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

(11) EP 1 001 491 A2

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
17.05.2000 Bulletin 2000/20

(51) Int. Cl.[7]: **H01R 12/20**

(21) Application number: **99122320.7**

(22) Date of filing: **09.11.1999**

(84) Designated Contracting States:
AT BE CH CY DE DK ES FI FR GB GR IE IT LI LU MC NL PT SE
Designated Extension States:
AL LT LV MK RO SI

(30) Priority: **10.11.1998 JP 31912298**

(71) Applicants:
- **Yutaka Electric Mfg. Co. Ltd**
  Kawasaki-city, Kanagawa, 211-0022 (JP)
- **Kyocera Elco Corporation**
  Yokohama-shi, Kanagawa (JP)

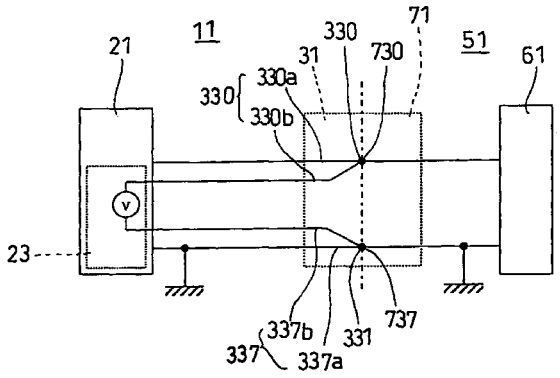
(72) Inventors:
- **Tanaka, Nobuyoshi,**
  c/o Yutaka Electric Mfg.Co.Ltd.
  Kawasaki-city, Kanagawa, 211-0022 (JP)
- **Yamashita, Satoshi**
  c/o Yutaka Electric Mfg.Co.Ltd.
  Kawasaki-city, Kanagawa, 211-0022 (JP)
- **Mori, Teruyuki,**
  c/o Kyocera Elco Corporation
  Yokohama-shi, Kanagawa (JP)
- **Tateda, Takayuki,**
  c/o Kyocera Elco Corporation
  Yokohama-shi, Kanagawa (JP)

(74) Representative:
Schaumburg, Thoenes & Thurn
Postfach 86 07 48
81634 München (DE)

(54) A connector

(57) A connector includes a plug having a first plurality of terminals; a receptacle having a corresponding second plurality of terminals which are connected with the first plurality of terminals, respectively, when the plug is connected with the receptacle; each of the second plurality of terminals, which is connected with a corresponding one of the first plurality of terminals when the plug is connected with the receptacle, includes a plurality of sub-terminals formed independent of one another so that the plurality of sub-terminals are electrically connected with one another via the corresponding one of the first plurality of terminals when the plug is connected with the receptacle.

Fig. 1



EP 1 001 491 A2

Description

BACKGROUND OF THE INVENTION

1. Field of the Invention

[0001] The present invention relates to a connector including a plug and a receptacle, and having a set of terminals for power supply and another set of terminals for measuring, for example, the supply voltage.

2. Description of the Related Art

[0002] A connector including a plug and a receptacle each having a set of terminals (e.g., contacts or pins) is used to connect a set of lines of a power circuit board having a power circuit thereon with another set of lines on another circuit board. Figure 7 shows a circuit which includes such a conventional connector. In this example shown in Figure 7, electrical power having a predetermined voltage is supplied from a power circuit 121 mounted on a power circuit board 111 to a main circuit (electrical circuit) 161 mounted on a main circuit board 151. The connector consists of a receptacle 131 and a plug 171 which are mounted on the power circuit board 111 and a main circuit board 151, respectively. The power circuit board 111 is provided with a voltage measuring circuit 123 which determines (measures) the voltage of the power supplied to the main circuit board 151 so that the power circuit 121 can control the voltage and current of the power output therefrom. Due to such a control, the receptacle 131 is provided with not only terminals 132 and 135 for supplying a constant voltage but also terminals 133 and 134 for controlling power supply. Likewise, the plug 171 is also provided with not only terminals 172 and 175 (which are respectively connected with the terminals 132 and 135) for supplying a constant voltage, terminals 173 and 174 (which are respectively connected with the terminals 133 and 134) are also provided for controlling the power supply. Accordingly, each receptacle 131 and each plug 171 is large and thus occupies a large mounting area on the corresponding circuit board 111 or 151, since each receptacle 131 and each plug 171 has two terminals for controlling power supply in addition to the two terminals for supplying a constant voltage.

SUMMARY OF THE INVENTION

[0003] The primary object of the present invention is to provide a connector including a plug and a receptacle which makes it possible to determine the voltage supplied via the plug and the receptacle at a position within the connector, thereby making it possible to reduce the number of terminals of the connector and the mounting area thereof.

[0004] To achieve the object mentioned above, according to an aspect of the present invention, there is provided a connector including: a plug having a first plurality of terminals; a receptacle having a corresponding second plurality of terminals which are connected with the first plurality of terminals, respectively, when the plug is connected with the receptacle; each of the second plurality of terminals, which is connected with a corresponding one of the first plurality of terminals when the plug is connected with the receptacle, includes a plurality of sub-terminals formed independent of one another so that the plurality of sub-terminals are electrically connected with one another via the corresponding one of the first plurality of terminals when the plug is connected with the receptacle.

[0005] According to this structure, signals can be transmitted from one terminal of the plug to a circuit on the receptacle side via a plurality of sub-terminals thereof, and can also be transmitted from a plurality of sub-terminals of the receptacle to a circuit on the plug side via one terminal thereof.

[0006] Preferably, the receptacle is connected with a power circuit and a voltage measuring circuit, the voltage measuring circuit measuring a voltage output from the power circuit, the power circuit controlling an output voltage thereof in accordance with the measured voltage. The main circuit is electrically connected with both the voltage measuring circuit and the power circuit via the receptacle and the plug; and one and another one of the plurality of sub-terminals of one of the second plurality of terminals are connected with the power circuit and the voltage measuring circuit, respectively. The power circuit controls an output voltage thereof in accordance with the voltage output measured by the voltage measuring circuit, the voltage measuring circuit being connected with one of the plurality of sub-terminals, a corresponding one of the first plurality of terminals which is connected to both of the plurality of sub-terminals, and another of the plurality of sub-terminals.

[0007] Preferably, the receptacle is fixed along an edge of a power circuit board on which the power circuit and the voltage measuring circuit are mounted. The plug is fixed along an edge of a main circuit board on which the main circuit is mounted. The power circuit board and the main circuit board are connected with each other via the receptacle and the plug.

[0008] Preferably, each of the first plurality of terminals includes a pin, wherein the plurality of sub-terminals pressingly holds corresponding the pin therebetween.

[0009] Preferably, the plurality of sub-terminals are apart from one another so as to be isolated from one another when the plug is disconnected from the receptacle.

[0010] According to another aspect of the present invention, there is provided a connector including: a receptacle having a first pair of terminals and a second pair of terminals, the one and the other terminals of the first pair being connected to a positive terminal of a power circuit and a positive terminal of a voltage meas-

uring circuit which determines an output voltage of the power circuit, respectively; the one and the other terminals of the second pair being connected to a negative terminal of the power circuit and a negative terminal of the voltage measuring circuit, respectively; and a plug which is connectable to the receptacle, the plug having a first terminal and a second terminal which are connected with the first pair of terminals and the second pair of terminals, respectively, when the plug is connected to the receptacle. The one and the other terminals of the first pair of the receptacle are electrically connected with each other via the first terminal of the plug when the plug is connected to the receptacle, whereas the one and the other terminals of the first pair of the receptacle are isolated from each other when the plug is disconnected from the receptacle, and wherein the one and the other terminals of the second pair of the receptacle are electrically connected with each other via the second terminal of the plug when the plug is connected to the receptacle, whereas the one and the other terminals of the second pair of the receptacle are isolated from each other when the plug is disconnected from the receptacle.

[0011] According to this structure, the output voltage of the power circuit can be controlled in accordance with the voltage measured by the voltage measuring circuit without increasing the number of terminals of the connector.

BRIEF DESCRIPTION OF THE DRAWINGS

[0012] The present invention will be described below in detail with reference to the accompanying drawings in which:

Figure 1 is a schematic diagram of a circuit including an embodiment of a connector to which the present invention is applied, wherein the connector connects a main circuit board with a power circuit board;

Figure 2 is a plan view of a pair of contacts provided in a slot of a receptacle and a corresponding pin of a plug in the embodiment of the connector shown in Figure 1;

Figure 3 is a partially-cutaway bottom view of the receptacle mounted on the power circuit board shown in Figure 1, showing the structure of the receptacle;

Figure 4 is a plan view of the plug mounted on the main circuit board shown in Figure 1;

Figure 5 is a side elevational view of the plug and the receptacle, showing a state where the receptacle is about to be connected with the plug;

Figure 6 is a plan view of the receptacle and the plug, showing a state where the receptacle is connected with the plug; and

Figure 7 is a schematic diagram of a circuit including a conventional connector, wherein the connector connects a main circuit board with a power circuit board.

DESCRIPTION OF THE PREFERRED EMBODIMENT

[0013] Figure 1 shows a circuit including an embodiment of a connector to which the present invention is applied. The connector includes a receptacle 31 and a plug 71 to connect a power circuit 21 with a main circuit 61 via the receptacle 31 and the plug 71.

[0014] The power circuit 21 outputs (supplies) power having a constant voltage. The power circuit 21 is provided with a voltage measuring circuit 23 for measuring the voltage output from the power circuit 21 so that the power circuit 21 can control the output voltage in accordance with the voltage measured by the voltage measuring circuit 23.

[0015] The power circuit 21 is mounted on a power circuit board 11. The receptacle 31 is fixed along an edge of the power circuit board 11. The main circuit 61 is mounted on a main circuit board 51. The plug 71, which is connected with the receptacle 31, is fixed along an edge of the main circuit board 61. The receptacle 31 is provided with an array of terminals, while the plug 71 is provided with a corresponding array of terminals.

[0016] The power circuit 21 supplies a constant voltage to the main circuit 61 via the receptacle 31 and the plug 71. At the same time, the voltage measuring circuit 23 of the power circuit 21 determines (monitors) the voltage supplied to the main circuit 61 so that the power circuit 21 can control the output voltage thereof to be constant in accordance with the measured voltage. The main circuit 61 includes a microcomputer and other electrical and electronics parts such as IC tips which are all mounted on the main circuit board 51. The power circuit 21 is also provided with electrical and electronics parts such as IC tips which are all mounted on the power circuit board 11.

[0017] The present embodiment is characterized in that each terminal of the array of terminals of the receptacle 31, which is brought into contact with a corresponding terminal of the array of terminals of the plug 71, is provided with a pair of sub-terminals which are formed independent of each other.

[0018] Figure 2 shows only single pair of contacts 330 (330a and 330b) of the receptacle 31 provided as single pair of sub-terminals, and a corresponding single pin 730 of the plug 71. The other pairs of contacts of the receptacle 31 and the other pins of the plug 71 have the same structure as the pair of contacts 330 and the pin 730 shown in Figure 2, respectively. The pair of contacts 330, which is brought into contact with the corresponding pin 730, includes two contacts 330a and 330b. In a free state there is provided a gap between the pair of contacts 330a and 330b so as to be isolated from each other. The gap between the pair of contacts 330a and 330b is smaller than the thickness of the corresponding pin 730, so that the pin 730 is tightly held between the

pair of contacts 330a and 330b by the elastic force of each contact when the receptacle 31 is connected with the plug 71, thereby establishing electrical connection between each pin 730 and the corresponding pair of contacts 330.

[0019] Figure 3 is a partially-cutaway bottom view of the receptacle 31, and Figure 4 is a plan view of the plug 71. As can be seen in Figures 3 and 4, the receptacle 31 is provided with a plurality of pairs of contacts (eight pairs in total in this particular embodiment) while the plug 71 is provided with a corresponding plurality of pins (eight pins in total in this particular embodiment). In Figure 3 only one pair of contacts positioned at one end of the receptacle 31 and another pair of contacts positioned at the other end of the receptacle 31 are designated by the reference numerals 330 and 337, respectively. Likewise, in Figure 4 only one pin positioned at one end of the plug 71 and another pin positioned at the other end of the plug 71 are designated by the reference numerals 730 and 737, respectively. The pins 730 and 737 are connectable with the pairs of contacts 330 and 337, respectively.

[0020] The pair of contacts 330 is fixed to a housing 35 of the receptacle 31 in a manner so that the contacts 330a and 330b are isolated from each other. The pair of contacts 330 and the pair of contacts 337 are positioned in receiving holes 360 and 367 formed in the housing 35, respectively. The open end of each receiving hole is provided with a slot 338 (see Figure 5) which is open at the under side of the housing 35 so that the corresponding pin can be plugged in the slot to be held by the corresponding pair of contacts.

[0021] Upon the receptacle 31 and the plug 71 being connected with each other, each of the pair of contacts 330a and 330b is electrically connected with the pin 730 and at the same time the pair of contacts 330a and 330b are electrically connected with each other via the pin 730.

[0022] In the present embodiment, the pair of contacts 337 (337a and 337b) is formed to have the same structure as the pair of contacts 330 (330a and 330b). Likewise, any of the remaining six pairs of contacts, which are used for the transmission of signals, is also formed to have the same structure as the pair of contacts 330. As can be seen in figure 3, each of the eight pairs of contacts is positioned in a corresponding one of the eight receiving holes formed parallel to one another in the housing 31 at predetermined intervals.

[0023] Figure 4 shows a plan view of the plug 71 which is connected to the receptacle 31. The plug 71 is provided with a plurality of pins arranged at predetermined intervals to correspond to the plurality of pairs of contacts of the receptacle 31. The plurality of pins are fixed to a housing 75 of the plug 71. In this embodiment, the pair of contacts 330 and the pair of contacts 337 are connected with the pin 730 and pin 737, respectively.

[0024] The receptacle 31 is fixed along an edge of the power circuit board 11 while the plug 71 is fixed along an edge of the main circuit board 51. The receptacle 31 is connected with the plug 71 in the direction of an arrow D shown in Figure 5 to connect the pairs of contacts of the receptacle 31 with the pins of the plug 71. Figure 6 is a plan view of the receptacle 31 and the plug 71 which are properly connected with each other.

[0025] In the illustrated embodiment, the contact 330a of the pair of contacts 330 is connected with a positive terminal of the power circuit 21, while the contact 330b of the pair of contacts 330 is connected with a positive terminal for measuring voltage of the voltage measuring circuit 23. The contact 337a of the pair of contacts 337 is connected with a negative (ground) terminal of the power circuit 21, while the contact 337b of the pair of contacts 337 is connected with a negative terminal for measuring voltage of the voltage measuring circuit 23. The pin 730 is connected with a positive terminal of the main circuit 61, while the pin 737 is connected with a ground terminal of the main circuit 61.

[0026] In the present embodiment, each contact of the receptacle 31 is connected with a corresponding terminal on the power circuit board 11 via a conductive pattern printed thereon. Likewise, each pin of the plug 71 is connected with a corresponding terminal on the main circuit board 51 via a conductive pattern printed thereon. For instance, the left ends, as viewed in Figure 3, of all the contacts of the receptacle 31, which extend outwardly from the housing 35, are formed to contact respective conductive patterns printed on the main circuit board 51.

[0027] In a state where the receptacle 31 and the plug 71 are connected with each other as shown in Figure 6, each pin of the plug 71 is engaged with the corresponding pair of contacts of the receptacle 31, so that the receptacle 31 and the plug 71 are electrically connected with each other in a manner as shown in Figure 2 in which the pin 730 is engaged with the pair of contacts 330a and 330b. At the same time, the contact 330a of the pair of contacts 330 is electrically connected with the other contact 330b of the pair of contacts 330 via the corresponding pin 730 of the plug 71. Likewise, one contact of any other pair of contacts of the receptacle 31 is electrically connected with the other contact of the receptacle 31 via the corresponding pin of the plug 71.

[0028] Accordingly, the contacts 330a and 330b are electrically connected with each other via the corresponding pin 730 while the contacts 337a and 337b are electrically connected with each other via the corresponding pin 737, so that the voltage at the pin 730 can be determined at the contact 330b, i.e., at a position within the connector. Accordingly, the power circuit 21 can control the output voltage thereof in accordance with the voltage measured by the voltage measuring circuit 23, which makes it possible to supply a constant voltage.

[0029] As can be understood from the above discussion, according to the present embodiment, one of a

pair of contacts of the receptacle 31 which are electrically connected with each other via a corresponding pin of the plug 71 is used for power supply while the other contact of the pair is used for voltage determination to control the output voltage of the power supply. This makes it possible to control the output voltage of the power supply without increasing the number of terminals (contacts or pins) of the connector. Accordingly, the connector including the receptacle 31 and the plug 71 can be made small so as not to occupy a large mounting area on the corresponding circuit board 11 or 51.

[0030] In the illustrated embodiment, although the pair of contacts 330 and the corresponding pin 730 which are respectively positioned at one end of the receptacle 31 and the plug 71 are used for power supply while the pair of contacts 337 and the corresponding pin 737 which are respectively positioned at the other end of the receptacle 31 and the plug 71 are used for measuring the supply voltage, any pair of contacts of the receptacle 31 and the corresponding pin of the plug 71 can be used for either power supply and or measuring the supply voltage, respectively. Furthermore, if one contact of each pair of contacts of the receptacle 31 is connected to a common positive terminal pattern printed on the power circuit board 11 while the other contact of the same is connected to a common negative terminal pattern printed on the power circuit board 11, the power circuit 21 can supply a large electric current to the main circuit board 51.

[0031] Although the present embodiment according to the present invention has been discussed above with reference to the accompany drawings, the present invention is not limited solely to the illustrated embodiment. For instance, in the illustrated embodiment each pair of terminals of the receptacle 31 is formed as a pair of contacts like tweezers, while each terminal of the plug 71 is formed as a pin. However, each pair of terminals of the receptacle 31 can be formed as a pair of semicylindrical contacts which together form a substantially hollow cylinder while each terminal of the plug 71 can be formed as a cylindrical contact which is held by the pair of semicylindrical contacts of the receptacle. Furthermore, any pair of contacts of the receptacle 31 can be used not only for power supply or voltage determination, but also for other purposes.

[0032] As can be understood from the foregoing, according to the present embodiment, since each terminal of the receptacle is formed as a plurality of sub-terminals formed independent of one another so that the plurality of sub-terminals are electrically connected with one another via a corresponding one of the plurality of terminals of the plug when the plug is connected with the receptacle, the voltage supplied via the plug and the receptacle can be determined at a position within the connector, which makes it possible to achieve a small connector which does not occupy a large mounting area on circuit boards.

[0033] Furthermore, according to the present embodiment, since both of a pair of sub-terminals of the receptacle are used for power supply and for voltage determination (voltage monitoring) of the power supply, respectively, to control the output voltage of the power supply in accordance with the measured voltage, the output voltage of power supply can be controlled without increasing the number of terminals of the connector.

[0034] Obvious changes may be made in the specific embodiments of the present invention described herein, such modifications being within the spirit and scope of the invention claimed. It is indicated that all matter contained herein is illustrative and does not limit the scope of the present invention.

Claims

1. A connector comprising:

a plug having a first plurality of terminals;
a receptacle having a corresponding second plurality of terminals which are connected with said first plurality of terminals, respectively, when said plug is connected with said receptacle;
each of said second plurality of terminals, which is connected with a corresponding one of said first plurality of terminals when said plug is connected with said receptacle, comprises a plurality of sub-terminals formed independent of one another so that said plurality of sub-terminals are electrically connected with one another via said corresponding one of said first plurality of terminals when said plug is connected with said receptacle.

2. The connector according to claim 1, wherein said receptacle is connected with a power circuit and a voltage measuring circuit, said voltage measuring circuit measuring a voltage output from said power circuit;
wherein said main circuit is electrically connected with both said voltage measuring circuit and said power circuit via said receptacle and said plug; and
wherein one and another one of said plurality of sub-terminals of one of said second plurality of terminals are connected with said power circuit and said voltage measuring circuit, respectively.

3. The connector according to claim 2, wherein said power circuit controls an output voltage thereof in accordance with said voltage output measured by said voltage measuring circuit, said voltage measuring circuit being connected with one of said plurality of sub-terminals, a corresponding one of said first plurality of terminals which is connected to both of said plurality of sub-terminals, and another of said plurality of sub-terminals.

4. The connector according to claim 3, wherein said receptacle is fixed along an edge of a power circuit board on which said power circuit and said voltage measuring circuit are mounted.

5. The connector according to claim 3 or 4, wherein said plug is fixed along an edge of a main circuit board on which said main circuit is mounted.

6. The connector according to any one of the foregoing claims, wherein each of said first plurality of terminals comprises a pin, wherein said plurality of sub-terminals pressingly holds corresponding said pin therebetween.

7. The connector according to any one of the foregoing claims, wherein said plurality of sub-terminals are apart from one another so as to be isolated from one another when said plug is disconnected from said receptacle.

8. A connector comprising:

a receptacle having a first pair of terminals and a second pair of terminals, said one and the other terminals of said first pair being connected to a positive terminal of a power circuit and a positive terminal of a voltage measuring circuit which determines an output voltage of said power circuit, respectively; said one and the other terminals of said second pair being connected to a negative terminal of said power circuit and a negative terminal of said voltage measuring circuit, respectively; and

a plug which is connectable to said receptacle, said plug having a first terminal and a second terminal which are connected with said first pair of terminals and said second pair of terminals, respectively, when said plug is connected to said receptacle;

wherein said one and the other terminals of said first pair of said receptacle are electrically connected with each other via said first terminal of said plug when said plug is connected to said receptacle, whereas said one and the other terminals of said first pair of said receptacle are isolated from each other when said plug is disconnected from said receptacle, and

wherein said one and the other terminals of said second pair of said receptacle are electrically connected with each other via said second terminal of said plug when said plug is connected to said receptacle, whereas said one and the other terminals of said second pair of said receptacle are isolated from each other when said plug is disconnected from said receptacle.

Fig. 1

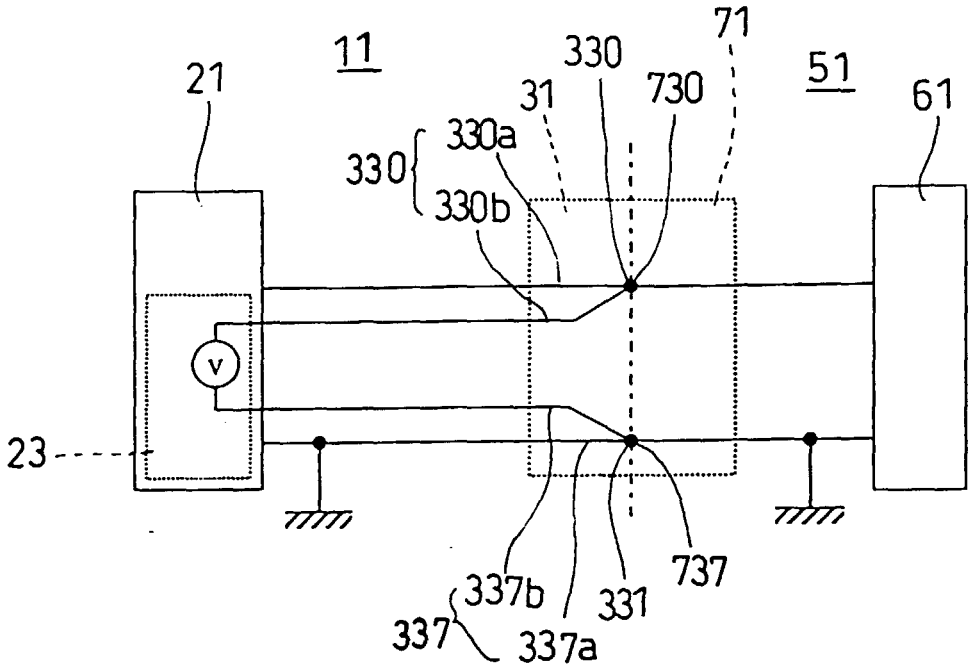

11
71
330
21
31
730
51
61
330a
330
330b
V
23
337b
331
737
337
337a

Fig. 2

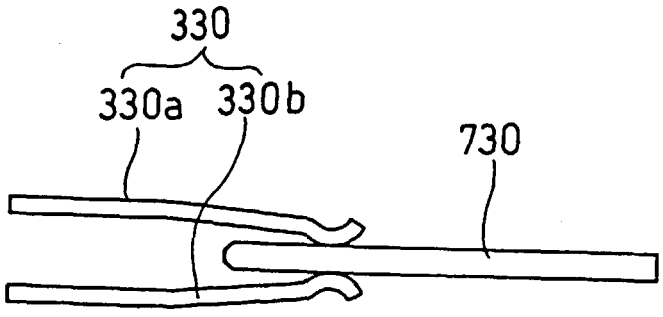

330
330a
330b
730

Fig. 3

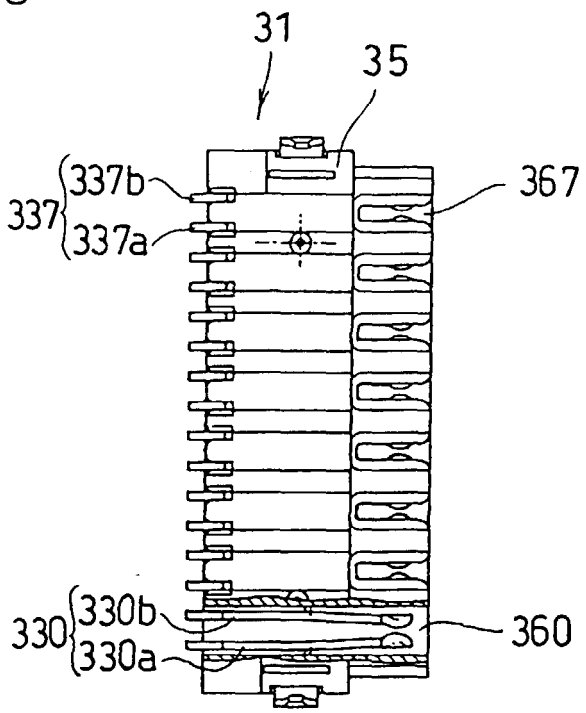


Fig. 4

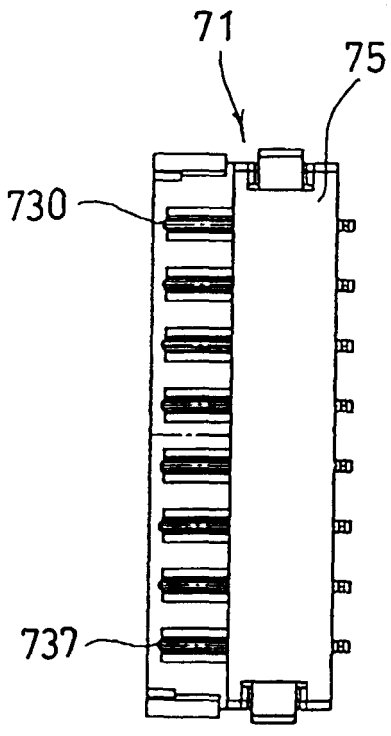


Fig. 5

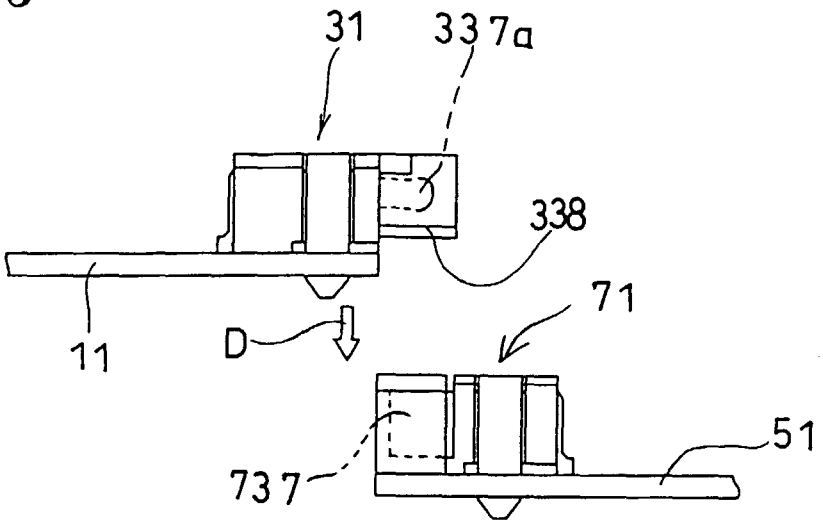

31
337a
338
71
11
D
51
737

Fig. 6

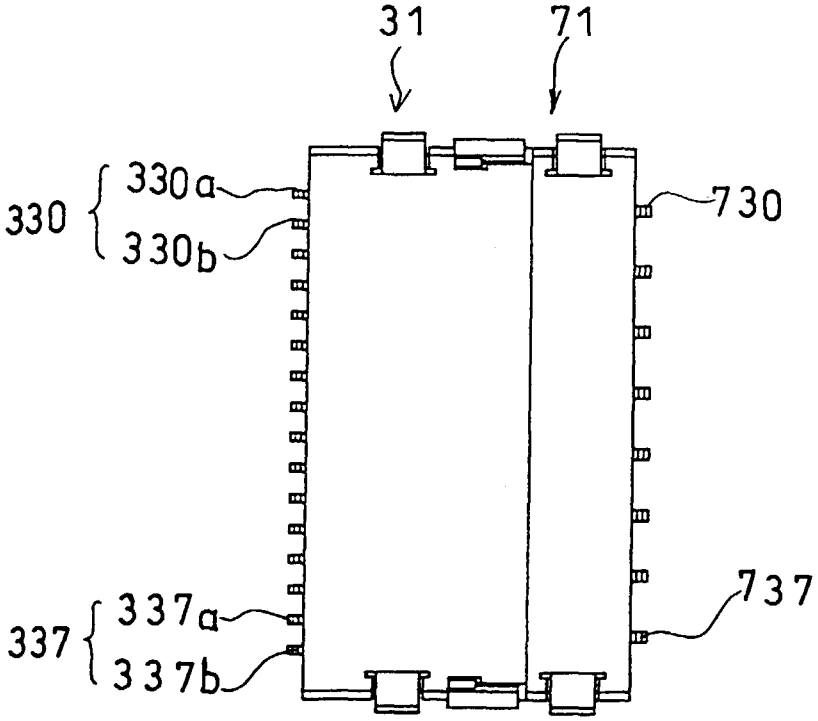

31
71
330
330a
330b
730
337
337a
337b
737

Fig. 7