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(54) Electric connector equipped with a cam mechanism

(57) Disclosed is an electrical connector equipped with a cam mechanism (3) to permit the mating of the connector plug (1) with the connector receptacle (2) with a reduced force. The cam mechanism (3) is capable of converting displacement of a slidable cover (26) of the connector receptacle to the mating of the plug terminals (12) of the connector plug (1) with the receptacle terminals (2) of the receptacle connector (2). The cam mechanism (3) is composed of at least one guide pin (5) and a guide slot (6). The guide pin is located on the connector plug whereas the slot is located in the slidable cover of the connector receptacle. The guide slot is shaped such that the movement of the cover on the receptacle connector causes the continuing of insertion of the mating section of the connector receptacle in the mating space (13) of the connector plug until the complete mating of plug and receptacle terminals has been achieved.

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Description

Background of the Invention:

The present invention relates to an electric connector for use in making an electric connection between different electric devices, and particularly to an electric connector which is equipped with a cam mechanism to permit the mating of the connector plug with the connector receptacle with a reduce force.

As is well known, a variety of electric connectors each including a plug and a receptacle are used in making connections between electrical device. Such connectors are designed to have shapes and mating mechanisms appropriate for particular purposes and places in which they are intended to be used.

It is desirable that such connectors include more and more terminals. Consequently such connectors require if greater force to mate the numerous plug and receptacle terminals. To reduce the mating forces it has been proposed that connectors be equipped with cam mechanisms, as for example in Japanese Utility Model Application Laid-Open No. 6-2577. Specifically one part of the electric connector, that is, the connector plug or connector receptacle has a projection formed thereon whereas the other counter part has a slot made therein for guiding the projection of the one part. When the connector plug is being mated with the connector receptacle, the projection follows the slot in such a way that the connector plug may be mated with the connector receptacle with a reduced mating force.

The cam mechanism has, in fact, the effect of reducing the mating force to be applied to the connector. A draw back however, is that the parts needed to assemble a connector increase in number also the labor an time involved for assembling increases thereby increasing the overall cost of the connector.

Summary of the Invention

One object of the present invention is to provide an electrical connector including a plug and a receptacle which is equipped with a cam mechanism to permit the mating of the connector plug with the connector receptacle with a reduced force and allowing the connector to be reduced in size and cost.

The achieve this object, an electrical connector equipped with a cam mechanism allowing the mating of the connector plug with the connector receptacle with a reduced force is improved according to the present invention in that the connector plug has a housing with a space defined therein to accommodate the mating connector receptacle. The connector receptacle has a housing and a protective cover slidably attached to the housing. The cover is movable on the housing in a lateral direction perpendicular to the mating direction and the cam mechanism is capable of converting lateral displacement of the cover to the movement of the connector plug and the connector receptacle along the mating axis of the connector. The cam mechanism includes at least one guide pin and a guide slot for guiding the guide pin. The guide pin is located on the connector plug and the guided slot is formed in the slidable cover of the connector receptacle.

The guide slot may be so formed that the cam ratio may vary to permit the mating of said connector plug and connector receptacle without changing of the force applied to the protection cover even though the force required for mating the male terminals of the connector plug with the female terminals of the connector receptacle varies from the beginning of the mating process until the end.

As may be understood from the above, one portion of the cam mechanism is integrally formed with the protection cover, thus requiring no extra parts for the cam mechanism.

Brief Description of the Drawings

Other objects and advantages of the present invention will be understood from the following description of an electrical connector according to one preferred embodiment of the present invention, which is shown in accompanying drawings.

FIGURE 1 is a plan view of an electrical connector equipped with a cam mechanism according to the present invention;
FIGURE 2 is a sectional view of the connector taken along the line X-X' of Fig. 1;
FIGURE 3 is a plan view of the plug of the connector;
FIGURE 4 is a front view of the plug of the connector;
FIGURE 5 is a side view of the plug as viewed in the direction indicated by arrow P of Figure 4;
FIGURE 6 is a plan view of the receptacle of the connector;
FIGURE 7 is a front view of the receptacle of the connector;
FIGURE 8 is a side view of the receptacle as viewed from the left of Figure 7;
FIGURE 9 is a plan view of the connector prior to the mating of the plug with the receptacle;
FIGURE 10 is a sectional view of the connector taken along the line Y-Y' of Fig. 9;
FIGURE 11 is a plan view of the connector at the beginning of the plug-and-receptacle mating;
FIGURE 12 is a plan view of the connector at the step subsequent to the mating, partly in section;
FIGURE 13 is a plan view of the connector prior to the final mating position, partly in section;
FIGURE 14 is a plan view of the connector in the final mating position, partly in section;
FIGURE 15 is a plan view of the connector in the final mating position;

FIGURE 16 is a sectional view of the connector taken along the line Z-Z' of Fig. 15;

FIGURE 17 is another plan view of the receptacle of the connector as viewed form the opposite or rear side of Fig. 6;

FIGURE 18 is another side view of the receptacle as viewed from the top side of Fig. 6; and

FIGURE 19 is still another side view of the receptacle as viewed from the right side of Fig. 7.

Description of Preferred Embodiments

As seen from Figs. 1 and 2, an electrical connector according to the present invention comprises a plug 1 and a receptacle 2. The connector plug 1 is mounted on a printed circuit board (not shown), which is a part of an electrical machine or apparatus (not shown), whereas the connector receptacle 2 is connected to a plurality of wires 24 extending from another electrical machine or apparatus (not shown). These electrical machines can be electrically connected to each other by the mating of the connector plug 1 and the connector receptacle 2.

The connector is equipped with a cam mechanism 3 allowing the mating of the connector plug 1 with the connector receptacle 2 to take place with a reduced force.

The cam mechanism 3 is capable of converting lateral displacement of a selected part (later described) of the connector to the mating of the connector plug 1 with connector receptacle 2 while applying to the connector plug 1 the mating force caused by the lateral displacement of the selected part. The cam mechanism 3 is composed of guide pins 5 and guide slots 6 for guiding the guide pins 5.

Referring to Figs. 3, 4 and 5, the connector plug 1 has a housing 11 and a plurality of plug terminals 12 mounted therein. the plug housing 11 has a receptacle enclosing space 13 defined therein to accommodate the connector receptacle 2 upon mating. More specifically, the plug terminals 12 are arranged in the receptacle enclosing space 13, and the guide pins 5 are formed on the floor and ceiling of the receptacle enclosure of the plug housing 11, as best seen from Fig. 4. The tail portions 14 of the plug terminals 12 appear on the rear side of the plug housing 11, as best seen from Fig. 5. The tail portions 14 can be soldered to selected conductors of a printed circuit board to which the connector plug is to be attached.

Referring to Figs. 6, 7, 8 17, 18 and 19, the connector receptacle 2 has a housing 21 and a plurality of female terminals 22 mounted therein. The receptacle housing 21 has a mating section 23 which enters the receptacle enclosing space 13 of the plug housing 11 upon mating. A protective cover 26 is slidably attached to the major opposite surfaces of the receptacle housing 21 to cover the emerging lengths of conductors 24 extending from the female terminals 22 to an electrical machine or apparatus which is to be connected to the printed circuit via the electric connector. The slidable, protective cover 26 has cam slots 6 located therein, particularly in the slidable section 27 lying over the mating section 23 of the receptacle housing 21.

Each cam slot 6 has a shape such that its cam ratio may differ from the pre-mating position to the post-mating position between the male and female terminals 12 and 22 of the connector plug and connector receptacle. More specifically the slot inclination relative to the longitudinal direction F in which the mating section 23 of the connector receptacle 2 enters the receptacle enclosing space 13 of the plug housing 11 may be at a relatively small angle prior to mating, and may be at a relatively large angle on the way to the final mating position, thereby assuring that little or no adverse effect is caused on the cam operation by the difference of the terminal mating force at the outset and sequential moment. The cam slot 6 ends with the laterally positioned end 7, which extends somewhat in the lateral direction M perpendicular to the connector-mating direction F, thereby putting the male and female terminals in a stable mating condition.

The slidable protection cover 26 has lock pieces 8a and 8b for locating the protection cover 26 in the correct positions at the start and at the finish of the plug and receptacle mating, respectively. Each lock piece has a catch projection 9a and 9b formed on its free end. At the start, the lock piece 8a of the slidable protection cover 26 is engaged by the lock slot 25 of the receptacle housing 21, as shown in Fig. 10. At a moment subsequent to the start the lock piece 8a is released from the lock slot 25. At the finish the lock piece 8b of the slidable protection cover 26 is engaged by the counter piece 15 of the plug housing 11, thereby holding the connector plug and receptacle in a mated condition.

The receptacle housing 21 has a catch projection 28 to catch a wire-binding strap 29. The strap 29 is used to wind and bind conductors 24 emerging from the connector receptacle 2 into a bundle, thereby placing the bundle of conductors apart from the area in which the slidable protection cover 26 moves to prevent any jamming with the bundle of connectors, which otherwise, would be caused by interference with the moving cover 26.

The slidable protection cover 26 may be designed to be movable in either direction, and in this particular embodiment it can move in the left lateral direction as indicated by arrow M. The direction in which the slidable protection cover 26 can be moved may be determined which way the connector is formed or in which direction the bundle of conductors 24 extend. Also, the catch projection 28 may be formed accordingly on either side of the housing 21.

The manner in which the electrical connector according to the present invention is used in described below.

As seen from Fig. 9 the connector receptacle 2 and the connector plug 1 are put in an opposite relationship, and then, the connector receptacle 2 is moved in the

longitudinal direction F until the mating section 23 of the receptacle housing 21 is received in the receptacle enclosing space 13 of the plug housing 11, as shown in Fig. 11. In this position, the guide pins 5 of the plug housing 11 enter the guide slots 6 of the protection cover 26 of the connector receptacle 2.

To ensure this preliminary engagement, the catch projection 9a of the lock arm 8a formed on the protection cover 26 is engaged by the lock slot 25 of the receptacle housing 21 (Fig. 10), thereby placing the protection cover 26 and the guide slots 6 in correct positions.

Thereafter, the protection cover 26 is moved in the lateral sliding direction M perpendicular to the longitudinal mating direction F, thereby causing the displacement of the connector receptacle 2 in the mating direction F by allowing the guide pins 5 to follow the guide slots 6 thereby permitting the continuing insertion of the mating section 23 of the receptacle housing 21 into the receptacle receiving space 13 of the plug housing 11. The catch projection 9a of the lock piece 8a is automatically released from the slot 25 of the receptacle housing 21. The protection cover 26 is moved further in the lateral direction M until the connector plug and connector receptacle 1 and 2 have been completely mated.

The mating operation is composed of three sequential steps: at the first step the mating section 23 of the receptacle housing 21 is fitted in the receptacle receiving space 13 of the plug housing 11, but the mating of the plug and receptacle terminals 12 and 22 is not started (Fig. 12); at the second step the mating of the plug and receptacle terminals 12 and 22 is started (Fig. 13); and finally at the third step the mating of the plug and receptacle terminals 12 and 22 is completed (Fig. 14).

Each mating step has a different cam ratio to control the varying terminal mating force so as to cause no effect on the operating force which is applied to the cam mechanism before and after the starting of the mating of the plug and receptacle terminals 12 and 22. Thus, the slidable protection cover 26 can be moved by applying a given constant force thereto all the way to the final position in the lateral sliding direction M. With this arrangement the connector plug and receptacle 1 and 2 can be mated by applying a constant force of reduced strength to the protection cover 26 of the connector receptacle 2.

The positive, reliable mating is assured by permitting the catch projection 9b to be engaged by the counter piece 15 of the plug housing 11, as shown in Figs. 15 and 16. The catch projection 9b can be released from the counter piece 15 of the plug housing 1 simply by pushing the lock arm 8b. The decoupling of the connector plug and receptacle can be performed by the reversal of the proceedings described above.

As may be understood from the above, the guide slots 6 of the cam mechanism 3 are formed in the slidable protection cover 26, thus requiring no extra separate parts to make up the cam mechanism. This has the effect of reducing the number of the assembled parts of connector plug and receptacle, and accordingly reducing the connector size and the manufacturing cost.

In the connector described above the connector plug housing 11 has guide pins 5 located in its receptacle receiving space 13, and the connector receptacle has guide slots 6 in its protection cover 26. Conversely, the connector plug housing 11 may have guide slots 6, and the connector receptacle may have guide pins 5 in its protection cover 26.

Claims

1. An electrical connector which includes a connector plug (1) and connector receptacle (2) each having a housing (11,21) mounting a plurality of terminals mateable with the terminals of the other connector, and

   a camming system (3) for moving the housings (11,21) towards and away from each other along a mating axis (F) to mate and unmate the connector,
   a protective cover (26) mounted on the receptacle connector housing (21) and slidably movable along a path transverse to the mating axis (F),
   the protective cover (26) including at least one cam track (6) extending oblique to the mating axis, the receptacle connector housing having at least one cam follower (5) projecting into the cam track (6) for mating the housings (11,21) in response to sliding movement of the protective cover.

2. An electrical connector according to claim 1 wherein said cam track is formed such that the cam ratio may vary to permit the mating of said connector plug (1) and connector receptacle (2) without changing the operating force to be applied to said protective cover (26) even though the force required for mating the male terminals (12) of said connector plug (1) with the female terminals (22) of said connector receptacle (2) varies during the mating process.

3. An electrical connector according to claim 1, wherein the connector plug housing (11) has an opening (13) for receiving said connector receptacle (2) and wherein said cam follower (5) extends into said receiving opening.

FIG. 1

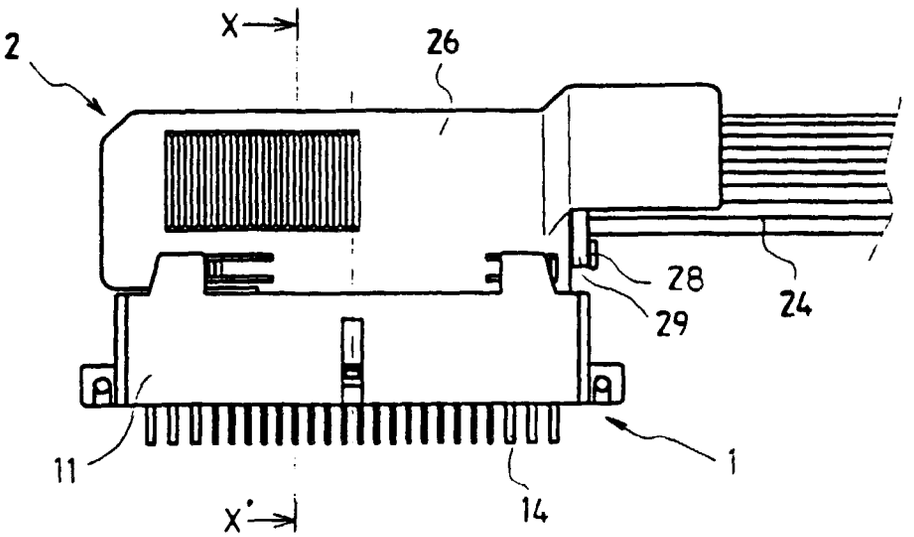

FIG. 2

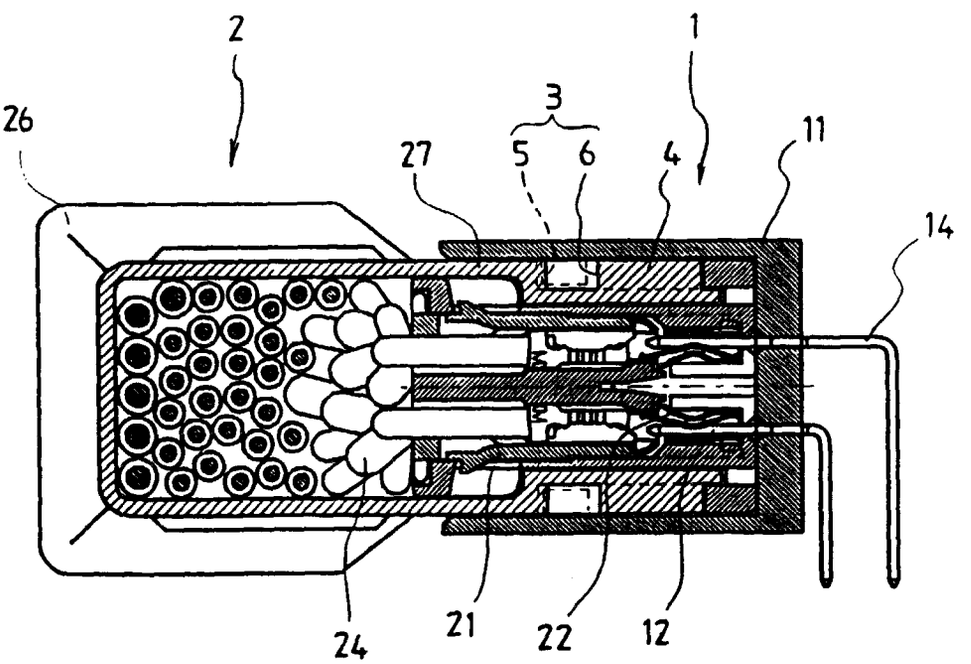

FIG. 3

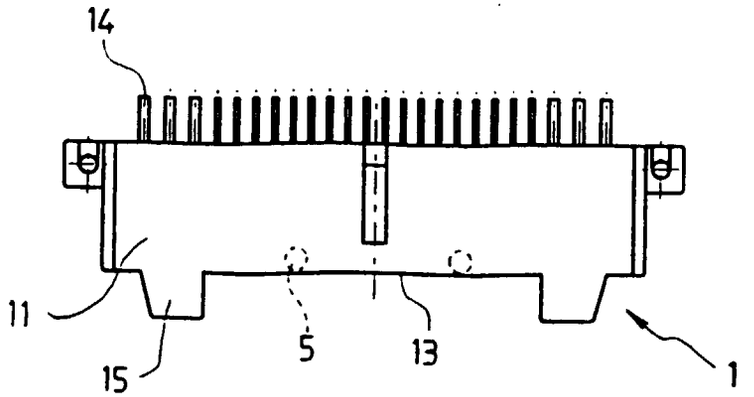

FIG. 4

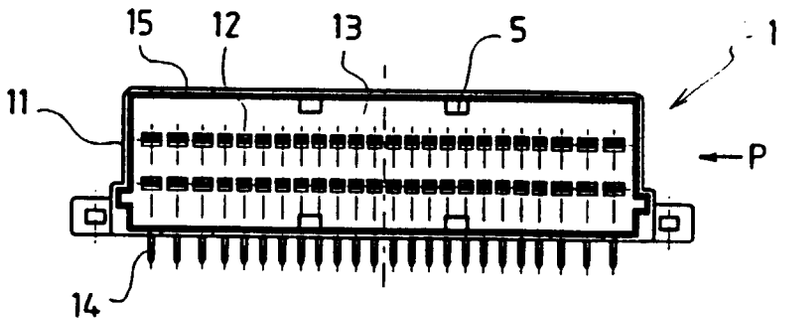

FIG. 5

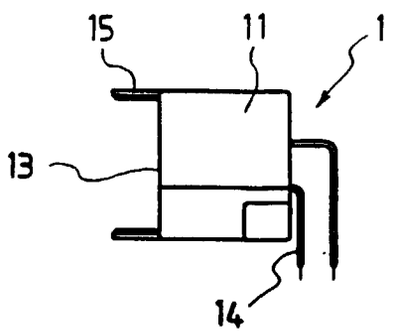

FIG. 6

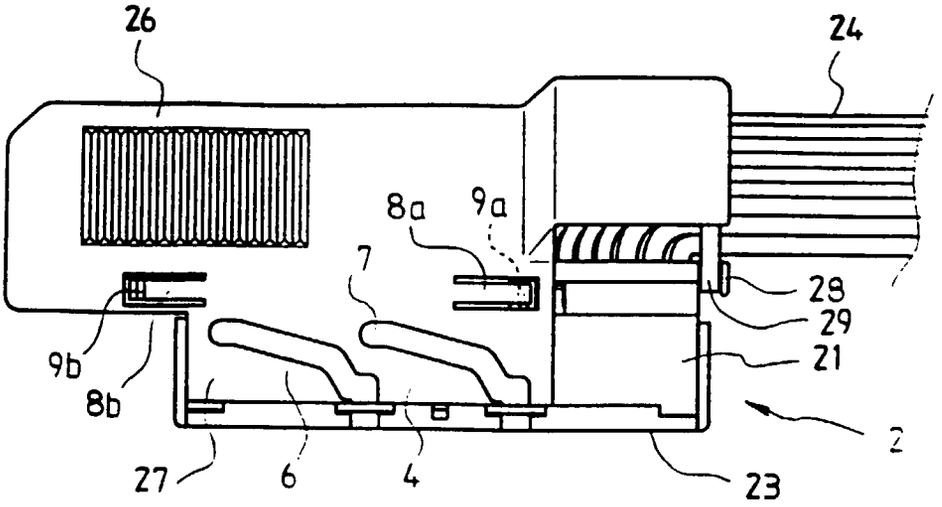

FIG. 7

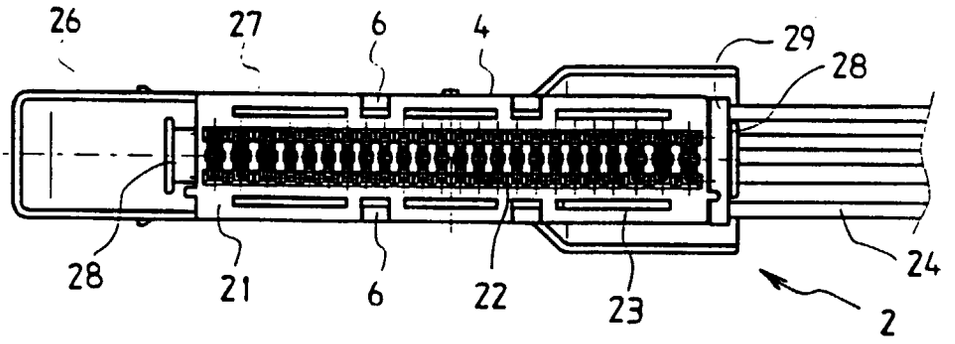

FIG. 8

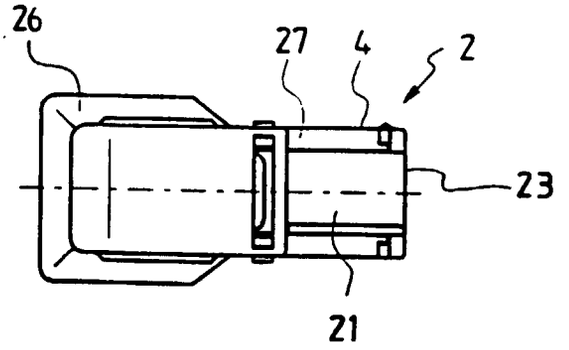

FIG. 9

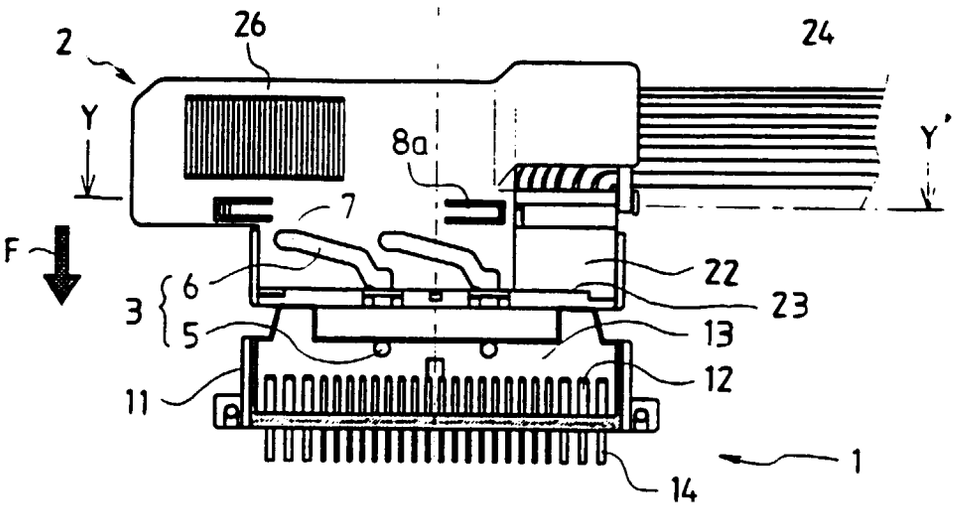

FIG. 10

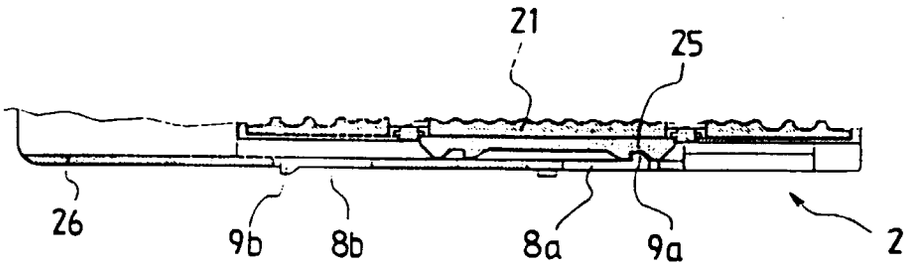

FIG. 11

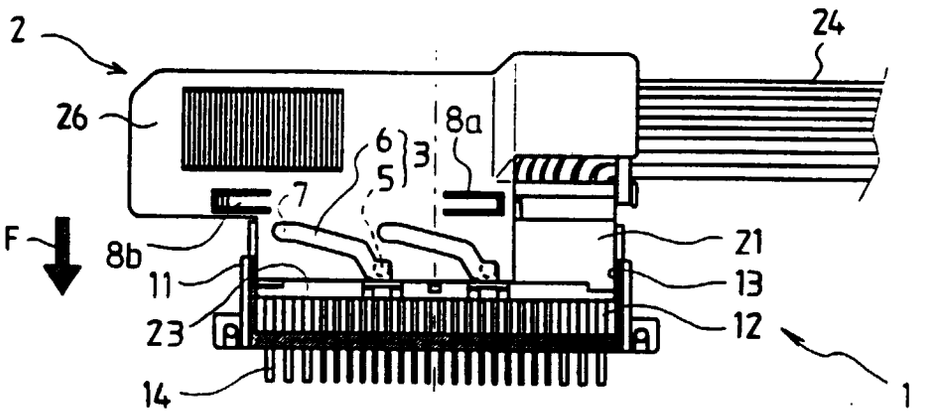

FIG. 12

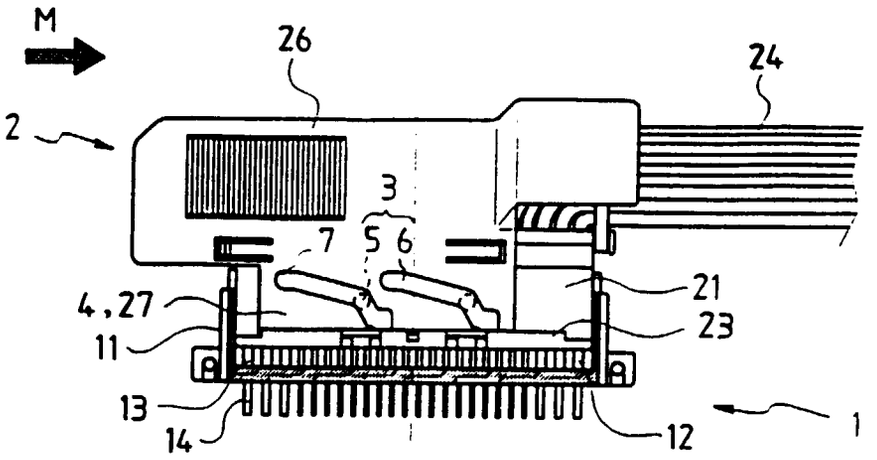

FIG. 13

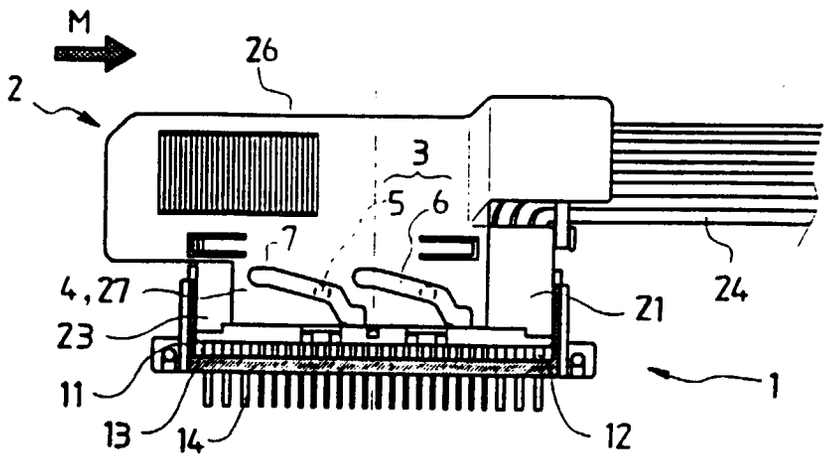

FIG. 14

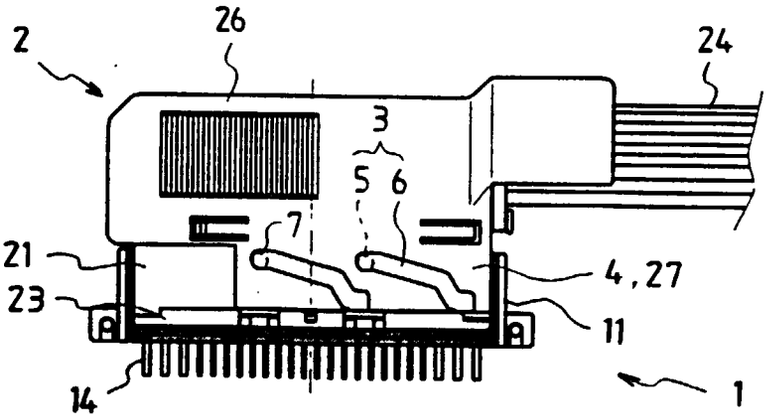

FIG. 15

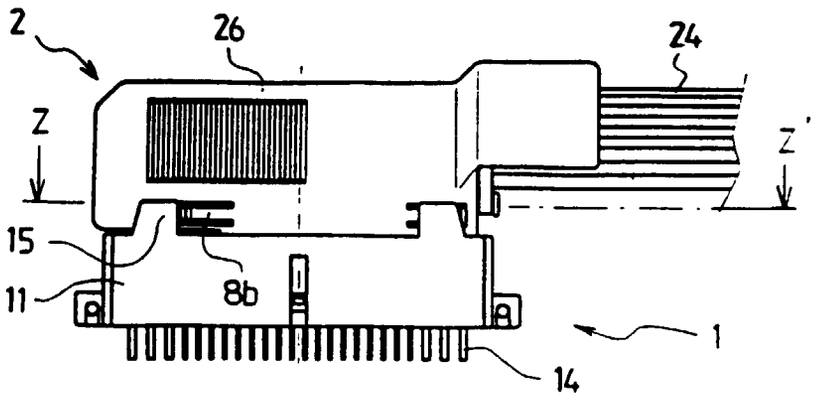

FIG. 16

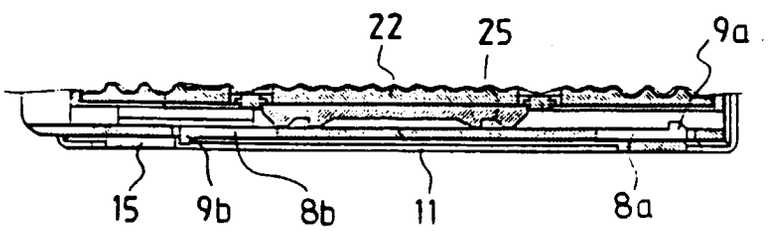

FIG. 17

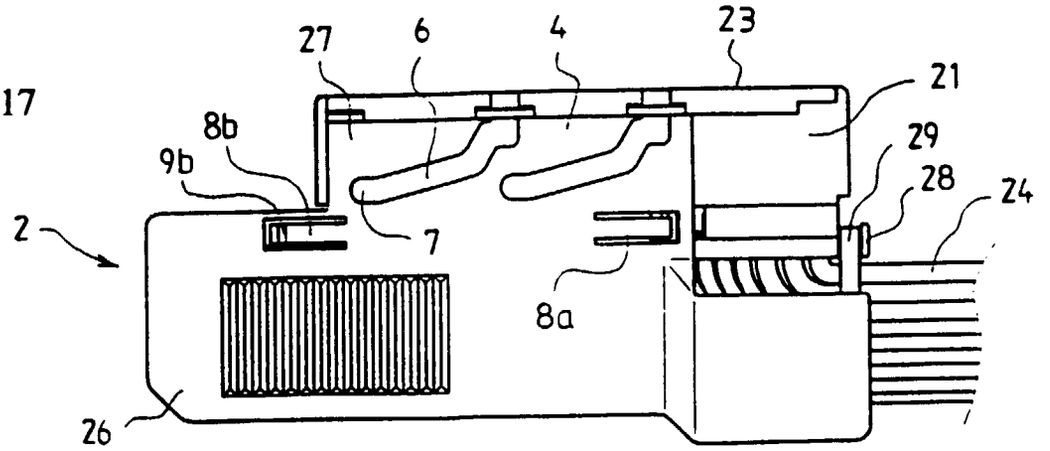

FIG. 18

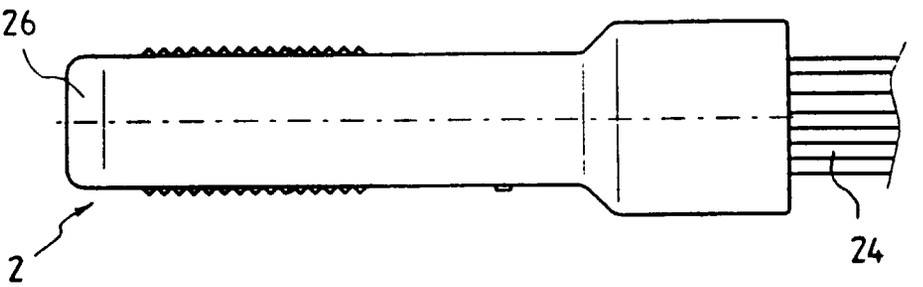

FIG. 19