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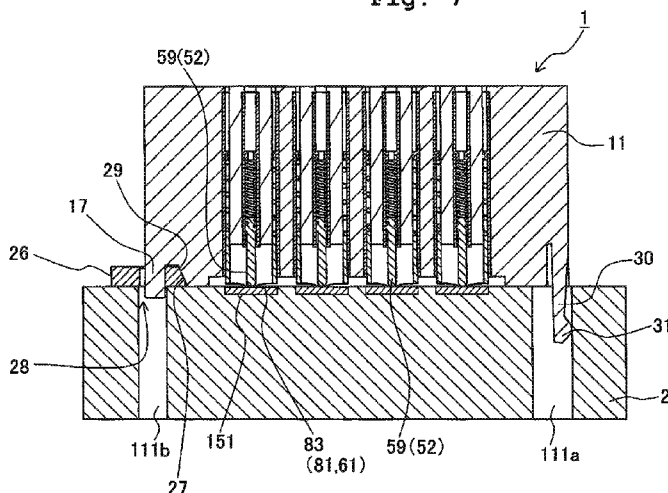
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[Continued on next page]

(54) Title: COAXIAL CONNECTOR

Fig. 7



(57) Abstract: A connector (1), which is attached to a circuit board (2) having a land (151), includes a housing (11); a terminal (51) which projects from the housing and which is brought into contact with the land; and a separate component (26) which is separate from the housing and is attached to the circuit board, the separate component having an inclined surface (27), with which the housing is brought into contact in a state that the separate component is attached to the circuit board; wherein when the housing is pressed toward the circuit board, while being brought into contact with the inclined surface of the separate component attached to the circuit board, the housing is moved slidably on the inclined surface to cause the terminal rub the land. Accordingly, there is provided a connector which is capable of performing the wiping even when the terminal has coaxial structure, regardless of the terminal structure.



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COAXIAL CONNECTOR

CROSS REFERENCE TO RELATED APPLICATION

[0001] The present application claims priority from Japanese Patent Application No. 2008-328948, filed on December 25, 2008, the disclosure of which is incorporated herein by reference in its entirety.

FIELD OF THE INVENTION

[0002] The present invention relates to a connector.

DESCRIPTION OF THE RELATED ART

[0003] Japanese Utility Model Application Laid-open No. 60-123666 discloses a coaxial movable contact probe 851, as shown in Fig. 15. The coaxial movable contact probe 851 includes a center conductor 852 and an outer conductor 861 having a plain cylindrical shape and surrounding the center conductor 852. As shown in Fig. 16, the probes 851 are held by a movable plate 802 movable relative to a target circuit board 801 on which semiconductors, electronic components, etc. are mounted as targets of measurement. Further, coaxial connectors (hereinafter referred to as "coaxial plugs") 961 are connected to one ends of the probes 851, respectively. Each of the coaxial plugs 961 is connected via a coaxial cable 962 to a measuring circuit board (not shown) on which a signal generator circuit, a comparator, etc. are mounted. At the time of the measurement, the movable plate 802 is moved toward the target circuit board 801 to bring the other ends of the probes 851 into contact with the target circuit board 801. Consequently, the coaxial plugs 961 are connected to the target circuit board 801 by the probes 851, to thereby connect the target circuit board 801 and the measuring circuit board to each other.

[0004] By using the coaxial probes 851, it is possible to reduce the influence caused by a noise signal, etc. Accordingly, an input signal outputted by the signal generator circuit in the measuring circuit board is transmitted or transferred to the target circuit board 801 via the probes 851 as maintaining its waveform satisfactorily. Further, an output signal outputted by a target of the measurement (measurement target) in the target circuit board 801 is transmitted to the measuring circuit board via the probes 851 while maintaining its waveform satisfactorily.

[0005] However, the coaxial movable contact probes 851 of Japanese Utility Model Application Laid-open No. 60-123666 are press-fit in cavities 814 formed in the movable plate 802; and the movable plate 802 is moved toward the target circuit board 801 to thereby move the coaxial movable contact probes 851 upwardly and downwardly so that the probes 851 are brought into contact with the target circuit board 801. As described above, the coaxial movable contact probes 851 are merely in pressure contact with the target circuit board 801 from below. Therefore, for example, in a case that oxide film, etc. is formed on a surface of a land of the target circuit board 801, there is a fear that the connection reliability is greatly lowered due to the oxide film, which in turn makes any accurate measurement to be difficult.

[0006] Japanese Patent Application Laid-open No. 7-272810 discloses a movable contact pin device. A measurement target is mounted on the movable contact pin device. At the time of the mounting, a contact member, of the movable contact pin device, which construct a terminal of the movable contact pin device is brought into pressurized contact with a connection terminal of the measurement target, and then the contact member is rotated by another twisted member constructing the movable contact pin device. In such a manner, the contact member is rotated in a state that the contact member is in contact with the connection terminal to thereby perform wiping when the measurement target is mounted on the movable contact pin device. By doing so, it is possible to rub off or remove the oxide film, etc. from the surfaces of the connection terminal and the contact member, making it possible to improve the connection reliability.

[0007] In the contact rotation mechanism of Japanese Patent Application Laid-open No. 7-272810, however, the contact member is rotated by using the another twisted constructing member which constructs the movable contact pin device. Therefore, it is necessary to arrange the another twisted constructing member at the position of the rotation axis of the contact member. Therefore, in a case that an attempt is made to rotate the outer conductor 861 in the coaxial movable contact probe 851 disclosed in Japanese Utility Model Application Laid-open No. 60-123666, it is necessary to arrange the another twisted constructing member at a position of the rotation axis of the outer conductor 861. In the coaxial movable contact probe 851, however, the center conductor 852 needs to be arranged at the center of the outer conductor 861. Thus, in the coaxial movable contact probe 851 disclosed in Japanese Utility Model Application Laid-open No. 60-123666, even if the attempt

were made to arrange the another twisted constructing member, disclosed in Japanese Patent Application Laid-open No. 7-272810, at the position of the rotation axis of the outer conductor 861, it is not possible to arrange the another twisted constructing member disclosed in Japanese Patent Application Laid-open No. 7-272810 at the position of the rotation axis since the center conductor 852 is already arranged at the position. As a result, in the coaxial movable contact probe 851, it is not possible to rotate the outer conductor 861 by using the another twisted constructing member in order to perform the wiping, which in turn greatly lowers the connection reliability of the coaxial movable contact probe 851.

SUMMARY OF THE INVENTION

[0008] An object of the present invention is to provide a connector capable of wiping terminals and a land of a circuit board, regardless of the structure of the terminals.

[0009] According to the present invention, there is provided a connector 1 which is attached to a circuit board 2 having a land 151, the connector 1 including: a housing 11; a terminal 51 which projects from the housing 11 and which is brought into contact with the land 151; and a separate component 26 which is separate from the housing 11 and is attached to the circuit board 2 and which has an inclined surface 27; wherein when the housing 11 is pressed toward the circuit board 2, while being brought into contact with the inclined surface 27 of the separate component 26 attached to the circuit board 2, the housing 11 is moved slidably on the inclined surface 27 to cause the terminal 51 rub the land 151.

[0010] In the present invention, upon attaching the housing 11 to the circuit board 2, the housing 11 is moved on the circuit board 2 by sliding on (along) the inclined surface 27 of the separate component 26, and during this movement, the terminal 51 rubs (rubs against) the land 151. Even when the terminal 51 is, for example, a terminal with a coaxial structure having a center terminal 52 and a cylindrical outer terminal 61 surrounding the center terminal 52, the wiping is performed by causing the terminal 51, which is brought into contact with the land 151, to move in such a manner on a surface of the circuit board 2. Therefore, the wiping can be performed regardless of the terminal structure. With this wiping, it is possible to rub off or remove an oxide film from the surface of the terminal 51 and the surface of the land 151 of the circuit board 2 and to remove dust or dirt which has been caught between the terminal 51 and the circuit board 2 when the connector 1 is attached to the circuit

board 2, thereby making it possible to prevent the degradation in contact reliability between the terminal 51 and the circuit board 2.

[0011] In the present invention, the connector 1 may further include a biasing member 71 which biases the terminal 51 so that the terminal 51 retractably projects from the housing 11.

[0012] For example, in a case that, different from the present invention, if the terminals 51 are fixedly projected from the housing 11, there is a possibility, due to non-uniform alignment of the terminals 51 with respect to the housing 11, etc., that the terminal(s) 51 is brought into contact with the circuit board 2 with an excessively high pressure contact force and/or that the circuit board 2 is damaged by the contact pressure of the terminal 51 when the connector 1 is attached to the circuit board 2. Further, there is also such a possibility that while some of the terminals 51 are in contact with the circuit board 2, the remaining terminals 51 float (are separated) from the circuit board 2.

[0013] In view of such possibility, in the present invention, the biasing member 71 is used to make the terminal 51 retractably project from the housing 11. This makes it possible, when the connector 1 is attached to the circuit board 2, to bring the terminal 51 into contact with the circuit board 2 with an appropriate pressure contact force and further to prevent the circuit board 2 from being damaged due to the pressure contact of the terminal 51. Therefore, it is possible to realize the wiping by the pressure contact of the terminal 51 with respect to the circuit board 2 while the housing 11 is moved slidably on or along the inclined surface 27 and, at the same time, it is possible to prevent a problem which would be otherwise caused due to an excessively high pressure contact force exerted by the terminal 51 with respect to the circuit board 2.

[0014] In the present invention, the connector 1 may further include: a resilient arm 30 which projects from the housing 11 and which is inserted into a hole 111a formed in the circuit board 2; and a projection 31 which projects from the resilient arm 30 and which is brought into contact with the circuit board 2 in the hole 111a; wherein the housing 11 may be moved slidably on the inclined surface to thereby bend the resilient arm 30 and to bring the projection 31 into pressure contact with the circuit board 2.

[0015] In this aspect, before the housing 11 is attached to the circuit board 2, the housing 11 is held at a position (shifted position) shifted or deviated from an

attachment position such that the resilient arm 30 is not substantially bent.

Accordingly, it is possible to perform the wiping in assured manner by ensuring that the housing 11 is moved from the shifted position to the attachment position upon attaching the housing 11 to the circuit board 2.

[0016] In the present invention, a hole 28 may be formed in the separate component 26; and the housing 11 may have a protruding portion 17 which is formed in the housing 11 and which is inserted in the hole 28; wherein the housing 11 may be stopped when the protruding portion 17 abuts on the separate component 26 in the hole 28.

[0017] In the present invention, since the housing 11 is attached to the circuit board 2 in the state that the protruding portion 17 abuts on the separate component 26 in the hole 28 formed in the separate component 26, it is possible to set the attachment position of the housing 11 by the separate component 26 and the protruding portion 17.

[0018] Further, when the hole 28 of the separate component 26 and the protruding portion 17 of the housing 11 are used in combination with the above-described resilient arm 30 and projection 31, the resilient arm 30 before the attachment attempts to straighten in the state that the projection 31 abuts on the circuit board 2.

Therefore, it is possible to make a position, at which the housing 11 is arranged or positioned before the housing is slidably moved on the inclined surface 27, to be the shifted position which is shifted from the attachment position. Then, upon attaching the housing 11 to the circuit board 2, the housing 11 is assuredly moved from the shifted position to the attachment position, which in turn makes it possible to perform the wiping assuredly. Moreover, since the movement range of the housing 11 is assuredly limited within a range at which the protruding portion 17 of the housing 11 is allowed to move in the hole 28 of the separate component 26, it is possible to define a formation range (size) of the land 151 of the circuit board 2 which is to be rubbed by the terminal 51.

[0019] In the present invention, the terminal 51 may have a projecting contact point 83 which is brought into contact with the land 151. Since the terminal 51 has the projecting contact point 83 which is brought into contact with the land 151, it is possible to assuredly perform the wiping for the land 151 by bringing the terminal 51 into contact with the land 151 at the projecting contact point 83 of the terminal 51 in an assured manner even when the terminal is formed to have a cylindrical shape

such as, for example, the outer terminal 61 of the coaxially-structured terminal 51. For example, it is possible to prevent the cylindrical outer terminal 61 from coming into contact with the circuit board 2 at a portion of the outer terminal 61 which is different from the projecting contact point 83.

[0020] As described above, according to the connector of the present invention, it is possible to wipe the terminal and the land of the circuit board irrespective of the terminal structure.

BRIEF DESCRIPTION OF THE DRAWINGS

[0021] Fig. 1 is a perspective view of a connector of an embodiment of the present invention seen from obliquely above;

[0022] Fig. 2 is a perspective view of the connector shown in Fig. 1 seen from obliquely below;

[0023] Fig. 3 is a perspective view of a metal plate shown in Fig. 1;

[0024] Fig. 4 is a perspective view showing a state that the connector shown in Fig. 1 is attached to a circuit board;

[0025] Fig. 5 is a cross-sectional view of the housing, the metal plate, and the circuit board shown in Fig. 1 when the housing is located at a shifted position;

[0026] Fig. 6 is a front view of the housing, the metal plate, and the circuit board shown in Fig. 1 when the housing is located at the shifted position shown in Fig. 5;

[0027] Fig. 7 is a cross-sectional view of the housing, the metal plate, and the circuit board shown in Fig. 1 when the housing is located at an attachment position;

[0028] Fig. 8 is a front view of the housing, the metal plate, and the circuit board shown in Fig. 1 when the housing is located at the attachment position shown in Fig. 7;

[0029] Fig. 9 is a perspective view showing a modification of the connector shown in Fig. 1;

[0030] Fig. 10 is a schematic view showing a first modification of a coaxial terminal of the connector shown in Fig. 1;

[0031] Fig. 11 is a schematic view showing a second modification of the coaxial terminal of the connector shown in Fig. 1;

[0032] Fig. 12 is a schematic view showing a third modification of the coaxial terminal of the connector shown in Fig. 1;

[0033] Fig. 13 is a schematic view showing a fourth modification of the coaxial

terminal of the connector shown in Fig. 1;

[0034] Fig. 14 is a schematic view showing a fifth modification of the coaxial terminal of the connector shown in Fig. 1;

[0035] Fig. 15 is a cross-sectional view showing a coaxial movable contact probe of a conventional art; and

[0036] Fig. 16 is a view showing a state in that the coaxial movable contact probes shown in Fig. 15 are in use.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0037] In the following, an embodiment of a connector of the present invention will be explained with reference to the drawings. It should be noted that the embodiment described below is an example of a preferred embodiment of the present invention and is not intended to limit the present invention.

[0038] A connector 1 of the embodiment has a housing 11 and a metal plate 26. Fig. 1 is a perspective view of the connector 1 seen from obliquely above, and Fig. 2 is a perspective view of the housing 11 of the connector 1 seen from obliquely below. Fig. 1 also shows a circuit board 2 to which the connector 1 is to be attached. Fig. 3 is a perspective view of the metal plate 26. Fig. 4 shows a state that the connector 1 is attached to the circuit board 2.

[0039] As shown in Fig. 1, a plurality of lands 151 are aligned on the circuit board 2 such that land rows are each formed of three pieces of the land 151. Electric wirings such as through holes (not shown) are connected to the three lands 151 aligned to form each of the land rows. Other than these, a through hole 111a into which a resilient arm 30 is to be inserted and a through hole 111b which is overlapped with a through hole 28 of the metal plate 26 are formed in the circuit board 2, as shown in Fig. 5 (to be described later).

[0040] The metal plate 26 is made of a metal material and has a substantially rectangular plate shape as shown in Fig. 3. An inclined surface 27 is formed on one end portion of the metal plate 26. Further, the through hole 28 is formed at the center portion of the metal plate 26. As shown in Fig. 1, the metal plate 26 is attached to the circuit board 2 before the housing 11 is attached to the circuit board 2. Furthermore, the metal plate 26 is attached to the circuit board 2 in a posture so that the inclined surface 27 faces the side of the through hole 111a formed in the circuit board 2. Moreover, the through hole 28 is overlapped and communicated with the

through hole 111b of the circuit board 2, as shown in Fig. 5 (to be described later).

[0041] The housing 11 is made of an insulative material such as resin and has an elongated plate shape which is long in one direction, as shown in Fig. 1. In the housing 11, a plurality of cavities 14 are formed in the housing 11 to penetrate through the housing 11 in an up and down direction. In the cavities 14, coaxial terminals 51 are accommodated respectively. As shown in Fig. 5 (to be described later), each of the coaxial terminals 51 has a coaxial structure constructed of a center terminal 52 and an outer terminal 61. As shown in Fig. 4, the housing 11 is attached to the circuit board 2 with a lower surface 11a of the housing 11 facing the circuit board 2. Further, as shown in Fig. 7 (to be described later), in the state that the housing 11 is attached to the circuit board 2, the center terminal 52 and the outer terminal 61, of each of the coaxial terminals 51, projecting downward from the housing 11 are in contact with the lands 151 of the circuit board 2. With this, the coaxial terminals 51 and the lands 151 of the circuit board 2 are electrically connected to each other.

[0042] As shown in Fig. 2, the resilient arm 30 is formed on one end in the longitudinal direction (right end portion in Fig. 2) of the housing 11. The resilient arm 30 is formed integrally with the housing 11 by using a resin material same as that forming the housing 11 and has a thin plate shape. Further, a lower end portion of the plate-shaped resilient arm 30 projects downward from the lower surface 11a of the housing 11. Further, the resilient arm 30 has an arm projection 31 which is formed on an outer surface (right surface in Fig. 2) of the resilient arm 30 at a lower end portion of the resilient arm 30. Since the arm projection 31 is formed in such a manner on the outer surface of the plate-shaped resilient arm 30 at the lower end portion thereof, when the arm projection 31 is pushed or pressed leftward in the state shown in Fig. 2, the plate-shaped resilient arm 30 is bent leftward. Note that the lower end portion of the resilient arm 30 is inserted in the through hole 111a of the circuit board 2 in Fig. 1. Further, as shown in Fig. 5 (to be described later), in a state that the resilient arm 30 is inserted in the through hole 111a, the arm projection 31 abuts on a side surface of the circuit board 2, in the through hole 111a.

[0043] On the other end portion in the longitudinal direction (left end portion in Fig. 2) of the housing 11, a recessed portion 32 accommodating or adapted to the metal plate 26 is formed. Further, a right side surface of the recessed portion 32 in Fig. 2 is formed to be an inclined surface 29. In the recessed portion 32, a protruding portion 17 is formed. The protruding portion 17 is inserted (insertable) in the hole 28

of the metal plate 26 shown in Fig. 1, as will be described later.

[0044] Fig. 5 is a cross-sectional view of the housing 11 and the metal plate 26. Fig. 5 also shows a cross section of the circuit board 2. Each of the coaxial terminals 51 includes the center terminal 52, the outer terminal 61, and an insulator 41.

[0045] The outer terminal 61 of the coaxial terminal 51 includes an outer conductor 62, an outer coil spring 71, and a cylindrical contact 81, each of which is formed by using a conductive material such as metal. The outer conductor 62 has a substantially cylindrical shape and has, on an upper portion of the outer conductor 62, a mating portion 66 with which a surrounding terminal of a coaxial plug (not shown) is to be mated. In the outer conductor 62 which is substantially cylindrical, the outer coil spring 71 is accommodated and one end of the cylindrical contact 81 having the cylindrical shape is inserted so as not to come off or drop therefrom. Owing to this structure, the cylindrical contact 81 projects downward from the lower edge of the outer conductor 62 in a state that the cylindrical contact 81 is biased by the outer coil spring 71.

[0046] The center terminal 52 of the coaxial terminal 51 includes a center conductor 53, a center coil spring 58, and a shaft-shaped contact 59, each of which is formed by using a conductive material. The center conductor 53 has a substantially shaft shape and has, on an upper portion thereof, a mating portion 55 with which an axial terminal of the coaxial plug (not shown) is to be mated. Further, the substantially shaft-shaped center conductor 53 has a center hole in which the center coil spring 58 is accommodated and into which one end of the shaft-shaped contact 59 is inserted so as not to come off or drop therefrom. Owing to this structure, the shaft-shaped contact 59 projects downward from the lower edge of the center conductor 53 in a state that the shaft-shaped conductor 53 is being biased by the center coil spring 58.

[0047] The insulator 41 is made of an insulative resin material or the like and has a substantially columnar shape. The columnar insulator 41 has a center hole 42 which is formed in the center of the insulator 41 and into which the center terminal 52 is to be inserted. Further, the columnar-shaped insulator 41 is inserted in the outer conductor 62 which is substantially cylindrical-shaped. With this, the center terminal 52 and the outer terminal 61 are held coaxially while being insulated from each other.

[0048] The center terminal 52 and the outer terminal 61, of each of the coaxial terminals 51, which are integrated in such a manner by the insulators 41 are inserted in one of the cavities 14 as shown in Fig. 5. Further, the shaft-shaped contact 59

and the cylindrical contact 81 of each of the coaxial terminals 51 project downward from the lower surface 11a of the housing 11. The cylindrical contacts 81 of each of the coaxial terminals 51 has two projecting contact points 83; and the two projecting contact points 83 of the cylindrical contact 81 and the shaft-shaped contact 59, of each of the terminals 51, which project from the lower surface 11a of the housing 11 come into contact with a set of three lands 151 which are arranged in a row on the circuit board 2.

[0049] Next, an explanation will be given as to a method of attaching the connector 1 to the circuit board 2 as shown in Fig. 4. Figs. 5 and 6 are views each showing a state that the coaxial terminals 51 are made to abut on the lands 151 of the circuit board 2. Figs. 7 and 8 are views each showing a state that the housing 11 is attached to the circuit board 2. Figs. 5 and 7 are cross-sectional views and Figs. 6 and 8 are front views.

[0050] Upon attaching the connector 1 to the circuit board 2, the connector 1 is first arranged or positioned at the position shown in Fig. 5 which is shifted in the right and left direction from the attachment position shown in Fig. 7, as is apparent from comparison, for example, between Figs. 5 and 7; and with the connector 1 positioned at the shifted position, the coaxial terminals 51 are made to abut on the lands 151 of the circuit board 2. In the following, the position shown in Figs. 5 and Fig. 6 will be referred to as "shifted position" and the position shown in Figs. 7 Fig. 8 will be referred to as "attachment position".

[0051] In the following, an explanation will be given about a method for attaching the connector 1, from the state that the metal plate 26 has been already attached to the circuit board 2 as shown in Fig. 1. As a method for attaching the metal plate 26 to the circuit board 2, any method may be used provided that the method is capable of attaching the metal plate 26 to the circuit board 2. An example of the method includes forming a through hole (not shown) in the circuit board 2 and a projection (not shown) on the metal plate 26; and then inserting the unillustrated projection in the unillustrated through hole.

[0052] As shown in Figs. 2 and 5, in the housing 11 before the housing 11 is attached to the circuit board 2, the cylindrical contact 81 and the shaft-shaped contact 59 of each of the coaxial terminals 51 project from the lower surface (surface attached to the circuit board 2; attachment surface) 11a of the housing 11.

[0053] Upon attaching the housing 11 to the circuit board 2, at first, the housing 11 is

placed on the circuit board 2. Specifically, as shown in Fig. 5, the resilient arm 30 is inserted in the hole 111a of the circuit board 2 and the protruding portion 17 is inserted in the hole 28 of the metal plate 26. By doing so, the shaft-shaped contact 59 and the pair of projecting contact points 83 of each of the cylindrical contacts 81 are brought into contact with the lands 151 of the circuit board 2.

[0054] Note that in the state shown in Fig. 5, the arm projection 31 comes into contact with the side surface of the circuit board 2, in the hole 111a of the circuit board 2, in a state that the resilient arm 30 is substantially straight (with a low biasing force). This causes the housing 11 to float above the circuit board 2 and to be positioned at the shifted position shifted or deviated leftward from the attachment position shown in Fig. 7. Further, the protruding portion 17 which is inserted in the hole 28 comes into contact with the metal plate 16 at the left side surface of the protruding portion 17 as shown in Fig. 5. The inclined surface 29 of the housing 11 comes into contact with the inclined surface 27 of the metal plate 26.

[0055] After arranging or positioning the housing 11 at the shifted position in this manner, the housing 11 is pressed toward or against the circuit board 2. By a force pressing the housing 11 toward the circuit board 2, the cylindrical contacts 81 and the shaft-shaped contacts 59 which are in contact with the lands 151 are pushed into the housing 11, in a state that the cylindrical contacts 81 and the shaft-shaped contact 59 are kept in contact with the lands 151, against biasing forces of the outer coil springs 71 and the center coil springs 58. Further, since the inclined surface 29 of the housing 11 is in contact with the inclined surface 27 of the metal plate 26, the housing 11 moves on the surface of the circuit board 2 while the housing 11 slides down the inclined surface 27. In Fig. 5, the housing 11 moves rightward in the drawing. Since the housing 11 is forcibly moved on the surface of the circuit board 2, the arm projection 31 formed on the lower end portion of the resilient arm 30 is brought into pressure contact with the side surface of the circuit board 2 in the hole 111a, and thus the resilient arm 30 is bent.

[0056] Then, in the state that the lower surface 11a of the housing 11 is in contact with the circuit board 2 as shown in Figs. 7 and 8, the resilient arm 30 is greatly bent and thus the arm projection 31 is biased toward the circuit board 2 with a high biasing force. Further, the protruding portion 17 is inserted through the hole 28 of the metal plate 26 to arrive at the through hole 111b overlapping with the hole 28 and the protruding portion 17 is brought into contact with the metal plate 26 at the right side

surface of the protruding portion 17 in Fig. 7. The metal plate 26 is accommodated in the recessed portion 32 of the housing 11. In this manner, the housing 11 is attached to the circuit board 2 at the attachment position. Note that the housing 11 may be further screw-fixed or may be fixed with soldering or an adhesive to the circuit board 2.

[0057] During a period that the housing 11 is moving on the surface of the circuit board 2 in such a manner from the shifted position shown in Fig. 5 to the attachment position shown in Fig. 7, the pairs of projecting contact points 83 and the shaft-shaped contacts 59, which are pressed against the lands 151 at the shifted position shown in Fig. 5, are moved together with the housing 11 on the surface of the circuit board 2 such that the pair of the projecting contact points 83 and the shaft-shaped contact 59 rub the lands 151. This makes it possible to remove or peel off an oxide film on a surface of the pair of projecting contact points 83, a surface of the shaft-shaped contact 59, and surfaces of the lands 151 and to remove dust caught therebetween at the time of the attachment.

[0058] After the connector 1 is thus attached to the circuit board 2 in such a manner, an unillustrated plug is attached onto the connector 1. The plug includes coaxial plugs (coaxial plug connectors) each of which has an axial terminal and a surrounding terminal arranged coaxially with each other; and the axial terminal is mated with the mating portion 55 of the center conductor 53 and the surrounding terminal is mated with the mating portion 66 of the outer conductor 62 of each of the coaxial terminals 51. By doing so, the axial terminal of each of the coaxial plug connectors is electrically connected to the center terminal 52 of one of the coaxial terminals 51, and the surrounding terminal of each of the coaxial plug connectors is electrically connected to the outer terminal 61 of one of the coaxial terminals 51. Further, the axial terminal of each of the coaxial plug connectors is electrically connected to the lands 151 of the circuit board 2 via the center terminal 52 of one of the coaxial terminals 51, and the surrounding terminal of each of the coaxial plug connectors is electrically connected to the lands 151 of the circuit board 2 via the outer terminal 61 of one of the coaxial terminals 51.

[0059] As described above, in the connector 1 of this embodiment, the housing 11 at the shifted position shown in Figs. 5 and 6 is pushed (pressed) toward the circuit board 2 so that the housing 11 is pushed while moving on the circuit board 2, and the housing 11 is attached to the circuit board 2 at the attachment position shown in Figs.

7 and 8. Therefore, the pairs of projecting contact points 83 and the shaft-shaped contacts 59, which are in contact with the lands 151 of the circuit board 2 when the housing 11 is at the shifted position shown in Figs. 5 and 6, are moved on the lands 151 such that the pairs of projecting contact points 83 and the shaft-shaped contacts 59 rub the lands 151 while the housing 11 moves from the shifted position shown in Figs. 5 and 6 to the attachment position shown in Figs. 7 and 8. This makes it possible to perform the wiping for the pairs of projecting contact points 83, the shaft-shaped contacts 59, and the lands 151.

[0060] As described above, in the connector 1 of this embodiment, even though the terminals of the housing 11 are the coaxial terminals 51, it is possible to perform the wiping when the housing 11 is attached to the circuit board 2. By this wiping, it is possible to rub off the oxide film from the surfaces of the pairs of projecting contact points 83, the shaft-shaped contacts 59, and the lands 151 and to remove dust caught therebetween, thereby making it possible to assuredly improve the connection reliability between the coaxial terminals 51 and the lands 151.

[0061] Further, it is possible to retract the cylindrical contacts 81 brought into pressure contact with the lands 151 into the housing 11 by compressing the outer coil springs 71, respectively and it is possible to retract the shaft-shaped contacts 59 biased toward the lands 151 into the housing 11 by compressing the center coil springs 58, respectively. Therefore, the pair of projecting contact points 83 of the cylindrical contacts 81 and the shaft-shaped contacts 59 are biased toward the lands 151 by a desired biasing force and thus do not damage the lands 151 of the circuit board 2 during the wiping, namely during the movement from the shifted position to the attachment position. On the other hand, in a case that, for example, the cylindrical contacts 81 and the shaft-shaped contacts 59 are fixed to the housing 11, the pairs of projecting contact points 83 and the shaft-shaped contacts 59 of some of the coaxial terminals 51 are biased toward the lands 151 by an excessive biasing force due to the non-uniform alignment or only some of the coaxial terminals 51 are biased toward the lands 151 due to the non-uniform alignment, thereby damaging the lands 151 of the circuit board 2 in some cases.

[0062] Since the terminals of the connector 1 are the coaxial terminals 51, it is possible to prevent crosstalk among the terminals. As a result, in the connector 1, it is possible to obtain the performance sufficient for transmitting or transferring high-frequency component of the signal. Accordingly, the connector 1 can be used

for connecting a target circuit board having a measurement target mounted thereon to a measuring circuit board having a signal generator circuit, a comparator, etc. mounted thereon, with the coaxial cables and without any soldering.

[0063] Note that in this embodiment, as shown in Fig. 2, one piece of the resilient arm 30 is formed on one end portion in the longitudinal direction of the housing 11 and the recessed portion 32 and the protruding portion 17 are formed on the other end portion in the longitudinal direction. On than these, it is allowable to form, for example as shown in Fig. 9, two pieces of the resilient arm 30 on the housing 11. Alternatively, it is allowable to form the recessed portion 32 for accommodating the metal plate 26 and the projecting portion 17 at the central portion of the housing 11.

[0064] In this embodiment, the inclined surface 27 is formed in the metal plate 26 and the inclined surface 29 is formed in the housing 11 as well. Alternatively, it is allowable that only the metal plate 26 is provided with the inclined surface 27, or that an inclined surface is formed in a part of a side surface of the housing 11. That is, it is enough that the inclined surface is formed on one of the metal plate 26 and the housing 11.

[0065] Further, in this embodiment, the protruding portion 17 is formed in the housing 11 and the hole 28 is formed in the metal plate 26. Alternatively, for example, it is allowable to form the protruding portion 17 in the metal plate 26 and to form the hole 28 in the housing 11.

[0066] Furthermore, the connector 1 of this embodiment includes the coaxial terminals 51 each having the center terminal 52 and the outer terminal 61 which are coaxial. Alternatively, for example, the connector 1 may include terminals each of which is constructed of the center terminal 52 or the outer terminal 61. Further, the connector may be, for example, a connector including a terminal soldered to the circuit board 2, rather than the connector used while being biased against the circuit board 2.

[0067] Moreover, the terminals provided in the connector are not limited to the coaxial terminals 51 constructed of the center conductor 53, the center coil spring 58 and the shaft-shaped contact 59 as in this embodiment; for example, the terminal may be formed of one member. Specifically, for example, the terminal may be a terminal 251 as shown in Fig. 10 which is made by performing press working for one sheet of metal plate to obtain a shape having a spring portion 252 and a pair of terminal portions 253, 254 formed above and below the spring portion 252; the

terminal may be a terminal 351 as shown in Fig. 11 which is made by bending one sheet of metal plate to have a substantially S-shape; or the terminal may be a terminal 451 as shown in Fig. 12 which is made by bending one sheet of metal plate to obtain a shape having a C-shaped portion 452 and a leg portion 453. Alternatively, the terminal may be a terminal 551 as shown in Fig. 13 formed of a center portion 552, of a long coil spring, which is not wound tightly (which is wound relatively loosely). Further alternatively, the terminal may be a terminal 651 as shown in Fig. 14 which is constructed of a metal plate 652 having a substantially U-shape and a metal ball 653 placed on the metal plate 652. Even when the terminals are the terminals 251, 351, 451, 551, 651 which are movable upwardly and downwardly, the present invention can be applied to thereby make it possible to perform the wiping upon attaching the connector.

[0068] Upon attaching the connector of the present invention to the circuit board, it is possible to perform the wiping by rubbing the terminals against the lands. Therefore, even when the terminals are, for example, terminals each of which has a coaxial structure, etc., it is possible to electrically connect the terminals and the lands with low contact resistance. Therefore, the connector of the present invention can be used as a connector in, for example, an IC testing apparatus or the like, in order to connect a target circuit board on which an IC as the measurement target is mounted and a measuring circuit board on which a signal generator circuit, a comparator and the like are mounted, with coaxial cables.

What is claimed is:

1. A connector which is attached to a circuit board having a land, the connector comprising:

a housing;

a terminal which projects from the housing and which is brought into contact with the land; and

a separate component which is separate from the housing and is attached to the circuit board and which has an inclined surface;

wherein when the housing is pressed toward the circuit board, while being brought into contact with the inclined surface of the separate component attached to the circuit board, the housing is moved slidably on the inclined surface to cause the terminal rub the land.

2. The connector according to claim 1, further comprising a biasing member which biases the terminal so that the terminal retractably projects from the housing.

3. The connector according to claim 1, further comprising:

a resilient arm which projects from the housing and which is inserted into a hole formed in the circuit board; and

a projection which projects from the resilient arm and which is brought into contact with the circuit board in the hole;

wherein the housing is moved slidably on the inclined surface to bend the resilient arm and to bring the projection into pressure contact with the circuit board.

4. The connector according to claim 1, wherein a hole is formed in the separate component;

the housing has a protruding portion which is formed in the housing and which is inserted in the hole formed in the separate component; and

the housing is stopped when the protruding portion abuts on the separate component in the hole formed in the separate component.

5. The connector according to claim 1, wherein the terminal has a projecting contact point which is brought into contact with the land.

6. The connector according to claim 1, wherein the terminal is a terminal with a coaxial structure having a center terminal and a cylindrical outer terminal surrounding the center terminal.

Fig. 1

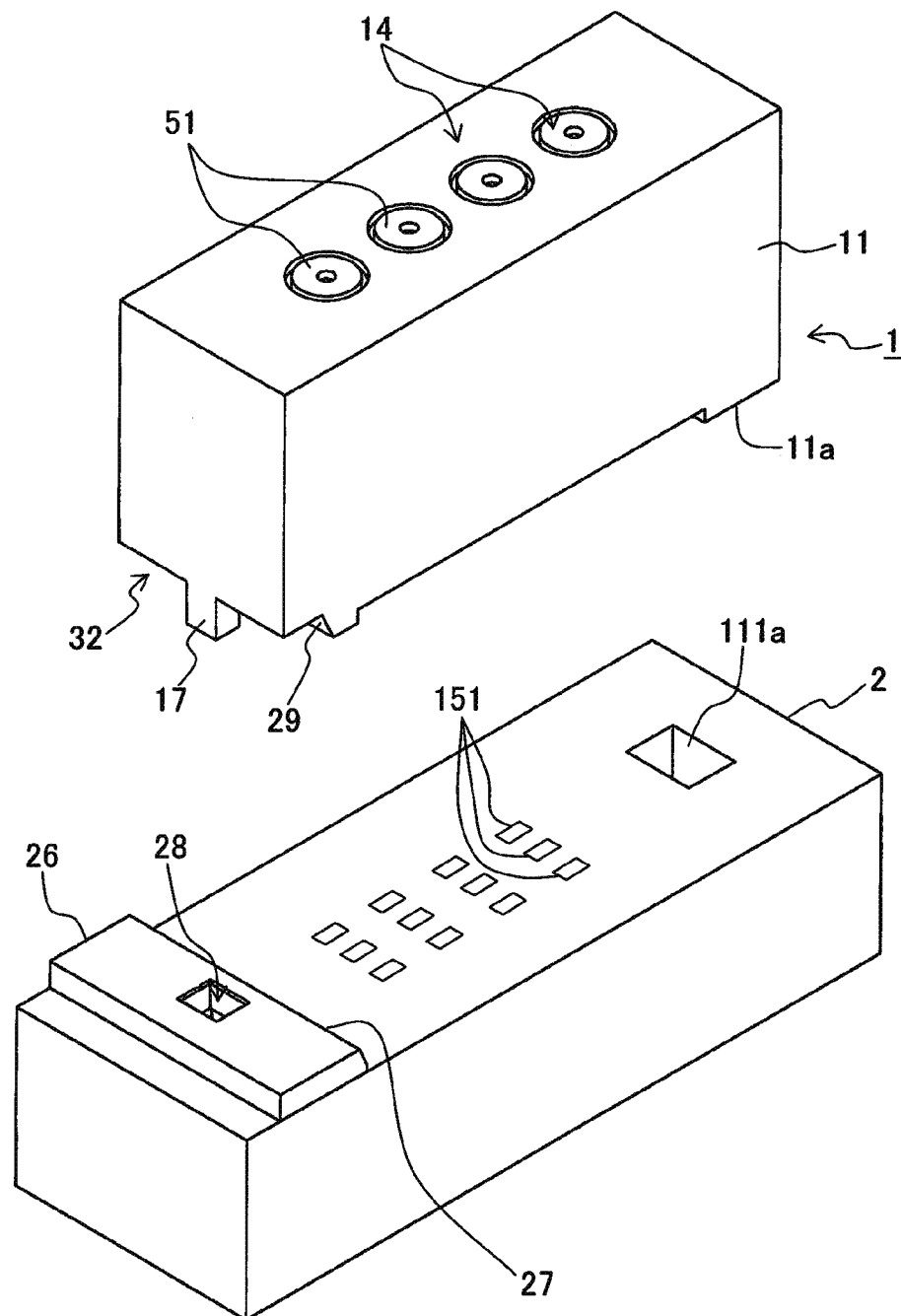


Fig. 2

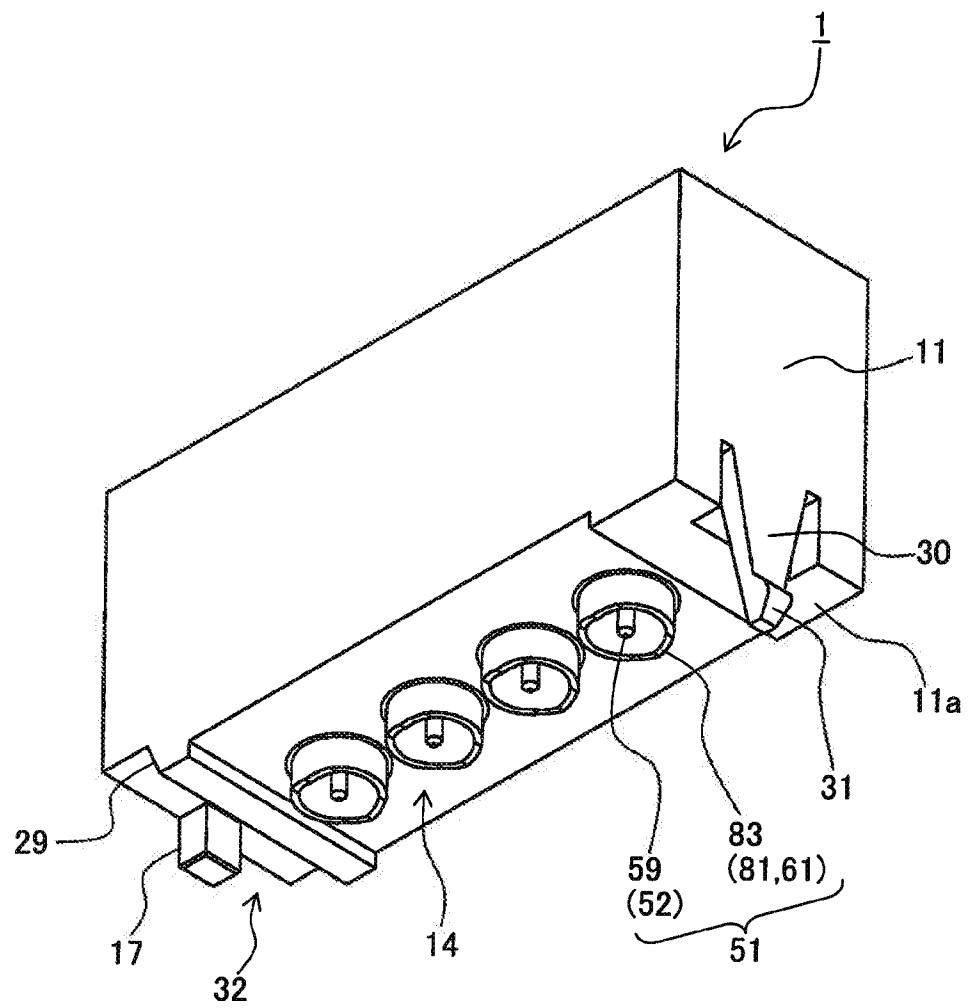


Fig. 3

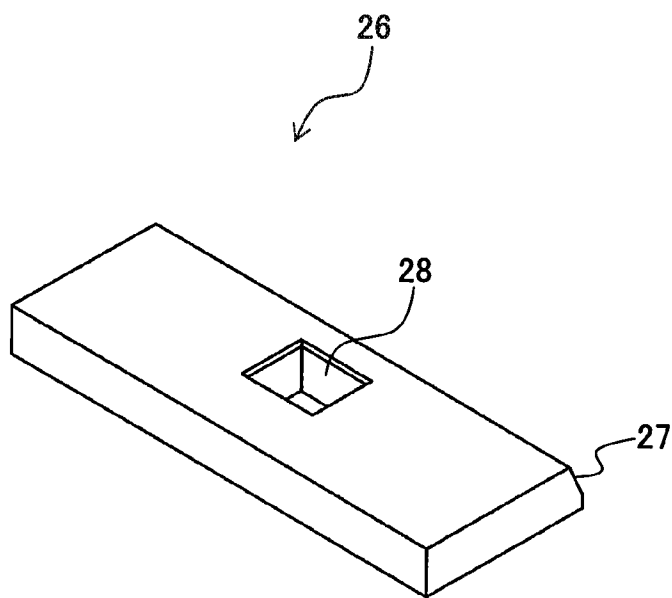


Fig. 4

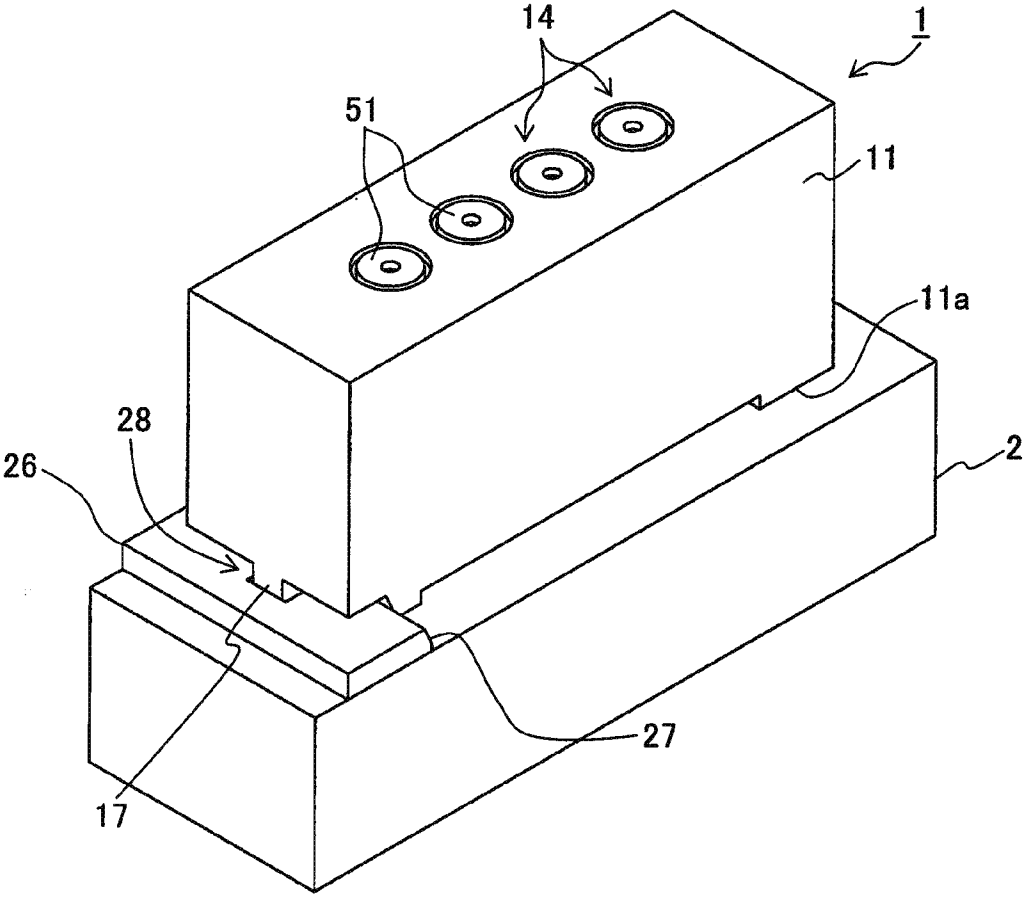


Fig. 5

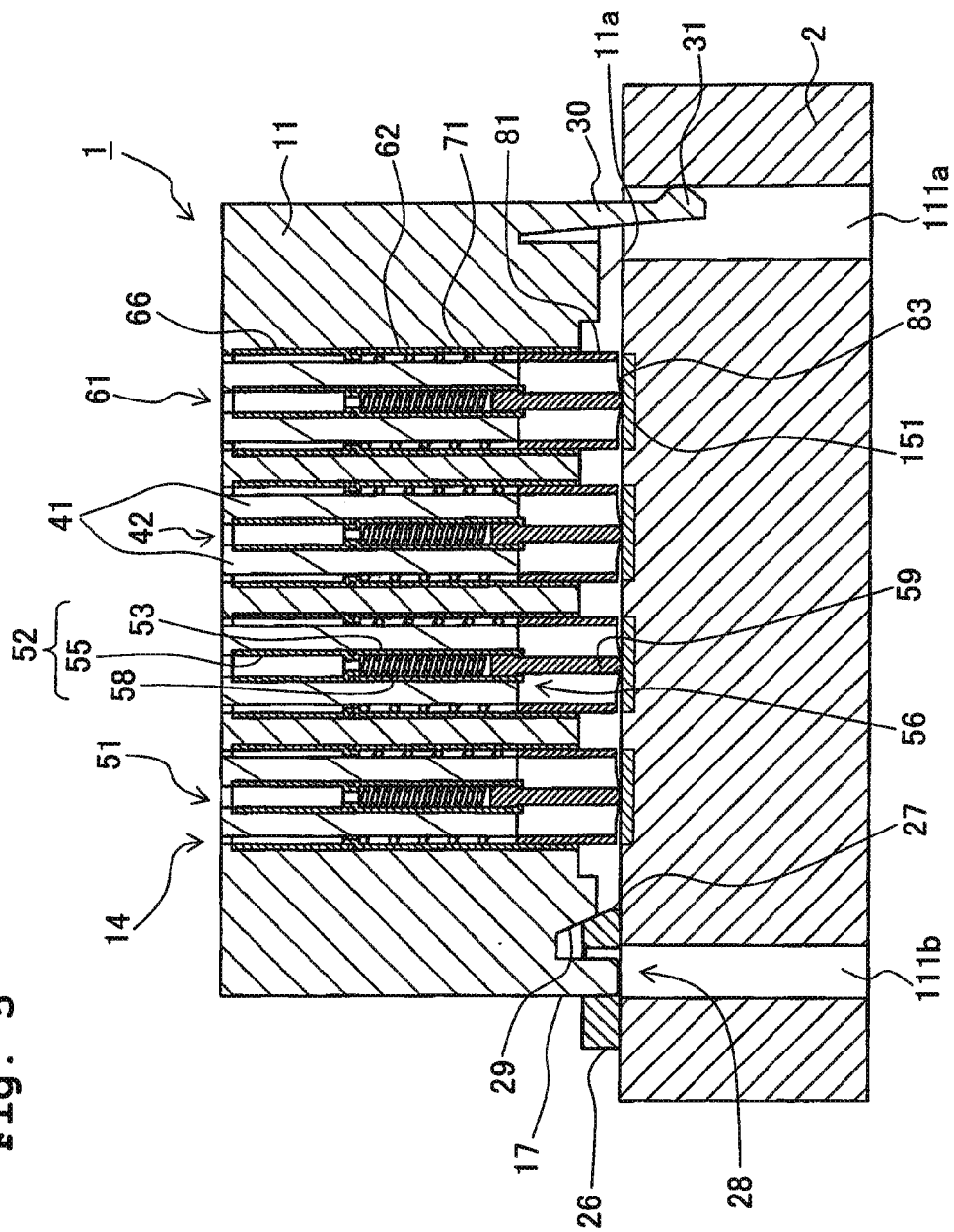


Fig. 6

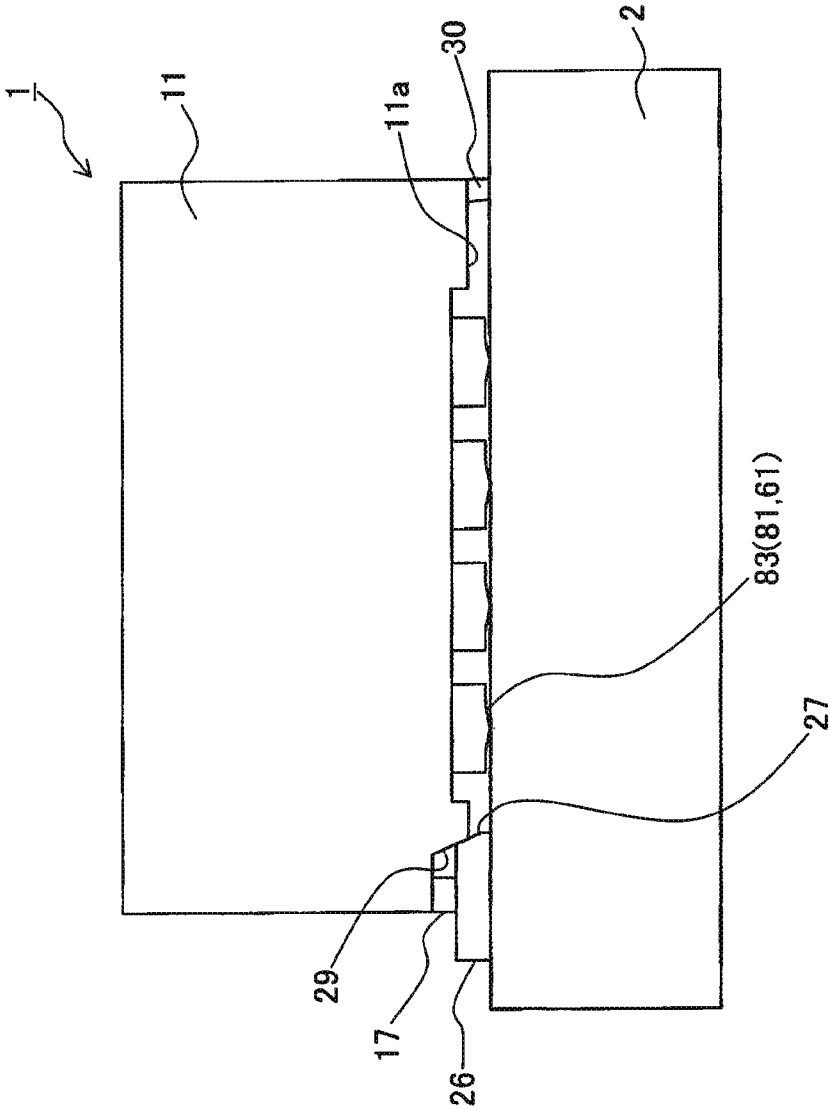


Fig. 7

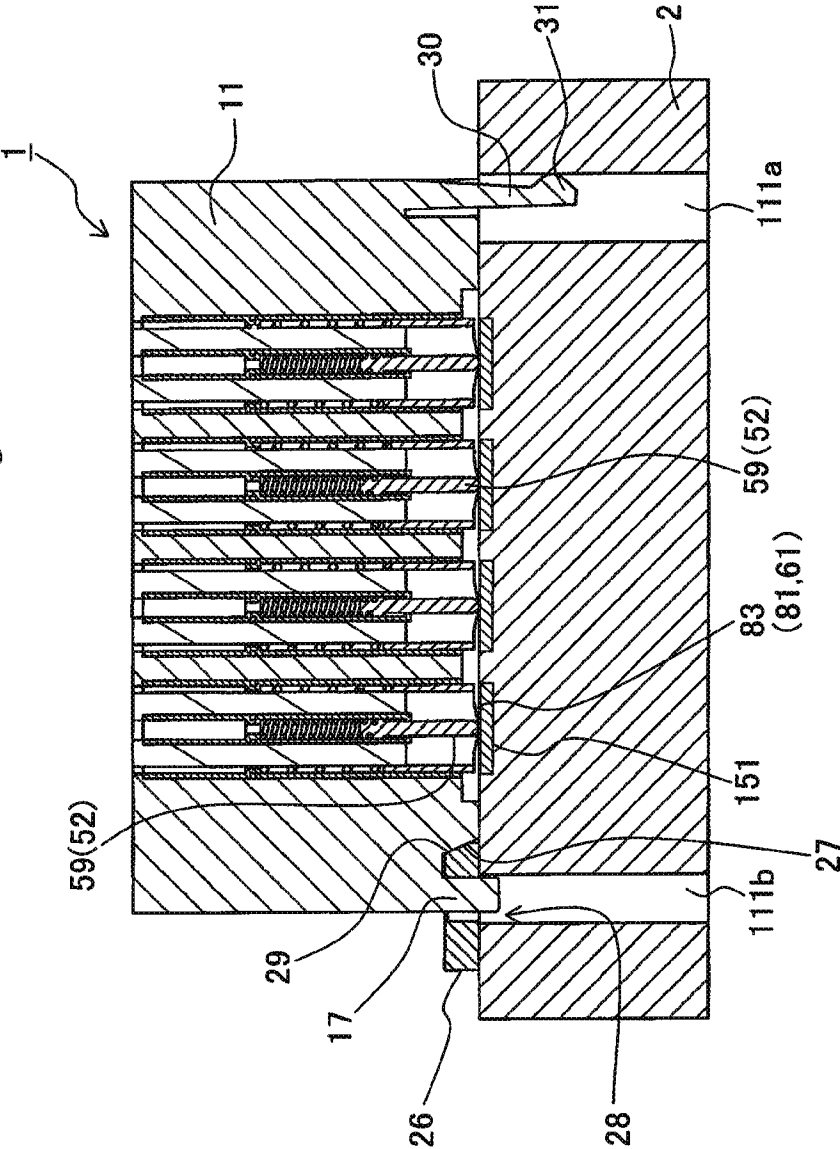


Fig. 8

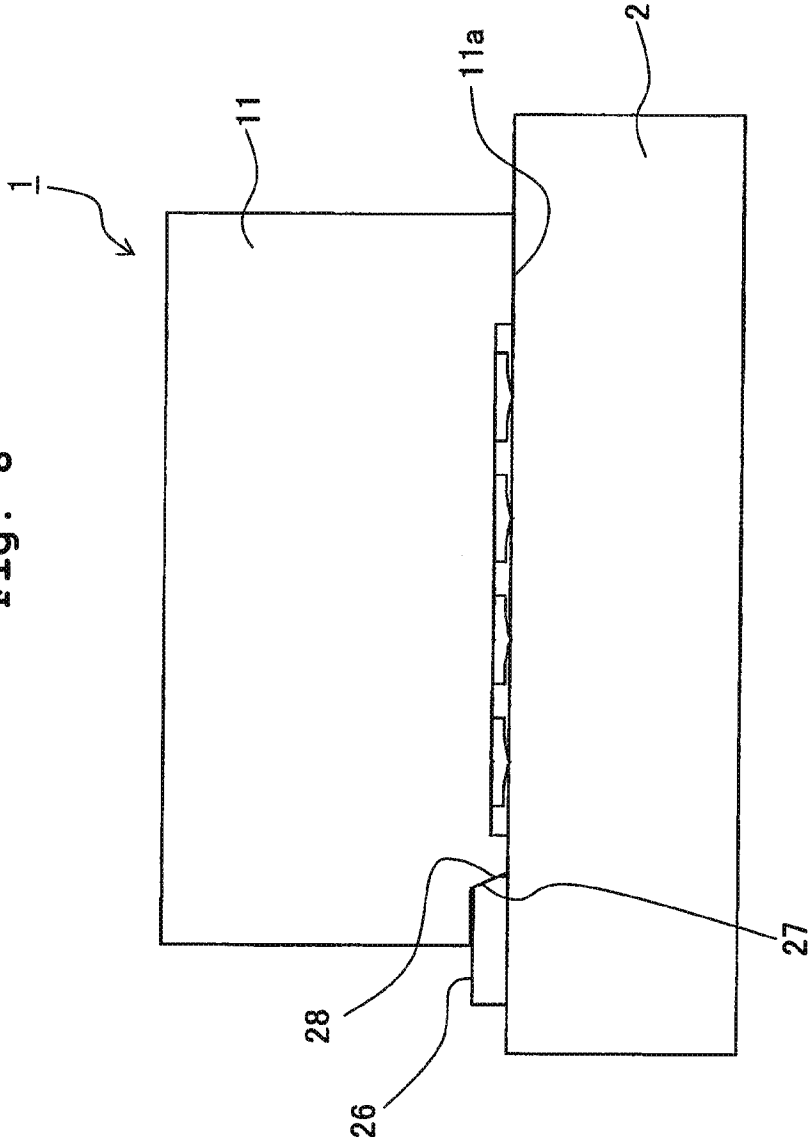


Fig. 9

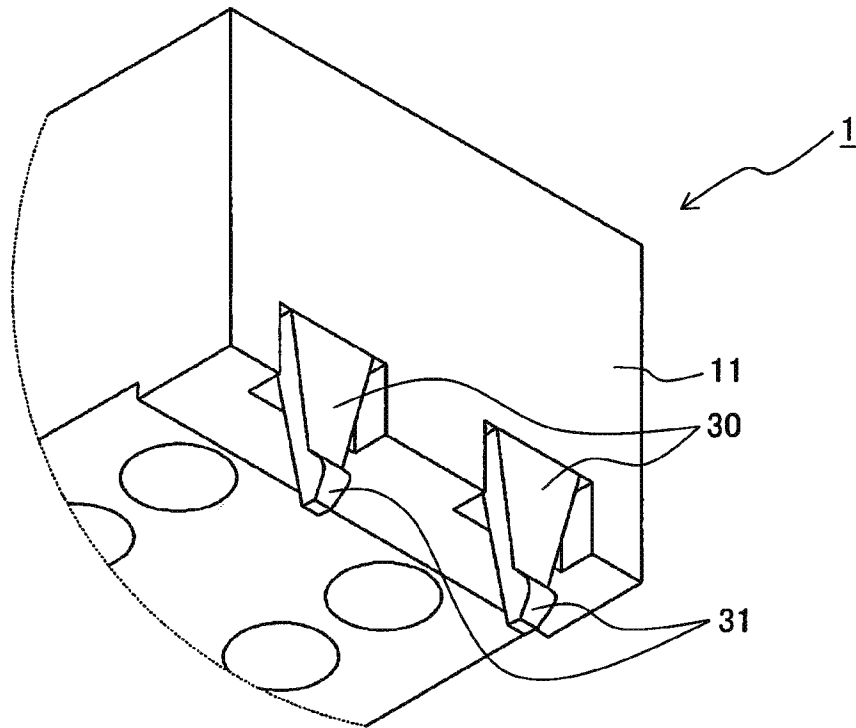


Fig. 10

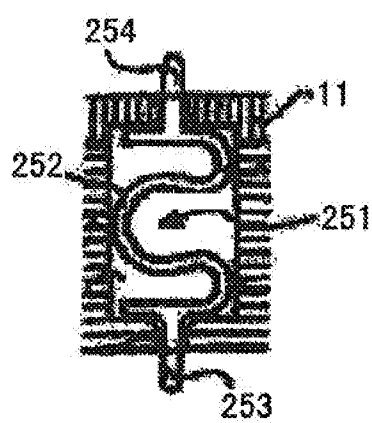


Fig. 11

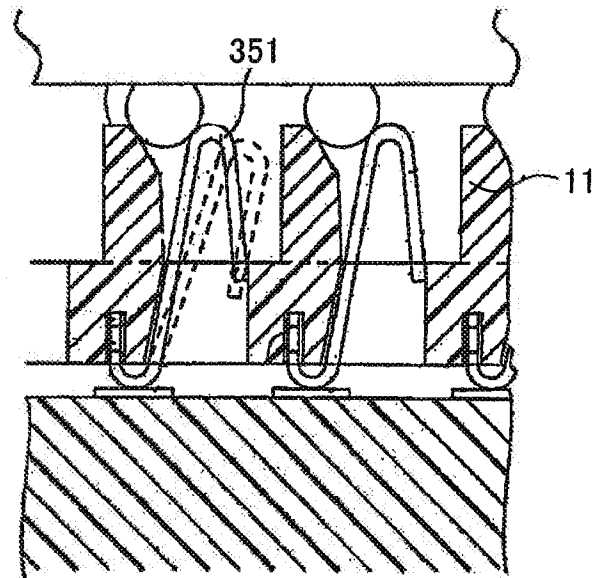


Fig. 12

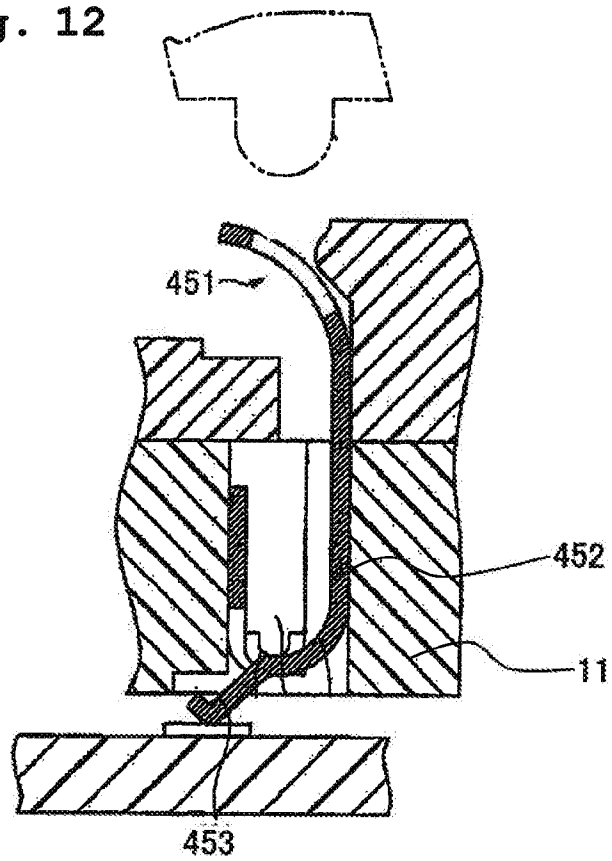


Fig. 13

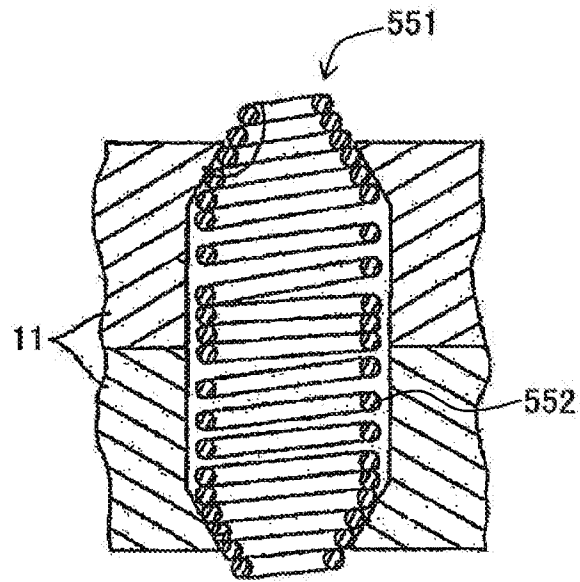


Fig. 14

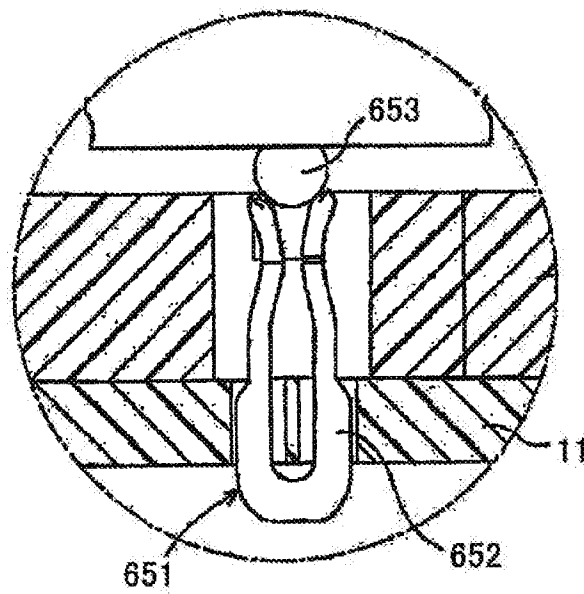
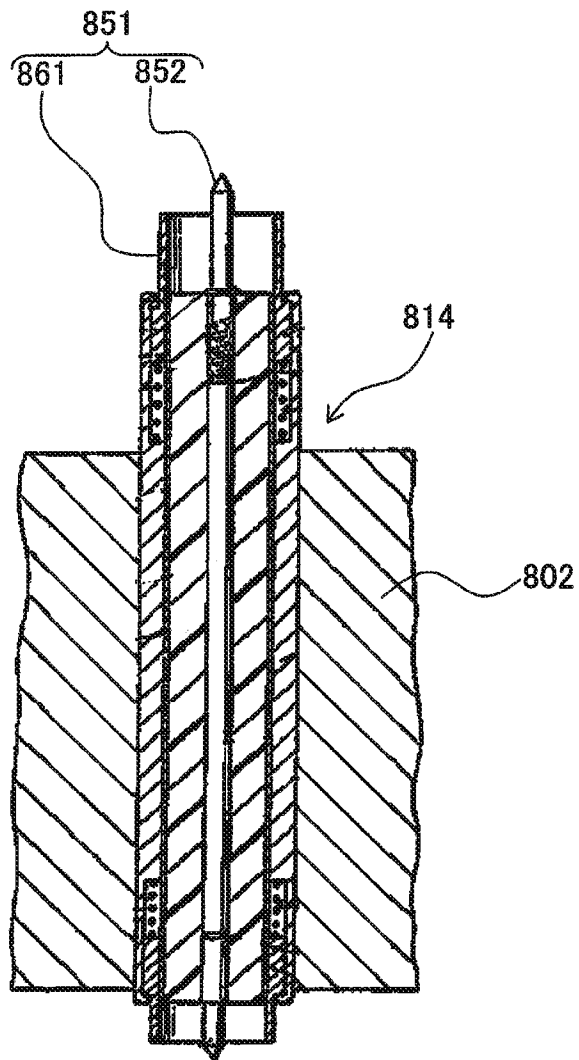
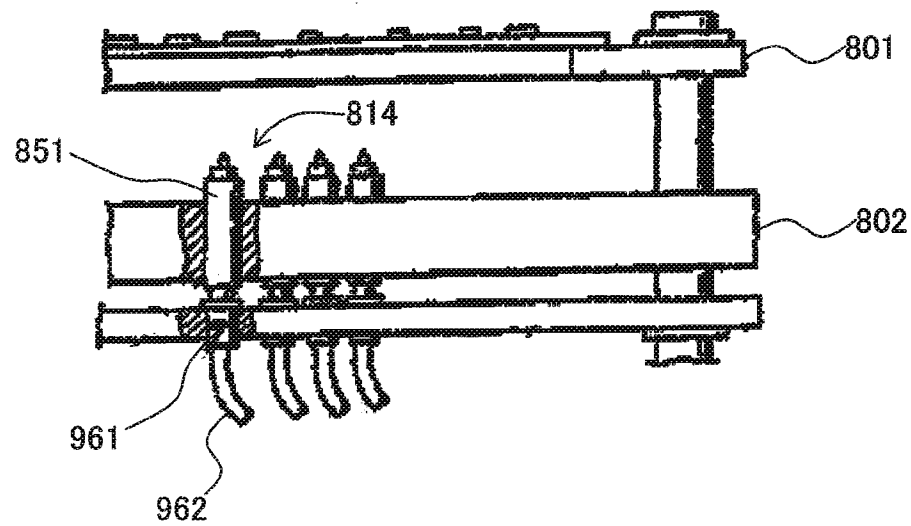


Fig. 15



Prior Art

Fig. 16



Prior Art

INTERNATIONAL SEARCH REPORT

International application No
PCT/US2009/069094

A. CLASSIFICATION OF SUBJECT MATTER

INV. H01R13/24 H01R12/04 G01R1/04
ADD. H01R13/658 G01R1/067 H01R13/631

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

H01R G01R

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 6 234 820 B1 (PERINO DONALD V [US] ET AL) 22 May 2001 (2001-05-22)	1-2,4
Y	figures 1-3	5-6
A	column 2, line 39 - column 3, line 41	3
Y	US 6 053 777 A (BOYLE STEPHEN A [US]) 25 April 2000 (2000-04-25)	5-6
	figures 1-2	
	columns 3-4	
A	WO 93/03516 A1 (ITT [US]) 18 February 1993 (1993-02-18)	3
	page 5, lines 10-27	
	figure 3	
	----- -/--	

☒ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

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Date of the actual completion of the international search

22 March 2010

Date of mailing of the international search report

31/03/2010

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Hugueny, Bertrand

INTERNATIONAL SEARCH REPORT

International application No
PCT/US2009/069094

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	JP 07 272810 A (ENPLAS CORP) 20 October 1995 (1995-10-20) cited in the application figures 1-12	1
A	JP 60 123666 U (-) 20 August 1985 (1985-08-20) cited in the application figures 1-4	1

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/US2009/069094

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 6234820	B1	22-05-2001	NONE
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