US012388204B2

(12) **United States Patent**
Wang et al.

(10) **Patent No.: US 12,388,204 B2**
(45) **Date of Patent: Aug. 12, 2025**

(54) **BUS CONNECTING CABLE**

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(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 312 days.

(21) Appl. No.: **18/211,221**

(22) Filed: **Jun. 16, 2023**

(65) **Prior Publication Data**

US 2024/0356252 A1 Oct. 24, 2024

(30) **Foreign Application Priority Data**

Apr. 21, 2023 (TW) 112114930

(51) **Int. Cl.**
H01R 12/00 (2006.01)
H01R 12/70 (2011.01)
H01R 12/72 (2011.01)

(52) **U.S. Cl.**
CPC ***H01R 12/7047*** (2013.01); ***H01R 12/707*** (2013.01); ***H01R 12/727*** (2013.01); *H01R 2201/06* (2013.01)

(58) **Field of Classification Search**
CPC H01R 12/707; H01R 12/727
See application file for complete search history.

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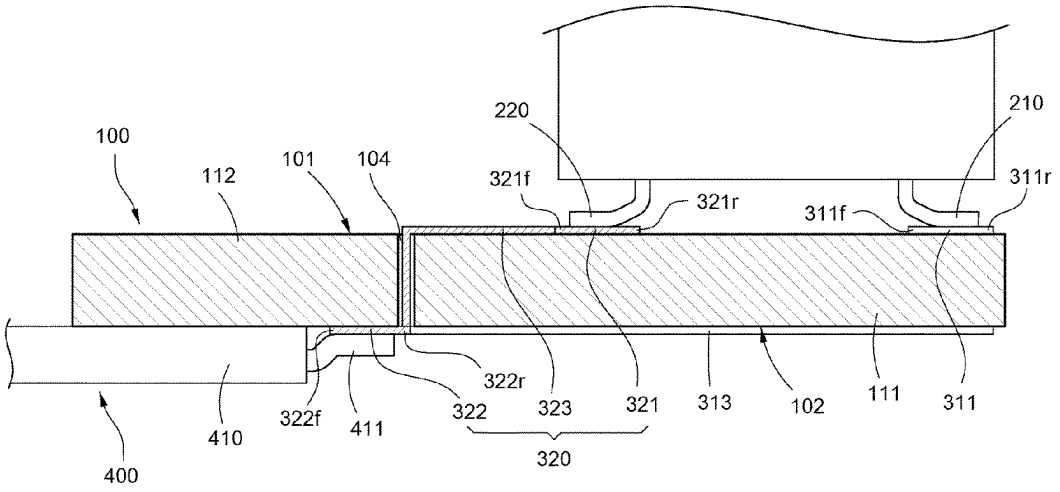
(57) **ABSTRACT**

A bus connecting cable includes a circuit board, a connector, circuits and a cable. The circuit board includes a top surface and a bottom surface. The connector on the top surface includes first terminals and second terminals. The circuits are arranged on the circuit board and include first circuits and second circuits. Each first circuit penetrates the circuit board and includes a first top end and a first bottom end. The first top ends are respectively connected to the first terminals. Each second circuit penetrates the circuit board and includes a second top end and a second bottom end. The second top ends are respectively connected to the second terminals. The first bottom ends and the second bottom ends are arranged along the bottom surface. The cable includes conductors. Each conductor is soldered to the first bottom ends and the second bottom ends.

13 Claims, 11 Drawing Sheets



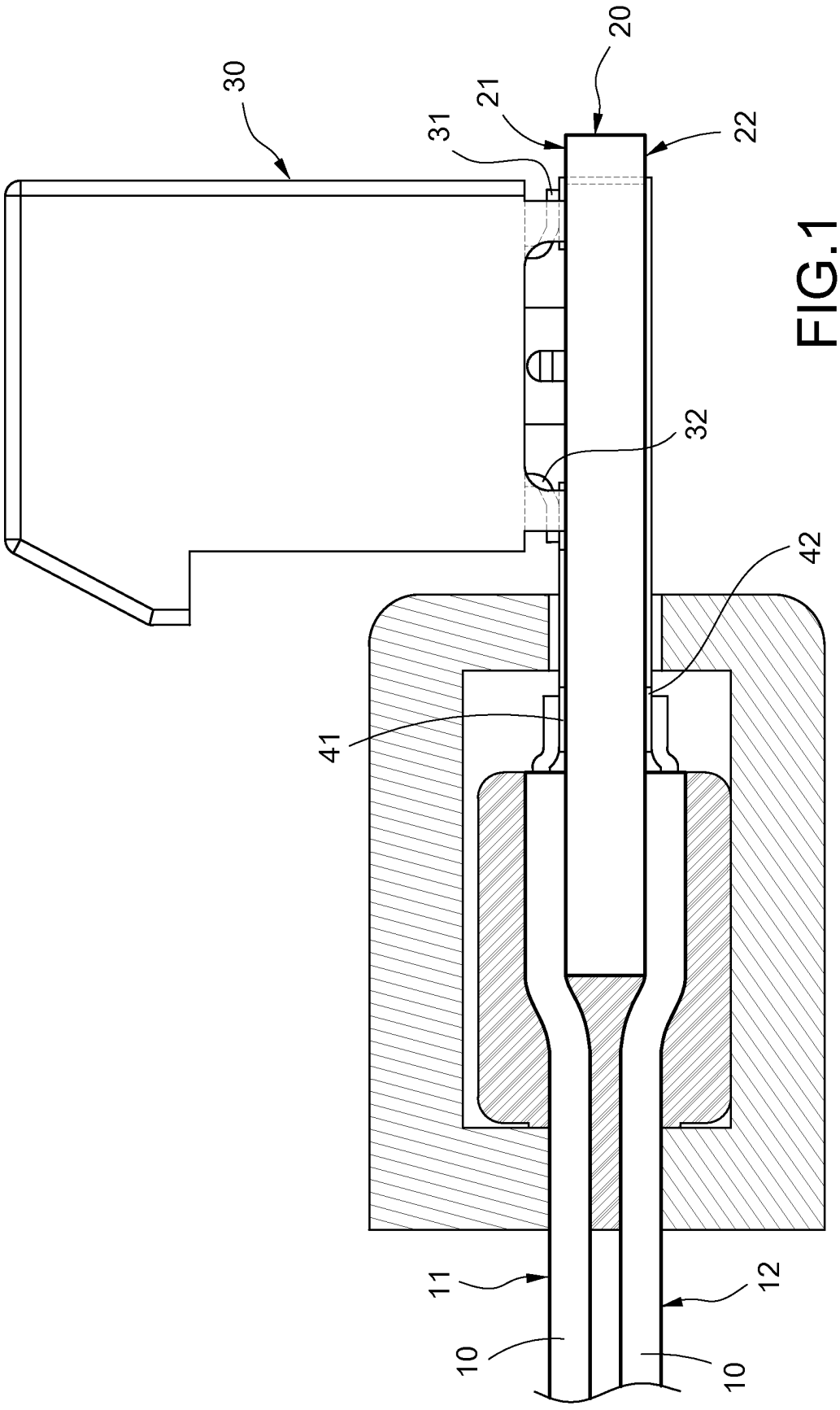


FIG.1
(Related Art)

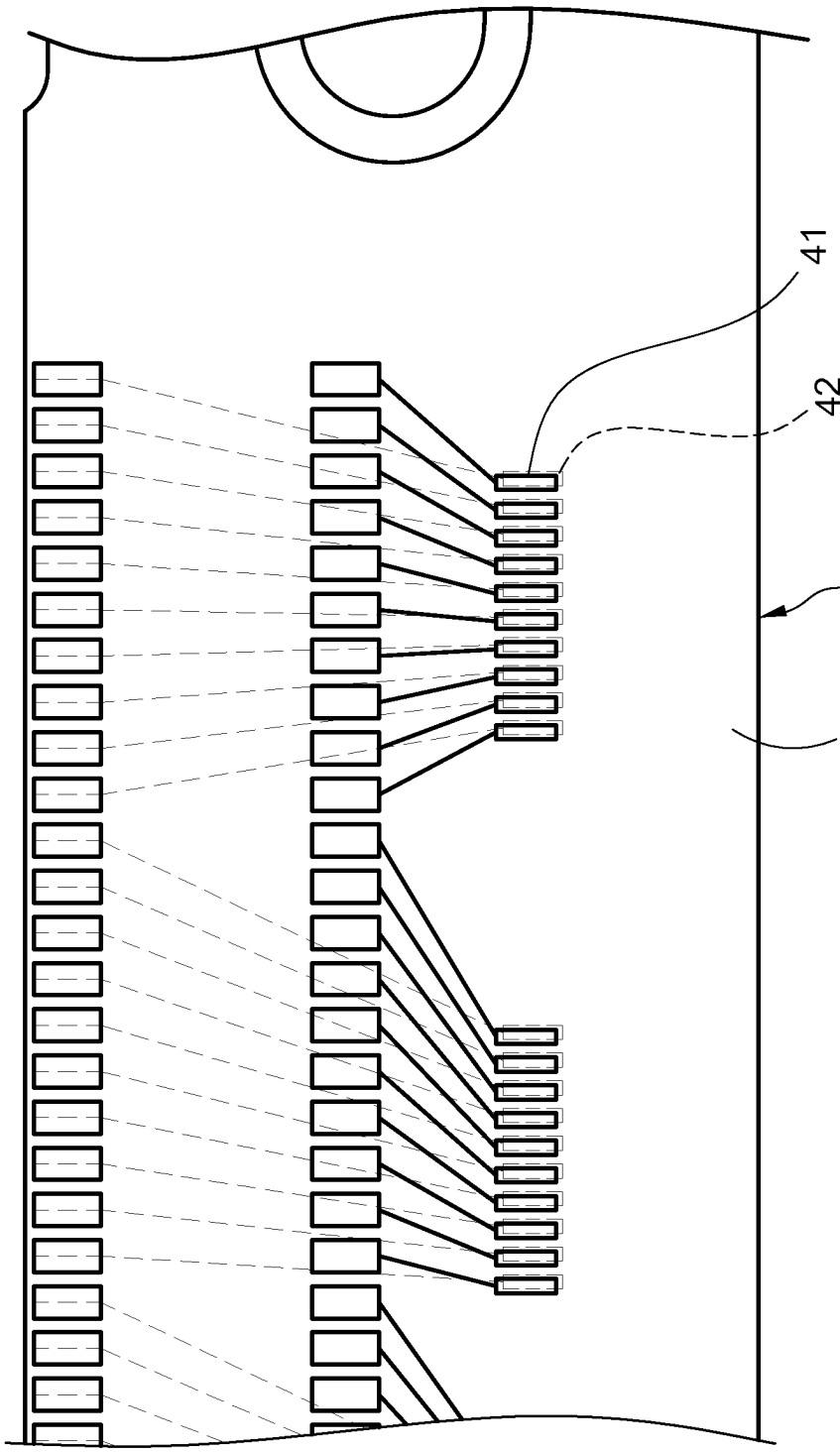


FIG.2
(Related Art)

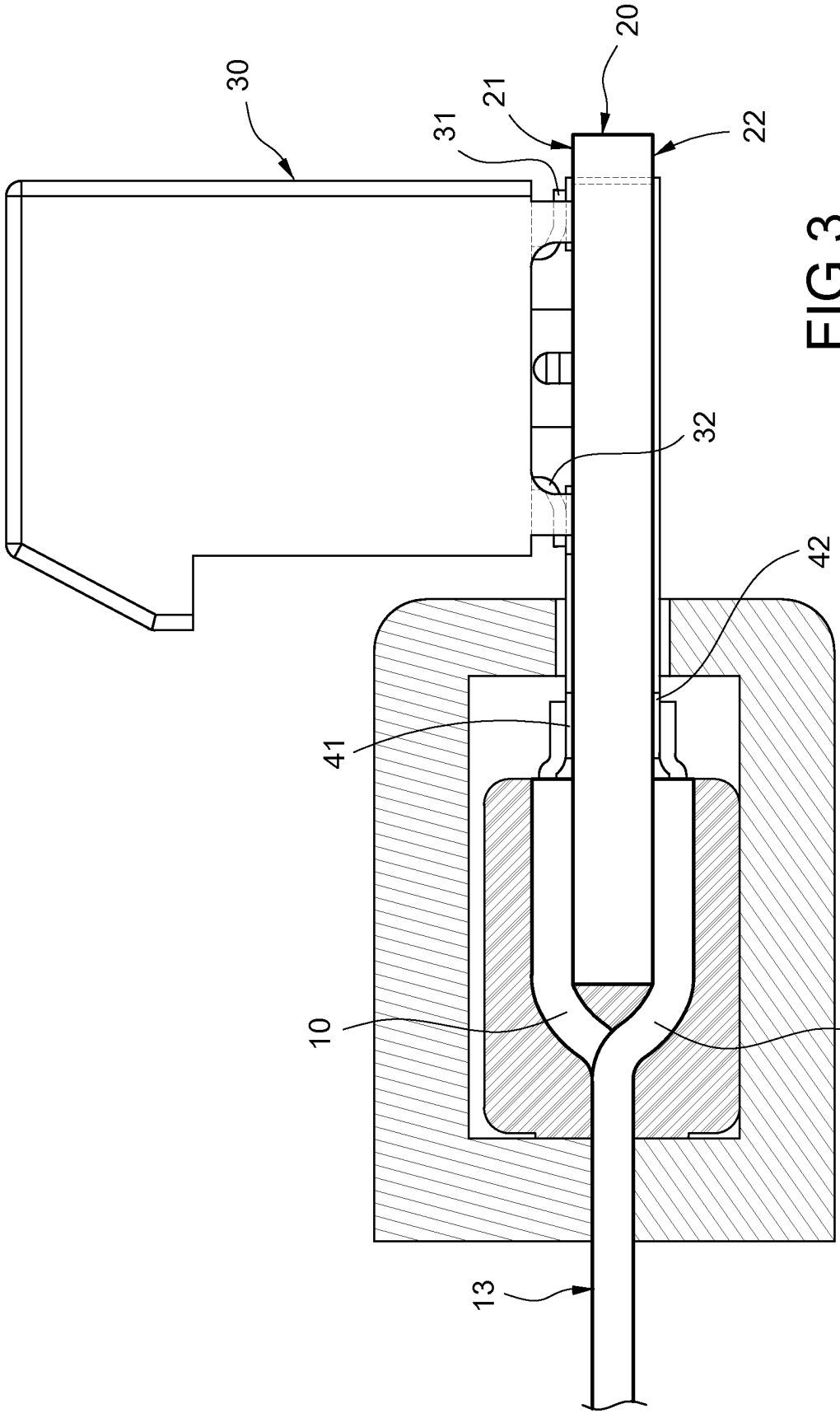


FIG.3
(Related Art)

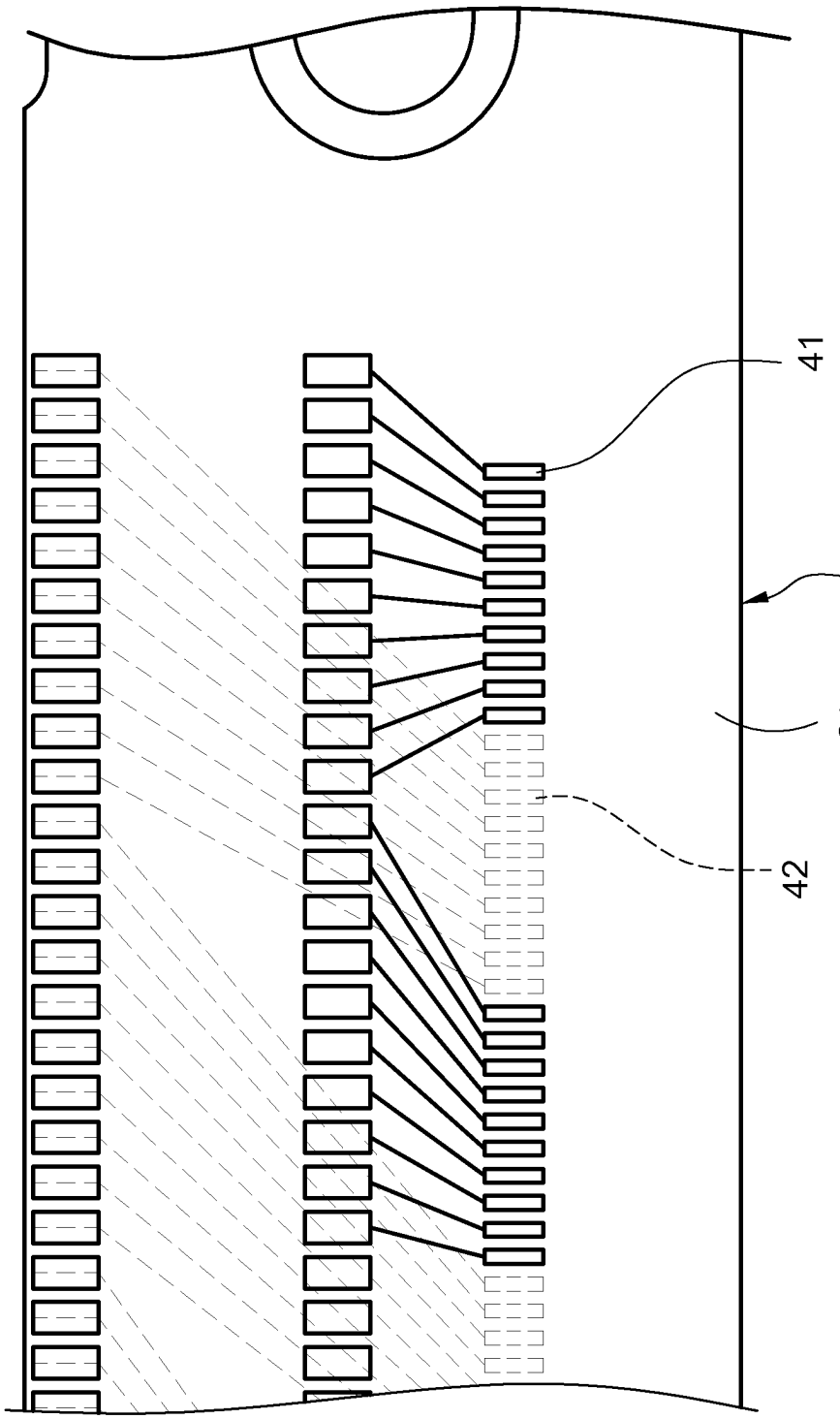


FIG.4
(Related Art)

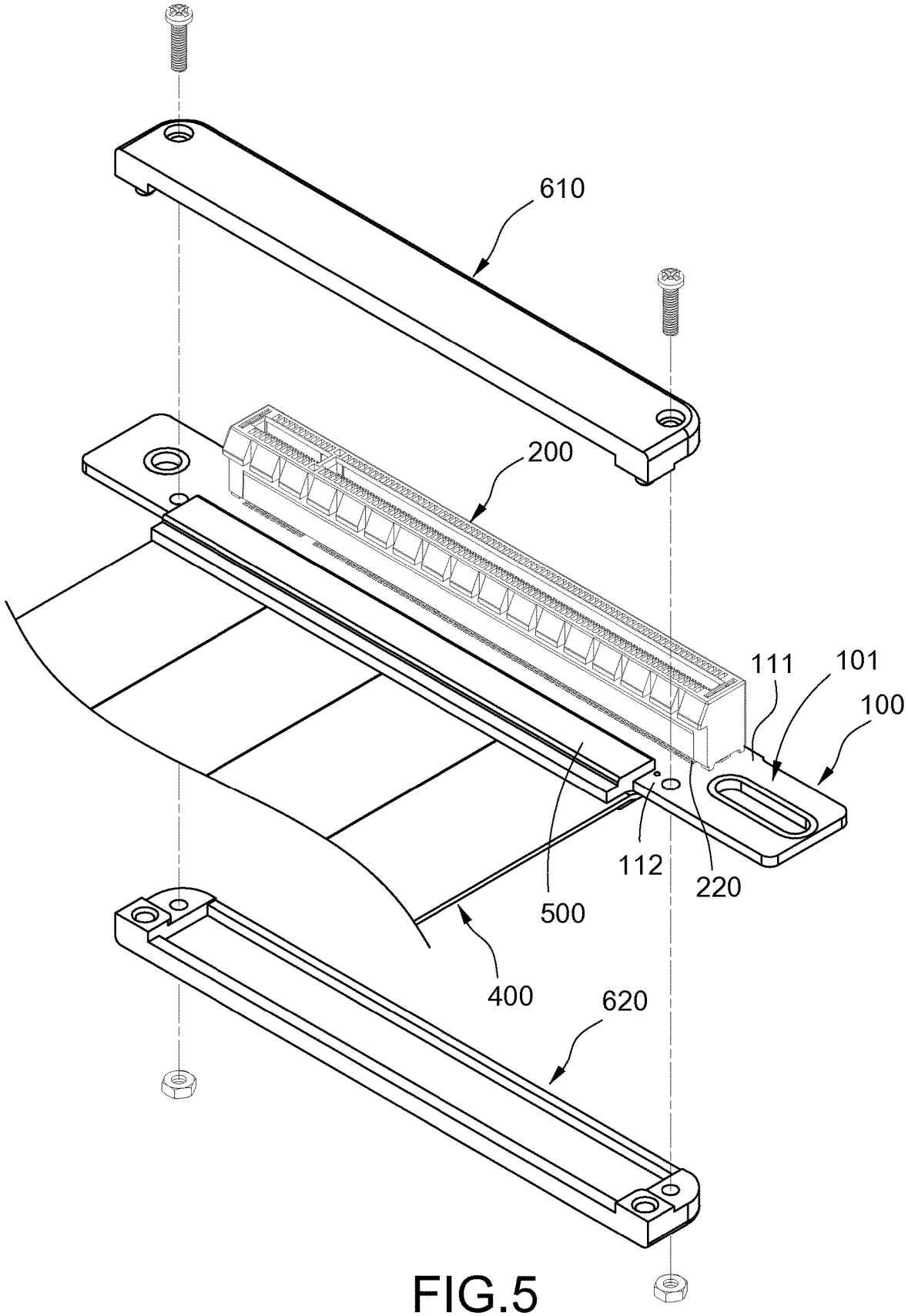


FIG.5

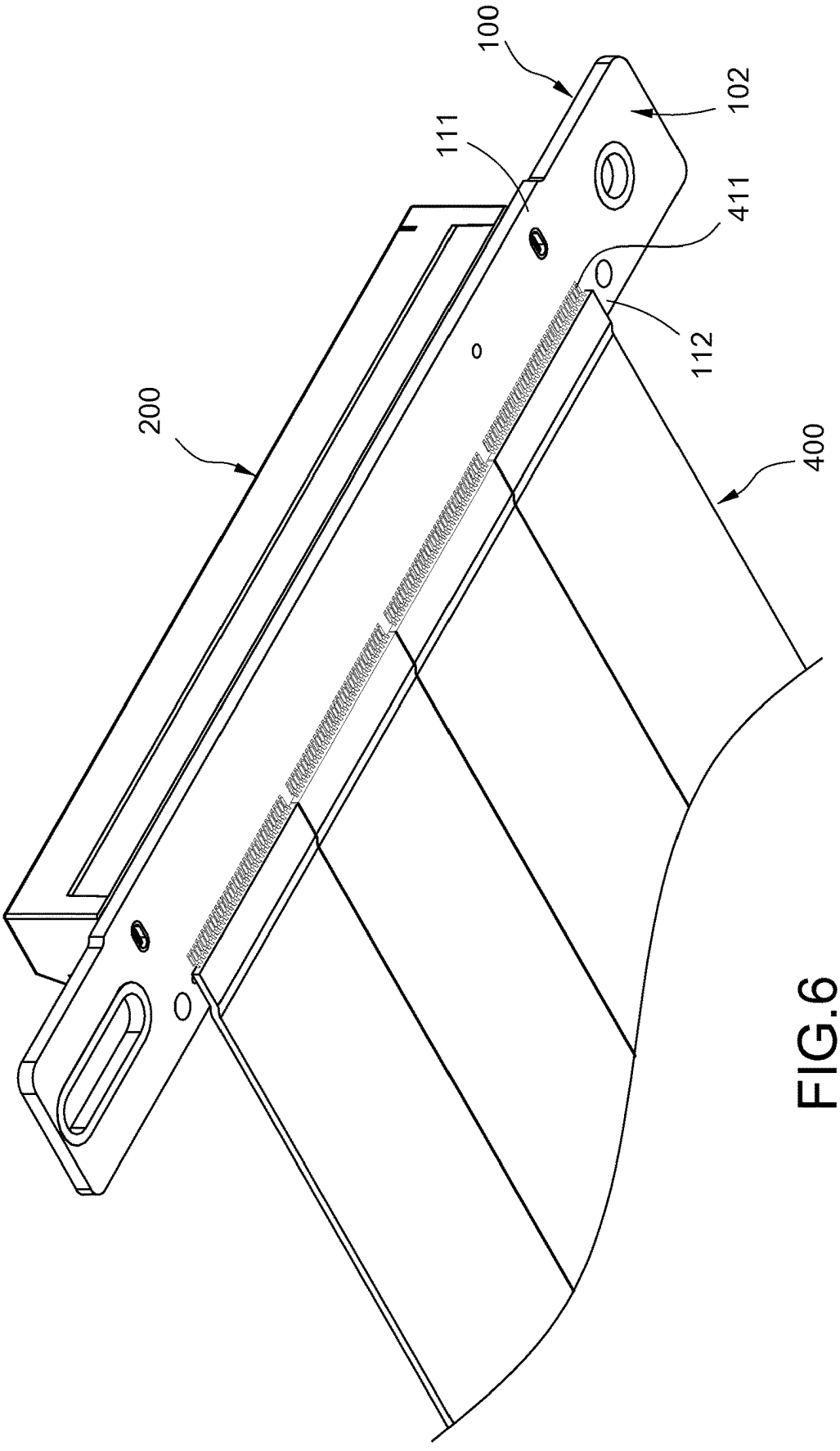


FIG.6

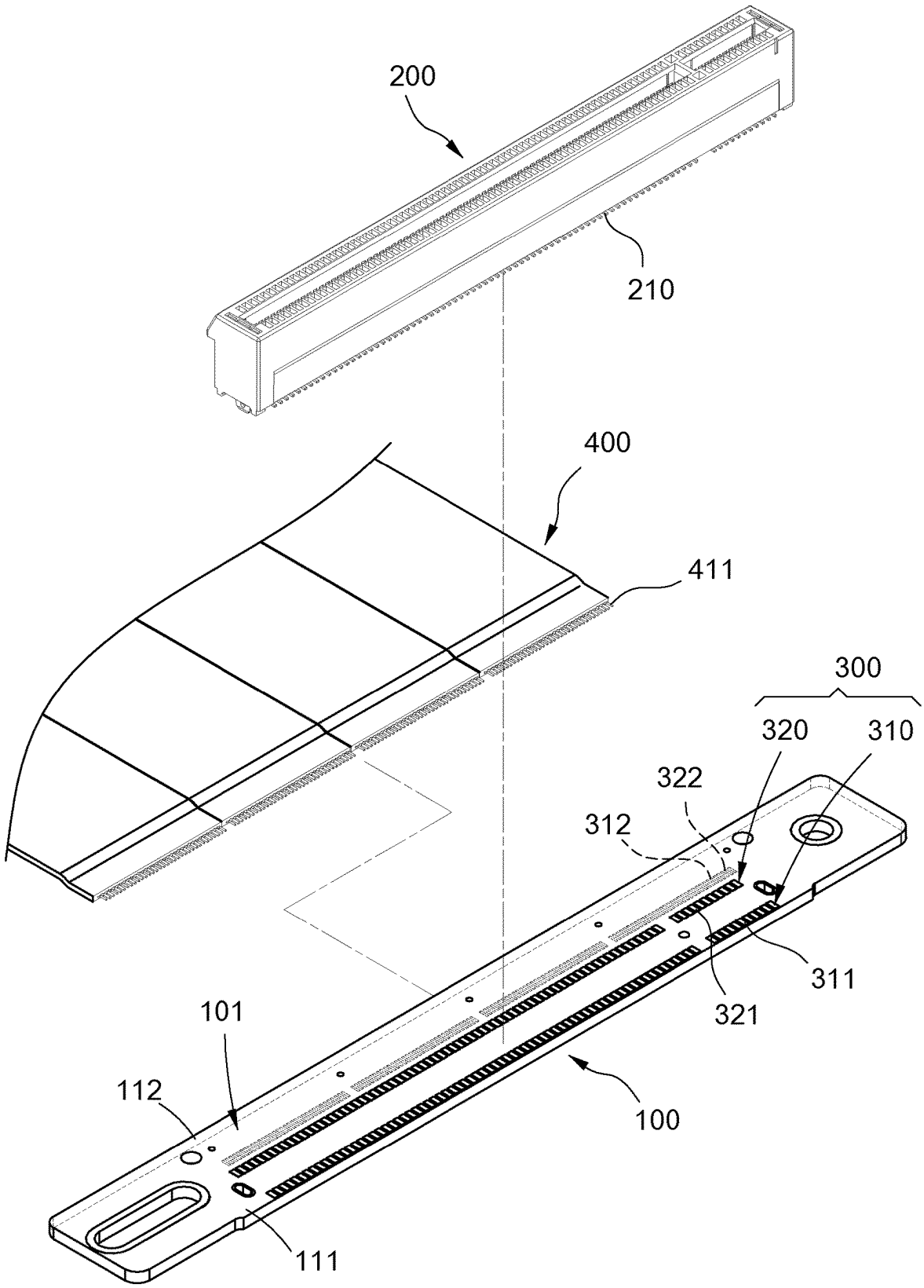


FIG.7

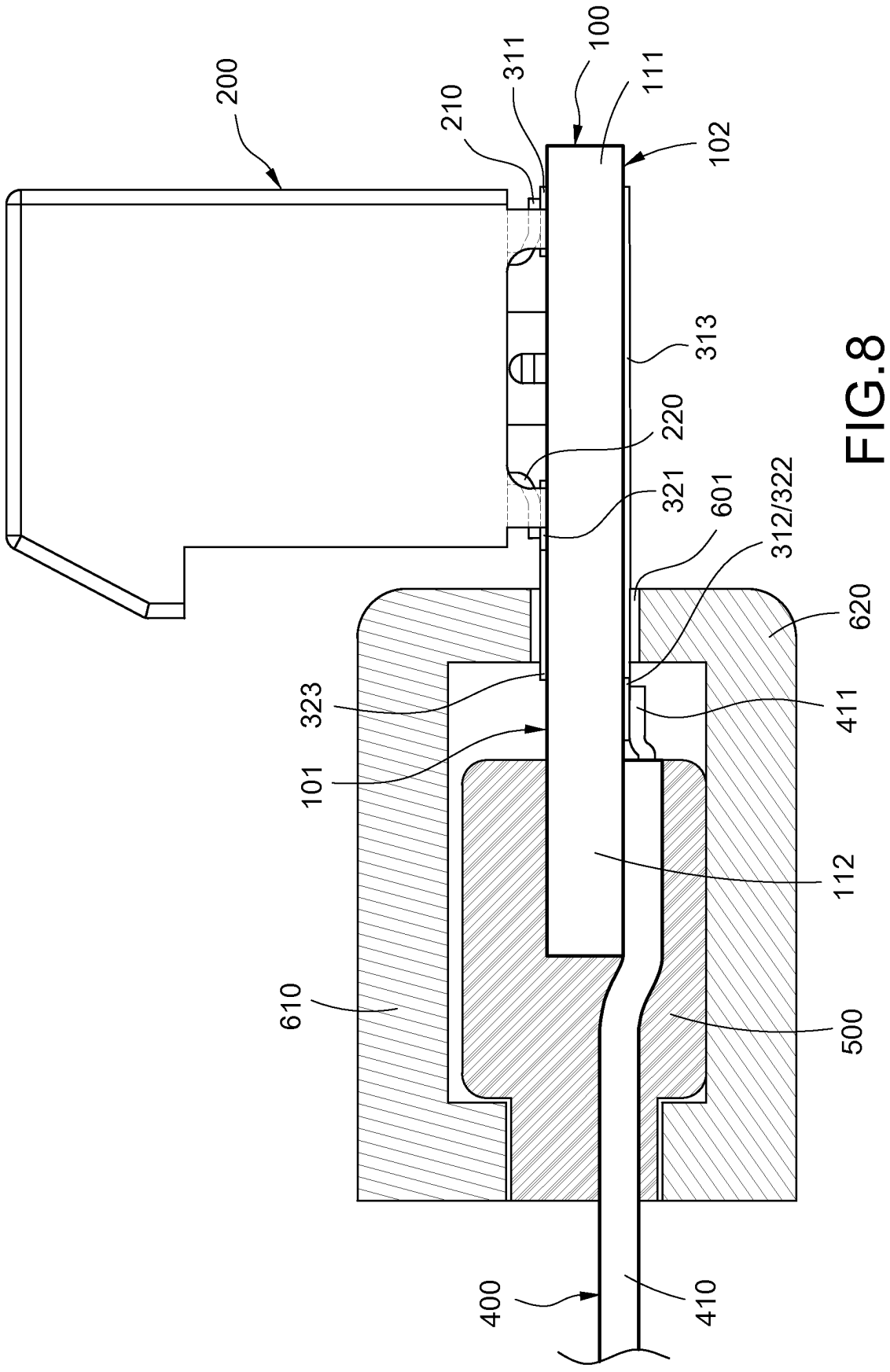

200
210
311
100
111
102
313
220
321
601
312/322
620
323
411
101
112
610
500
400
410

FIG.8

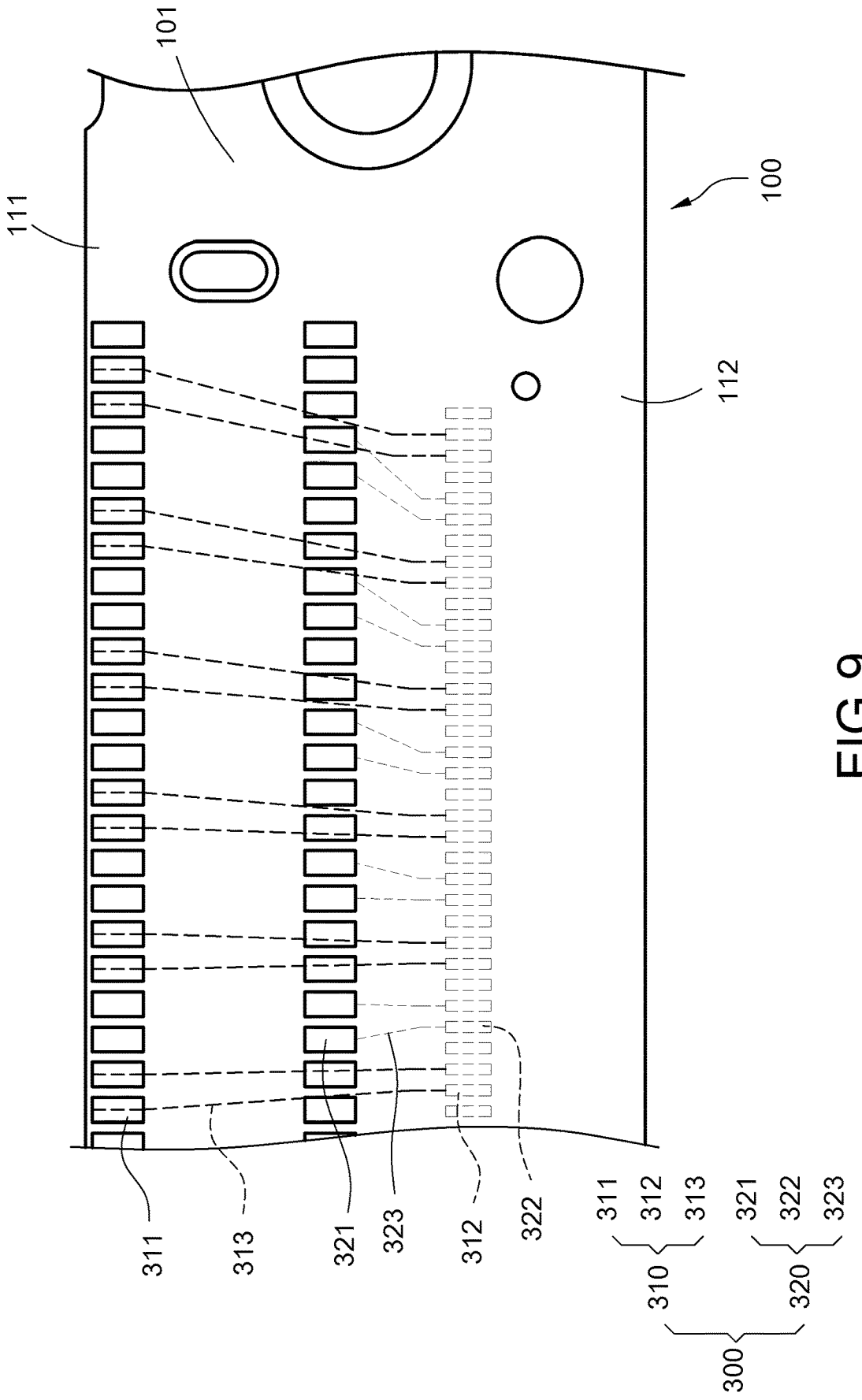

101
111
100
112
311
313
321
323
312
322
311
312
313
321
322
323
310
320
300

FIG.9

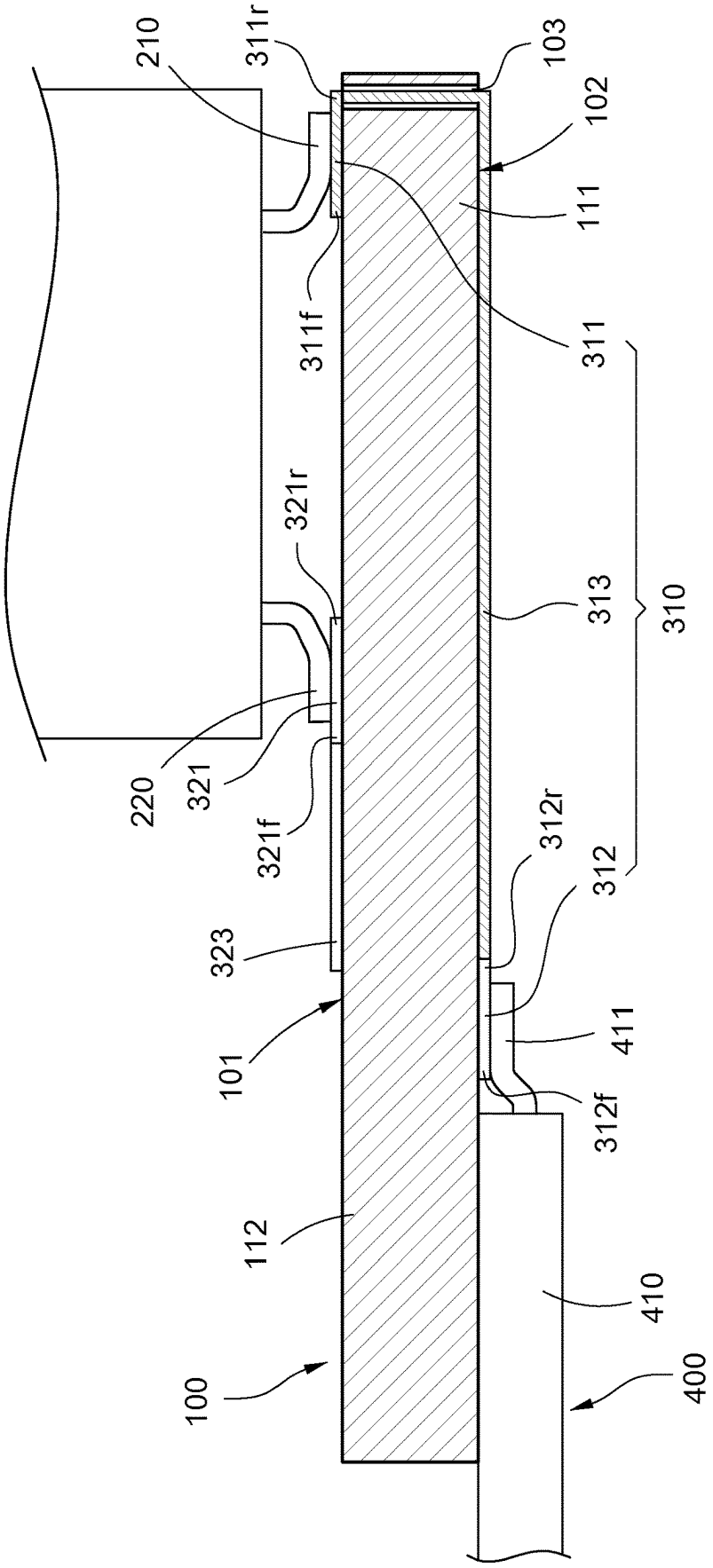

210
311r
103
102
111
311f
311
321r
313
310
220
321
321f
312r
312
323
411
101
312f
112
410
100
400

FIG.10

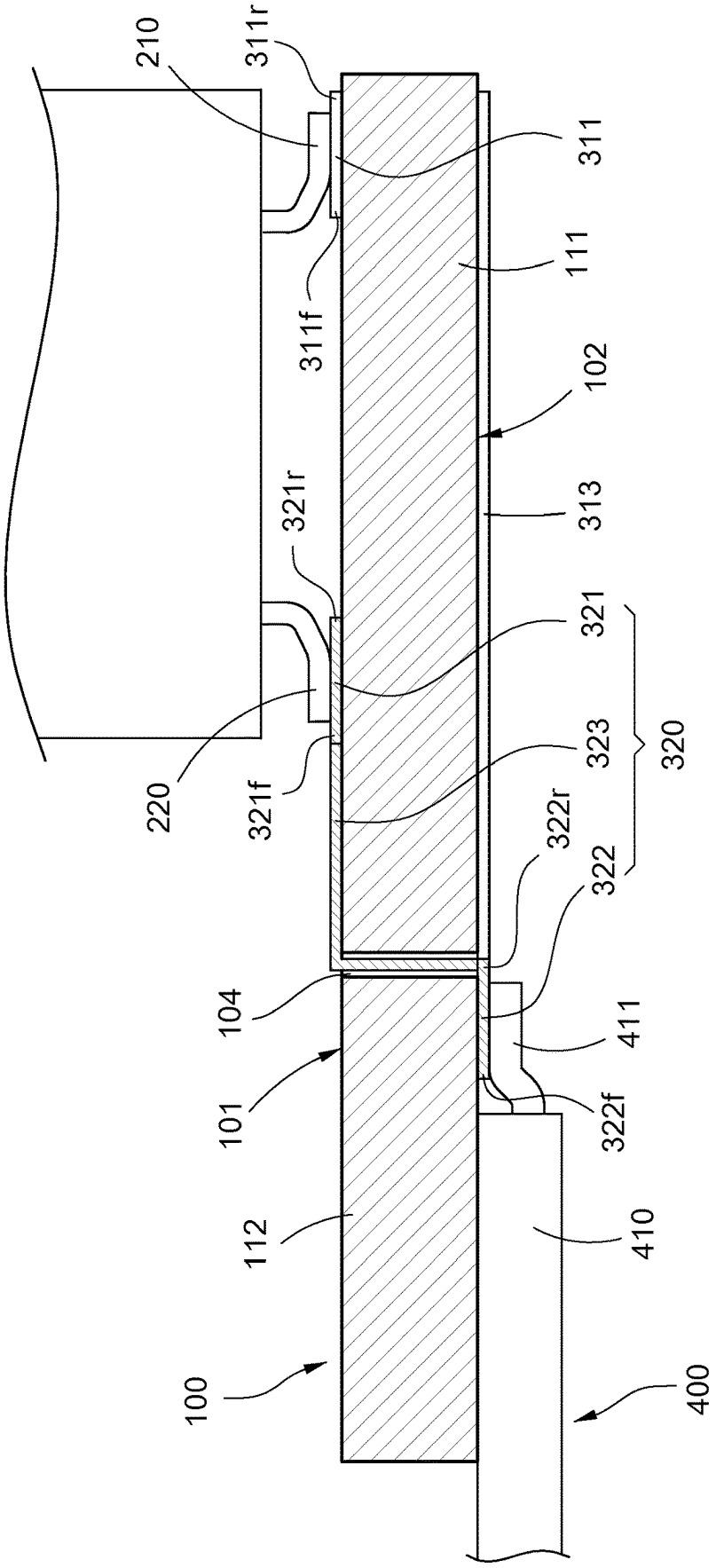

210
311r
311
111
311f
102
321r
313
321
323
320
220
321f
322r
322
104
411
101
322f
112
410
100
400

FIG.11

BUS CONNECTING CABLE

BACKGROUND

Technical Field

The disclosure relates to a bus connecting cable, particularly to a bus connecting cable with uniform electrical characteristics.

Related Art

According to related-art shown in FIGS. **1** to **4**, a PCIe cable assembly is generally used for plugging into a bus connector on a computer motherboard. Generally speaking, the cable assembly includes multiple conductors **10** and a circuit board **20**, and a connector **30** is arranged on the circuit board **20**. This connector **30** usually has two parallel rows of terminals, and the circuit board **20** is printed with various circuits corresponding to the two rows of terminals respectively. According to various configuration of the connector **30** on the circuit board **20**, it may be roughly divided into two types, which are a straddle structure having the two rows of terminals welded on two surfaces of the circuit board respectively, and a stand structure having a connector standing on one surface of the circuit board (referred to a top surface **21** hereinafter).

This disclosure is related to an improvement of the stand structure. The stand structure has circuits printed on two surfaces of the circuit board corresponding to the two rows of terminals. The circuits are respectively extended to the same side edge of the circuit board **20** for soldering with each conductor **10**. The circuit of one of the rows of terminals (referred to rear row terminals **31** hereinafter), which are away from the side edge, needs to cross the other row of terminals (referred to front row terminals **32** hereinafter). The circuits are extended to penetrate the circuit board **20** through via holes penetrating the circuit board **20**, the circuit passing the via holes have discontinuous impedances, and the discontinuous impedance seriously reduces the quality of signal transmission between each terminal and its corresponding conductor. Therefore, the signal transmission qualities in the two rows of terminals are ununiform. Various stand structures according to related art are described below.

According to a bus connection cable of related art shown in FIGS. **1** and **2**, the rear row terminals **31** are extended to form circuits penetrating the circuit board **20** and the circuits are extended to the corresponding conductors **10** respectively along the other surface (referred to a bottom surface **22** hereinafter) of the circuit board **20**. The front row terminals **32** are extended to form circuits directly extended to the corresponding conductors **10** along the top surface **21** of the circuit board **20**, and the circuits on the top surface **21** may have better signal transmission quality than that on the bottom surface **22**. The circuits of the rear row terminals **31** are extended to penetrate the circuit board **20** through the via holes. Once the circuits pass through the via hole, the impedance oscillation may be increased and the transmission qualities of the signal between the rear row terminals **31** and the corresponding conductors may be seriously decreased. Therefore, the signal transmission qualities of the two rows of terminals are ununiform. Moreover, soldering spots **41** disposed on the top surface **21** of the circuit board **20** corresponding to the front row terminals **32** for soldering with the conductors **10** correspondingly and soldering spots **42** disposed on the bottom surface **22** of circuit board **20** corresponding to the rear row terminals **31** for soldering with the conductors **10** correspondingly are disposed in a symmetrical arrangement. Therefore, the conductors **10** should be integrated into two rows of cables **11** and **12** overlapped with each other, so that the stack of the conductors **10** is thick. When the conductors **10** are bent, bending radii of the two rows of cables **11** and **12** are ununiform, and a cabling arrangement is not aesthetic.

According to a bus connection cable of related art as shown in FIGS. **3** and **4**, the rear terminals **31** are respectively extended to form circuits to the conductors **10** corresponding thereto along the bottom surface **22** of the circuit board **20**, and the front row terminals **32** are respectively extended to form circuits to the conductors **10** corresponding thereto directly along the top surface **21** of the circuit board **20**. The soldering spots **41** corresponding to the front row terminals **32** disposed on the top surface **21** of the circuit board **20** for soldering with the conductors **10** and the soldering spots **42** corresponding to the rear row terminal **31** disposed on the bottom surface **22** of the circuit board **20** for the soldering with the conductors **10** are in the same row, so that the conductors **10** are integrated in the same row of cable **13**. Therefore, the cable is not stacked, and the bending radius of each conductor **10** may be uniform when the row of cable **13** is bent. However, the layout of the circuits on the circuit board **20** is limited. The soldering spots **41**, **42** are segmentally and alternately disposed, and this arrangement leads to a large offset between the soldering spots **41**, **42** and the corresponding terminals **31**, **32**. Therefore, the circuits on two sides of the circuit board **20** need to be extended, and this leads to greater loss of signal transmission.

In view of this, the inventors have devoted themselves to the above-mentioned related art, researched intensively and cooperated with the application of science to try to solve the above-mentioned problems. Finally, the invention which is reasonable and effective to overcome the above drawbacks is provided.

SUMMARY

The disclosure provides a bus connecting cable with uniform electrical characteristics.

The disclosure provides a bus connecting cable, which includes a circuit board, a connector, multiple circuits and a cable. The circuit board includes a top surface and a bottom surface opposite to the top surface. The connector is upright arranged on the top surface and includes multiple first terminals in a row and multiple second terminals in a row. The circuits are arranged on the circuit board and include multiple first circuits and multiple second circuits. Each first circuit penetrates through the circuit board. Each first circuit includes a first top end on the top surface and a first bottom end on the bottom surface. The first top ends are respectively connected to the first terminals. Each second circuit penetrates through the circuit board. Each second circuit includes a second top end on the top surface and a second bottom end on the bottom surface. The second top ends are respectively connected to the second terminals. The first bottom ends and the second bottom ends are alternately arranged in a row along the bottom surface. The cable includes multiple conductors parallelly connected to each other. Each conductor is soldered to the first bottom ends and the second bottom ends respectively.

In an embodiment of the disclosure, the first bottom ends and the second bottom ends are alternately arranged in a row.

In an embodiment of the disclosure, the conductors in the cable are disposed side by side in a row to be a band shape, and the conductors are sequentially soldered to the first bottom ends and the second bottom ends arranged alternately.

In an embodiment of the disclosure, the circuit board is of a strip shape and includes a component side and a wiring side opposite to the component side, the row of first top ends and the row of second top ends are arranged at an interval and respectively extended along the component side, and the row of second top ends is more adjacent to the wiring side than the row of first top ends.

In an embodiment of the disclosure, the first bottom ends and the second bottom ends are arranged along the wiring side.

In an embodiment of the disclosure, each first circuit includes a first extending segment, the first extending segment is connected between a corresponding pair of the first top end and the first bottom end in each first circuit, and each first extending segment is extended along the bottom surface to cross the connector.

In an embodiment of the disclosure, corresponding to the circuits, the circuit board has a plurality of via holes penetrating the circuit board, and the plurality of via holes have a plurality of first via holes corresponding to the first circuits respectively. In each first circuit, the first top end has a front edge and a rear edge, the front edge of the first top end is closer to the wiring side than the rear edge of the first top end, the first bottom end has a front end and a rear end, the front edge of the first bottom end is closer to the wiring side than the rear edge of the first bottom end. The first terminal corresponding to the first circuit has a distal end extended from the front edge of the first top end to the rear edge of the first top end. The first via hole corresponding to the first circuit penetrates the circuit board from the rear edge of the first top end.

In an embodiment of the disclosure, each first circuit has a first extending segment. In each first circuit, the first extending segment is connected between the first top end and the first bottom end, the first extending segment of the first circuit is extended from the rear edge of the first top end through the first via hole and further extended toward the wiring side along the bottom surface of the circuit board to the rear edge of the first bottom end.

In an embodiment of the disclosure, the circuit board has a plurality of via holes penetrating the circuit board corresponding to the circuits, and the plurality of via holes have a plurality of second via holes corresponding to the second circuits respectively. In each second circuit, the second top end has a front edge and a rear edge, the front edge of the second to end is closer to the wiring side than the rear edge of the second top end. The second bottom end has a front end and a rear end, and the front edge of the second bottom end is closer to the wiring side than the rear edge of the second bottom end. The second terminal corresponding to the second circuit has a distal end extended from the rear edge of the second top end to the front edge of the second top end. The second via hole corresponding to the second circuit penetrates the circuit board from the rear edge of the second bottom end.

In an embodiment of this disclosure, each second circuit has a second extending segment. In each second circuit, the second extending segment is connected between the second top end and the second bottom end, the second extending segment of the second circuit is extended from the front edge of the second top end to the second via hole along the top surface of the circuit board and further extended through the second via hole to connected to the rear edge of the second bottom end.

In an embodiment of the disclosure, the bus connecting cable further includes a positioning block disposed on the wiring side of the circuit board, part of an edge of the circuit board is buried in the positioning block, part of each conductor is buried in the positioning block, each conductor includes a soldering end projecting from the positioning block, and each soldering end is soldered to a corresponding one of the first bottom ends or the second bottom ends. The bus connecting cable further includes a pair of shells, the pair of shells clamp the wiring side of the circuit board, and the positioning block is received in the shells. The soldering ends are received in the shells.

In an embodiment of the disclosure, each of the shells has an avoiding opening, the circuits are disposed separately from the corresponding shells through the avoiding openings.

In an embodiment of the disclosure, the circuit board has a plurality of via holes penetrating the circuit board corresponding to the circuits, and each circuit passes through one of the via hole.

In the bus connecting cable of the disclosure, all of the first circuit and the second circuit penetrate through the circuit board, so that signals transmitted in the first circuit and the second circuit have losses equal to each other when penetrating the circuit board. Therefore, transmission qualities of the signals in the first circuit and the second circuit are kept uniform.

BRIEF DESCRIPTION OF THE DRAWINGS

FIGS. **1** and **2** are perspective views showing a related-art bus connecting cable.

FIGS. **3** and **4** are perspective views showing another related-art bus connecting cable.

FIG. **5** is an exploded view of the bus connecting cable of the disclosure:

FIG. **6** is a schematic view of some elements of the bus connecting cable of the disclosure:

FIG. **7** is an exploded schematic view of the bus connecting cable of the disclosure:

FIG. **8** is a side view of the bus connecting cable of the disclosure:

FIG. **9** is a layout view of the circuit on the circuit board of the bus connecting cable of the disclosure:

FIG. **10** is a schematic view of the arrangement of the first circuit on the circuit board of the bus connecting cable of the disclosure; and

FIG. **11** is a schematic view of the arrangement of the second circuit on the circuit board of the bus connecting cable of the disclosure.

DETAILED DESCRIPTION

The technical contents of this disclosure will become apparent with the detailed description of embodiments accompanied with the illustration of related drawings as follows. It is intended that the embodiments and drawings disclosed herein are to be considered illustrative rather than restrictive.

Please refer to FIGS. **5-8**, an embodiment of the disclosure provides a bus connecting cable, which includes a circuit board **100**, a connector **200**, multiple circuits **300** disposed on the circuit board **100**, and a cable **400**.

In the embodiment, the circuit board **100** is of a strip shape and has a component side **111** and a wiring side **112** opposite to the component side **111**. The circuit board **100** includes a top surface **101** and a bottom surface **102** opposite to the top surface **101**.

The connector **200** is upright arranged on the top surface **101** of the circuit board **100** and includes multiple first terminals **210** in one row and multiple second terminals **220** in another row. The first terminals **210** and the second terminals **220** are parallelly arranged at an interval. In the embodiment, the connector **200** with the PCIe specification is taken as an example, but not limited to this.

Please refer to FIG. **9**, which show the arrangement of the circuits **300** on the circuit board **100**. The circuits **300** disposed on the circuit board **100** include multiple first circuits **310** and multiple second circuits **320**.

As shown in FIGS. **10** and **11**, corresponding to the circuits **300**, the circuit board **100** has a plurality of via holes penetrating the circuit board **100**, the plurality of via holes have a plurality of first via holes **103** respectively corresponding to the first circuits **310** and a plurality of second via holes **104** respectively corresponding to the second circuits **320**. Only one of the first via holes **103** and one of the second via holes **104** are shown in FIGS. **10** and **11** for illustrating.

As shown in FIGS. **9** and **10**, each first circuit **310** is disposed through the first via hole **103** correspondingly to penetrate the circuit board **100**. Each first circuit **310** includes a first top end **311**, a first bottom end **312** and a first extending segment **313**. In each first circuit **310**, the first top end **311** and the first bottom end **312** are respectively located at two ends of the first circuit **310**, and the first extending segment **313** is connected between the first top end **311** and the first bottom end **312** correspondingly. The first top end **311** is exposed and disposed on the top surface **101** of the circuit board **100**. The first bottom end **312** is exposed and disposed on the bottom surface **102** of the circuit board **100**. The first top ends **311** are respectively connected to the first terminals **210**. On the component side **111**, each first circuit **310** is extended from each first top end **311** to penetrate through the circuit board **100** and further extended along the bottom surface **102** of the circuit board **100** to each first bottom end **312**. Each first extending segment **313** is extended along the bottom surface **102** to cross the connector **200**. In the embodiment, the first extending segment **313** is extended on the bottom surface **102**, and a cover layer may be disposed on the bottom surface **102** of the circuit board **100** to cover the first extending segments **313**.

According to FIGS. **9** and **11**, each second circuit **320** is disposed through the second via hole **104** correspondingly to penetrate the circuit board **100**, and each second circuit **320** includes a second top end **321** on the top surface **101** and a second bottom end **322** on the bottom surface **102**. The second top ends **321** are respectively connected to the second terminals **220**. Each second circuit **320** has a second extending segment **323**. In each second circuit **320**, the second extending segment **323** is connected between the second top end **321** and the second bottom end **322** correspondingly. Each second circuit **320** is extended from each second top end **321** to the wiring side **112** along the top surface **101** and penetrates through the circuit board **100** to each second bottom end **322**. In the embodiment, the second extending segment **323** is extended along the top surface **101**. A covering layer may be arranged on the top surface **101** to cover the second extending segment **323**.

As shown in FIGS. **10** and **11**, each of the first circuits **310** and each second circuits **320** passes through one of the via holes (first via holes **103**, second via holes **104**), so that the loss of signal transmission in each first circuit **310** at the portions passing through the via hole is equal to that of each second circuit **320**. Although this arrangement may have some losses of signal transmission in the second circuits **320** (the second via holes **104** lead to loss of signal transmission), qualities of signal transmission in the first circuits **310** and the second circuits **320** may be maintained uniform.

As shown in FIG. **10**, in each first circuit **310**, the first top **311** thereof has a front edge **311***f* and a rear edge **311***r*, and the front edge **311***f* of the first top **311** is closer to the wiring side **112** than the rear edge **311***r* of the first top **311**; the bottom end **312** has a front edge **312***f* and a rear edge **312***r*, and the front edge **312***f* of the first bottom end **312** is closer to the wiring side **112** than the rear edge **312***r* of the first bottom end **312**; a distal end of the first terminal **210** corresponding to the first circuit **310** is extended from the front edge **311***f* of the first top end **311** toward the rear edge **311***r* of the first top end **311**. In each first circuit **310**, in order to prevent the first circuit **310** from a loss of the signal transmission quality in a path from the first terminal **210** to the first bottom end **312** caused by a stub effect, the first via hole **103** is extended to penetrate the circuit board **100** at the rear edge **311***r* of the first top end **311**, and the first extending segment **313** of the first circuit **310** is extended from the rear edge **311***r* of the first top end **311** through the first via hole **103** and further extended along the bottom surface **102** of the circuit board **100** toward the wiring side **112** to the rear edge **312***r* of the first bottom end **312**. Similarly, as shown in FIG. **11**, in each second circuit **320**, the second top **321** thereof has a front edge **321***f* and a rear edge **321***r*, and the front edge **321***f* of the second top **321** is closer to the wiring side **112** than the rear edge **321***r* of the second top **321**; the second bottom end **322** has a front edge **322***f* and a rear edge **322***r*, and the front edge **322***f* of the second bottom end **322** is closer to the connection side **112** than the rear edge **322***r* of the second bottom end **322**; a distal end of the second terminal **220** corresponding to the second circuit **320** is extended from the rear edge **321***r* of the second top end **321** toward the front edge **321***f* of the second top end **321**. In each of the second circuits **320**, in order to avoid losses of signal transmission quality caused by a stub effect occurred in a path of the second circuit **320** extending from the second terminal **220** to the second bottom end **322**, the second via hole **104** is disposed to penetrated the circuit board **100** at the rear edge **322***r* of the second bottom end **322**, the second extending segment **323** of the second circuit **320** is extended from the front edge **321***f* of the second top end **321** toward the wiring side **112** along the top surface **101** of the circuit board **100** to the second via hole **104** and extended through the second via hole **104** to be connected to the rear edge **322***r* of the second bottom end **322**.

According to FIG. **9**, the row of first bottom ends **311** and the row of second bottom ends **321** are parallelly arranged at an interval and respectively extended along the component side **111**. The row of second top ends **321** is more adjacent to the wiring side **112** than the row of first top ends **311**. The first bottom ends **312** and the second bottom ends **322** are arranged along the bottom surface **102**. In detail, the first bottom ends **312** and the second bottom ends **322** are alternately arranged along the bottom surface **102** in a row, and the first bottom ends **312** and the second bottom ends **322** are arranged along the wiring side **112**, but not limited to this. For example, the first bottom ends **312** and the second bottom ends **322** may be alternately arranged along the bottom surface **102** in multiple rows. The disclosure does not limit the order of the alternate arrangement of the first bottom ends **312** and the second bottom ends **322**. For

example, a single first bottom end **312** and a single second bottom end **322** are alternatively arranged in order, a single first bottom end **312** and multiple second bottom ends **322** in a group are alternatively arranged in order, multiple first bottom ends **312** in a group and a single second bottom end **322** are alternatively arranged in order, or multiple first bottom ends **312** in a group and multiple second bottom ends **322** in a group are alternatively arranged in order, etc. Specifically, the first bottom ends **312** may be arranged scatteredly so as to increase the intervals between a part of the first bottom ends **312** and another adjacent first bottom ends **312**, thereby preventing the first bottom ends **312** from a crowded arrangement which may lead to large offset between the first bottom ends **312** and the first top end **311** corresponding thereto, so that lengths of the first extending segments **313** are effectively reduced and length differences between the first extending segments **313** are reduced as well. The second bottom ends **322** are alternately arranged with the scattered first bottom ends **312**, in order to avoid over deviations between the second bottom end **322** and the corresponding second top end **311** corresponding thereto, so that lengths of the second extending segments **323** are effectively reduced and length differences between the second extending segments **323** are reduced as well.

According to FIGS. **5** to **8**, the cable **400** includes multiple conductor **410**, each conductor **410** is of a wire shape, the conductors **410** are disposed side by side in a row and connected to each other to form a belt (or band) shape or multiple belts disposed side by side. The conductors **410** are respectively soldered to the first bottom ends **312** and the second bottom ends **322**. That is, each conductor **410** is correspondingly soldered with one of the first bottom ends **312** and the second bottom ends **322**. Specifically, the conductors **410** are sequentially soldered to the first bottom end **312** and the second bottom end **322** arranged alternately.

According to FIG. **8**, in an embodiment of the disclosure, the bus connecting cable further includes a positioning block **500** disposed on the wiring side **112** of the circuit board **100**. Part of an edge of the circuit board **100** is buried in the positioning block **500**. Part of each conductor **410** is buried in the positioning block **500** to position the conductors **410** on the circuit board **100**. In detail, the positioning block **500** may be formed on the edge of the circuit board by injection molding. Each conductor **410** has a soldering end **411** projecting from the positioning block **500**. The soldering ends **411** are respectively arranged and positioned corresponding to the first bottom ends **312** or the second bottom ends **322**. Each soldering end **411** is soldered to a corresponding one of the first bottom ends **312** or the second bottom ends **322**. The positioning block **500** may fix the relative position of each conductor **410** and the corresponding first bottom end **312** or second bottom end **322** to facilitate soldering and prevent each soldering end **411** from falling off from the circuit board **100**.

According to FIGS. **5** to **8**, in an embodiment of the disclosure, the bus connecting cable further includes a pair of shells **610**, **620** fastened to the circuit board **100**. The pair of shells **610**, **620** clamps the wiring side **112** of the circuit board **100**. The positioning block **500** and the soldering ends **411** are received in the shells **610**, **620** to prevent the junction of the cable **400** and the circuit board **100** from being collided. Each casing **610**, **620** has an avoiding opening **601**, the first circuits **310** and the second circuits **320** are allowed to pass therethrough respectively, and the first circuits **310** and the second circuits **320** are respectively separated from the casing **610**, **620** corresponding thereto. The housings **610**, **620** are generally made of polypropylene plastic (Polypropylene, PP), dielectric coefficients (Dk) of the housings **610**, **620** are approximately 2.1, and a dielectric coefficient (Dk) of air is 1.00054. The avoiding openings **601** prevent the housings **610**, **620** from contacting the first circuit **310** and the second circuit **320** respectively so as to prevent the dielectric coefficients (Dk) of the first circuits **310** and the second circuits **320** from increasing, and losses of signal transmission are reduced.

In the bus connecting cable of the disclosure, all of the first circuit **310** and the second circuit **320** penetrate through the circuit board **100** to reduce the impedance difference between the first circuit **310** and the second circuit **320**. The first extending segments **313** and the second extending segments **323** are respectively disposed on two sides of the circuit board **100** to effectively use the layout space so as to prevent the second extending segments **323** from compressing layout space of the first extending segments **313**. The first bottom end **312** and the second bottom end **322** are alternately arranged along the bottom surface **102** of the circuit board **100** in a row to reduce the length difference between the first circuits **310** and reduce the length difference between the second circuits **320**. As a result, the impedance difference between the circuits **300** may be reduced.

The bus connecting cable of this disclosure has the first bottom end **312** of the first circuit **310** and the second bottom end **322** of the second circuit **320** which are disposed on the bottom surface **102** of the circuit board **100** and alternately arranged in a row, and it is therefore suitable for cables **400** or scattered conductors **410**, and the conductors **410** of the cable **400** are not necessary to be overlapped with each other. Moreover, the first bottom ends **312** and the second bottom ends **322** are arranged scatteredly and alternately so that wiring distance of the first extending segment **313** and wiring distance of the second extending segment **323** in the circuit **300** on the circuit board **100** are decreased, and the first extending segments **313** and the second extending segments **323** have small length differences respectively. The first extending segment **313** and the second extending segment **323** are disposed extensively on the top surface **100** and the bottom surface **102** of the circuit board **100** so that the first extending segment **313** and the second extending segment **323** are prevented from a parallel arrangement, and crosstalk is therefore reduced. All of the conductors **410** are all soldered to the bottom surface **102** of the circuit board **100**, and this single-side structure is easy to be processed.

While this disclosure has been described by means of specific embodiments, numerous modifications and variations could be made thereto by those skilled in the art without departing from the scope and spirit of this disclosure set forth in the claims.

What is claimed is:

1. A bus connecting cable, comprising:

a circuit board, comprising a top surface and a bottom surface opposite to the top surface;

a connector, upright arranged on the top surface, and comprising a plurality of first terminals and a plurality of second terminals;

a plurality of circuits, arranged on the circuit board, comprising a plurality of first circuits and a plurality of second circuits, each first circuit penetrating through the circuit board and comprising a first top end located on the top surface and a first bottom end located on the bottom surface, a plurality of first top ends connected to each first terminal, each second circuit penetrating through the circuit board and comprising a second top end located on the top surface and a second bottom end

located on the bottom surface, a plurality of second top ends connected to each second terminal, and a plurality of first bottom ends and a plurality of second bottom ends arranged along the bottom surface; and

a cable, comprising a plurality of conductors parallelly connected to each other, and the conductors soldered to the first bottom ends and the second bottom ends respectively.

2. The bus connecting cable of claim **1**, wherein each first circuit comprises a first extending segment connected between the first top end and the first bottom end, and the first extending segment is extended along the bottom surface to cross the connector.

3. The bus connecting cable of claim **1**, wherein the circuit board comprises a plurality of via holes defined thereon corresponding to the circuits, and each circuit passes through one of the via holes.

4. The bus connecting cable of claim **1**, wherein the first bottom ends and the second bottom ends are alternately arranged in a row.

5. The bus connecting cable of claim **4**, wherein the conductors of the cable are disposed side by side in a row to be a band shape, and the conductors are sequentially soldered to the first bottom ends and the second bottom ends arranged alternately.

6. The bus connecting cable of claim **1**, further comprising a pair of shells, wherein the pair of shells are configured to clamp the wiring side of the circuit board, and the soldering end is received in the pair of shells.

7. The bus connecting cable of claim **6**, wherein each of the shells comprises an avoiding opening, the circuits are disposed separately from the shell through the avoiding opening.

8. The bus connecting cable of claim **1**, wherein the circuit board is of a strip shape and comprises a component side and a wiring side opposite to the component side, the first top ends and the second top ends are arranged spacedly and extended along the component side, and the second top ends is closer to the wiring side than the first top ends.

9. The bus connecting cable of claim **8**, wherein the first bottom ends and the second bottom ends are arranged along the wiring side.

10. The bus connecting cable of claim **8**, wherein the circuit board comprises a plurality of via holes defined thereon corresponding to the circuits, and the via holes comprise a plurality of first via holes corresponding to the first circuits respectively:

wherein, in each first circuit, a front edge of the first top end is closer to the wiring side than a rear edge of the first top end, a front edge of the first bottom end is closer to the wiring side than a rear edge of the first bottom end, a distal end of the first terminal corresponding to the first circuit is extended from the front edge of the first top end to the rear edge of the first top end, the first via hole corresponding to the first circuit penetrates the circuit board from the rear edge of the first top end;

wherein each first circuit comprises a first extending segment;

wherein the first extending segment is connected between the first top end and the first bottom end in each first circuit, the first extending segment of the first circuit is extended from the rear edge of the first top end through the first via hole and further extended toward the wiring side along the bottom surface of the circuit board to the rear edge of the first bottom end.

11. The bus connecting cable of claim **8**, wherein the circuit board comprises a plurality of via holes defined thereon corresponding to the circuits, and the via holes comprise a plurality of second via holes corresponding to the second circuits respectively;

wherein, in each second circuit, a front edge of the second to end is closer to the wiring side than a rear edge of the second top end, a front edge of the second bottom end is closer to the wiring side than a rear edge of the second bottom end, a distal end of the second terminal corresponding to the second circuit is extended from the rear edge of the second top end to the front edge of the second top end, the second via hole corresponding to the second circuit penetrates the circuit board from the rear edge of the second bottom end;

wherein each second circuit comprises a second extending segment;

wherein the second extending segment is connected between the second top end and the second bottom end in each second circuit, the second extending segment of the second circuit is extended from the front edge of the second top end to the second via hole along the top surface of the circuit board and further extended through the second via hole to be connected to the rear edge of the second bottom end.

12. The bus connecting cable of claim **8**, further comprising a positioning block disposed on the wiring side of the circuit board, wherein a part of an edge of the circuit board is buried in the positioning block, a part of each conductor is buried in the positioning block, each conductor comprises a soldering end projecting from the positioning block, and the soldering end is soldered to the first bottom end or the second bottom end correspondingly.

13. The bus connecting cable of claim **12**, further comprising a pair of shells, wherein the pair of shells are configured to clamp the wiring side of the circuit board, and the positioning block is received in the pair of shells.

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