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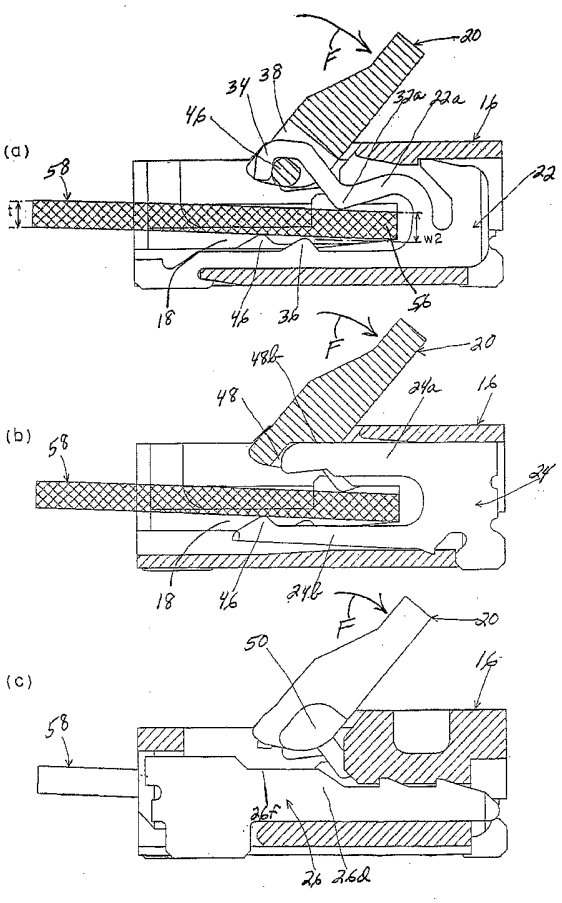
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[Continued on next page]

(54) **Title:** FLAT CIRCUIT CONNECTOR WITH PIVOTED ACTUATOR



(57) **Abstract:** An electrical connector is provided for terminating a flat electrical circuit. The connector includes a dielectric housing having an opening at a front end thereof 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 laterally along the opening. An actuator is movably mounted for pivotal movement between an open position allowing the flat circuit to be inserted into the opening with substantially zero insertion forces, a closed position biasing the flat circuit against contact portions of the terminals and an intermediate position whereat the flat circuit is tentatively held in stable condition while allowing readjustment thereof.

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FLAT CIRCUIT CONNECTOR WITH PIVOTED ACTUATOR

Field of the Invention:

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

Background of the Invention:

A wide variety of electrical connectors have been designed for terminating flat cables or circuits, such as flat flexible cables, flexible printed circuits or the like. 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.

Examples of such flat circuit connectors are shown in Japanese Patent Laid-Open No. 2002-134194; No. 2002-329536; and No. 2003-45526.

The contact portions of the terminals in such flat circuit connectors are spaced inwardly of the inlet to the elongated opening or slot in the housing for receiving the end of the flat circuit. Heretofore, most such flat circuit connectors originally created substantial resistance to insertion of the circuit into the opening and into engagement with the contact portions of the terminals. In fact, some of the contacts on the flat circuit often were deformed or damaged.

Consequently, flat circuit connectors have been designed so that the opening in the connector housing, including the interior area at the contact portions of the terminals, is wider than the thickness of the flat circuit. Therefore, the flat circuit can be inserted into the opening with no substantial resistance forces (commonly called "zero insertion force" or "ZIF"). This

permits the flat circuit to be inserted with ease and prevents deformation or damage to either the contacts on the flat circuit or the contact portions of the connector terminals.

Unfortunately, such zero insertion force connectors often are too loose or free during insertion of the flat circuit. The circuit cannot be tentatively held in position, prior to final clamping, to provide for correct reinsertion or readjustment of the circuit prior to its final clamped and terminated condition. The present invention is directed to solving these problems by providing a flat circuit connector having an actuator which not only is movable between a first position allowing free insertion of the flat circuit and a second position clamping the circuit in terminated position, but the actuator is movable to an intermediate position facilitating tentative holding of the flat circuit in stable condition while allowing readjustment thereof.

Summary of the Invention:

An object, therefore, of the invention is to provide a new and improved flat circuit connector of the character described.

In the exemplary embodiment of the invention, an electrical connector is provided for terminating a flat electrical circuit. The connector includes a dielectric housing having an opening at a front end thereof 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 laterally along the opening. An actuator is movably mounted for pivotal movement between an open position allowing the flat circuit to be inserted into the opening with substantially zero insertion forces, a closed position biasing the flat circuit against contact portions of the terminals and an intermediate position whereat the flat circuit is tentatively held in stable condition while allowing readjustment thereof.

According to one aspect of the invention, some of the terminals are generally U-shaped to define an upper hook arm extending over the opening and a lower contact arm extending below the opening. The hook arm has a bearing portion and the contact arm has a contact portion. The flat circuit is tentatively held between the bearing portion and the contact portion in the intermediate position of the actuator. Hook portions of the terminals cooperate with pivot means on the actuator to mount the actuator for pivotal movement between said positions. The terminals have detent means engageable with complementary detent means on the actuator to hold the actuator in its intermediate position. As disclosed herein, the detent means comprise interengaging flat surfaces on the actuator and the terminals. These terminals are mounted on the

housing from the front end thereof. According to the preferred embodiment, the terminals have tail portions for connection to appropriate circuit traces on a printed circuit board.

According to another aspect of the invention, some of the terminals are generally U-shaped to define an upper cam arm extending over the opening and a lower contact arm extending below the opening. The upper cam arm engages a cam portion of the actuator to lift the actuator in its intermediate position. These terminals are mounted on the housing from a rear end thereof. In the preferred embodiment, the terminals have tail portions for connection to the circuit traces on the printed circuit board.

According to a further aspect of the invention, at least one fitting nail is fixed to the housing for securement to the printed circuit board. The fitting nail has a bearing portion for engaging the actuator and facilitating pivotally mounting the actuator on the connector.

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

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 a perspective view of a flat circuit connector according to a first embodiment of the invention;

FIG. 2(a) is a front-to-rear vertical section through the connector of FIG. 1 and taken along a selected first terminal, with the actuator in its closed or terminating position, but with the flat circuit omitted to facilitate the illustration;

FIG. 2(b) is a view similar to that of FIG. 2(a), but taken along a selected second terminal;

FIG. 2(c) is a front-to-rear vertical section taken along one of the fitting nails of the connector, with the actuator again in its closed or terminating position;

FIGS. 3(a), (b) and (c) are views similar to that of FIGS. 2(a), (b) and (c), but with the actuator pivoted upwardly from its closed position;

FIGS. 4(a), (b) and (c) are views similar to that of FIGS. 3(a), (b) and (c), but with the actuator pivoted upwardly to its intermediate position;

FIGS. 5(a), (b) and (c) are views similar to that FIGS. 4(a), (b) and (c), but with the actuator pivoted to its fully open position and with a flat circuit inserted into the connector;

FIGS. 6(a), (b) and (c) are views similar to that of FIGS. 4(a), (b) and (c), but with the flat circuit inserted into the connector;

FIGS. 7(a), (b) and (c) are views somewhat similar to that of FIGS. 3(a), (b) and (c), but with the flat circuit inserted into the connector;

FIGS. 8(a), (b) and (c) are views similar to that of FIGS. 2(a), (b) and (c), but with the flat circuit inserted into the connector;

FIG. 9 is a somewhat schematic illustration showing how different forces act on the flat circuit;

FIG. 10 is a fragmented side elevational view of a modified form of one of the first terminals;

FIG. 11 is a view similar to that of FIG. 2(a) but showing a first terminal according to a second embodiment of the invention; and

FIG. 12 is a view similar to that of FIG. 11, but with a flat circuit inserted into the connector.

Detailed Description of the Preferred Embodiments:

Referring to the drawings in greater detail, and first to FIGS. 1 and 2, the invention is embodied in a flat circuit electrical connector, generally designated 14 (Fig. 1) according to a first embodiment of the invention. The connector is designed for mounting on a printed circuit board (not shown). The connector includes a dielectric housing, generally designated 16, having a front end 16a and a rear end 16b. The housing defines an opening 18 which opens at the front end for receiving an end of a flat circuit as will be seen hereinafter. The housing is a one-piece structure molded of dielectric material such as plastic or the like. An actuator, generally designated 20, is movably mounted for pivotal movement between an open position (described hereinafter) allowing the flat circuit to be inserted into opening 18 with substantially zero insertion forces and a closed position shown in FIGS. 1 and 2 biasing the flat circuit against contact portions of a plurality of terminals, again as will be described in greater detail

hereinafter. Generally, actuator 20 is pivotally movable to an intermediate position whereat the flat circuit is tentatively held in stable condition while allowing readjustment thereof.

More particularly, FIG. 2(a) shows one of a plurality of first terminals, generally designated 22, and FIG. 2(b) shows one of a plurality of second terminals, generally designated 24. The first and second terminals are staggered and spaced laterally along opening 18 in a side-by-side array. FIG. 2(c) shows a fitting nail, generally designated 26, which is mounted in the connector housing 16 at each extreme opposite side or end of opening 18.

Each first terminal 22 is generally U-shaped to define an upper flexible hook arm 22a and a lower rigid contact arm 22b. Each first terminal 22 is inserted in the direction of arrow "A" into a respective terminal slot 28 in housing 16. The terminal has a rear engagement portion 22c which has a forwardly projecting latch portion 22d which latches behind an interior latch shoulder 30 formed on the underside of a ceiling plate 16c of the housing. A tail portion 22e of the terminal abuts against a front edge of a floor plate 16d of the housing. The tail portion is connected to an appropriate circuit trace on the printed circuit board.

Still referring to FIG. 2(a), the flexible upper hook arm 22a of each first terminal 22 has a hook portion 32 defining a downwardly projecting bearing portion 32a which extends into opening 18. The upper hook arm terminates in a front, downwardly opening hook portion 34 having an interior horizontal flat surface 34a and a front vertical flat surface 34b. Finally, lower contact arm 22b of each first terminal 22 has an upwardly projecting contact portion 36 generally intermediate opposite ends of the contact arm and extending upwardly into opening 18.

Still referring to FIGS. 2(a), actuator 20 includes a front end 20a and a rear end 20b. A plurality of slots 38 are formed in the rear end of the actuator and are spaced longitudinally thereof for accommodating hook portions 34 of first terminals 22. A pivot pin 40 spans each slot 38 and is disposed generally within the hook portion of each terminal. The pivot pin has a circular surface 40a and a flat surface 40b. Opening 18 is open at the top of housing 16, as at 42, to accommodate pivoting movement of the actuator, as will be seen hereinafter. The actuator has a pressing end 44 projecting inwardly from pivot pins 40.

Referring to FIG. 2(b), each second terminal 24 is generally U-shaped to define a rigid upper cam arm 24a which extends over opening 18 and a lower contact arm 24b which extends below the opening. The arms project forwardly of a mounting portion 24c which has a latch tooth 24d that bites into the plastic material of floor plate 16d of the housing to fix the terminal

in the housing. Second terminals 24 are inserted in the direction of arrow "B", into respective slots 44 from rear end 16b of housing 16. A tail portion 24e projects downwardly from mounting portion 24c for connection to an appropriate circuit trace on the printed circuit board. Finally, a contact portion 46 projects upwardly into opening 18 at a distal end of the lower contact arm 24b of each second terminal 24.

Still referring to FIG. 2(b), actuator 20 has a plurality of slots 48 spaced along rear end 20b of the actuator for accommodating the forward distal ends of upper cam arms 24a of second terminals 24. Each slot 48 has a platform surface 48a and a ramp surface 48b, for purposes described hereinafter.

Referring to FIG. 2(c), each fitting nail 26 is inserted in the direction of arrow "C" into a respective mounting slot 48 within the housing. Each fitting nail has a forwardly extending mounting post 26a having teeth 26b for skiving into the plastic material of the housing within mounting slot 48 to fix the fitting nail to the housing. The fitting nail has a generally square base 26c and a generally rectangular rearward extension or bearing portion 26d. The square base has an upper edge 26e, and the rectangular extension has an upper edge 26f. Upper edge 26e of square base 26c is higher than upper edge 26f of rectangular extension 26b. The base forms a tail portion 26g for connection, as by soldering, to a mounting pad on the printed circuit board. Upper edge 26f of the fitting nail is exposed in a vertical direction in the open area 42 of the housing above opening 18.

Still referring to FIG. 2(c), actuator 20 includes a bearing boss or wing 50 which has a flat surface 50a and an accurate surface 50b. In the closed position of FIG. 2(c), the flat surface 50a of the bearing boss engages the upper edge 24c of bearing portion 26d of the fitting nail. As seen in FIG. 1, a pair of the bearing bosses or wings 50 project outwardly from opposite sides of actuator 20 for engaging the tops of fitting nails 26. FIG. 1 also shows that tail portions 26g of the fitting nails are generally flat in a horizontal plane for secure connection, as by soldering, to the mounting pads on the printed circuit board.

All of the staggered first and second terminals 22 and 24, respectively, along with the two fitting nails 26, may be stamped and formed of conductive sheet metal material. For instance, the fitting nails may be stamped out of stainless steel. It also can be understood from the above detailed description, that actuator 20 is captured on housing 16 by bearing wings 50 engaging the tops of fitting nails 26, while pivot pins 40 (Fig. 2(a)) are captured within the undersides of hook

portions 34 of first terminals 22. FIG. 2 shows the actuator in its closed position for clamping the flat circuit against contact portions 36 and 46 of first and second terminals 22 and 24, respectively, as will be seen hereinafter.

As can be seen in FIG. 2(a), pivot pins 40 are spaced below horizontal flat surfaces 34a of hook portions 34 of first terminals 22. Actuator 20 is pivotally rotated from its closed position shown in FIG. 2, upwardly in the direction of arrows "D" (Fig. 3), until the actuator reaches a generally vertical, intermediate position shown in FIG. 4. During the rotation shown in FIG. 3, ramp surfaces 48b (Fig. 3(b)) on the actuator engage the distal ends of upper cam arms 24a of second terminals 24. This applies upward forces "f2" (Fig. 4(b)) to the actuator. Simultaneously, accurate surfaces 50b of bearing bosses or wings 50 engage upper edges 26f of fitting nails 26 as seen in FIG. 3(c). These interengagements of the actuator with the second terminals and the fitting nails cause actuator 20 to be lifted upwardly in the direction of arrows "E" (Fig. 4). When the actuator is lifted, flat surfaces 40b (Fig. 4(a)) of pivot pins 40 engage horizontal flat surfaces 34a of hook portions 34 of first terminals 22. These interengaging flat surfaces form detent means to hold the actuator in its intermediate position of FIG. 4.

The affect of rotating actuator 20 from its closed position of FIG. 2 to its intermediate position of FIG. 4 should be further explained in relation to upper hook arms 22a of first terminals 22. Specifically, as the actuator is pivoted upwardly, the distal ends of rigid cam arms 24a (Fig. 4(b)) of second terminals 24 apply a force "f2" to ramp surface 48b of the actuator. This causes the flexible upper hook arms 22a to yieldably bend upwardly, applying a reactionary force (f1) to pivot pins 40 of the actuator. FIG. 2(a) shows a gap (W1) between bearing portions 32a and contact portions 36 of the first terminals when the actuator is in its closed position. When the actuator is pivoted upwardly, this gap is enlarged.

FIG. 5 shows actuator 20 pivoted further from its intermediate position of FIG. 4 to its completely open position allowing an end 56 of a flat circuit 58 to be inserted into opening 18 in housing 16 of the connector with zero insertion force. The flat circuit has a thickness "t". This thickness is smaller than gap "W2" between bearing portions 32a and contact portions 36 of first terminals 22. Therefore, although the bottom surface of flat circuit 58 may engage contact portions 46 of second terminals 24, the flat circuit can be inserted into all of the U-shaped terminals 22 and 24 with zero insertion forces.

After flat circuit 58 is inserted into the connector with actuator 20 in its open position of FIG. 5, the actuator is pivoted back to its intermediate position as shown in FIG. 6. In this intermediate position of the actuator, the flat circuit is tentatively held in stable condition while still allowing readjustment of the circuit, such as correcting its final position. This tentative holding condition of the actuator is afforded by the application of forces "f3" by upper hook arms 22a of first terminals 22, as bearing portions 32a of the hook arms engage the top of the flat circuit. In other words, the flat circuit is sandwiched between bearing portions 32a and contact portions 36 of the first terminals. These forces do not rigidly clamp the flat circuit but temporarily hold the circuit while allowing readjustment thereof. Although pressing end 44 of actuator 20 is in engagement with the top surface of flat circuit 58, no clamping forces have yet to be applied. In other words, the distal ends of upper cam arms 24a (Fig. 6(b)) of second terminals 24 are applying a force "f5" to ramp surfaces 48b of the actuator to keep the actuator in its elevated position. Contact portions 46 of lower contact arms 24b of second terminals 24 apply a reactionary or supporting force "f4" to the underside of the flat circuit. FIG. 6(c) also shows that pressing end 44 of actuator 20 is in engagement with upper edges 26f of fitting nails 26, also to maintain the actuator elevated so that the flat circuit is only tentatively held.

As actuator 20 is pivoted downwardly in the direction of arrows "G" in FIG. 7 to its closed or terminating position of FIG. 8, pressing end 44 of the actuator presses or clamps the flat circuit against contact portions 36 and 46 of the terminals. The pressing end of the actuator moves beneath the distal ends of the rigid upper cam arms 24a of second terminals 24 as platform surfaces 48a of the actuator engage the undersides of the rigid upper cam arms. The circuit is biased against contact portions 36 and 46 of the terminals by the combined forces of upper hook arms 22a of first terminals 22 and pressing end 44 of the actuator under the biasing influence of the upper cam arms 24a of the second terminals.

FIG. 9 shows somewhat schematically these clamping forces between bearing portions 32a of first terminals 22, along with pressing end 44 of the actuator and contact portions 36 of the first terminals to form a three-point engagement of good electrical contact.

Forming contact portion 36 on the upper edge of fixed, lower contact arm 22b of each first terminal 22 is advantageous to lower the profile of the overall flat circuit connector 14. This is in comparison to contact portions 60 on cantilevered contact arms 62 of the prior art as shown

in FIG. 10. Although contact portion 60 can flex in the direction of arrow 64, the overall height of the connector is increased.

FIGS. 11 and 12 show a second embodiment of a flat circuit connector, generally designated 14A. In this embodiment, upper hook arms 22a of first terminals 22 do not have downwardly projecting bearing portions 32a. In addition, dielectric housing 16 has a recess 66 to accommodate the leading end of a flat circuit. Otherwise, like reference numerals have been applied in FIGS. 11 and 12 corresponding to like components described above in relation to FIGS. 1-8.

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 terminating a flat electrical circuit, comprising:

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

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

an actuator movably mounted for pivotal movement between an open position allowing the flat circuit to be inserted into said opening with substantially zero insertion forces, a closed position biasing the flat circuit against contact portions of the terminals and an intermediate position whereat the flat circuit is tentatively held in stable condition while allowing readjustment thereof.

2. The electrical connector of claim 1 wherein some of said terminals are generally U-shaped to define an upper hook arm extending over the opening and a lower contact arm extending below the opening, the hook arm having a bearing portion and the contact arm having a contact portion, with the flat circuit being tentatively held between the bearing portion and the contact portion in said intermediate position of the actuator.

3. The electrical connector of claim 2 wherein said some of the terminals are mounted on the housing from the front end of the housing.

4. The electrical connector of claim 2 wherein said some of the terminals have tail portions for connection to appropriate circuit traces on a printed circuit board.

5. The electrical connector of claim 2 wherein said some of the terminals have hook portions cooperating with pivot means on the actuator to mount the actuator for pivotal movement between said positions.

6. The electrical connector of claim 1 wherein some of said terminals are generally U-shaped to define an upper cam arm extending over the opening and a lower contact arm extending below the opening, the upper cam arm engaging a cam portion of the actuator to lift the actuator in said intermediate position thereof.

7. The electrical connector of claim 6 wherein said some of the terminals are mounted on the housing from a rear end of the housing.

8. The electrical connector of claim 6 wherein said some of the terminals have tail portions for connection to appropriate circuit traces on a printed circuit board.

9. The electrical connector of claim 1 wherein some of said terminals have detent means engageable with complementary detent means on the actuator to hold the actuator in said intermediate position thereof.

10. The electrical connector of claim 9 wherein said detent means comprise interengaging flat surfaces on the actuator and said some of the terminals.

11.The electrical connector of claim 1, including at least one fitting nail fixed to the housing for securement to a printed circuit board, the fitting nail having a bearing portion for engaging the actuator and facilitating pivotally mounting the actuator on the connector.

12. An electrical connector for terminating a flat electrical circuit, comprising:

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

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

an actuator movably mounted for pivotal movement between an open position allowing the flat circuit to be inserted into said opening with substantially zero insertion forces, a closed position biasing the flat circuit against contact portions of the terminals and an intermediate

position whereat the flat circuit is tentatively held in stable condition while allowing readjustment thereof;

a first plurality of said terminals being generally U-shaped to define an upper hook arm extending over the opening and a lower contact arm extending below the opening, the hook arm having a bearing portion and the contact arm having a contact portion, with the flat circuit being tentatively held between the bearing portion and the contact portion in said intermediate position of the actuator; and

a second plurality of said terminals being generally U-shaped to define an upper cam arm extending over the opening and a lower contact arm extending below the opening, the upper cam arm engaging a cam portion of the actuator to lift the actuator in said intermediate position thereof.

13. The electrical connector of claim 12 wherein said first terminals are mounted on the housing from the front end thereof and said second terminals are mounted on the housing from the rear end thereof.

14. The electrical connector of claim 12 wherein all of said terminals have tail portions for connection to appropriate circuit traces on a printed circuit board.

15. The electrical connector of claim 12 wherein said first terminals have hook portions cooperating with pivot means on the actuator to mount the actuator for pivotal movement between said positions.

16. The electrical connector of claim 12 wherein said first terminals have detent means engageable with complementary detent means on the actuator to hold the actuator in said intermediate position thereof.

17. The electrical connector of claim 16 wherein said detent means comprise interengaging flat surfaces on the actuator and the first terminals.

18. The electrical connector of claim 12, including at least one fitting nail fixed to the housing for securement to a printed circuit board, the fitting nail having a bearing portion for engaging the actuator and facilitating pivotally mounting the actuator on the connector.

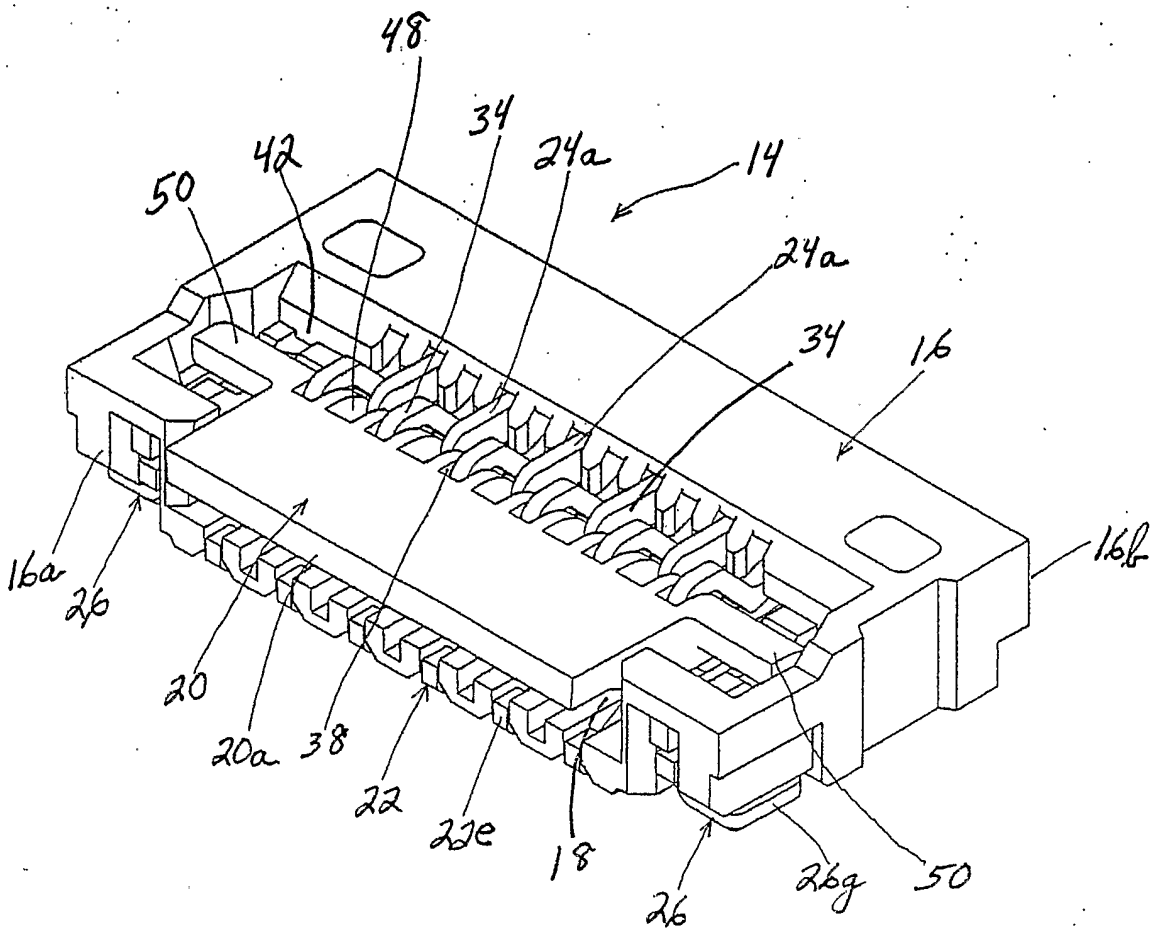


FIG. 1

FIG. 2

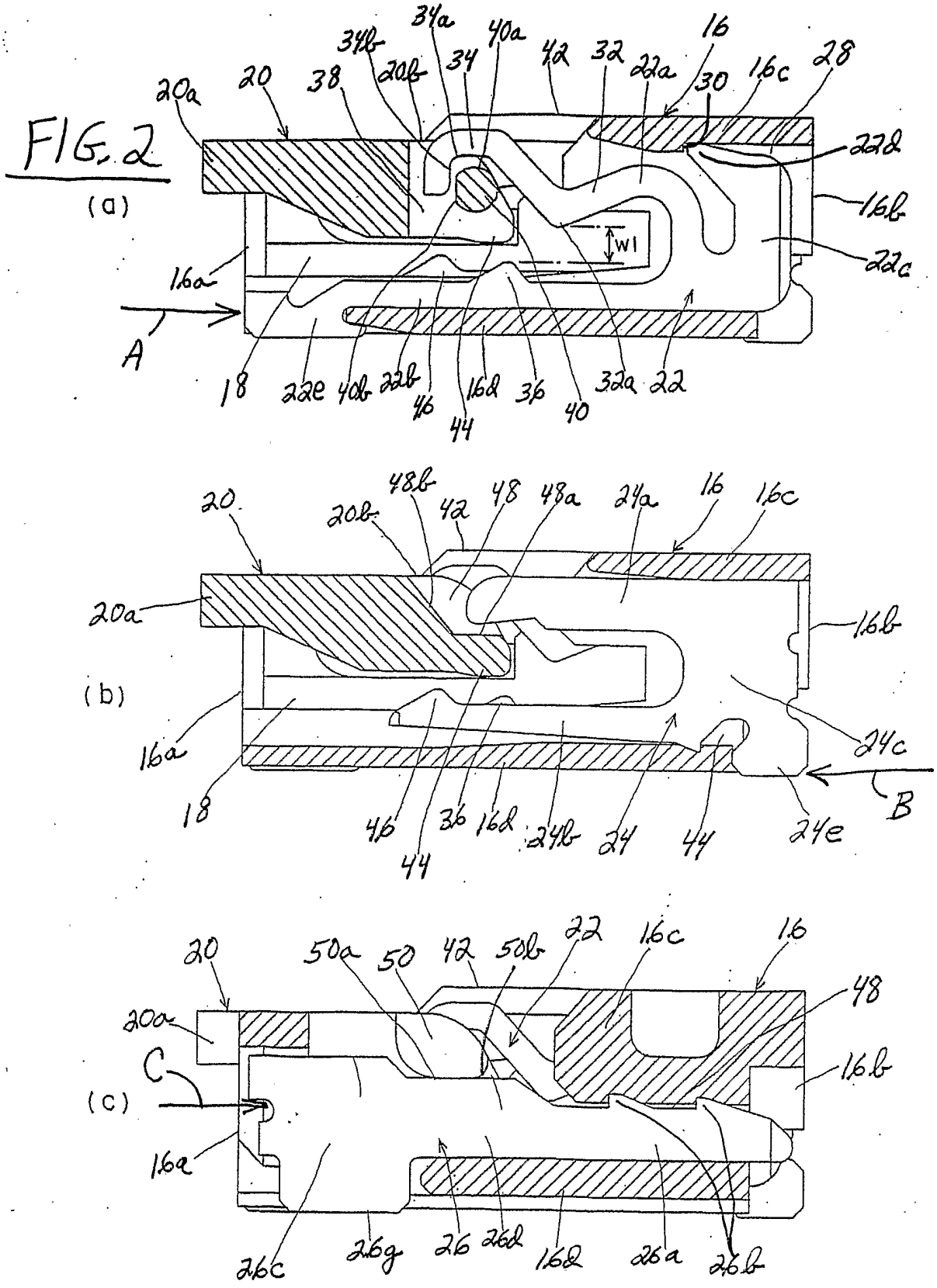

(a)
20a
20
38
34b
34a
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22c
W1
16a
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FIG.3

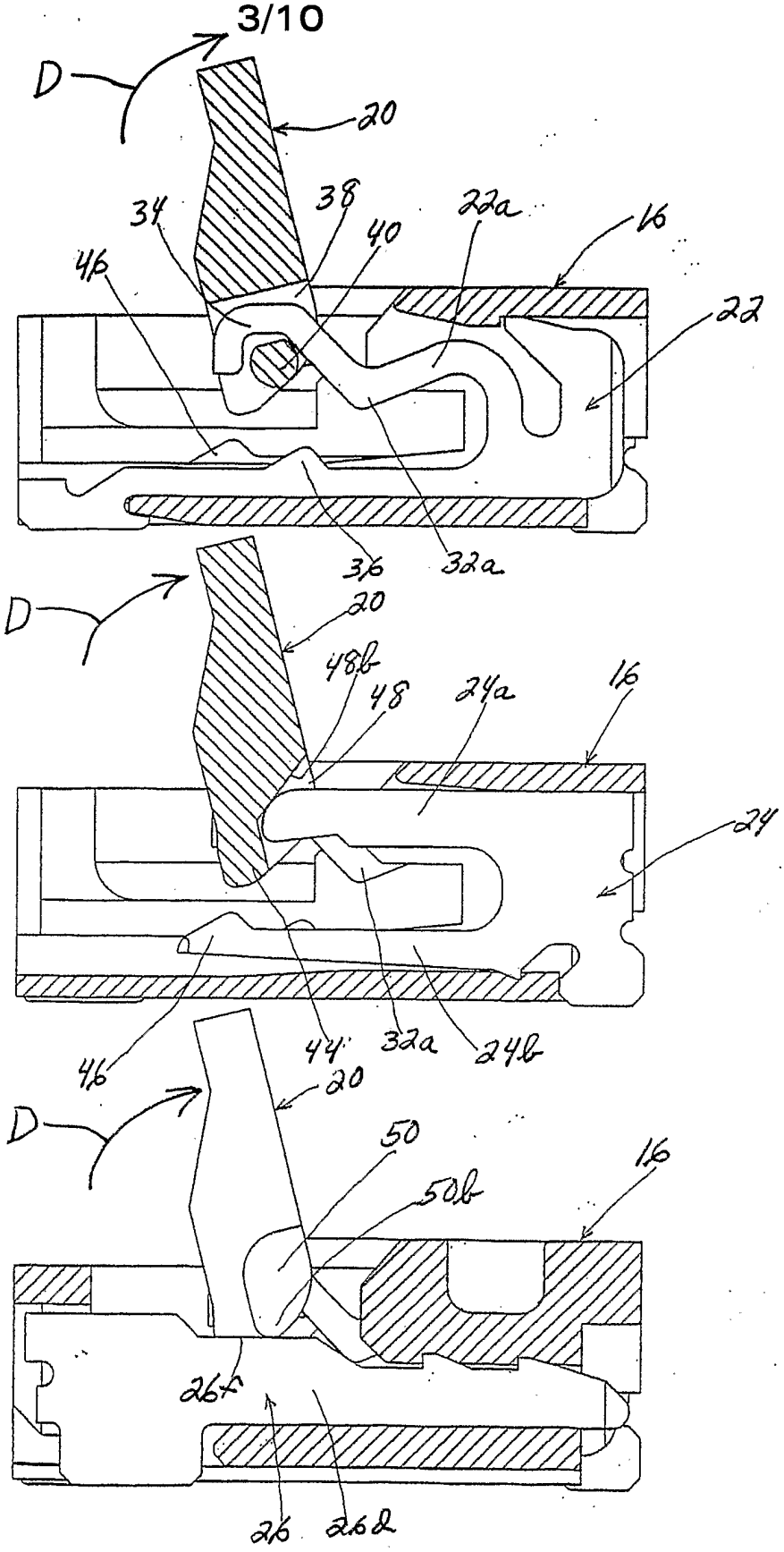

(a)
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FIG. 4

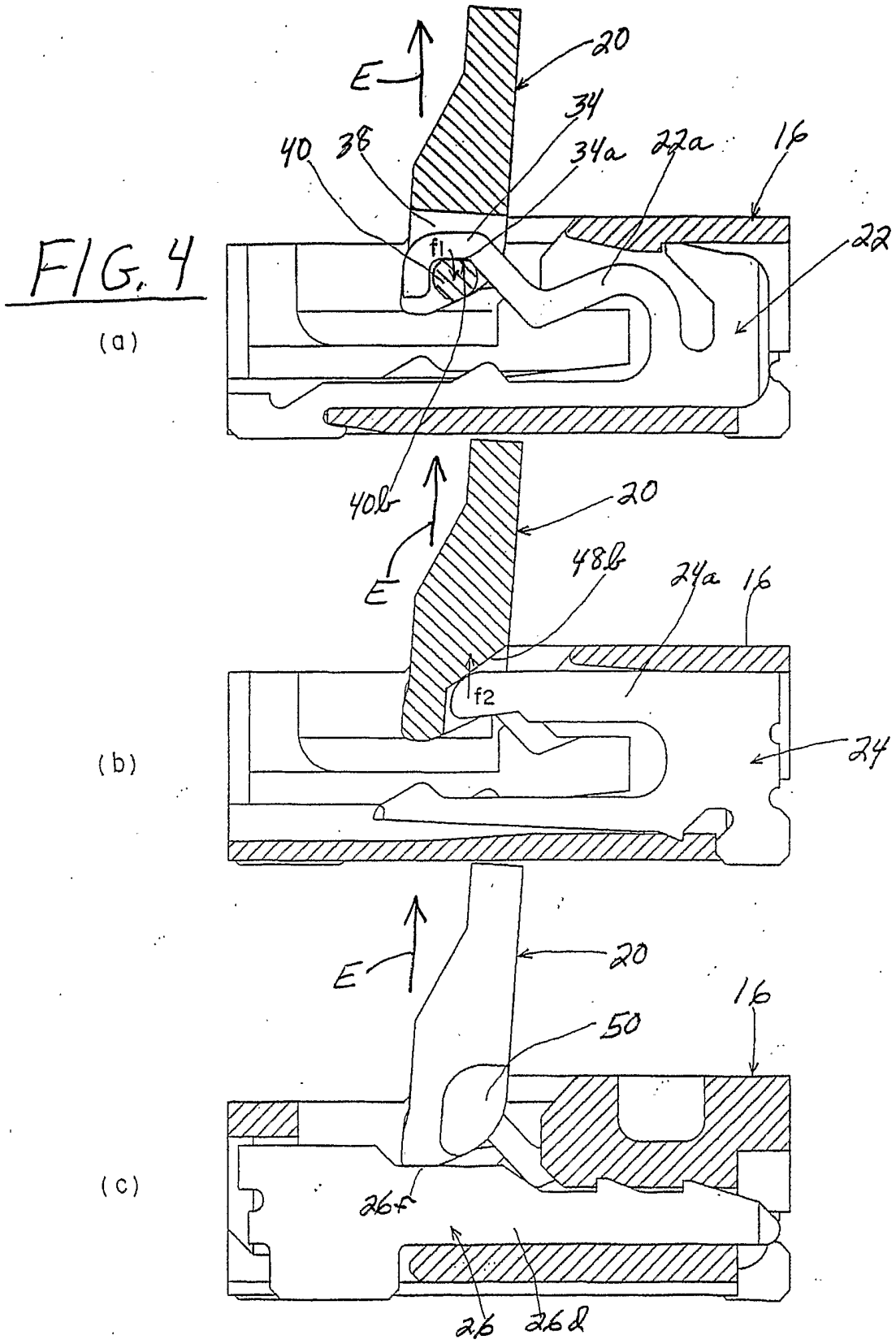

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FIG. 5

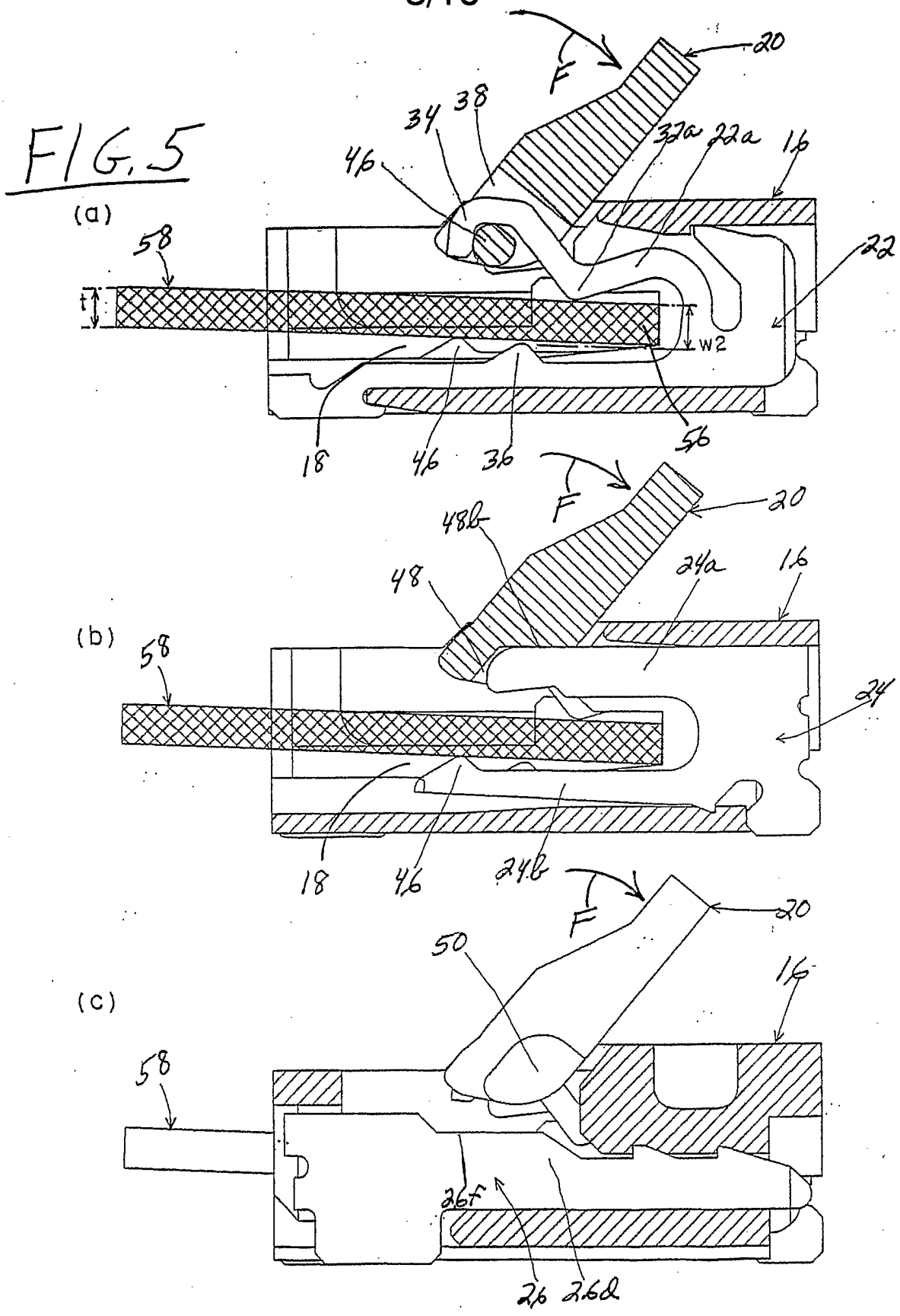

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26a

FIG. 6

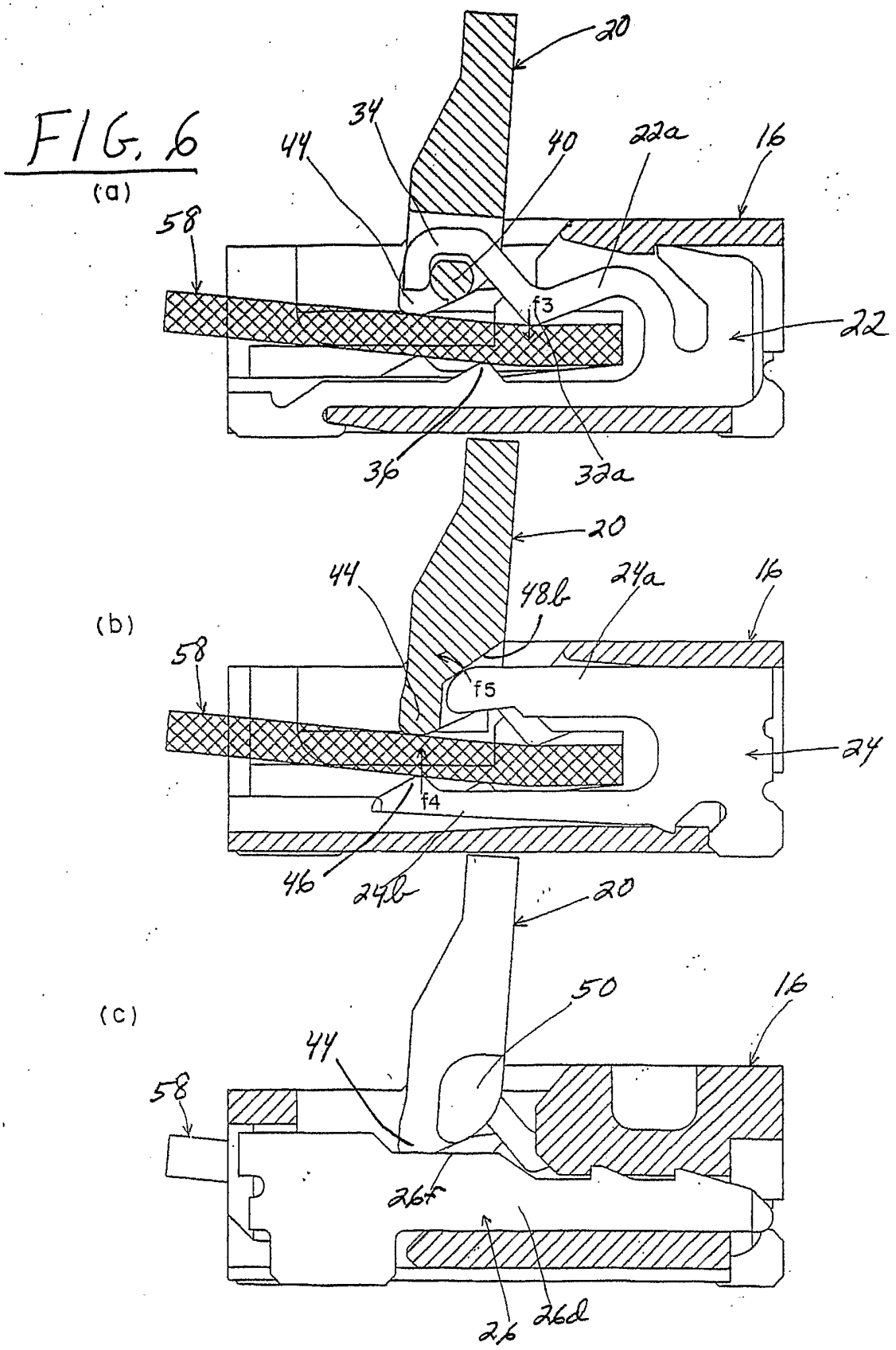

(a)
20
34
44
40
22a
16
58
f3
22
36
32a
(b)
20
44
48b
24a
16
58
f5
24
f4
46
24b
(c)
20
50
16
44
58
26f
26d
26

FIG. 7

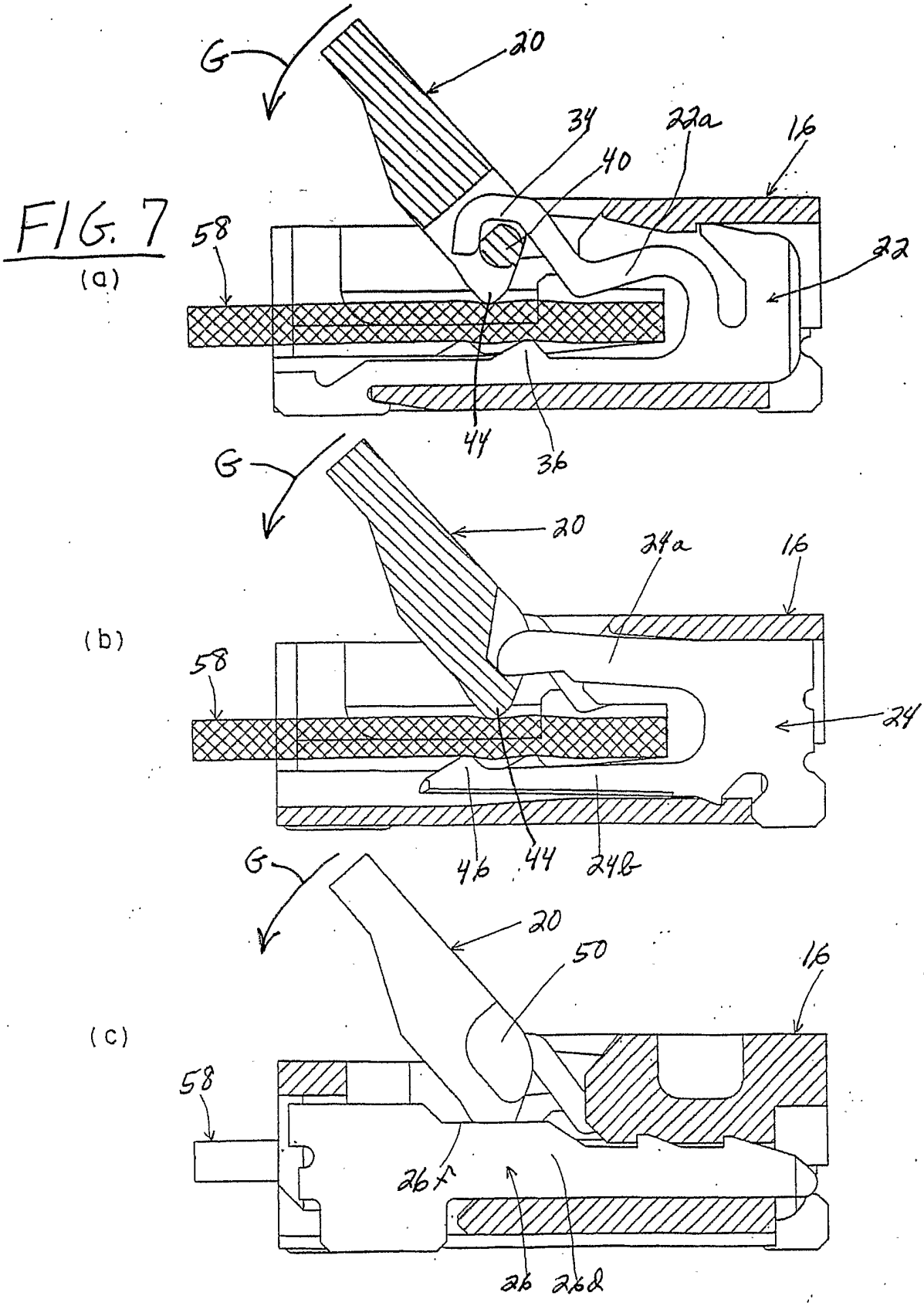
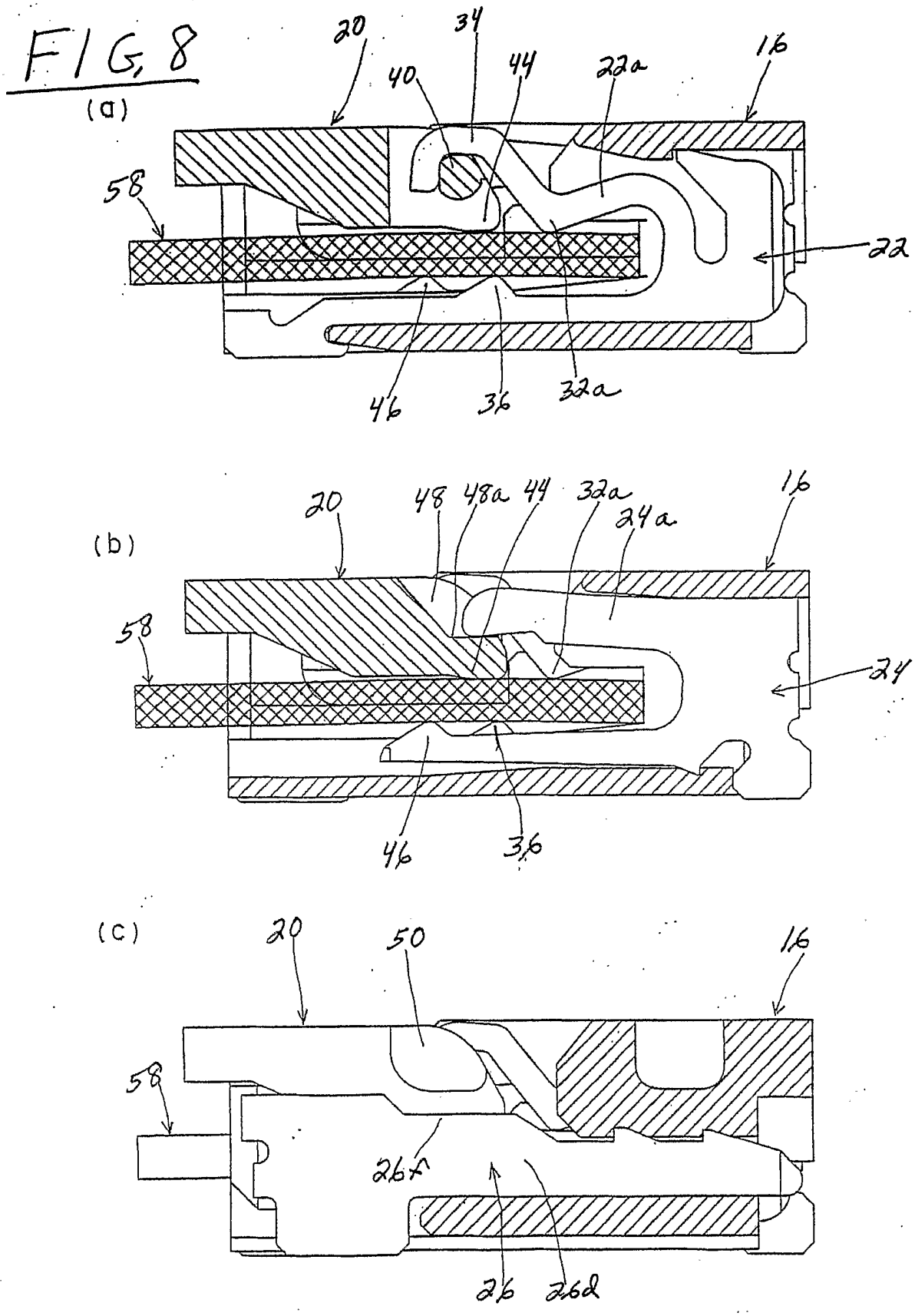

(a)
G
20
34
22a
16
40
58
22
44
36
(b)
G
20
24a
16
58
24
46
44
24B
(c)
G
20
50
16
58
26A
26
26B

FIG. 8


(a)
20
34
40
44
22a
16
58
22
46
36
32a
(b)
20
48
48a
44
32a
24a
16
58
24
46
36
(c)
20
50
16
58
26f
26
26d

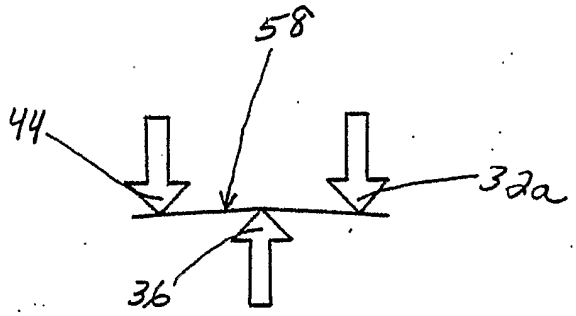


FIG. 9

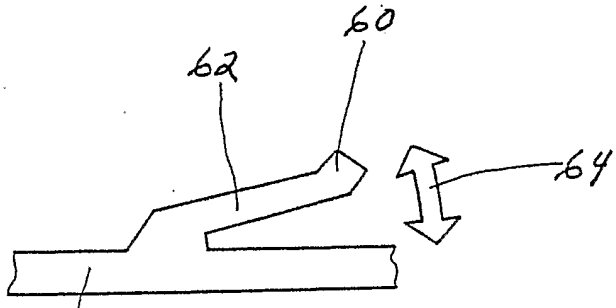


FIG. 10

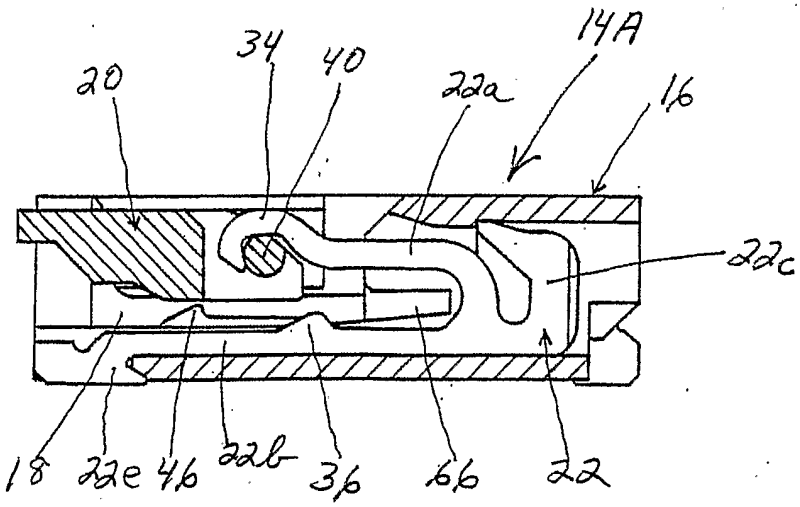


FIG. 11

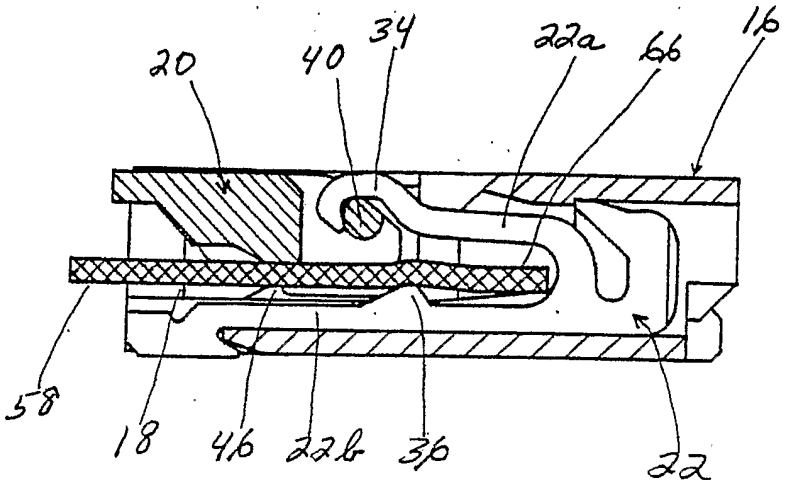


FIG. 12

INTERNATIONAL SEARCH REPORT

International application No
PCT/US2005/023548

A. CLASSIFICATION OF SUBJECT MATTER
H01R12/28

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)
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, PAJ

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	PATENT ABSTRACTS OF JAPAN vol. 2003, no. 03, 5 May 2003 (2003-05-05) & JP 2002 329536 A (KYOCERA ELCO CORP), 15 November 2002 (2002-11-15) cited in the application abstract	1,6,12
A	EP 1 378 966 A (HIROSE ELECTRIC CO., LTD) 7 January 2004 (2004-01-07) paragraph '0019!; figure 3	1-5,12
A	EP 1 311 028 A (MOLEX INCORPORATED) 14 May 2003 (2003-05-14) paragraphs '0024!, '0025!; figures 8-10	11,18
A	US 6 116 947 A (TAKAYASU ET AL) 12 September 2000 (2000-09-12) column 3, line 31 - line 54; figures 1-3	1,12

-/--

[X] Further documents are listed in the continuation of Box C.

[X] See patent family annex.

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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
31 January 2006	09/02/2006

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL – 2280 HV Rijswijk Tel. (+31–70) 340–2040, Tx. 31 651 epo nl, Fax: (+31–70) 340–3016	Jiménez, J

INTERNATIONAL SEARCH REPORT

International application No
PCT/US2005/023548

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	EP 0 743 715 A (MOLEX INCORPORATED) 20 November 1996 (1996-11-20) column 4, line 47 - column 5, line 25; figures 11-22	1,12
A	US 5 580 272 A (YAMAGUCHI ET AL) 3 December 1996 (1996-12-03) abstract; figures 3,4	1,12

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/US2005/023548

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
JP 2002329536 A	15-11-2002	NONE	
EP 1378966 A	07-01-2004	CN 1476126 A	18-02-2004
		JP 2004039321 A	05-02-2004
		US 2004002254 A1	01-01-2004
EP 1311028 A	14-05-2003	CN 1419317 A	21-05-2003
		JP 3666445 B2	29-06-2005
		JP 2003151660 A	23-05-2003
		TW 549650 Y	21-08-2003
		US 2003092310 A1	15-05-2003
US 6116947 A	12-09-2000	DE 69821836 D1	01-04-2004
		EP 0895320 A2	03-02-1999
		JP 3356265 B2	16-12-2002
		JP 11054218 A	26-02-1999
		TW 540853 Y	01-07-2003
EP 0743715 A	20-11-1996	DE 69611320 D1	01-02-2001
		DE 69611320 T2	13-06-2001
		ES 2154362 T3	01-04-2001
		JP 2824747 B2	18-11-1998
		JP 8321365 A	03-12-1996
		KR 212925 B1	02-08-1999
		SG 66309 A1	20-07-1999
		US 5695360 A	09-12-1997
US 5580272 A	03-12-1996	CA 2150845 A1	06-02-1996
		DE 69515229 D1	06-04-2000
		DE 69515229 T2	30-11-2000
		EP 0696090 A2	07-02-1996
		JP 2892945 B2	17-05-1999
		JP 8050968 A	20-02-1996
		KR 154609 B1	16-11-1998