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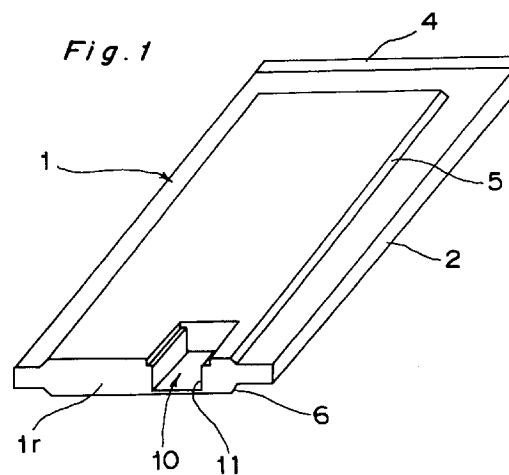
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(54) **Modular-jack connector**

(57) A modular-jack connector allowing a modular-jack to connect with a plate member directly and being convenient to use is provided. A groove 11 for inserting the modular-jack thereinto is provided at an end portion of a PC card 1, the groove is elongated from an end face of the end portion to inner side of the PC card 1 in a direction along the card plane, and opens on one side in a thickness direction of the PC card 1. And, connector electrodes 12 being able to contact with an electrode of the modular-jack is provided on an inside wall 11b of the groove 11. Also, the modular-jack connector has a securing member 15 for securing the modular-jack, being formed as a separated part from the PC card 1, and a support means 11h, 15b which supports the securing member changeably between an accommodated position in the direction along the plane of the PC card 1 and a securing position to secure the modular-jack.



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Description

Field of the Invention

The present invention relates to a modular-jack connector to be provided at an end portion of a relatively thin plate member and makes it possible to connect a modular-jack to the plate member directly.

Description of the Prior Art

As widely known, recently, the use of what we call electronic cards named e.g. PC card or IC card, being provided with electric circuits or electronic circuits such as semiconductor integral circuits etc., has been expanding rapidly.

These cards are used, for example, in computer devices such as personal computers and work stations etc., or in electronic equipments such as multi-functional telephone sets, and they are used by being inserted into card slots provided on the bodies of the equipments.

By the way, among the above-mentioned cards, the card with so-called modem function needs a modular-jack connector (i.e. a connector for a modular-jack) to be connected with a modular-jack, in order to interface with an outer telecommunication line such as a telephone line for instance, in addition to a connector for connecting the card to the body of the equipment.

However, in the case of thin devices such as the foregoing electronic cards, it is commonly very difficult to incorporate a modular-jack connector in the body, since its thickness is limited to a certain value (for example 3.3mm or 5mm).

In the specification, the term of "thin" indicates that the thickness is equal or less than the height or width dimension of the modular-jack to be connected, and the term of "thin device" indicates thin plate member provided with electric circuits or electronic circuits, including said electronic cards named PC card or IC card.

Therefore, formerly, as shown in Fig.27 or Fig.28 for instance, connectors 111,121 for a dedicated conversion cable 112 or an adapter 122 are provided at the rear sides of thin devices (e.g. PC cards) 110,120, and modular-jacks are connected to them through the conversion cable 112 or the adapter 122.

That is to say, in the example shown in Fig.27, a modular-jack 113 is connected to an end portion of the conversion cable 112, and in the example shown in Fig.28, a modular-jack connector 123 is provided on the back side of the adapter 122.

However, when other connecting appliances such as the dedicated conversion cable 112 or the adapter 122 are used as mentioned in the above, their handling is troublesome, and also, it is very inconvenient, in particular, when the thin devices are used in portable equipments or devices, because said connecting appliances must be carried with them.

In relation to such a problem, for example, Japa-

nese patent Laid-open Publication No. Hei 6-52923, Hei 6-61658, Hei 6-176813 or Japanese utility model Laid-open publication No. Hei 6-19289 etc. disclose a constitution of a card being provided with an insert-opening vertical to the plane area thereof, wherein a modular-jack being to be inserted into said opening in the vertical direction to the card plane. And, said Japanese utility model Laid-open Hei 6-19289 also discloses a construction of a card being provided with an inserting groove turned sideways by 90 degrees and elongated in the direction along the card plane at a rear end face of the card, and a modular-jack is to be inserted into said groove, being turned sideways by 90 degrees.

In all of these conventional modular-jack connectors, a guide means which guides the inserting motion of the modular-jack, a stopper means which stops the modular-jack to a set position and a securing means which secures the inserted modular-jack in inserted state are formed as one body-like in the card walls.

However, the above-mentioned conventional modular-jack connectors, in the case of the connector having the insert-opening vertical to the plane area of the card, since the inserting direction of the modular-jack is vertical to the plane area of the card, the connector is commonly inconvenient to use, and has a problem that application of the card is limited, in particular, when it is used in an equipment with a plurality of card slots close to each other, these card slots can not be used at a time.

Also, in this case, there exists another problem that such a construction is not preferable for trying to improve the endurance of the card, because the inserting direction of the modular-jack is vertical to the plane area of the card, and the card tends to be subject to a bending moment when the modular-jack is inserted.

On the other hand, in the case of the connector being provided with an inserting groove turned sideways at an end face of the card, since the upper and lower walls of the groove serve as the guides which guide the inserting motion of the modular-jack, the thickness of the portion forming the connector thereon must be designed greater a certain degree than the width dimension of the modular-jack, and this limits to reduce the thickness of that portion.

Further, in this case, since the modular-jack must be inserted being turned sideways by 90 degrees, it is also inconvenient to handle in depend upon the applied place.

Summary of the Invention

The present invention has been developed to solve the above-mentioned conventional problems, and has objects of providing a modular-jack connector which allows a modular-jack to connect with a plate member directly without any other connecting appliances such as dedicated conversion cables or adapters etc., and being convenient to use, in connecting a modular-jack to a relatively thin plate member.

Thus, according to an aspect of the present invention which is developed to achieve the above-mentioned objects, there is provided a modular-jack connector, which is to be provided at an end portion of a plate member having a predetermined thickness, allowing a modular-jack to connect with the plate member directly by inserting the modular-jack in a direction along a plane of the plate member, comprising: a groove for inserting the modular-jack therein, being provided at an end portion of the plate member, being elongated from an end face of the end portion to inner side of the plate member, and opens on one side in a thickness direction of the plate member; a connector electrode being provided on an inside wall of the groove, and being able to contact with an electrode of the modular-jack when the modular-jack is inserted into the groove; a securing member being formed as a separated part from the plate member, being placed on said one side in the thickness direction of the plate member, and secures said modular-jack inserted into the groove in an inserted state; and a support means which supports the securing member changeably between an accommodated position in the direction nearly along the plane of the plate member and a securing position raised from the direction along the plane of the plate member to secures the modular-jack.

In the above-mentioned modular-jack connector according to an aspect of the invention, the thickness of said plate member does not need to be designed greater than the height dimension of the modular-jack, because the groove for insertion of the modular-jack opens on one side in the thickness direction of the plate member and the securing member which secures the modular-jack inserted into the groove in inserted state is formed as a separated part from the plate member.

Accordingly, the above-mentioned connector makes it possible to connect the modular-jack directly to the plate member the thickness of which is equal or less than the height dimension of the modular-jack, without any other connecting appliances such as dedicated conversion cables and adapters.

Also, the modular-jack connector in accordance with the invention is convenient to use, in comparison with conventional one wherein a modular-jack being inserted into the opening vertically to the plane area of the card, because the modular-jack can be inserted into the groove of the modular-jack connector in the direction along the plane of the plate member, further, since no bending moment act on the plate member when the modular-jack is inserted, the possibility of acting a bad influence upon durability of the plate member will be eliminated.

Further, in the above-mentioned modular-jack connector, it is preferable that a biasing mechanism which biases the modular-jack in a reverse direction of its insertion is further provided in the groove.

In this case, since said biasing mechanism is further provided, the modular-jack inserted into the groove is secured more firmly in the groove to prevent its com-

ing off surely, the reliability of the connection between the modular-jack and the connector is elevated still higher.

Still further, in the above-mentioned modular-jack connector, a shutter slidable in an insert direction of the modular-jack may be provided in the groove, the shutter covering the connector electrode when the modular-jack is not inserted, and being slidden in the groove inwardly further than a position of the connector electrode when the modular-jack is inserted.

In this case, since the shutter slidable in the inserting direction of the modular-jack is provided in the groove and the connector electrode of the modular-jack connector is covered by said shutter when the modular-jack is not inserted, the connector electrode can be protected effectively when the connector is not in use.

Still further, in the above-mentioned modular-jack connector, it is more preferable that a biasing means which biases the modular-jack in a reverse direction of its insertion is further provided to the shutter.

In this case, since said biasing mechanism is further provided to the shutter, the modular-jack inserted into the groove is secured more firmly in the groove to prevent its coming off surely, the reliability of the connection between the modular-jack and the connector is elevated still higher.

Still further, in the above-mentioned modular-jack connector, it is preferable that the securing means is changeable between an accommodated position laid down on a bottom wall of the groove and a securing position raised from the bottom wall of the groove to secure the modular-jack.

In this case, the securing member can be formed relatively thick, because it is accommodated in lying down on the bottom wall of the groove. That is to say, the thickness of the securing member can be determined to be equal to the depth dimension of the groove at maximum, for example, in the scope of the thickness of the plate member is kept not to increase. Accordingly, it comes to be possible to increase the strength and rigidity of the securing member.

Still further, in the above-mentioned modular-jack connector, it is more preferable that the securing member is accommodated in the groove not to exceed a surface of the plate member in the accommodated position.

In this case, the increase of the total thickness of the plate member including the thickness of the securing member can be firmly prevented, because the securing member is accommodated in the groove not to exceed the surface of the plate member.

Further, in the above-mentioned modular-jack connector, a pair of transverse slots perpendicular to the groove may be provided on both side walls of the groove, and the securing member is formed by being divided into two parts in perpendicular to the insert direction of the modular-jack, each half of the securing member being positioned to an opening of the transverse slot to the groove, and being changeable between

an accommodated position laid down on a bottom wall of each transverse slot and a securing position raised from the bottom wall of each transverse slot to secure the modular-jack .

In this case, the thickness of the securing member depends upon only the width dimension of said transverse slot, and can be determined in no relation to the thickness of the plate member. Therefore, the thickness of the securing member can be designed to be thicker all the more, and it comes to be possible to increase its strength and rigidity.

Still further, in the above-mentioned modular-jack connector, it is more preferable that said each half of the securing member is accommodated in the transverse slot not to exceed the surface of the plate member in the accommodated position.

In this case, the increase of the total thickness of the plate member including the thickness of the securing member can be surely prevented, because each half of the securing member can be accommodated in each transverse slot not to exceed the surface of the plate member.

Further, in the above-mentioned modular-jack connector, a plurality of modular-jack connectors may be provided at an end portion of the plate member, and at least one of them is provided, with regard to an obverse and reverse of the plate member, on a reverse side to other connectors.

In this case, when there exist some interruptions on whichever side of the obverse and reverse of the plate member, by using the connector provided on the other side, the modular-jack can be connected to the plate member without any trouble. Accordingly, the convenience of the connector can be elevated higher.

Still further, in the above-mentioned modular-jack connector, the plate member may form a body of a thin device.

In this case, the same advantage as described in the above-mentioned modular-jack connectors are obtained in said thin device.

Further, in the above-mentioned modular-jack connector, the plate member may be formed as a separated part from a body of a thin device, and contained in a containing cavity provided at an end portion of the body.

In this case, the connector electrode of the modular-jack connector can be protected effectively, because the modular-jack connector is provided on the plate member formed as a separated part from the body of the thin device and the plate member is contained in the cavity provided at the end portion of the body of the thin device when the modular-jack is not connected thereto. Also, when the modular-jack is not connected, an appearance of the end portion of the thin device is improved.

Still further, in the above-mentioned modular-jack connector, it is more preferable that between the plate member and an inside wall of the containing cavity, a slide member being slidable to the inside wall may be positioned, and the plate member may be retained

rotatably to the slide member.

In this case, since the plate member is retained rotatably to the slide member, the plate member is provided with a degree of freedom in the rotating direction and a still higher convenience is obtained in connecting modular-jack thereto.

Brief Description of the Drawings

These and other objects, features and advantages of the present invention will become clear from the following description taken in conjunction with the preferred embodiments with reference to the accompanying drawings, and in which :

Fig. 1 is a perspective view of the PC card in the first embodiment of the present invention;

Fig. 2 is a side view of the PC card in the first embodiment of the present invention;

Fig. 3 is a disassembled perspective view of the PC card in the first embodiment of the present invention;

Fig. 4 is a perspective view of the modular-jack connector in the first embodiment of the present invention;

Fig. 5 is a perspective view illustrates the modular-jack connector and the modular-jack in a mutually connected state in the first embodiment of the present invention;

Fig. 6 is a vertical cross-sectional view of Fig.4 as taken along line VI-VI;

Fig. 7 is a vertical cross-sectional view of Fig.5 as taken along line VII-VII;

Fig. 8 is a plan view illustrates the modular-jack connector and the modular-jack in a mutually connected state in the first embodiment of the present invention;

Fig. 9 is a front view of the securing member in the first embodiment of the present invention;

Fig. 10 is a side view illustrates the modular-jack secured by the securing member in the first embodiment of the present invention;

Fig. 11 is a perspective view of the modular-jack connector in the second embodiment of the present invention;

Fig. 12 is a front view of the modular-jack connector in the second embodiment of the present invention;

Fig. 13 is a vertical cross-sectional view of Fig.11 as taken along line XIII-XIII;

Fig. 14 is a vertical cross-sectional view illustrates the modular-jack connector and the modular-jack in a mutually connected state in the second embodiment of the present invention;

Fig. 15 is a perspective view illustrates the modular-jack connector covered by the shutter in the third embodiment of the present invention;

Fig. 16 is a vertical cross-sectional view of Fig.15 as taken along line XVI-XVI;

Fig. 17 is a perspective view illustrates the modular-

jack connector in the third embodiment of the present invention wherein the shutter being slidden inwardly;

Fig. 18 is a perspective view illustrates the modular-jack connector in the fourth embodiment of the present invention wherein the securing member being in an accommodated state;

Fig. 19 is a perspective view illustrates the modular-jack connector in the fourth embodiment of the present invention wherein the securing member being in an raised state;

Fig. 20 is a vertical cross-sectional view illustrates the modular-jack connector being connected with the modular-jack in the fourth embodiment of the present invention;

Fig. 21 is a perspective view illustrates the modular-jack connector in the fifth embodiment of the present invention wherein the securing member being in an accommodated state;

Fig. 22 is a perspective view illustrates the modular-jack connector in the fifth embodiment of the present invention wherein the securing member being in an raised state;

Fig. 23 is a perspective view illustrates the modular-jack connectors provided to the PC card in the sixth embodiment of the present invention;

Fig. 24 is a perspective view illustrates the connector unit in a contained state in the seventh embodiment of the present invention ;

Fig. 25 is a perspective view illustrates the connector unit in a drawn state in the seventh embodiment of the present invention;

Fig. 26 is a perspective view illustrates the connector unit in a drawn state in the eighth embodiment of the present invention;

Fig. 27 is a perspective view of a conventional PC card and a conversion cable; and

Fig. 28 is a perspective view of a conventional PC card and an adapter.

Detailed Description of the Preferred Embodiment

Hereinafter, preferred embodiments of the present invention, in the case of being applied to what we call PC card as a kind of thin device, will be explained in detail with reference to attached drawings.

First of all, a first embodiment of a modular-jack connector shown in Fig.1 - Fig.10 will be explained.

Fig.1, Fig.2 and Fig.3 show the perspective view, the side view and the disassembled perspective view of a PC card in the first embodiment of the modular-jack connector according to the present invention. As shown in these figures, the PC card 1 is formed generally as a plate-like member having a predetermined thickness less than the height dimension of a modular-jack to be connected thereto, and a main-connector 4 for connection with an equipment (not shown) in which the PC card is to be used, is mounted on an end (front end) portion. And the periphery of the card body 1, except for that

front end, is surrounded by a frame 2 made of plastic.

Said PC card 1 is provided with an electric circuit board 3 on which prescribed electronic components are mounted, the main-connector 4 mounted at an end of the electric circuit board 3 and to be connected to electric circuits of the board 3, and a pair of panels made of e.g. metal which cover upper and lower of the electric circuit board 3 respectively.

And, the PC card 1 is assembled as one body, by stacking the frame 2 and the electric circuit board 3 in prescribed order and by binding them each other, after mounting the main-connector 4 to the electric circuit board 3.

For example, at rear side (i.e. the reverse side of front side the main-connector is mounted thereto) end of the PC card 1, a modular-jack connector 10 for connecting a modular-jack to the PC card 1 directly.

This modular-jack connector 10 is formed in a groove 11 which elongates from the rear end face 1r to inner side of the card in a direction along the card plane, and opens on one side in a thickness direction of the card 1. This groove 11 has suitable width to receive the modular-jack and insert it thereto smoothly, and each wall (inner wall 11a, bottom wall 11b and left and right side wall 11c, 11d) is formed as a part of plastic frame 2, as is understood well from Fig.3.

Also, said modular-jack connector 10 is provided with a pair of leaf spring-like connector electrodes 12 which may contact with an electrode of the modular-jack 9 when this is inserted, and a securing member 15 which may secure the modular-jack 9 inserted into the groove 11 in a inserted state. Said modular-jack 9 is the same as one well known conventionally, therefore, detailed explanations, for example, about its inner construction etc. are eliminated.

Said connector electrodes 12 are placed on one of the walls (the bottom wall 11b, in this embodiment) define the groove 11, and are connected to an electric circuit on the electric circuit board 3 through electro-conductivities 13. In this embodiment, more preferably, a connector electrode 12 and a electro-conductivity 13 are formed in one body, and the electro-conductivity 13 is connected to an electric circuit by soldering for instance at an end portion thereof, and its major part is buried to fix itself in the bottom wall 11b of the groove 11.

Said securing member 15 is formed by bending work of a metal wire rod for instance, and, as shown in detail in Fig.9 and Fig.10, it is provided with a pair of engaging stairs 15a which engage with the lever 9a of the inserted modular-jack 9, and a pair of shafts 15b to be supported rotatably against the PC card 1.

At the upper opening end of the groove 11, a pair of stairs 11e having a depth dimension greater than a thickness of the securing member 15 at least, and on the side at a prescribed portion of relatively inner side of each stair 11e, there provided a pair of holes 11h which support the shafts 15b of the securing member 15 rotatably.

The securing member 15 is mounted to the PC card 1 by inserting each shaft 15b into the hole 11h, and each shaft 15b of the securing member 15 and each hole 11h formed at each stair 11e of the groove 11 form the support means which supports the securing member 15 changeably between an accommodated position in a direction along a plane of the PC card 1 and a securing position raised from the direction along the plane of the PC card 1 to secure the modular-jack 9.

The securing member 15 is, as is understood well from Fig.4 and Fig.6, accommodated in the groove 11 (i.e. in the stairs 11e), being held in horizontal along the plane direction of the PC card 1, and not to exceed the surface of the PC card 1, when any modular-jack is not inserted into the groove. Accordingly, in this accommodated state of the securing member 15, the total thickness of the PC card 1 including the thickness of the securing member 15 is kept within the body thickness of the PC card 1.

And, in inserting the modular-jack 9 into the groove 11, the securing member is to be raised by pivoting at first, and the modular-jack 9 is inserted into the groove 11 in the direction along the plane of the PC card 1. In this operation, the inserting motion of the modular-jack 9 is guided by left and right wall 11c, 11d and the bottom wall 11b of the groove 11, and stopped by the inner wall 11a at a prescribed set position. In this condition, the modular-jack 9 is secured in inserted position, because its lever 9a is engaged with the stairs 15a of the securing member 15, and prevented it from coming off surely.

As mentioned in the above, the modular-jack 9 is connected to the PC card 1 directly, by inserting it into said groove 11 in the direction along the plane of the PC card 1.

Also, in pulling the inserted modular-jack 9 out of the groove 11, the engagement of the securing member 15 with the lever 9a of the modular-jack 9 is to be released by pushing down the lever 9a and lifting up the securing member 15, and then the modular-jack 9 is drawn from the groove 11.

As explained in the above, in this embodiment of the modular-jack connector according to the invention, the thickness of PC card 1 does not need to be determined greater than the height dimension of the modular-jack, because the groove 11 for insertion of said modular-jack opens on one side in the thickness direction of the PC card 1 and the securing member 15 which secures the modular-jack 9 inserted into the groove in an inserted state is produced as a separated part from the body of the PC card 1. Also, in this case, the total thickness of the PC card 1 including the thickness of the securing member 15 does not increase, because the securing member 15 is accommodated in the groove 11 not to exceed the surface of the PC card in its accommodated position.

Accordingly, the above-mentioned connector makes it possible to connect the modular-jack 9 directly to the PC card 1 whose thickness is equal or less than the height dimension of the modular-jack 9, without any

other connecting appliances such as dedicated conversion cables and adapters.

Also, the modular-jack connector in accordance with the invention is convenient to use, in comparison with conventional one wherein a modular-jack being inserted into the opening vertically to the plane area of the card, because the modular-jack 9 can be inserted into the groove 11 of the modular-jack connector 10 in the direction along the plane of the PC card 1. Further, since no bending moment act on the PC card 1 when the modular-jack is inserted, the possibility that the connecting operation of the modular-jack 9 acts a bad influence upon durability of the PC card 1 is eliminated.

In the next place, referring to Fig.11 - Fig.14, the second embodiment of a modular-jack connector in accordance with the invention will be explained.

In the explanation below, the same components as in the first embodiment are designated by same reference numerals, and duplicated explanation is eliminated.

In this embodiment, a biasing mechanism which biases the modular-jack 9 in reverse direction to its insertion is provided, in the groove 21 being formed at the rear end portion of a PC card 23.

A movable plate 26 parallel to the inner wall 21a is placed in the groove 21, and an elastic body 27 consists of e.g. a coil spring is arranged between the movable plate 26 and the inner wall 21a. The biasing mechanism which biases the modular-jack 9 in reverse direction to its insertion is consists of said coil spring 27 and said movable plate 26.

The length of said coil spring 27 is kept to its free length (refer to Fig.13), when the modular-jack 9 is not connected to the modular-jack connector 20 (i.e. not inserted into the groove 21). In this embodiment, a coil spring 27 is used as the elastic body arranged between the inner wall 21a of the groove and the movable plate 26, however, another kind of spring such as leaf spring or some substance which has high elasticity such as rubber may be arranged alternatively.

And, in connecting the modular-jack 9, after lifting up the securing member 15, by inserting the modular-jack 9 into the groove 21, the movable plate 26 is moved to the inner side of the groove 21 against the biasing force of the coil spring 27. And, after the travelling length reaches equal or more a predetermined value, the modular-jack 9 can be secured in an inserted condition, by engaging the engaging stair 15a of the securing member 15 with the lever 9a of the modular-jack 9.

In this operation, the coil spring 27 is in a compressed state by a certain length from its free length, the modular-jack 9 is pushed by the biasing force corresponding to the compression in reverse direction to its inserting motion, and the modular-jack 9 is to be secured firmly, being sandwiched between the movable plate 26 and the securing member 15 (refer to Fig.14).

In drawing the inserted modular-jack 9, by pushing down the lever 9a and pushing the modular-jack 9 to inner side, a clearance is generated between the secur-

ing member 15 and the lever 9a, and the engaging condition between both parts 15, 9a is released, then, the modular-jack 9 can be drawn by lifting up the securing member 15.

As is understood well from Fig.12, on both of left and right side of the movable plate 26, for example, L-shape protrusion 26a is formed, and, on left and right wall 21c, 21d of the groove 21, a guide groove 21g which fits each protrusion 26a thereinto is formed in direction of insertion of modular-jack 9, and the movable plate 26 may move smoothly, since each of left and right protrusion 26a moves in each guide groove 21g respectively.

As explained in the above, in this embodiment of the modular-jack connector according to the invention, the advantages same as in the first embodiment is obtained, also, since the coil spring 27 and the movable plate 26 are provided as a biasing mechanism which biases the modular-jack 9 in reverse direction to its insertion are further provided, the modular-jack 9 inserted into the groove 21 is secured more firmly in the groove 21 to prevent its coming off surely, and the reliability of the connection between the modular-jack 9 and the connector 20 is raised still higher.

In the next place, referring to Fig.15 - Fig. 17, the third embodiment of a modular-jack connector in accordance with the invention will be explained.

In this embodiment, a shutter 36 slidable in the insert direction of the modular-jack 9 is placed in the groove 31. Said shutter 36 consists of a vertical wall 36a of which the height is generally equal to the depth dimension of the groove 31, and a ceiling 36b elongated from the upper end of the vertical wall 36a perpendicularly thereto and has a prescribed length. And the shutter has a suitable width dimension for being accommodated in the groove 31 and for sliding smoothly therein. On the other hand, the groove 31 is formed so that the length in its inner direction is longer than by a predetermined value than that of the shutter 36, and this shutter 36 can slide by said predetermined length at maximum.

When the modular-jack 9 is not inserted, the shutter 36 is placed to the initial position where the vertical wall 36 is aligned in generally flat with the rear end face 33r of the PC card 33, in this condition, the connector electrodes 12 of the modular-jack connector 30 are covered by the shutter 36 (refer to Fig.15 and Fig.16).

And, when the modular-jack is inserted, the shutter 36 is pushed by the modular-jack 9 and slidden to the inner side of the groove 31 further than the position of the electrodes 12, and, this enable the contact between the electrodes 12 and the electrode (not shown) of the modular-jack 9 (refer to Fig.17).

Behind the shutter 36, i.e. between the inner wall 31a of the groove 31 and the vertical wall 36a of the shutter 36, an elastic body consists of e.g. a coil spring 37 is arranged as a biasing mechanism which biases the modular-jack 9 in the reverse direction to its insertion. The length of said coil spring 37 is determined to be kept in its free length when the shutter 36 is posi-

tioned to the initial position (refer to Fig.16).

And, as same as in the second embodiment, by inserting the modular-jack 9 into the groove 31, the shutter 36 is moved to the inner side of the groove 31 against the biasing force of the coil spring 37. And after the travelling length reaches equal or more a predetermined value, the modular-jack 9 can be secured in an inserted condition, by engaging the securing member 35 with the lever 9a of the modular-jack 9.

In this operation, the coil spring 37 is in a compressed state by a certain length from its free length, the modular-jack 9 is pushed by the biasing force corresponding to the compression in the reverse direction to its insertion, and said modular-jack 9 is to be secured firmly, being sandwiched between the shutter 36 and the securing member 35.

When the modular-jack 9 is pulled off, the shutter 36 will return to its initial position by the biasing force of the coil spring 37. In this embodiment, a coil spring 37 is used as the elastic body arranged between the inner wall 31a of the groove and the vertical wall 36a of the shutter 36, but, another kind of spring such as leaf spring or some substance which has high elasticity such as rubber may be used alternatively.

Also, in this embodiment, on the surface of the PC card beside the groove 31, a pair of bosses 33b a little raised from the card surface are provided, and left and right shafts 35b are supported rotatably by said bosses 33b. Therefore, the shutter 36 can slide without any interruption with the securing member 35, even if the securing member 35 is in the accommodated condition.

The securing member may be accommodated in the stair provided on the upper side of the groove alternatively, as same as in the first or second embodiment. In this case, the height of shutter may be reduced by the depth of the stair for accommodating the securing member. This makes it possible to reduce the thickness of the card by the height dimension of the bosses 33b.

As explained in the above, in this embodiment of the modular-jack connector according to the invention, the advantages same as in the first embodiment is obtained, except for the securing member 35 is placed on the surface of the PC card 33 in the accommodated condition. Also, in this case, since the shutter 36 slidable in the inserting direction of the modular-jack is provided in the groove 31, and the connector electrodes 12 of the modular-jack connector 30 are covered by said shutter 36 when the modular-jack is not inserted, the connector electrodes 12 can be protected effectively when the connector 30 is not in use.

Still further, in this case, since said biasing mechanism which biases the modular-jack 9 in the reverse direction to its insertion is further provided to the shutter 36, the modular-jack 9 inserted into the groove 31 is secured more firmly in the groove 31 to prevent it from coming off surely, the reliability of the connection between the modular-jack 9 and the connector 30 is elevated still higher.

In the next place, referring to Fig.18 - Fig. 20, the

fourth embodiment of the modular-jack connector in accordance with the invention will be explained.

In this embodiment of the modular-jack connector 40, when the modular-jack 9 is not connected, a securing member 45 which secures the modular-jack 9 is accommodated in the groove 41, being lied down on the bottom wall 41b of the groove 41 (refer to Fig.18), and when the modular-jack 9 is connected, the position of the securing member is changed to the securing position that secure the modular-jack 9, being raised from the bottom wall 41b of the groove (refer to Fig.19 and Fig.20).

Said securing member 45 can be formed thicker than that of the connectors in the 1st - the 3rd embodiment, because it is accommodated lying down on the bottom wall 41b of the groove. In other words, in the scope of the thickness of the PC card is kept not to increase, the thickness of the securing member 45 can be designed to be equal to the depth dimension of the groove 41 at maximum.

The securing member 45 is formed basically to be for example rectangular in its cross section. The end portions of left and right side column 45c are supported rotatably on left and right wall 41c,41d of the groove 41 respectively, and can be rotated by about 90 degrees between an accommodated position and a securing position. A curved surface portion 45d is provided at the end portion of said column 45c, so that rotating motion of the securing member 45 can be performed smoothly.

In this embodiment of a modular-jack connector according to an aspect of the invention, the advantages same as in the first embodiment is obtained. And, in particular, in this case, said securing member 45 can be formed relatively thick (the thickness equal to the depth dimension of the groove 41 at maximum, in the scope of the thickness of the PC card 43 is kept not to increase), the strength and rigidity of the securing member can be increased remarkably.

In the next place, referring to Fig.21 and Fig. 22, the fifth embodiment of the modular-jack connector in accordance with the invention will be explained.

In this embodiment of the modular-jack connector 50, on the both side walls 51c,51d of a groove 51, a pair of transverse slots 52 having generally same depth as the groove 51 and are perpendicular thereto are formed. On the other hand, the securing member 55 is formed, being divided into two pieces in the direction perpendicular to insert direction of modular-jack, and each half piece 55H of the securing member 55 is positioned at the opening 52p of each transverse slot 52 to the inserting groove 51 for a modular-jack. They are accommodated in lying down on the bottom wall of each transverse slot 52 respectively, when the modular-jack is not connected (refer to Fig.21).

In this state, each half 55H of the securing member 55 is accommodated in each transverse slot 52 not to exceed the surface of PC card 53, therefore, the total thickness of PC card 53 including said securing member 55 is kept within the thickness of the body of PC

card 53, in the accommodating condition of the securing member 55.

Also, in this case, since each half 55H is accommodated in each transverse slot 52 perpendicular to the inserting groove 51 for the modular-jack 9, the thickness of the securing member 55 depends upon only the width of the transverse slot 52, and can be determined in no relation to the thickness of PC card 53.

Each half piece 55H of the securing member 55 is formed basically to be e.g. rectangular in its cross section, and the end portions of the column 55c are supported rotatably on the walls of the transverse slot 52. When the modular-jack 9 is connected, the position of the each half is changed to the securing position that secure the modular-jack 9, being raised from the bottom wall of the transverse slot 52 (refer to Fig.22).

The bottom plate 55e for fixing is formed at the end portion of the column 55c of each half 55H, on the other hand, a rectangular concavity 51e a little larger than said bottom plate 55e is provided on the bottom wall 51b of the groove 51, and more preferably, the depth of said concavity 51e is determined to be equal or more than the thickness of the bottom plate 55e. And, when the modular-jack 9 is inserted into the groove 51 after raising each half 55H, the bottom plate 55e is fixed under the modular-jack 9, being fitted in the concavity 51e, and each half 55H is fixed to the bottom wall 51b of the groove 51.

According to the modular-jack connector of this embodiment, the same effects as the first embodiment is obtained, and particularly, since each half 55H is accommodated in each transverse slot 52 perpendicular to the inserting groove 51 for the modular-jack 9, the thickness of said securing member 55 depends upon only the width of the transverse slot 52, and can be determined in no relation to the thickness of PC card 53. Therefore, it becomes to be possible to design the thickness of the securing member 55 to be greater than that of the connector in the fourth embodiment.

In the next place, referring to Fig.23, the sixth embodiment of the modular-jack connector in accordance with the invention will be explained.

In this embodiment, a plurality of modular-jack connectors with same function are provided at a rear end portion of a PC card, and at least one connector is provided on reverse side to the others, with regard to the obverse and reverse of the PC card.

In other word, in the example shown in Fig.23, a couple of modular-jack connectors 60 are provided on reverse side each other, with regard to the obverse and reverse of the PC card.

By employing such a constitution, in connecting a modular-jack 9 to a PC card 63, when there exist some interruptions on whichever side of the obverse and reverse of the body of the PC card 63, for example, when the card is applied to an equipment with a plurality of card slots close to each other, the connecting of the modular-jack 9 can be conducted without any trouble, by using the modular-jack connector 60 provided on the

other side of the body.

In the example shown in Fig.23, the same connectors 60 for a modular-jack as shown in the first embodiment are provided at the end portion of the PC card 63, however, the connectors are not to be limited to that type, and, another type of modular-jack connectors may be provided. Also, different types of modular-jack connectors may be provided on the obverse and reverse side of the PC card.

In the next place, referring to Fig.24 and Fig.25, the seventh embodiment of the modular-jack connector in accordance with the invention will be explained.

In this embodiment of the modular-jack connector, a cavity 74 is formed at an end portion of a PC card 73, and in said cavity 74, a connector unit 79 being fabricated separately from the card body 73 is contained drawably to rear side. Said connector unit 79 is constructed, by forming a inserting groove 71 for a modular-jack in the plate-like base plate 78, and mounting the securing member 75 for securing modular-jack to said groove 71. Then, the connector unit 79 become to be available to use, by drawing the base plate 78 from the cavity 74.

As the securing member, the same one as described in the fourth embodiment is shown in the Fig.24, however, another type of securing member may be provided alternatively.

On the left and right side of the connector unit 79, a pair of rod-like slide guides 77 guided through the guide grooves 74g formed on the cavity side walls are provided, and stopper 77a for preventing from dropping off is formed at an end portion of each slide guide 77.

In order to facilitate its drawing from the cavity in a contained state, more preferably, the connector unit 79 is designed so that its end face protrudes a little from the rear end face 73r of PC card 73, in the contained condition in the cavity 74.

According to this embodiment, the connector electrode (not shown) of the modular-jack connector 70 can be protected effectively, because the modular-jack connector 70 is provided on the connector unit 79 being formed as a separated component from the card body 73 and the connector unit 79 is contained in the cavity 74 provided at the end portion of the card body 73 when the modular-jack is not connected thereto. Also, when the modular-jack is not connected, the appearance of said end portion of the PC card 73 is improved.

In the next place, referring to Fig.26, the eighth embodiment of the modular-jack connector in accordance with the invention will be explained.

In this embodiment of the modular-jack connector, a pair of holders 86 for holding the connector unit 89 are provided at the end portion of each slide guide 87 which can slide along the guide groove 84g on each side wall of the cavity 84, and the base plate 88 of the connector unit 89 is supported rotatably by the pin 86p mounted to the holder 86.

According to such a construction, after drawing the connector unit 89 (i.e. the modular-jack connector 80),

the base plate 88 can be rotate continuously within 180 degrees at maximum around said pin 86p, and the angle of the connector unit 89 to the PC card 83 can be changed properly in accordance with the circumferential condition.

That is to say, in addition to the same advantages as in the seventh embodiment, by giving the degree of freedom in vertical direction to the connector unit 89, it makes it possible to increase the convenience in connecting the modular-jack 9.

It is also possible to turn the connector unit 89 by stage, by being provided with a meshing mechanism which meshes with the holder of the connector unit 89 every prescribed angle.

Among various kind of securing members explained in the 1st - 5th embodiment, a desired one may be provided in the groove 81 formed on the connector unit 89.

Also, providing the drawer type of connector unit 79,89 shown in the seventh or the eighth embodiment to the rear end portion of the PC card, as shown in the sixth embodiment, and at least one may be provided on the reverse side to the others, with regard to the obverse and reverse side of the PC card.

The invention is not limited within the foregoing embodiments, and can be applied to various kind of thin device other than PC card, also, it is to be understood that the various kind of improvements and the alternation in design is possible in the scope of the invention.

A modular-jack connector allowing a modular-jack to connect with a plate member directly and being convenient to use is provided. A groove 11 for inserting the modular-jack thereto is provided at an end portion of a PC card 1, the groove is elongated from an end face of the end portion to inner side of the PC card 1 in a direction along the card plane, and opens on one side in a thickness direction of the PC card 1. And, connector electrodes 12 being able to contact with an electrode of the modular-jack is provided on an inside wall 11b of the groove 11. Also, the modular-jack connector has a securing member 15 for securing the modular-jack, being formed as a separated part from the PC card 1, and a support means 11h,15b which supports the securing member changeably between an accommodated position in the direction along the plane of the PC card 1 and a securing position to secure the modular-jack.

Claims

1. A modular-jack connector to be provided at an end portion of a plate member having a predetermined thickness, allowing a modular-jack to connect with the plate member directly by inserting the modular-jack in a direction along a plane of the plate member, comprising:

a groove for inserting the modular-jack thereto, being provided at the end portion of the

plate member, being elongated from an end face of the end portion to inner side of the plate member in the direction along the plane of the plate member, and opens on one side in a thickness direction of the plate member;

a connector electrode being provided on an inside wall of the groove, and being able to contact with an electrode of the modular-jack when the modular-jack is inserted into the groove;

a securing member being formed as a separated part from the plate member and being placed on said one side in the thickness direction of the plate member, and secures the modular-jack inserted into the groove in an inserted state; and

a support means which supports the securing member changeably between an accommodated position in the direction nearly along the plane of the plate member and a securing position raised from the direction along the plane of the plate member to secure the modular-jack.

2. A modular-jack connector according to claim 1, wherein a biasing mechanism which biases the modular-jack in a reverse direction of its insertion is further provided in the groove.

3. A modular-jack connector according to claim 1, wherein a shutter slidable in an inserting direction of the modular-jack is provided in the groove, the shutter covering the connector electrode when the modular-jack is not inserted, and being slidden in the groove inwardly further than a position of the connector electrode when the modular-jack is inserted.

4. A modular-jack connector according to claim 3, wherein a biasing means which biases the modular-jack in a reverse direction of its insertion is further provided to the shutter.

5. A modular-jack connector according to claim 1, wherein the securing member is changeable between an accommodated position laid down on a bottom wall of the groove and a securing position raised from the bottom wall of the groove to secure the modular-jack.

6. A modular-jack connector according to any one of claim 1 - claim 5, wherein the securing member is accommodated in the groove not to exceed a surface of the plate member in the accommodated position.

7. A modular-jack connector according to claim 1, wherein a pair of transverse slots perpendicular to the groove are provided on both side walls of the groove, and the securing member is formed by being divided into two parts in perpendicular to the

inserting direction of the modular-jack, each half of the securing member being positioned to an opening of the transverse slot to the groove, and being changeable between an accommodated position laid down on a bottom wall of each transverse slot and a securing position raised from the bottom wall of each transverse slot to secure the modular-jack.

8. A modular-jack connector according to claim 7, wherein said each half of the securing member is accommodated in the transverse slot not to exceed the surface of the plate member in the accommodated position.

9. A modular-jack connector according to any one of claim 1 - claim 8, wherein a plurality of modular-jack connectors are provided at the end portion of the plate member, and at least one of them is provided, with regard to an obverse and reverse of the plate member, on a reverse side to other connectors.

10. A modular-jack connector according to any one of claim 1 - claim 9, wherein the plate member forms a body of a thin device.

11. A modular-jack connector according to any one of claim 1 - claim 9, wherein the plate member is formed as a separated part from a body of a thin device, and contained drawably in a containing cavity provided at an end portion of the body.

12. A modular-jack connector according to claim 11, wherein between the plate member and an inside wall of the containing cavity, a slide member being slidable to the inside wall is positioned, and the plate member is retained rotatably to the slide member.

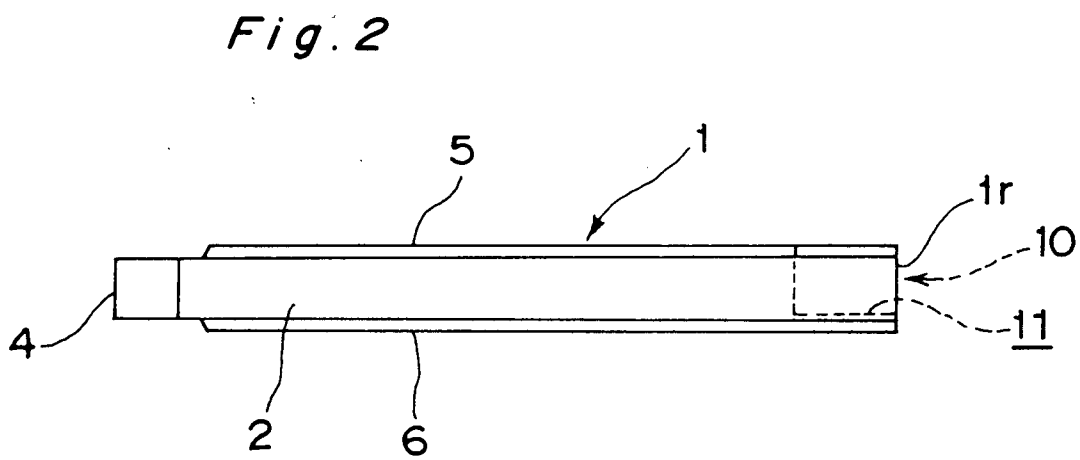
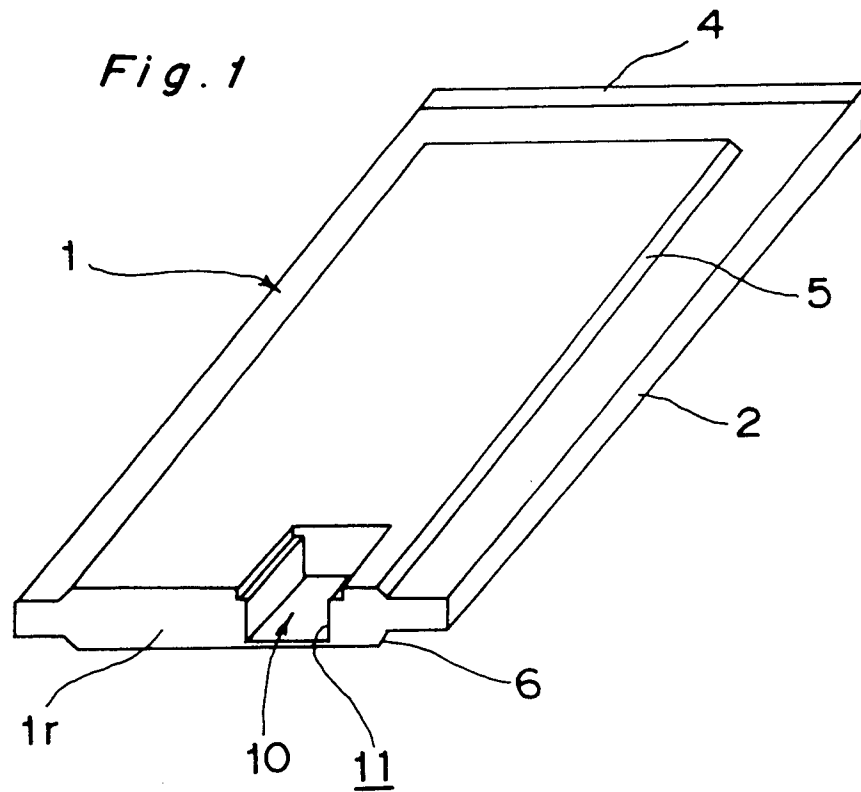


Fig. 3

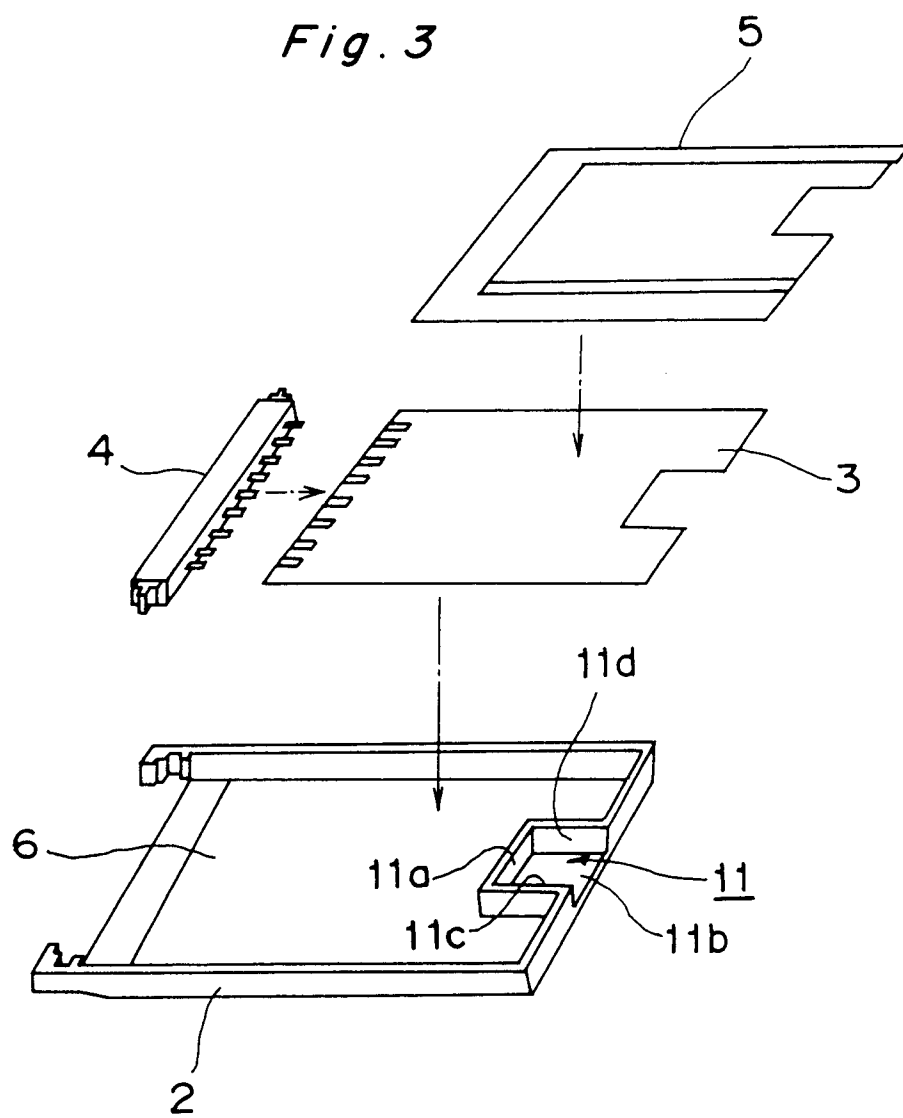


Fig. 4

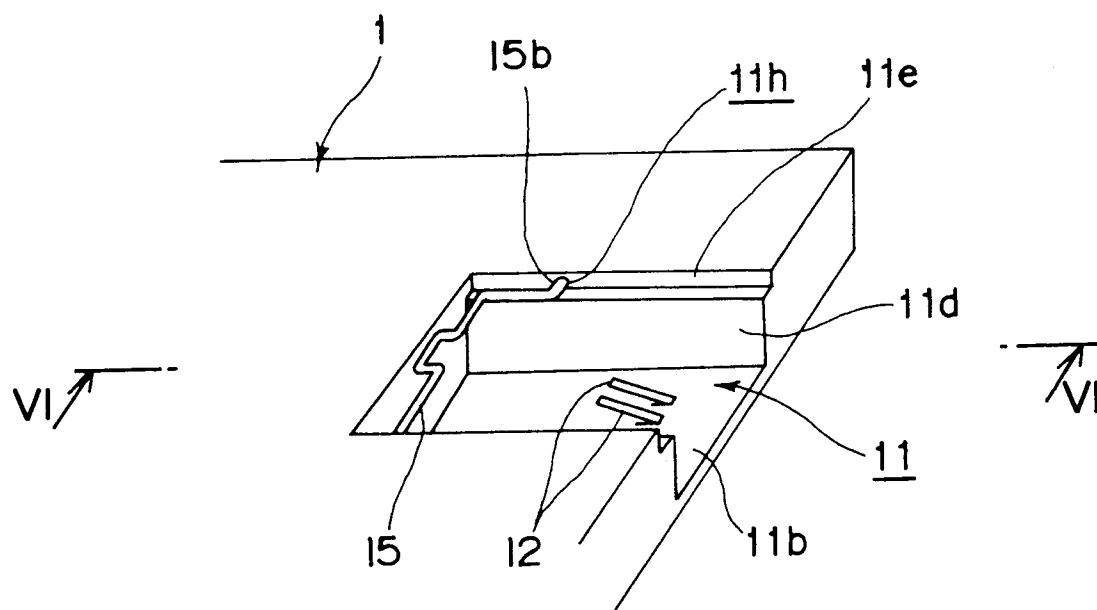


Fig. 5

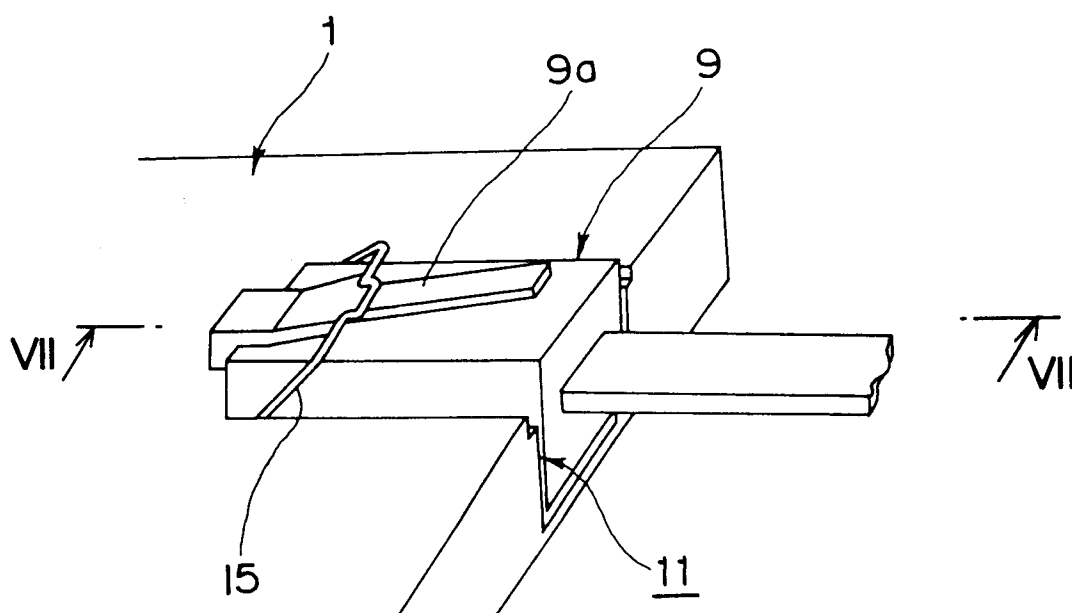


Fig. 6

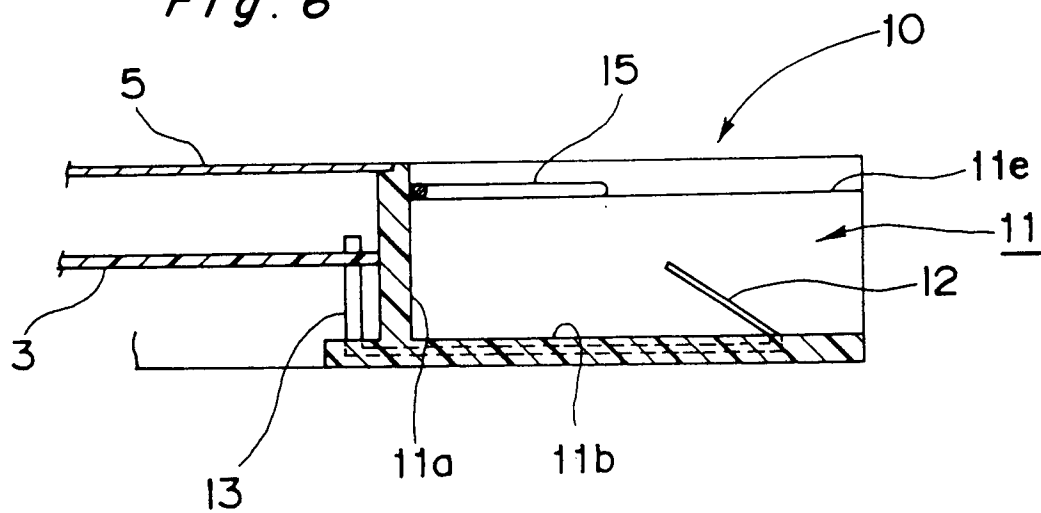


Fig. 7

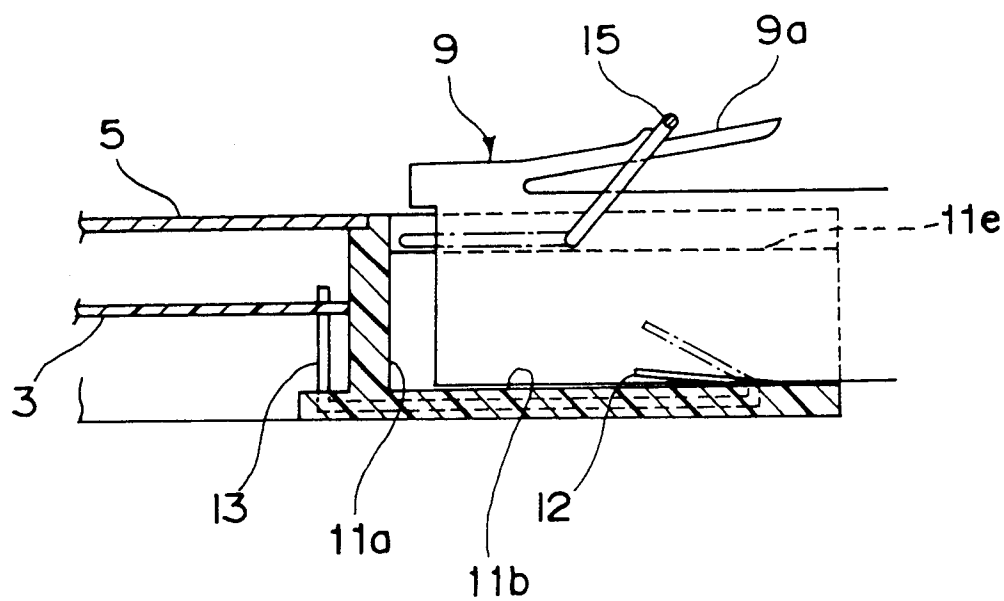


Fig. 8

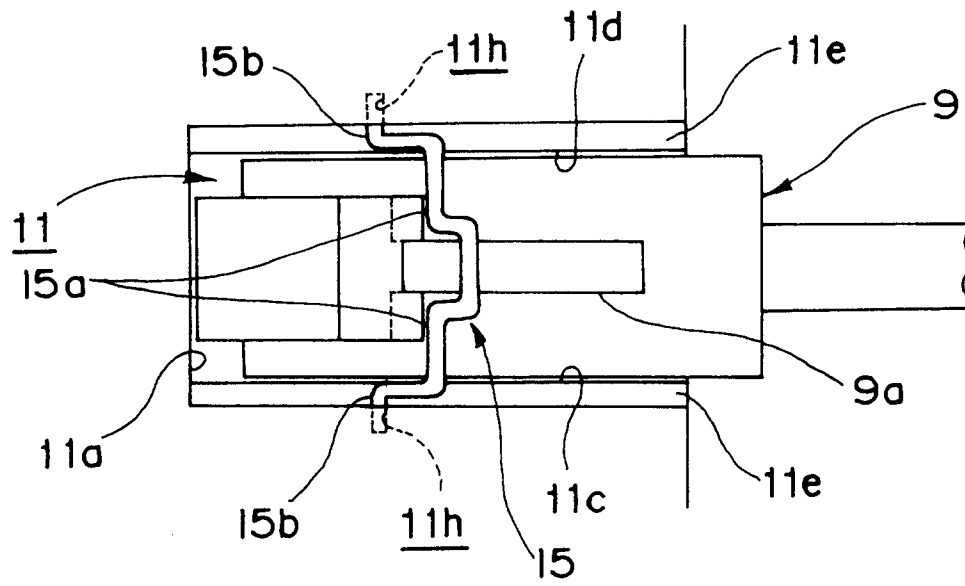


Fig. 9

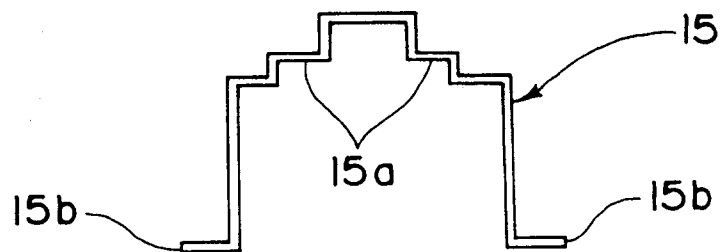


Fig. 10

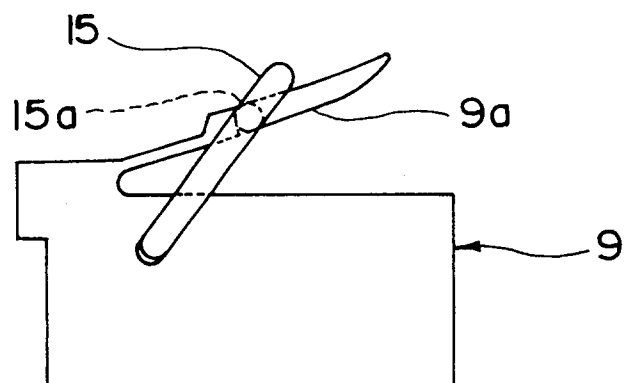


Fig. 11

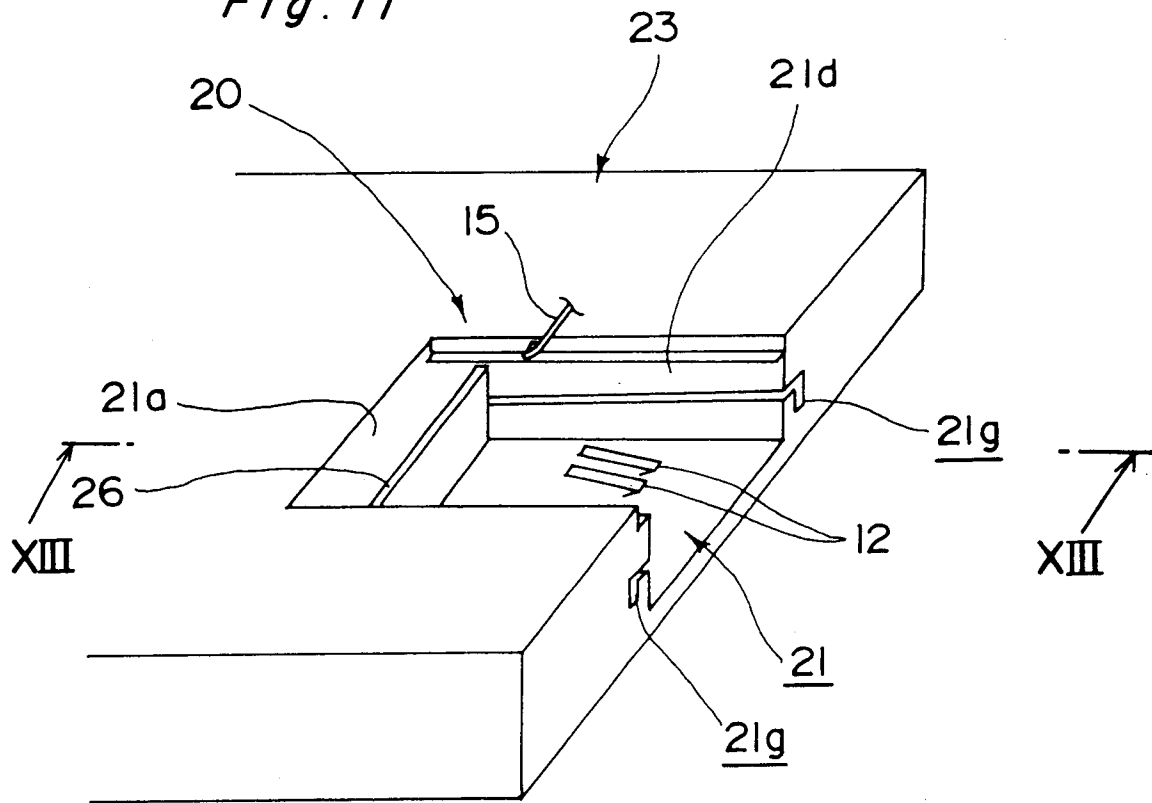


Fig. 12

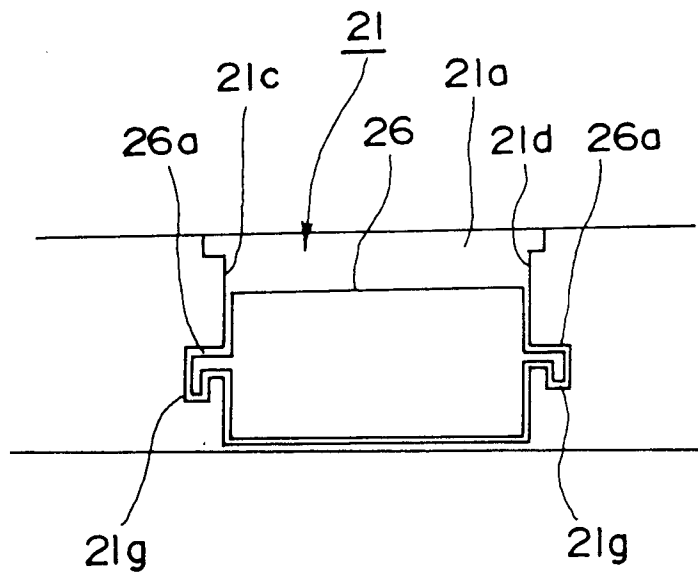


Fig. 13

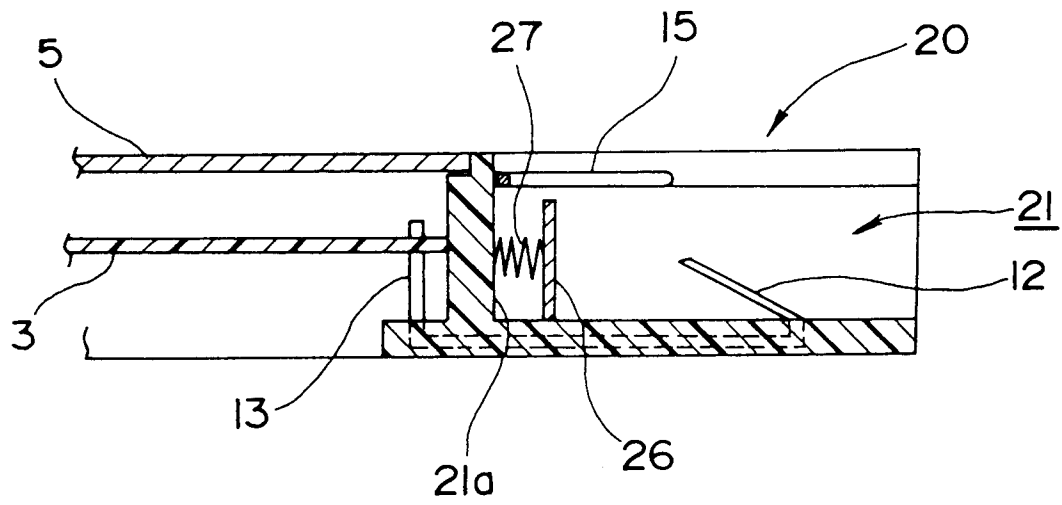


Fig. 14

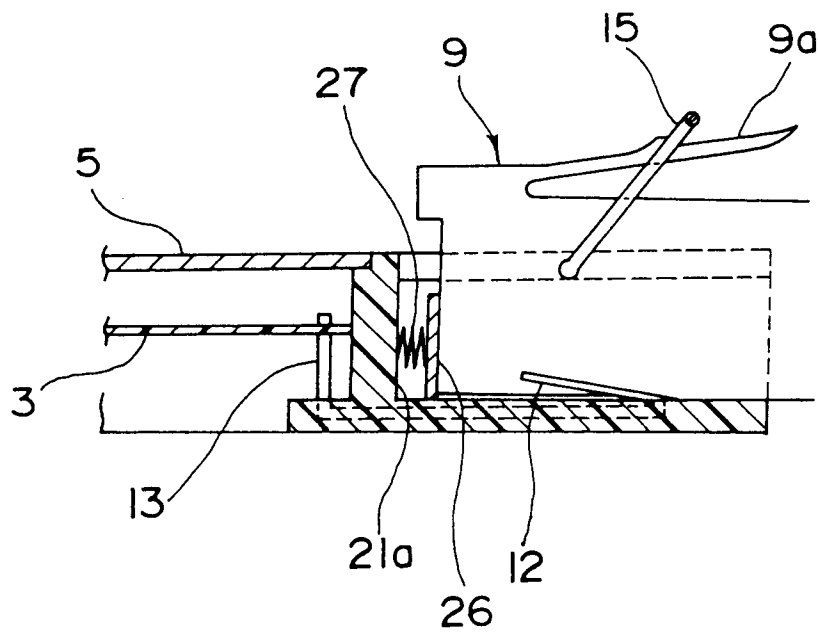


Fig. 15

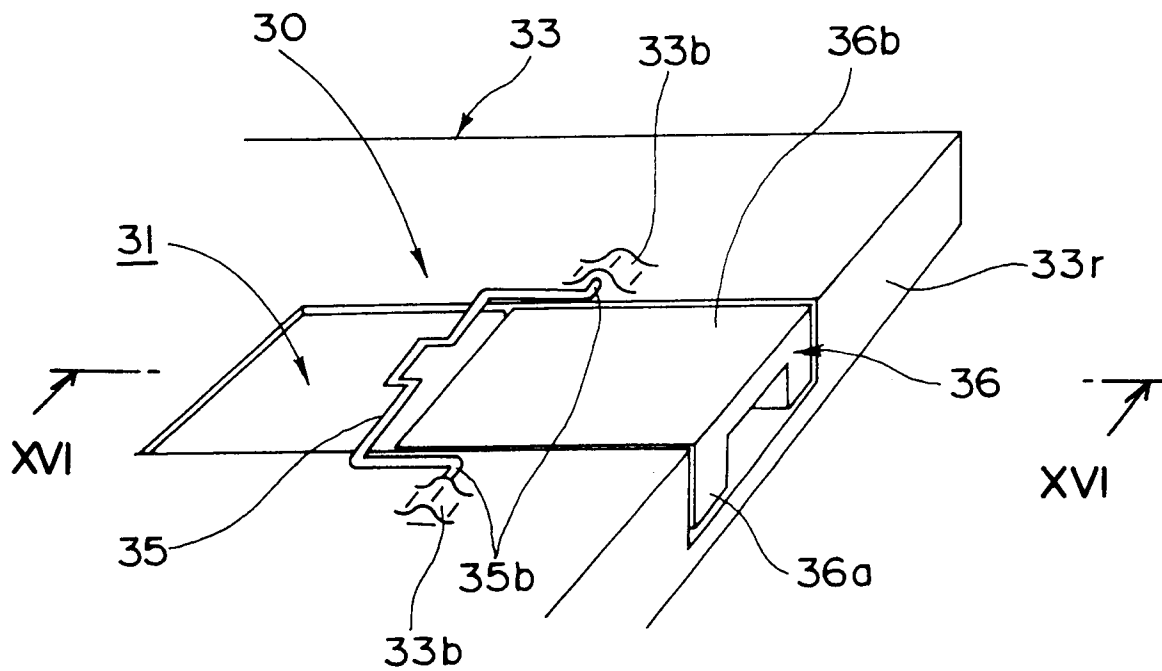


Fig. 16

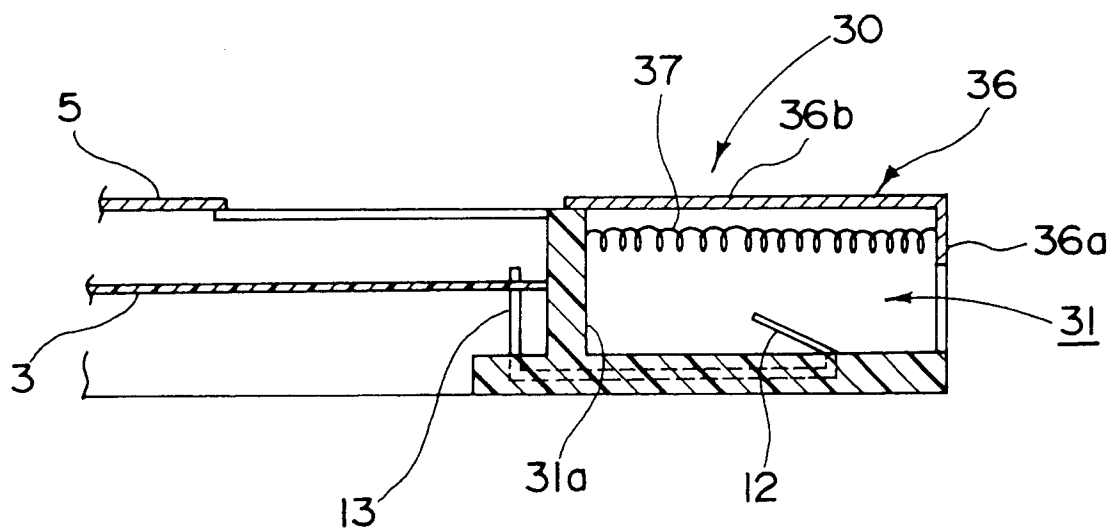


Fig. 17

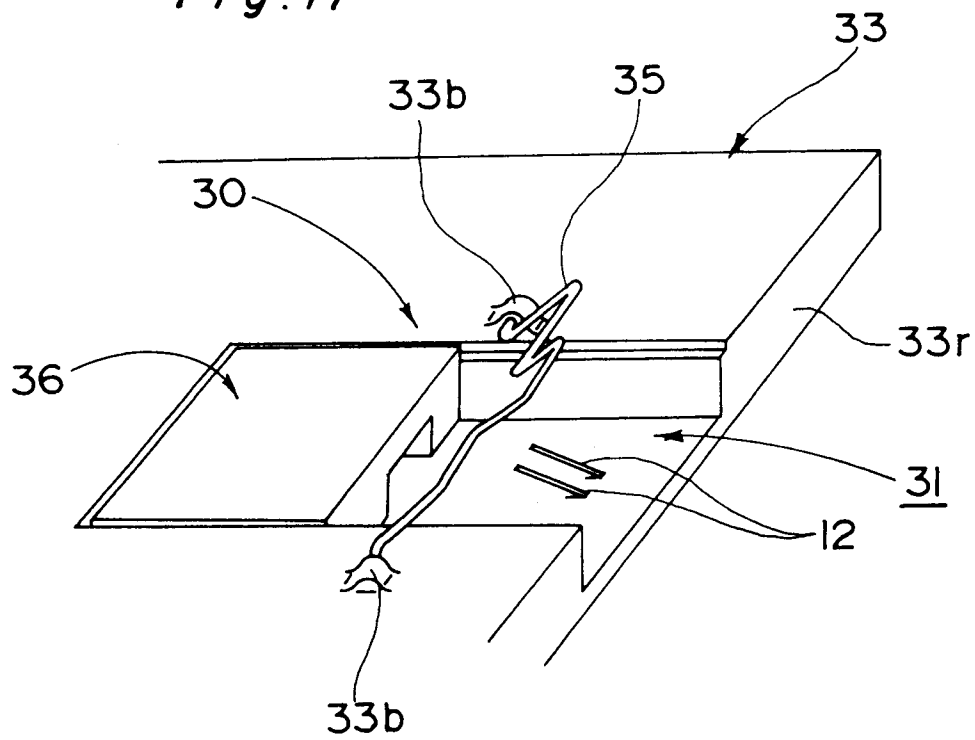


Fig. 18

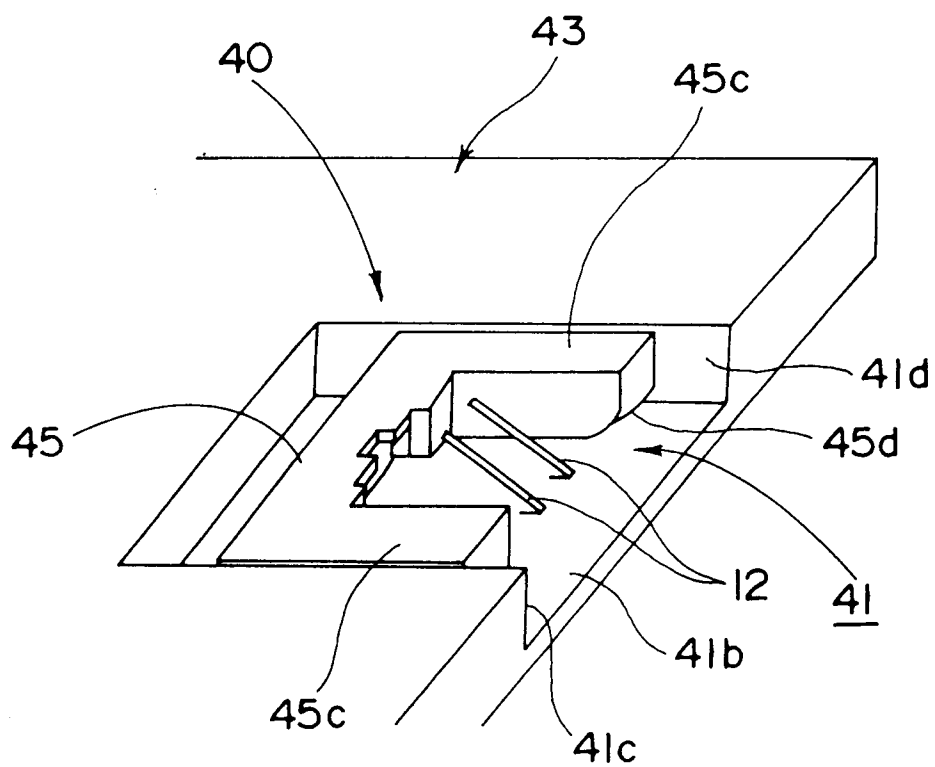


Fig. 19

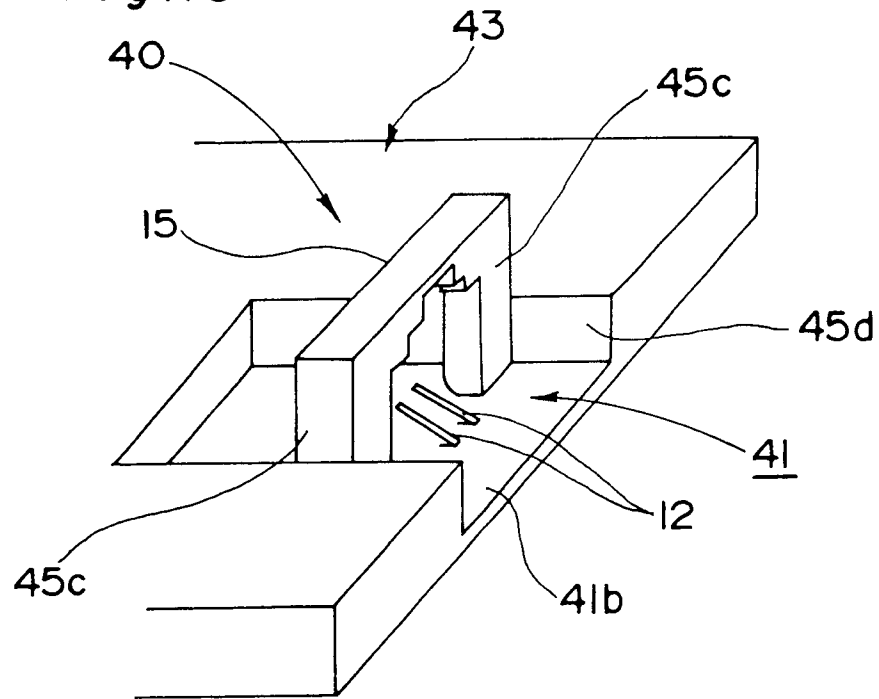
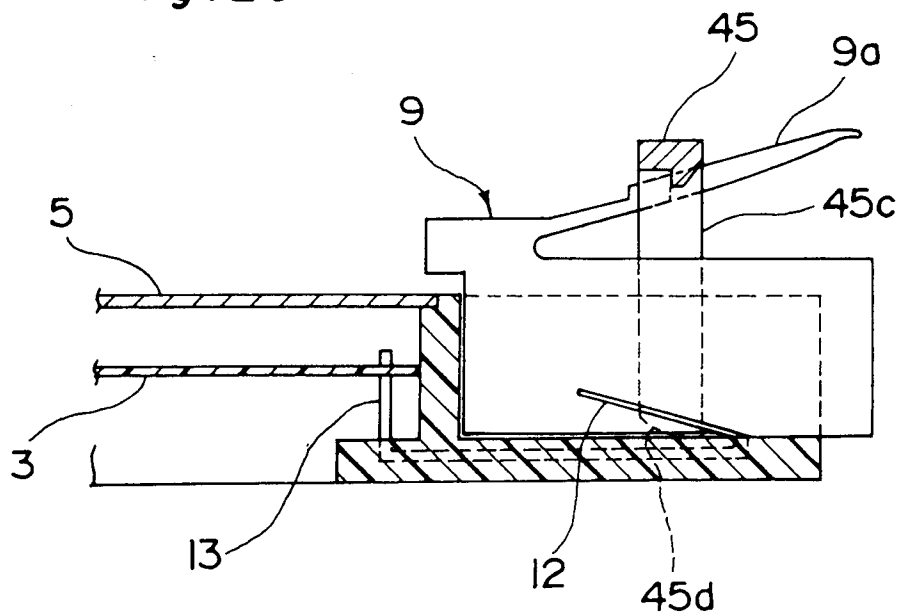


Fig. 20



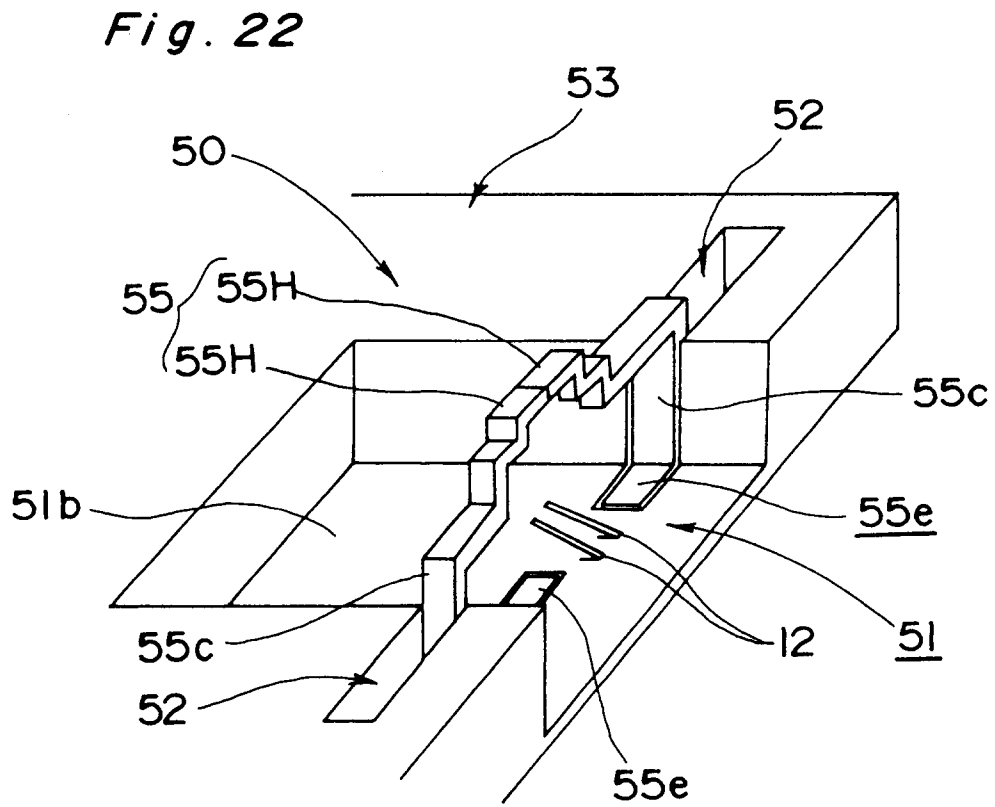
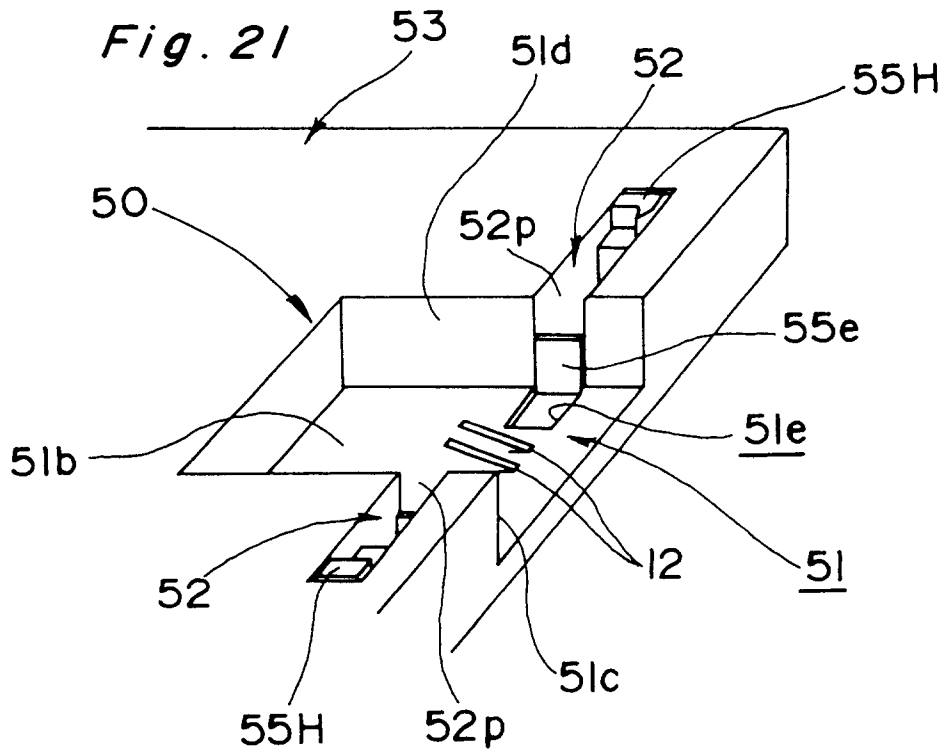


Fig. 23

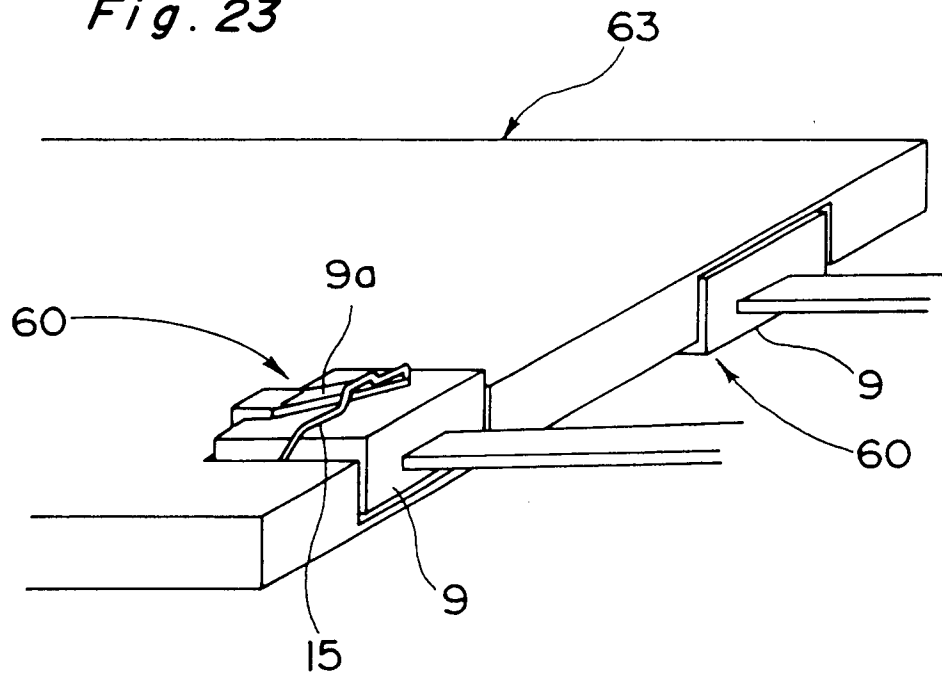


Fig. 24

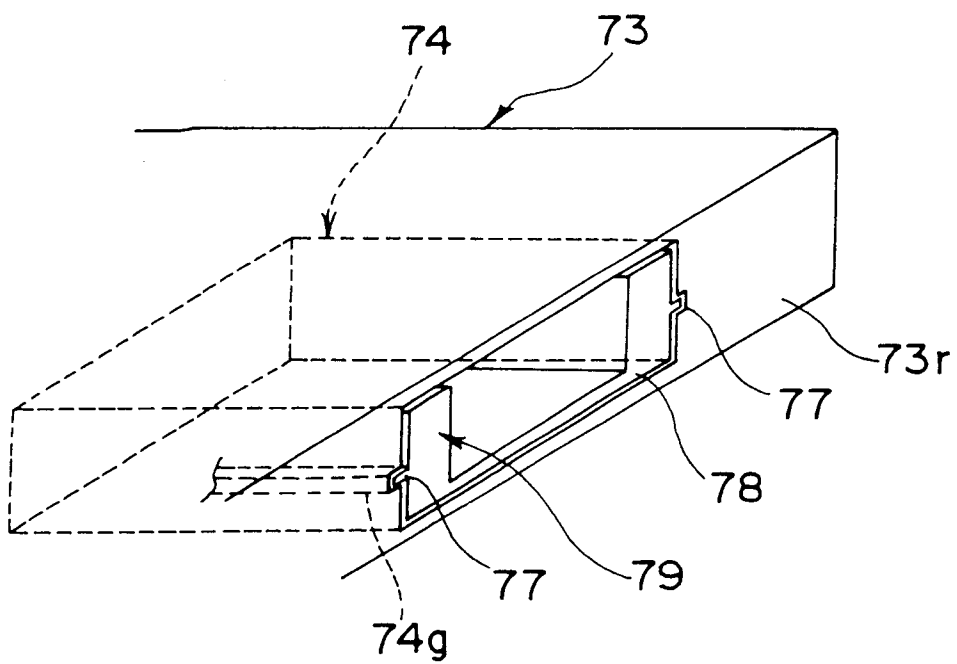


Fig. 25

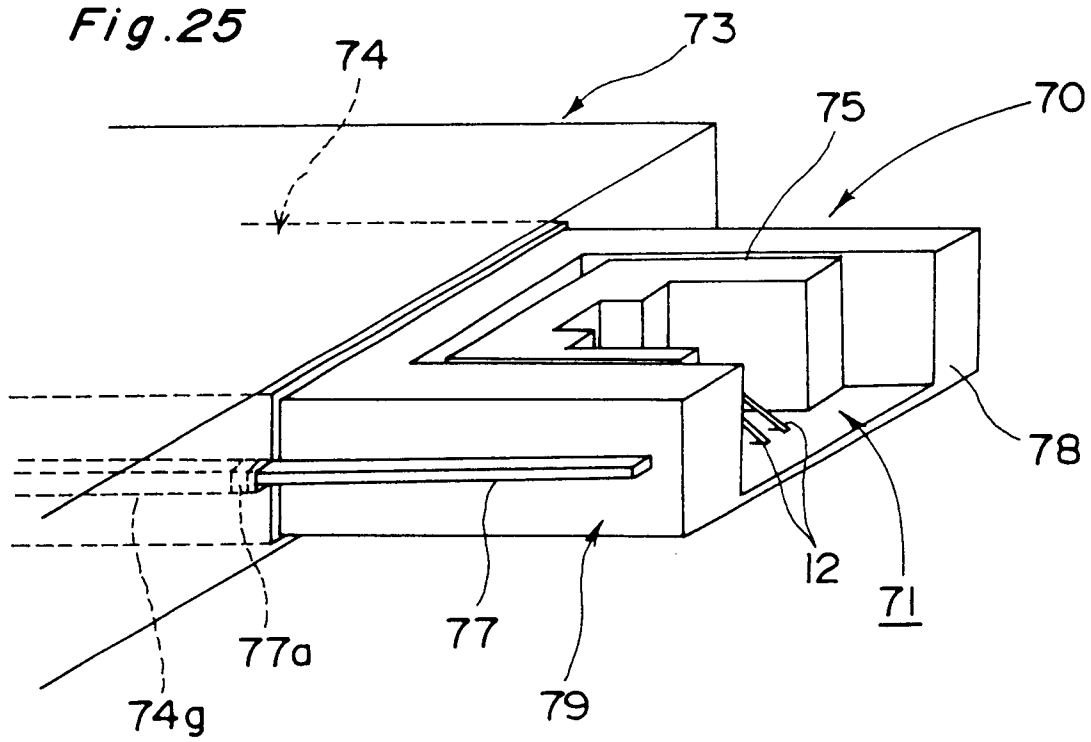


Fig. 26

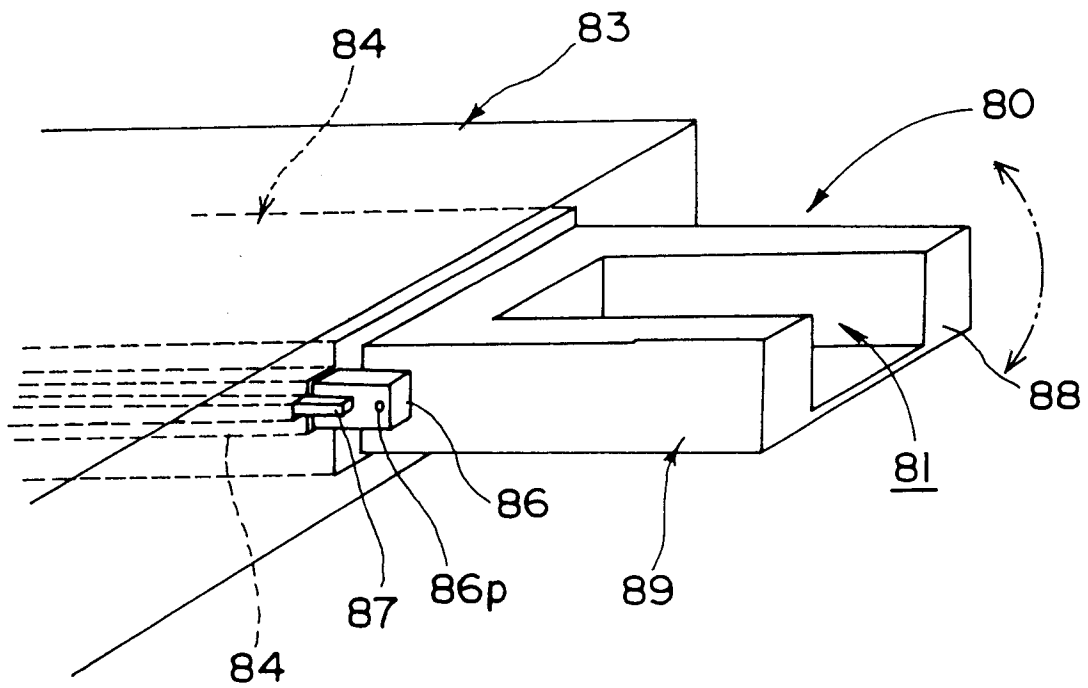


Fig. 27 PRIOR ART

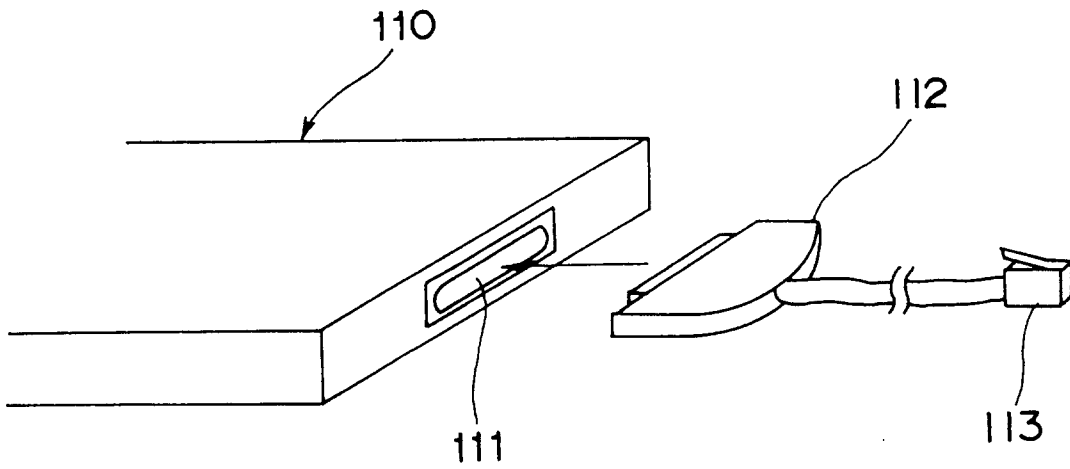


Fig. 28 PRIOR ART

