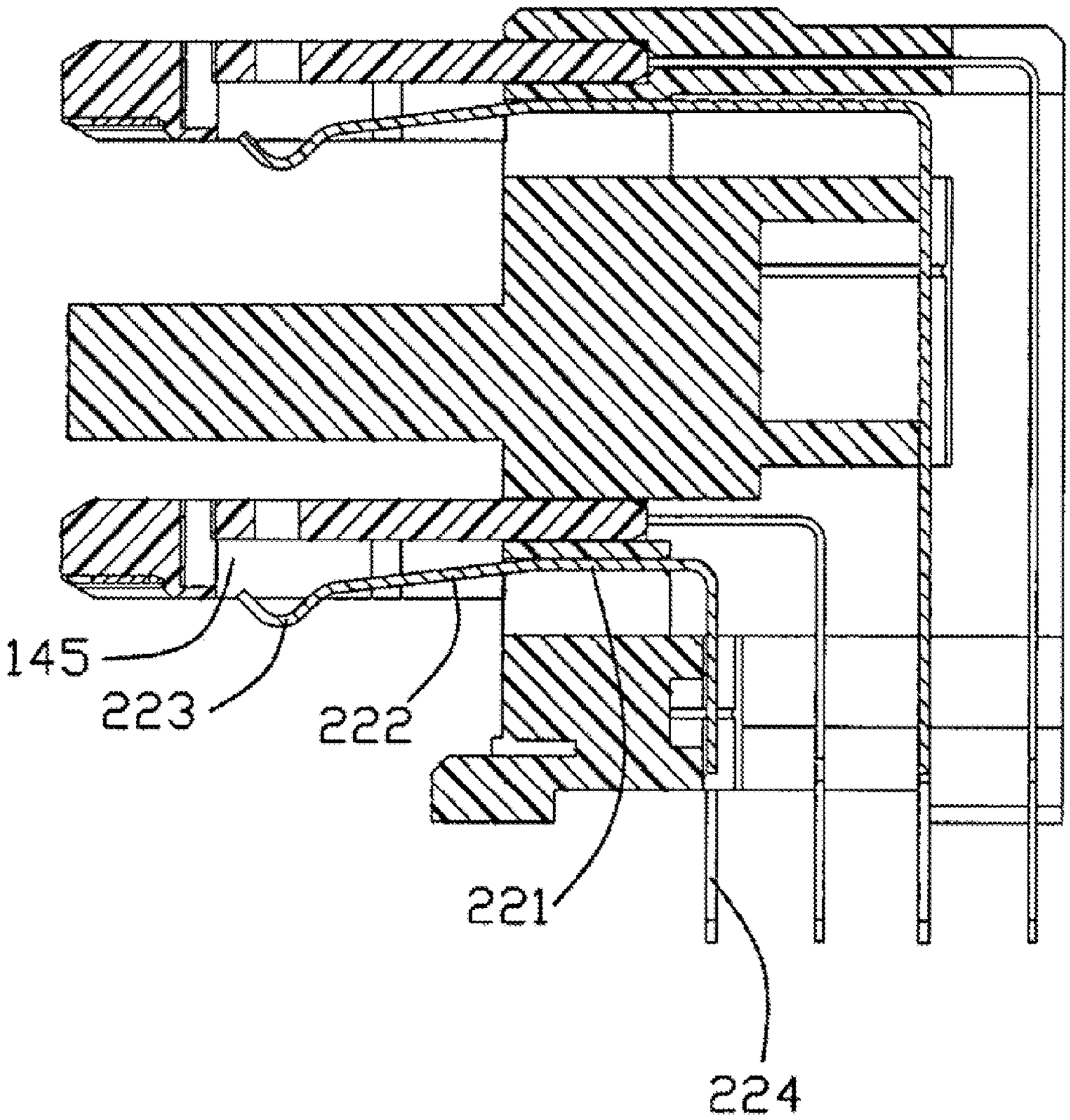


FIG. 8

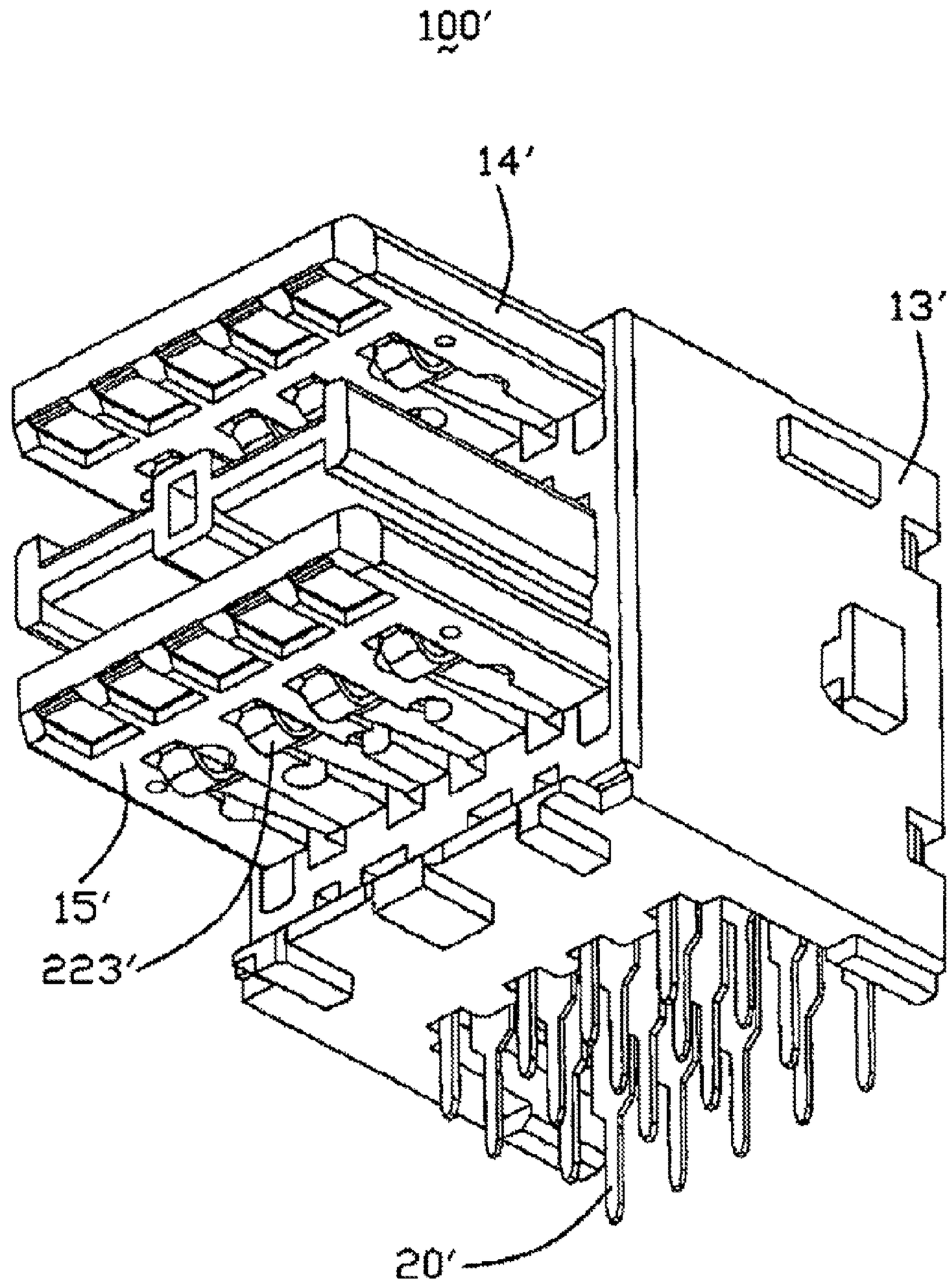


FIG. 9

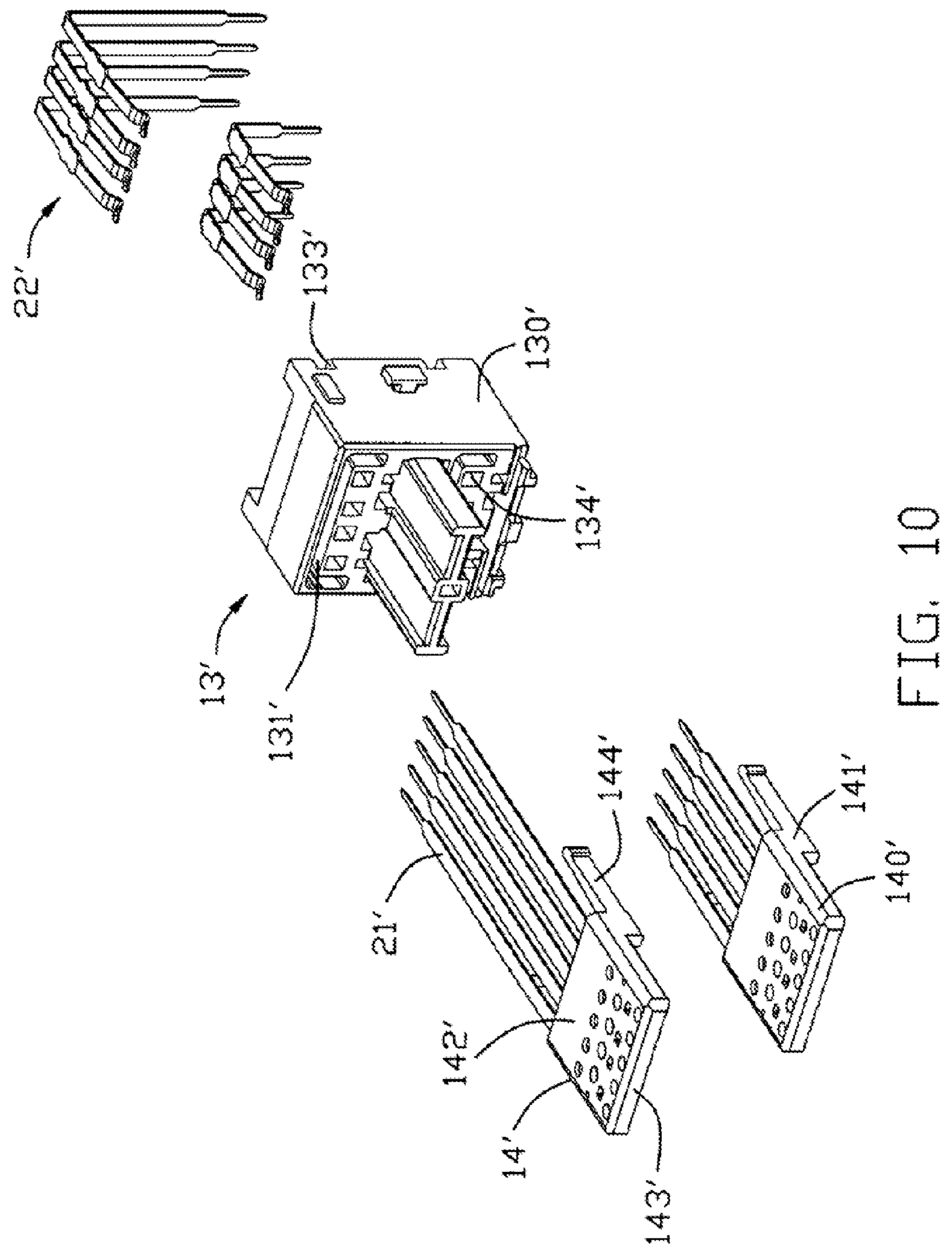


FIG. 10

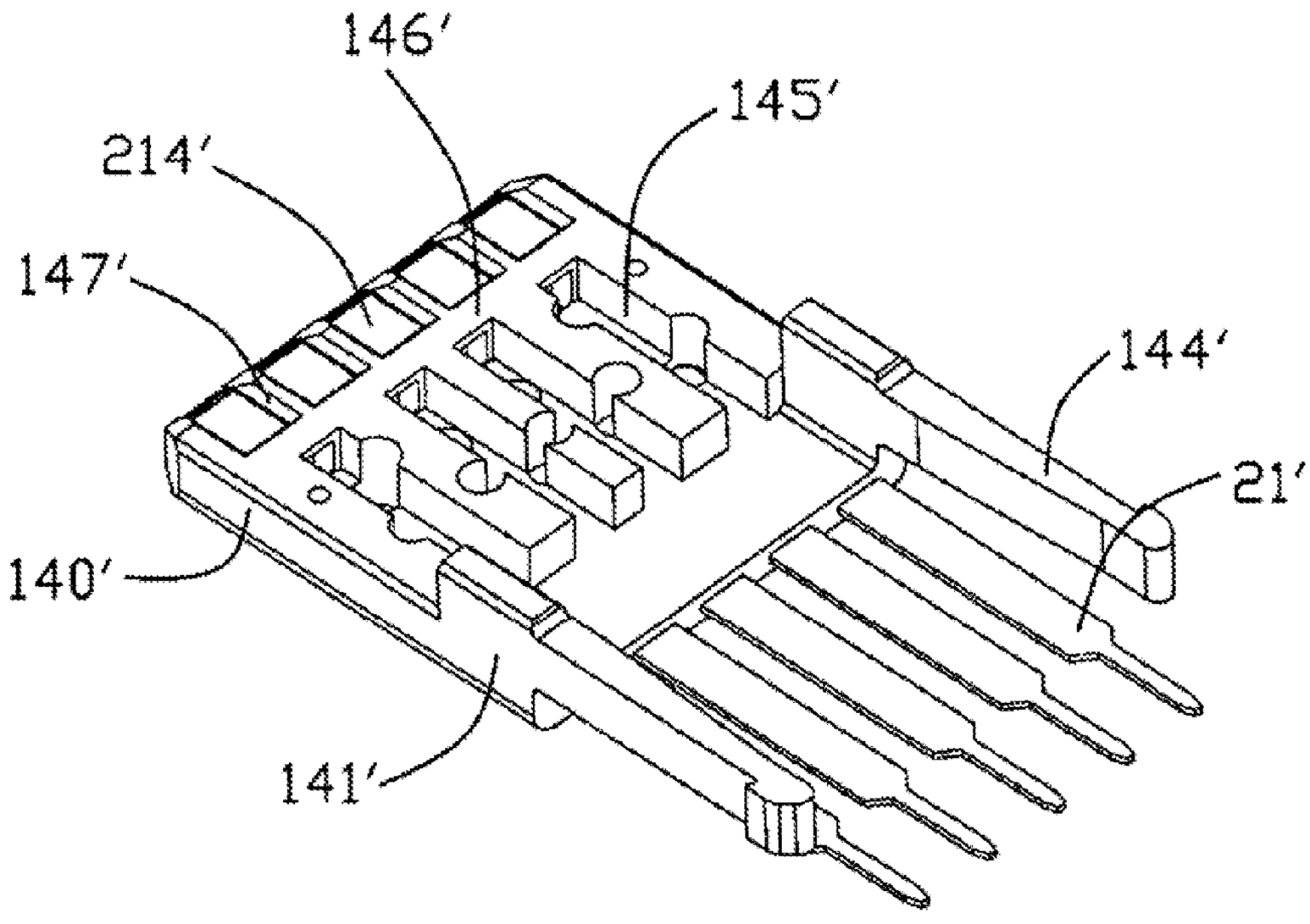


FIG. 11

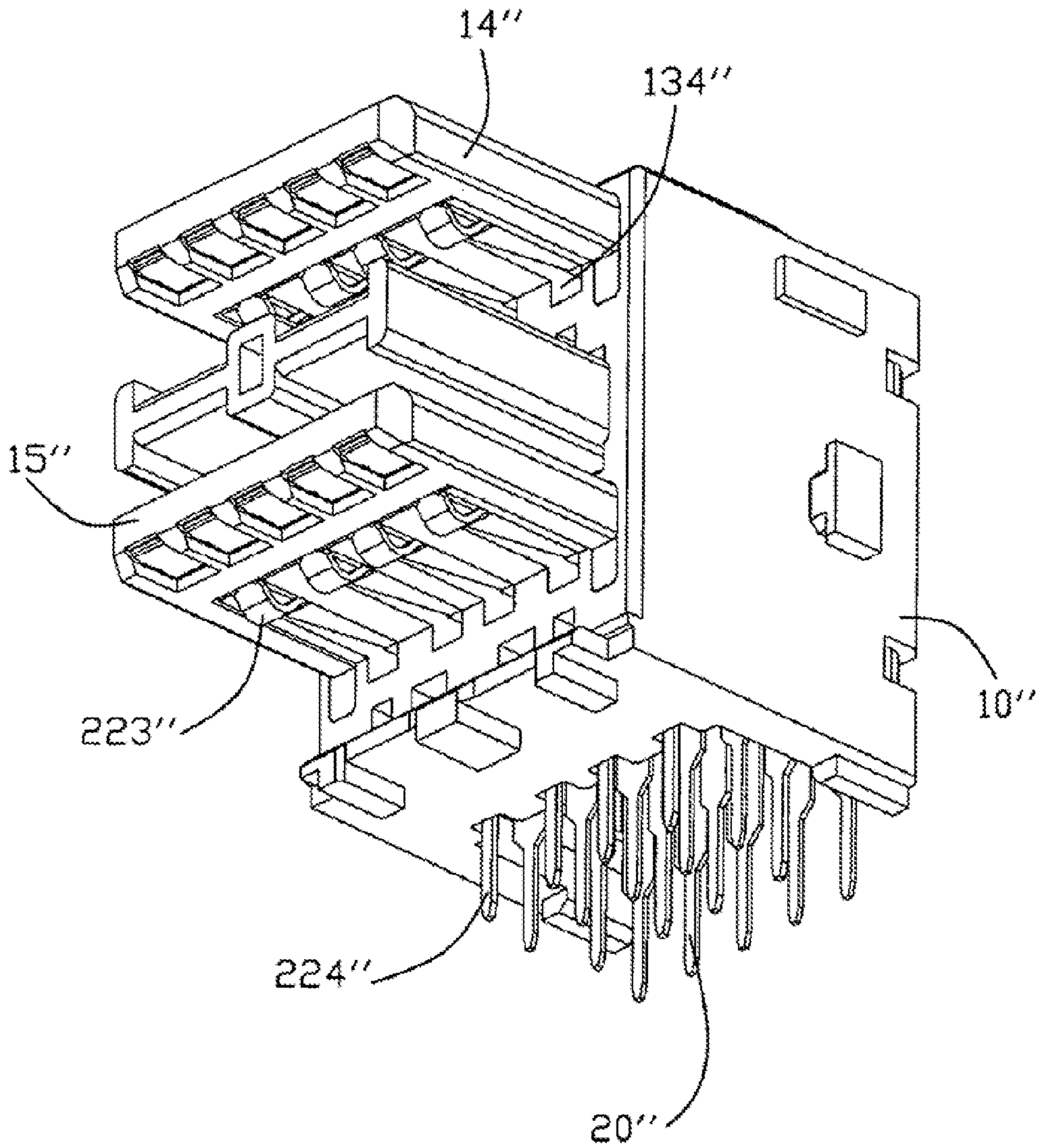


FIG. 12

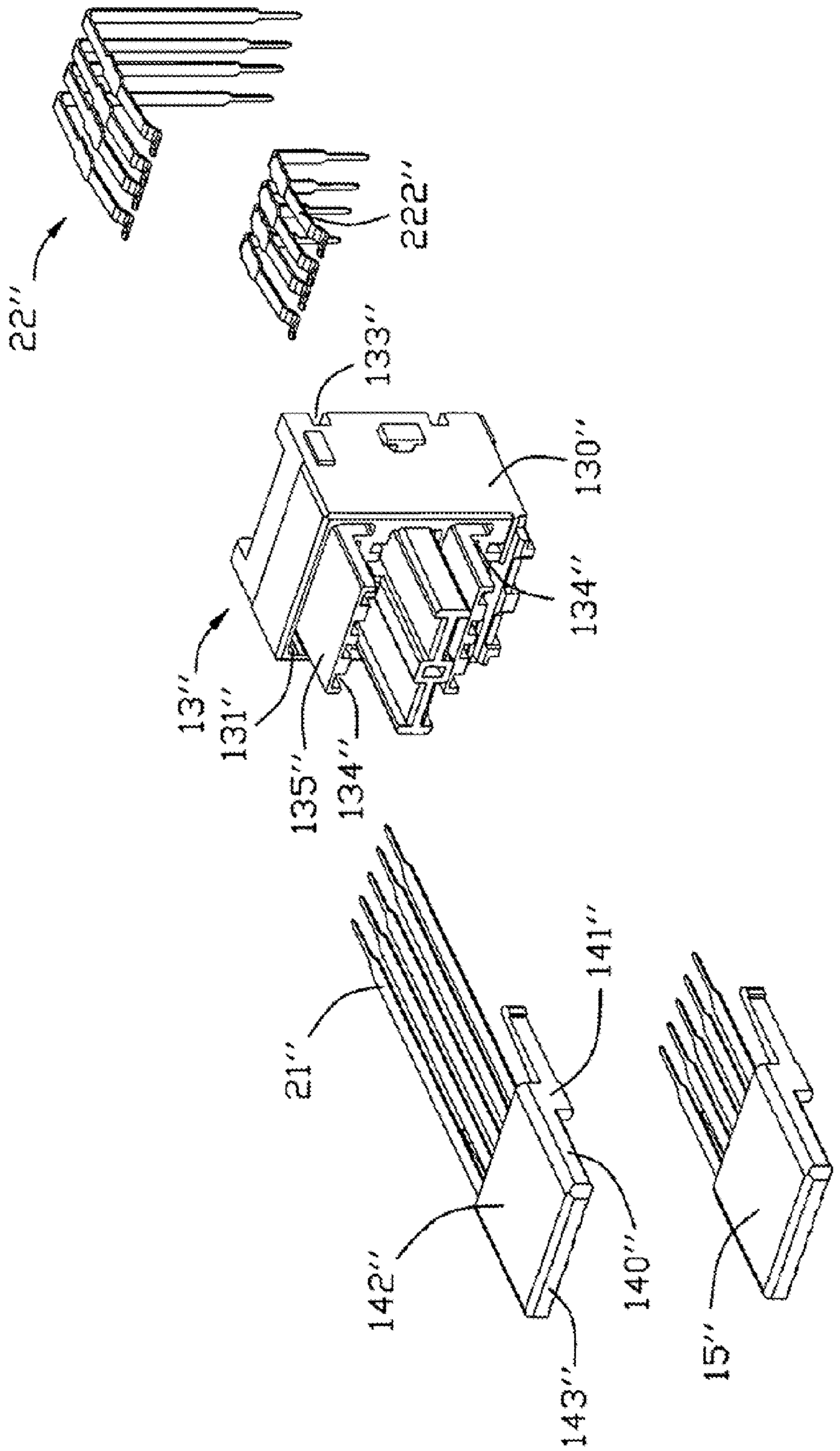


FIG. 13

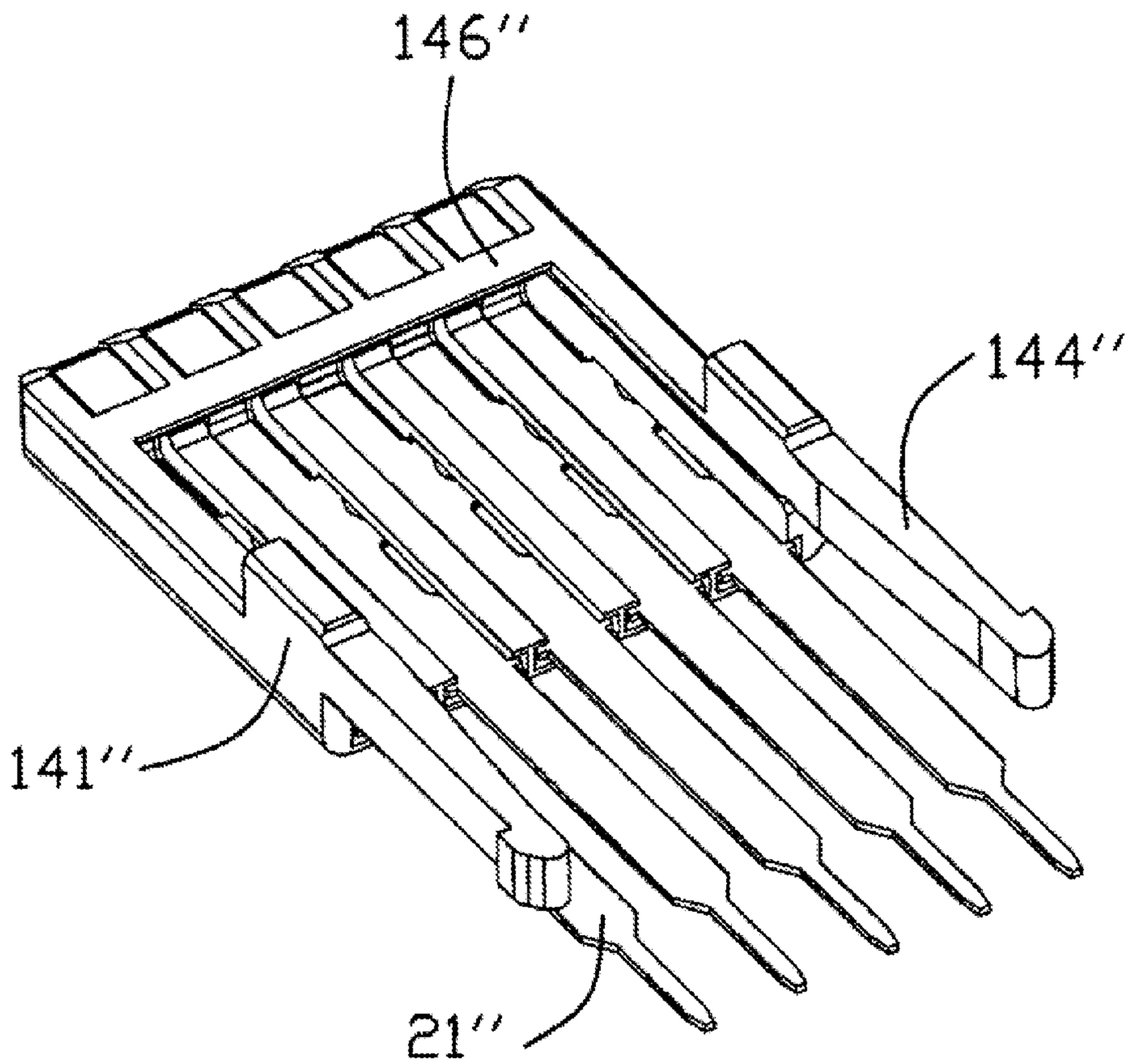


FIG. 14

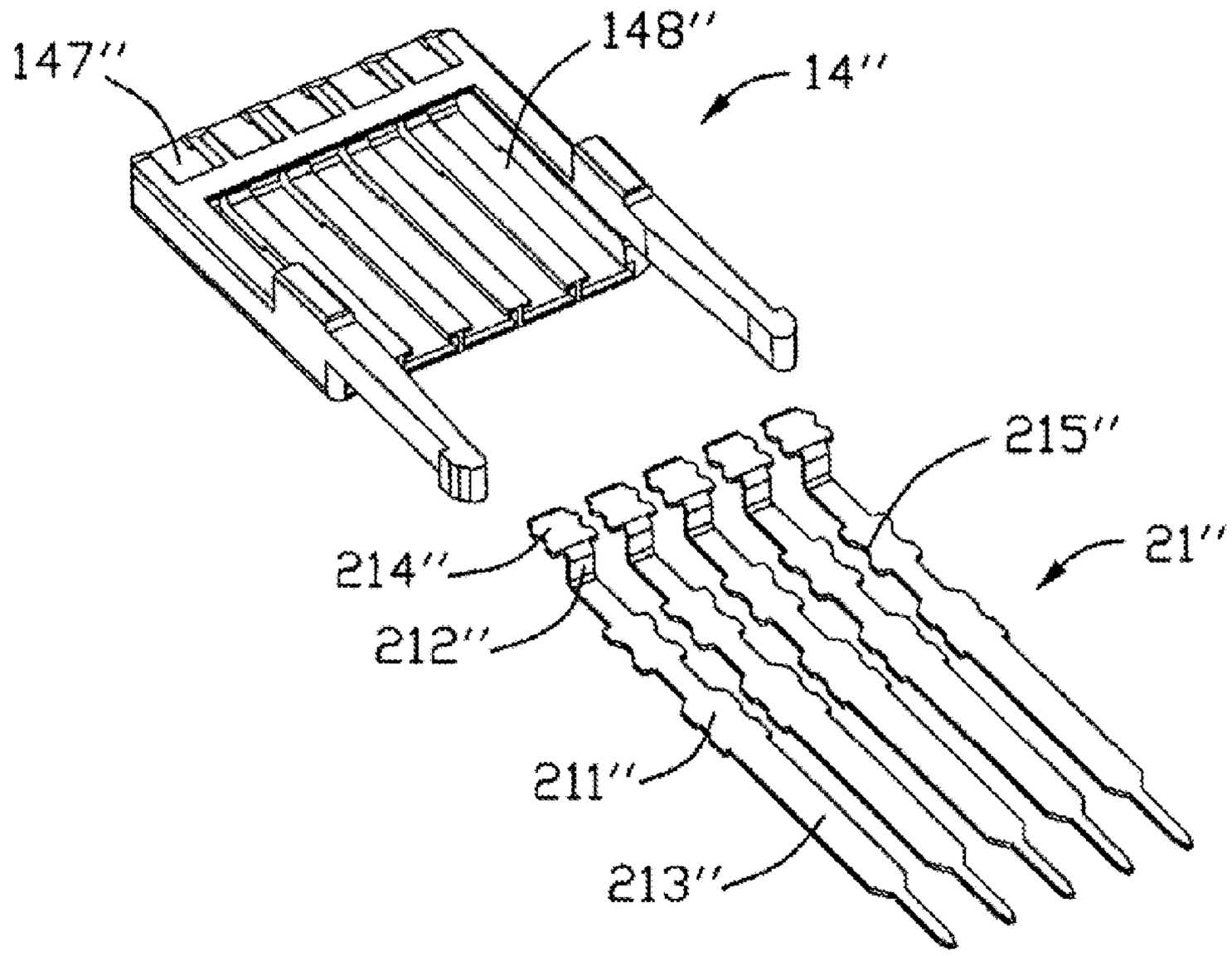


FIG. 15

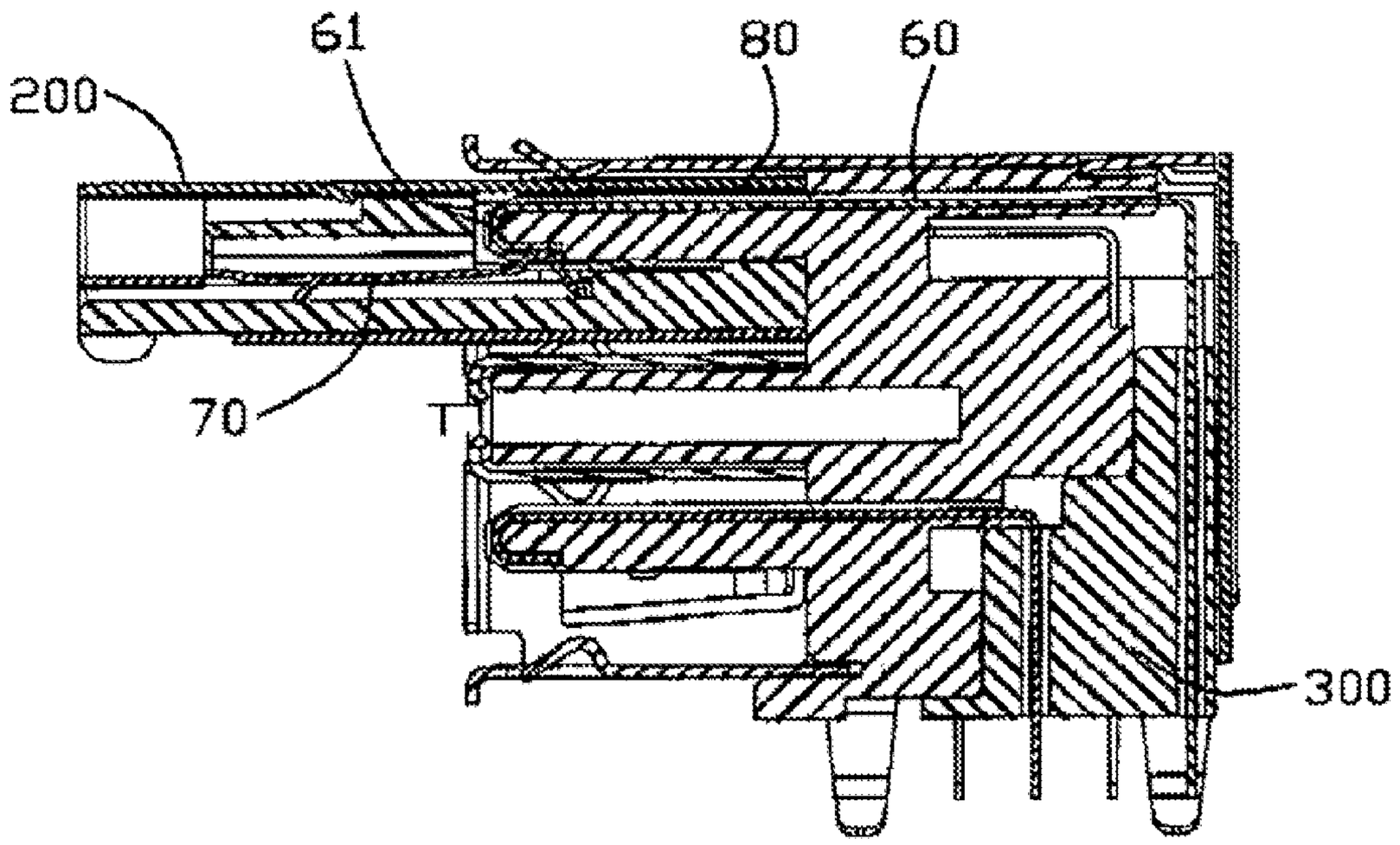


FIG. 16
(PRIOR ART)

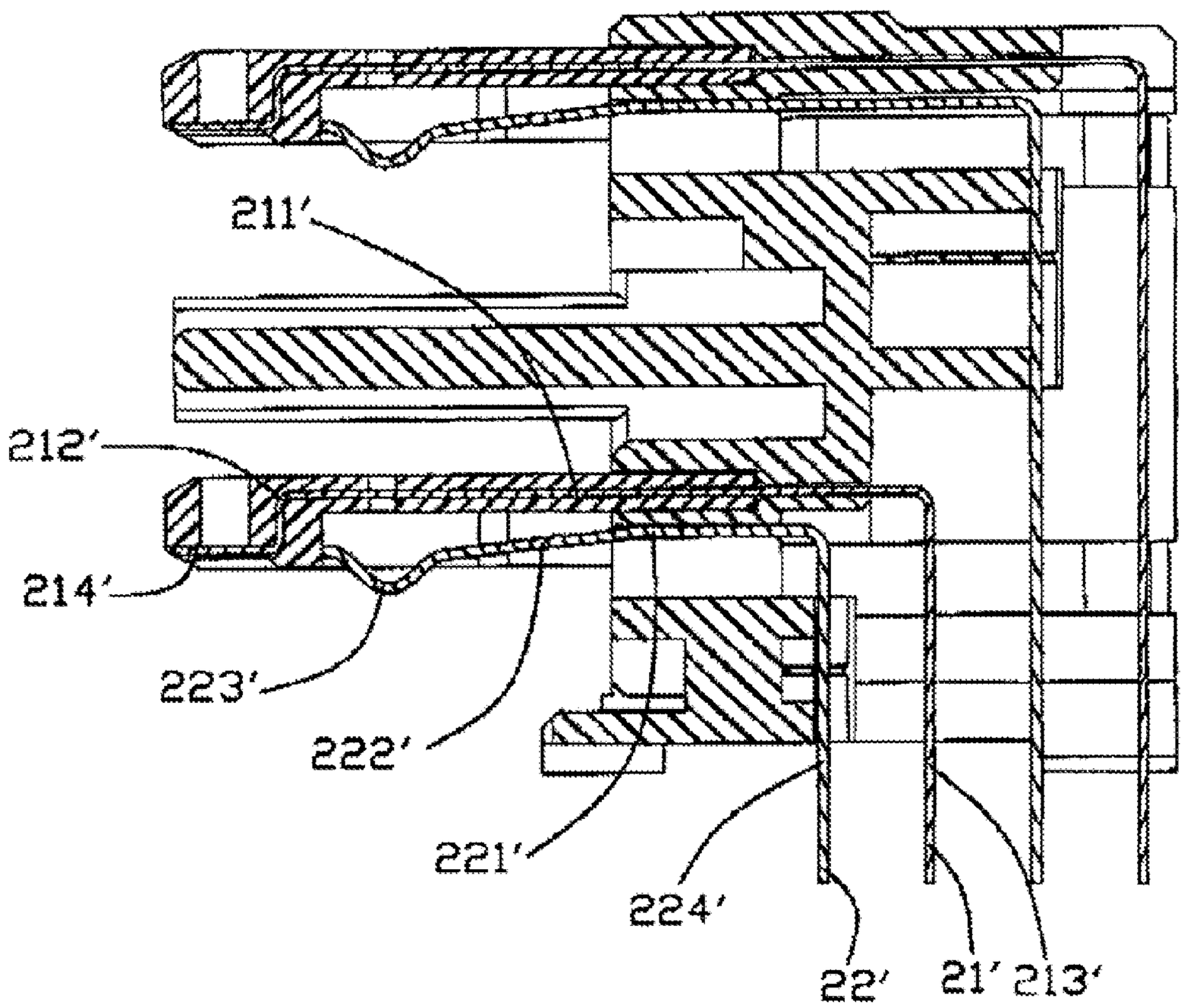


FIG. 17

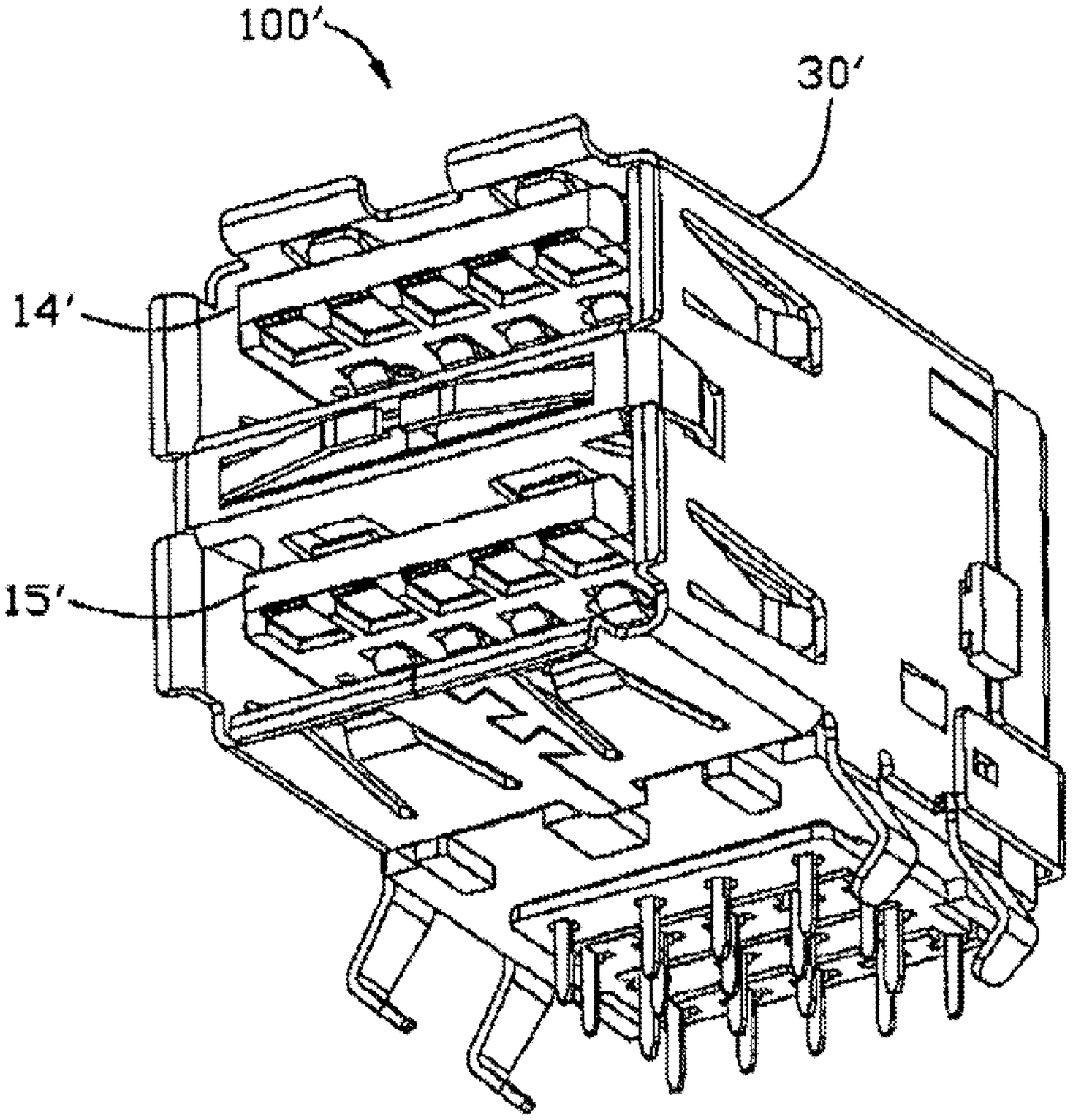


FIG. 18

ELECTRICAL CONNECTOR WITH ESD PROTECTION

Matter enclosed in heavy brackets [ ] appears in the original patent but forms no part of this reissue specification; matter printed in italics indicates the additions made by reissue.

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates generally to electrical connector, and more particularly to a connector having improved electrical contacts.

2. Description of Related Art

Electrical connectors are typically used to couple PCB (Printed Circuit Board) which have numerous electrical devices. Some electrical connectors have a mating end wherein conductive terminals are exposed for engagement with the terminals of a mating connector. When mating the connectors, opposite charges at the connector interface may result in an ESD between the two connectors. In fact, electrostatic discharges can be generated simply by a person approaching or touching the connector interface or touching the terminal contacts. As known, when the ambient relative humidity drops to fifty percent or below, the human body accumulates a large electrical charge which can be in excess of 20.000 volts. Generally, very little current is associated with an electrostatic discharge; however, the voltage can be high enough to damage or destroy certain types of electrical devices such as semiconductor devices. Consequently, when the connector contacts or terminals are electrically associated with such devices on a circuit board, the electrostatic discharge may damage or destroy the electrical devices on the circuit board.

In order to alleviate the electrostatic discharge problem, some electrical connectors include features to provide ESD protection. In at least some connectors, ESD protection is provided with a shield in the form of a plate, bar, or the like located in close proximity to the connector interface and connected to ground in close proximity to the connector. But in some cases, the electrostatic discharge also occurs at the signal contacts. Please refer to FIG. **16**, which discloses an electrical connector **300** having J-shaped contacts **60** and a portion **61** thereof is exposed at the front area of the connector **300**. A mating plug **200** includes a plurality of plug contacts **70** for mating with the contacts **60** of the electrical connector **300** and a shell **80** shielding the electrical contacts. At the front area of the electrical connector **300**, there is a potential for the high speed contacts **60** to short with the shell **80** of the mating plug **200** which could also result in ESD problem.

Hence, it is desired to provide an electrical connector to overcome the problems mentioned above.

BRIEF SUMMARY OF THE INVENTION

Accordingly, an object of the present invention is to provide an electrical connector having improved electrical contacts for ESD protection.

The present invention is directed to an electrical connector for receiving a plug, comprising an insulative housing, a set of first contacts and a set of second contacts attached to the insulative housing. The insulative housing comprises a base portion and a wafer, and a latch mechanism fastened the wafer to the base portion. The insulative housing defines a mating direction for engaging with the plug. Each electrical contact is

attached to the insulative housing and comprises a contact section connecting with the plug and a mounting section extending out of the insulative housing. The contact sections of the first contacts are staggered with the contact sections of the second contacts along the mating direction, and wherein the contacts section of the first contacts are closed to a front edge thereof.

The first contacts can be inserted in the wafer by insert molding. The first contacts also can be pressed into the wafer. The first contacts and the wafer constitute an insert module attached to the base portion simultaneously. The second contacts are inserted into the base portion and the wafer simultaneously. The wafer encloses the first contacts at a front edge thereof to avoid the first contacts connecting with the plug.

Other objects, advantages and novel features of the invention will become more apparent from the following detailed description of the present embodiment when taken in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

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

FIG. **2** is an exploded view of the electrical connector shown in FIG. **1**;

FIG. **3** is a partial view of the electrical connector shown in FIG. **2**, showing the relationship of the contacts and the insulative housing before assembling;

FIG. **4** is a perspective view of the electrical connector shown in FIG. **3**, wherein the metal shield is removed therefrom;

FIG. **5** is a perspective view of the upper contacts and the wafer before assembling to the base portion;

FIG. **6** is similar to FIG. **5**, while taken from a different aspect;

FIG. **7** is a cross sectional view of the insulative housing and the electrical contacts shown in FIG. **4**;

FIG. **8** is a cross sectional view of the insulative housing and the electrical contacts shown in FIG. **4**;

FIG. **9** is a perspective view of an electrical connector according to a second embodiment of the present invention, wherein a metal shield thereof is removed therefrom;

FIG. **10** is a partial view of the electrical connector shown in FIG. **9**, showing the relationship of the contacts and the insulative housing before assembling;

FIG. **11** a perspective view of the upper contacts and the wafer shown in FIG. **10**;

FIG. **12** is a perspective view of the electrical connector according to a third embodiment of the present invention, wherein the metal shield thereof is removed therefrom;

FIG. **13** is a partial view of the electrical connector shown in FIG. **12**, showing the relationship of the contacts and the insulative housing before assembling;

FIG. **14** is a perspective view of the upper contacts and the wafer shown in FIG. **13**;

FIG. **15** is an exploded view of the upper contacts and the wafer shown in FIG. **14**; and

FIG. **16** is a cross sectional view of a related art with a mating plug inserted therein.

FIG. **17** is a cross-sectional view of the electrical connector of FIG. **9**; and

FIG. **18** is a perspective view of the electrical connector of FIG. **9** with a metal shield attached thereon.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

Reference will be made to the drawing figures to describe the present invention in detail, wherein depicted elements are

not necessarily shown to scale and wherein like of similar elements are designated by same or similar reference numeral through the several views and same or similar terminology.

Referring to FIG. **1**, the present invention is directed to an electrical connector **100** mounting to a PCB or motherboard (not shown) having an insulative housing **10** including a plurality of receiving spaces or receptacle openings **11**, **12** each adapted to receive a complementary electrical plug **200** as shown in FIG. **16**. The connector **100** includes a plurality of electrical contacts **20** arranged in first and second groups corresponding to their respective receptacle openings **11**, **12**. The connector **100** has an outer shield **30** that generally surrounds the housing **10** and has grounding contacts **31** to create an electrical connection between the conductive outer shell **80** and the plug **200** when inserted therein.

While the drawings display a dual stacked connector system **100**, the present invention could be used with any type of electrical connector. While each receptacle is shown with nine contacts **20** in a group, the invention can be employed with any desired number of contacts **20** in a group. Similarly, while two receptacles **11**, **12** are shown, the invention can be employed with a single receptacle or any desired number of stacked receptacles.

Referring to FIGS. **1** and **2**, the shield **30** is preferably stamped from a single sheet of suitable conductive material, which includes a top wall **32**, opposed lateral walls **33**, **34**, and a bottom wall **35**. The opposed top and bottom walls **32**, **35** each have longitudinal springs **36** extending into the receptacles **11**, **12** to bear against the corresponding shell **80** of the plug **200**. Board locks **37** mate with the PCB and aid in positioning the electrical connector **100** with respect to the PCB. The shield **30** further comprises a separated rear wall **38** and a separate front wall **39** attached thereon for further shielding the electrical contacts **20** at front and rear face **17**, **18** of the insulative housing **10**.

As illustrated in FIG. **3** to **6**, the insulative housing **10** has a base portion **13**, two wafers **14**, **15**, and a latching mechanism fastening the wafers **14**, **15** to the base portion **13**. The base portion **13** and the wafers **14**, **15** carry the electrical contacts **20**. The contacts **20** may be signal contacts, power contacts, or ground contacts in various combinations as desired in accordance with a particular application. The base portion **13** comprises a rectangular body **130** provided with two receiving spaces **131** therein and a plurality of passageways **134** below the receiving space **131**. A middle flange **132** extends from the rectangular body **130** to separate receptacle openings **11**, **12**.

Each wafer **14**, **15** comprises a tongue **140** and a retention portion **141** extending into the receiving space **131** of base portion **13**. The tongue **140** and the base portion **13** defines the receiving opening **11**, **12**. The wafer **14**, **15** comprises a top wall **142** and a front wall **143** perpendicular thereto. The tongue **140** defines a plurality of grooves **145** corresponding to the passageways **134** and a plurality of recesses **147** corresponding to the receiving space **131**. An inner bar **146** locates between the grooves **145** and the recesses **147**. The latch mechanism comprises a protrusion **133** disposed in the receiving space **131** of the base portion **13** and a recess **144** defining on the retention portion **141** of the wafer **14**, **15** to engage with each other, thereby latching the base portion **13** and the wafers **14**, **15** together.

As illustrated in FIGS. **2**, **7** and **8**, each group of electrical contacts **20** includes a set of upper contacts **21** and a set of lower contacts **22**. The lower contacts **22** are inserted into the base portion **13** and the wafer **14**, **15** and each includes a body section **221** engaging with the insulative housing **10**. An elastic contact section **222** extends from one end of the body section **221** along a mating direction of the electrical connector **100** and has a convex bend **223** for mating with the plug contact **70** of the mating plug **200**. The contact sections **222** are arranged in the grooves **145** of the wafer **14**, **15**. The lower contacts **22** also include a mounting section **224** extending from the other end of the body section **221** for mounting to the PCB.

The upper contacts **21** are inserted in the wafer **14**, **15** by insert molding and each includes a body section **211** engaging with the wafer **14**, **15** at an upper side thereof, a connect to section **212** bending from one end of the body section **211**, and a mounting section **213** extending from the other end of the body section **211**. The connect section **212** is extending from a front edge of the body section **211** to a lower side of the wafer **14**, **15**. A flat non-elastic contact section **214** is extending forwardly from the connect section **212** and parallel to the body section **211**. The body section **211** is on top of the contact section **214**.

Referring to FIGS. **7** and **8**, the contact portions **214**, **222** of the upper contacts **21** and the lower contacts **22** are located on the lower side of the wafer **14**, **15** and staggered along the mating direction of the electrical connector **100**. The contact portions **214** of the upper contacts **21** are arranged in a front position of the receiving opening **11**, **12** and closer to the front edge of the wafer **14**, **15** than the contact sections **222** of the lower contacts **22**. The contact points, namely the contact sections **214** and the convex bends **223** of the upper contacts **21** and the lower contacts **22** also staggered along a vertical direction thereby to mating with the contacts **70** of the plug **200** at different height.

During manufacturing, firstly, form the wafer **14**, **15** on the tipper contacts **21** by insert molding and constitute a insert module, wherein the upper contacts **21** are straight at that time. Secondly, press the insert module including the upper contacts **21** and the wafer **14**, **15** into the base portion **13** from a front side thereof simultaneously. Thirdly, insert the lower contacts **22** to the passageways **134** of base portion **13** and further disposed on the wafer **14** from a rear side of the base portion **13** at one time. Finally, bend the upper contacts **21** with the mounting sections **213** thereof extending out of the base portion **13**. A spacer **50** is attached to the base portion **13** for positioning the upper and lower contact **21**, **22** at a mounting end.

After assembly, the contact sections **214** of the upper contacts **21** are disposed in the recesses **147** and expose to a bottom face of the wafer **14**, **15**. The front wall **143** encloses the upper contacts **21** from an exterior at the front edge of the wafer **14**, **15**. The contact sections **222** of the lower contacts **22** are arranged in the grooves **145** and project out of the bottom face of the wafer **14**, **15**. The inner bar **146** separates the contacts sections **214** of the upper contacts **21** from the contact sections **222** of the lower contacts **22** along the mating direction. Next referring to FIGS. **9** to **11**, **17-18**, description will be made of a connector **100'** according to a second embodiment of the present invention. The connector **100'** comprises a plurality of electrical contacts **20'**, an insulative housing holding the electrical contacts **20'** thereon, and a shield **30'** surrounding all of the above mentioned components. The insulative housing comprises a base portion **13'**, two wafers **14'**. **15'**, and a latch mechanism far fastening the wafers **14'**, **15'** to the base portion **13'**. The electrical contact **20'** also includes a set of upper contacts **21'** and a set of lower contacts **22'**.

The lower contacts **22'** are inserted into the base portion **13'** and the wafer **14'**, **15'** and each includes a body section **221'** engaging with the insulative housing **10'**. An elastic contact section **222'** extends from one end of the body section **221'**

along a mating direction of the electrical connector **100'** and has a convex bend **223'**. The lower contacts **22'** also include a mounting section **224'** extending from the other end of the body section **221'** for mounting to the PCB. The upper contacts **21'** are attached to the wafer **14'**, **15'** by insert molding and each includes a body section **211'** engaging with the wafer **14'**, **15'** at an upper side thereof, a connect section **212'** bending from one end of the body section **211'**, and a mounting section **213'** extending from the other end of the body section **211'**. The body section **211'** is on top of the contact section **214'**. The contact portions **214'**, **222'** of the upper contacts **21'** and the lower contacts **22'** are located on the lower side of the wafer **14'**, **15'** and staggered along the mating direction of the electrical connector **100'**. The contact portions **214'** of the upper contacts **21'** are arranged in a front position of the insulative housing and closer to a front edge of the wafer **14'**, **15'** than the contact sections **222'** of the lower contacts **22'**. The contact points, namely the contact sections **214'** and the convex bends **223'** also staggered along a vertical direction thereby to mating with the plug at different height.

The electrical connector **100'** is similar to the electrical connector **100** except the wafer **14'**, **15'** and the base portion **13'**. The base portion **13'** comprises a rectangular body **130'** provided with two receiving spaces **131'** therein and a plurality of passageways **134'** below the receiving spaces **131'**. Each wafer **14'**, **15'** comprises a tongue **140'** and a retention portion **141'** extending into the receiving space **131'** of base portion **13'**. The wafer **14'**, **15'** comprises a top wall **142'** and a front wall **143'** perpendicular thereto.

The tongue **140'** defines a plurality of grooves **145'** corresponding to the passageways **134'** and a plurality of recesses **147'** corresponding to the receiving space **131'**. An inner bar **146'** separates the contact sections **214'** of the upper contacts **21'** from the contact sections **222'** of the lower contacts **22'** along the mating direction. The latch mechanism comprises a spring arm **144'** arranged on the retention portion **141'**, and a retention section **133'** arranged on the base portion **13'** engaging with each other.

As illustrated in FIGS. **12** to **15**, description will be made of a connector **100"** according to a third embodiment of the present invention. The connector **100"** comprises a plurality of electrical contacts **20"**, an insulative housing **10"** holding the electrical contacts **20"** thereon, and a shield (not shown) surrounding all of the above mentioned components. The insulative housing **10"** comprises a base portion **13"**, two wafers **14"**, **15"**, and a latch mechanism for fastening the wafers **14"**, **15"** to the base portion **13"**.

The electrical contact **20"** also includes a set of upper contacts **21"** and a set of lower contacts **22"**. Each upper contact **21"** comprises a contact section **214"** exposed to a receiving space for receiving the plug **200** and a mounting section **213"** extending out of the base portion **13"**. Each lower electrical contact **22"** comprises an elastic contact section **223**∝ extending into the receiving space and a mounting section **224"** extending out of the base portion **13"**.

The base portion **13"** comprises a rectangular body **130"** provided with two receiving spaces **131"** and a support plate **135"** projecting from the body and provided with a plurality of passageways **134"**. The support plate **135"** is located at a lower side of the wafer **14"**, **15"** and the contacts sections **222"** of the lower contacts **22"** are received therein.

Each wafer **14"**, **15"** comprises a tongue **140"** and a retention portion **141"** extending into the receiving space **131"** of base portion **13"**. The wafer **14"**, **15"** comprises a top wall **142"** and a front wall **143"** perpendicular thereto. The tongue **140'** defines a plurality of grooves **148"** corresponding to the receiving space **131"** and a plurality of recesses **147"** corresponding to the grooves **148"**. An inner bar **146"** separates the contact sections **214"** of the upper contacts **21"** from the contact sections **222"** of the lower contacts **22"** along the mating direction. The latch mechanism comprises a spring arm **144"** arranged on the retention portion **141"**, and a retention section **133"** arranged on a rear side of the base portion **13"** engaging with each other.

Each upper contact **21"** is pressed into the groves **148"** and includes a retention section **215"** for engaging therewith. The contact sections **214"** of the upper contacts **21"** are disposed in the recesses **147"** and exposed to a bottom face of the wafer **14"**, **15"**. The front wall **143"** encloses the upper contacts **21"** from an exterior at a front edge of the wafer **14"**, **15"**.

It is to be understood, however, that even though numerous characteristics and advantages of the present invention have been set forth in the foregoing description, together with details of the structure and function of the invention, the disclosure is illustrative only, and changes may be made in detail, especially in matters of shape, size, and arrangement of parts within the principles of the invention to the full extent indicated by the broad general meaning of the terms in which the appended claims are expressed.

We claim:

1. An electrical connector for mating with a plug, comprising:

an insulative housing comprising a base portion and a wafer, and a latch mechanism fastened the wafer to the base portion, the insulative housing defining a mating direction for engaging with the plug;

a set of first contacts attached to the insulative housing each comprising a contact section mechanically connecting with the plug and a mounting section extending out of the insulative housing;

a set of second contacts attached to the insulative housing each comprising a contact section mechanically connecting with the plug and a mounting section extending out of the insulative housing; and wherein

the contact sections of the first contacts are staggered with the contact sections of the second contacts along the mating direction, and wherein the contact sections of the first contacts are closed to a front edge of the wafer; wherein

the latch mechanism comprises a spring arm arranged on the wafer, and a retention section arranged on the base portion for latching with the spring arm.

2. The electrical connector according to claim **1**, wherein the contact sections of the second contacts are project out of a bottom face of the wafer.

3. The electrical connector according to claim **1**, wherein the wafer enclosed the first contacts from an exterior at the front edge, and wherein the contact sections of the first contacts are exposed to a bottom face of the wafer.

4. The electrical connector according to claim **1**, wherein the wafer comprises a tongue and a retention portion extending into the base portion, and wherein the tongue and the base portion defining a receiving opening for receiving the plug.

5. The electrical connector according to claim **1**, wherein the first contacts are insert-molded to the wafer, and wherein the wafer defines a plurality of grooves for receiving the contacts sections of the second contacts.

6. A receptacle connector, comprising:

an insulative housing having a base portion and a tongue portion extending therefrom;

at least a first contact terminal substantially submerged under a first surface of the tongue portion, and including a first contact section accessibly surfaced on a front area

of the first surface and a first mounting section extending beyond the insulative housing; and

at least a second contact terminal assembled to the base of the insulative housing, the second contact having a second contact terminal section extending along the first surface and dielectrically distant to the first contact section, and a second mounting section extending beyond the insulative housing;

wherein the first and the second contact sections are offset from each other, and the first contact section is closer to a front end of the second contact section; and

wherein the first and second contact terminals are assembled to the base of the insulative housing by a resilient retention portion coupled to the first and second contact terminals and engaging with a retention section arranged on the insulative housing for receiving the resilient retention portion, thereby holding the first and second contact terminals within the insulative housing.

7. The receptacle connector as recited in claim 6, wherein the first contact terminal is integrally molded with the tongue portion.

8. The receptacle connector as recited in claim 6, wherein the tongue portion defines at least one groove to receive the second contact section of the second contact terminal.

9. The receptacle connecter as recited in claim 6, wherein the second contact terminal is securely retained in the base portion.

10. The receptacle connector as recited in claim 6, wherein the tongue portion is assembled to the base portion by engagement between a spring arm located on the tongue portion and the retention section of the base portion.

11. An electrical connector for mating with a plug, comprising:

an insulative housing comprising a base portion and a wafer assembled to the base portion, the wafer having a tongue protruding forwardly;

a set of first contacts fastened to the wafer, each first contact comprising a non-elastic contact section located and exposed on a first side of the tongue along a thickness direction of the tongue and a mounting section extending out of the insulative housing; and

a set of second contacts retained to the insulative housing, each second contact comprising an elastic contact section exposed to the first side and projecting beyond a surface of the tongue on the first side, and a mounting section extending out of the insulative housing;

wherein the contact sections of the first contacts are arranged in a first row, the contact sections of the second contacts are arranged in a second row, and the first row is located in front of the second row and is closer to a front edge of the wafer; and

wherein the wafer comprises a conformable retention portion that engages with a retention section arranged on the insulative housing for receiving the conformable retention portion, thereby holding the wafer within the insulative housing.

12. The electrical connector according to claim 11, wherein the first contacts are inserted in the wafer by insert molding, and the second contacts are assembled to the insulative housing.

13. The electrical connector according to claim 11, wherein the tongue defines a plurality of grooves, and the contact sections of the second contacts are inserted into the wafer and arranged in the grooves.

14. The electrical connector according to claim 13, wherein the base portion defines a plurality of passageways, and the second contacts are inserted into the passageways from a rear side of the base portion and further extend to be disposed on the wafer.

15. The electrical connector according to claim 13, wherein the base portion defines a receiving space, and the wafer comprises the retention portion extending into the receiving space of the base portion.

16. The electrical connector according to claim 13, where in the tongue defines a plurality of recesses, the contact sections of the first contacts are disposed in the recesses, and an inner bar is located between the grooves and the recesses and separates the contact sections of the first contacts from the contact sections of the second contacts along a mating direction.

17. The electrical connector according to claim 11, wherein the base portion comprises a support plate projecting from the base portion and provided with a plurality of passageways, wherein the support plate is located at the first side of the tongue, and wherein the contact sections of the second contacts are received in the passageways.

18. The electrical connector according to claim 17, wherein each first contact is pressed into one of a plurality of grooves in the wafer and includes a retention section for engaging with the grooves.

19. An electrical connector, comprising:

an insulative housing enclosed by a metallic shell and commonly forming an assembly, said assembly defining a plug receiving space in a front portion thereof;

an insulative wafer defining opposite first and second faces, and integrally formed with a plurality of first terminals extending along a mating direction and fastened to the assembly to essentially occupy a portion of said plug receiving space under a condition that each of the first terminals defines a first contacting region essentially located around a first area on the first face of the wafer which is adjacent to a front edge of the wafer while other portions thereof offset from the first face toward the second face; and

a plurality of second terminals extending along the mating direction, each of said second terminals defining a second contacting region essentially located around a second area on the first face of the wafer under a condition that said second area is located behind the first area and both said first contacting region and said second contacting region face commonly toward the plug receiving space in a same direction opposite to said second face;

wherein the first terminals are not deflectable while the second terminals are deflectable during mating; and

wherein said wafer defines a plurality of grooves in the first face to respectively receive the corresponding second terminals; and

wherein the insulative wafer comprises a deformable retention portion that engages with a retention section arranged on the insulative housing for receiving the deformable retention portion, thereby holding the insulative wafer within the insulative housing.

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