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(54) **MALE AND FEMALE CONNECTION STRUCTURE**

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H01R 13/187 (2006.01)

(52) **U.S. Cl.** **439/843**; 439/748; 439/866

(58) **Field of Classification Search** 439/748, 439/835, 837, 843, 832, 866, 259, 263, 265
See application file for complete search history.

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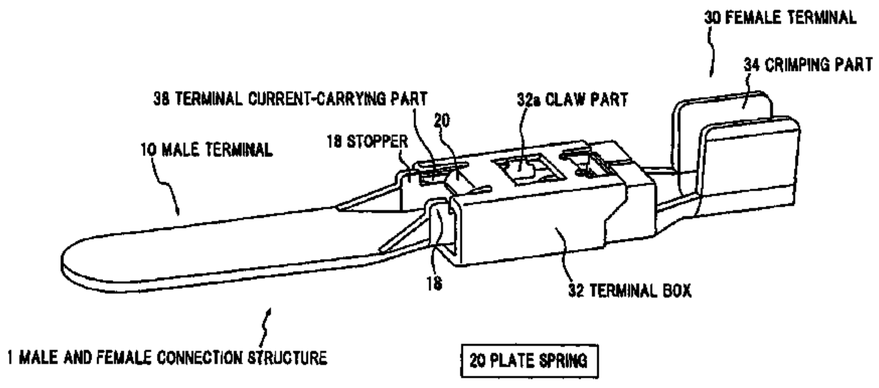
(57) **ABSTRACT**

A male and female connection structure includes a female terminal, and a male terminal to electrically connect to the female terminal by being inserted into a connection position of the female terminal and to electrically disconnect from the female terminal by being withdrawn from the connection position. The female terminal includes a dimple to electrically connect to the male terminal, a male terminal pressing spring disposed opposite the dimple for pressing the male terminal to be inserted on the dimple against the dimple, and a press switching part for switching between a non-pressed state that the male terminal pressing spring does not press the male terminal located in the female terminal and a pressed state that the male terminal pressing spring presses the male terminal located in the female terminal by changing a shape of the male terminal pressing spring. The press switching part switches the non-pressed state to the pressed state, when the male terminal is inserted into the connection position, by using an insertion force applied when the male terminal is inserted into the female terminal, and it switches the pressed state to the non-pressed state, when the male terminal is withdrawn from the connection position, by using a withdrawal force applied when the male terminal is withdrawn from the female terminal.

15 Claims, 14 Drawing Sheets



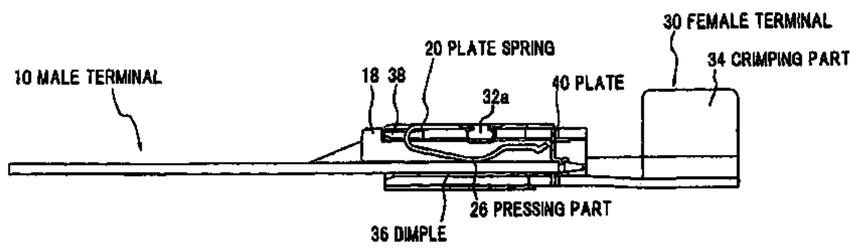


FIG. 1A

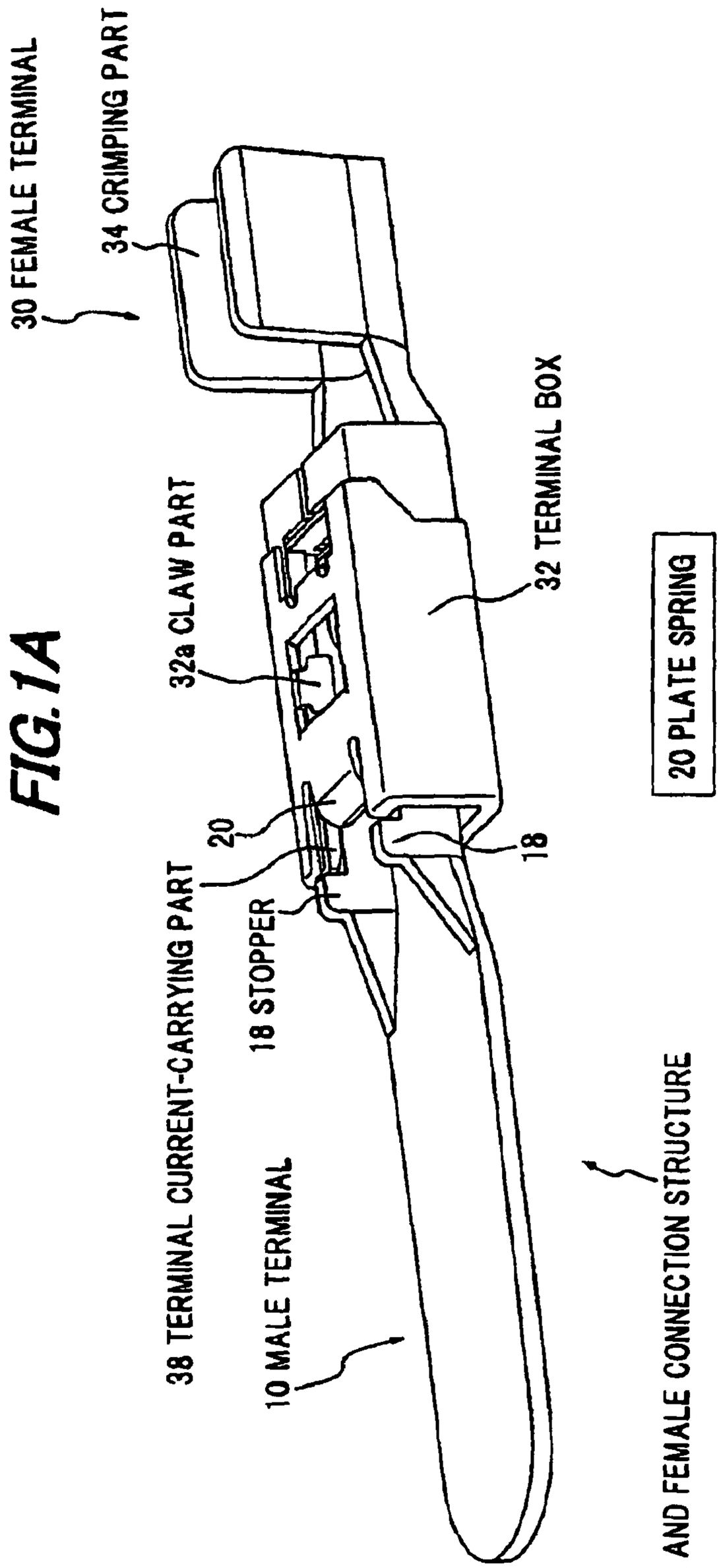

30 FEMALE TERMINAL
34 CRIMPING PART
32a CLAW PART
32 TERMINAL BOX
20 PLATE SPRING
20
18 STOPPER
18
38 TERMINAL CURRENT-CARRYING PART
10 MALE TERMINAL
1 MALE AND FEMALE CONNECTION STRUCTURE

FIG. 1B

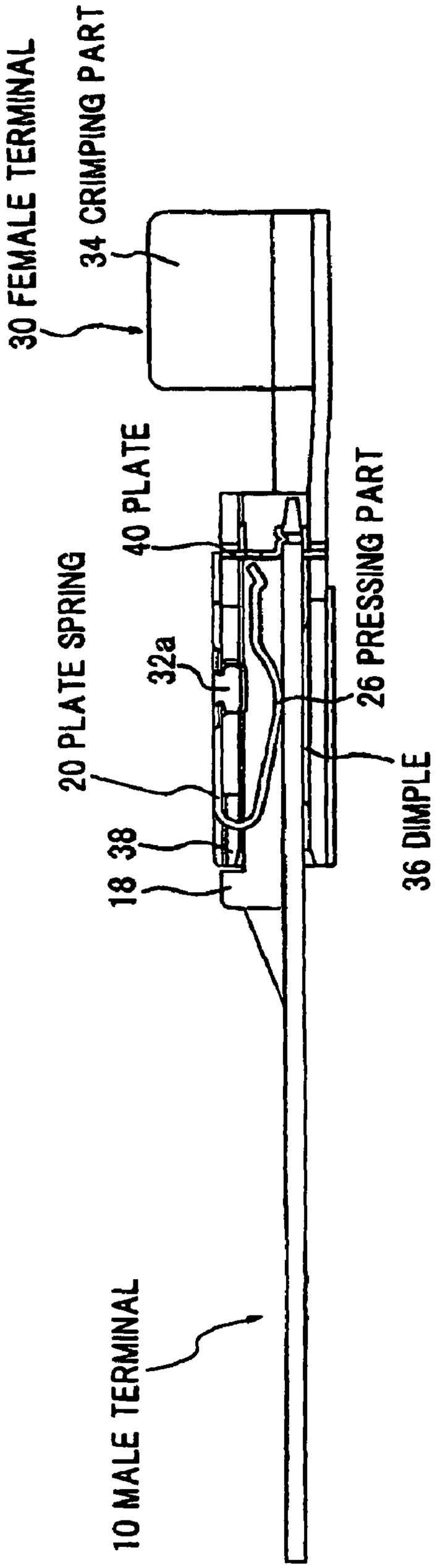

30 FEMALE TERMINAL
34 CRIMPING PART
40 PLATE
20 PLATE SPRING
32a
26 PRESSING PART
18
38
36 DIMPLE
10 MALE TERMINAL

FIG. 1C

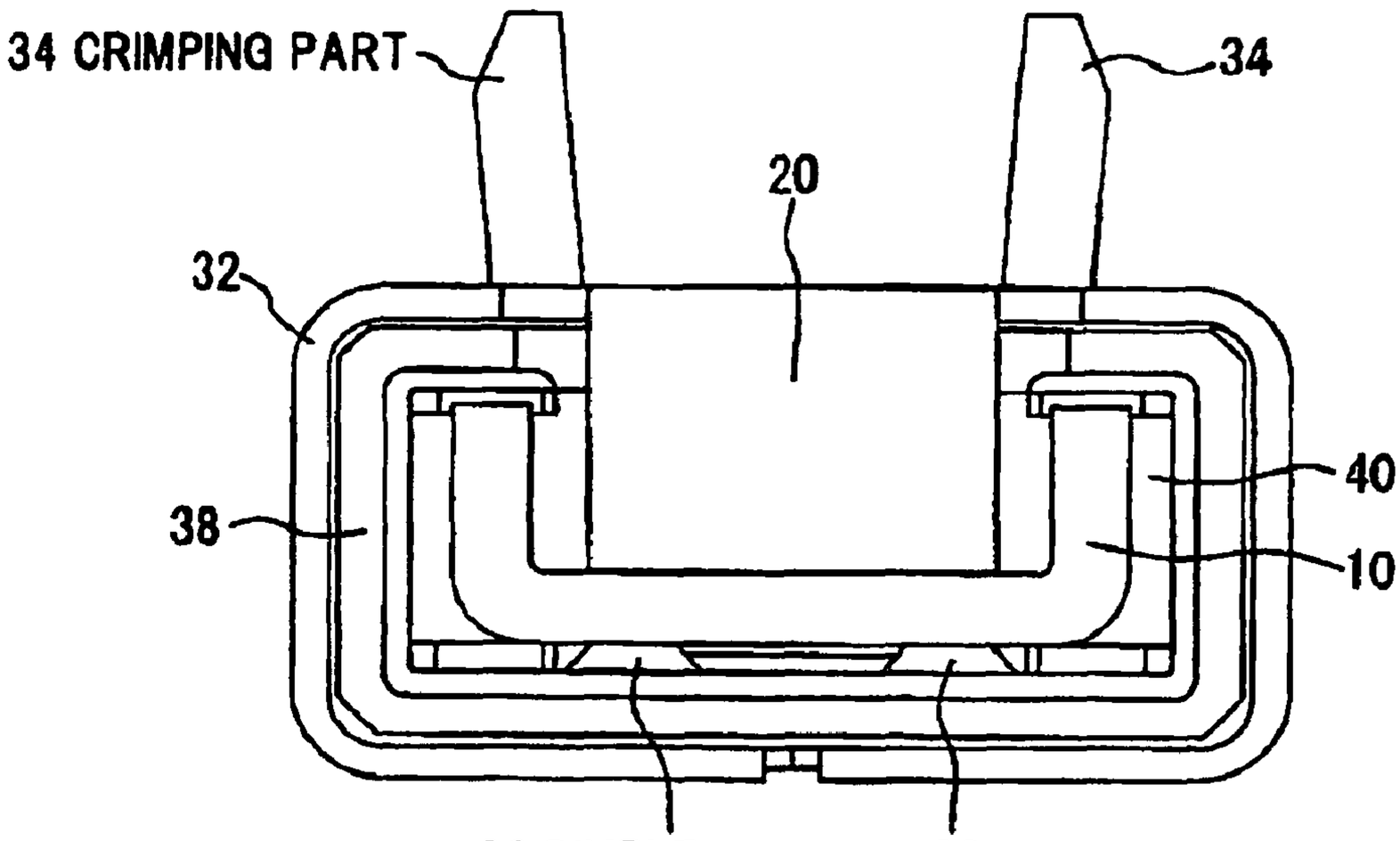


FIG.2

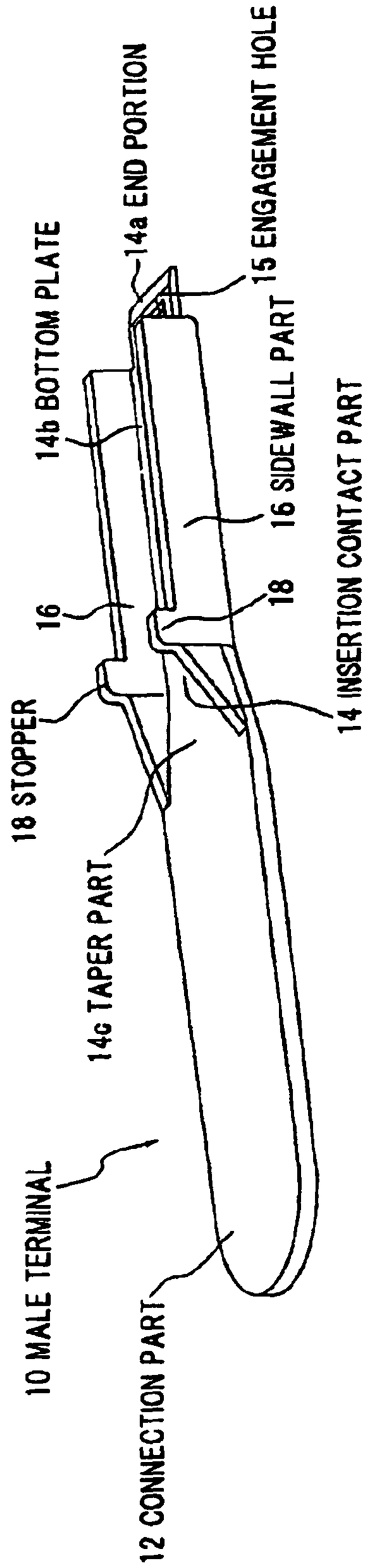

10 MALE TERMINAL
12 CONNECTION PART
14 INSERTION CONTACT PART
14a END PORTION
14b BOTTOM PLATE
14c TAPER PART
15 ENGAGEMENT HOLE
16
16 SIDEWALL PART
18
18 STOPPER

FIG.3

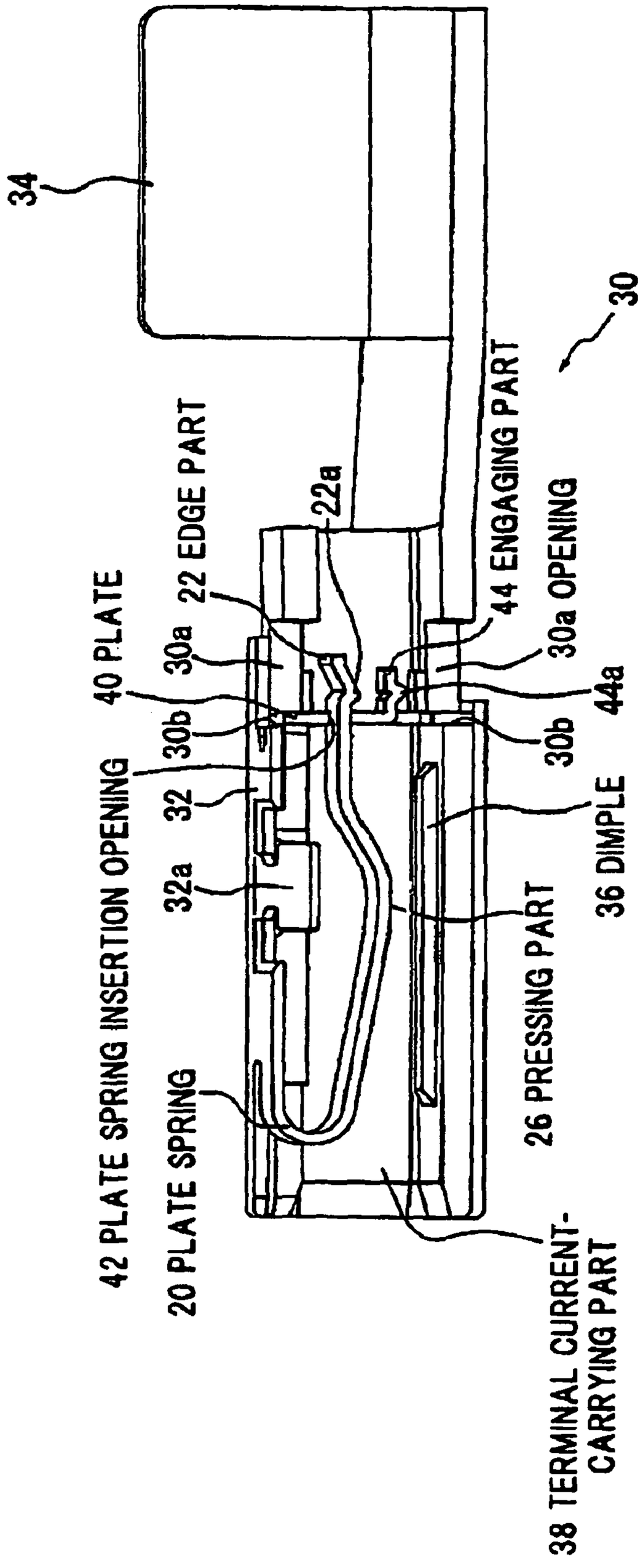

34
30
44 ENGAGING PART
30a OPENING
44a
30b
36 DIMPLE
26 PRESSING PART
38 TERMINAL CURRENT-CARRYING PART
22a
22 EDGE PART
30a
40 PLATE
30b
INSERTION OPENING
32
32a
42 PLATE SPRING
20 PLATE SPRING
22a PROTRUDING PART

FIG.4

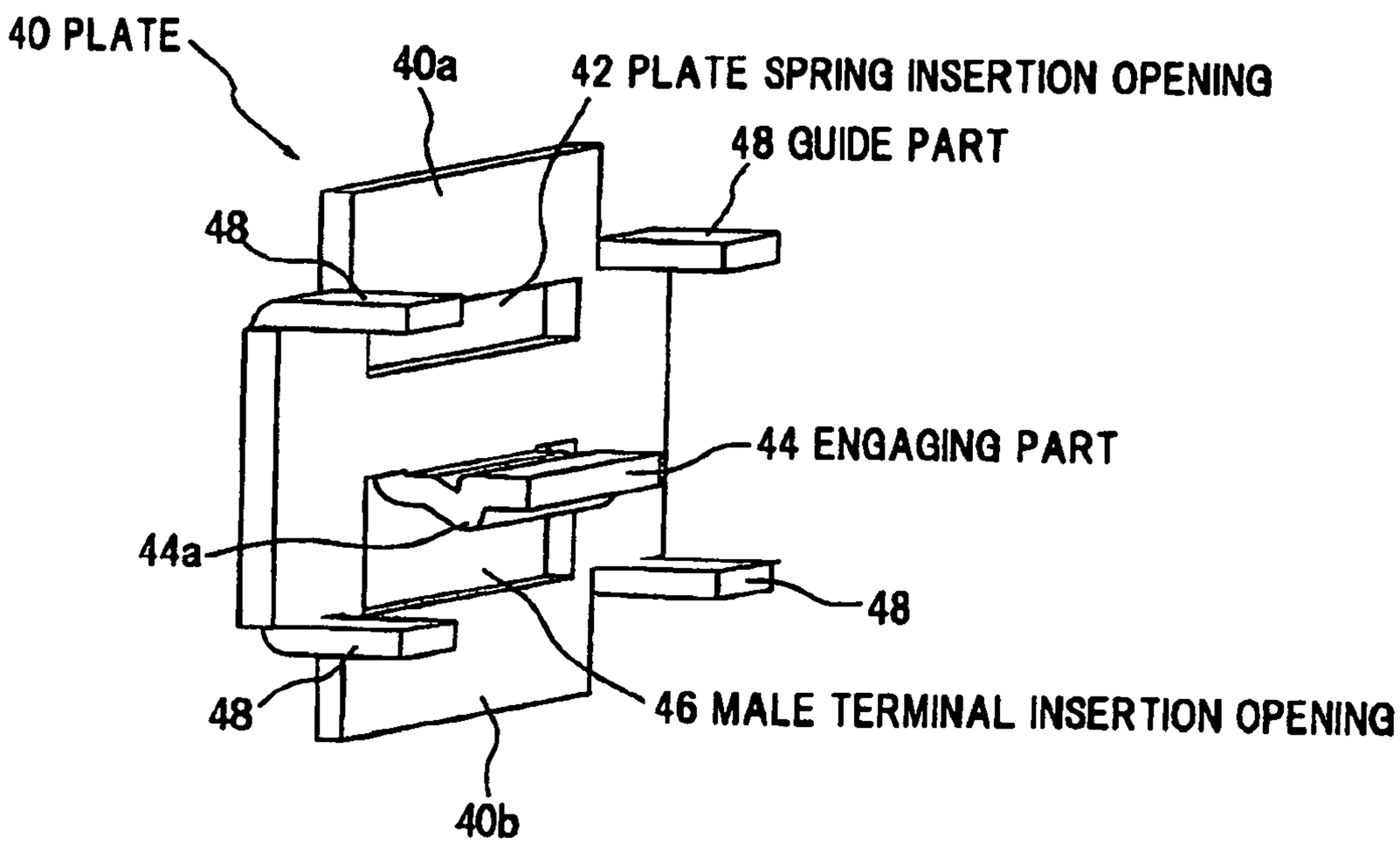

40 PLATE
40a
42 PLATE SPRING INSERTION OPENING
48 GUIDE PART
48
44 ENGAGING PART
44a
48
48
46 MALE TERMINAL INSERTION OPENING
40b

FIG.5

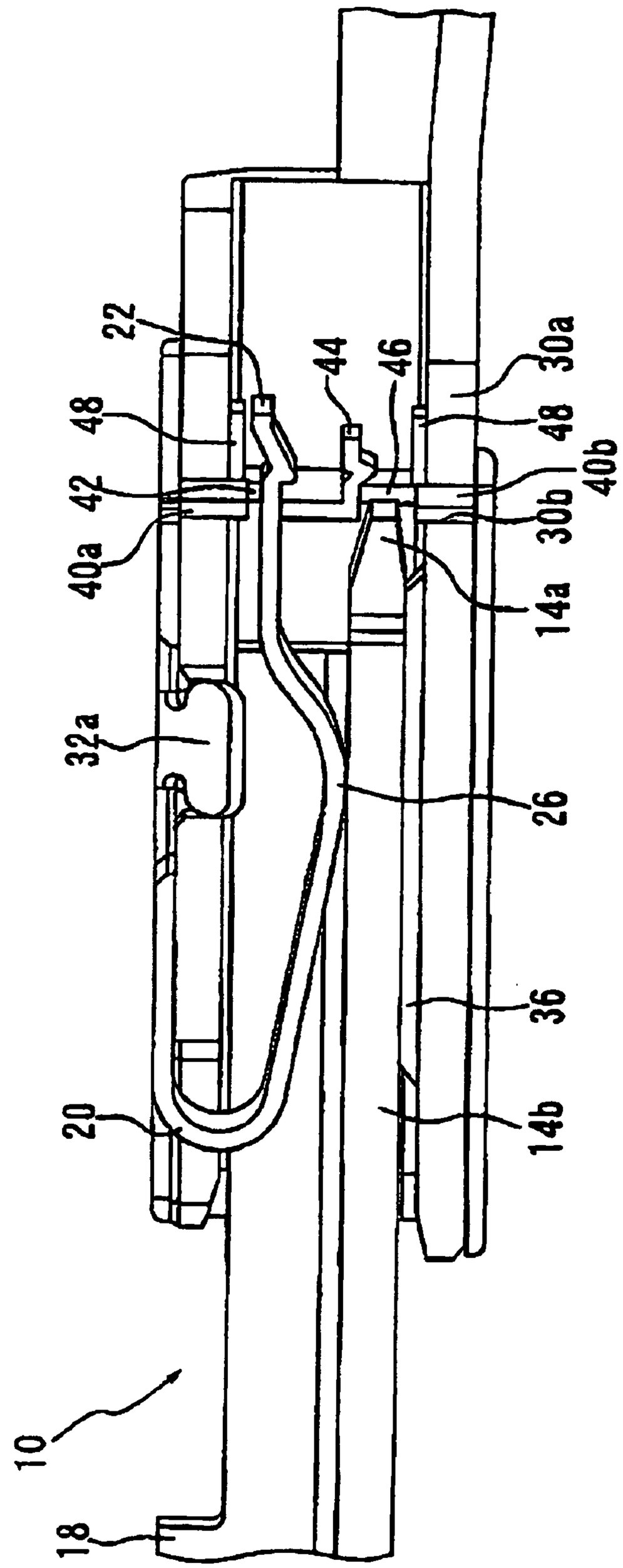


FIG. 6

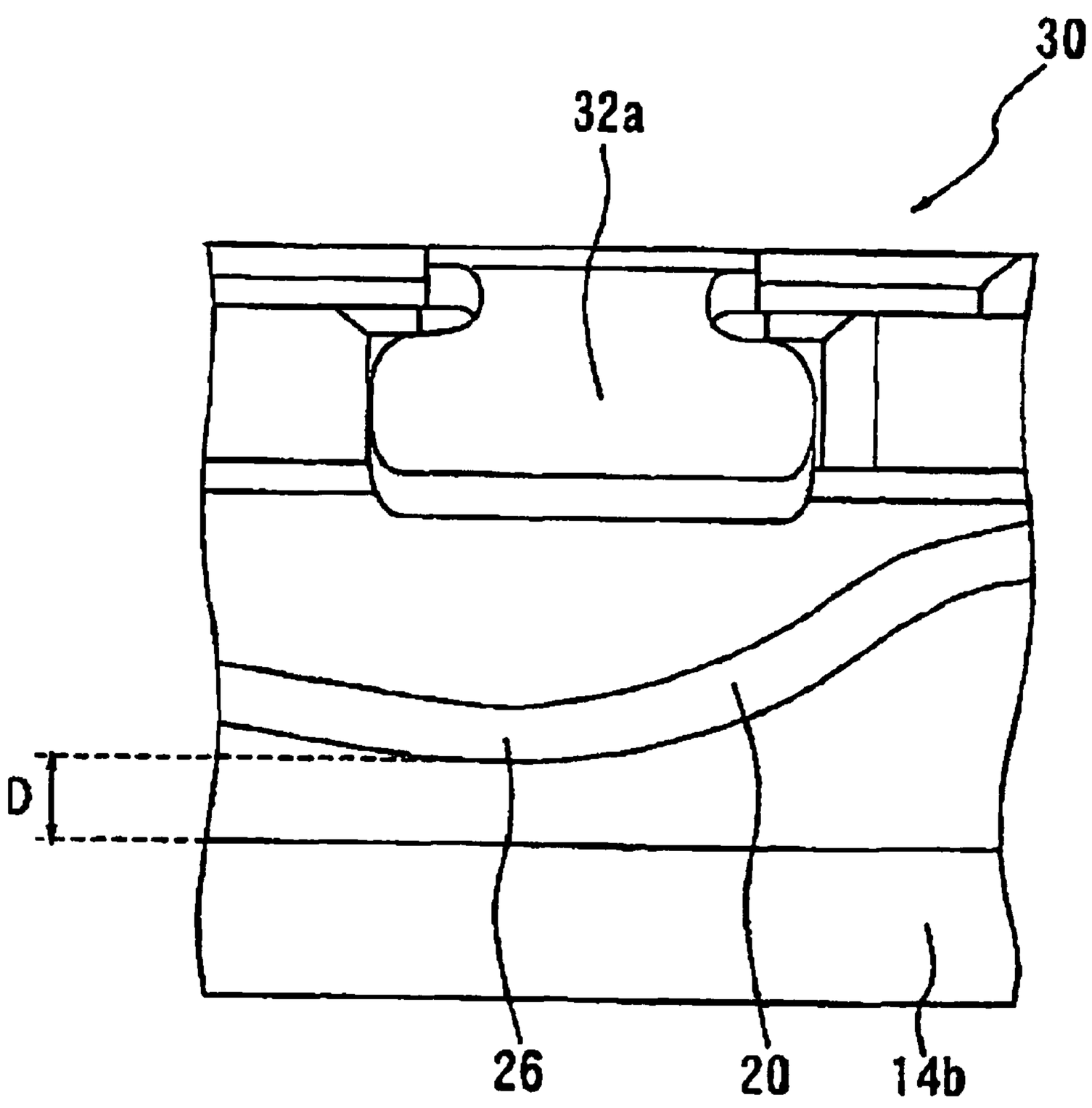


FIG. 7

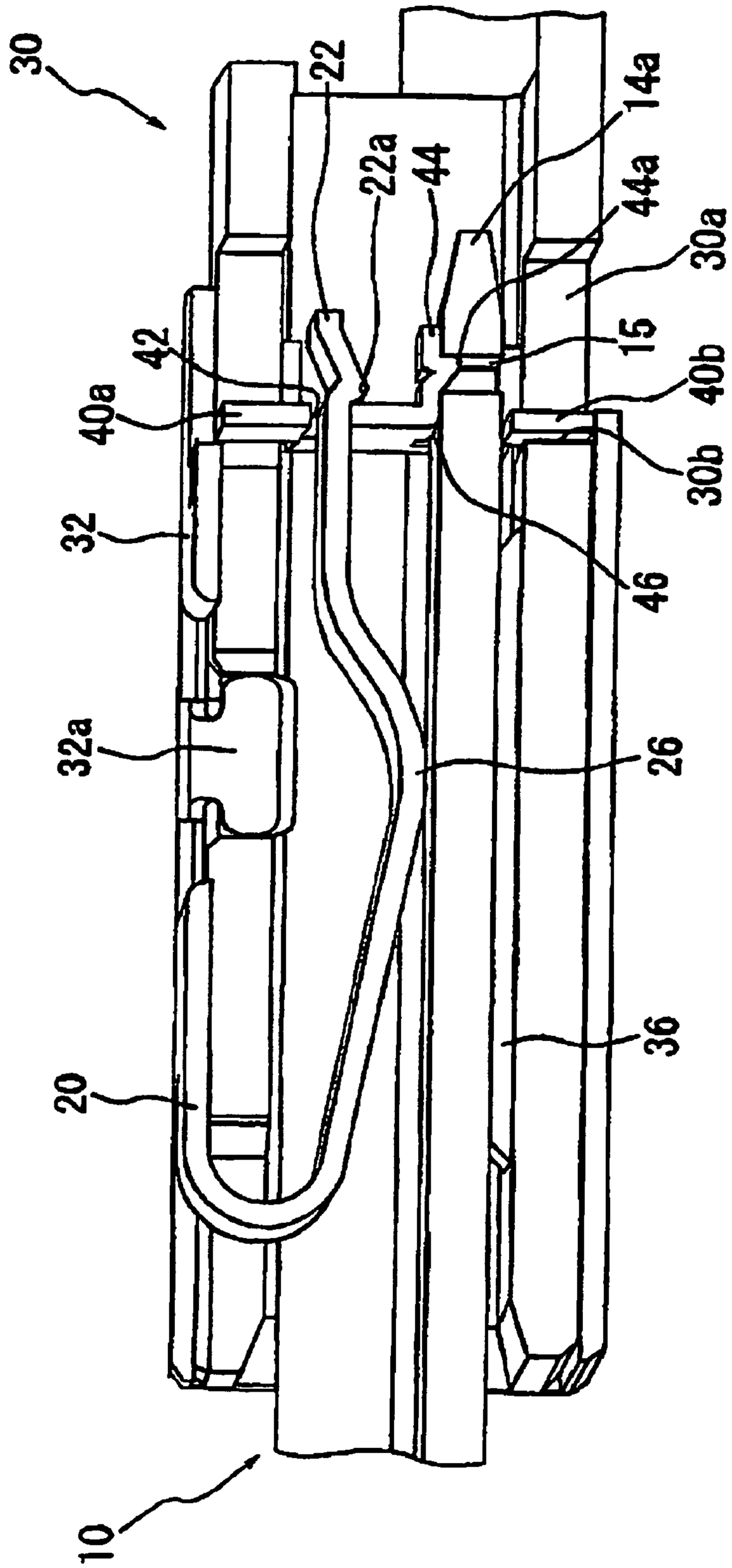


FIG.8

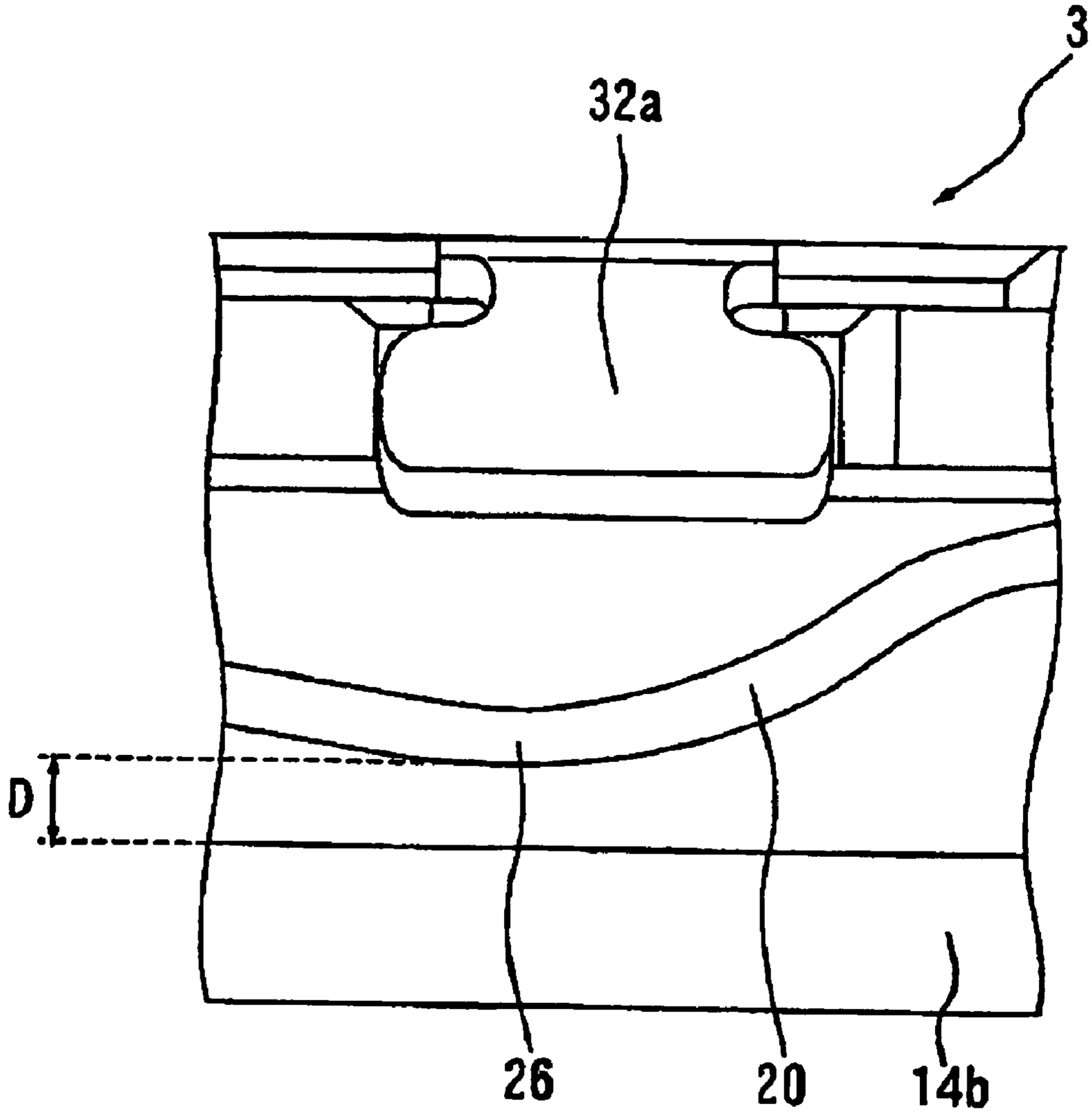


FIG.9

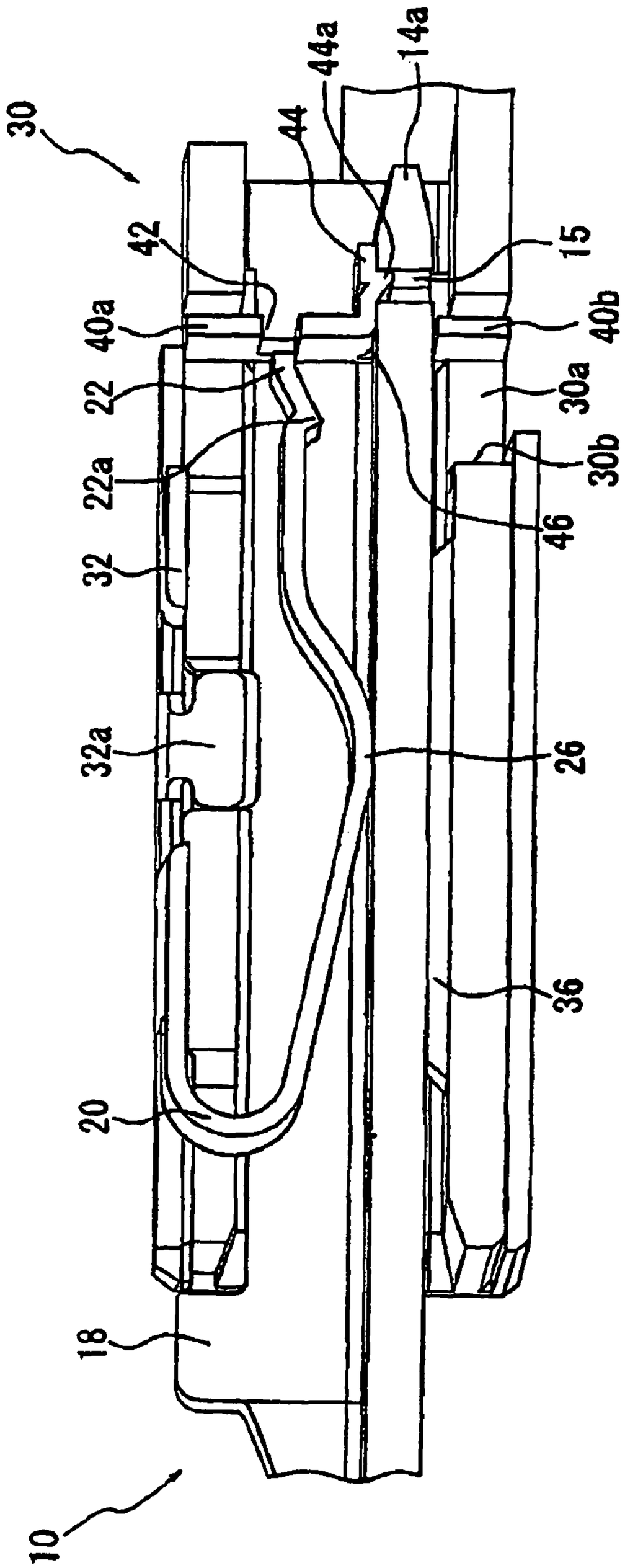


FIG. 10

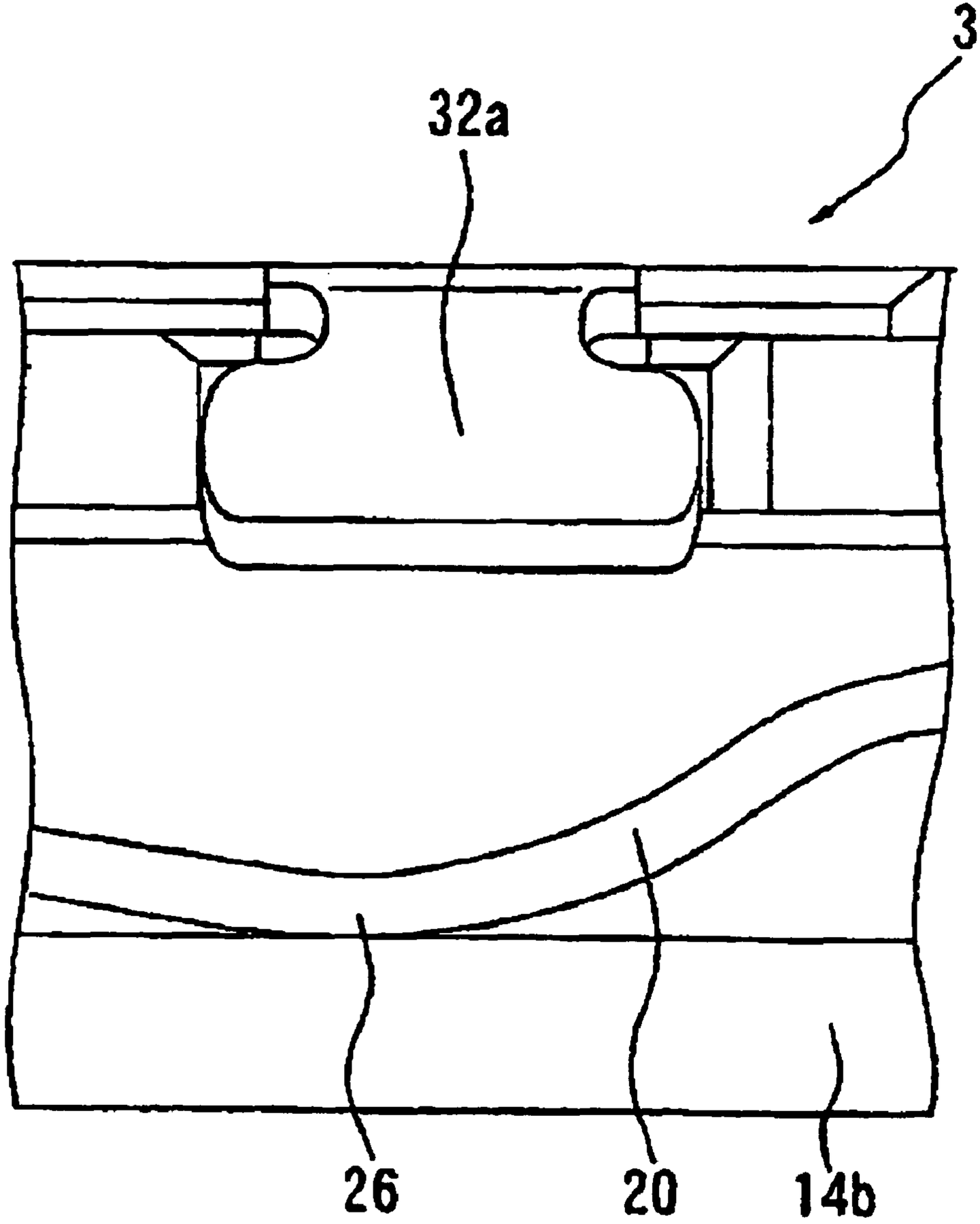


FIG. 11

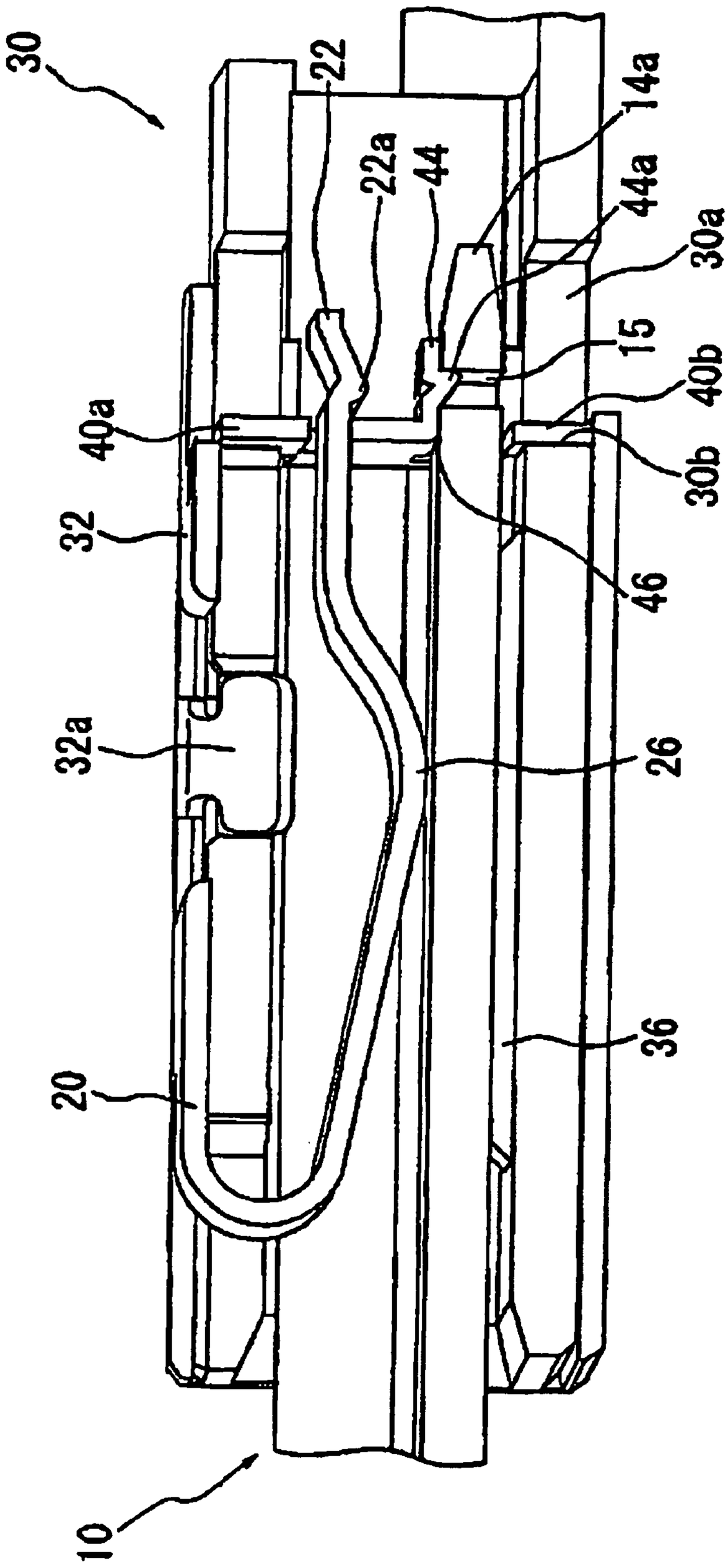
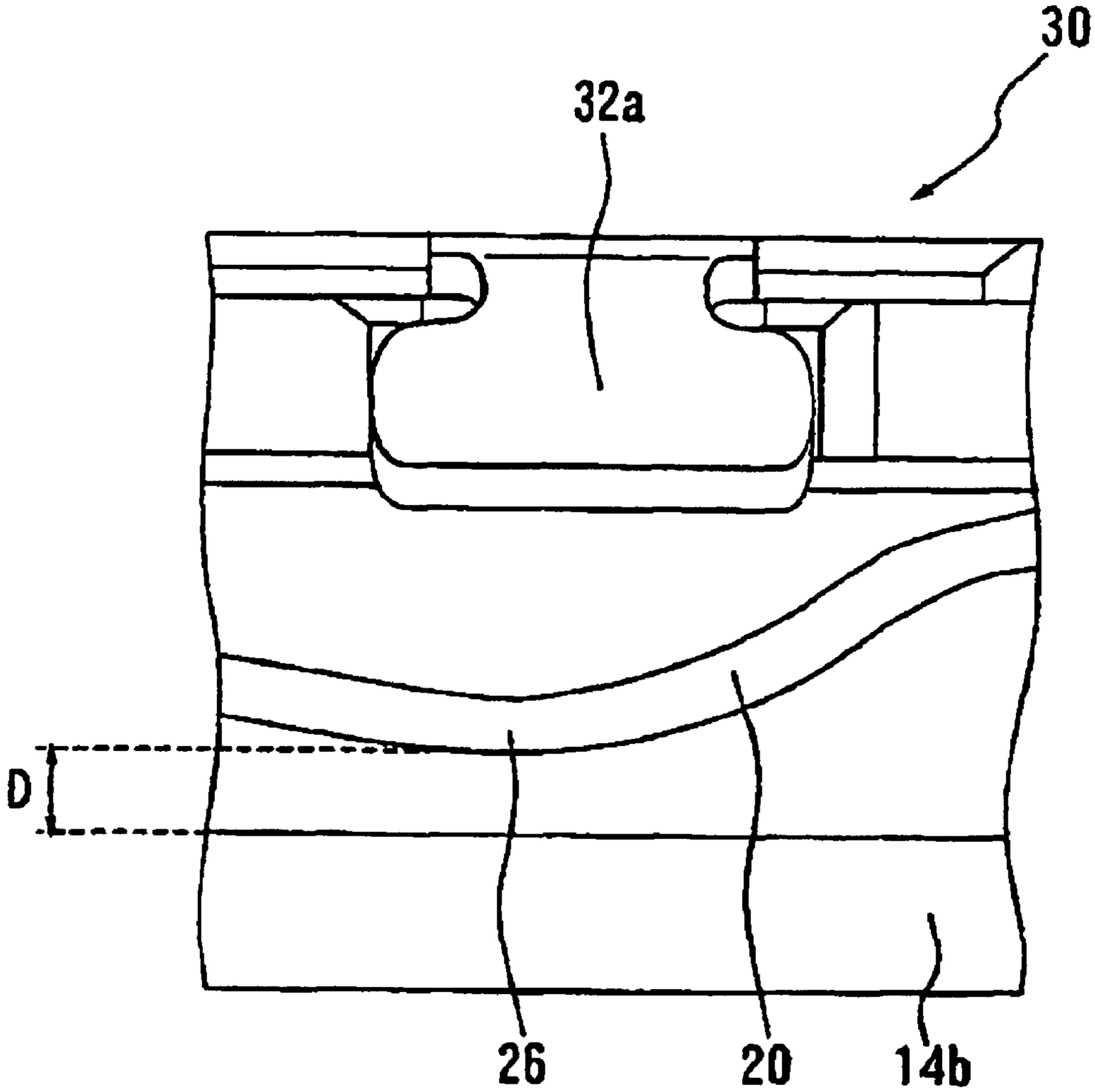


FIG. 12



MALE AND FEMALE CONNECTION STRUCTURE

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

The present application is based on Japanese patent application No. 2008-297816 filed on Nov. 21, 2008, the entire contents of which are incorporated herein by reference.

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates to a male and female connection structure and, in particular, to a male and female connection structure suited for carrying large current.

2. Description of the Related Art

A connector as a conventional male and female connection structure is known, the connector comprising a male connector and a female connector being able to be fitted into a hood part of a male connector housing having a male tab, where a lock arm is formed on the female connector housing having a female terminal fitting, and a pressing part formed on the lock arm presses down a receiving part of an elastic contact segment for sandwiching the male tab formed in the female terminal fitting together with the start of fitting operation between the male connector and the female connector, so that before the male tab contacts the contact part of the contact segment, the contact part is pressed down. This technique is disclosed in JP-A-2006-216272.

The male and female connection structure described in JP-A-2006-216272 has a structure that the contact part of the contact segment is elastically changed in the shape in a direction getting away from the male tab together with the start of fitting operation, so that a fitting resistance is reduced and reduction of an insertion force can be realized.

However, since the connector as a conventional male and female connection structure disclosed in JP-A-2006-216272 has a structure that the pressing part is pressed down by that an operator presses the elastic contact segment by using the lock arm separately from the fitting operation between the male connector and the female connector, as a result, it is difficult that the fitting operation between the male connector and the female connector is easily carried out. Particularly, the difficulty is remarkably increase in the case that an energizing force of the elastic contact segment is enlarged as a countermeasure against a vibration affecting the fitting condition between the male tab (male terminal) and the female terminal fitting (female terminal). Further, the above-mentioned problem occurs in a case that the male terminal is inserted into the female terminal, but, on the contrary, it similarly occurs in a case that the male terminal is removed from the female terminal.

SUMMARY OF THE INVENTION

Therefore, it is an object of the invention to solve the above-mentioned problem and provide a male and female connection structure that is capable of easily inserting and removing a male terminal into (from) a female terminal, even if a male terminal hold spring having a large energizing force is used.

(1) According to one embodiment of the invention, a male and female connection structure comprises:

a female terminal; and a male terminal to electrically connect to the female terminal by being inserted into a connection position of the female terminal and to electrically disconnect from the female terminal by being withdrawn from the connection position,

wherein the female terminal comprises:

a dimple to electrically connect to the male terminal;

a male terminal pressing spring disposed opposite the dimple for pressing the male terminal to be inserted on the dimple against the dimple; and

a press switching part for switching between a non-pressed state that the male terminal pressing spring does not press the male terminal located in the female terminal and a pressed state that the male terminal pressing spring presses the male terminal located in the female terminal by changing a shape of the male terminal pressing spring,

wherein the press switching part switches the non-pressed state to the pressed state, when the male terminal is inserted into the connection position, by using an insertion force applied when the male terminal is inserted into the female terminal, and

the press switching part switches the pressed state to the non-pressed state, when the male terminal is withdrawn from the connection position, by using a withdrawal force applied when the male terminal is withdrawn from the female terminal.

In the above embodiment (1), the following modifications and changes can be made.

(i) The press switching part comprises a spring insertion opening for engaging with an edge part of the male terminal pressing spring before the male terminal is inserted into the female terminal, and a male terminal insertion opening for engaging with an end part of the male terminal at a position adjacent to the spring insertion opening, and when the male terminal moves to the connection position along an insertion direction in which the male terminal is inserted while the end part of the male terminal is engaged with the male terminal insertion opening, the spring insertion opening is disengaged from the edge part of the male terminal pressing spring so as to switch the non-pressed state to the pressed state.

(ii) When the male terminal moves along a withdrawal direction in which the male terminal is withdrawn and away from the connection position while the end part of the male terminal is engaged with the male terminal insertion opening, the spring insertion opening is engaged with the edge part of the male terminal pressing spring so as to switch the pressed state to the non-pressed state.

(iii) The press switching part is movable with respect to the male terminal pressing spring along the insertion direction and the withdrawal direction.

(iv) After the male terminal is inserted into the female terminal and the end part of the male terminal is engaged with the male terminal insertion opening, the press switching part moves to the connection position according as the male terminal moves in the insertion direction, and the spring insertion opening is disengaged from the edge part of the male terminal pressing spring at the connection position according as the male terminal moves in the insertion direction.

(v) The press switching part moves according as the male terminal moves in the withdrawal direction, and the spring insertion opening is engaged with the edge part of the male terminal pressing spring at a position away from the connection position in the withdrawal direction according as the male terminal moves in the withdrawal direction.

Points of the Invention

According to one embodiment of the invention, a male and female connection structure is constructed such that a female terminal is provided with a plate that is capable of automatically switching a shape of a plate spring for pressing a male terminal against a dimple between a pressed state and a non-pressed state according as the male terminal is inserted into the female terminal. Therefore, even when the male terminal is inserted/withdrawn into/from the female terminal, it is not necessary for the operator to press down the plate spring separately by using a lock arm or the like and a force can be prevented from being applied by the plate spring to the male terminal. Thus, the male terminal can be easily inserted/withdrawn into/from the female terminal.

BRIEF DESCRIPTION OF THE DRAWINGS

The preferred embodiments according to the invention will be explained below referring to the drawings, wherein:

FIG. **1**A is a perspective view schematically showing a male and female connection structure according to one embodiment of the invention;

FIG. **1**B is a longitudinal cross-sectional view schematically showing a male and female connection structure according to one embodiment of the invention;

FIG. **1**C is a transverse cross-sectional view schematically showing a male and female connection structure according to one embodiment of the invention;

FIG. **2** is a perspective view schematically showing a male terminal used for one embodiment of the invention;

FIG. **3** is a perspective view schematically showing a female terminal used for one embodiment of the invention;

FIG. **4** is a perspective view schematically showing a plate used for one embodiment of the invention;

FIG. **5** is a perspective view schematically showing a state in the process of inserting the male terminal into the female terminal in one embodiment of the invention;

FIG. **6** is a partial enlarged view of a pressing part shown in FIG. **5**;

FIG. **7** is a perspective view schematically showing a state that the male terminal is inserted into the female terminal and an end part of the male terminal is held in the plate in one embodiment of the invention;

FIG. **8** is a partial enlarged view of a pressing part shown in FIG. **7**;

FIG. **9** is a perspective view schematically showing a state that the male terminal and the female terminal are electrically connected to each other in one embodiment of the invention;

FIG. **10** is a partial enlarged view of a pressing part shown in FIG. **9**;

FIG. **11** is a perspective view schematically showing a state in the process of removing the male terminal from the female terminal in one embodiment of the invention; and

FIG. **12** is a partial enlarged view of a pressing part shown in FIG. **11**.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Embodiment

The preferred embodiments according to the invention will be explained below referring to the drawings.

FIG. **1**A is a perspective view schematically showing a male and female connection structure according to one embodiment of the invention, FIG. **1**B is a longitudinal cross-sectional view schematically showing a male and female

connection structure according to one embodiment of the invention and FIG. **1**C is a transverse cross-sectional view schematically showing a male and female connection structure according to one embodiment of the invention.

Outline of Male and Female Connection Structure

First, referring to FIG. **1**, a male and female connection structure **1** according to the embodiment includes a male terminal **10** and a female terminal **30** to be electrically connected to the male terminal **10**. The female terminal **30** includes a terminal body part having a terminal current-carrying part **38** of a box shape to which the male terminal **10** is inserted and a crimping part **34** formed on the side of one end of the terminal current-carrying part **38** for fixing a wire (not shown) to the female terminal **30**, and a terminal box **32** having almost the same shape as the terminal current-carrying part **38** of the terminal body part, to be fitted to the terminal body part **38** and to be fixed to the terminal current-carrying part **38** by a claw part **32**a. And, the terminal box **32** includes a plate spring **20** integrally formed with the terminal box **32** as a spring for pressing the male terminal. And, the male terminal **10** has a stopper **18** which contacts one end of the terminal box **32** and/or terminal current-carrying part **38** when inserted into the female terminal. The male terminal **10** is inserted into the female terminal **30**, and is fixed to and held in the female terminal **30** by the plate spring **20**.

Further, the male and female connection structure **1** according to the embodiment is shown, as an example, in a case that it is used for a connection of a motor and an inverter which drive a hybrid electric vehicle (HVE) capable of reducing a discharge of toxic gases and reducing a fuel consumption extremely, and dependent on a system of the HEV, in a case that it is used for a high-capacity electric power harness where large current of not less than 100 A is carried. Particularly, it is shown in a case that it is adopted to a male connector of a dual-partitioning type formed by that a male housing where the male terminal **10** is housed and a female housing where the female terminal **30** is housed are fitted, the male connector being installed on the side of one end of the high-capacity electric power harness. Namely, an end part (a connection part **12** described below) of the male terminal **10** located in a side that is not inserted into the female terminal **30** is a male terminal of the male connect or of the high-capacity electric power harness, and is inserted into the motor and/or the inverter.

FIG. **1**B is a longitudinal cross-sectional view schematically showing the male and female connection structure **1** in a state that the male terminal **10** and the female terminal **30** are electrically connected to each other. The female terminal **30** has a dimple **36** electrically connectable to the male terminal **10** in an inner surface of the terminal current-carrying part **38**. And, the plate spring **20** is formed so as to face to the dimple **36** and has a pressing part **26** for pressing the male terminal **10** inserted into the terminal box **32** (terminal current-carrying part **38**) toward the dimple **36**. The male terminal **10** is inserted into a place that is on the dimple **36** and at a lower side of the pressing part **26** of the plate spring **20**. Further, although details will be described below, the female terminal **30** has a plate **40** as a press switching part for switching a shape of the plate spring **20** between a shape in a state (a pressed state) that the plate spring **20** presses the male terminal **10** and a shape in a state (a non-pressed state) that the plate spring **20** does not press the male terminal **10** in the terminal box **32**.

FIG. **1**C is a transverse cross-sectional view schematically showing the male and female connection structure **1** in a state that the male terminal **10** and the female terminal **30** are electrically connected to each other. The male terminal **10** is

formed so as to have a shape that at least a part thereof to be inserted into the terminal box **32** has a U-shaped cross-section. And, the male terminal **10** is electrically connected to the dimples **36** by that it is pressed toward a dimple **36** of the female terminal **30** by the plate spring **20** so as to be held by the female terminal **30**.

Detail of Male Terminal **10**

FIG. **2** is a perspective view schematically showing a male terminal used for one embodiment of the invention.

The male terminal **10** used for the embodiment is formed of a plate material having a long and thin shape which is formed of a high electrical conducting material such as copper. Particularly, the male terminal **10** includes the connection part **12** formed in one end to electrically connect to an external electric equipment, an insertion contact part **14** formed so as to extend from the connection part **12** to another end, sidewall parts **16** formed almost perpendicularly to a surface of the insertion contact part **14** along the longitudinal direction of the insertion contact part **14**, and stoppers **18** formed at ends of the sidewall parts **16**. The upper surfaces of the stoppers **18** are formed so as to be higher than the upper surfaces of the sidewall parts **16**, where the height means a height from a bottom plate **14**b.

And, the insertion contact part **14** includes an end portion **14**a formed at an end part of an opposite side of the connection part **12** (at an another end of the male terminal **10**), a taper part **14**c having a width that gradually becomes narrow toward the end portion **14**a from the connection part **12**, and the bottom plate **14**b formed between the taper part **14**c and the end portion **14**a. Further, the sidewall parts **16** is formed along edges of the bottom plate **14**b and the taper part **14**c. And, the end portion **14**a has an engagement hole **15** which is engaged with a plate **40** described below.

Further, the male terminal **10** can be formed of a high electrical conducting material having an electric conductivity of not less than 60% IACS. It is preferable that the terminal is formed of a high electrical conducting material having an electric conductivity of not less than 93% IACS. For example, the male terminal **10** can be formed of an oxygen free high conductivity copper having an electric conductivity of not less than 97% IACS. Further, "IACS" is short for "International Annealed Copper Standard".

Detail of Female Terminal **30**

FIG. **3** is a perspective view schematically showing a female terminal used for one embodiment of the invention.

The female terminal **30** used for the embodiment includes a terminal box **32** formed so as to have a box shape having a hollow square-shaped cross-section, a claw part **32**a formed on an upper surface of the terminal box **32** and being able to be bent toward an inside of the terminal box **32**, a terminal current-carrying part **38** fixed to an inside of the terminal box **32** by the claw part **32**a and formed so as to have a box shape having a hollow square-shaped cross-section, a plate spring **20** integrally formed with the terminal box **32**, a dimple **36** formed so as to electrically connect to the terminal current-carrying part **38** and so as to face to the plate spring **20**, and being able to be electrically connected to the male terminal **10** to be inserted, and a crimping part **34** formed in an opposite side to the terminal box **32** into which the male terminal **10** is inserted.

The plate spring **20** includes a pressing part **26** for pressing the bottom plate **14**b of the male terminal **10** to be inserted into the terminal current-carrying part **38** toward the dimple **36** (toward the lower surface of the terminal box **32**), and an edge part **22** having a protruding part **22**a whose protrusion is directed toward the lower surface of the terminal box **32**. The plate spring **20** is bent from the upper surface toward the lower surface of the terminal box **32** via a curved part, extends up to near the center of terminal box **32** on a plan view from the bent part toward the crimping part **34** at a gentle downward gradient, and after extends from the pressing part **26** closest to the dimple **36** at an upward gradient, is formed so as to have a shape that includes the edge part **22** having a protruding part **22**a via a part extending in a perpendicular direction to a surface of the plate **40**, in a state that the edge part **22** of the plate spring **20** is held in the plate **40**. And, the plate spring **20** presses the bottom plate **14**b of the male terminal **10** to be inserted into the terminal current-carrying part **38** toward the dimple **36**, so that it allows the bottom plate **14**b and the dimple **36** to be electrically connected and allows the male terminal **10** to be fixed to and held in the female terminal **30**.

And, the female terminal **30** includes the plate **40** having a plate spring insertion opening **42** into which the edge part **22** of the plate spring **20** is inserted and which is engaged with the plate spring **20** by the protruding part **22**a of the edge part **22**, and a male terminal insertion opening **46** into which the end portion **14**a of the male terminal **10** and which is engaged with the male terminal **10** by a protruding part **44**a of the engaging part **44**. Here, the terminal current-carrying part **38** has an opening **30**a in each of the upper surface and the lower surface. And, the plate **40** is formed, so that it is relatively movable to the plate spring **20** and the terminal current-carrying part **38**, and a plate upper part and a plate lower part thereof are inserted into the opening **30**a formed in the terminal current-carrying part **38**, and simultaneously, the plate upper part and the plate lower part thereof are brought into contact with an opening sidewall **30**b of the opening **30**a. Further, details of the plate upper part and the plate lower part will be explained below.

In the embodiment, in a state that the male terminal **10** and the female terminal **30** are not electrically connected to each other (including a case that the male terminal **10** is not inserted into the female terminal **30**), the edge part **22** of the plate spring **20** is inserted into the plate spring insertion opening **42** and the protruding part **22**a of the edge part **22** is engaged with the plate spring insertion opening **42**. Due to the fact that the protruding part **22**a of the edge part **22** is engaged with the plate spring insertion opening **42**, the plate spring **20** is maintained to have a shape that a distance between a surface of the dimple **36** and a surface of the pressing part **26** is broader than a thickness of the male terminal **10** (particularly, the bottom plate **14**b) to be inserted.

On the other hand, in a state that the male terminal **10** and the female terminal **30** are electrically connected to each other, the edge part **22** of the plate spring **20** is removed from the plate spring insertion opening **42**, so that the edge part **22** of the plate spring **20** is released from the plate spring insertion opening **42**. When the male terminal **10** is inserted up to a predetermined position of the female terminal **30** and the edge part **22** of the plate spring **20** is released from the plate spring insertion opening **42**, the plate spring **20** is maintained to have a shape that a distance between a surface of the dimple **36** and a surface of the pressing part **26** is not broader than a thickness of the male terminal **10** (particularly, the bottom plate **14**b) to be inserted. In this case, the male terminal **10** is pressed toward the dimple **36** by the pressing part **26**.

The terminal current-carrying part **38** is formed of a high electrical conducting material such as copper. Particularly, the terminal current-carrying part **38** can be formed of a high electrical conducting material having an electric conductivity of not less than 60% IACS. And, it is preferable that the terminal current-carrying part **38** is formed of a high electrical conducting material having an electric conductivity of not

less than 93% IACS. For example, the terminal current-carrying part **38** can be formed of an oxygen free high conductivity copper having an electric conductivity of not less than 97% IACS. And, the terminal current-carrying part **38** is covered with the terminal box **32** formed of a material which has a larger mechanical strength than a material constituting the terminal current-carrying part **38** and is held in the terminal box **32**. Here, the terminal box **32** and the plate **40** can be formed of SUS which is superior to a stress relaxation characteristic.

Detail of Plate **40**

FIG. **4** is a perspective view schematically showing a plate used for one embodiment of the invention.

The plate **40** used for the embodiment includes a plate upper part **40**a, a plate lower part **40**b opposite to the plate upper part **40**a, a plate spring insertion opening **42** formed between the plate upper part **40**a and the plate lower part **40**b as a spring insertion opening and a male terminal insertion opening **46** formed at a location adjacent to the plate spring insertion opening **42**, an engaging part **44** formed on the side of the plate spring insertion opening **42** of the male terminal insertion opening **46** and toward a normal direction of the surface of the plate **40** and four guide parts **48** formed by bending four corners of a flat plate almost at a right angle. Further, the guide parts **48** prevent the plate **40** from inclining to the terminal box **32** when the plate **40** moves along an inner wall of the terminal current-carrying part **38**.

The edge part **22** of the plate spring **20** is inserted into the plate spring insertion opening **42** and the protruding part **22**a of the edge part **22** is engaged with the plate spring insertion opening **42**, so that the plate spring insertion opening **42** holds the edge part **22** of the plate spring **20**. Further, the plate spring insertion opening **42** is engaged with the edge part **22** of the plate spring **20** before the male terminal **10** is inserted into the female terminal **30**. And, the male terminal insertion opening **46** is an opening into which the end portion **14**a of the male terminal **10** is inserted. And, when the end portion **14**a is inserted into the male terminal insertion opening **46**, the protruding part **44**a of the engaging part **44** is engaged with the engagement hole **15**. Due to this, the end portion **14**a of the male terminal **10** is engaged with the plate **40**.

Connection Method of Male Terminal **10** and Female Terminal **30**

FIG. **5** is a perspective view schematically showing a state in the process of inserting the male terminal into the female terminal in one embodiment of the invention, and FIG. **6** is a partial enlarged view of a pressing part shown in FIG. **5**.

First, a case that the male terminal **10** is inserted into the female terminal **30** will be explained. Further, in the embodiment, a direction that the male terminal **10** is inserted into the female terminal **30** may be referred to as "insertion direction" and a direction that the male terminal **10** is removed from the female terminal **30** may be referred to as "removal direction". For example, the insertion direction and the removal direction are directions that are nearly parallel to longitudinal directions of the male terminal **10** and the female terminal **30**. And, in the embodiment, the plate **40** is formed so as to be movable to at least the plate spring **20** along the insertion direction and the removal direction.

Referring to FIG. **5**, before the male terminal **10** is inserted into the female terminal **30** or in the middle of inserting the male terminal **10** into the female terminal **30** along the insertion direction, the edge part **22** of the plate spring **20** is engaged with the plate spring insertion opening **42** of the plate spring **20**. Due to this, the plate spring **20** is changed in shape and maintained to have the shape that a distance between the surface of the dimple **36** and the surface of the pressing part **26** is broader than a thickness of the male terminal **10** (particularly, the bottom plate **14**b) to be inserted. Namely, a space is formed between the plate spring **20** and the bottom plate **14**b so that the plate spring **20** is maintained to have a shape in the non-pressed state that the plate spring **20** does not press the male terminal **10**.

Referring to FIG. **6**, the plate **40** allows the plate spring **20** to maintain to have a shape in the non-pressed state, so that a space having a distance D is formed between the surface of the bottom plate **14**b and the surface of the pressing part **26**. In the embodiment, the distance D is broader than a thickness of the bottom plate **14**b. Consequently, no force (no energizing force) is applied to the male terminal **10** (particularly, the bottom plate **14**b) from the plate spring **20** until the male terminal **10** is inserted into an insertion position described below along the insertion direction.

FIG. **7** is a perspective view schematically showing a state that the male terminal is inserted into the female terminal and an end part of the male terminal is held in the plate in one embodiment of the invention, and FIG. **8** is a partial enlarged view of a pressing part shown in FIG. **7**.

Next, a state that the male terminal **10** is further inserted into the female terminal **30** will be explained. In this case, the end portion **14**a is inserted into the male terminal insertion opening **46** of the plate **40** and the protruding part **44**a of the engaging part **44** is engaged with the engagement hole **15** of the male terminal **10**, so that the male terminal **10** is held in the plate **40**. Namely, when the male terminal **10** is inserted into the female terminal **30** from a state shown in FIG. **5** to a state shown in FIG. **7**, the end portion **14**a of the male terminal **10** is inserted into the male terminal insertion opening **46** in the vicinity of a position where the plate lower part **40**b of the plate **40** contacts the opening sidewall **30**b (a sidewall of the opening **30**a on the near side to a side where the male terminal **10** is inserted), and the protruding part **44**a of the engaging part **44** is engaged with the engagement hole **15**.

In this state, the edge part **22** of the plate spring **20** remains in a state of being engaged with the plate spring insertion opening **42** of the plate **40**. Consequently, as shown in FIG. **8**, the plate **40** allows the plate spring **20** to maintain to have a shape in the non-pressed state, so that a space having a distance D is formed between the surface of the bottom plate **14**b and the surface of the pressing part **26**. In the case, the distance D is also broader than a thickness of the bottom plate **14**b. Therefore, no force (no energizing force) is applied to the bottom plate **14**b from the plate spring **20** until the male terminal **10** is inserted into an insertion position described below, and the surface of the bottom plate **14**b of the male terminal **10** does not contacts the plate spring **20** and the bottom plate **14**b is not pressed to the dimple **36**.

FIG. **9** is a perspective view schematically showing a state that the male terminal and the female terminal are electrically connected to each other in one embodiment of the invention, and FIG. **10** is a partial enlarged view of a pressing part shown in FIG. **9**.

Subsequently, when the male terminal **10** is further inserted into the female terminal **30**, since the protruding part **44**a of the engaging part **44** is engaged with the engagement hole **15**, the plate **40** moves in a direction that the plate upper part **40**a and the plate lower part **40**b get away from the opening sidewall **30**b in accordance with the movement of the male terminal **10** in the insertion direction. Here, a position of the plate spring insertion opening **42** of the plate **40** to the plate spring **20** also moves in accordance with the insertion of the male terminal **10**. And, if the position of the plate spring insertion opening **42** moves to a position that is nearer to the position of the edge part **22** of the plate spring **20** than a

position of the protruding part **22**a of the edge part **22**, the protruding part **22**a is released from the plate spring insertion opening **42**. Due to this, as shown in FIG. **9**, the plate spring **20** is released from the plate **40**. Further, a position of the plate **40** and a position of the male terminal **10** to the female terminal **30** where the protruding part **22**a is released from the plate spring insertion opening **42** are referred to as "a connection position".

The plate **40** moves to the connection position, so that the plate spring **20** is released from the plate **40**. And, as shown in FIG. **10**, the plate spring **20** is changed in shape to have a shape that the pressing part **26** applies a pressure to the bottom plate **14**b. Namely, the plate spring **20** contacts the bottom plate **14**b, and the plate spring **20** is changed in shape and maintained to have the shape in the pressed state that the plate spring **20** presses the male terminal **10** (namely, being switched from the non-pressed state to the pressed state). Due to this, the bottom plate **14**b electrically contacts the dimple **36** appropriately, so that the male terminal **10** and the female terminal **30** are electrically connected to each other, and large current can be fed between the male terminal **10** and the female terminal **30**.

FIG. **11** is a perspective view schematically showing a state in the process of removing the male terminal from the female terminal in one embodiment of the invention and FIG. **12** is a partial enlarged view of a pressing part shown in FIG. **11**.

Next, in the male terminal **10** and the female terminal **30** constituting the male and female connection structure **1**, a case that the male terminal **10** is removed from the female terminal **30** will be explained. Since the protruding part **44**a of the engaging part **44** of the plate **40** is engaged with the engagement hole **15**, in accordance with the movement of the male terminal **10** along the removal direction from the female terminal **30**, the plate **40** also follows the movement of the male terminal **10**. And, when the plate spring insertion opening **42** of the plate **40** reaches a position apart from the connection position in the removal direction, the edge part **22** of the plate spring **20** is inserted into the plate spring insertion opening **42** and the protruding part **22**a is engaged with the plate spring insertion opening **42** again. And, as shown in FIG. **11**, the plate spring **20** is switched and maintained in shape again to have the shape in the non-pressed state from the pressed state. Due to this, the male terminal **10** is electrically cut from the female terminal **30**.

In this state, as shown in FIG. **12**, the pressing part **26** does not contact the bottom plate **14**b, and the plate spring **20** is maintained to have a shape in the non-pressed state having the space of the distance D, so that the plate spring **20** does not press the bottom plate **14**b. And, when the male terminal **10** is further moved in the removal direction from the female terminal **30** (a direction to get away from the connection position and to be apart from the crimping part **34**), the plate lower part **40**b butts against the opening sidewall **30**b. When the plate lower part **40**b butts against the opening sidewall **30**b, the protruding part **44**a of the engaging part **44** is removed from the engagement hole **15** of the male terminal **10**, so that the male terminal **10** is disengaged from the plate **40**. Due to this, the male terminal **10** can be removed from the female terminal **30**.

Advantages of the Embodiment

The male and female connection structure **1** according to the embodiment of the invention includes the female terminal **30** having the plate **40** that is capable of automatically switching a shape of the plate spring **20** for pressing the male terminal **10** toward the dimple **36** between the pressed state and the non-pressed state in accordance with the insertion of the male terminal **10** into the female terminal **30**, namely, the male and female connection structure **1** includes the plate **40** as a press switching part that is capable of switching from the non-pressed state to the pressed state, if the male terminal **10** is inserted up to the connection position, by using an insertion force applied when the male terminal **10** is inserted into the female terminal **30**, and switching from the press state to the non-pressed state, if the male terminal **10** is removed from the connection position, by using an removal force applied when the male terminal **10** is removed from the female terminal **30**, so that in both cases that the male terminal **10** is inserted into the female terminal **30** and the male terminal **10** is removed from the female terminal **30**, a pressing down operation that an operator presses down the plate spring **20** separately by using a lock arm or the like becomes unnecessary, and simultaneously, it can be prevented that a force from the plate spring **20** is applied to the male terminal **10**, and as a result, the male terminal **10** can be easily inserted and removed into (from) the female terminal **30**. Further, when the male terminal **10** is inserted and removed into (from) the female terminal **30**, the surfaces of the male terminal **10** and the dimple **36** can be prevented from abrasion.

And, the male and female connection structure **1** according to the embodiment of the invention can use the plate **40** which is increased in a force (an energizing force) for pressing the male terminal **10** to the dimple **36**, so that a resistance of contact part between the male terminal **10** and the dimple **36** of the female terminal **30** can be reduced. Here, in the embodiment, when the male terminal **10** is inserted and removed into (from) the female terminal **30**, the plate spring **20** does not press the male terminal **10** to the dimple **36**, so that the surfaces of the male terminal **10** and the dimple **36** can be prevented from abrasion and simultaneously, the male and female connection structure **1** corresponding to a large current application can be provided.

Further, the male and female connection structure **1** according to the embodiment of the invention can use the plate spring **20** which has a large energizing force, so that it can be appropriately applied to, for example, a harness etc. for a motor car or the like which causes a vibration exceedingly.

In the male and female connection structure **1** according to the embodiment of the invention, when the male terminal **10** is inserted and removed into (from) the female terminal **30**, the space of the distance D is formed between the surface of the bottom plate **14**b and the surface of the pressing part **26**, but it is not indispensable to form the distance D. Namely, the male and female connection structure **1** can have a structure that at the insertion and removal of the male terminal **10** into (from) the female terminal **30**, the pressing part **26** contacts the bottom plate **14**b to an extent that the pressing part **26** does not press the bottom plate **14**b within a range of preventing the surfaces of male terminal **10** and dimple **36** from being worn away.

Although the invention has been described with respect to the specific embodiments for complete and clear disclosure, the appended claims are not to be thus limited but are to be construed as embodying all modifications and alternative constructions that may occur to one skilled in the art which fairly fall within the basic teaching herein set forth.

What is claimed is:

1. A male and female connection structure, comprising:

a female terminal; and

a male terminal to electrically connect to the female terminal by being inserted into a connection position of the

female terminal and to electrically disconnect from the female terminal by being withdrawn from the connection position,

wherein the female terminal comprises:

a dimple to electrically connect to the male terminal;

a male terminal pressing spring disposed opposite the dimple for pressing the male terminal to be inserted on the dimple against the dimple; and

a press switching part for switching between a non-pressed state that the male terminal pressing spring does not press the male terminal located in the female terminal and a pressed state that the male terminal pressing spring presses the male terminal located in the female terminal, by changing a shape of the male terminal pressing spring,

wherein the press switching part switches the non-pressed state to the pressed state, when the male terminal is inserted into the connection position, by using an insertion force applied when the male terminal is inserted into the female terminal, and

wherein the press switching part switches the pressed state to the non-pressed state, when the male terminal is withdrawn from the connection position, by using a withdrawal force applied when the male terminal is withdrawn from the female terminal.

2. The male and female connection structure according to claim **1**, wherein the press switching part comprises a spring insertion opening for engaging with an edge part of the male terminal pressing spring before the male terminal is inserted into the female terminal, and a male terminal insertion opening for engaging with an end part of the male terminal at a position adjacent to the spring insertion opening, and

wherein when the male terminal moves to the connection position along an insertion direction in which the male terminal is inserted while the end part of the male terminal is engaged with the male terminal insertion opening, the spring insertion opening is disengaged from the edge part of the male terminal pressing spring so as to switch the non-pressed state to the pressed state.

3. The male and female connection structure according to claim **2**, wherein when the male terminal moves along a withdrawal direction in which the male terminal is withdrawn and away from the connection position while the end part of the male terminal is engaged with the male terminal insertion opening, the spring insertion opening is engaged with the edge part of the male terminal pressing spring so as to switch the pressed state to the non-pressed state.

4. The male and female connection structure according to claim **3**, wherein the press switching part is movable with respect to the male terminal pressing spring along the insertion direction and the withdrawal direction.

5. The male and female connection structure according to claim **4**, wherein after the male terminal is inserted into the female terminal and the end part of the male terminal is engaged with the male terminal insertion opening, the press switching part moves to the connection position according as the male terminal moves in the insertion direction, and

wherein the spring insertion opening is disengaged from the edge part of the male terminal pressing spring at the connection position according as the male terminal moves in the insertion direction.

6. The male and female connection structure according to claim **4**, wherein the press switching part moves according as the male terminal moves in the withdrawal direction, and

wherein the spring insertion opening is engaged with the edge part of the male terminal pressing spring at a position away from the connection position in the withdrawal direction according as the male terminal moves in the withdrawal direction.

7. The male and female connection structure according to claim **1**, wherein the male terminal is inserted in a gap between the male terminal pressing spring and the dimple.

8. The male and female connection structure according to claim **1**, wherein, in the pressed state, the male terminal pressing spring and the dimple are placed on opposite sides of the male terminal.

9. The male and female connection structure according to claim **1**, wherein the male terminal pressing spring presses the male terminal toward the dimple.

10. The male and female connection structure according to claim **1**, wherein the press switching part comprises a spring insertion opening for engaging with an edge part of the male terminal pressing spring before the male terminal is inserted into the female terminal.

11. The male and female connection structure according to claim **10**, wherein the press switching part further comprises a male terminal insertion opening for engaging with an end part of the male terminal at a position adjacent to the spring insertion opening.

12. The male and female connection structure according to claim **1**, wherein the press switching part is movable with respect to the male terminal pressing spring along an insertion direction and a withdrawal direction of the male terminal.

13. A male and female connection structure, comprising:

a female terminal; and

a male terminal to electrically connect to the female terminal by being inserted into a connection position of the female terminal and to electrically disconnect from the female terminal by being withdrawn from the connection position,

wherein the female terminal comprises:

a dimple to electrically connect to the male terminal;

a male terminal pressing spring disposed opposite the dimple for pressing the male terminal to be inserted on the dimple against the dimple; and

a press switching part for switching between a non-pressed state that the male terminal pressing spring does not press the male terminal located in the female terminal and a pressed state that the male terminal pressing spring presses the male terminal located in the female terminal by changing a shape of the male terminal pressing spring by moving along a longitudinal direction of the female terminal,

wherein the press switching part engages with an edge part of the male terminal pressing spring before the male terminal is inserted into the female terminal,

wherein the press switching part switches the non-pressed state to the pressed state, when the male terminal is inserted into the connection position, by releasing an engaged edge part of the male terminal pressing spring by moving the press switching part along the longitudinal direction of the female terminal, and

wherein the press switching part switches the pressed state to the non-pressed state, when the male terminal is withdrawn from the connection position.

14. The male and female connection structure according to claim 13, wherein the press switching part switches the non-pressed state to the pressed state by using an insertion force applied when the male terminal is inserted into the female terminal.

15. The male and female connection structure according to claim 13, wherein the press switching part switches the pressed state to the non-pressed state by using a withdrawal force applied when the male terminal is withdrawn from the female terminal.

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