(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 3 076 496 A1

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
05.10.2016 Bulletin 2016/40

(51) Int Cl.:
H01R 13/66 *(2006.01)* ***H01R 24/30*** *(2011.01)*
H01R 13/713 *(2006.01)*

(21) Application number: **16159318.1**

(22) Date of filing: **09.03.2016**

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA ME
Designated Validation States:
MA MD

(30) Priority: **31.03.2015 JP 2015074238**

(71) Applicant: **Panasonic Intellectual Property Management Co., Ltd.**
Osaka-shi, Osaka 540-6207 (JP)

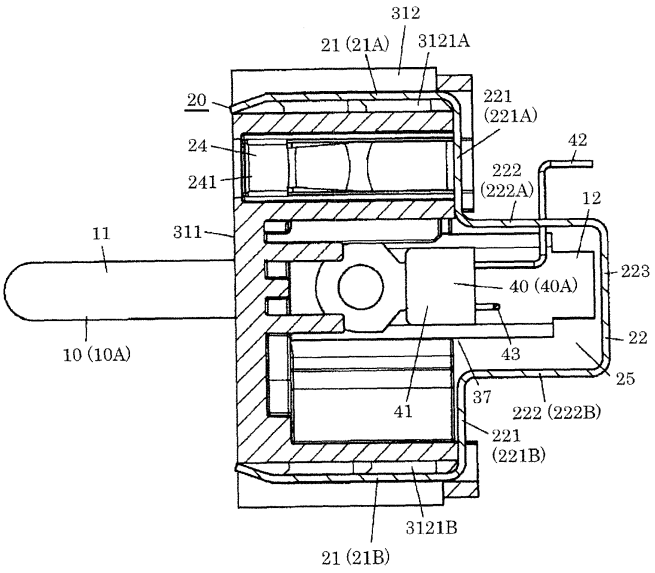
(72) Inventors:
- **KAWAMOTO, Takashi**
  Osaka-shi, Osaka 540-6207 (JP)
- **MORISHITA, Naoto**
  Osaka-shi, Osaka 540-6207 (JP)

(74) Representative: **Müller-Boré & Partner Patentanwälte PartG mbB**
Friedenheimer Brücke 21
80639 München (DE)

(54) PLUG WITH THERMAL SENSOR

(57) A plug according to the present invention includes: a plug body (30) which includes a front wall (311), and a peripheral wall (312) protruding rearward from the front wall (311); a plurality of conductive pins (10) housed in the plug body (30); an earth bracket (20) which includes a pair of contact portions (21) exposed from surfaces of the peripheral wall (312), and a joint portion (22) joining the pair of contact portions (21) in the plug body (30); and a plurality of temperature sensor elements (40) which detect temperatures of the plurality of conductive pins (10). The joint portion (22) is bent into a shape having a recess (25) which opens toward the front wall (311). The recess (25) forms at least a portion of a housing space (37) for housing the plurality of temperature sensor elements (40) between the front wall (311) and the earth bracket (20).

FIG. 1



EP 3 076 496 A1

Description

[Technical Field]

[0001] The present invention relates to plugs, and in particular relates to a plug which detects heat generated by a plurality of conductive pins.

[Background Art]

[0002] The plug disclosed in PTL 1 includes: a plug body which includes a front wall, and a peripheral wall having a hollow shape and protruding rearward from the front wall; a plurality of plug pins housed in the plug body such that front end portions of the plurality of plug pins protrude forward from the front wall; and a ground terminal which includes a pair of terminal portions exposed from surfaces of the peripheral wall, and a joint portion which joins the pair of terminals portions to one another in the plug body.

[0003] The plug disclosed in PTL 2 includes a pair of plug pins which are round rod shaped, and a thermistor which detects temperatures of the pair of plug pins. If the plug disclosed in PTL 2 is used, heat generated by the pair of plug pins due to poor contact between the plug and a receptacle can be detected.

[Citation List]

[Patent Literature]

[0004]

[PTL 1] International Patent Application Publication No. 2014/091552
[PTL 2] Japanese Unexamined Patent Application Publication No. 2014-38785

[Summary of Invention]

[Technical Problem]

[0005] The plug according to PTL 1 does not include a thermistor and cannot detect heat generated by a pair of pins. Thus, it is possible to provide the plug according to PTL 1 with a thermistor as disclosed in PTL 2.

[0006] The plug according to PTL 1 includes the joint portion of the ground terminal in the plug body. Accordingly, if a thermistor is provided in the plug disclosed in PTL 1, the thermistor needs to be disposed behind the ground terminal so as not to be in contact with the ground terminal. In this case, the plug body needs to have a size sufficient for housing the thermistor to be disposed behind the ground terminal. Consequently, the size of the plug body is unavoidably increased. Furthermore, if the thermistor is disposed behind the ground terminal, the thermistor and the plug pins are further away from one another, and thus it is difficult to accurately detect heat generated by the pair of plug pins.

[0007] An object of the present invention is to provide a plug which accurately detects heat generated by a plurality of conductive pins while avoiding an increase in the size of a plug body.

[Solution to Problem]

[0008] A plug according to the present invention includes: a plug body which includes a front wall, and a peripheral wall having a hollow shape and protruding rearward from the front wall; a plurality of conductive pins housed in the plug body such that front end portions of the plurality of conductive pins protrude forward from the front wall; a ground rail which includes a pair of contact portions having an elongated shape and exposed from surfaces of the peripheral wall, and a joint portion joining the pair of contact portions to one another in the plug body; and a plurality of temperature sensor elements which are, in the plug body, spaced apart from the plurality of conductive pins, and detect temperatures of the plurality of conductive pins. The joint portion is bent into a shape having a recess which opens toward the front wall. The recess forms at least a portion of a housing space for housing the plurality of temperature sensor elements between the front wall and the ground rail.

[Advantageous Effects of Invention]

[0009] The present invention achieves a plug which accurately detects heat generated by a plurality of conductive pins while avoiding an increase in the size of a plug body.

[Brief Description of Drawings]

[0010]

FIG. 1 is a cross-sectional view of a principal part of a plug according to an embodiment of the present invention;
FIG. 2 is an exploded perspective view of the plug according to the embodiment;
FIG. 3 is a front view of the plug according to the embodiment;
FIG. 4 is a plan view of the plug according to the embodiment;
FIG. 5 is a bottom view of the plug according to the embodiment;
FIG. 6 is a side view of a ground rail of the plug according to the embodiment;
FIG. 7 is a perspective view of an internal structure of the plug according to the embodiment;
FIG. 8 is a front view of the internal structure of the plug according to the embodiment;
FIG. 9 is a rear view of the internal structure of the plug according to the embodiment; and
FIG. 10 is a cross-sectional view of the plug accord-

ing to the embodiment.

[Description of Embodiments]

[Embodiment]

[0011] The following describes a plug according to an embodiment of the present invention, with reference to FIGS. 1 to 10. Note that FIG. 1 is a cross-sectional view taken along line A-A in FIG. 3. Note that the configuration of the plug is partially omitted in FIG. 1. FIG. 10 is a cross-sectional view taken along line B-B in FIG. 4.

[0012] The plug according to the present embodiment is a CEE7/7 plug. The plug according to the present embodiment includes a plurality of (two in the present embodiment) conductive pins (plug pins) 10, single ground rail (ground terminal) 20, plug body 30, a plurality of (two in the present embodiment) temperature sensor elements 40, and cable 50, as illustrated in FIGS. 2 to 5. In the following, one of two conductive pins 10 is referred to as first conductive pin 10A, whereas the other is referred to as second conductive pin 10B, when necessary. Furthermore, one of two temperature sensor elements 40 is referred to as first temperature sensor element 40A, whereas the other is referred to as second temperature sensor element 40B, when necessary.

[0013] Cable 50 includes five lines 51 to 55 and sheath 56 which covers five lines 51 to 55 as illustrated in FIG. 2. Five lines 51 to 55 are exposed from sheath 56 at a first end of cable 50, and a second end of cable 50 is connected to a given device (for example, a plug or a receptacle). Five lines 51 to 55 include two (first and second) conductive lines 51 and 52, ground line 53, two (first and second) signal lines 54 and 55. In the present embodiment, first conductive line 51 is a voltage line, and second conductive line 52 is a neutral line. First conductive line 51 is electrically connected to first conductive pin 10A, second conductive line 52 is electrically connected to second conductive pin 10B, ground line 53 is electrically connected to ground rail 20, first signal line 54 is electrically connected to first temperature sensor element 40A, and second signal line 55 is electrically connected to second temperature sensor element 40B.

[0014] First conductive pin 10A and second conductive pin 10B are each shaped like a rod made of metal, as illustrated in FIG. 2. Conductive pins 10 each include contact 11 and line connection 12, for example. Contact 11 is shaped like a round rod. Specifically, conductive pins 10 are round pins. A tip portion of contact 11 is used for an electrical connection with a receptacle in conformity with the plug according to the present embodiment. Line connection 12 is formed on the rear end side of contact 11. Line connection 12 is formed into a rectangle rod shape.

[0015] The plurality of conductive pins 10 are disposed parallel to one another lengthwise. In the present embodiment, first conductive pin 10A and second conductive pin 10B each have a length parallel to a first direction which is a front-back direction of the plug (vertical direction in FIGS. 4 and 5), and are spaced apart from one another in a second direction (for example, the lateral direction of the plug, and the lateral direction in FIG. 3) orthogonal to the first direction.

[0016] Ground rail 20 is formed of metal. More specifically, ground rail 20 is obtained by bending a metal plate having a predetermined shape. Ground rail 20 includes a pair of contact portions 21, joint portion 22, line connection 23, and ground pin receptacle 24, as illustrated in FIGS. 2 and 6. Hereinafter, one of the pair of contact portions 21 is referred to as first contact portion 21A, and the other is referred to as second contact portion 21B, when necessary.

[0017] The pair of contact portions 21 each have an elongated shape. The pair of contact portions 21 are disposed parallel to one another lengthwise. In the present embodiment, first contact portion 21A and second contact portion 21B each have a length parallel to the first direction (vertical direction in FIGS. 4 and 5), and are spaced apart from one another in a third direction (for example, the vertical direction of the plug, and the vertical direction in FIG. 3) orthogonal to the first direction and the second direction. The pair of contact portions 21 are at the same position in the first direction.

[0018] Joint portion 22 connects the pair of contact portions 21 to one another. The center portion of joint portion 22 is recessed rearward, thus forming recess 25 which opens frontward.

[0019] More specifically, as illustrated in FIG. 6, joint portion 22 includes a pair of vertical portions 221, a pair of horizontal portions 222, and connection portion 223. Hereinafter, one of the pair of vertical portions 221 is referred to as first vertical portion 221A, and the other is referred to as second vertical portion 221B, when necessary. Furthermore, one of the pair of horizontal portions 222 is referred to as first horizontal portion 222A, and the other is referred to as second horizontal portion 222B, when necessary.

[0020] First vertical portion 221A extends from one of the pair of contact portions 21 (first contact portion 21A) toward the other (second contact portion 21B), and second vertical portion 221B extends from the other of the pair of contact portions 21 (second contact portion 21B) to the one (first contact portion 21A). In the present embodiment, first vertical portion 221A extends, in the third direction, from the rear end of first contact portion 21A, and second vertical portion 221B extends, in the third direction, from the rear end of second contact portion 21B. In the present embodiment, first vertical portion 221A is longer than second vertical portion 221B. However, first vertical portion 221A may be shorter than second vertical portion 221B, or may have the same length as second vertical portion 221B.

[0021] First horizontal portion 222A extends rearward from first vertical portion 221A. Second horizontal portion 222B extends rearward from second vertical portion 221B. In the present embodiment, first horizontal portion

222A extends, in the first direction, from the end of first vertical portion 221A in a direction away from first contact portion 21A, and second horizontal portion 222B extends, in the first direction, from the end of second vertical portion 221B in a direction away from second contact portion 21B. First horizontal portion 222A and second horizontal portion 222B are parallel to one another, and have the same length.

[0022] Connection portion 223 joins first horizontal portion 222A and second horizontal portion 222B to one another. In the present embodiment, connection portion 223 extends in the third direction, and joins the ends of first horizontal portion 222A and second horizontal portion 222B to one another. Note that the total length of connection portion 223, first vertical portion 221A, and second vertical portion 221B is substantially equal to the distance between the pair of contact portions 21.

[0023] Joint portion 22 forms recess 25 which has a space surrounded by first horizontal portion 222A, second horizontal portion 222B, and connection portion 223.

[0024] Line connection 23 is used for connecting ground line 53. As illustrated in FIG. 2, line connection 23 has a plate-like shape, and is provided at joint portion 22. More specifically, line connection 23 extends, in the third direction, from first horizontal portion 222A of joint portion 22 in a direction away from second horizontal portion 222B. Note that line connection 23 may be provided at a portion of joint portion 22 other than first horizontal portion 222A.

[0025] Ground pin receptacle 24 is used for connection to a ground pin arbitrarily included in a receptacle to which the plug according to the present embodiment is connected. Ground pin receptacle 24 includes a pair of spring portions 241. Ground pin receptacle 24 holds a ground pin between the pair of spring portions 241. The pair of spring portions 241 are provided at joint portion 22. More specifically, the pair of spring portions 241 extend from the sides (lateral sides in the width direction) of first vertical portion 221A forward (toward first contact portion 21A in the first direction).

[0026] First temperature sensor element 40A and second temperature sensor element 40B each include temperature sensitive portion 41, and a pair of terminals (lead terminals) 42 and 43, as illustrated in FIGS. 7 to 9. Temperature sensitive portion 41 is a portion which detects the ambient temperature. Temperature sensitive portion 41 has a plate-like shape, and includes flat temperature sensing surface 44. Temperature sensor elements 40 are, for example, thermistors, or more specifically, positive temperature coefficient (PTC) thermistors. Thus, temperature sensitive portion 41 has a resistance that varies according to the ambient temperature.

[0027] Terminal 43 of first temperature sensor element 40A and terminal 43 of second temperature sensor element 40B are electrically connected to one another. Specifically, first temperature sensor element 40A and second temperature sensor element 40B are connected in series. Terminal 43 of first temperature sensor element 40A and terminal 43 of second temperature sensor element are output terminals, and electrically connected to first signal line 54 and second signal line 55, respectively.

[0028] The plurality of temperature sensor elements 40 are spaced apart from the plurality of conductive pins 10, and detect temperatures of the plurality of conductive pins 10. In particular, the plurality of temperature sensor elements 40 include first temperature sensor element 40A, and second temperature sensor element 40B different from first temperature sensor element 40A, in the present embodiment.

[0029] First temperature sensor element 40A is used to detect the temperature of first conductive pin 10A. In particular, temperature sensing surface 44 of first temperature sensor element 40A is opposed to line connection 12 of first conductive pin 10A.

[0030] Second temperature sensor element 40B is used to detect the temperature of second conductive pin 10B. In particular, temperature sensing surface 44 of second temperature sensor element 40B is opposed to line connection 12 of second conductive pin 10B.

[0031] Plug body 30 includes first cover (front cover) 31, body block 32, second cover (rear cover) 33, shell 34, a pair of screws 35, and contact prevention member 36, as illustrated in FIGS. 2 to 5. Furthermore, plug body 30 has housing space 37 for housing the plurality of temperature sensor elements 40, as illustrated in FIG. 1.

[0032] First cover 31, body block 32, second cover 33, shell 34, and contact prevention member 36 are formed of electrically insulating resin.

[0033] First cover 31 mainly forms a front side portion of plug body 30. First cover 31 includes front wall 311 and peripheral wall 312.

[0034] Front wall 311 is a front wall of plug body 30. Front wall 311 has a substantially disk-like shape. Front wall 311 includes a plurality of (two in the present embodiment) conductive pin insertion holes 3111, and ground pin receiving hole 3112, as illustrated in FIG. 2. Hereinafter, one of two conductive pin insertion holes 3111 is referred to as first conductive pin insertion hole 3111A, and the other is referred to as second conductive pin insertion hole 3111B, when necessary. Conductive pin insertion holes 3111 each have a size which allows contact 11 of conductive pin 10 to pass through, but does not allow line connection 12 to pass through. In the present embodiment, conductive pin insertion holes 3111 have a round shape. Ground pin receiving hole 3112 is formed in a size which allows the aforementioned ground pin to pass through. In the present embodiment, ground pin receiving hole 3112 has a round shape.

[0035] Peripheral wall 312 is a peripheral wall of plug body 30. Peripheral wall 312 has a hollow shape. In the present embodiment, peripheral wall 312 has a hollow square shape, in particular. Peripheral wall 312 protrudes rearward from front wall 311. Peripheral wall 312 has a pair of grooves 3121 (3121A and 3121B) for exposing the pair of contact portions 21. The pair of grooves 3121A and 3121B are formed in the sides of peripheral wall 312

in the third direction. Specifically, the pair of grooves 3121A and 3121B are spaced apart from one another in the third direction, as illustrated in FIG. 3. The pair of grooves 3121A and 3121B are located between first conductive pin insertion hole 3111A and second conductive pin insertion hole 3111B, in the second direction. The rear ends of the pair of grooves 3121A and 3121B are both open. Peripheral wall 312 includes, on surfaces in the third direction, a pair of first engagement portions 3122 spaced apart from one another in the second direction. First engagement portions 3122 are used for connecting first cover 31 and body block 32 to one another.

[0036] In the plug according to the present embodiment, first conductive pin 10A, second conductive pin 10B, and ground rail 20 are attached to first cover 31.

[0037] Ground rail 20 is disposed behind front wall 311 to position the pair of contact portions 21A and 21B in the pair of groove 3121A and 3121B of peripheral wall 312, as illustrated in FIG. 1. In this manner, housing space 37 is formed between front wall 311 and ground rail 20. Recess 25 of joint portion 22 of ground rail 20 opens toward front wall 311, and forms a portion of housing space 37 (rear portion in the present embodiment).

[0038] First conductive pin 10A is attached to first cover 31 such that the front end portion (contact 11) protrudes forward from front wall 311 through first conductive pin insertion hole 3111A, as illustrated in FIG. 2. Second conductive pin 10B is attached to first cover 31 such that the front end portion (contact 11) protrudes forward from front wall 311 through second conductive pin insertion hole 3111B. This places first conductive pin 10A and second conductive pin 10B on the sides of housing space 37 in the second direction. Specifically, housing space 37 is surrounded by first conductive pin 10A, second conductive pin 10B, and the pair of contact portions 21A and 21B.

[0039] Body block 32 mainly forms a rear portion of plug body 30, and includes a pair of side walls 321 (321A, 321B), and storing portion 322 located between the pair of side walls 321.

[0040] The pair of side walls 321 each have a plate-like shape. The pair of side walls 321 each include recess 3211 and a pair of second engagement portions 3212. Recess 3211 houses line connection 12 of conductive pin 10. Recess 3211 is formed in the external surface of side wall 321 (on the side of side wall 321 opposite storing portion 322). The pair of second engagement portions 3212 are spaced apart from one another in the third direction. Body block 32 includes four second engagement portions 3212 in total. Second engagement portions 3212 are used for connecting body block 32 and first cover 31 to one another.

[0041] Storing portion 322 houses the plurality of temperature sensor elements 40 (first temperature sensor elements 40A and 40B), as illustrated in FIG. 10. Storing portion 322 is used to electrically insulate the plurality of temperature sensor elements 40 from the plurality of conductive pins 10 and ground rail 20. Storing portion 322 includes two walls 3221 (3221A and 3221B) parallel to one another. Two walls 3221 each have a plate-like shape. Storing portion 322 has a rectangular box-like shape, one side of which is open (upper surface in FIG. 10), for example. In the present embodiment, the external surface of wall 3221A (the surface facing outside of storing portion 322, the right surface in FIG. 10) serves as a bottom surface of recess 3211 of side wall 321A, and the external surface of wall 3221B (the surface facing outside of storing portion 322, the left surface in FIG. 10) serves as a bottom surface of recess 3211 of side wall 321B.

[0042] Second cover 33 is attached to the rear side of body block 32 to hold cable 50 between body block 32 and second cover 33. Second cover 33 has a plate-like shape. In the present embodiment, second cover 33 is fixed to body block 32 using the pair of screws 35.

[0043] Shell 34 covers a portion of first cover 31, body block 32, second cover 33, and a first end of cable 50. Shell 34 is a component formed by insert molding, rather than a component prepared in advance. Thus, shell 34 is not illustrated in FIG. 2.

[0044] Contact prevention member 36 is a member for preventing contact between ground rail 20 and the output terminals of temperature sensor elements 40. In the plug according to the present embodiment, first temperature sensor element 40A and second temperature sensor element 40B are located in housing space 37 between front wall 311 and ground rail 20, as illustrated in FIG. 1. Accordingly, output terminal 42 of first temperature sensor element 40A extends beside ground rail 20 (in particular, joint portion 22), to connect first temperature sensor element 40A and first signal line 54 to one another. Similarly, output terminal 42 of second temperature sensor element 40B extends beside ground rail 20 (in particular joint portion 22).

[0045] Contact prevention member 36 includes first contact prevention portion 361 (361A), second contact prevention portion 361 (361B), and joining portion 362 which joins first contact prevention portion 361A and second contact prevention portion 361B to one another, as illustrated in FIGS. 8 and 9.

[0046] First contact prevention portion 361A is located between output terminal 42 of first temperature sensor element 40A and ground rail 20. First contact prevention portion 361A is sized to cover the entirety of output terminal 42. Second contact prevention portion 361B is located between output terminal 42 of second temperature sensor element 40B and ground rail 20. Second contact prevention portion 361B is sized to cover the entirety of output terminal 42.

[0047] Joining portion 362 has a shape which engages with a portion of body block 32. Accordingly, contact prevention member 36 is attached to body block 32 via joining portion 362.

[0048] A brief description of a method for assembling the plug according to the present embodiment is now given. The description below is a mere example, and a method for assembling the plug according to the present

embodiment is not limited to the example below.

[0049] First, first conductive line 51 of cable 50 is connected to line connection 12 of first conductive pin 10A, second conductive line 52 is connected to line connection 12 of second conductive pin 10B, first signal line 54 is connected to output terminal 42 of first temperature sensor element 40A, and second signal line 55 is connected to output terminal 42 of second temperature sensor element 40B.

[0050] Next, temperature sensor elements 40A and 40B are housed into storing portion 322 of body block 32. At this time, as illustrated in FIG. 10, temperature sensing surface 44 of first temperature sensor element 40A is opposed to wall 3221A, and temperature sensing surface 44 of second temperature sensor element 40B is opposed to wall 3221B. Furthermore, contact prevention member 36 is attached to body block 32.

[0051] Line connection 12 of first conductive pin 10A is disposed in recess 3211 of side wall 321A of body block 32, and line connection 12 of second conductive pin 10B is disposed in recess 3211 of side wall 321B of body block 32.

[0052] In this manner, as illustrated in FIG. 10, temperature sensing surface 44 of first temperature sensor element 40A is opposed to line connection 12 of first conductive pin 10A and furthermore, wall 3221A is located between temperature sensing surface 44 of first temperature sensor element 40A and line connection 12 of first conductive pin 10A. Also, temperature sensing surface 44 of second temperature sensor element 40B is opposed to line connection 12 of second conductive pin 10B and furthermore, wall 3221B is located between temperature sensing surface 44 of second temperature sensor element 40B and line connection 12 of second conductive pin 10B.

[0053] Next, ground rail 20 is disposed in a predetermined position of body block 32. In this manner, storing portion 322 of body block 32 is located in a space (housing space 37) surrounded by the pair of contact portions 21A and 21B and joint portion 22 of ground rail 20. As illustrated in FIGS. 7 to 9, output terminals 42 of first temperature sensor element 40A and second temperature sensor element 40B extend beside ground rail 20. However, first contact prevention portion 361A is located between output terminal 42 of first temperature sensor element 40A and ground rail 20, and second contact prevention portion 361B is located between output terminal 42 of second temperature sensor element 40B and ground rail 20.

[0054] Ground line 53 of cable 50 is electrically connected to line connection 23 of ground rail 20.

[0055] After that, first cover 31 is attached to the front side of body block 32, and second cover 33 is attached to the rear side of body block 32.

[0056] When first cover 31 is attached to body block 32, contact 11 of first conductive pin 10A and contact 11 of second conductive pin 10B are inserted into first conductive pin insertion hole 3111A and second conductive pin insertion hole 3111B, respectively. Furthermore, the pair of contact portions 21A and 21B of ground rail 20 are disposed in the pair of grooves 3121A and 3121B, respectively. Furthermore, ground pin receptacle 24 of ground rail 20 is inserted into ground pin receiving hole 3112. Four first engagement portions 3122 of peripheral wall 312 and four second engagement portions 3212 of body block 32 are engaged with one another so that first cover 31 is fixed to body block 32. Accordingly, temperature sensor elements 40 are housed in housing space 37, as illustrated in FIG. 1.

[0057] Second cover 33 is attached to the rear side of body block 32 using the pair of screws 35.

[0058] Lastly, shell 34 is formed by insert molding.

[0059] The above achieves the plug according to the present embodiment as illustrated in FIGS. 3 to 5. The plug according to the present embodiment includes plug body 30 which includes front wall 311, and peripheral wall 312 having a hollow shape and protruding rearward from front wall 311; a plurality of conductive pins 10 housed in plug body 30 such that front end portions (contacts) 11 of the plurality of conductive pins 10 protrude forward from front wall 311; a plurality of temperature sensor elements 40 which are, in plug body 30, spaced apart from the plurality of conductive pins 10, and detect temperatures of the plurality of conductive pins 10; and ground rail 20 which includes a pair of contact portions 21 having an elongated shape and exposed from surfaces of peripheral wall 312, and a joint portion joining the pair of contact portions 21 to one another in plug body 30. Joint portion 22 is bent into a shape having recess 25 which opens toward front wall 311. Recess 25 forms at least a portion of housing space 37 for housing the plurality of temperature sensor elements 40 between front wall 311 and ground rail 20.

[Other Embodiments]

[0060] In a plug according to another embodiment of the present invention, the joint portion (22) may include: vertical portions (221) each extending from a different one of the pair of contact portions (21) toward the other of the pair of contact portions (21); a first horizontal portion (222A) extending rearward from one of the vertical portions (221); a second horizontal portion (222B) extending rearward from the other of the vertical portions (221); and a connection portion (223) joining the first horizontal portion (222A) and the second horizontal portion (222B) to one another. In this case, the recess (25) has a space surrounded by the first horizontal portion (222A), the second horizontal portion (222B), and the connection portion (223).

[0061] Thus, in the plug according to the present invention, the joint portion (22) may be bent into a shape having the recess (25) which opens toward the front wall (311).

[0062] In a plug according to another embodiment of the present invention, the recess (25) may form not a

portion of, but the entirety of a housing space (37). Thus, if the recess (25) forms at least a portion of the housing space (37), an increase in the size of the plug body (30) can be prevented.

[0063] A plug according to another embodiment of the present invention may include: a first signal line (54) extending beside the ground rail (20) and connected to the first temperature sensor element (40A); and a second signal line (55) extending beside the ground rail (20) and connected to the second temperature sensor element (40B). The plug body (30) further includes a first contact prevention portion (361A) and a second contact prevention portion (361B) which are electrically insulating. The first contact prevention portion (361A) is located between the first signal line (54) and the ground rail (20). The second contact prevention portion (361B) is located between the second signal line (55) and the ground rail (20).

[0064] The shapes of the first contact prevention portion (361A) and the second contact prevention portion (361B) are not particularly limited, and may be shapes which prevent contact with the ground rail (20).

[0065] In other words, in the plug according to the present invention, an electrically insulating member may be disposed between the ground rail (20) and a line for extracting the output of a temperature sensitive portion (41) of each temperature sensor element (40) to the outside.

[0066] A plug according to another embodiment of the present invention may not include the cable (50). In this case, the plug may include a terminal block to which the cable (50) is detachably connected.

[0067] A plug according to another embodiment of the present invention may not include the shell (34).

[0068] In a plug according to another embodiment of the present invention, the plug body (30) may be a stationary plug body.

[0069] In a plug according to another embodiment of the present invention, the temperature sensor elements (40) may be negative temperature coefficient (NTC) thermistors. In other words, the type of the temperature sensor elements (40) is not particularly limited.

[0070] The plug according to the present invention may not be a CEE7/7 plug. For example, the plug according to the present invention may be a plug compatible with a standard (such as CEE7/4) other than CEE7/7. Thus, the present invention is applicable to a plug which includes a ground rail. The number of lines of the cable (50), the number of the conductive pins (10), whether the ground pin receptacle (24) is included, and arrangement of the pins (conductive pins and a ground pin), for instance, are changed according to a standard. Furthermore, the shape of the conductive pins (10) is also changed according to a standard. For example, the conductive pins (10) may have a rectangular rod shape. In other words, the conductive pins (10) may be rectangular pins.

[Aspects of Present Invention]

[0071] As is clear from the above embodiments, a plug according to a first aspect of the present invention includes: a plug body (30) which includes a front wall (311), and a peripheral wall (312) having a hollow shape and protruding rearward from the front wall (311); a plurality of conductive pins (10) housed in the plug body (30) such that front end portions (contacts 11) of the plurality of conductive pins (10) protrude forward from the front wall (311); a ground rail (20) which includes a pair of contact portions (21) having an elongated shape and exposed from surfaces of the peripheral wall (312), and a joint portion (22) joining the pair of contact portions (21) to one another in the plug body (30); and a plurality of temperature sensor elements (40) which are, in the plug body (30), spaced apart from the plurality of conductive pins (10), and detect temperatures of the plurality of conductive pins (10). The joint portion (22) is bent into a shape having a recess (25) which opens toward the front wall (311). The recess (25) forms at least a portion of a housing space (37) for housing the plurality of temperature sensor elements (40) between the front wall (311) and the ground rail (20).

[0072] According to the plug according to the first aspect, the joint portion (22) of the ground rail (20) is bent into a shape having the recess (25) which opens toward the front wall (311), and the recess (25) forms at least a portion of the housing space (37) for housing the plurality of temperature sensor elements (40) between the front wall (311) and the ground rail (20). The plurality of temperature sensor elements (40) are housed not behind the ground rail (20), but in front of the ground rail (20). Accordingly, an increase in the size of the plug body (30) is prevented. Furthermore, the temperature sensor elements (40) are disposed closer to the front end portions of the conductive pins (10). Typically, heat is generated at the front end portions of the conductive pins (10). The accuracy of detecting heat generated by the conductive pins (10) thus improves. Furthermore, the plug includes the plurality of temperature sensor elements (40) which detect temperatures of the plurality of conductive pins (10), and thus more accurately detects heat generated by the plurality of conductive pins (10) than the case where the plug includes only one temperature sensor element for the plurality of conductive pins (10). Thus, heat generated by the plurality of conductive pins (10) is accurately detected while preventing an increase in the size of the plug body (30).

[0073] A plug according to a second aspect of the present invention is achieved by a combination with the first aspect. In the second aspect, the joint portion (22) includes: a first vertical portion (221A) extending from a first contact portion of the pair of contact portions (21) toward a second contact portion of the pair of contact portions (21); a second vertical portion (221B) extending from the second contact portion toward the first contact portion; a first horizontal portion (222A) extending rear-

ward from the first vertical portion (221A); a second horizontal portion (222B) extending rearward from the second vertical portion (221B); and a connection portion (223) joining the first horizontal portion (222A) and the second horizontal portion (222B) to one another The recess (25) has a space surrounded by the first horizontal portion (222A), the second horizontal portion (222B), and the connection portion (223).

[0074] According to the plug according to the second aspect, a first temperature sensor element (40A) and a second temperature sensor element (40B) are housed in a space surrounded by a first conductive pin (10A), a second conductive pin (10B), and the pair of contact portions (21). Accordingly, an increase in the size of the plug body (30) can be further prevented.

[0075] A plug according to a third embodiment of the present invention is achieved by a combination with the first or second aspect. In the third aspect, the plurality of conductive pins (10) include a first conductive pin (10A) and a second conductive pin (10B). The first conductive pin (10A) and the second conductive pin (10B) are spaced apart from one another in a second direction orthogonal to a first direction along a front-rear direction of the plug body (30). The pair of contact portions (21A, 21B) are spaced apart from one another in a third direction orthogonal to the first direction and the second direction, and located between the first conductive pin (10A) and the second conductive pin (10B) in the second direction. The plurality of temperature sensor elements (40) include a first temperature sensor element (40A) which detects a temperature of the first conductive pin (10A), and a second temperature sensor element (40B) which detects a temperature of the second conductive pin (10B). The housing space (37) is surrounded by the first conductive pin (10A), the second conductive pin (10B), and the pair of contact portions (21A, 21B).

[0076] The plug according to the third aspect, the first temperature sensor element (40A) and the second temperature sensor element (40B) are housed in a space surrounded by the first conductive pin (10A), the second conductive pin (10B), and the pair of contact portions (21A, 21B). Accordingly, a plug can be further miniaturized.

[0077] A plug according to a fourth aspect of the present invention is achieved by a combination with the third aspect. In the fourth aspect, the plug body (30) further includes a first contact prevention portion (361A) and a second contact prevention portion (361B) which are electrically insulating. The first temperature sensor element (40A) and the second temperature sensor element (40B) have respective output terminals (42) extending beside the ground rail (20). The first contact prevention portion (361A) is located between the output terminal (42) of the first temperature sensor element (40A) and the ground rail (20). The second contact prevention portion (361B) is located between the output terminal (42) of the second temperature sensor element (40B) and the ground rail (20).

[0078] The plug according to the fourth aspect reliably prevents the first and second temperature sensor elements (40A, 40B) from being grounded. Accordingly, reliability of temperature detection by the plug improves.

[0079] A plug according to a fifth aspect of the present invention is achieved by a combination with the third aspect. In the fifth aspect, the plug further includes: a first signal line (54) extending beside the ground rail (20) and connected to the first temperature sensor element (40A); and a second signal line (55) extending beside the ground rail (20) and connected to the second temperature sensor element (40B). The plug body (30) further includes a first contact prevention portion (361A) and a second contact prevention portion (361B) which are electrically insulating. The first contact prevention portion (361A) is located between the first signal line (54) and the ground rail (20). The second contact prevention portion (361B) is located between the second signal line (55) and the ground rail (20).

[0080] The plug according to the fifth aspect reliably prevents the first and second temperature sensor elements (40A, 40B) from being grounded. Accordingly, reliability of temperature detection by the plug improves.

[0081] A plug according to a sixth aspect of the present invention is achieved by a combination with any one of the third to fifth aspects. In the sixth aspect, the plug body (30) further includes a first wall (3221A) and a second wall (3221B) which are electrically insulating. The first wall (3221A) is located between the first conductive pin (10A) and the first temperature sensor element (40A). The second wall (3221B) is located between the second conductive pin (10B) and the second temperature sensor element (40B).

[0082] The plug according to the sixth aspect electrically insulates the first and second conductive pins (10A, 10B) and the first and second temperature sensor elements (40A, 40B) from one another, reliably. Furthermore, the first and second walls (3221A, 3221B) help conducting heat from the first and second conductive pins (10A, 10B) to the first and second temperature sensor elements (40A, 40B), and thus the accuracy of detecting heat generated by the first and second conductive pins (10A, 10B) improves.

[0083] Although the present invention has been described and illustrated in detail, it is clearly understood that the same is by way of example only and is not to be taken by way of limitation, the scope of the present invention being limited only by the terms of the appended claims.

[Reference Signs List]

[0084]

10	conductive pin
10A	first conductive pin
10B	second conductive pin
20	ground rail

21	contact portion
22	joint portion
221A	first vertical portion
221B	second vertical portion
222A	first horizontal portion
222B	second horizontal portion
223	connection portion
25	recess
30	plug body
311	front wall
312	peripheral wall
3221A	first wall
3221B	second wall
361A	first contact prevention portion
361B	second contact prevention portion
37	housing space
40	temperature sensor element
40A	first temperature sensor element
40B	second temperature sensor element
42	output terminal
54	first signal line
55	second signal line

Claims

1. A plug comprising:

a plug body which includes a front wall, and a peripheral wall having a hollow shape and protruding rearward from the front wall;
a plurality of conductive pins housed in the plug body such that front end portions of the plurality of conductive pins protrude forward from the front wall;
a ground rail which includes a pair of contact portions having an elongated shape and exposed from surfaces of the peripheral wall, and a joint portion joining the pair of contact portions to one another in the plug body; and
a plurality of temperature sensor elements which are, in the plug body, spaced apart from the plurality of conductive pins, and detect temperatures of the plurality of conductive pins, wherein
the joint portion is bent into a shape having a recess which opens toward the front wall, and
the recess forms at least a portion of a housing space for housing the plurality of temperature sensor elements between the front wall and the ground rail.

2. The plug according to claim 1, wherein
the joint portion includes:

a first vertical portion extending from a first contact portion of the pair of contact portions toward a second contact portion of the pair of contact portions;
a second vertical portion extending from the second contact portion toward the first contact portion;
a first horizontal portion extending rearward from the first vertical portion;
a second horizontal portion extending rearward from the second vertical portion; and
a connection portion joining the first horizontal portion and the second horizontal portion to one another, and
the recess has a space surrounded by the first horizontal portion, the second horizontal portion, and the connection portion.

3. The plug according to claim 1 or 2, wherein
the plurality of conductive pins include a first conductive pin and a second conductive pin,
the first conductive pin and the second conductive pin are spaced apart from one another in a second direction orthogonal to a first direction along a front-rear direction of the plug body,
the pair of contact portions are spaced apart from one another in a third direction orthogonal to the first direction and the second direction, and located between the first conductive pin and the second conductive pin in the second direction,
the plurality of temperature sensor elements include a first temperature sensor element which detects a temperature of the first conductive pin, and a second temperature sensor element which detects a temperature of the second conductive pin, and
the housing space is surrounded by the first conductive pin, the second conductive pin, and the pair of contact portions.

4. The plug according to claim 3, wherein
the plug body further includes a first contact prevention portion and a second contact prevention portion which are electrically insulating,
the first temperature sensor element and the second temperature sensor element have respective output terminals extending beside the ground rail,
the first contact prevention portion is located between the output terminal of the first temperature sensor element and the ground rail, and
the second contact prevention portion is located between the output terminal of the second temperature sensor element and the ground rail.

5. The plug according to claim 3, further comprising:

a first signal line extending beside the ground rail and connected to the first temperature sensor element; and
a second signal line extending beside the ground rail and connected to the second temperature sensor element, wherein

the plug body further includes a first contact prevention portion and a second contact prevention portion which are electrically insulating,
the first contact prevention portion is located between the first signal line and the ground rail, and
the second contact prevention portion is located between the second signal line and the ground rail.

6. The plug according to any one of claims 3 to 5, wherein
the plug body further includes a first wall and a second wall which are electrically insulating,
the first wall is located between the first conductive pin and the first temperature sensor element, and
the second wall is located between the second conductive pin and the second temperature sensor element.

FIG. 1

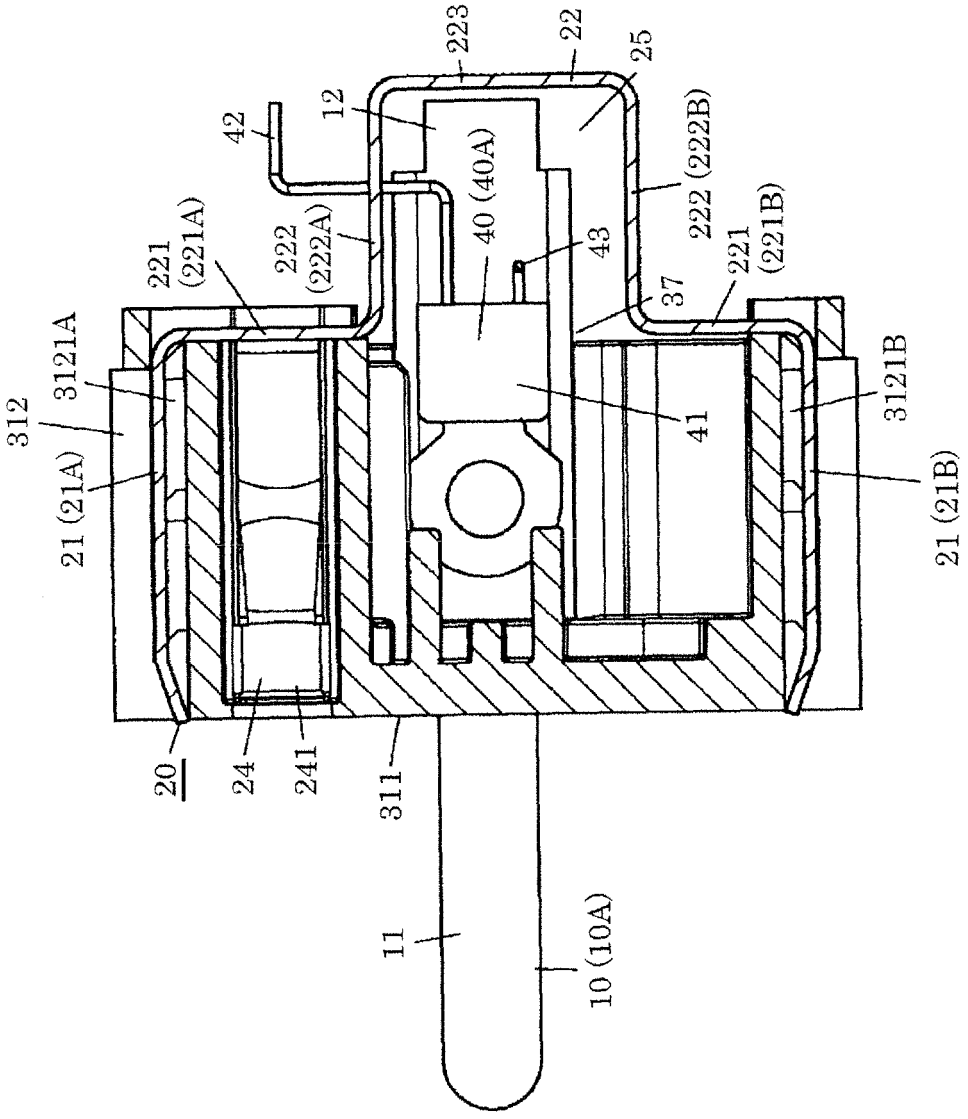

223
22
25
42
12
222 (222B)
40 (40A)
43
221
(221A)
222
(222A)
221
(221B)
37
3121A
312
41
3121B
21 (21A)
21 (21B)
20
24
241
311
11
10 (10A)

FIG. 2

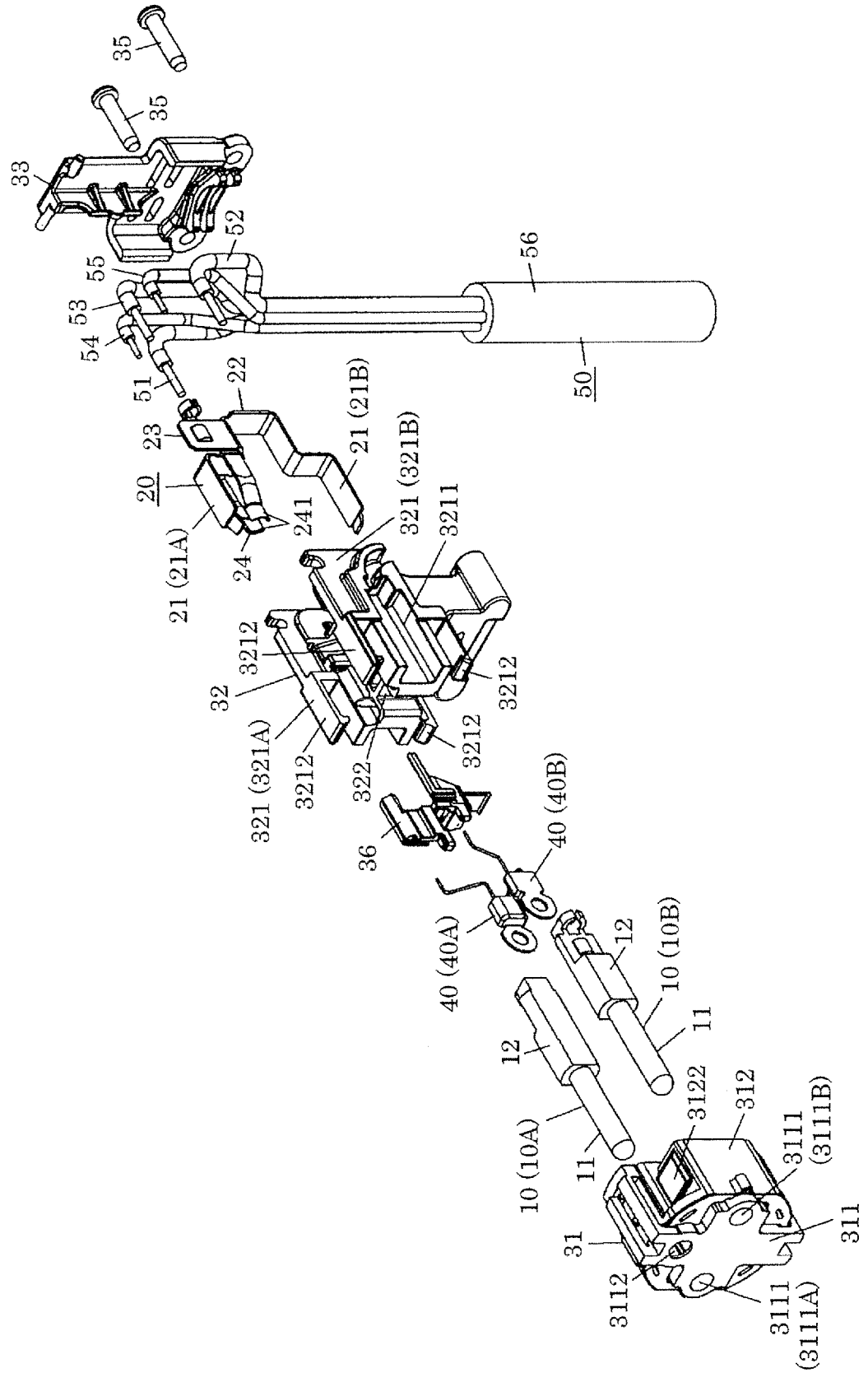

35
35
33
52
56
55
53
54
51
22
50
23
21 (21B)
20
241
321 (321B)
3211
21 (21A)
24
3212
32
3212
3212
321 (321A)
3212
322
3212
36
40 (40B)
40 (40A)
12
10 (10B)
12
11
10 (10A)
3122
312
3111
(3111B)
11
31
311
3112
3111
(3111A)

FIG. 3

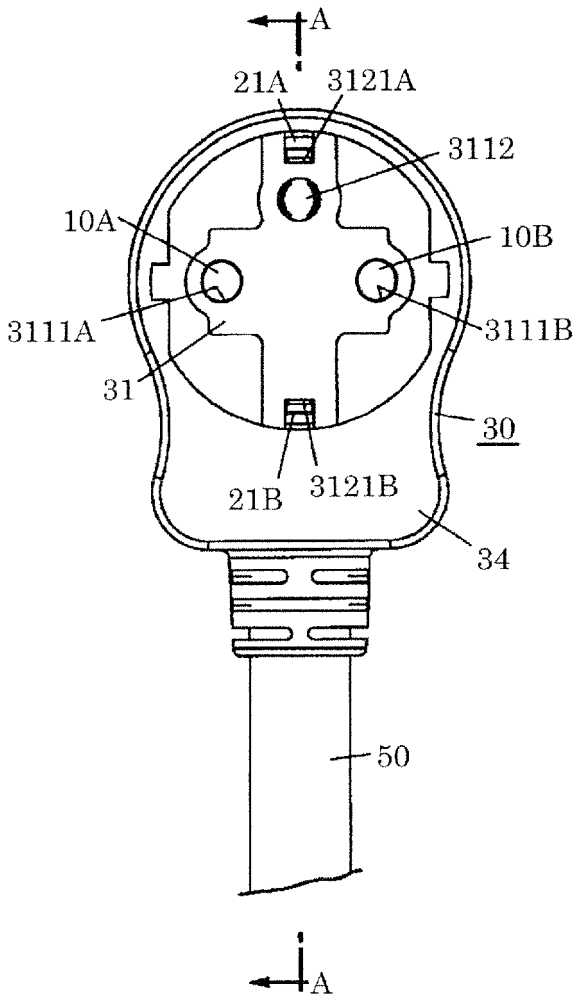


FIG. 4

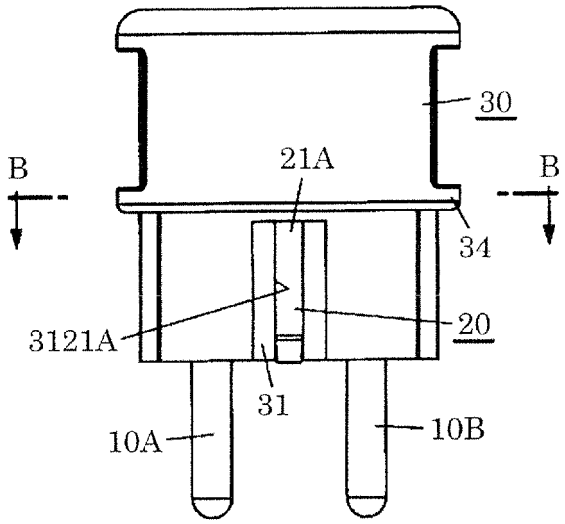


FIG. 5

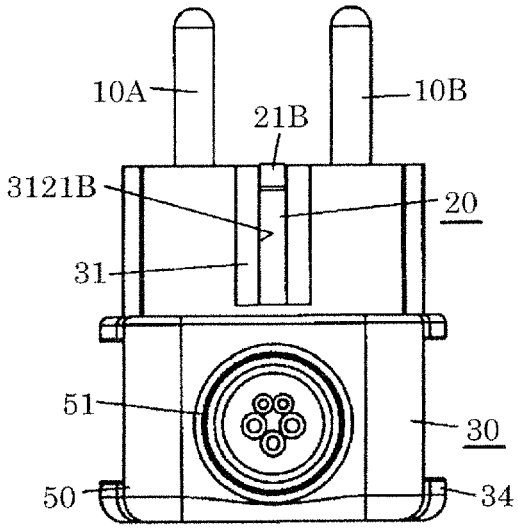


FIG. 6

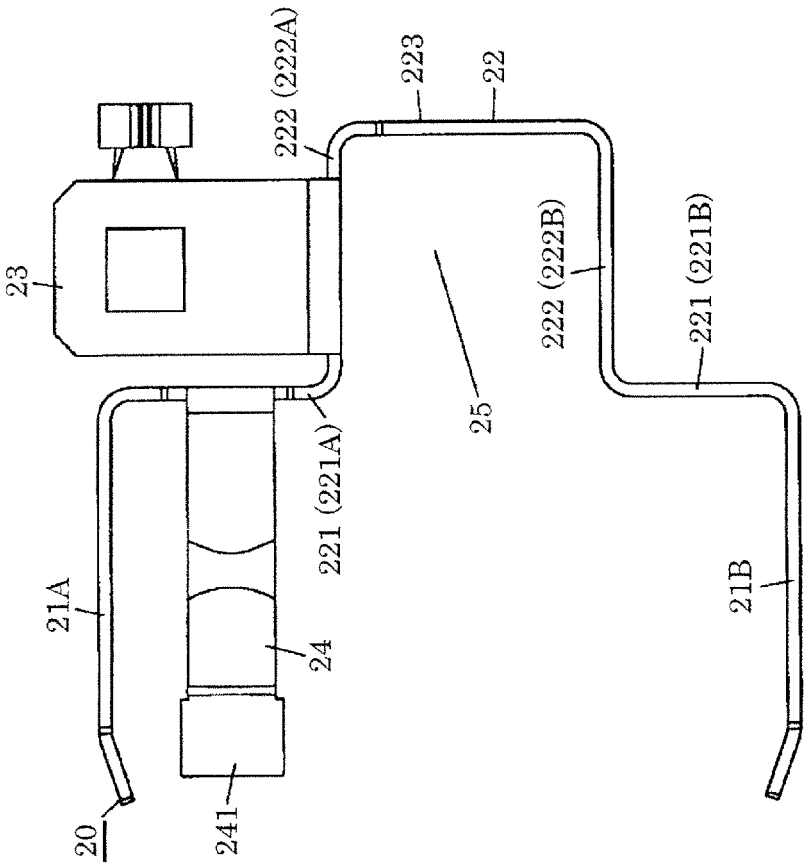

222 (222A)
223
22
23
222 (222B)
221 (221B)
25
221 (221A)
21A
24
21B
20
241

FIG. 7

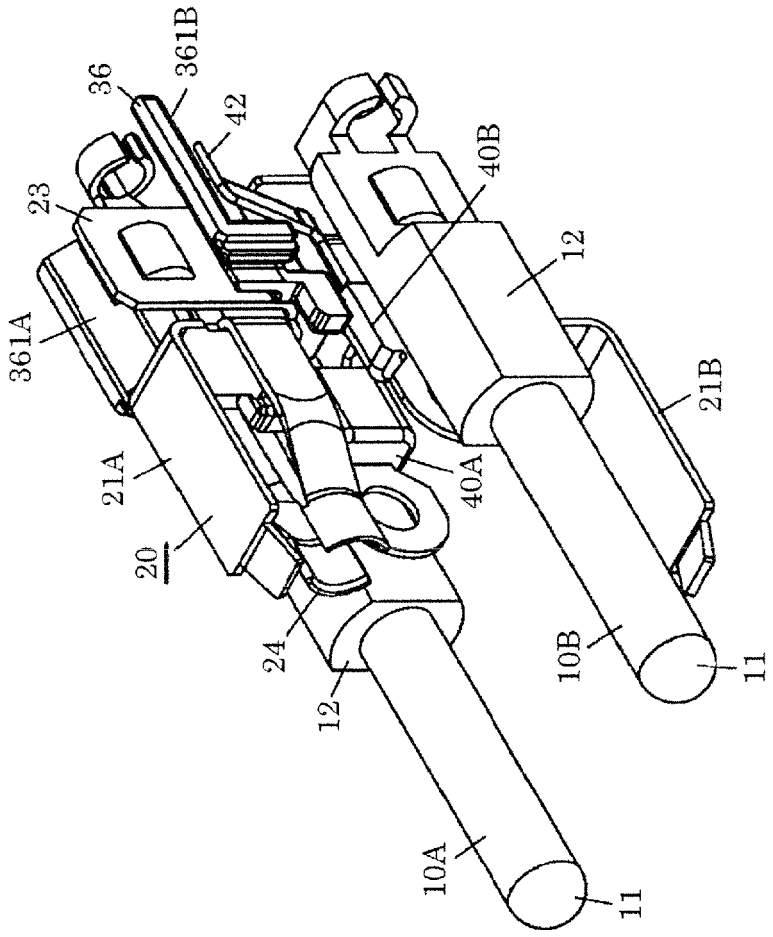


FIG. 8

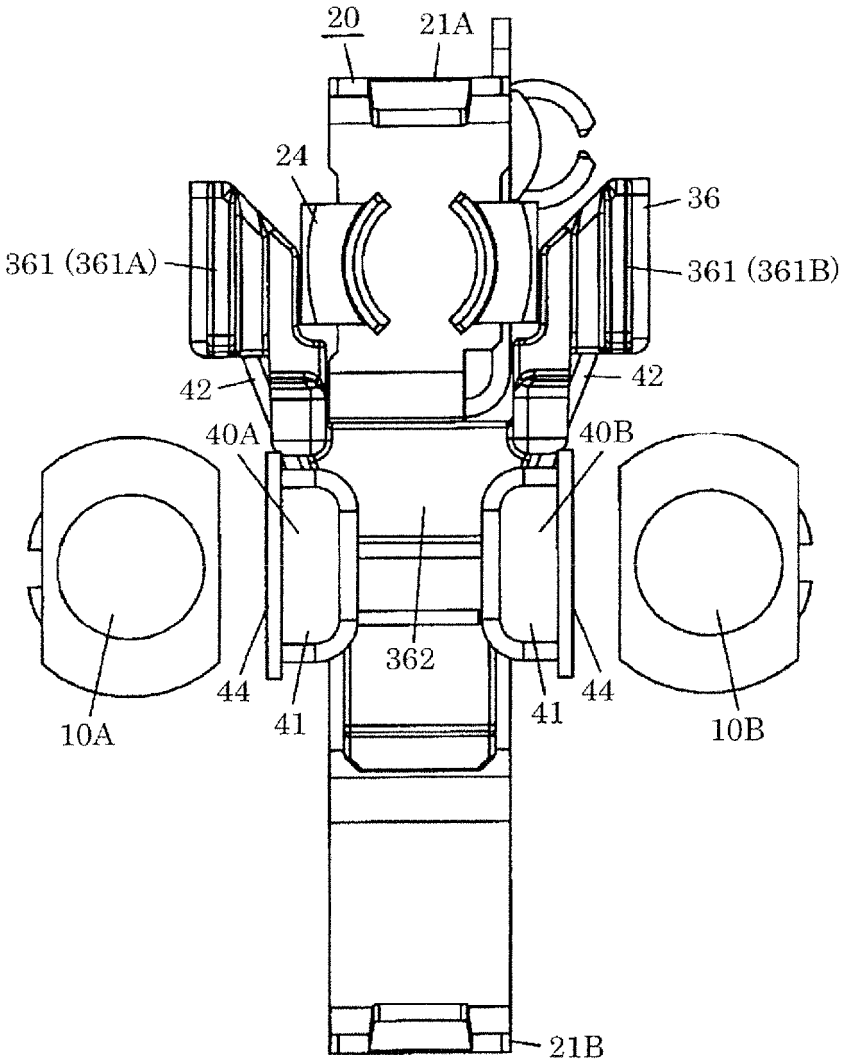

20
21A
24
36
361 (361A)
361 (361B)
42
42
40A
40B
362
44
41
41
44
10A
10B
21B

FIG. 9

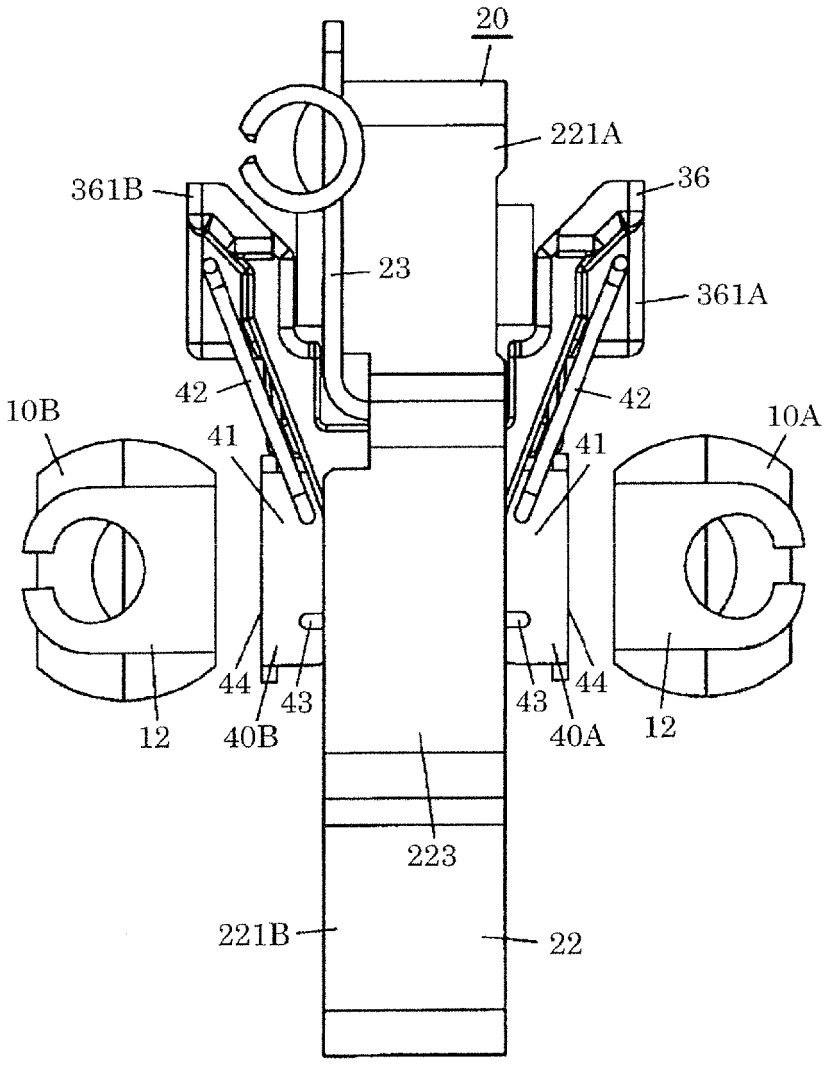
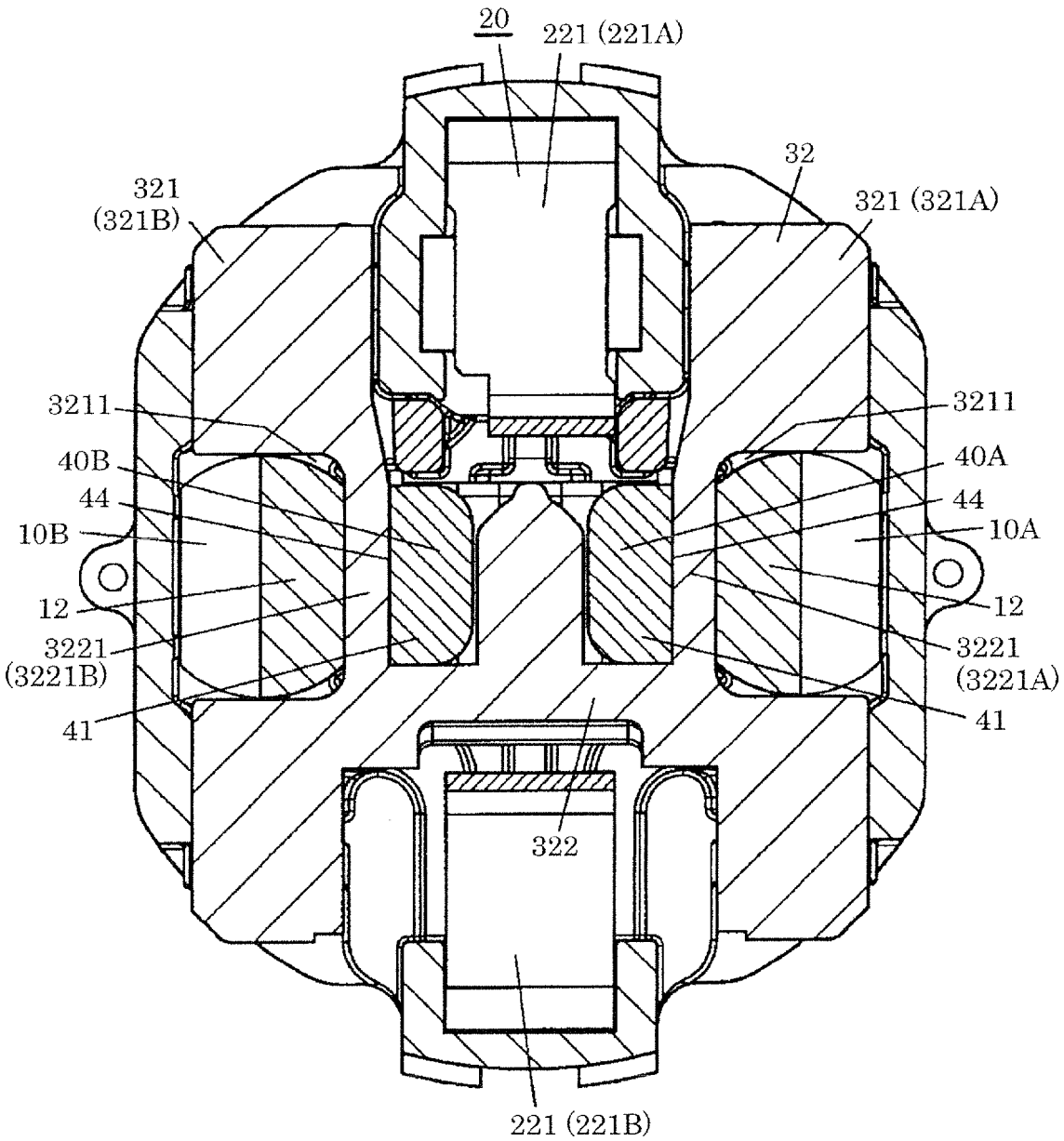

20
221A
361B
36
23
361A
42
42
10B
41
41
10A
44
43
43
44
12
40B
40A
12
223
221B
22

FIG. 10


20
221 (221A)
32
321
(321B)
321 (321A)
3211
3211
40B
40A
44
44
10B
10A
12
12
3221
(3221B)
3221
(3221A)
41
41
322
221 (221B)

Europäisches Patentamt
European Patent Office
Office européen des brevets

EUROPEAN SEARCH REPORT

Application Number
EP 16 15 9318

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
Y,D	WO 2014/091552 A1 (FUJI DENSEN KOGYO KK) 19 June 2014 (2014-06-19) * figures 1-4,11 * & EP 2 933 880 A1 (FUJI ELECTRIC WIRE IND CO LTD [JP]) 21 October 2015 (2015-10-21) * paragraph [0129] * * figures 1-4,11 *	1-6	INV. H01R13/66 H01R24/30 ADD. H01R13/713
Y	EP 2 811 580 A2 (PANASONIC CORP [JP]) 10 December 2014 (2014-12-10) * figures 1-2 *	1-6	

TECHNICAL FIELDS SEARCHED (IPC)

H01R

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	16 August 2016	Hugueny, Bertrand

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

EPO FORM 1503 03.82 (P04C01)

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 16 15 9318

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

16-08-2016

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO 2014091552 A1	19-06-2014	EP 2933880 A1	21-10-2015
		JP 5916896 B2	11-05-2016
		WO 2014091552 A1	19-06-2014
EP 2811580 A2	10-12-2014	CN 104241917 A	24-12-2014
		EP 2811580 A2	10-12-2014
		JP 2014235981 A	15-12-2014
		KR 20140143085 A	15-12-2014
		TW 201509014 A	01-03-2015
		US 2014364014 A1	11-12-2014

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

- JP 2014091552 A **[0004]**
- JP 2014038785 A **[0004]**