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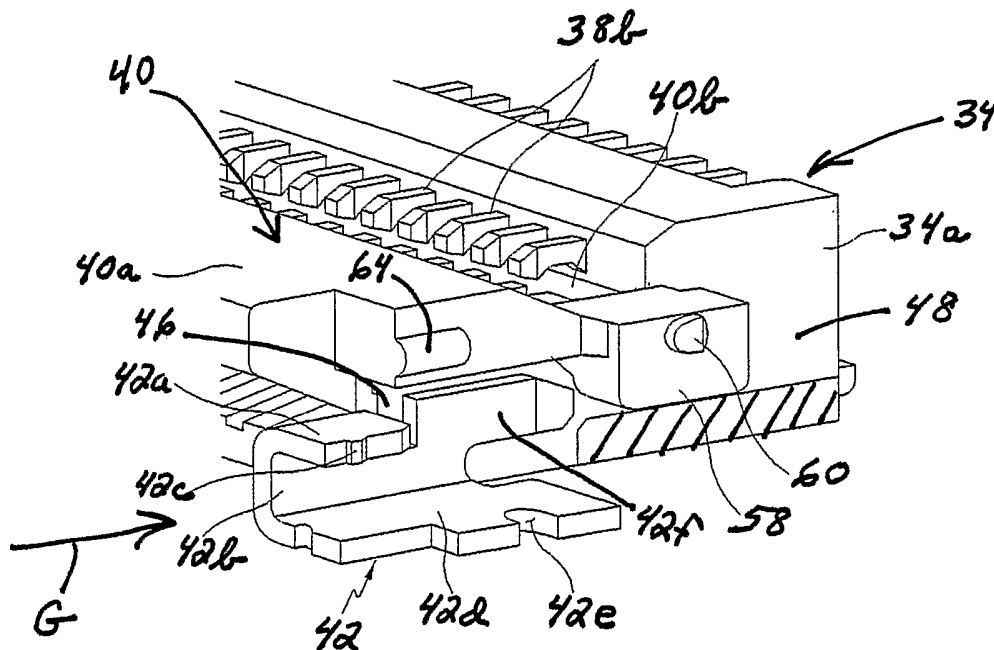
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(54) Title: FLAT CIRCUIT CONNECTOR WITH IMPROVED FITTING NAILS



(57) Abstract: An electrical connector is provided for connecting a flat electrical circuit to a printed circuit board. The connector includes a dielectric housing having an opening for receiving an end of the flat circuit. A plurality of terminals are mounted on the housing in a side-by-side array and spaced along the opening. An actuator is movably mounted on the housing for movement between an open position allowing the flat circuit to be inserted into the opening and a closed position biasing the flat circuit against the terminals. A fitting nail is mounted on the housing for fixing the connector to the printed circuit board. The fitting nail has a support portion supporting the actuator.



For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

FLAT CIRCUIT CONNECTOR WITH IMPROVED FITTING NAILS

Field of the Invention:

This invention generally relates to the art of electrical connectors and, particularly, to a connector for connecting a flat circuit, such as a flat flexible circuit, a flexible printed circuit or other flat electrical cable to a printed circuit board.

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Background of the Invention:

A wide variety of electrical connectors have been designed for terminating flat cables or circuits. A typical connector for flat circuits includes a dielectric housing molded of plastic material, for instance. The housing has an elongated opening or slot for receiving an end of the flat circuit which has generally parallel, laterally spaced conductors exposed across the end. A plurality of terminals are mounted in the housing and are spaced laterally along the slot, with contact portions of the terminals engageable with the laterally spaced conductors of the flat circuit. An actuator often is movably mounted on the housing for movement between a first position whereat the flat circuit is freely insertable into the slot and a second position whereat the actuator clamps the circuit in the housing and biases the circuit against the contact portions of the terminals.

FIGS. 8 and 9 herein show a prior art flat circuit connector of the character described above. The connector includes a housing, generally designated 20, having a plurality of terminals, generally designated 22, mounted in the housing from the rear thereof. The housing is mounted on a printed circuit board (not shown) and is fabricated of dielectric plastic material. The housing has a slot 20a at the front thereof for receiving an end of a flat circuit in a circuit insertion direction as indicated by arrow "B". The housing includes a rear portion 24b having a plurality of pairs of terminal-receiving passages 20c into which terminals 22 are mounted. Finally, the housing is elongated and includes a pair of walls or fixing arms 20d having fixing grooves 20e formed on the insides thereof. An elongated actuator, generally designated 24, is pivotally mounted on housing 20 by means of a pair of fixing protrusions 24a having pivot bosses 24b at opposite ends of the housing. The fixing protrusions are rotatably mounted in fixing grooves 20e formed inside arms 20d. A pair of locking protrusions 24c are formed at

opposite ends of the elongated actuator at the front thereof. The locking protrusions are hooked against the front of the housing when the actuator is in a closed position as shown in FIG. 8.

A pair of substantially enclosed fitting nails 26 are mounted over generally inverted T-shaped mounting portions 20f of the housing in the direction of arrows "B". The fitting nails are fabricated of metal material and are soldered to mounting pads on the printed circuit board to secure the connector to the board.

Actuator 24 is rotated 90° from its closed position shown in FIG. 8, to stand upright, and its rear end is inserted between fixing arms 20d of the housing. Fixing protrusions 24a are respectfully inserted into fixing grooves 20e inside arms 20d to fixed the actuator to the housing. This defines the open position of the actuator. While the actuator is in this open position, the end of the flat circuit is inserted into slot 20a in the direction of arrow "A". The actuator then is rotated about pivot bosses 24b to the closed position shown in FIG. 8 to bias appropriate contacts on the bottom of the flat circuit against terminals 22.

The prior art connector described above has problems in that the actuator is not solidly locked in its closed position. The present invention helps to support the actuator by means of a fitting nail which performs a dual-function of also fixing the connector to a printed circuit board.

Summary of the Invention:

An object, therefore, of the invention is to provide an electrical connector for connecting a flat circuit to a printed circuit board and including a new and improved fitting nail system.

In the exemplary embodiment of the invention, the connector includes a dielectric housing having an opening for receiving an end of the flat circuit. A plurality of terminals are mounted on the housing in a side-by-side array and spaced along the opening. An actuator is movably mounted on the housing for movement between an open position allowing the flat circuit to be inserted into the opening and a closed position biasing the flat circuit against the terminals. A fitting nail is mounted on the housing for fixing the connector to the printed circuit board. The fitting nail has a support portion supporting the actuator.

According to one aspect of the invention, the actuator is mounted for vertical movement on the housing as well as said movement between its open and closed position. The support portion of the fitting nail is located to elevate the actuator into a fixed position when the fitting nail is assembled to the housing.

According to another aspect of the invention, the actuator is mounted by pivot means for pivotal movement between its open and closed positions. The support portion of the fitting nail is located to bias the actuator into engagement with the pivot means.

According to a further aspect of the invention, the fitting nail is stamped and formed of sheet metal material. The fitting nail includes a mounting portion for mounting the fitting nail on the housing, a foot portion for fixing the connector to the printed circuit board, and said support portion for engaging the actuator. The foot portion comprises a generally horizontal fixing plate. The mounting portion includes a generally upright support plate extending vertically of the horizontal fixing plate to define an L-shaped configuration. The support portion of the fitting nail comprises an upright support plate formed as an extension of the upright support plate of the mounting portion.

Other objects, features and advantages of the invention will be apparent from the following detailed description taken in connection with the accompanying drawings.

15 **Brief Description of the Drawings:**

The features of this invention which are believed to be novel are set forth with particularity in the appended claims. The invention, together with its objects and the advantages thereof, may be best understood by reference to the following description taken in conjunction with the accompanying drawings, in which like reference numerals identify like elements in the figures and in which:

FIG. 1 is perspective view of a flat circuit connector according to the invention, with the actuator in its closed position;

FIG. 2 is an exploded perspective view of the connector;

FIG. 3 is an enlarged perspective view of the right-hand fitting nail as viewed in FIG. 2;

25 FIG. 4 is an enlarged perspective view, partially in section, showing the fitting nail of FIG. 3 in the process of being inserted into the connector housing;

FIG. 5 is an enlarged front-to-rear section through the connector, with the actuator in its open position;

30 FIG. 6 is a view similar to that of FIG. 4, with the fitting nail in its fully assembled position;

FIG. 7 is a view similar to that of FIG. 5, with the actuator in its closed position; and

FIGS. 8 and 9 are views of the prior art connector described in the Background, above.

Detailed Description of the Preferred Embodiment:

Referring to the drawings in greater detail, and first to FIGS. 1 and 2, the invention is embodied in an electrical connector, generally designated 30, for connecting a flat electrical circuit 32 (not shown) to a printed circuit board (not shown). The flat electrical circuit may include flat cables or circuits, flat flexible cables, flexible printed circuits or the like.

Connector 10 includes a dielectric housing, generally designated 34, which is elongated and may be molded of plastic material. The housing defines a slot, generally designated 36, at the front end of the housing for receiving an end of the flat circuit in a circuit insertion direction as indicated by arrow "C" in FIG. 2. A plurality of conductive terminals, generally designated 38, are mounted in housing 34 in a side-by-side array and spaced along slot 36. Only the two end-most terminals are shown in FIG. 2. An actuator, generally designated 40, is pivotally mounted on housing 34 for movement between an open position (Fig. 5) allowing the flat circuit to be inserted into slot 36 and a closed position (Fig. 7) biasing the flat circuit against the terminals, as will be seen hereinafter. The terminals are inserted into the rear of the housing in the direction of arrows "D" and a pair of fitting nails, generally designated 42, are inserted into the front of the housing in the direction of arrows "E".

Still referring to FIGS. 5 and 7 in conjunction with FIG. 2, terminals 38 are inserted into terminal-receiving passages 43 in housing 34. Each terminal includes a generally horizontally oriented, U-shaped configuration defined by a base, 38a, an upper pivot arm 38b and a lower contact arm 38c. The upper pivot arm has a pivot groove 38d formed in the underside thereof near the distal end thereof. The contact arm has a contact portion 38e at the distal end thereof projecting into the circuit-receiving slot 36. A foot 38f projects downwardly from base 38a and is disposed generally flush with the bottom of housing 34 for connection to an appropriate circuit trace on the printed circuit board. The terminals are stamped and formed of conductive sheet metal material.

Housing 34 is elongated and includes an upstanding rear portion 34a and a bottom, forwardly projecting platform portion 34b whereby the circuit-receiving slot 36 is open in an upward and forward direction. A plurality of generally parallel guide grooves 44 are spaced along platform portion 34b between a plurality of partitions 44a. When terminals 38 are inserted

into the housing, contact arms 38c are guided into grooves 44, with the contact portions 38e projecting upwardly into the circuit-receiving slot 36.

5 A pair of end walls 34c are formed integrally with housing 34. Fitting nails 42 are inserted in the direction of arrows "E" into a pair of inverted L-shaped nail-receiving passages 46 formed in the pair of end walls and opening at the front of the housing. An upwardly opening actuator-receiving slot 48 is formed in each end wall 34c at the rear thereof behind and in communication with the respective nail-receiving passage 46. A rotating cam groove or recess 50 is formed inside each end wall 34c within slot 48. The cam-receiving groove 50 includes a first cam groove or recess 50a and a second cam groove or recess 50b above the first groove, for purposes described hereinafter. A locking groove 52 is formed on the inside of each end wall 10 34c above the respective nail-receiving passage 46.

Actuator 40 is elongated and includes an elongated pressure plate 40a along the front thereof and an elongated pivot shaft 40b along the rear thereof spaced from the pressure plate. The actuator is a one-piece structure, and pivot shaft 40b is connected to pressure plate 40a by a plurality of supports 54 at spaced intervals along the length of the actuator, and defining spaces 15 56 between the supports. A rounded pressing portion 40c is formed at the bottom rear corner of the actuator.

Actuator 40 further includes a block-like support boss 58 at each opposite end thereof. A rotating cam 60 projects outwardly from the outer surface of boss 58. Boss 58 has a support 58a and a movement prevention portion 58b, for purposes described hereinafter. Pressure plate 40a of actuator 40 includes a cut-out 62 at each corner thereof. Finally, a locking protrusion 64 projects outwardly from each opposite end of pressure plate 40a. 20

Referring to FIG. 3 in conjunction with FIGS. 1 and 2, each fitting nail 42 includes an L-shaped mounting portion 42a defined by a vertical or upright support plate 42b and a horizontal support plate 42c. The L-shaped mounting portion is insertable into the respective L-shaped passage 46 at the front of the respective end wall 34c of the housing. The fitting nail has a horizontal fixing plate or foot 42d at the bottom thereof and which will be generally flush with housing 34 for connection, as by soldering, to a mounting pad on the printed circuit board to fix the connector to the board. An open-sided hole 42e is formed in the outer edge of fixing plate 25 42d for receiving a fixing member (not shown) to further fix the connector to the board. According to the invention, each fitting nail 42 includes a biasing portion or elevating arm 42f in 30

the form of a vertical plate for biasing actuator 40 upwardly and securely seat pivot shaft 40b of the actuator into pivot grooves 38d of terminals 38. In essence, plate 42f vertically supports the actuator, particularly in its closed position.

FIG. 5 shows actuator 40 in an upright or open position so that an end of a flat circuit can be inserted freely into slot 36 in the direction of arrow "C". It can be seen that pivot shaft 40b is seated in pivot grooves 38d in the underside of pivot arms 38b of terminals 38. After the flat circuit is inserted into space 36, actuator 40 is pivoted downwardly in the direction of arrow "F" to its closed position shown in FIG. 7. In this position, pressure plate 40a of the actuator will press the flat circuit against contact portions 38e of contact arms 38c of the terminals.

FIG. 4 shows the fitting nail 42 of FIG. 3 being inserted into its respective male-receiving passage 46 in the front of housing 34. It can be seen that actuator 40 is in its closed position, with support boss 58 of the actuator in actuator-receiving slot 48 at one end of rear portion 34a of the housing. The fitting nail is inserted into passage 46 in the direction of arrow "G".

FIG. 6 shows fitting nail 42 completely inserted into passage 46 to its fully seated position. When fully inserted, the support portion 42f of the fitting nail engages the underside of actuator 40 and biases pivot shaft 40b of the actuator into pivot grooves 38d of terminals 38 as seen in FIGS. 5 and 7. This upward elevating of the actuator also moves cam projections 60 upwardly from first groove 50a (Fig. 2) to second groove 50b. Therefore, fitting nails 42 perform dual functions of (1) securing the connector to appropriate mounting pads on the circuit board, and (2) securely seating actuator 40 in housing 34 by seating the pivot shaft of the actuator into the pivot grooves of the terminals as well as seating cam projections 60 in the grooves of the housing.

It will be understood that the invention may be embodied in other specific forms without departing from the spirit or central characteristics thereof. The present examples and embodiments, therefore, are to be considered in all respects as illustrative and not restrictive, and the invention is not to be limited to the details given herein.

CLAIMS:

What is claimed is:

1. An electrical connector for connecting a flat electrical circuit to a printed circuit board, comprising:

a dielectric housing having an opening for receiving an end of the flat circuit;

5 a plurality of terminals mounted on the housing in a side-by-side array and spaced along the opening;

an actuator movably mounted on the housing for movement between an open position allowing the flat circuit to be inserted into said opening and a closed position biasing the flat circuit against the terminals; and

10 a fitting nail mounted on the housing for fixing the connector to the printed circuit board, the fitting nail having a support portion supporting the actuator.

2. The electrical connector of claim 1 wherein said fitting nail includes a mounting portion for mounting the fitting nail on the housing, a foot portion for fixing the connector to the printed circuit board, and said support portion for engaging the actuator.

3. The electrical connector of claim 2 wherein said foot portion comprises a generally horizontal fixing plate.

4. The electrical connector of claim 2 wherein said mounting portion includes a generally upright support plate.

5. The electrical connector of claim 4 wherein said mounting portion is generally L-shaped and includes said upright support plate and a horizontal mounting plate.

6. The electrical connector of claim 4 wherein said support portion of the fitting nail comprises an upright support plate formed as an extension of said upright support plate of the mounting portion.

7. The electrical connector of claim 1 wherein said fitting nail is stamped and formed of sheet metal material.

8. The electrical connector of claim 1 wherein said actuator is mounted for vertical movement on the housing as well as said movement between said open and closed positions, and the support portion of the fitting nail is located to elevate the actuator into a fixed position.

9. The electrical connector of claim 1 wherein said actuator is mounted by pivot means for pivotal movement between said open and closed positions, and the support portion of the fitting nail is located to bias the actuator into engagement with the pivot means.

10. An electrical connector for connecting a flat electrical circuit to a printed circuit board, comprising:

a dielectric housing having an opening for receiving an end of the flat circuit;

5 a plurality of terminals mounted on the housing in a side-by-side array and spaced along the opening;

an actuator movably mounted on the housing for movement between an open position allowing the flat circuit to be inserted into said opening and a closed position biasing the flat circuit against the terminals; and

10 a fitting nail mounted on the housing for fixing the connector to the printed circuit board, the fitting nail being stamped and formed of sheet metal material and including

a generally L-shaped mounting portion including an upright plate and an upper horizontal plate for mounting the fitting nail on the housing,

a generally horizontal foot portion extending from the bottom of said upright plate beneath said horizontal mounting plate for fixing the connector to the printed circuit board, and

15 a support portion in the form of an upright support plate formed as an extension of said upright support plate of the mounting portion for supporting the actuator in the connector housing.

11. The electrical connector of claim 10 wherein said actuator is mounted for vertical movement on the housing as well as said movement between said open and closed positions, and the support portion of the fitting nail is located to elevate the actuator into a fixed position.

12. The electrical connector of claim 10 wherein said actuator is mounted by pivot means for pivotal movement between said open and closed positions, and the support portion of the fitting nail is located to bias the actuator into engagement with the pivot means.

13. A method of manufacturing an electrical connector for connecting a flat electrical circuit to a printed circuit board, comprising the steps of:

providing a dielectric housing, a plurality of terminals, an actuator, and a fitting nail for fixing the connector to the printed circuit board;

5 assembling the actuator to the housing;

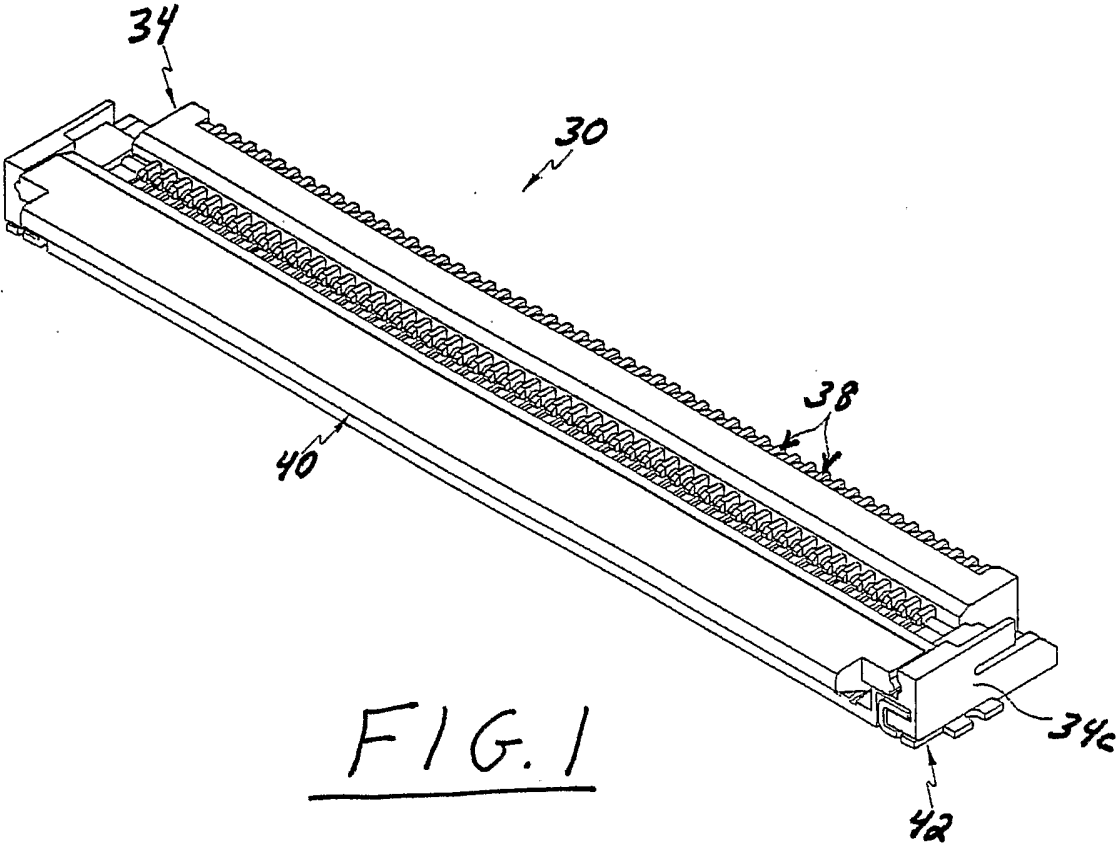
assembling the terminals to the housing before or after assembling the actuator to the housing; and

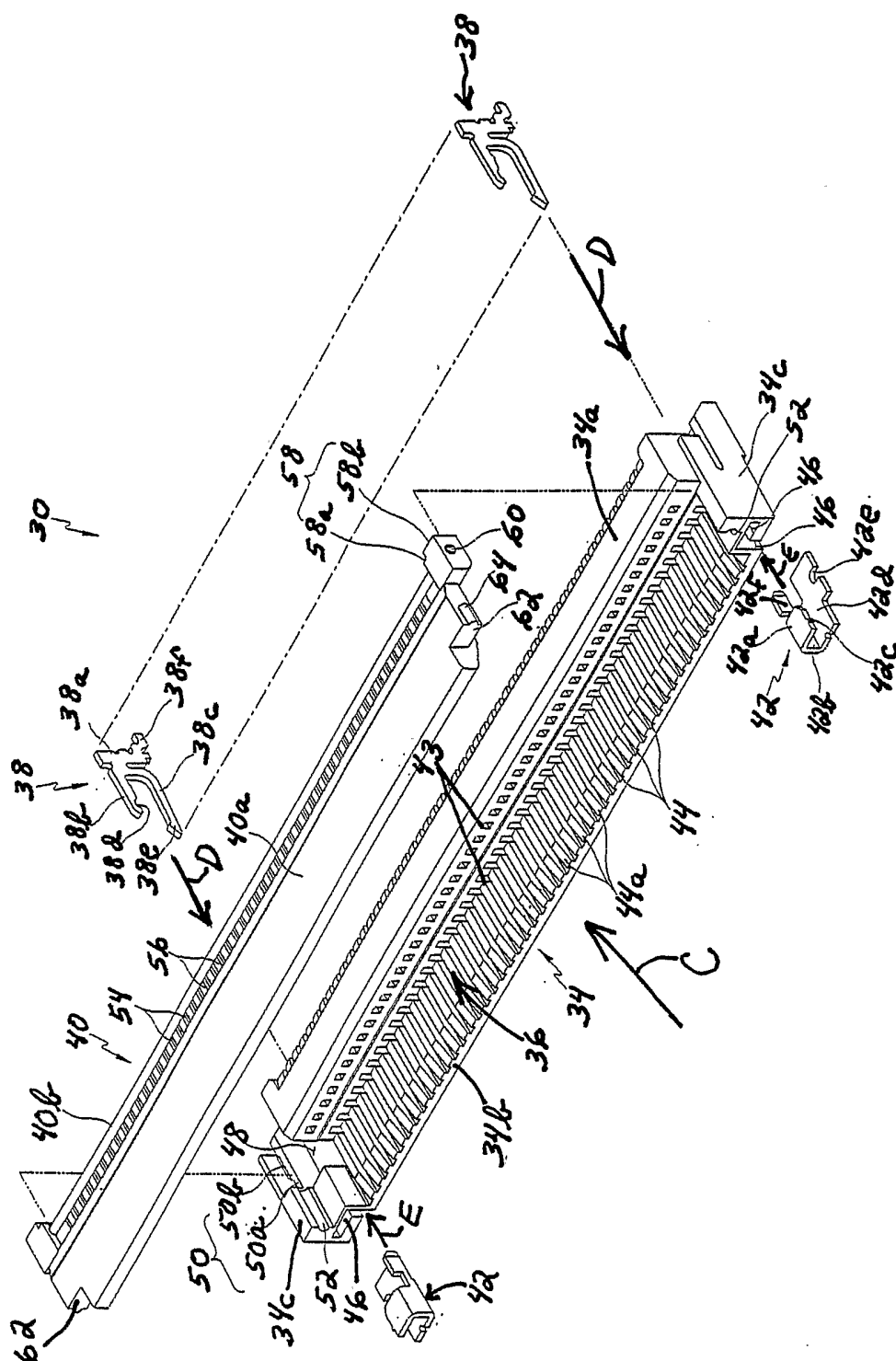
assembling the fitting nail to the housing into engagement with the actuator to support the actuator on the housing.

14. The method of claim 13 wherein said actuator is assembled to the housing from the front thereof.

15. The method of claim 14 wherein said terminals are assembled to the housing from the rear thereof.

16. The method of claim 14 wherein said fitting nail is assembled to the housing from the front thereof.





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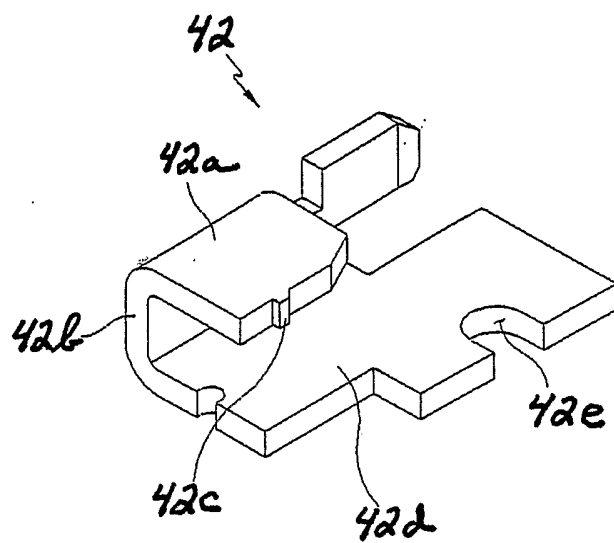


FIG. 3

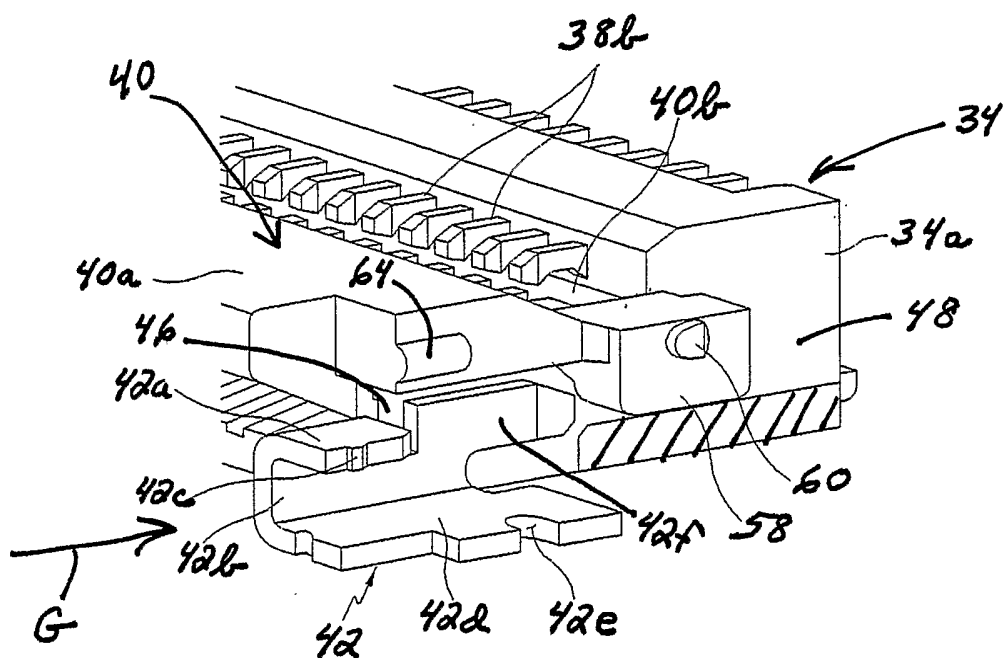


FIG. 4

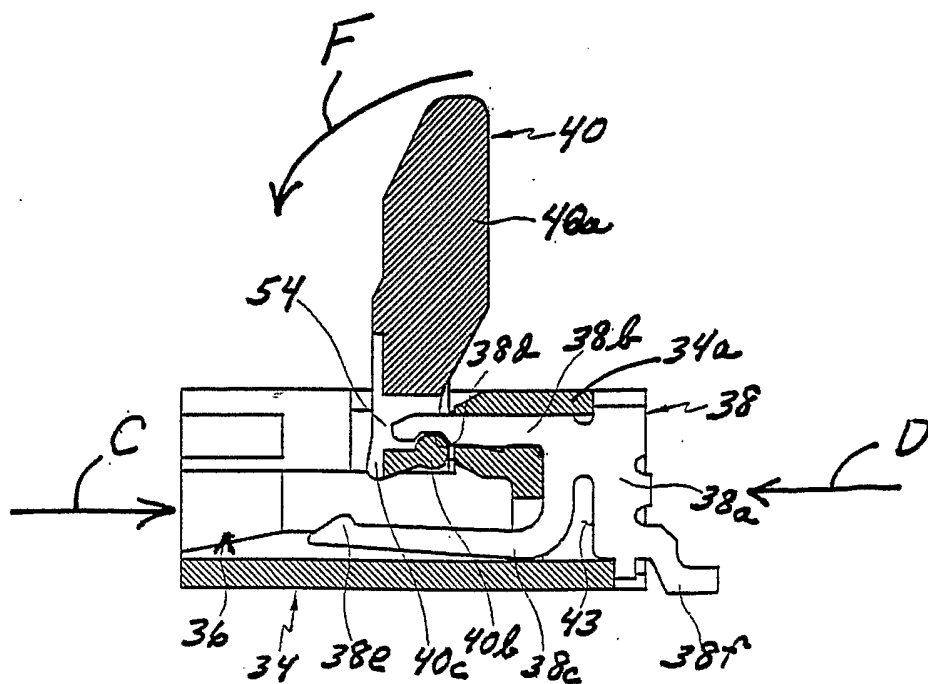


FIG. 5

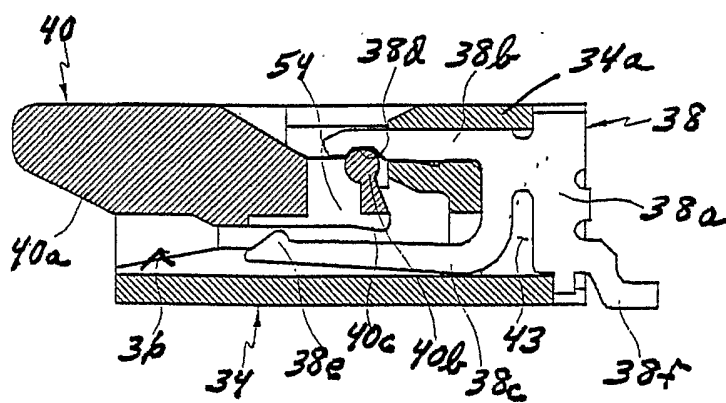


FIG. 7

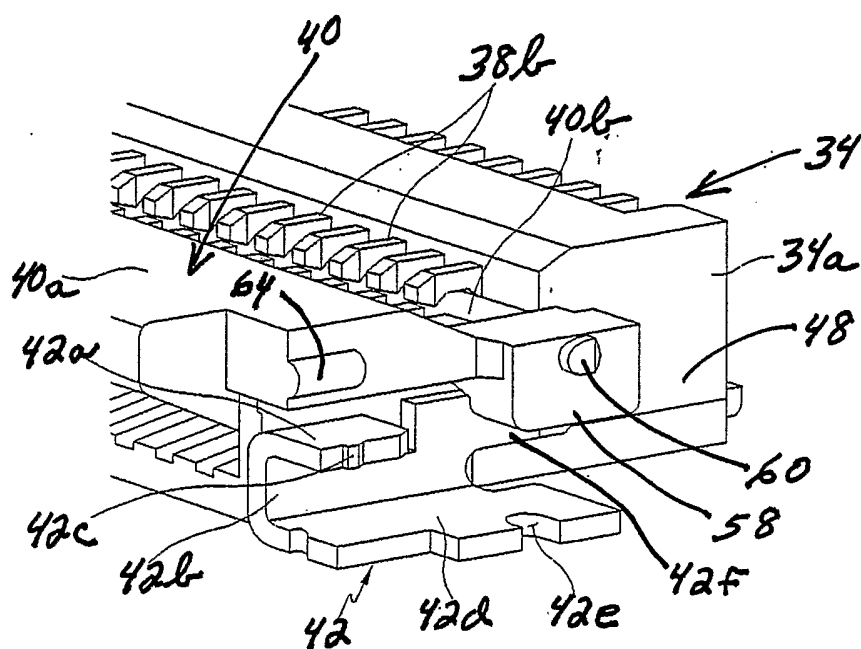


FIG. 6

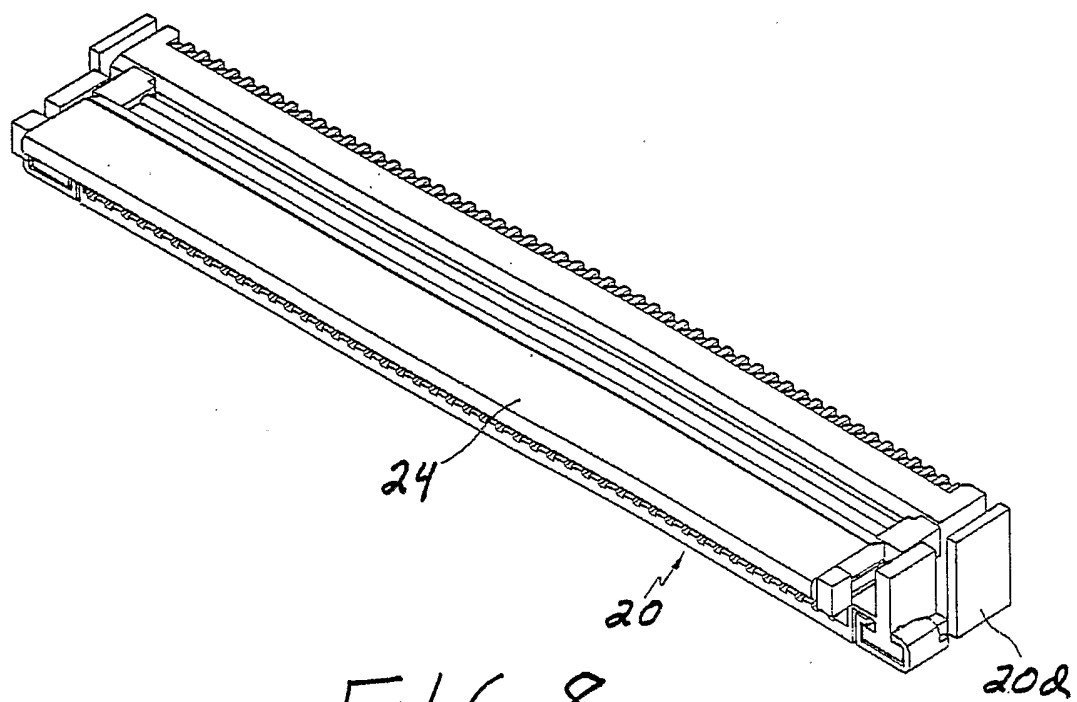


FIG. 8
(PRIOR ART)

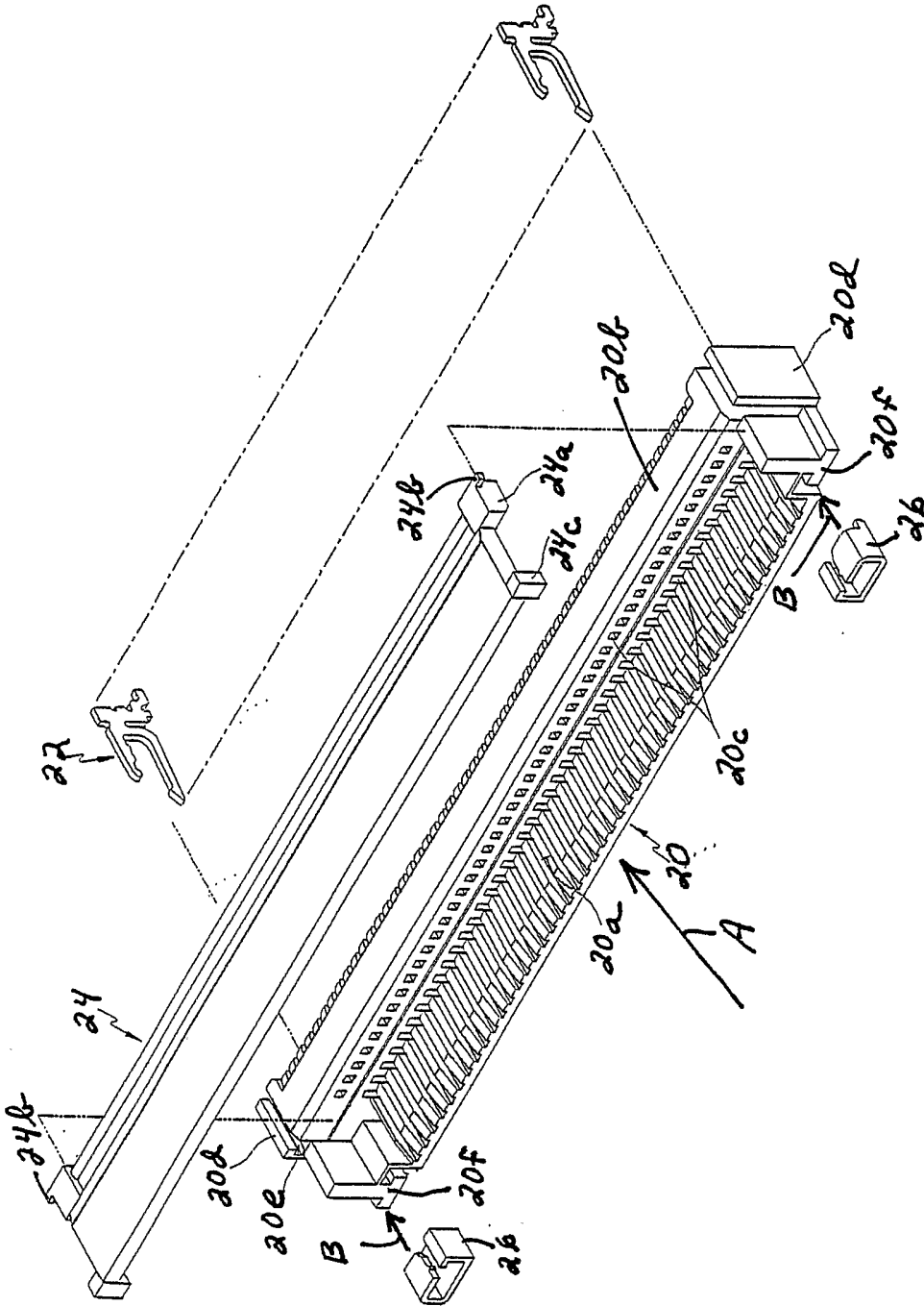


FIG. 9
(PRIOR ART)

INTERNATIONAL SEARCH REPORT

International Application No
PCT/US2004/027554

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 H01R12/08

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 H01R

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

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

EPO-Internal, WPI Data, PAJ

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	EP 1 311 028 A (MOLEX INC) 14 May 2003 (2003-05-14) column 4, line 33 - column 6, line 52; figures 1-8	1-16
A	US 5 354 214 A (ASO AKIRA ET AL) 11 October 1994 (1994-10-11) column 3, line 25 - column 4, line 52; figure 1	1-16
A	EP 1 311 027 A (MOLEX INC) 14 May 2003 (2003-05-14) column 3, line 17 - line 54; figure 1	1-16

☐ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

* Special categories of cited documents:

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Date of the actual completion of the international search

25 November 2004

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INTERNATIONAL SEARCH REPORT

International Application No
PCT/US2004/027554

Information on patent family members

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