US012394928B2

(12) **United States Patent**
Aihara

(10) **Patent No.: US 12,394,928 B2**
(45) **Date of Patent: Aug. 19, 2025**

(54) **CIRCUIT BOARD ELECTRICAL CONNECTOR**

(71) Applicant: **HIROSE ELECTRIC CO., LTD.**, Kanagawa (JP)

(72) Inventor: **Kazuki Aihara**, Kanagawa (JP)

(73) Assignee: **HIROSE ELECTRONIC CO., LTD.**, Kanagawa (JP)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 329 days.

(21) Appl. No.: **18/103,059**

(22) Filed: **Jan. 30, 2023**

(65) **Prior Publication Data**

US 2023/0246366 A1 Aug. 3, 2023

(30) **Foreign Application Priority Data**

Feb. 3, 2022 (JP) 2022-015585

(51) **Int. Cl.**
H01R 12/91 (2011.01)
H01R 12/71 (2011.01)

(52) **U.S. Cl.**
CPC ***H01R 12/91*** (2013.01); ***H01R 12/716*** (2013.01)

(58) **Field of Classification Search**
CPC H01R 12/91; H01R 12/716; H01R 12/57; H01R 13/2407; H01R 12/73; H01R 13/02; H01R 12/71; H01R 13/40; H01R 13/2492; H01R 13/2414; H01R 13/502
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

9,225,089 B2 * 12/2015 Sato H01R 13/2457
9,917,403 B2 * 3/2018 Doi H01R 12/91
10,062,995 B2 8/2018 Doi
(Continued)

FOREIGN PATENT DOCUMENTS

JP 6438382 B2 12/2018
JP 2019-192527 A 10/2019

OTHER PUBLICATIONS

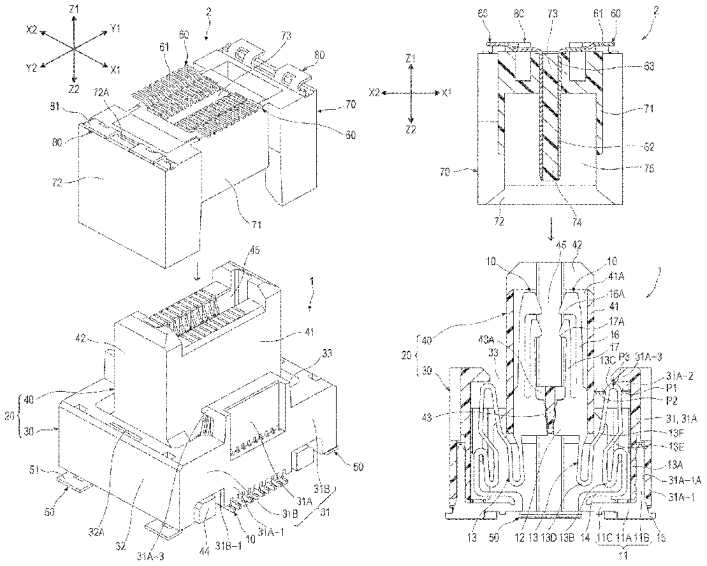
Extended European Search Report (EESR) dated Jun. 9, 2023 for European Patent Application No. 23154232.5.
(Continued)

Primary Examiner — Edwin A. Leon
(74) *Attorney, Agent, or Firm* — RANKIN, HILL & CLARK LLP

(57) **ABSTRACT**

A circuit board electrical connector includes: plurality of terminals; fixed housing fixed to a circuit board via the terminals; and a movable housing relatively movable with respect to the fixed housing, in which the terminals are provided to be bridged between the fixed housing and the movable housing, the terminals include fixed side held portion held by the fixed housing, a movable side held portion positioned on an inner side in a connector width direction than the fixed side held portion and held by the movable housing, and an elastically deformable intermediate portion positioned between the fixed side held portion and the movable side held portion, the intermediate portion includes a plurality of elastic portions reversed by repeating a bending direction in a connector height direction, and the specific elastic portion of the plurality of elastic portions is positioned to he different in the connector height direction from another elastic portion and positioned to have a range overlapping in the connector width direction.

7 Claims, 7 Drawing Sheets



(56) **References Cited**

U.S. PATENT DOCUMENTS

10,608,361	B2 *	3/2020	Teruki	H01R 13/506
10,804,630	B2	10/2020	Horii	
11,152,747	B2 *	10/2021	Shioda	H01R 12/71
11,381,019	B2 *	7/2022	Morita	H01R 13/24
11,552,420	B2 *	1/2023	Obata	H01R 12/7005
2014/0134890	A1 *	5/2014	Kobayashi	H01R 12/712 439/691
2017/0170588	A1	6/2017	Doi	

OTHER PUBLICATIONS

Japanese Office Action (JPOA) mailed on Jun. 3, 2025 for the Japanese Patent Application No. 2022-015585 with its English machine translation.

* cited by examiner

FIG. 1

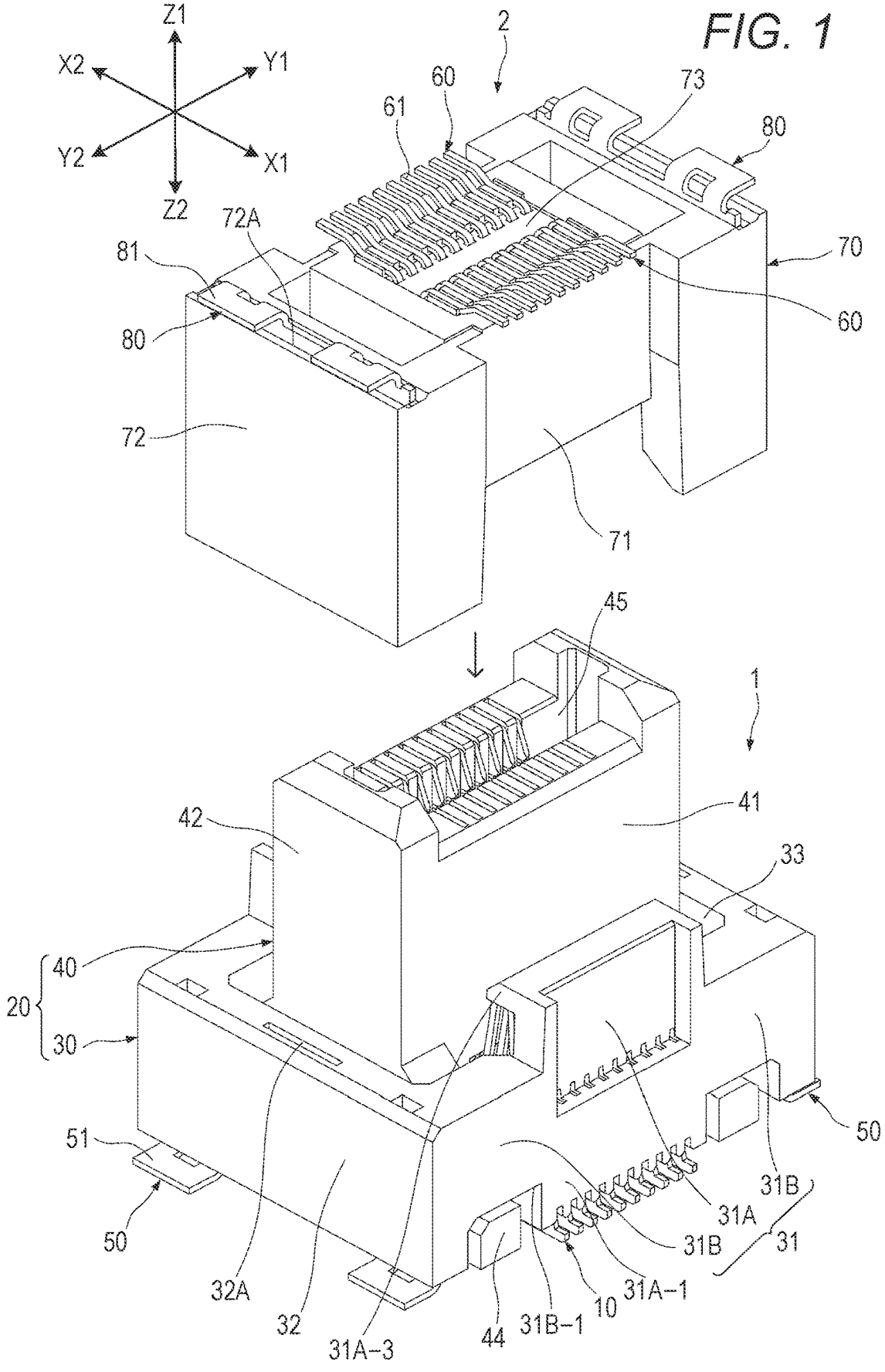

Z1
X2
Y1
Y2
X1
Z2
2
60
61
73
80
72A
81
70
80
60
72
71
45
1
42
41
33
40
20
30
51
50
50
31B
31A
31B
31
32A
31A-1
10
32
31A-3
44
31B-1

FIG. 2

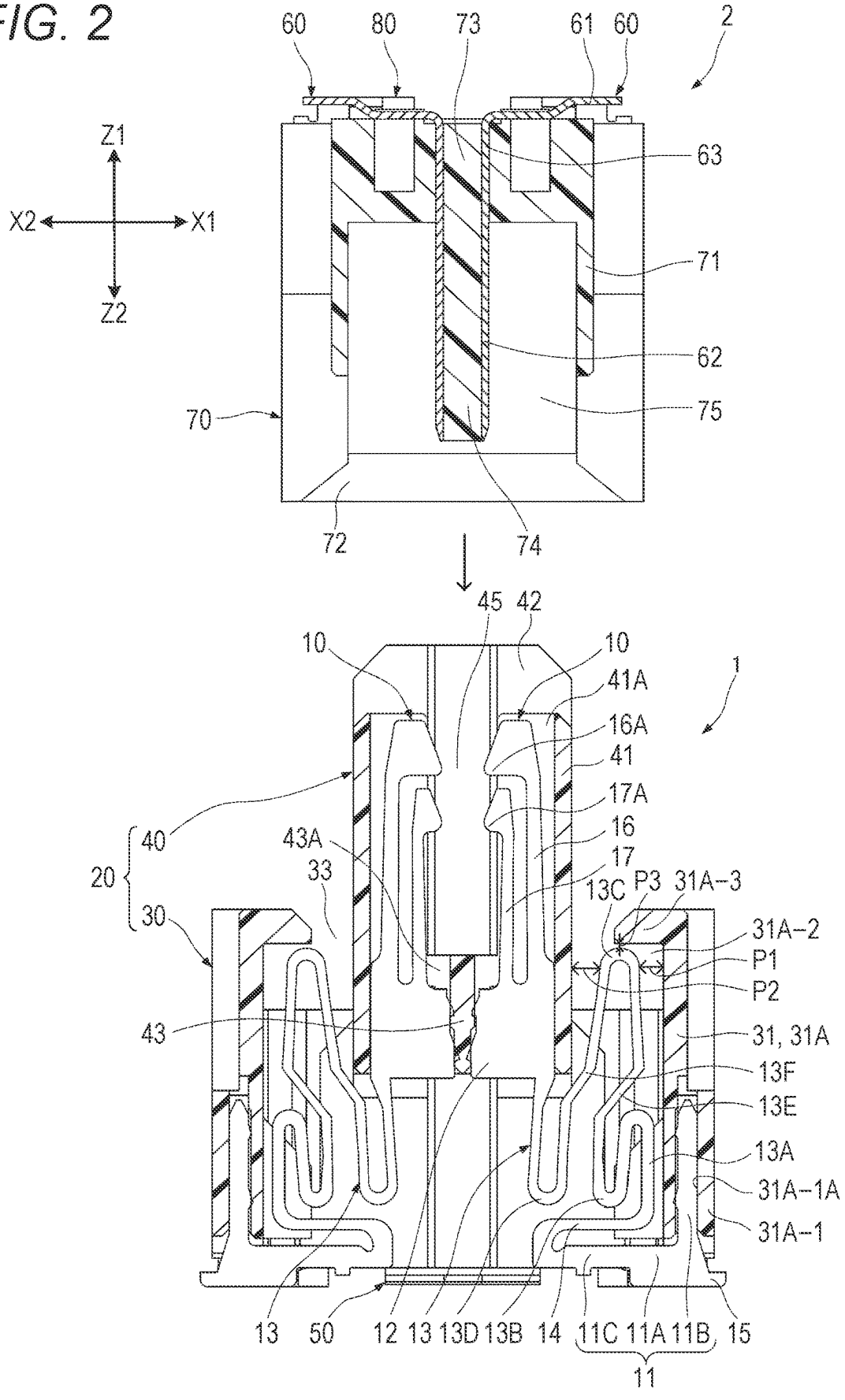

60
80
73
61
60
2
Z1
X2
X1
Z2
63
71
62
75
70
72
74
45
42
10
10
41A
1
16A
41
17A
16
17
40
20
30
43A
33
13C
P3
31A-3
31A-2
P1
P2
43
31, 31A
13F
13E
13A
31A-1A
31A-1
13
50
12
13
13D
13B
14
11C
11A
11B
15
11

FIG. 3

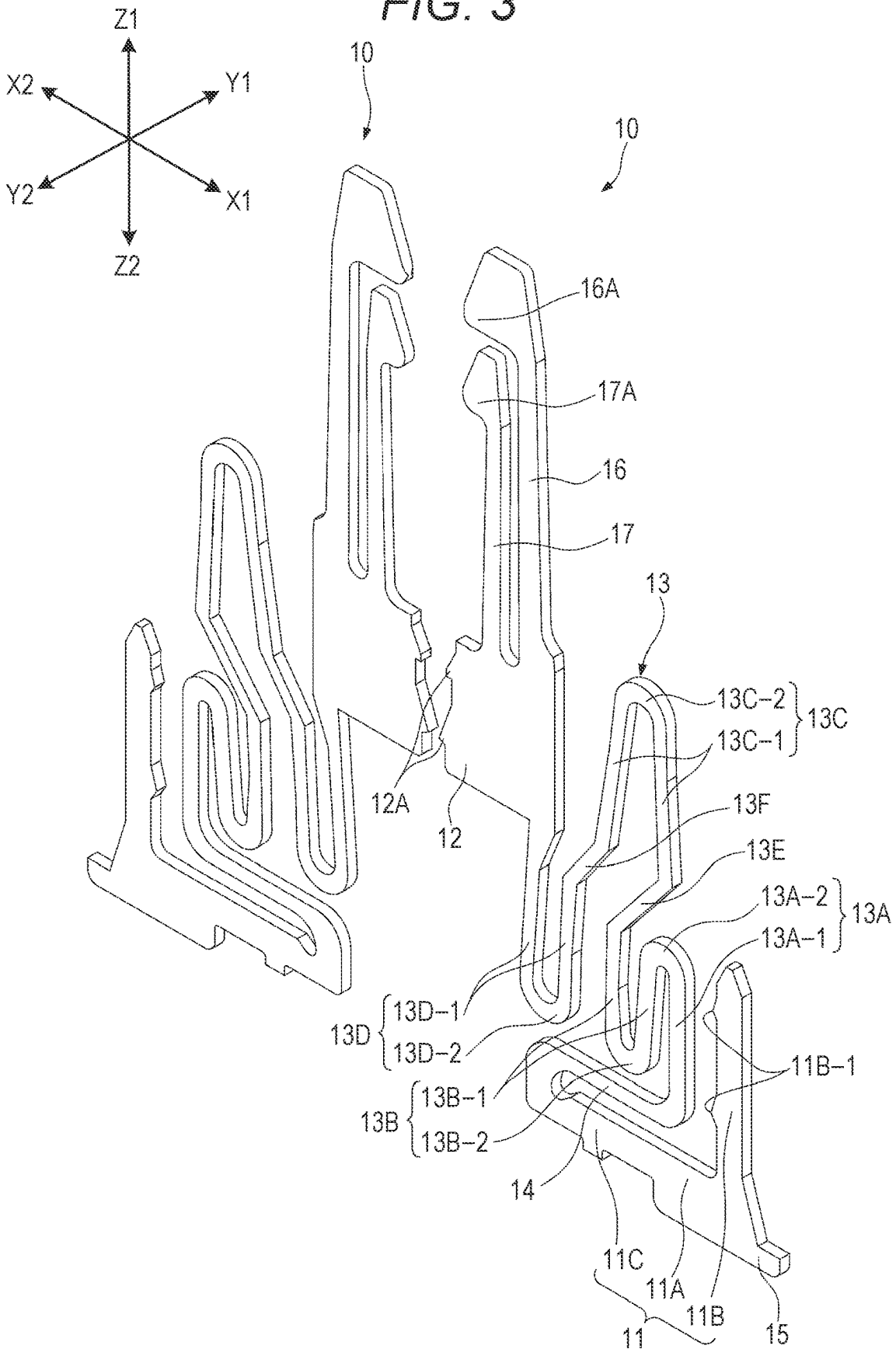

Z1
X2
Y1
Y2
X1
Z2
10
10
16A
17A
16
17
13
13C-2
13C
13C-1
12A
12
13F
13E
13A-2
13A
13A-1
13D
13D-1
13D-2
11B-1
13B
13B-1
13B-2
14
11C
11A
11B
11
15

FIG. 4

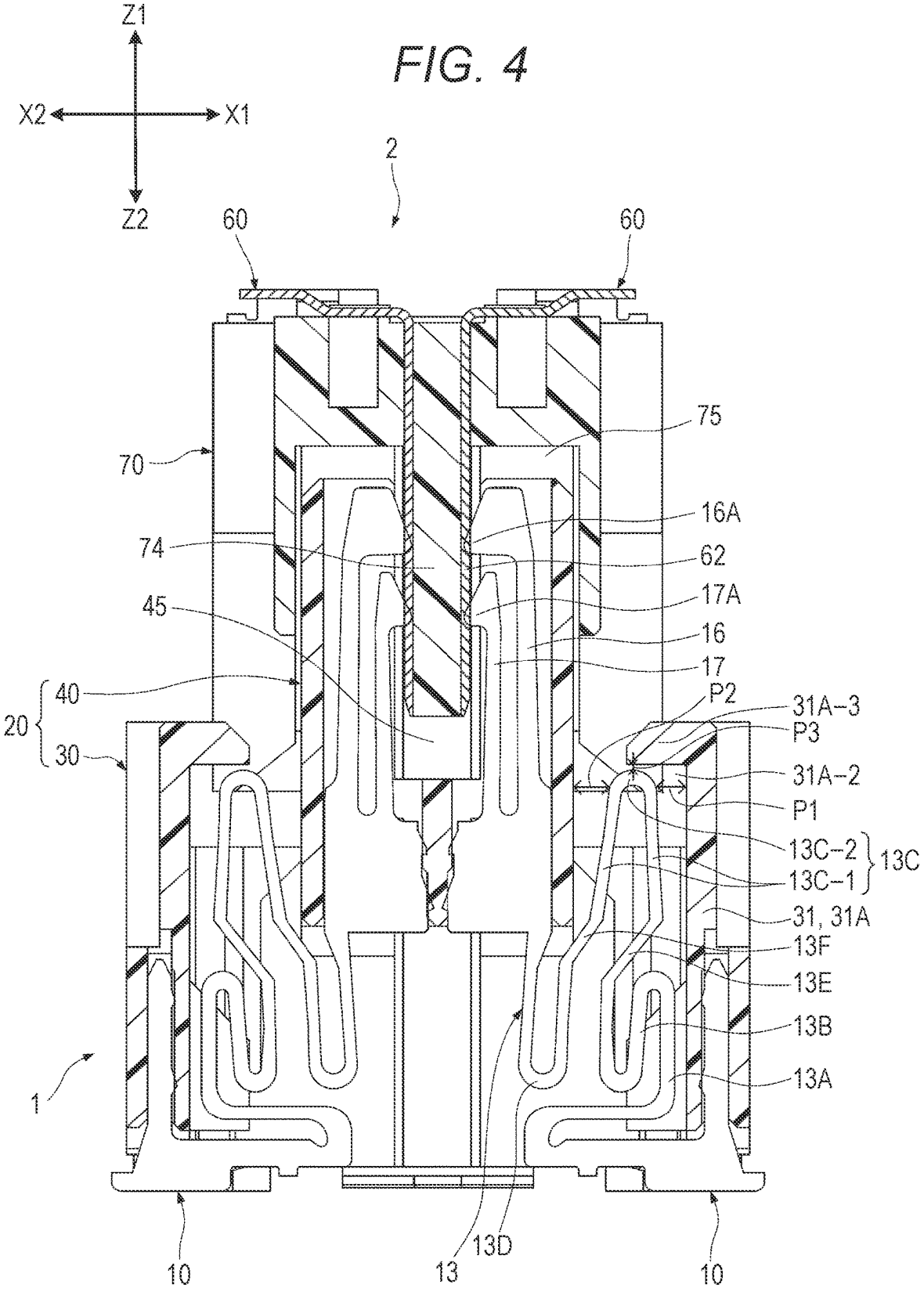

Z1
X2
X1
Z2
2
60
60
75
70
16A
74
62
17A
45
16
17
20
40
30
P2
31A-3
P3
31A-2
P1
13C-2
13C
13C-1
31, 31A
13F
13E
13B
13A
1
10
13
13D
10

FIG. 5

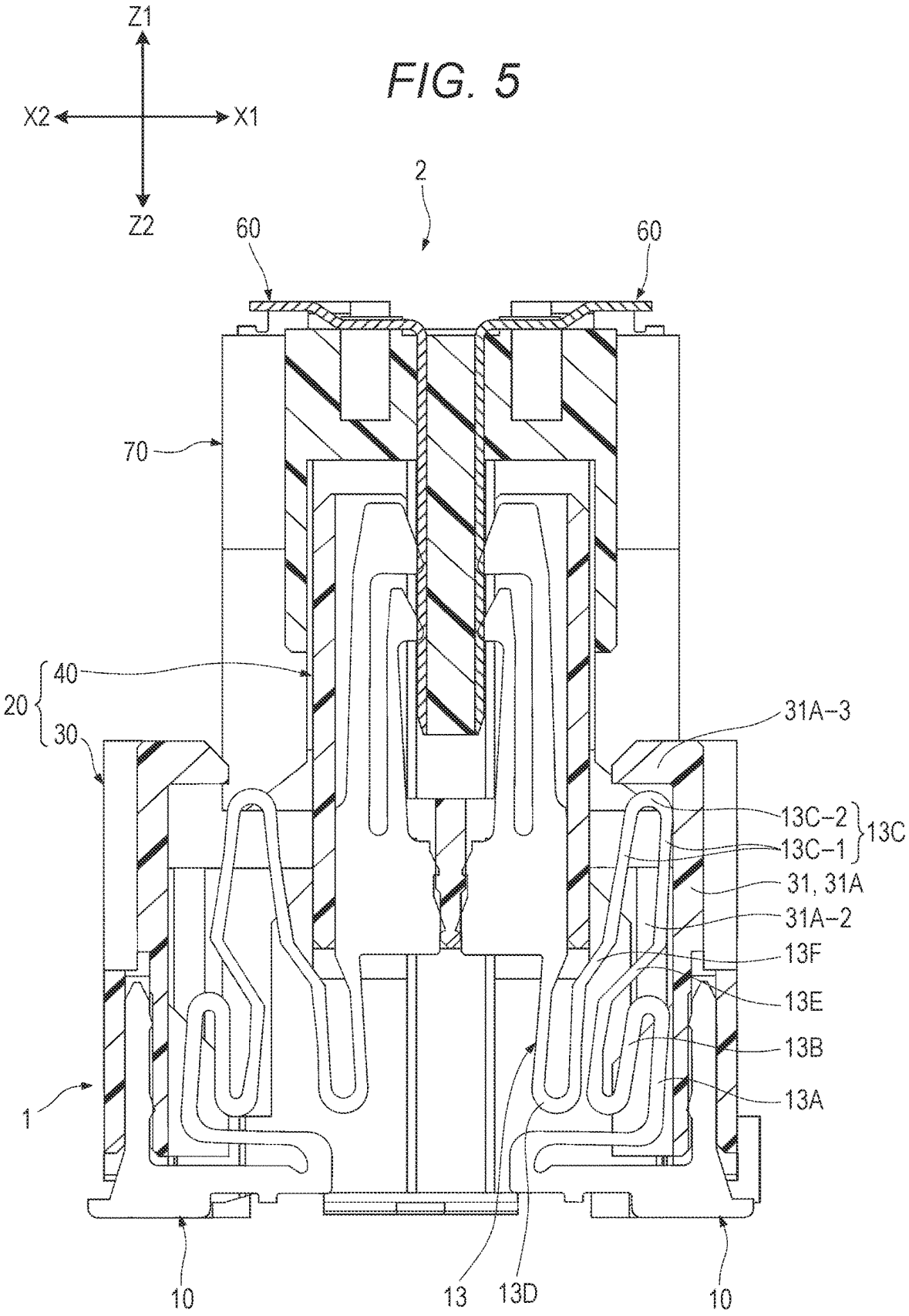

Z1
X2
X1
Z2
2
60
60
70
20
40
30
31A-3
13C-2
13C-1
13C
31, 31A
31A-2
13F
13E
13B
13A
1
10
13
13D
10

FIG. 6

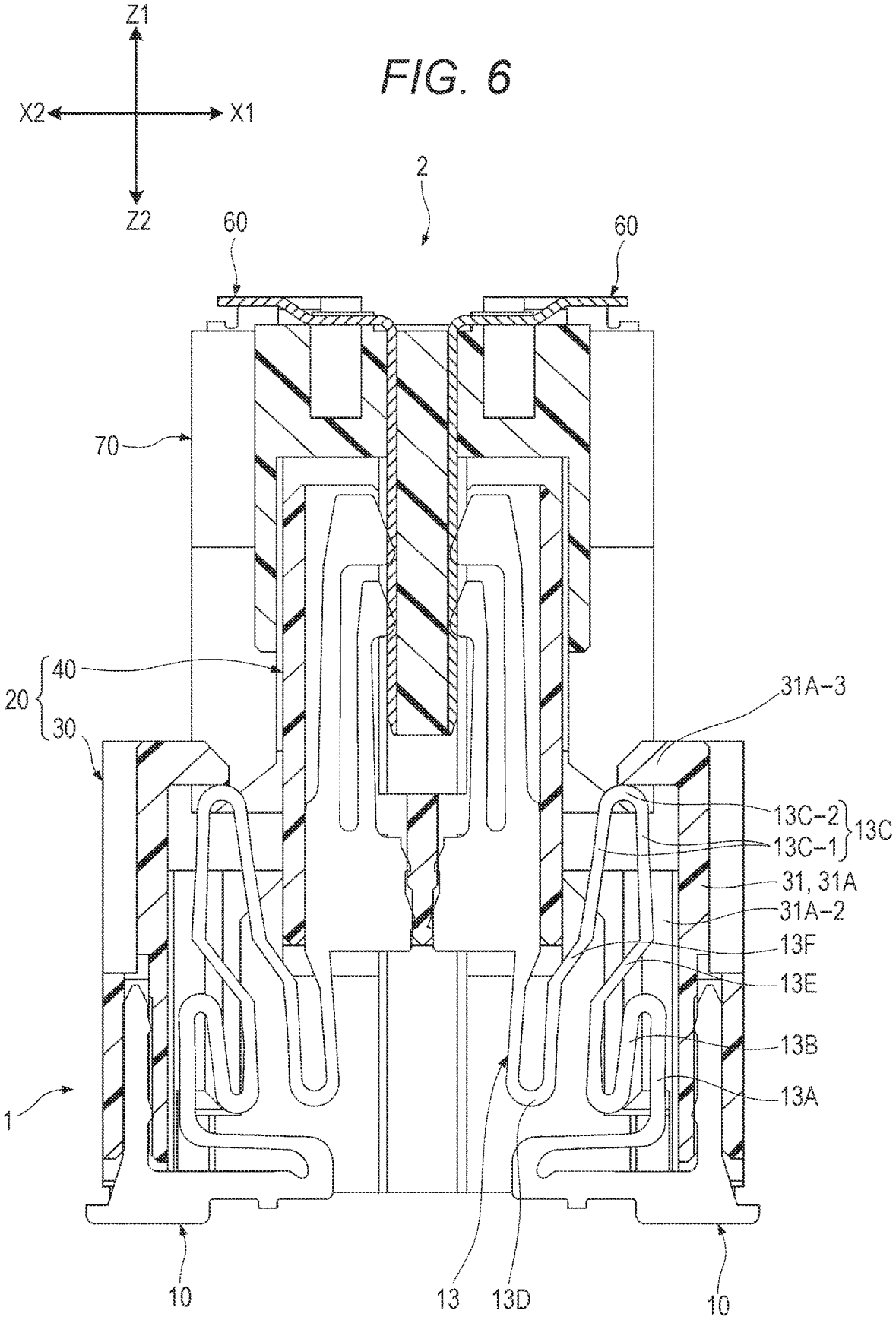
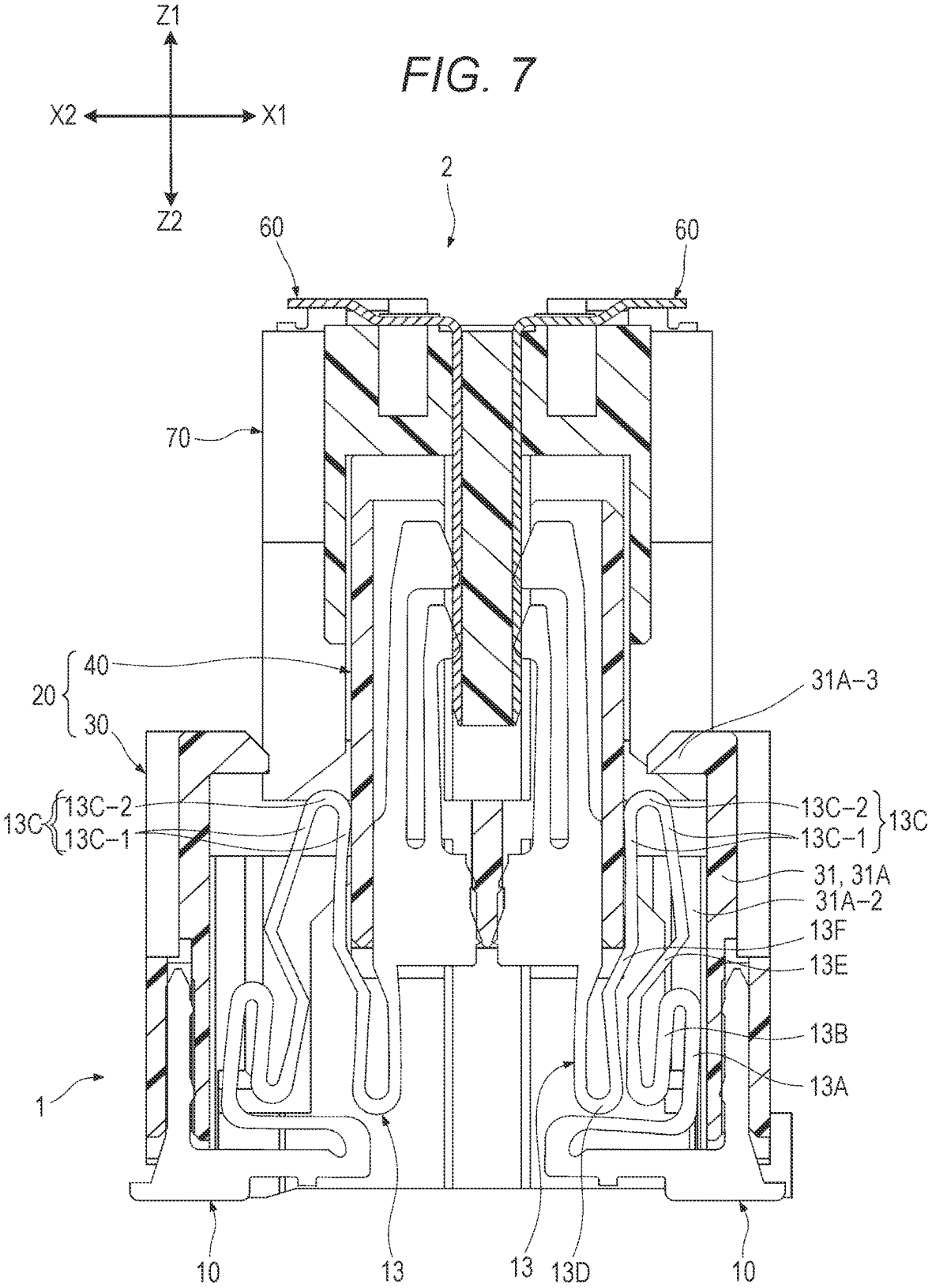

Z1
X2
X1
Z2
2
60
60
70
20
40
30
31A-3
13C-2
13C-1
13C
31, 31A
31A-2
13F
13E
13B
13A
1
10
13
13D
10

FIG. 7


Z1
X2
X1
Z2
2
60
60
70
20
40
30
31A-3
13C
13C-2
13C-1
13C-2
13C-1
13C
31, 31A
31A-2
13F
13E
13B
13A
1
10
13
13
13D
10

CIRCUIT BOARD ELECTRICAL CONNECTOR

CROSS-REFERENCE TO RELATED APPLICATION

This application claims priority from Japanese Patent Application No. 2020-015585 filed with the Japan Patent Office on Feb. 3, 2022, the entire content of which is hereby incorporated by reference.

BACKGROUND

1. Technical Field

One aspect of the present disclosure relates to a circuit board electrical connectors.

2. Related Art

Japanese Patent No. 6438382, for example, discloses a so-called floating connector as a circuit board electrical connector disposed on a circuit board. A floating connector has a plurality of terminals, a fixed housing fixed to a circuit board via the terminals, and a movable housing relatively movable with respect to the fixed housing. Terminals are provided to be bridged between the fixed housing and the movable housing.

In the floating connector of Japanese Patent No. 6438382, terminals are formed by punching a metal plate member in the plate thickness direction. The terminals are divided into a fixed side column portion held by the fixed housing at one end side, a movable side column portion held by the movable housing at the other end side, and an elastic portion capable of elastic deformation positioned between the fixed side column portion and the movable side column portion The elastic portion includes three wavy portions having bending direction repeatedly reversed along the vertical direction, specifically, two inverted U-shaped wavy portions convexly curved upward, and one U-shaped wavy portion convexly curved downward between the two inverted U-shaped sections. The overall shape of the elastic portion is substantially M-shaped (see FIG. **3** (B), FIG. **5**, and the like of Japanese Patent No. 6438382). In the elastic portion, two leg portions of each wavy portion are displaced by widening or narrowing in the connector width direction (horizontal direction in FIG. **3** (B) and FIG. **5** of Japanese Patent No. 6438382), and is elastically deformed in the connector width direction. This realizes favorable floating in the connector width direction.

SUMMARY

A circuit board electrical connector includes: plurality of terminals; fixed housing fixed to a circuit board via the terminals; and a movable housing relatively movable with respect to the fixed housing, in which the terminals are provided to be bridged between the fixed housing and the movable housing, the terminals include fixed side held portion held by the fixed housing, a movable side held portion positioned on an inner side in a connector width direction than the fixed side held portion and held by the movable housing, and an elastically deformable intermediate portion positioned between the fixed side held portion and the movable side held portion, the intermediate portion includes a plurality of elastic portions reversed by repeating a bending direction in a connector height direction, and the specific elastic portion of the plurality of elastic portions is positioned to be different in the connector height direction from another elastic portion and positioned to have a range overlapping in the connector width direction.

BRIEF DESCRIPTION OF DRAWINGS

FIG. **1** is a perspective view of a receptacle connector and a plug connector according to an embodiment of the present disclosure, illustrating a state before mating connection of both connectors;

FIG. **2** is a cross-sectional view illustrating a cross section of the receptacle connector and the plug connector of FIG. **1** taken along a plane perpendicular to a terminal arrangement direction, illustrating a state before the mating connection of the both connectors;

FIG. **3** is a perspective view of a receptacle terminal of the receptacle connector of FIG. **1**;

FIG. **4** is a cross-sectional view illustrating the cross section of the receptacle connector and the plug connector of FIG. **1** taken along the plane perpendicular to the terminal arrangement direction, illustrating a mating connection state of the both connectors;

FIG. **5** is a cross-sectional view illustrating the cross section of the receptacle connector and the plug connector of FIG. **1** taken along the plane perpendicular to the terminal arrangement direction, FIG. **5** illustrates a state in which floating occurs in a connector width direction due to vibration received during use of a connector;

FIG. **6** is a cross-sectional view illustrating the cross section of the receptacle connector and the plug connector of FIG. **1** taken along the plane perpendicular to the terminal arrangement direction, FIG. **6** illustrates a state in which floating occurs in a connector height direction due to vibration received during use of a connector; and

FIG. **7** is a cross-sectional view illustrating the cross section of the receptacle connector and the plug connector of FIG. **1** taken along the plane perpendicular to the terminal arrangement direction, FIG. **7** illustrates a state in which floating occurs in the connector width direction at a time when the mating connection of a connector is completed.

DETAILED DESCRIPTION

In the following detailed description, for purpose of explanation, numerous specific details are set forth in order to provide a thorough understanding of the disclosed embodiments. It will be apparent, however, that one or more embodiments may be practiced without these specific details. In other instances, well-known structures and devices are schematically shown in order to simplify the drawing.

In general, it is preferable that a sufficiently large amount of floating is ensured in a floating connector mounted on a circuit board. For that purpose, it is preferable to increase the length of the elastic portion of the terminal, that is, the spring length. In addition, connectors are often required to be miniaturized, for example, miniaturized in the connector width direction. In the floating connector of Japanese Patent No. 6438382, as described above, the overall shape of the elastic portion of the terminal is substantially M-shaped, and all the wavy portions (three wavy portions described above) are positioned to be different from each other in the connector width direction. Therefore, if the number of wavy portions in the elastic portion of the terminal is increased in order to ensure a larger floating amount, the entire elastic portion becomes larger in the connector width direction. As

a result, there is a possibility that the size of the connector is increased in the connector width direction. In this respect, the floating connector of Japanese Patent No. 6438382 has room for improvement.

One object of the present disclosure is to provide a circuit board electrical connector that can easily avoid an increase in size in the connector width direction and can ensure a sufficiently large spring length of a terminal.

A circuit board electrical connector according to an aspect of the present disclosure (the circuit board electrical connector) includes: plurality of terminals; fixed housing fixed to a circuit board via the terminals; and a movable housing relatively movable with respect to the fixed housing, in which the terminals are provided to be bridged between the fixed housing and the movable housing.

In the circuit board electrical connector, the terminals include fixed side held portion held by the fixed housing, a movable side held portion positioned on an inner side in a connector width direction than the fixed side held portion and held by the movable housing, and an elastically deformable intermediate portion positioned between the fixed side held portion and the movable side held portion, the intermediate portion includes a plurality of elastic portions reversed by repeating a bending direction in a connector height direction, and the specific elastic portion of the plurality of elastic portions is positioned to be different in the connector height direction from another elastic portion and positioned to have a range overlapping in the connector width direction.

In the circuit board electrical connector, a specific elastic portion of the plurality of elastic portions provided in the intermediate portion of the terminal is positioned to be different in the connector height direction from another elastic portion and positioned to have a range overlapping in the connector width direction. Therefore, even in a case where the number of elastic portions in the intermediate portion of the terminal is increased and the spring length of the intermediate portion is increased, at least parts of the intermediate portion are overlapped and positioned in the connector width direction. Therefore, compared with the case where all the elastic portions are positioned differently without overlapping as in the typical art, it is easier to avoid an increase in the size of the intermediate portion of the terminal in the connector width direction and thus an increase in the size of the connector.

In the circuit board electrical connector, the plurality of elastic portions may include at least one movable side elastic portion that is an elastic portion positioned between the specific elastic portion and the movable side held portion besides the specific elastic portion, and the at least one movable side elastic portion may be positioned to have a range that overlaps with the movable side held portion in the connector width direction. In this configuration, at least one movable side elastic portion is positioned to have a range that overlaps with the movable side held portion in the connector width direction. As a result, it is possible to ensure a sufficient spring length of the intermediate portion while avoiding an increase in the size of the connector in the connector width direction.

In the circuit board electrical connector, the plurality of elastic portions may include a movable side elastic portion that is an elastic portion positioned between the specific elastic portion and the movable side held portion besides the specific elastic portion, and a fixed side elastic portion that is an elastic portion positioned on a side of the fixed side held portion than the specific elastic portion, the specific elastic portion may be coupled to the movable side elastic portion via a movable side inclined portion and coupled to the fixed side elastic portion via a fixed side inclined portion, and the movable side inclined portion and the fixed side inclined portion may be inclined toward a same side in the connector width direction.

In this configuration, the movable side inclined portion and the fixed side inclined portion that are inclined toward the same side in the connector width direction are provided between the specific elastic portion, and the movable side elastic portion and the fixed side elastic portion. As a result, the elastic portion is positioned on the side where the movable side inclined portion and the fixed side inclined portion are inclined without being largely inclined. Thus, stress generated in the specific portion can be dispersed favorably when the specific elastic portion is elastically deformed in the connector width direction.

In the circuit board electrical connector, the specific elastic portion may include a shape bent on a side away from the circuit board in the connector height direction, and positioned on an outer side in the connector width direction with respect to the movable side held portion, and positioned to have a range that overlaps in the connector height direction. In this configuration, the specific elastic portion is positioned to have a range that overlaps with the movable side held portion in the connector height direction. As a result, it is possible to avoid an increase in size of the connector not only in the connector width direction but also in the connector height direction.

In the circuit board electrical connector, the terminals may further include an arm portion positioned between the intermediate portion and the fixed side held portion, and the arm portion may extend along the connector width direction to be continuous with the intermediate portion, and elastically deformable in the connector height direction. In this configuration, the terminals are provided with the arm portion elastically deformable in the connector height direction. As a result, it is possible to improve the floating function in the connector height direction. In addition, the arm portion extends in the connector width direction. Therefore, increase in size of the terminal and thus the size of the connector in the connector height direction is minimized.

According to the above aspect of the present disclosure, it possible to provide a circuit board electrical connector that can easily avoid an increase in size in the connector width direction and can ensure a sufficiently large spring length of a terminal.

Hereinafter, an embodiment of the present disclosure will be described below based on the accompanying drawings.

FIG. **1** is a perspective view of a receptacle connector **1** and a plug connector **2** according to the present embodiment, illustrating a state before mating connection of both connectors. The receptacle connector **1** is a circuit board electrical connector mounted on a mounting surface of a circuit board (not illustrated). In addition, the plug connector **2** as a mating connection body (mating connector) of the receptacle connector **1** is a circuit board electrical connector mounted on a mounting surface of another circuit board (not illustrated). The receptacle connector **1** and the plug connector **2** are mated and connected in a posture in which the mounting surfaces of the circuit board are parallel to each other and in a connector height direction (vertical direction illustrated as the Z-axis direction) perpendicular to the mounting surfaces. Thus, the electrical connector assembly is constituted. In the present embodiment, the plug connector **2** is mated and connected to the receptacle connector **1** from above.

The receptacle connector **1** includes a plurality of metal plate receptacle terminals **10**, a receptacle housing **20** made of an electrical insulating material (for example, made of resin), and a metal receptacle fixing bracket **50**. The plurality of receptacle terminals **10** is arranged with one direction (Y-axis direction) parallel to the mounting surface of the circuit board as the terminal arrangement direction. The receptacle housing **20** holds the plurality of receptacle terminals **10**. The receptacle fixing brackets **50** are held at both end portions of the receptacle housing **20** in the terminal arrangement direction.

FIG. **2** is a cross-sectional view illustrating a cross section of the receptacle connector **1** and the plug connector **2** before the mating connection taken along a plane perpendicular to the terminal arrangement direction, illustrating a cross section at a position of the receptacle terminal **10**. The receptacle terminals **10** are arranged in two rows. The two rows of receptacle terminals **10** face each other in a direction symmetrical in the connector width direction (X-axis direction) perpendicular to both the terminal arrangement direction (Y-axis direction) and the vertical direction (Z-axis direction). As illustrated in FIG. **2**, the receptacle housing **20** includes a fixed housing **30** fixed to a circuit board (not illustrated) via the receptacle terminal **10** and a movable housing **40** relatively movable with respect to the fixed housing **30**. The receptacle terminals **10** are provided to be bridged between the fixed housing **30** and the movable housing **40**.

FIG. **3** is a perspective view illustrating two receptacle terminals **10** facing each other in the connector width direction. As illustrated in FIGS. **2** and **3**, the receptacle terminal **10** is a female terminal made by punching a metal plate member in the wall thickness direction while maintaining its flat surface. The receptacle terminal **10** includes a fixed side held portion **11** held by the fixed housing **30**, a movable side held portion **12** held by the movable housing **40**, an intermediate portion **13**, a lateral arm portion **14** (arm portion), a connecting portion **15**, an outer contact arm portion **16**, and an inner contact arm portion **17**. The intermediate portion **13** is positioned between the fixed side held portion **11** and the movable side held portion **12** and is elastically deformable. The lateral arm portion **14** (arm portion) is positioned between the fixed side held portion **11** and the intermediate portion **13** and is elastically deformable. The connecting portion **15** extends from the fixed side held portion **11** and is solder-connected to the circuit board. The outer contact arm portion **16** and the inner contact arm portion **17** extend from the movable side held portion **12** and come into contact with the plug connector **2**.

Prior to further description of the receptacle terminal **10**, configurations of the fixed housing **30** and the movable housing **40** will be described based on FIGS. **1** and **2**. As illustrated in FIG. **1**, the fixed housing **30** includes a pair of side walls **31** extending in the terminal arrangement direction (Y-axis direction), and a pair of end walls **32** extending in the connector width direction (X-axis direction) and coupling the end portions of the pair of side walls **31**. The fixed housing **30** forms peripheral walls with the pair of side walls **31** and the pair of end walls **32**. The space surrounded by the peripheral wall and penetrating the vertical direction forms a central space **33** that accommodates a part of the movable housing **40** from below (see also FIG. **2**).

As illustrated in FIG. **1**, in the side wall **31**, a side wall central portion **31**A that is positioned in the central region in the terminal arrangement direction is formed to protrude upward than a side wall end portion **31**B positioned in both end regions. This side wall central portion **31**A arranges and holds the receptacle terminals **10**. As illustrated in FIG. **2**, the side wall central portion **31**A is provided to overlap the entire intermediate portion **13** of the receptacle terminal **10** in the vertical direction. A lower portion of the side wall central portion **31**A forms a terminal holding portion **31**A-**1** for holding the receptacle terminal **10**. Specifically, a terminal holding hole portion **31**A-**1**A extending in the vertical direction is formed penetrating through the terminal holding portion **31**A-**1**. The terminal holding portion **31**A-**1** is configured to hold a held arm portion **11**B, which will be described later, of the receptacle terminal **10** press-fit from below by the terminal holding hole portion **31**A-**1**A.

In addition, as illustrated in FIG. **2**, the side wall central portion **31**A is formed in a manner that a fixed side accommodating portion **31**A-**2** for accommodating a part of the intermediate portion **13** of the receptacle terminal **10** is recessed from the inner surface of the side wall central portion **31**A (a surface perpendicular to the connector width direction) and extends over the entire region of the side wall central portion **31**A in the terminal arrangement direction. The fixed side accommodating portion **31**A-**2** extends in the vertical direction within a range from the position near the upper end of the side wall **31** to the lower end in the vertical direction. In addition, a top wall **31**A-**3** is formed on the upper portion of the side wall central portion **31**A. The top wall **31**A-**3** projects inward in the connector width direction from the inner wall surface of the side wall central portion **31**A and closes the upper end of the fixed side accommodating portion **31**A-**2**. In other words, the inner surface of the side wall central portion **31**A (the surface perpendicular to the connector width direction) forms the side inner wall surface of the fixed side accommodating portion **31**A-**2**. Furthermore, the lower surface of the top wall **31**A-**3** (the surface perpendicular to the vertical direction) forms the upper inner wall surface of the fixed side accommodating portion **31**A-**2**. Note that the lower end of the fixed side accommodating portion **31**A-**2** is opened.

As illustrated in FIG. **2**, the top wall **31**A-**3** is provided to have a range that overlaps with a part of the intermediate portion **13** of the receptacle terminal **10** in the connector width direction. Specifically, the top wall **31**A-**3** has a range that overlaps with the entire portion of a first elastic portion **13**A, a part of a second elastic portion **13**B (an outer portion in the connector width direction), and a part of a third elastic portion **13**C (an outer portion in the connector width direction), and the entire portion of a fixed side inclined portion **13**E, which will be described later.

As illustrated in FIG. **1**, in the side wall end portion **31**B, a restriction concave portion **31**B-**1** that restricts the upward movement of the movable housing **40** is formed to be recessed from the lower surface of the side wall end portion **31**B and penetrate in the connector width direction (wall thickness direction of side wall end portion **31**B). As illustrated in FIG. **1**, the restriction concave portion **31**B-**1** accommodates a restricted portion **44** of the movable housing **40**, which will be described later, from below. The restricting concave portion **31**B-**1** restricts the upward movement of the restricted portion **44** by positioning its upper inner wall surface to be able to abut on the upper surface of the restricted portion **44**.

In the end wall **32**, as illustrated in FIG. **1**, an end groove portion **32**A is formed in a slit shape extending perpendicularly to the terminal arrangement direction. This end groove portion **32**A accommodates and press-fits and holds a part of the receptacle fixing bracket **50**.

The movable housing **40** disposed by being inserted into the central space **33** of the fixed housing **30** from below. As

can be seen in FIG. **1**, the majority of the movable housing **40**, excluding the upper half portion and the restricted portion **44**, which will be described later, is accommodated in the central space **33** (see also FIG. **2**). The movable housing **40** includes a pair of long walls **41** extending in the terminal arrangement direction, a pair of short walls **42**, a bottom wall **43** (see FIG. **2**), and the restricted portion **44**. The pair of short walls **42** extends in the connector width direction and couples the end portions of the pair of long walls **41**. The bottom wall **43** closes the space surrounded by the peripheral walls including the pair of long walls **41** and the pair of short walls **42** from below. The restricted portion **44** extends outward in the connector width direction from the lower portion of the short wall **42**. The space surrounded by the peripheral wall and opened upward forms a receiving portion **45** for receiving a part of the plug connector **2**.

As illustrated in FIG. **2**, the portion accommodated in the central space **33** in the movable housing **40** includes a part of the intermediate portion **13** of the receptacle terminal **10** in the vertical direction, specifically, a range overlapping with the entire portion of the third elastic portion **13**C, which will be described later.

In the long wall **41**, as illustrated in FIG. **2**, a movable side accommodating portion **41**A recessed from the inner wall surface over the entire region in the vertical direction is arranged and formed. The movable side accommodating portion **41**A accommodates the outer contact arm portion **16** and the inner contact arm portion **17** of the receptacle terminal **10**.

As illustrated in FIG. **2**, the bottom wall **43** is positioned in the space of the upper half portion of the central space **33** of the fixed housing **30**. In the bottom wall **43**, a bottom groove portion **43**A for accommodating and press-fitting and holding the movable side held portion **12** of the receptacle terminal **10** from below is arranged and formed in the terminal arrangement direction. As illustrated in FIG. **2**, the bottom groove portion **43**A has a slit shape extending perpendicularly to the terminal arrangement direction. The bottom groove portion **43**A penetrates the bottom wall **43** in the vertical direction and communicates with the movable housing portion **41**A.

The restricted portion **44** extends outward in the connector width direction from the outer surface of the lower portion of the short wall **42** (the surface perpendicular to the connector width direction). The distal end portion of the restricted portion **44** is accommodated in the restriction concave portion **31**B-**1** of the fixed housing **30**, and positioned to have a gap in the vertical direction and the terminal arrangement direction with respect to the inner wall surface of the restriction concave portion **31**B-**1**. Therefore, the restricted portion **44** and the movable housing **40** are movable in the vertical direction and the terminal arrangement direction within the range of the gap, and the restricted portion **44** abuts on the inner wall surface of the restriction concave portion **31**B-**1**. Thus, further movement is restricted.

Description will go back to the receptacle terminal **10**. As illustrated in FIGS. **2** and **3**, the fixed side held portion **11** of the receptacle terminal **10** includes a base portion **11**A positioned in the lower portion of the fixed housing **30**, the held arm portion **1113** extending upward from the base portion **11**A, and an extended portion **11**C extending inwardly in the connector width direction from the base portion **11**A. The held arm portion **11**B extends in a straight shape within the terminal holding hole portion **31**A-**1**A of the fixed housing **30** from the position of the base portion **11**A that is closer to the outer side in the connector width direction. As illustrated in FIG. **3**, the held arm portion **11**B includes a plurality of press-fit protrusions **11**B-**1** on the inner edge (the edge extending in the vertical direction) in the connector width direction. The held arm portion **11**B is press-fit and held in the terminal holding hole portion **31**A-**1**A by the press-fit protrusions **11**B-**1**. The extending portion **11**C extends in a straight shape from the base portion **11**A inward in the connector width direction. As illustrated in FIG. **2**, the extending portion **11**C is positioned to have a gap between it and the mounting surface (upper surface) of the circuit board (not illustrated) in the vertical direction.

As illustrated in FIGS. **2** and **3**, the lateral arm portion **14** extends along the upper edge of the fixed side held portion **11** from the distal end portion of the extended portion **11**C (the inner side end portion in the connector width direction) and extends straight outward in the connector width direction. The lateral arm portion **14** is positioned directly below the intermediate portion **13**. The lateral arm portion **14** is positioned to have a gap between it and the fixed side held portion **11** in the vertical direction. The lateral arm portion **14** is elastically deformable in the vertical direction within the range of the gap, with its base end portion, that is, the portion coupled to the distal end portion of the extended portion **11**C as a fulcrum.

Thus, by providing the receptacle terminal **10** in the lateral arm portion **14** elastically deformable in the vertical direction, the floating function in the vertical direction can be improved. The lateral arm portion **14** extends in the connector width direction. Therefore, increase in size of the receptacle terminal **10** and thus the receptacle connector **1** in the vertical direction by providing the lateral arm portion **14** is minimized. In addition, the lateral arm portion **14** is positioned within the range of the intermediate portion **13** in the connector width direction. As a result, an increase in the size of the receptacle terminal **10** and thus the receptacle connector **1** in the connector width direction is avoided. It should be noted that providing the lateral arm portion **14** is not necessary in a case where a sufficiently large amount of elastic deformation in the vertical direction can be ensured in the intermediate portion **13**.

The connecting portion **15** extends in the connector width direction continuously to the lower portion of the base portion **11**A of the fixed side held portion **11**. As illustrated in FIG. **2**, the distal end of the connecting portion **15** extends outside the fixed housing **30**. The connecting portion **15** is solder-connected to the corresponding circuit portion on the mounting surface of the circuit board at its lower end.

The movable side held portion **12** is held by the bottom wall **43** of the movable housing **40**, as illustrated in FIG. **2**. As illustrated in FIG. **3**, the movable side held portion **12** includes a plurality of press-fit protrusions **12**A on the inner edge (the edge extending in the vertical direction) in the connector width direction. The movable side held portion **12** is press-fit and held from below in the bottom groove portion **43**A of the bottom wall **43** by the press-fit protrusions **12**A.

As illustrated in FIG. **2**, the outer contact arm portion **16** extends straight upward from the position of the movable side held portion **12** that is closer to the outer side in the connector width direction into the movable side accommodating portion **41**A of the movable housing **40**. At the upper end portion of the outer contact arm portion **16**, as illustrated in FIGS. **2** and **3**, an upper contact portion **16**A for contacting a plug terminal **60** (see FIG. **2**) of the plug connector **2** is provided. It is formed to protrude toward the inner side in the connector width direction. As illustrated in FIG. **2**, the inner contact arm portion **17** is positioned on the inner side than the outer contact arm portion **16** in the connector width

direction. The inner contact arm portion **17** extends straight upward from the movable side held portion **12** in the movable side accommodating portion **41**A of the movable housing **40**. The inner contact arm portion **17** is shorter than the outer contact arm portion **16**, as illustrated in FIGS. **2** and **3**. The upper end portion of the inner contact arm portion **17** is positioned directly below the upper contact portion **16**A of the outer contact arm portion **16**. At the upper end portion of the inner contact arm portion **17**, the lower contact portion **17**A for contact with the plug terminal **60** of the plug connector **2** is formed to protrude inward in the connector width direction.

Hereinafter, in a case where the outer contact arm portion **16** and the inner contact arm portion **17** need not be distinguished specifically, they are collectively referred to as "contact arm portions **16** and **17**". In addition, in a case where the upper contact portion **16**A and the lower contact portion **17**A need not be distinguished specifically, they are collectively referred to as "contact portions **16**A and **17**A".

As illustrated in FIG. **2**, when the contact arm portions **16** and **17** are in the free state, the protruding ends of the contact portions **16**A and **17**A protrude from the movable side accommodating portion **41**A and are positioned within the receiving portion **45**. Then, when the plug connector **2** is mated and connected to the receptacle connector **1**, the protruding ends of the contact portions **16**A and **17**A receive the pressing force from the plug terminal **60**. As a result, the contact arm portions **16** and **17** are elastically deformed outward in the connector width direction.

As illustrated in FIGS. **2** and **3**, the intermediate portion **13** includes four elastic portions that are positioned between the lateral arm portion **14** and the movable side held portion **12** and reversed by repeating the bending direction in the vertical direction (Z-axis direction). As a result, the intermediate portion **13** is elastically deformable in the connector width direction, the terminal arrangement direction, and the vertical direction. Specifically, the intermediate portion **13** has the first elastic portion **13**A, the second elastic portion **13**B (fixed side elastic portion), and the third elastic portion **13**C (specific elastic portion), and a fourth elastic portion **13**D (movable side elastic portion) from the lateral arm portion **14** side toward the movable side held portion **12** side in this order. In addition, as illustrated in FIGS. **2** and **3**, the third elastic portion **13**C is coupled to the second elastic portion **13**B via the fixed side inclined portion **13**E, and is coupled to the fourth elastic portion **13**D via a movable side inclined portion **13**F.

As illustrated in FIG. **3**, the first elastic portion **13**A has an inverted J shape as a whole. The first elastic portion **13**A includes a first straight portion **13**A-**1** that is extending straight upward from the end portion of the lateral arm portion **14** (the outer end portion in the connector width direction) and a first bent portion **13**A-**2** that is bent inward and downward in the connector width direction from the upper end of the straight portion **13**A-**1**. The first elastic portion **13**A is elastically deformable in the connector width direction with the lower end portion of the first straight portion **13**A-**1** as a fulcrum.

As illustrated in FIG. **2**, the first elastic portion **13**A is provided below the bottom surface of the bottom wall **43** of the movable housing. The first elastic portion **13**A is accommodated in the fixed side accommodating portion **31**A-**2** of the fixed housing **30**. In addition, the first elastic portion **13**A is positioned to have a gap in the connector width direction between the first elastic portion **13**A and the side inner wall surface (the wall surface perpendicular to the connector width direction) of the fixed side accommodating portion **31**A-**2**. The first elastic portion **13**A can be elastically deformed outward in the connector width direction within the range of this gap.

As illustrated in FIG. **3**, the second elastic portion **13**B has a U shape as a whole. The second elastic portion **13**B includes two second straight portions **13**B-**1** extending in the vertical direction and a second bent portion **13**B-**2** having an upwardly bent shape coupling lower end portions of the second straight portions **13**B-**1**. The second elastic portion **13**B is elastically deformable in the connector width direction when the interval between the two second straight portions **13**B-**1** is narrowed or widened.

The second elastic portion **13**B is provided on the inner side than the first elastic portion **13**A in the connector width direction and positioned in substantially the same range as the first elastic portion **13**A in the vertical direction. Therefore, the second elastic portion **13**B forms a horizontal S shape together with the first elastic portion **13**A. In addition, as illustrated in FIG. **2**, the second straight portion **13**B-**1** positioned on the outer side in the connector width direction of the two second straight portions **13**B-**1** and a portion of the second bent portion **13**B-**2** positioned on the outer side in the connector width direction is accommodated in the fixed side accommodation portion **31**A-**2**.

As illustrated in FIG. **3**, the third elastic portion **13**C has an inverted U shape as a whole. The third elastic portion **13**C includes two third straight portions **13**C-**1** extending in the vertical direction and a third bent portion **13**C-**2** having a downwardly bent shape coupling upper end portions of the third straight portions **13**C-**1**. As illustrated in FIGS. **2** and **3**, the two third straight portions **13**C-**1** extend to be slightly inclined in a direction away from each other as they go downward. The third elastic portion **13**C is elastically deformable in the connector width direction when the interval between the two third straight portions **13**C-**1** is narrowed or widened.

As illustrated in FIGS. **2**, the third elastic portion **13**C is provided above the first elastic portion **13**A, the second elastic portion **13**B, and the fourth elastic portion **13**D of the intermediate portion **13**. Therefore, the third elastic portion **13**C is positioned to be different in the vertical direction (connector height direction) with respect to the first elastic portion **13**A, the second elastic portion **13**B, and the fourth elastic portion **13**D of the intermediate portion **13**. That is, the third elastic portion **13**C is disposed at a position different in the vertical direction from those of the first elastic portion **13**A, the second elastic portion **13**B, and the fourth elastic portion **13**D of the intermediate portion **13**.

The third elastic portion **13**C is positioned to have a range that overlaps with the movable side held portion **12** in the vertical direction. Thus, by providing the third elastic portion **13**C at a position overlapping with the movable side held portion **12**, an increase in size of the receptacle connector **1** in the vertical direction is avoided. A portion of the third elastic portion **13**C, specifically, the third straight portion **13**C-**1** positioned on the outer side in the connector width direction of the two third straight portions **13**C-**1**, and a portion of the third bent portion **13**C-**2** positioned on the outer side in the connector width direction is accommodated in the fixed side accommodating portion **31**A-**2** as illustrated in FIG. **2**.

As illustrated in FIG. **2**, the third elastic portion **13**C is positioned to have a gap P**1** in the connector width direction between the third elastic portion **13**C and the side inner wall surface of the fixed side accommodating portion **31**A-**2**, that is, the inner side surface of the side wall central portion **31**A. The third elastic portion **13**C can be elastically deformed

outward in the connector width direction within the range of the gap P1. In addition, as illustrated in FIG. 2, the third elastic portion 13C is positioned to have a gap P2 between the third elastic portion 13C and the outer wall surface of the movable housing 40, that is, the side wall surface of the bottom wall 43 (the surface perpendicular to the connector width direction). The third elastic portion 13C can be elastically deformed inward in the connector width direction within the range of this gap P2. In addition, as illustrated in FIG. 2, the third elastic portion 13C is positioned to have a gap P3 in the connector width direction between the third elastic portion 13C and the upper inner wall surface of the fixed side accommodating portion 31A-2, that is, the lower surface of the top wall 31A-3. The third elastic portion 13C can be elastically deformed upward, that is, in a direction away from the circuit board (not illustrated) within the range of this gap P3.

As illustrated in FIG. 3, the fourth elastic portion 13D has a U shape as a whole. The fourth elastic portion 13D includes fourth second straight portions 13D-1 extending in the vertical direction and a fourth bent portion 13D-2 having an upwardly bent shape coupling lower end portions of the fourth straight portions 13D-1. The fourth elastic portion 13D is elastically deformable in the connector width direction when the interval between the two fourth straight portions 13D-1 is narrowed or widened.

The fourth elastic portion 13D is positioned on the inner side of the first elastic portion 13A, the second elastic portion 13B, and the third elastic portion 13C in the connector width direction, and is provided in substantially the same range as the first elastic portion 13A and the second elastic portion 13B in the vertical direction. In addition, as illustrated in FIG. 2, the fourth elastic portion 13D is positioned directly below the bottom wall 43 of the movable housing 40 in the vertical direction, and within the range of the wall thickness of the long walls 41 of the movable housing 40 in the connector width direction. In the fourth elastic portion 13D, as illustrated in FIGS. 2 and 3, the fourth straight portion 13D-1 positioned on the inner side in the connector width direction of the two fourth straight portions 13D-1, and the portion of the fourth bent portion 13D-2 that is positioned on the inner side in the connector width direction is positioned directly below the movable side held portion 12 in the vertical direction and positioned within the range of the movable side held portion 12 in the connector width direction.

Thus, in the present embodiment, the fourth elastic portion 13D is positioned to have a range that overlaps with the movable side held portion 12 in the connector width direction. As a result, it is possible to ensure a sufficient spring length of the intermediate portion 13 while avoiding an increase in the size of the receptacle connector 1 in the connector width direction. In the present embodiment, in the connector width direction, as the movable side elastic portion having a range that overlaps with the movable side held portion 12 on the inner side than the third elastic portion 13C, only one elastic portion that is, the fourth elastic portion 13D is provided. In this regard, two or more movable side elastic portions may be provided.

As illustrated in FIGS. 2 and 3, the fixed side inclined portion 13E and the movable side inclined portion 13F extend straight to be inclined outward in the connector width direction as they go upward. As described above, the third elastic portion 13C is coupled to the second elastic portion 13B via the fixed side inclined portion 13E, and is coupled to the fourth elastic portion 13D via the movable side inclined portion 13F. As a result, the third elastic portion 13C is positioned to have a range that overlaps with the first elastic portion 13A and the second elastic portion 13B in the connector width direction. As a result, the third elastic portion 13C is disposed at a position that overlaps with at least a part of another elastic portion (first elastic portion 13A and second elastic portion 13B) in the connector width direction. Specifically, the portion of the third elastic portion 13C from the third straight portion 13C-1 to the third bent portion 13C-2, positioned on the outer side in the connector width direction, is positioned overlapping with the portion of the first elastic portion 13A from the first bent portion 13A-2 to the second elastic portion 13B in the connector width direction.

Thus, in the present embodiment, the third elastic portion 13C is positioned to have a range that overlaps with the first elastic portion 13A and the second elastic portion 13B in the connector width direction. Therefore, even if a plurality of elastic portions is provided in the intermediate part 13 and the spring length of the intermediate part 13 is increased, compared with the case where all the elastic portions are positioned differently without overlapping as in the typical art, it is easier to avoid an increase in the size of the intermediate portion 13 of the receptacle terminal 10 in the connector width direction and thus an increase in the size of the receptacle connector 1.

In addition, in the present embodiment, the fixed side inclined portion 13E and the movable side inclined portion 13F that are inclined on the same side as in the connector width direction (outer side in the present embodiment) are provided between the third elastic portion 13C, and the second elastic portion 13B and the fourth elastic portion 13D. As a result, the third elastic portion 13C can be positioned on the outer side in the connector width direction without being largely inclined. Thus, stress generated in the third elastic portion 13C can be dispersed favorably when the third elastic portion 13C is elastically deformed in the connector width direction.

The receptacle fixing bracket 50 is made by bending a metal plate member in a plate thickness direction. The receptacle fixing bracket 50 is bent at the lower edge of the held plate portion (not illustrated) held by the end walls 32 of the fixed housing 30 and the both end portions of the held plate portion in the connector width direction, and includes a fixed portion 51 (see FIG. 1) extending outward in the terminal arrangement direction. The receptacle fixing bracket 50 is held by press-fitting the held plate portion into the end groove portion 32A of the end wall 32 from below, and is solder-connected to the mounting surface of the circuit board on the lower surface of the fixed portion 51.

Next, the configuration of the plug connector 2 will be described based on FIGS. 1 and 2. The plug connector 2 includes a plurality of metal plate plug terminals 60, a plug housing 70 made of an electrical insulating material (for example, made of resin), and a metal plug fixing bracket 80. The plug terminals 60 is arranged with one direction (Y-axis direction of FIGS. 1 and 2) parallel to the mounting surface of the circuit board as the terminal arrangement direction. The plug housing 70 includes a plurality of plug terminals 60. The plug fixing brackets 80 are held at both end portions of the plug housing 70 in the terminal arrangement direction. As seen in FIGS. 1 and 2, the plug terminals 60 are arranged in two rows. The two rows of plug terminals 60 face each other in such a direction as to be symmetrical in the connector width direction.

As illustrated in FIGS. 1 and 2, the plug housing 70 includes a pair of side walls 71 extending in the terminal arrangement direction (Y-axis direction), a pair of end walls

72, a bottom wall 73, and a central wall 74. The pair of end walls 72 extends in the connector width direction (X-axis direction) and couples the end portions of the pair of side walls 71. The bottom wall 73 closes the upper end of the peripheral wall formed by the pair of side walls 71 and the pair of end walls 72. The central wall 74 rises from the bottom wall 73 within the peripheral wall. As illustrated in FIG. 2, the annular space surrounded by the peripheral wall and the central wall 74 and opened downward includes a receiving portion 75 formed for receiving the peripheral wall of the movable housing 40 of the receptacle connector 1 from below. In the end wall 72, as illustrated in FIG. 1, an end groove portion 72A is formed in a slit shape extending perpendicularly to the terminal arrangement direction. This end groove portion 72A accommodates and press-fits and holds a part of the plug fixing bracket 80.

The plug terminal 60 is a male terminal made by bending a metal strip in the wall thickness direction. As illustrated in FIG. 2, the plug terminal 60 includes a connecting portion 61 formed at one end side, a contact arm portion 62 formed at the other end side, and a held portion 63 coupling the connecting portion 61 and the contact arm portion 62. The connecting portion 61 extends in the connector width direction along the bottom surface of the bottom wall 73 of the plug housing 70 (top surface in FIGS. 1 and 2). The connecting portion 61 is solder-connected to the corresponding circuit portion on the mounting surface of the circuit board (not illustrated). As illustrated in FIG. 2, the contact arm portion 62 extends straight in the vertical direction along the side surface of the central wail 74. The contact arm portion 62 has a plate surface exposed to the receiving portion 75. The contact arm portion 62 can contact the contact portions 16A and 17A of the receptacle terminal 10 by this plate surface. As illustrated in FIG. 2, the held portion 63 has an inverted L shape. The held portion 63 is held by integral molding (insert molding) on the bottom wall 43 of the plug housing 70 by the vertically extending portion.

The plug fixing bracket 80 is made by bending a metal plate member in a plate thickness direction. The plug fixing bracket 80 includes a held plate portion (not illustrated) held by the end walls 72 of the plug housing 70 and includes a fixed portion 81 (see FIG. 1) extending outward in the direction. The fixed portion 81 is bent at the upper edge of the both end portions of the held plate portion in the connector width direction and extends outward in the terminal arrangement direction. As illustrated in FIG. 1, the plug fixing bracket 80 is held by press-fitting the held plate portion into the end groove portion 72A of the end wall 72 from above. Furthermore, the plug fixing bracket 80 is solder-connected to the mounting surface of the circuit board on the upper surface of the fixed portion 81.

Next, the mating connection operation between the receptacle connector 1 and the plug connector 2 will be described with reference to FIGS. 1, 2 and 4. Here, FIG. 4 is a cross-sectional view illustrating a cross section of the receptacle connector 1 and the plug connector 2 in a mating connection state taken along a plane perpendicular to the terminal arrangement direction, illustrating a cross section at a position of the receptacle terminal 10.

First, the receptacle connector 1 and the plug connector 2 are mounted on the corresponding mounting surfaces of a circuit board (not illustrated) by solder connection. That is, the receptacle connector 1 is attached to the circuit board by solder-connecting the connecting portion 15 of the receptacle terminal 10 and the fixed portion 51 of the receptacle fixing bracket 50 by solder-connecting to the mounting surface. The plug connector 2 is attached to the circuit board by solder-connecting the connecting portion 61 of the plug terminal 60 and the fixed portion 81 of the plug fixing bracket 80 by solder-connecting to the mounting surface.

Next, as seen in FIGS. 1 and 2, the plug connector 2 is positioned above the receptacle connector 1 in the posture with the receiving portion 75 (see FIG. 2) facing downward. After that, by lowering the plug connector 2 in the same posture, the central wall 74 is caused to enter the receiving portion 45 of the movable housing 40 of the receptacle connector 1 from above. At the same time, the peripheral wall of the movable housing 40 enters the receiving portion 75 of the plug connector 2 from below. Thus, as illustrated in FIG. 4, the receptacle connector 1 and the plug connector 2 are mated together.

When the plug connector 2 is mated with the receptacle connector 1, as illustrated in FIG. 4, the contact arm portions 62 of the plug terminals 60 positioned on both side surfaces of the central wall 74 of the plug connector 2 is made to abut on the contact portions 16A and 17A of the pair of receptacle terminals 10 to elastically deform these contact arm portions 16 and 17 to push them outward in the connector width direction. Thus, the contact arm portion 62 of the plug terminal 60 and the contact portions 16A and 17A of the receptacle terminal 10 are brought into contact with each other with contact pressure and are electrically connected. In this way, the mating connection operation between the receptacle connector 1 and the plug connector 2 is completed. Note that in FIG. 4, the contact arm portions 16 and 17 of the receptacle terminal 10 are at the same positions as in FIG. 2, and the contact arm portions 16A and 17A and the contact arm portion 62 are illustrated in the overlapped state. In this regard, actually, the contact arm portions 16 and 17 of the receptacle terminal 10 are elastically deformed outward in the connector width direction by this overlapped portion.

In a case where there is no deviation in the relative positions of the receptacle connector 1 and the plug connector 2 at the time when the mating connection operation is completed, the receptacle connector 1 and the plug connector 2 are in the normal positions illustrated in FIG. 4. In this normal position, the third elastic portion 13C of the receptacle terminal 10 is positioned to have the gap P1 in the connector width direction with respect to the side inner wall surface of the fixed side accommodating portion 31A-2 of the fixed housing 30, the gap P2 in the connector width direction with respect to the outer wall surface of the movable housing 40, and the gap P3 in the vertical direction with respect to the upper inner wall surface of the fixed side accommodating portion 31A-2 of the fixed housing 30.

In a case where there is deviation in the relative positions of the receptacle connector 1 and the plug connector 2 just before the connector mating is started, during the connector mating process and after the connector mating, the receptacle terminal 10 is elastically deformed in the direction in which deviation occurs and the movable housing 40 relatively moves (floats) with respect to the fixed housing 30. As a result, mating connection in a state in which deviation is absorbed is possible (see FIG. 7).

In addition, even in a case where the receptacle connector 1 and the plug connector 2 are in their normal positions (see FIG. 4) at the time when the mating connection operation is completed, after that, for example, when the connector is used in an environment where vibration occurs, the vibration is absorbed by the floating of the movable housing 40 of the receptacle connector 1.

FIG. 5 is a cross-sectional view illustrating the receptacle connector 1 together with the plug connector 2 in a state in

which the movable housing **40** floats in the connector width direction due to vibration generated during use of the connector after the connector has been mated and connected. FIG. **5** illustrates a cross section at the position of the receptacle terminal **10**, taken along a plane perpendicular to the terminal arrangement direction. In addition, FIG. **5** illustrates a state in which the movable housing **40** of the receptacle connector **1** floats toward the X1 side in the connector width direction (X-axis direction). In a case where the movable housing **40** floats to the X1 side, each of elastic portions **13**A to **13**D of the two receptacle terminals **10** illustrated in FIG. **5**, that is, both receptacle terminals **10** positioned on the X1 side and the X2 side elastically deform toward the X1 side. That is, in the intermediate portion **13** of the receptacle terminal **10** on the X1 side, each of straight portions **13**A-**1** to **13**D-**1** are deformed to narrow the interval between. On the other hand, in the intermediate portion **13** of the receptacle terminal **10** on the X2 side, each of the straight portions **13**A-**1** to **13**D-**1** are deformed to widen the interval between.

As illustrated in FIG. **5**, the third elastic portion **13**C of the receptacle terminal **10** positioned on the X1 side is elastically deformed in a manner that the entire third elastic portion **13**C falls outward in the connector width direction the interval between the two third straight portions **13**C-**1** is narrowed. Such elastic deformation of the third elastic portion **13**C is allowed with the gap P**1** as a limit (see FIG. **4**). At this time, when the frequency of vibration generated in the usage environment of the connector approaches the natural frequency of the receptacle terminal **10**, the amount of deformation of the intermediate portion **13** of the receptacle terminal **10** increases. In the present embodiment, when the third elastic portion **13**C is elastically deformed with the deformation amount of the above gap P**1** outward in the connector width direction, as illustrated in FIG. **5**, the upper portion of the third straight portions **13**C-**1** on the outer side (X1 side) in the connector width direction abuts on the side inner wall surface of the fixed side accommodating portion **31**A-**2**. Therefore, further deformation of the third elastic portion **13**C is restricted. Therefore, since the intermediate portion **13** is not excessively deformed, damage to the receptacle terminal **10** due to plastic deformation and the like is suppressed favorably.

In the state in which the third elastic portion **13**C abuts on the side inner wall surface of the fixed side accommodating portion **31**A-**2**, the intermediate portion **13** of the receptacle terminal **10** is elastically deformable not in the entire portion but from the abutment position to a portion positioned on the inner side in the connector width direction, that is, a portion including only the third bent portion **13**C-**2** of the third elastic portion **13**C, the third straight portion **13**C-**1** on the inner side (X2 side), the movable side inclined portion **13**F, and the fourth elastic portion **13**D. Therefore, in the state in which the third elastic portion **13**C abuts on the side inner wall surface of the fixed housing portion **31**A-**2**, the spring length of the intermediate portion **13** is shorter than in the state in which the third elastic portion **13**C does not abut on the side inner wall surface of the fixed side accommodating portion **31**A-**2**. As a result, the natural frequency of receptacle terminal **10** increases. In other words, when the third elastic portion **13**C abuts on the side inner wall surface of the fixed side accommodating portion **31**A-**2**, difference in the frequency of vibration occurring in the usage environment of the connector and the natural frequency of the receptacle terminal **10** becomes large. Therefore, resonance is less likely to occur than before abutment.

In addition, in the present embodiment, the intermediate portion **13** is provided with the fourth elastic portion **13**D and the movable side inclined portion **13**F positioned between the third elastic portion **13**C and the movable side held portion **12**. When the intermediate portion **13** is elastically deformed and the third elastic portion **13**C abuts on the side inner wall surface of the fixed side accommodating portion **31**A-**2**, the fourth elastic portion **13**D and the movable side inclined portion **13**F are included in the elastically deformable portion. Therefore, when the third elastic portion **13**C abuts on the above side inner wall surface, compared with the state before abutment, even in a case where the spring length of the intermediate portion **13** is shortened, sufficient floating amount can be ensured because the fourth elastic portion **13**D and the movable side inclined portion **13**F are elastically deformable.

FIG. **6** is a cross-sectional view illustrating the receptacle connector **1** together with the plug connector **2** in a state in which the movable housing **40** floats upward due to vibration generated during use of the connector after the connector has been mated and connected. FIG. **6** illustrates a cross section at the position of the receptacle terminal **10**, taken along a plane perpendicular to the terminal arrangement direction.

Upward elastic deformation of the third elastic portion **13**C of the receptacle terminals **10** on both the X1 side and the X2 side is allowed with the gap P**3** as a limit (see FIG. **4**). In the present embodiment, as illustrated in FIG. **6**, when the third elastic portion **13**C elastically deforms upward with the amount of deformation of the gap P**3**, the third bent portion **13**C-**2** abuts on the upper inner wall surface of the fixed side accommodating portion **31**A-**2**, that is, the lower surface of the top wall **31**A-**3**. Therefore, further deformation of the third elastic portion **13**C is restricted. Therefore, since the intermediate portion **13** is not excessively deformed, damage to the receptacle terminal **10** due to plastic deformation and the like is suppressed favorably.

In the state in which the third elastic portion **13**C abuts on the top wall **31**A-**3**, the intermediate portion **13** of the receptacle terminal **10** is elastically deformable not in the entire portion but from the abutment position to a portion positioned on the inner side in the connector width direction, that is, the third straight portion **13**C-**1** on the inner side (X2 side) of the third elastic portion **13**C, the movable side inclined portion **13**F, and the fourth elastic portion **13**D. Therefore, in the state in which the third elastic portion **13**C abuts on the top wall **31**A-**3**, the spring length of the intermediate portion **13** is shorter than in the state in which the third elastic portion **13**C does not abut on the top wall **31**A-**3**. As a result, the natural frequency of receptacle terminal **10** increases. In other words, when the third elastic portion **13**C abuts on the top wall **31**A-**3**, difference in the frequency of vibration occurring in the usage environment of the connector and the natural frequency of the receptacle terminal **10** becomes large. Therefore, resonance is less likely to occur than before abutment.

As described above, in a case where there is deviation in the relative positions of the receptacle connector **1** and the plug connector **2** just before the connector mating is started, deviation is absorbed because the movable housing **40** floats, FIG. **7** is a cross-sectional view illustrating the receptacle connector **1** together with the plug connector **2** in a state in which the movable housing **40** floats in the connector width direction at a time when the mating connection of a connector **1** is completed. FIG. **7** illustrates a cross section at the position of the receptacle terminal **10**, taken along a plane perpendicular to the terminal arrange-

ment direction. In addition, FIG. **7** illustrates a state in which the movable housing **40** of the receptacle connector **1** floats toward the X1 side in the connector width direction (X-axis direction).

As can be seen by comparing FIG. **7** and FIG. **5**, the form of elastic deformation of the receptacle terminal **10** is different between the case where the movable housing **40** floats to absorb the deviation of the relative positions of the connectors in the connector mating process (see FIG. **7**) and the case where the movable housing **40** floats by receiving vibration during the use of the connector (see FIG. **5**).

As illustrated in FIG. **7**, in a case where the movable housing **40** floats toward the X1 side, each of the elastic portions **13**A to **13**D of the receptacle terminal **10** positioned on the X1 side is deformed to narrow the interval between each of the straight portions **13**A-**1** to **13**D-**1**. As a result, the third elastic portion **13**C is pushed by the outer wall surface on the X1 side of the movable housing **40** that has moved to the X1 side, and abuts on outer wall surface of the movable housing **40** at the upper portion of the third straight portion **13**C-**1** on the inner side (X2 side) in the connector width direction.

On the other hand, at the receptacle terminal **10** positioned on the X2 side, the first elastic portion **13**A, the second elastic portion **13**B, and the third elastic portion **13**C are elastically deformed to fall on the inner side in the connector width direction. In addition, at the same time, the straight portions **13**A-**1** of the first elastic portion **13**A are deformed to narrow the interval between. Furthermore, the straight portions **13**B-**1** of the second elastic portion **13**B and the straight portions **13**C-**1** of the third elastic portion **13**C are deformed to widen the interval between. In addition, the fourth elastic portion **13**D is deformed to narrow the interval between the straight portions **13**D-**1**. When each of the elastic portions **13**A to **13**D is deformed, the third elastic portion **13**C abuts on the outer wall surface on the X2 side of the movable housing **40** at the upper portion of the third straight portion **13**C-**1** on the inner side (X1 side) of the connector width direction.

The connectors **1** and **2** in a mated state illustrated in FIG. **7** are used in a state in which the third elastic portions **13**C of the receptacle terminals **10** on both sides in the connector width direction abut on the outer wall surfaces on both sides of the movable housing **40**. When the connectors **1** and **2** receive vibration while the connectors are in use, the receptacle terminal **10** is elastically deformed while maintaining the abutment state between the third elastic portion **13**C and the movable housing **40**. At this time, the intermediate portion **13** of the receptacle terminal **10** is elastically deformable not in the entire portion but from the abutment position to a portion positioned on the outer side in the connector width direction, that is, the third bent portion **13**C-**2** of the third elastic portion **13**C, the third straight portion **13**C-**1** on the outer side, the fixed side inclined portion **13**E, the second elastic portion **13**B, and the first elastic portion **13**A. Therefore, in the state in which the third elastic portion **13**C abuts on the outer wall surface of the movable housing **40**, the spring length of the intermediate portion **13** is shorter than in the state in which the third elastic portion **13**C does not abut on the outer wall surface. As a result, the natural frequency of receptacle terminal **10** increases. In other words, when the third elastic portion **13**C abuts on the movable housing **40**, difference in the frequency of vibration occurring in the usage environment of the connector and the natural frequency of the receptacle terminal **10** becomes large. Therefore, resonance is less likely to occur compared with the case where there is no abutment.

In addition, in the present embodiment, when the occurrence of resonance of the terminals is avoided, the intermediate portion **13** of the receptacle terminal **10** is largely shaken not only in the connector width direction and the vertical direction but also in the terminal arrangement direction, making it difficult to deform. As a result of suppressing excessive deformation in the terminal arrangement direction, it is possible to favorably avoid the intermediate portions **13** of receptacle terminals **10** adjacent to each other in the terminal arrangement direction accidentally coming into contact with each other and short-circuit.

In the present embodiment, the intermediate portion of the receptacle terminal is provided with four elastic portions. In this regard, the number of elastic portions can. be set as appropriate. It is sufficient if two or more elastic portions are provided and at least one specific elastic portion of the two elastic portions is positioned to be different in the vertical direction from the other elastic portion and positioned to have a range overlapping in the connector width direction. At this time, in a case where there is no problem even if the connector becomes large in the vertical direction, the specific elastic portion may be provided below the other elastic portion. In addition, in the present embodiment, the specific elastic portion is provided overlapping with the other elastic portion positioned on the outer side in the connector width direction. Alternatively, the specific elastic portion may be provided to overlap with the other elastic portion located on the inner side than the specific elastic portion. At this time, in a case where the specific elastic portion is positioned overlapping with the movable housing in the vertical direction, it is preferable that the other elastic portion is provided on the outer side than the movable housing in the connector width direction

The foregoing detailed description has been presented for the purposes of illustration and description. Many modifications and variations are possible in light of the above teaching. It is not intended to be exhaustive or to limit the subject matter described herein to the precise form disclosed. Although the subject matter has been described in language specific to structural features and/or methodological acts, it is to be understood that the subject matter defined in the appended claims is not necessarily limited to the specific features or acts described above. Rather, the specific features and acts described above are disclosed as example forms of implementing the claims appended hereto.

What is claimed is:

1. A circuit board electrical connector comprising:

a plurality of terminals;

a fixed housing fixed to a circuit board via the terminals; and

a movable housing relatively movable with respect to the fixed housing, wherein

the terminals are provided to be bridged between the fixed housing and the movable housing,

the terminals include

a fixed side held portion held by the fixed housing,

a movable side held portion positioned on an inner side in a connector width direction than the fixed side held portion and held by the movable housing, and

an elastically deformable intermediate portion positioned between the fixed side held portion and the movable side held portion,

the intermediate portion includes a plurality of elastic portions reversed by repeating a bending direction in a connector height direction,

the plurality of elastic portions include a specific elastic portion that is positioned to be different in the connec-

tor height direction from another elastic portion and positioned to have a range overlapping in the connector width direction,

the fixed side held portion includes an extended portion extending inward in the connector width direction,

the terminals further include an arm portion positioned between the intermediate portion and the fixed side held portion,

the arm portion extends from an inner side end portion of the extended portion outward in the connector width direction to be continuous with the intermediate portion, and

the arm portion is positioned to have a gap between the arm portion and the extended portion in the connector height direction such that the arm portion is elastically deformable in the connector height direction.

2. The circuit board electrical connector according to claim **1**, wherein

the plurality of elastic portions further includes a movable side elastic portion that is an elastic portion positioned between the specific elastic portion and the movable side held portion besides the specific elastic portion, and

at least one movable side elastic portion is positioned to have a range that overlaps with the movable side held portion in the connector width direction.

3. The circuit board electrical connector according to claim **1**, wherein

the plurality of elastic portions further includes a movable side elastic portion that is an elastic portion positioned between the specific elastic portion and the movable side held portion besides the specific elastic portion, and a fixed side elastic portion that is an elastic portion positioned on a side of the fixed side held portion than the specific elastic portion,

the specific elastic portion is coupled to the movable side elastic portion via a movable side inclined portion and coupled to the fixed side elastic portion via a fixed side inclined portion, and the movable side inclined portion and the fixed side inclined portion are inclined toward a same side in the connector width direction.

4. The circuit board electrical connector according to claim **1**, wherein

the specific elastic portion includes a shape bent on a side away from the circuit board in the connector height direction, and positioned on an outer side in the connector width direction with respect to the movable side held portion, and positioned to have a range that overlaps in the connector height direction.

5. The circuit board electrical connector according to claim **2**, wherein

the specific elastic portion includes a shape bent on a side away from the circuit board in the connector height direction, and positioned on an outer side in the connector width direction with respect to the movable side held portion, and positioned to have a range that overlaps in the connector height direction.

6. The circuit board electrical connector according to claim **3**, wherein

the specific elastic portion includes a shape bent on a side away from the circuit board in the connector height direction, and positioned on an outer side in the connector width direction with respect to the movable side held portion, and positioned to have a range that overlaps in the connector height direction.

7. The circuit board electrical connector according to claim **1**, wherein

the arm portion is positioned within a range of the intermediate portion in the connector width direction.

* * * * *