

[54] **PRINTED CIRCUIT CONNECTOR AND KEYING STRUCTURE**

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[58] Field of Search..... **317/101 DH, ; 339/176 MP,
339/184 R, 184 M, 17 LC**

[56] **References Cited**

UNITED STATES PATENTS

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FOREIGN PATENTS OR APPLICATIONS

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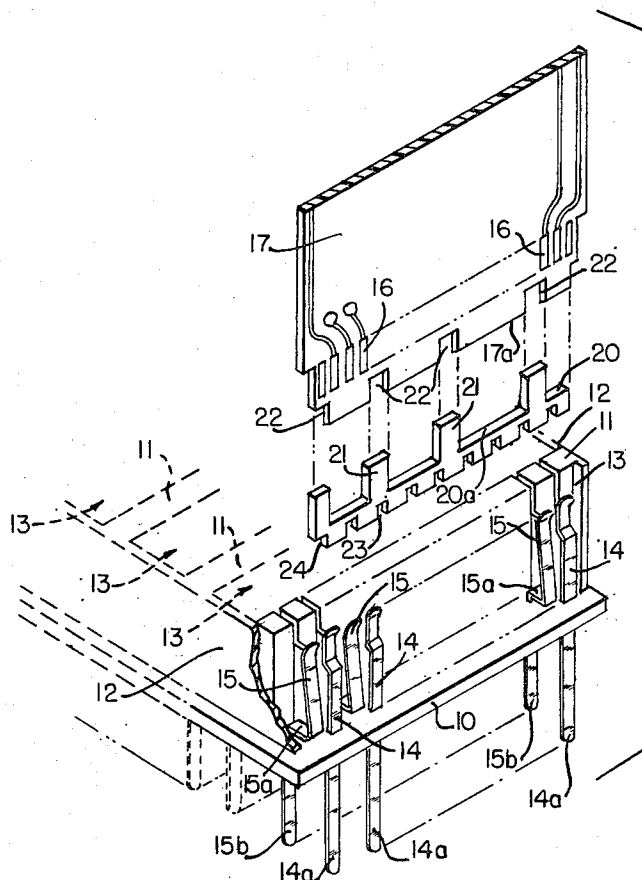
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[57] **ABSTRACT**

A printed circuit connector is provided comprising a plurality of open-topped channels having an array of spring fingers therein adjacent one side of each channel. Some of the spring fingers include integral portions extending transversely across the bottom of the channel toward the other side of the channel. An elongated keying structure is removably locked within the channel, adjacent the spring fingers, to assure that only a preselected circuit board may be inserted into the channel sufficiently far to make electrical contact with the spring fingers. The lower edge of the keying structure is notched to straddle the transverse spring finger portions, and to engage the bottom of the channel between said transverse portions, thereby to transfer forces imposed upon the keying structure, open insertion of a printed circuit board, away from said transverse portions and directly to the bottom of the channel.

8 Claims, 3 Drawing Figures



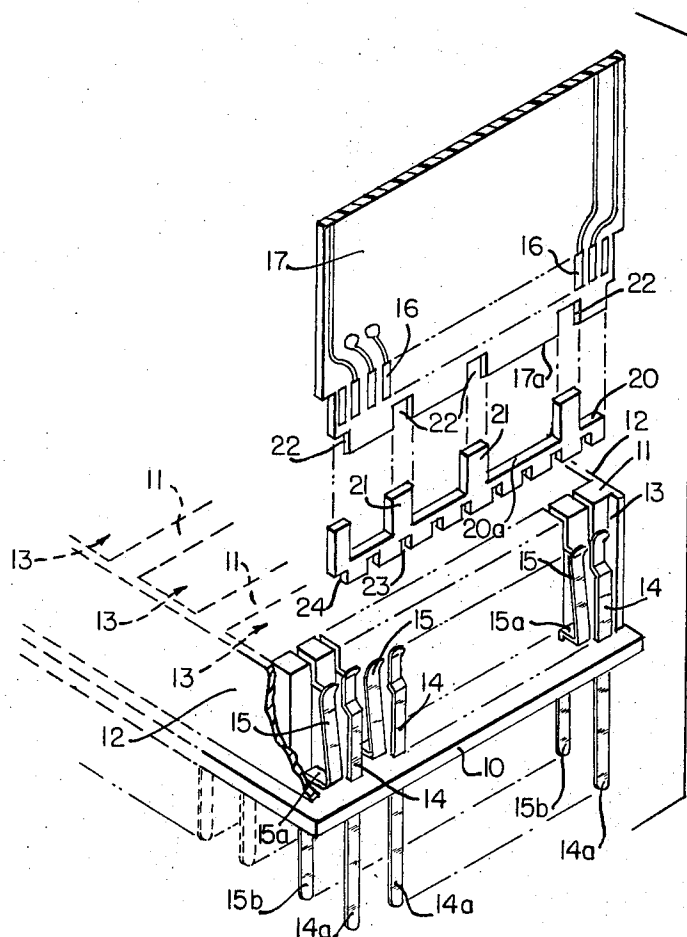


FIG. 1.

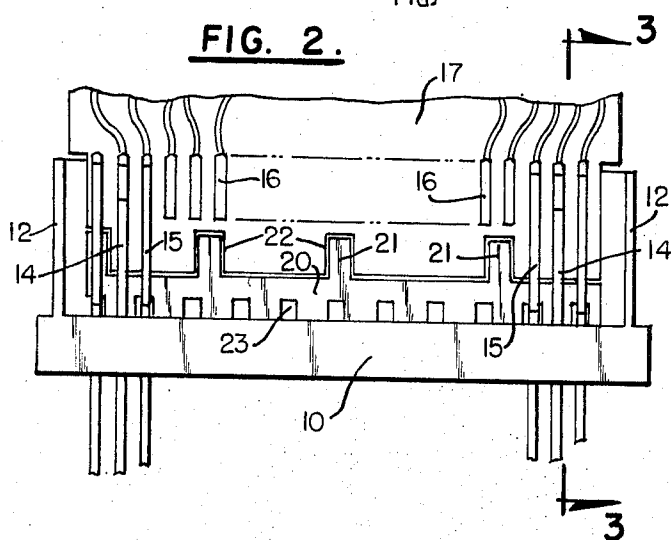


FIG. 2.

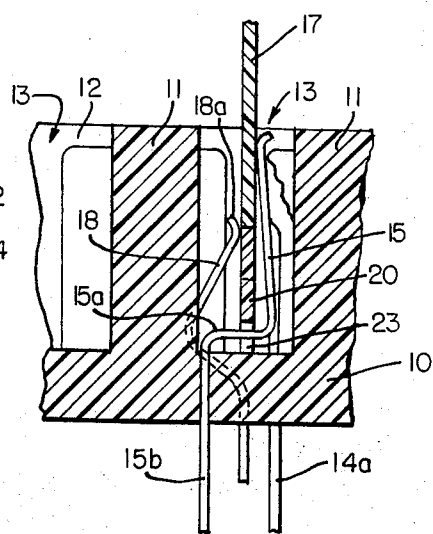


FIG. 3.

PRINTED CIRCUIT CONNECTOR AND KEYING STRUCTURE

BACKGROUND OF THE INVENTION

Printed circuit connectors of certain known types comprise a body structure defining a plurality of open topped channels each of which is provided, adjacent one side thereof, with a linear array of spring fingers adapted to electrically contact conductors on a printed circuit board when said printed circuit board is inserted into said channel. The spring fingers are in turn associated with terminal structures for energizing the board circuit and for transferring signals to and from the board circuit via said spring fingers. The terminals associated with each connector channel are intended to cooperate with a preselected circuit; and if the wrong circuit board should be inserted into a given connector channel, an improper circuit configuration will be produced which can cause a dangerous malfunction to occur and/or which can render the entire circuit inoperative.

In order to obviate the possibility of inserting a circuit board into an improper connector channel, the channel should be polarized or keyed for cooperation with a complementary structure on a particular circuit board. Various keying structures capable of achieving this result have been suggested heretofore, e.g., see Richardson U.S. Pat. No. 2,765,450, Johnson U.S. Pat. No. 3,008,113, Curtis et al. U.S. Pat. No. 3,112,974, Fergusson U.S. Pat. No. 3,492,538, Bushey et al. U.S. Pat. No. 3,518,620, Silverstein U.S. Pat. No. 3,614,714 and Zell U.S. Pat. No. 3,634,816. In some cases, these prior art keying structures have been fabricated as integral portions of the connector; but this approach has had the disadvantage of increasing the cost of the connector, and limiting its versatility. In other cases, therefore, the approach has been to add a separate key structure to a standard form connector. However, the type of add-on keys which have been suggested heretofore have generally been clearly visible in and readily removable from the connector channel and, in some cases could fall out of the channel inadvertently. The prior art types of add-on key structures accordingly suffer the major disadvantage that the polarizing feature afforded thereby can be easily nullified, and may even be lost inadvertently.

The present invention is intended to provide an improved add-on key structure which will obviate the foregoing disadvantages. As will appear hereinafter, the key structure of the present invention, when inserted in place, is substantially invisible to the eye thereby minimizing any temptation to remove it, is secured in position against inadvertent removal, and cannot even be intentionally removed without the use of a special tool.

The problem of providing an add-on key structure is aggravated when the connector employed takes the known form wherein an array of spring fingers is disposed adjacent one side only of a channel adapted to receive a printed circuit board, and wherein at least some of the spring fingers are bent at their lower ends to provide integral portions which extend transversely across the bottom of the channel to the other side of the channel for connection with terminals disposed adjacent said other side of the channel. Any keying structure which is employed has significant forces imposed

thereon whenever a proper circuit board is inserted into the channel, or whenever an effort is made to insert an improper circuit board into the channel; and since these forces are directed toward the bottom of the channel, i.e., toward the aforementioned transverse portions of the spring fingers which overlie the bottom of the channel, the use of a keying structure in a connector of the type specified may operate to impose forces on said transverse portions of the spring fingers with resultant permanent deformation of said transverse portions and consequent loss of contact force between the associated spring fingers and the printed circuit board. The present invention, recognizing this further difficulty, provides a keying structure which prevents such force transfer and loss of contact pressure.

SUMMARY OF THE INVENTION

The present invention provides, in combination, a printed circuit connector of particular type associated with an add-on keying structure of novel configuration and disposition. The printed circuit connector comprises a body structure defining a plurality of open-topped channels each of which has an array of spring fingers therein adjacent one side only of the channel for making electrical contact with conductors on the edge of a printed circuit board when the board is inserted into the open top of said channel. Some of the spring fingers extend linearly through the bottom of the connector structure to provide a row of terminals which is positioned below said one side of the channel. Others of the spring finger are bent, near the bottom of the channel, to provide transverse portions which extend across the bottom of the channel and which are then bent further to extend through the bottom of the connector structure to provide a further row of terminals below the other side of the channel. The printed circuit connector also includes an array of back springs which are positioned across the other side of the channel, and which cooperate with the aforementioned spring fingers to resiliently grasp a printed circuit inserted into the channel to insure that the spring fingers are in firm contact with conductors on the edge of the printed circuit board.

A keying structure is removably inserted into the channel at a position between the aforementioned transverse portions of some of the spring fingers, and the free ends of the back spring members. The keying structure, so located, is firmly retained in place by the coaction of the spring fingers and back spring members and, when so inserted, is substantially invisible to the eye.

The keying structure comprises an elongated member of insulating material, preferably of thin substantially rectangular configuration, having one or more upstanding projections or tabs on its upper edge each of which is sized and located to cooperate with a complementary recess on the lower edge of a preselected printed circuit board. When said preselected printed circuit board is inserted into the channel, the upstanding projections on the keying structure mate with the complementary recesses on the printed circuit board edge, to permit the printed circuit board to be inserted sufficiently far into the channel to achieve electrical contact between the free ends of the spring fingers and the conductors on the printed circuit board. If an effort is made to insert an improper board into the channel,

the entering edge of the board is stopped at a location corresponding to the uppermost edges of the upstanding key projections, thereby to prevent the spring fingers from contacting the conductors on the printed circuit board.

Inasmuch as insertion of a proper printed circuit board, or an attempt to insert an improper board, imposes forces on the upper edge of the key member which are transmitted toward the bottom of the channel and toward the transverse spring finger portions discussed earlier, the lower edge of the keying structure is notched to straddle said transverse spring finger portions, and to bear upon the bottom of the channel at positions between said transverse portions. As a result, any forces imposed upon the keying structure are transferred directly to the bottom of the channel, and bypass the transverse portions of the aforementioned spring fingers, thereby to prevent deformation of said transverse portions and resultant loss of spring pressure contact.

BRIEF DESCRIPTION OF THE DRAWINGS

The foregoing objects, advantages, construction and operation of the present invention will become more readily apparent from the following description and accompanying drawings wherein:

FIG. 1 is an exploded diagrammatic view of a printed circuit connector, keying structure, and associated printed circuit board constructed in accordance with the present invention;

FIG. 2 is a cross-sectional view showing the parts of FIG. 1 in assembled configuration; and

FIG. 3 is a side view taken on line 3—3 of FIG. 2.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring to the several figures, like numerals of which refer to like parts throughout, it will be seen that the printed circuit connector employed in the present invention comprises a body structure which includes a bottom wall member 10 and a plurality of divider walls 11 upstanding from one side of the bottom wall member in parallel relation to one another. The facing surfaces of adjacent divider walls 11 cooperate with the intervening upper surface of bottom wall member 10, and with the interior intervening surfaces of connector side wall members 12 to provide a plurality of open topped channels 13 (the forwardmost one of which has been broken away in FIG. 1) each of which is adapted to receive the entry edge of a printed circuit board. The general type of printed circuit connector shown in the drawing is, in itself, commercially available from GTE Sylvania Inc.; certain details of the divider walls 11 have not been shown in the drawings since they are not necessary to an understanding of the present invention.

Each channel 13 includes an array of elongated resilient spring fingers disposed in side-by-side relation to one another adjacent one side of the channel. The array includes a first plurality of fingers 14 which extend substantially linearly through the bottom wall member 10 to provide a first row of terminals 14a, integral with each of said spring fingers 14 respectively, disposed along a line adjacent the juncture between the wall 11 which forms one side of the channel 13 and said bottom wall member 10, i.e., the row of terminals 14a protrude outwardly of the bottom wall member 10

along a line adjacent one side of the associated channel 13. A further plurality of spring fingers 15 are disposed in intervening relation to the several spring fingers 14; and each spring finger 15 is bent at its lower end, adjacent the upper surface of bottom wall member 10, to provide an integral portion 15a which extends transversely across the bottom of the channel in spaced relation thereto toward the other side of the channel, and which is then bent downwardly and extends through bottom wall member 10, thereby to provide a further row of terminals 15b protruding outwardly from the connector adjacent the other side of said channel.

The uppermost free ends of the spring fingers 14 and 15 are disposed in aligned relation to one another adjacent the open top of each channel, for engagement with conductors 16 on a printed circuit board 17 inserted into the associated channel 13, to achieve electrical continuity between the several conductors 16 and the two rows of terminals 14a, 15b. In order to hold the printed circuit board 17 in place, and to assure that the free ends of the spring fingers are in firm engagement with conductors 16, the connector is provided with a plurality of back springs 18 (see FIG. 3) disposed on the side of the channel opposite to the array of spring fingers. The several back springs 18 are bent toward the spring fingers 14, 15 and terminate in free ends 18a which are disposed adjacent said spring fingers at a position below the free ends of said spring fingers.

A keying structure 20 is inserted into each channel to polarize the channel for reception of only a preselected circuit board 17. Keying structure 20 comprises an elongated member fabricated of a plastic or other insulating material, which is adapted to be inserted into its associated channel 13 in a region between spring fingers 14, 15 and back spring members 18 (see FIG. 3). When so inserted, the keying structure 20 is substantially invisible to the eye, and substantially impossible to remove without a special tool, since the top edge of the keying structure is partially overlapped by the free ends of spring fingers 14, 15 and of back springs 18, i.e., said cooperating spring fingers and back springs conceal and retain keying structure 20 in place. The concealment and retention is completed by the fact that the ends of each channel 13 are closed by the connector side walls 12.

Elongated keying structure 20 is of thin, substantially rectangular configuration, and is adapted to be inserted into channel 13 with the opposing faces of the keying structure 20 being in substantially parallel planar relation to the facing surfaces of the cooperating pair of divider walls 11 which form said channel. The upper comparatively narrow edge of keying structure 20 is provided with one or more upstanding, rectangular projections or tabs 21 disposed at an end of and/or at one or more intermediate positions along said upper edge. The number of projections 21 which are provided, and their locations along the upper edge of keying structure 20, are preselected to conform to a complementary arrangement of recesses 22 provided on the entry edge 17a of printed circuit board 17. The height of the several upstanding projections 21, and the corresponding depth of mating recesses 22, are so chosen that when the edge 17a of printed circuit board 17 is inserted into channel 13 sufficiently far to cause the board edge portions between slots 22 to seat on the portions of the keying structure 20 between tabs 21, the conductors 16 of said printed circuit board will

then be in position for engagement by the free ends of spring fingers 14, 15. On the other hand, if an effort should be made to insert a printed circuit board which does not have a pattern of recesses 22 which corresponds to the pattern of projections 21, the free edge 17a of the board will be incapable of insertion into the channel beyond the uppermost edges of projections 21, and contact between spring fingers 14, 15 and conductors 16 will accordingly be prevented.

In order to prevent distortion of transverse spring finger portions 15a, and resultant loss of contact pressure at the free ends of spring fingers 15, due to the forces exerted on the keying structure when a printed circuit board is inserted or attempted for insertion into a channel 13, the lower edge of keying structure 20 is provided with a plurality of notches 23 which are spaced from one another in accordance with the spacing between the several transverse portions 15a of spring fingers 15. The width of each notch 23 is slightly in excess of the width of a transverse portion 15a, and the depth of each notch 23 is slightly in excess of the spacing between the upper surface of a transverse portion 15a and the upper surface of bottom wall member 10. As a result, the several notches 23 cause the lower edge of keying member 20 to straddle each of the transverse spring finger portions 15a, and to engage the bottom of the channel at locations between said transverse portions 15a, thereby to transfer forces imposed on the keying structure directly to the bottom of the channel and away from the transverse portions 15a. A similar result could be achieved, of course, by employing a notch configuration wherein relatively wider notches are provided, which are adapted to straddle two or more adjacent transverse spring finger portions 15a, and which accordingly cause the keying structure 20 to engage the bottom of the channel at a number of relatively widely spaced locations rather than at points adjacent every transverse portion 15a.

One end of the keying structure 20 is provided with a corner notch 24 which is adapted to overlies the transverse portion 15a of the spring finger 15 which is disposed at one end of channel 13. Corner notch 24 accordingly acts as a locating element which assures that the keying structure is properly positioned within its associated channel. Other types of locating elements could, however, be used.

While we have thus described preferred embodiments of the present invention, many variations will be suggested to those skilled in the art. It must therefore be understood that the foregoing description is intended to be illustrative only and not limitative of the present invention, and all such variations and modifications as are in accord with the principles described are meant to fall within the scope of the appended claims.

Having thus described our invention, we claim:

1. In combination, a printed circuit connector of the type comprising a plurality of open-topped channels each of which has spring fingers therein adjacent one side of the channel adapted to make electrical contact with conductors on a printed circuit board inserted into the open top of said channel, at least some of said spring fingers including an integral transverse portion extending across the bottom of said channel in spaced relation thereto and toward the other side of said channel, and an elongated keying structure disposed within said channel above the said transverse portions of said

spring fingers for assuring that only a preselected circuit board may be inserted into said channel sufficiently far to make said electrical contact, the upper edge of said keying structure which faces the open top of said channel having a predetermined shape adapted to mate with a complementary shape on the inserted edge of the preselected circuit board, and the lower edge of said keying structure which faces the bottom of said channel being notched to straddle said transverse portions of said spring fingers and to engage the bottom of said channel at positions adjacent at least some of said transverse portions, thereby to transfer forces, imposed upon said keying structure by insertion of a printed circuit board into said channel, away from said transverse portions and directly to the bottom of said channel.

2. The combination of claim 1 wherein said keying structure is removable from said channel, and spring means extending from the other side of said channel to a position adjacent the upper edge of said keying structure for retaining said keying structure within said channel.

3. The combination of claim 1 wherein said keying structure includes a locating element at one end thereof for positioning said keying structure at a predetermined location within said channel.

4. The combination of claim 1 wherein said integral transverse portions are regularly spaced from one another across the bottom of said channel, the lower edge of said keying member including regularly spaced rectangular notches positioned and dimensioned to straddle each of said transverse portions respectively.

5. In combination, a printed circuit connector comprising a bottom wall member, a plurality of divider walls upstanding from one side of said bottom wall member in parallel relation to one another, the facing surfaces of each adjacent pair of divider walls cooperating with the intervening portion of said one side of said bottom wall member to define an open-topped channel for the reception of a printed circuit board, an array of elongated resilient spring fingers disposed in side-by-side relation to one another in said channel, said spring fingers having free ends disposed along a line adjacent one side of the open top of said channel for resiliently contacting conductors on the printed circuit board, said array comprising a first plurality of resilient spring fingers disposed in spaced relation to one another adjacent one side of said channel and extending in substantially linear configuration through said bottom wall member at a position adjacent the juncture of said bottom wall member and one of said cooperating pair of divider walls to provide a first row of terminals which protrude outwardly of the other side of said bottom wall member adjacent said one side of said channel, said array further comprising a second plurality of resilient spring fingers disposed in spaced relation to one another adjacent said one side of said channel in intervening relation respectively to said first plurality of spring fingers, each of said second spring fingers being bent at a position spaced from the free end thereof to provide a transverse portion which extends in spaced substantially parallel relation to said one side of said bottom wall member toward the other side of said channel and which is then bent further to extend through said bottom wall member at a second location adjacent the juncture of said bottom wall member and the other of said cooperating pair of divider walls, to

provide a second row of terminals substantially parallel to said first row of terminals and protruding outwardly of said other side of said bottom wall member adjacent said other side of said channel, and a key structure disposed within said channel for assuring that only a preselected circuit board may be inserted into said channel to effect electrical contact between the free ends of said spring fingers and conductors on said printed circuit board, said key structure comprising an elongated member extending across said channel at a position between the free ends of said spring fingers and the transverse portions of said second spring fingers, said member having at least one upstanding projection extending toward the free ends of said spring fingers and adapted to mate with a complementary recess in the edge of the preselected circuit board, and said member including a plurality of further projections extending downwardly therefrom into engagement with said one side of said bottom wall member at positions between said transverse portions of said second spring fingers to transfer forces, imposed on said member upon insertion of a printed circuit board into said channel, directly to said bottom wall member and to prevent application of said forces to said transverse portions of said second spring fingers.

6. The combination of claim 5 wherein said elongated member is of thin substantially rectangular configuration, the opposing faces of said member being substantially parallel to the facing surfaces of said cooperating pair of divider walls, said upstanding projection being integral with the upper comparatively thin edge of said member, the lower comparatively thin

edge of said member being notched at plural locations to provide said plurality of further projections, the depth of each said notch being greater than the spacing between the transverse portions of said second spring fingers and the said one side of said bottom wall member.

7. The combination of claim 6 wherein said first and second pluralities of spring fingers are disposed in regularly spaced alternating relation to one another, the lower edge of said member being notched at regularly spaced intervals corresponding to the spacing between said second spring fingers to provide a pair of said downwardly extending projections adjacent the opposing edges respectively of at least some of the transverse portions of said second spring fingers.

8. The combination of claim 5 wherein said connector includes a plurality of resilient back spring members disposed within said channel in spaced relation to one another adjacent the other of said cooperating pair of divider walls, each of said back spring members including a portion extending toward said one of said cooperating pair of divider walls and terminating in a free end which is located above said bottom wall member at a position adjacent said spring fingers and below the free ends of said spring fingers, said elongated member being disposed in the region between said spring fingers and said back spring members and below the free ends of said back spring members for retention in said channel by said back spring members and said spring fingers.

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