CONNECTOR FOR FLEXIBLE PRINTED CIRCUIT

BACKGROUND

1. Technical Field

[0001]

The present invention relates to a connector for flexible printed circuits, and more particularly to a connector for flexible printed circuits that is used for connecting flexible flat cables (FFCs) or flat flexible printed circuits such as flexible printed circuits (FPCs) to equipment and the like.

2. Related Art

[0002]

Flexible flat cables and printed circuits (referred to collectively below by the representative term "FPCs") are principally used to effect electrical connections between mechanically movable and moving parts and between equipment. Such FPCs are usually connected to equipment and the like using a connector that is specifically for use with FPCs – what is known as a flexible printed circuit connector (referred to as an "FPC connector" below).

This FPC connector has multiple contact terminals, an electrically insulating connector housing in which such terminals are installed in a widthwise array at a particular spacing and which has an insertion opening for insertion of an FPC, and a pressing member that is turnably installed to such housing. The structure is such that an FPC is inserted into the insertion opening so that the conductors at the FPC's end portion are brought into contact with the contact terminals, and by turning of the pressing member, the FPC's conductors are pressed against the contact terminals, and connection is effected. Also, with such connector, the FPC can be pulled out from the connector housing when the pressing member is returned to the original position. Since with such connector the FPC and contact terminals, etc., can be connected and separated by turning the

pressing member, almost without any force being applied, such a connector is sometimes generally called a "zero insertion force" (ZIF) connector. The connector of this type may be referred to as the "ZIF connector" below.

[0003]

Various different types of ZIF connector have been developed to date. Examples of such ZIF type FPC connectors are those disclosed in JP-A-2003-109695 and JP-A-2000-113933.

[0004]

Figs. 13A and 13B are cross-sectional views of the FPC connector disclosed in JP-A-2003-109695.

As Figs. 13A and 13B show, an FPC connector 20 disclosed in JP-A-2003-109695 has: an insulative housing 21 in which is defined an FPC receiving hollow 22; multiple terminals 24, 25 that are installed in widthwise arrays at a particular spacing in the insulative housing 21; and a turnably installed actuator 23 for causing the contacting portions 24a, 25a of the terminals 24, 25 to contact and engage with the contacts of an FPC inserted into the FPC receiving hollow 22. The contacting portions 24a of one set of terminals 24 are disposed at the front part of the FPC receiving hollow 22, while the contacting portions 25a of the other set of terminals 25 are disposed at the inward part of the FPC receiving hollow 22.

[0005]

Also, the contacts 25 are provided with movable beams 25b that are opposed the contacting portions 25a thereof, and the spacing between engaging protrusions 25b' formed in such movable beams 25b and the contacting portions 25a opposed thereto is made to be roughly equal to or slightly smaller than the thickness of the FPC. Also, when the FPC's contacts and the contacting portions 24a, 25a of the terminals 24, 25 are brought into contact and engaged through turning of the actuator 23, cams 23a provided on the actuator 23 elastically deform the movable beams 25b, so that the FPC is pushed toward the contacting portions 25a by the engaging protrusions 25b'.

[0006]

The movable beams 25b are provided cantilever-like on the terminals 25. Also, these terminals 25 provided with movable beams 25b additionally have bearing beams 25c that support the actuator 23 in such a way as to allow it to turn. The cams 23a of the actuator 23 are pinched between the tip portions 25c' of the bearing beams 25c and the tip portion of the movable beams 25b, and when the actuator 23 turns, the cams 23a act on the tip portions of the movable beams 25b and thereby elastically deform the movable beams 25b.

[0007]

The FPC connector disclosed in JP-A-2000-113933 has a structure such that an FPC can be inserted through a single insertion opening on two levels, upper and lower, and the FPC's conductors are mechanically and electrically joined to the contact terminals via manipulation of a pressing member.

[0008]

With the FPC connector disclosed in JP-A-2003-109695, movable beams 25b are provided so as to oppose the contacting portions 25a disposed in the inward part of the FPC receiving hollow 22, and the spacing between the engaging protrusions 25b' formed in such movable beams 25b and the contacting portions of the terminals 24, 25 is made to be roughly equal to or slightly smaller than the thickness of the FPC, thanks to which, almost no external force is required for insertion of the FPC, which can be inserted and removed smoothly. Thus, workability is improved. Also, when the actuator 23 is turned and thereby the FPC's contacts and the contacting portions 24a, 25a of the terminals 24, 25 are brought into contact and engaged, the cams 23a of the actuator 23 elastically deform the movable beams 25b, so that the FPC is pushed toward the contacting portions, thanks to which, the electrically necessary contacting pressure is applied between the FPC's contacts and the contacting portions 24a, 25a of the terminals 24, 25. Since the engaging protrusions 25b' are already in contact with the FPC, the amount by which the movable beams 25b are displaced need only be small, and consequently there will be little resistance to the turning of the actuator 23. Thus,

workability of connection also is improved.

[0009]

However, the FPC of JP-A-2003-109695 has several intrinsic problems. Namely, because the FPC is pinched between the terminals 24, 25, there is a danger that the FPC will fall out if somewhat excessive pulling force acts thereon. Also, since the actuator 23 is installed above the terminals 24, 25, and the contacting portions of the terminals are pressed into contact with the FPC's contacts through manipulation of the actuator 23, the connector housing in which the terminals 24, 25 and the actuator 23 are installed is high-profile, which means that the connector cannot be rendered flat. Similarly, with the connector disclosed in JP-A-2000-113933, the pressing member is installed above the terminals and consequently the connector is high-profile and cannot be rendered flat.

SUMMARY

[0010]

An advantage of some aspects of the present invention is to provide a ZIF type FPC connector that has a low-profile connector housing and hence can be rendered flat.

[0011]

An advantage of other aspects of the invention is to provide a ZIF type FPC connector that affords good electrical connection between the conductors of the FPC, which is mechanically joined to the connector housing, and the contact terminals.

[0012]

An advantage of further aspects of the invention is to provide a ZIF type FPC connector in which noise is curbed through electrostatic shielding.

[0013]

An advantage of still further aspects of the invention is to provide a ZIF type FPC connector in which mechanical coupling is effected, and moreover electrical connection is maintained, by means of an electrostatic shielding member.

[0014]

According to a first aspect of the present invention, a flexible printed circuit connector includes: multiple contact terminals; an electrically insulative connector housing in which the contact terminals are installed at a predetermined spacing and which has a receiving cavity in which a flexible printed circuit ("FPC" below) is received; and an open/closable cover member that is pivotally supported to inside the receiving cavity by a rotation axle and covers the receiving cavity; and has the innovative feature that the multiple contact terminals being arrayed in a widthwise row, at a predetermined spacing, in the front part of the receiving cavity of the connector housing; an insertion aperture through which the FPC is inserted being formed at the rotation axle of the cover member; and the rotation axle being pivotally supported to rearward of the contacting portions of the multiple contact terminals inside the receiving cavity.

[0015]

With such flexible printed circuit connector of the first aspect, the fact that the cover member's rotation axle is pivoted rearward of the contact portions of the multiple contact terminals inside the receiving cavity means that the contact terminals and the rotation axle are disposed almost on a level. Consequently, the height of the connector housing can be made low, and as a result the connector can be rendered flat. More precisely, the height of the connector housing can be made low because there is no need to position the rotation axle of the cover (which serves as the pressing member) above the contact terminals, as is done in the related art. Also, the FPC is inserted into an insertion aperture provided in the rotation axle, so that when the receiving cavity's mouth is covered by the cover member the end portion of the FPC, which is inserted in the insertion aperture, will be mechanically fixed, and the FPC will thereby be prevented from falling out.

[0016]

Also, in such first aspect the cover member will preferably have an electrically insulative cover frame including the rotation axle, and a shield plate removably installed to the cover frame.

[0017]

With such preferred aspect, a shield plate is installed to the cover member, and therefore electrostatic shielding can be effected via such shield plate, so that noise will not penetrate into the portions that connect the FPC with the contact terminals, nor into the like parts.

[0018]

Also, in such first aspect the periphery of the connector housing, where the cover member is installed, will preferably be covered by a shielding member.

[0019]

With such preferred aspect, the fact the connector housing's periphery, where the cover member is installed, is covered by a shielding member means that, as with the foregoing shield plate, electrostatic shielding can be effected, so that noise will not penetrate into the portions that connect the FPC with the contact terminals, nor into the like parts.

[0020]

Also, in such first aspect the shielding member will preferably be constituted of metal sheet material having resilient pieces in certain parts thereof, and such resilient pieces have bias force in the direction in which the cover member closes over the receiving cavity.

[0021]

With such preferred aspect, the cover member is biased in the closing direction thereof by the resilient pieces formed on the shielding member, so that through the bias force of such resilient pieces, the cover member is mechanically fixed, and at the same time is electrostatically shielded. Also, as a result of such fixing of the cover member, the FPC is mechanically fixed between the cover member and the receiving cavity, and moreover pressing force acts between the FPC's conductors and the contact terminals, rendering the electrical connection good.

[0022]

According to a second aspect of the present invention, a flexible printed

circuit connector includes: first and second multiple contact terminals; an electrically insulative connector housing in which the first and second contact terminals are installed at a predetermined spacing and which has a receiving cavity in which an FPC is received; and an open/closable cover member that is pivotally supported to inside the receiving cavity by a rotation axle and covers the receiving cavity; and has the innovative feature that the multiple contact terminals being arrayed in a widthwise row, at a predetermined spacing, in the front part of the receiving cavity of the connector housing; the multiple second contact terminals are arrayed in a widthwise row, at a predetermined spacing, in the rear part of the receiving cavity of the connector housing; an insertion aperture through which the FPC is inserted is formed at the rotation axle of the cover member; and the rotation axle is pivotally supported between the contacting portions of the first and second contact terminals inside the receiving cavity.

[0023]

With such flexible printed circuit connector of the second aspect, the fact that the cover member's rotation axle is inside the receiving cavity and pivoted between the contact portions of the first and second contact terminals means that the first and second contact terminals and the rotation axle are disposed almost on a level. Consequently, the height of the connector housing can be made low, and as a result the flexible printed circuit connector can be rendered flat. More precisely, the height of the connector housing can be made low because there is no need to position the rotation axle of the cover (which serves as the pressing member) above the contact terminals, as is done in the related art. Also, the FPC is inserted into an insertion aperture provided in the rotation axle, so that when the receiving cavity's mouth is covered by the cover member the end portion of the FPC, which is inserted in the insertion aperture, will be mechanically fixed, and the FPC will thereby be prevented from falling out.

[0024]

Also, in such second aspect the rotation axle has an actuation piece, onto which the tip portions of the second contact terminals will preferably be placed, at

the FPC end portion exit side of the insertion aperture of the rotation axle.

[0025]

With such preferred aspect, an actuation piece onto which the tip portions of the second contact terminals mount is provided at the exit side of the rotation axle's insertion aperture, so that when the cover member is opened or closed, the actuation piece will, in the manner of a lever, cause the second contact terminals to move up or down. Hence, if the contacting portions of the second contact terminals are made to move upward only when the cover member is closed, then, with the cover member in the closed state the FPC will be pressed against the second contact terminals, with the result that good electrical connection is effected, and also an FPC dislodgement prevention effect is obtained, and moreover the load during insertion of the FPC is reduced.

[0026]

Also, in such second aspect the cover member will preferably have an electrically insulative cover frame including the rotation axle, and a shield plate removably installed to the cover frame.

[0027]

With such preferred aspect, a shield plate is installed to the cover member, and therefore electrostatic shielding can be effected via such shield plate, so that noise will not penetrate into the portions that connect the FPC with the contact terminals, nor into the like parts.

[0028]

Also, in such second aspect the periphery of the connector housing, where the cover member is installed, will preferably be covered by a shielding member.

[0029]

With such preferred aspect, the fact the connector housing's periphery, where the cover member is installed, is covered by a shielding member means that, as with the foregoing shield plate, electrostatic shielding can be effected, so that noise will not penetrate into the portions that connect the FPC with the contact terminals, nor into the like parts.

[0030]

Also, in such second aspect the shielding member will preferably be constituted of metal sheet material having resilient pieces in certain parts thereof, and such resilient pieces have bias force in the direction in which the cover member closes over the receiving cavity.

[0031]

With such preferred aspect, the cover member is biased in the closing direction thereof by the resilient pieces formed on the shielding member, so that through the bias force of such resilient pieces, the cover member is mechanically fixed and at the same time is electrostatically shielded. Also, as a result of such fixing of the cover member, the FPC is mechanically fixed between the cover member and the receiving cavity, and moreover pressing force acts between the FPC's conductors and the contact terminals, rendering the electrical connection good.

[0032]

Also, in such second aspect the first and second multiple contact terminals will preferably each be disposed with equal spacings in the connector housing, and moreover the second contact terminals will be disposed on the extension of the center lines of the each gaps between the first contact terminals.

[0033]

With such preferred aspect, the first and second multiple contact terminals disposed in the connector housing are each disposed with equal spacings, and moreover the positions of the first and of the second contact terminals are staggered by one half spacing relative to each other, so that the first and the second contact terminals can be connected alternately to the FPC's multiple conductors.

BRIEF DESCRIPTION OF THE DRAWINGS

[0034]

The invention will be described with reference to the accompanying drawings, wherein like numbers reference like elements.

Fig. 1 illustrates an FPC connector, Fig. 1A being a general perspective view of the FPC connector seen from a particular direction, and Fig. 1B being a general perspective view of the FPC connector in Fig. 1A rotated 180 degrees.

Fig. 2 is an exploded perspective view of the FPC connector in Fig. 1.

Fig. 3 illustrates the housing in Fig. 2, Fig. 3A being a perspective view of the housing seen from a particular direction, and Fig. 3B being a perspective view of the housing in Fig. 3A rotated 180 degrees.

Fig. 4 illustrates the cover frame that is a component of the cover member in Fig. 2, Fig. 4A being a perspective view of the cover frame seen from a particular direction, and Fig. 4B being a perspective view of the cover frame in Fig. 4A rotated 180 degrees.

Fig. 5A is a plan view of the shield plate that is installed to the cover frame, and Fig. 5B is a perspective view of the shielding member.

Fig. 6A is a perspective view of a first contact terminal, and Fig. 6B is a side view of the contact terminal in Fig. 6A.

Fig. 7A is a perspective view of a second contact terminal, and Fig. 7B is a side view of the contact terminal in Fig. 7A.

Fig. 8 illustrates the assembled connector, Fig. 8A being a front view, Fig. 8B a top view, Fig. 8C a rear view, Fig. 8D a left side view and Fig. 8E a right side view thereof.

Fig. 9A is a cross-sectional view along line IXA – IXA in Fig. 8A, and Fig. 9B is a cross-sectional view along line IXB – IXB in Fig. 8A.

Fig. 10 illustrates the assembled connector in Fig. 9 with the cover lifted up, Figs. 10A and 10B being cross-sectional views corresponding to Figs. 9A and 9B respectively.

Fig. 11 gives explanatory views of the installation of the FPC to the connector, which correspond to the views in Fig. 10.

Fig. 12 gives explanatory views of the installation of the FPC to the connector, which correspond to the views in Fig. 9.

Fig. 13 gives cross-sectional views of an FPC connector of the related art.

DESCRIPTION OF EXEMPLARY EMBODIMENT

[0035]

An exemplary embodiment of the present invention will now be described with reference to the accompanying drawings. It should be understood however that the following embodiment is intended by way of example of an FPC connector that carries out the technical concepts of the invention, not by way of limiting the invention to this particular FPC connector. The invention could equally well be adapted by those skilled in the art to yield other embodiments without departing from the scope and spirit of the claims.

[0036]

First of all, an overview of an FPC connector will be given with reference to Figs. 1 and 2. Fig. 1 illustrates an FPC connector, Fig. 1A being a general perspective view of the FPC connector seen from a particular direction, and Fig. 1B being a general perspective view of the FPC connector in Fig. 1A rotated 180 degrees. Fig. 2 is an exploded perspective view of the FPC connector in Fig. 1.

[0037]

As Figs. 1 and 2 show, an FPC connector 1 includes: two types – a first and a second set – of multiple contact terminals 2 and 3; a connector housing (hereinafter, "a housing") 4 that houses the multiple contact terminals 2, 3 and that is constituted of electrically insulative material; a cover member 11 that is rotatably fixed to the housing 4; and a shielding member 18 that covers the top surface of the housing 4 and is constituted of metal sheet material.

[0038]

The individual members composing this FPC connector will now be described in detail with reference to Figs. 2 to 7. Fig. 3 illustrates the housing in Fig. 2, Fig. 3A being a perspective view of the housing seen from a particular direction, and Fig. 3B being a perspective view of the housing in Fig. 3A rotated 180 degrees.

[0039]

The housing 4, as Fig. 3 shows, has rectangular top and bottom walls 4a, 4b of a particular breadth, and front and rear walls 4c, 4d and left and right walls 4e, 4f of a particular thickness; takes the form of a relatively thin block that is provided, in the surface of the top wall 4a, with a receiving cavity 5 having a bottom at a particular depth, for receiving an FPC or the like; and is molded from electrically insulative synthetic resin. The receiving cavity 5 is formed as a flat-bottomed trench having length, width and depth such as to receive an FPC and the cover member 11. This receiving cavity 5, that is, this flat-bottomed trench, is formed with a top opening 5a and front opening 5c provided in part of the top wall 4a and front wall 4c, and with left and right inner walls 5e, 5f, a back inner wall 5d, and a bottom wall 5b. The top opening 5a of the receiving cavity 5 is the portion that is closed by the cover member 11, while the front opening 5c is the portion through which the FPC is drawn when inserted. In the left and right inner walls 5e, 5f there are formed bearing slots 6a, 6b into which are inserted pivots 14a, 14b (see Fig. 4) at the two ends of a rotation axle 14 provided in the cover member 11. Also, in the bottom wall 5b between the bearing slots 6a, 6b there is formed a long slot 4b' (see Fig. 8C) which is of a size such that an actuation piece 16 to be described hereafter can turn freely therein. Further, in the bottom wall 5b there are formed, at equal spacings, multiple slits 8_1 to 8_n into which the first multiple contact terminals 2 are positioned and inserted.

[0040]

Also, the front wall 4c of the housing 4 consists of the front opening 5c of the receiving cavity 5 and a portion 4c' (referred to as the "small front wall" below) where such front opening 5c is not formed, and in this small front wall 4c' there are formed, at roughly equal spacings, multiple front terminal insertion holes 7_1 to 7_n into which the first multiple contact terminals 2 are inserted respectively. These front terminal insertion holes 7_1 to 7_n communicate with the multiple slits 8_1 to 8_n, respectively, provided in the bottom wall 5b of the receiving cavity 5.

[0041]

Further, in the surface of the rear wall 4d of the housing 4, as Fig. 3B

shows, there are formed, at roughly equal spacings, multiple rear terminal insertion holes 9_1 to 9_n into which the second multiple contact terminals 3 are inserted. These rear terminal insertion holes 9_1 to 9_n are formed with spacings equal to those of the front terminal insertion holes 7_1 to 7_n, and the positions thereof are staggered by one half-spacing relative to the front terminal insertion holes 7_1 to 7_n, so that the rear terminal insertion holes 9_1 to 9_n are so disposed as to be positioned in between the front terminal insertion holes 7_1 to 7_n. Also, in the back inner wall 5d of the receiving cavity 5 there are formed slits 10_1 to 10_n that communicate with the rear terminal insertion holes 9_1 to 9_n, and an insertion slot 10_{FPC} into which the leading end of the FPC is inserted. The fact that, as mentioned above, the positions of the rear terminal insertion holes 9_1 to 9_n and of the front terminal insertion holes 7_1 to 7_n are staggered by one half-spacing relative to each other means that the first and second contact terminals 2, 3 that are inserted into such terminal insertion holes can each be made to contact with a different set of conductors, C_1 and C_2 respectively, of the FPC. More specifically, with the FPC's conductors C_1 and C_2 arrayed, say, in a widthwise row, the odd-numbered FPC conductors C_1 can be connected to the first contact terminals 2, and the even-numbered FPC conductors C_2 to the second contact terminals 3, or alternatively such connections can be effected with the odd- and even-numbered items reversed. Further, although in this embodiment a structure is described whereby the FPC conductors C_1 are connected to the first contact terminals 2 and the FPC conductors C_2 to the second contact terminals 3, it would alternatively be possible to position the rear terminal insertion holes 9_1 to 9_n and front terminal insertion holes 7_1 to 7_n on a level, and to connect the first and second contact terminals 2, 3 to the same FPC conductors.

[0042]

The cover member and shielding member will next be described, with reference to Figs. 4 and 5. Fig. 4 illustrates the cover frame that is a component of the cover member in Fig. 2, Fig. 4A being a perspective view of the cover frame seen from a particular direction, and Fig. 4B being a perspective view of the cover

frame in Fig. 4A rotated 180 degrees. Fig. 5A is a plan view of the shield plate that is installed to the cover frame, and Fig. 5B is a perspective view of the shielding member.

[0043]

As Fig. 2 shows, the cover member 11 has a cover frame 12 and a shield plate 17 that is removably installed to such cover frame 12. The cover frame 12, as Fig. 4 shows, has a pair of opposed finger pieces 12a, 12b separated by a particular gap 12_0 therebetween, and a connecting piece 12c that connects one pair of ends of the finger pieces 12a, 12b. Joined into a whole, these form a plate body that is roughly U-shaped viewed from above, and is molded from electrically insulative resin. The lengths of the pair of finger pieces 12a, 12b in the longitudinal direction are made roughly the same as the length of the left and right inner walls 5e, 5f of the receiving cavity 5 provided in the housing 4, and the pair of finger pieces 12a, 12b are constituted as plate-form pieces having a particular thickness. In the opposed sidewall faces of this pair of finger pieces 12a, 12b there are formed slots 12_1, 12_1 into which the shield plate 17 is inserted. Further, the connecting piece 12c is composed of a connecting plate 12c' that joins the end portions of the pair of finger pieces 12a, 12b, and the rotation axle 14 provided at the ends of the connecting plate 12c'. In addition, a support piece 13 that supports the shield plate 17 is formed almost in the center of the top face of the connecting plate 12c'.

[0044]

The rotation axle 14 of the cover frame 12 consists of an approximately round columnar body having a diameter slightly smaller than the thickness of the housing 4, and has, at either end, the pivots 14a, 14b, between which there is formed an insertion aperture 15 through which the FPC is inserted. Also, at the bottom surface of the insertion aperture 15, the ledge-like actuation piece 16 is formed roughly in parallel with the ends of the connecting plate 12c', and projecting away from the connecting plate 12c'. Multiple mounting slots 16_1 to 16_n into which tip portions 3a' of the second contact terminals 3 are

inserted/mounted are formed at roughly equal spacings in the top surface of the actuation piece 16.

[0045]

The shield plate 17, as Fig. 5 shows, is formed as a rectangular metal sheet that is installed between the cover frame 12's pair of finger pieces 12a, 12b, occupying the gap 12_0 therebetween. More specifically, it is formed as a rectangular metal sheet having opposed long edges 17a, 17b and short edges 17c, 17d. Each long edge 17a, 17b is made approximately the same length as the distance between the pair of finger pieces 12a, 12b of the cover frame 12, and each short edge 17c, 17d is made approximately the same length as the longitudinal length of the pair of finger pieces 12a, 12b. In one long edge 17b there is formed a pair of projections 17_1, 17_1 with a particular gap 17_0 therebetween. Upon being installed to the cover frame 12, the shield plate 17 is fixed by the entry of the support piece 13 of the connecting plate 12c' into the gap 17_0.

[0046]

The shielding member 18, as Fig. 5B shows, has a pair of opposed attaching parts 18a, 18b with a gap 18_0 therebetween of roughly the same dimension as the width of the housing 4, a connecting part 18c that connects the end portions of the attaching parts 18a, 18b, and two springing pieces 18c', 18c' that project from the connecting part 18c into the gap 18_0. These elements are formed as an integral whole by punching and bending processing of a single metal sheet. The pair of attaching parts 18a, 18b have almost the same shape, and have U-shaped hollows 18_1, 18_1 of a size roughly the same as the thickness of the housing 4. Also, the two springing pieces 18c', 18c' consist of resilient strips and perform the function of pressing and fixing the cover member 11 when the shielding member 18 is installed to the housing 4.

[0047]

The first and second contact terminals 2, 3 will next be described, with reference to Figs. 6 and 7. Fig. 6A is a perspective view of a first contact terminal and Fig. 6B is a side view of the first contact terminal in Fig. 6A. Likewise, Fig.

7A is a perspective view of a second contact terminal and Fig. 7B is a side view of the second contact terminal in Fig. 7A.

[0048]

The first contact terminals 2 are disposed in front of the housing 4, or more precisely, at the front wall 4c side of the housing 4. In more detail, as Fig. 6A shows, the first contact terminals 2 are formed from metal strips of good conductivity, and have a contacting portion 2a formed at one end, a connection portion 2b, for connection to a lead wire or the like, formed at the other end, and a fixing portion 2c, for fixing to the housing 4, formed between the contacting portion 2a and connection portion 2b. As Fig. 6B shows, the contacting portion 2a slopes upward due to a slight bending near the fixing portion 2c, and furthermore is so shaped as to be bent downward near a tip portion 2a'. By making the contacting portion 2a slope at a certain angle in this manner, resilient spring force acting in the direction in which the FPC is pushed is imparted to the housing 4 when the fixing portions 2c of the first contact terminals 2 are fixed thereto. Also, the connection portion 2b curves gently downward crank-like at the middle part thereof, and hence, as viewed from the fixing portion 2c, is so shaped that the tip and vicinity thereof fall off downward.

[0049]

The second contact terminals 3 are disposed at the rear of the housing 4, or more precisely, at the rear wall 4d side of the housing 4. In more detail, as Fig. 7A shows, the second contact terminals 3 are formed from metal strips of good conductivity, and have a contacting portion 3a formed at one end, a connection portion 3b, for connection to a lead wire or the like, formed at the other end, and a fixing portion 3c, for fixing to the housing 4, formed between the contacting portion 3a and connection portion 3b. As Fig. 7B shows, the contacting portion 3a is so shaped as to extend level with the fixing portion 3c and to bend downward near the tip portion 3a' thereof. In addition, the tip portion 3a' contacts against the inside of a slot in the actuation piece 16. Also, the connection portion 3b curves gently downward crank-like at the middle part thereof, and hence, as viewed

from the fixing portion 3c, is so shaped that the tip and vicinity thereof fall off downward.

[0050]

Next, the assembly of the FPC connector 1 using such members and the method of installing an FPC will be described, with reference to Figs. 1 to 10. Fig. 8 illustrates the assembled connector, Fig. 8A being a front view, Fig. 8B a top view, Fig. 8C a rear view, Fig. 8D a left side view and Fig. 8E a right side view thereof. Also, Fig. 9A is a cross-sectional view along line IXA – IXA in Fig. 8A, and Fig. 9B is a cross-sectional view along line IXB – IXB in Fig. 8A. Further, Fig. 10 illustrates the assembled connector in Fig. 9 with the cover lifted up, Figs. 10A and 10B being cross-sectional views thereof corresponding to Figs. 9A and 9B respectively.

[0051]

First of all, the first contact terminals 2 are positioned and fixed in the housing 4. This is done by inserting the multiple first contact terminals 2 into the front terminal insertion holes 7_1 to 7_n in the front wall 4c of the housing 4 respectively. As the front terminal insertion holes 7_1 to 7_n communicate with the slits 8_1 to 8_n provided in the bottom wall 5b of the receiving cavity 5, the contact portions 2a protrude through the slits 8_1 to 8_n towards the receiving cavity 5 when the first contact terminals 2 are inserted into the front terminal insertion holes 7_1 to 7_n. The fixing portions 2c of the first contact terminals 2 are fixed proximate to the front terminal insertion holes 7_1 to 7_n. As a result of the fixing portions 2c being fixed, the contacting portions 2a are fixed inside the slits 8_1 to 8_n in a vertically movable state.

[0052]

Next, the cover member 11 is installed to the housing 4. To do so, first the shield plate 17 is installed to the cover frame 12, and the pivots 14a, 14b of the cover frame 12 with the shield plate 17 are fitted into and turnably fixed in the bearing slots 6a, 6b respectively of the housing 4. Then the second contact terminals 3 are positioned and fixed in the housing 4. Such positioning and fixing

is done by inserting the multiple second contact terminals 3 into the rear terminal insertion holes 9_1 to 9_n in the rear wall 4d of the housing 4. As the rear terminal insertion holes 9_1 to 9_n communicate with the slits 10_1 to 10_n provided in the back inner wall 5d of the receiving cavity 5, the fixing portions 3c are fixed proximate to the rear terminal insertion holes 9_1 to 9_n when the second contact terminals 3 are inserted into the slits 10_1 to 10_n, and as a result, the contacting portions 3a are fixed inside the slits 10_1 to 10_n in a vertically movable state respectively. At the same time, the tip portions 3a' of the second contact terminals 3 are mounted onto the mounting slots 16_1 to 16_n respectively in the actuation piece 16 (see Fig. 9B).

[0053]

Finally, the shielding member 18 is fixed to the housing 4. In more detail, the housing 4's left and right walls 4e, 4f are inserted into the U-shaped hollows 18_1, 18_1 formed in the shielding member 18's pair of attaching parts 18a, 18b, and thereby the left and right walls 4e, 4f are gripped and fixed by the installation parts 18a, 18b. When the shielding member 18 is fixed to the housing 4, the shielding member 18's springing pieces 18c', 18c' press on the cover member 11. As a result of such pressing, the cover member 11 is pushed inside the receiving cavity 5 of the housing 4, and moreover, when the FPC is installed, the FPC's conductors are press-connected to the first and second contact terminals 2, 3, so that good connection will be maintained.

[0054]

The motion of the second contact terminals 3, which is concomitant with the open/closing motion of the cover member 11 will now be described, with reference to Figs. 9 and 10.

As Figs. 9A and 9B show, when the shielding member 18 is installed to the housing 4, the springing pieces 18c', 18c' of the shielding member 18 contact against the cover member 11, so that the cover member 11 is pushed inside the receiving cavity 5 of the housing 4. With such state, the tip portions 3a' of the second contact terminals 3 enter into and are mounted inside the mounting slots 16_1 to 16_n in the actuation piece 16 of the cover frame 12. Thereby, the contacting

portions 3a of the second contact terminals 3 are maintained in a lifted-up state by the actuation piece 16.

[0055]

When, with such state, the cover member 11 is lifted upward against the bias force of the shielding member 18's springing pieces 18c', 18c', the cover member 11, as Figs. 10A and 10B show, turns clockwise (as viewed in Fig. 10) about the rotation axle 14, and moreover the actuation piece 16 that is provided as an integral part of the rotation axle 14 also rotates clockwise. Hence, when the cover member 11 is lifted up in this manner, the contacting portions 3a of the second contact terminals 3 cease to be lifted up by the actuation piece 16, and extend level with the fixing portions 3c.

[0056]

Conversely, when the cover member 11 is closed, or more precisely, when the cover member 11 is lowered down by the resilience of the shielding member 18's springing pieces 18c', 18c', then as Figs. 9A and 9B show, the cover member 11 turns counterclockwise (as viewed in Fig. 9) about the rotation axle 14, and moreover the actuation piece 16 that is provided as an integral part of the rotation axle 14 also rotates counterclockwise. Hence, when the cover member 11 is lowered down in this manner, the contacting portions 3a of the second contact terminals 3 return to the state of being lifted up by the actuation piece 16.

[0057]

Thus, the contacting portions 3a of the second contact terminals 3 move upward and downward in concert with the open/closing motion of the cover member 11. Thanks to the motions of the cover member 11 and the motions of the contacting portions 3a being synchronized in this manner, the contacting pressure between the second contact terminals 3 and the FPC's conductors when the FPC is installed to the housing 4 is heightened, and thereby the connection between the two is improved.

[0058]

Installation of the FPC to the FPC connector 1 will now be described, with

reference mainly to Figs. 9 to 12. Figs. 11 and 12 give explanatory views of the installation of the FPC to the connector, Fig. 11 corresponding to Fig. 10 and Fig. 12 to Fig. 9 respectively.

[0059]

In the FPC connector 1 prior to connection of the FPC, the cover member 11 is fitted into the receiving cavity 5 of the housing 4, as Figs. 8 and 9 show. In order to connect the FPC to the FPC connector 1 in such state, first of all the end of the cover member 11 is, say, grasped with the fingers and lifted up above the housing 4 against the pressing force of the shielding member 18's springing pieces 18c', 18c'. As Figs. 10A and 10B show, when the cover member 11 is lifted up, the cover member 11 rotates together with the rotation axle 14, and an obliquely-angled (viewed from the side) space opens up between the housing 4 and the cover member 11. As Figs. 11A and 11B show, the FPC is then inserted along the cover member 11 through the insertion aperture 15 into this obliquely-angled space, so that the leading end of the FPC is inserted into the insertion slot 10_{FPC}, and thereby the FPC's conductors C_2 are brought into contact with the contacting portions 3a of the second contact terminals 3. At the portions of the FPC that contact with the first and second contact terminals 2, 3, the insulative sheathing is stripped away, so that the FPC's conductors C_1, C_2 are exposed at such portions. The FPC's conductors C_1, C_2 are contacts that contact with the contacting portions 2a and 3a respectively of the first and second contact terminals 2, 3. Hence, the FPC's conductors C_1, C_2 are so positioned as to contact with the contacting portions 2a and 3a respectively of the first and second contact terminals 2, 3.

[0060]

As Figs. 12A and 12B show, when the FPC is inserted into the insertion aperture 15, the cover member 11 is made to rotate about the rotation axle 14, so that the end portion of the cover member 11 is lowered and returns into the receiving cavity 5 in the housing 4. In such process of returning the cover member 11, the actuation piece 16 turns in concert with the turning of the rotation axle 14, and the tip portions 3a' of the second contact terminals 3 are lifted upward

by the mounting slots 16_1 to 16_n in the actuation piece 16. As a result of the tip portions 3a' being thus lifted up, the contacting portions 3a are also lifted upward, and are press-contacted against the FPC's conductors C_2, effecting good electrical connection.

[0061]

At this point, the leading end of the FPC is pinched between the top wall of the insertion slot 10_{FPC} and the contacting portions 3a of the second contact terminals 3, and moreover the portion of the FPC that is inserted in the insertion aperture 15 is kept flexed. In more detail, the fact that the length L (see Fig. 9B) of the gap formed between the upper surface of the insertion aperture 15 and the upper tip portion of the contacting portions 3a of the second contact terminals 3 is made smaller than the thickness of the FPC means that, when the FPC is inserted in the FPC connector 1, the leading end thereof is lifted upward by the bias force of the contacting portions 3a of the second contact terminals 3, but the portion inserted in the insertion aperture 15 contacts against the upper surface of the insertion aperture 15 and therefore is restrained from lifting upward. As a result, the portion inserted in the insertion aperture 15 will be in a flexed state. With a flexed portion formed in a part of the FPC in this manner, the FPC is mechanically fixed in a robust manner and thus is prevented from falling out.

[0062]

Further, through returning of the cover member 11 to its original position, the FPC is pressed by the cover member 11 so as to be press-contacted against the bottom wall 5b of the receiving cavity 5, with the result that the contacting portions 2a of the first contact terminals 2, which are protruding from the bottom wall 5b, are satisfactorily connected to the FPC's conductors C_1.

[0063]

When the cover member 11 is returned into the receiving cavity 5 with the FPC inserted as described above, the cover member 11 is held mechanically by the springing pieces 18c', 18c' of the shielding member 18, which contact against the cover member 11. Due to the cover member 11 being so held, the FPC is robustly

fixed so as to be prevented from falling out, and moreover, good electrical connections are obtained between the FPC's conductors C_1, C_2 and the first and second contact terminals 2, 3.

[0064]

With the foregoing structure, the FPC connector 1 of this embodiment has an insertion aperture 15, for insertion of an FPC, formed in the rotation axle 14 of the cover member 11. Thanks to this, the rotation axle 14 can be disposed in a position lying in the insertion path of the FPC, or more precisely, between the first and second contact terminals 2 and 3. This enables the connector itself to be rendered flat. Also, once inserted in the insertion aperture 15, the FPC is so held that part thereof is in a flexed state, and thereby the FPC is robustly fixed and prevented from falling out.

[0065]

Also, in the FPC connector 1 of the foregoing embodiment, an actuation piece 16 having mounting slots 16_1 to 16_n onto which the tip portions 3a' of the second contact terminals 3 mount is provided at the lower surface of the insertion aperture 15. Thanks to this, the second contact terminals 3 can be made to move vertically in concert with the motion of the actuation piece 16. Hence, when the cover member 11 is closed, the second contact terminals 3 are lifted upward and are thereby press-contacted against and connected to the FPC's conductors C_2, so that good electrical connection is obtained. Further, the cover member 11 is at all times pushed downward by the shielding member 18's springing pieces 18c', 18c', and therefore is press-contacted robustly against the housing 4. Hence, the FPC's conductors C_1 and the contacting portions 2a of the first contact terminals 2 are press-contacted and connected together by means of the cover member 11, so that good electrical connection is obtained.

[0066]

Furthermore, in the FPC connector 1 of the foregoing embodiment, almost the whole of the housing 4 is covered by the shield plate 17 and shielding member 18, so that noise from the exterior will not reach the connecting portions of the

FPC's conductors C_1, C_2 and the first and second contact terminals 2, 3. Thus, a connector is obtained that is hard for noise to penetrate.

[0067]

Above, an exemplary embodiment of the present invention has been described. It should however be understood that the present invention is not limited to such FPC connector. Numerous variants thereof will be possible – for example a connector in which the second contact terminals are omitted and first contact terminals of a single type are used.

What is claimed is:

1. A flexible printed circuit connector comprising:

multiple contact terminals;

an electrically insulative connector housing in which the contact terminals are installed at a predetermined spacing and which has a receiving cavity in which a flexible printed circuit ("FPC" below) is received; and

an open/closable cover member that is pivotally supported to inside the receiving cavity by a rotation axle and covers the receiving cavity;

the multiple contact terminals being arrayed in a widthwise row, at a predetermined spacing, in the front part of the receiving cavity of the connector housing;

an insertion aperture through which the FPC is inserted being formed at the rotation axle of the cover member; and

the rotation axle being pivotally supported to rearward of the contacting portions of the multiple contact terminals inside the receiving cavity.

2. The flexible printed circuit connector according to claim 1, wherein the cover member has an electrically insulative cover frame including the rotation axle, and a shield plate removably installed to the cover frame.

3. The flexible printed circuit connector according to claim 1, wherein the periphery of the connector housing, where the cover member is installed, is covered by a shielding member.

4. The flexible printed circuit connector according to claim 3, wherein the shielding member is constituted of metal sheet material having resilient pieces in certain parts thereof, and such resilient pieces have bias force in the direction in which the cover member closes over the receiving cavity.

5. A flexible printed circuit connector comprising:

first and second multiple contact terminals;

an electrically insulative connector housing in which the first and second contact terminals are installed at a predetermined spacing and which has a

receiving cavity in which an FPC is received; and

an open/closable cover member that is pivotally supported to inside the receiving cavity by a rotation axle and covers the receiving cavity;

the multiple first contact terminals being arrayed in a widthwise row, at a predetermined spacing, in the front part of the receiving cavity of the connector housing;

the multiple second contact terminals being arrayed in a widthwise row, at a particular spacing, in the rear part of the receiving cavity of the connector housing;

an insertion aperture through which the FPC is inserted being formed at the rotation axle of the cover member;

and the rotation axle being pivotally supported between the contacting portions of the first and second contact terminals inside the receiving cavity.

6. The flexible printed circuit connector according to claim 5, wherein the rotation axle has an actuation piece, onto which the tip portions of the second contact terminals are placed, at the FPC end portion exit side of the insertion aperture of the rotation axle.

7. The flexible printed circuit connector according to claim 5, wherein the cover member has an electrically insulative cover frame including the rotation axle, and a shield plate removably installed to the cover frame.

8. The flexible printed circuit connector according to claim 5, wherein the periphery of the connector housing, where the cover member is installed, is covered by a shielding member.

9. The flexible printed circuit connector according to claim 8, wherein the shielding member is constituted of metal sheet material having resilient pieces in certain parts thereof, and such resilient pieces have bias force in the direction in which the cover member closes over the receiving cavity.

10. The flexible printed circuit connector according to claim 5, wherein the first and second multiple contact terminals are each disposed with equal spacings in the connector housing, and the second contact terminals are disposed on the

extension of the center lines of the each gaps between the first contact terminals.