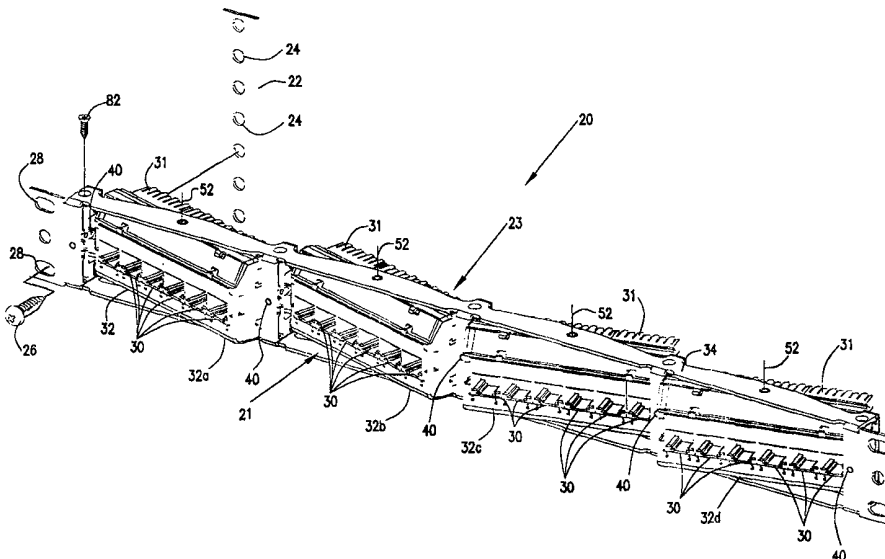




## INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

<p>(51) International Patent Classification<sup>6</sup> : <b>H01R 13/518</b></p>	<p><b>A1</b></p>	<p>(11) International Publication Number: <b>WO 99/63628</b></p> <p>(43) International Publication Date: 9 December 1999 (09.12.99)</p>
<p>(21) International Application Number: PCT/US99/11120</p> <p>(22) International Filing Date: 20 May 1999 (20.05.99)</p> <p>(30) Priority Data: 09/092,545                      5 June 1998 (05.06.98)                      US</p> <p>(71) Applicant: ADC TELECOMMUNICATIONS, INC. [US/US]; 12501 Whitewater Drive, Minnetonka, MN 55343 (US).</p> <p>(72) Inventor: FOLLINGSTAD, Michael, Jay; 5825 York Avenue South, Edina, MN 55410 (US).</p> <p>(74) Agent: BRUESS, Steven, C.; Merchant &amp; Gould P.C., 3100 Norwest Center, 90 South Seventh Street, Minneapolis, MN 55402-4131 (US).</p>		<p>(81) Designated States: AE, AL, AM, AT, AT (Utility model), AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CU, CZ, CZ (Utility model), DE, DE (Utility model), DK, DK (Utility model), EE, EE (Utility model), ES, FI, FI (Utility model), GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SK (Utility model), SL, TJ, TM, TR, TT, UA, UG, UZ, VN, YU, ZA, ZW, ARIPO patent (GH, GM, KE, LS, MW, SD, SL, SZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).</p> <p><b>Published</b> <i>With international search report. Before the expiration of the time limit for amending the claims and to be republished in the event of the receipt of amendments.</i></p>

(54) Title: TELECOMMUNICATIONS PATCH PANEL WITH ANGLED CONNECTOR MODULES AND METHOD OF ASSEMBLING SUCH A PANEL



## (57) Abstract

A telecommunications patch panel is provided having a plurality of connector modules rotatably mounted to a frame member. Each connector module has a front face and an opposite facing rear face, and each front face includes a plurality of connector jacks. Each rear face includes a plurality of wire termination blocks. The wire termination blocks are electrically connected to the connector jacks. Each connector module is rotatable about a rotation axis relative to the frame member. A lock selectively locks each connector module to the frame member as desired. The connector jacks and the connector modules are arranged in linear arrays perpendicular to the axis of rotation.

**FOR THE PURPOSES OF INFORMATION ONLY**

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.

AL	Albania	ES	Spain	LS	Lesotho	SI	Slovenia
AM	Armenia	FI	Finland	LT	Lithuania	SK	Slovakia
AT	Austria	FR	France	LU	Luxembourg	SN	Senegal
AU	Australia	GA	Gabon	LV	Latvia	SZ	Swaziland
AZ	Azerbaijan	GB	United Kingdom	MC	Monaco	TD	Chad
BA	Bosnia and Herzegovina	GE	Georgia	MD	Republic of Moldova	TG	Togo
BB	Barbados	GH	Ghana	MG	Madagascar	TJ	Tajikistan
BE	Belgium	GN	Guinea	MK	The former Yugoslav Republic of Macedonia	TM	Turkmenistan
BF	Burkina Faso	GR	Greece	ML	Mali	TR	Turkey
BG	Bulgaria	HU	Hungary	MN	Mongolia	TT	Trinidad and Tobago
BJ	Benin	IE	Ireland	MR	Mauritania	UA	Ukraine
BR	Brazil	IL	Israel	MW	Malawi	UG	Uganda
BY	Belarus	IS	Iceland	MX	Mexico	US	United States of America
CA	Canada	IT	Italy	NE	Niger	UZ	Uzbekistan
CF	Central African Republic	JP	Japan	NL	Netherlands	VN	Viet Nam
CG	Congo	KE	Kenya	NO	Norway	YU	Yugoslavia
CH	Switzerland	KG	Kyrgyzstan	NZ	New Zealand	ZW	Zimbabwe
CI	Côte d'Ivoire	KP	Democratic People's Republic of Korea	PL	Poland		
CM	Cameroon	KR	Republic of Korea	PT	Portugal		
CN	China	KZ	Kazakstan	RO	Romania		
CU	Cuba	LC	Saint Lucia	RU	Russian Federation		
CZ	Czech Republic	LI	Liechtenstein	SD	Sudan		
DE	Germany	LK	Sri Lanka	SE	Sweden		
DK	Denmark	LR	Liberia	SG	Singapore		
EE	Estonia						

TELECOMMUNICATIONS PATCH PANEL WITH ANGLED CONNECTOR MODULES AND METHOD OF ASSEMBLING SUCH A PANEL

### **Field of the Invention**

5                   The present invention relates to a telecommunications connecting panel and, more particularly, to a cross-connect patch panel including a frame with jacks on one side and wire termination locations on an opposite side.

### **Background of the Invention**

10                   Local area networks and telecommunications connections often use patch panels, especially at the customer's premises to enable cross-connection between telecommunications equipment. Patch panels typically include front and rear connection locations. The rear connections are typically a more permanent type of connection, such as insulation displacement connectors to connect to copper  
15 based, twisted pair telecommunications cable. The front connections of the patch panel may include any of a variety of jacks for receipt of a plug of a patch cord or other transmission cable. The jack and plug allows fairly rapid connection and disconnection between two jacks in the same patch panel, or between one jack in the patch panel and another jack in a nearby patch panel, with the patch cord. One type  
20 of jack and plug arrangement for a patch panel is an RJ45 type connector. U.S. Patent No. 5,639,261 is an example of a cross-connect panel including rear insulation displacement connectors, and front connector jacks for receiving plugs of patch cords.

                    There is an increasing need for cable management in order to protect  
25 and organize the various cables. One area where damage and/or loss of performance may occur with copper based, twisted pair cables is when excessive bending of the cable occurs. This is especially a concern as higher frequencies are used, such as category 5 and greater. Falling below minimum bend radii of the cables can adversely affect performance with the transmission of signals through the copper  
30 wire patch cords. Therefore, there is a need for patch panels which address the cable management concerns noted above.

### **Summary of the Invention**

35                   A telecommunications patch panel according to one aspect of the invention includes a connector module, and a frame member for mounting the connector module. The connector module includes a connector jack along a front face. A rear face includes a connection location for connecting to a conductive wire or other transmission cable. Each connector module defines an axis of rotation

relative to the frame member generally parallel to the front face. The connector module is positionable in one of three positions, a parallel position to the frame member, a first angled position relative to the frame member, and a second angled position relative to the frame member where the second angled position is in an opposite direction to the first angled position.

A plurality of connector modules in at least one linear array are preferably provided. Preferably, a plurality of connector jacks are provided on each connector module. The connector jacks are preferably arranged in linear arrays generally perpendicular to each axis of rotation of the connector module or modules.

Locks are provided to lock the connector modules to the frame member in one of the selected positions.

According to another aspect of the present invention, a telecommunication patch panel includes a plurality of connector modules including linear arrays of connector jacks with each jack connected to a wire termination block. The connector modules are mounted to a frame member where each of the linear arrays of connector jacks is positioned at an angle relative to a front face of the frame member.

#### **Brief Description of the Drawings**

Figure 1 is an exploded perspective view of an embodiment of a patch panel and a portion of a rack for holding the patch panel in accordance with the present invention, with two connector modules angled to the left and two connector modules angled to the right when the panel is mounted to the rack horizontally;

Figure 2 is a top view of the patch panel of Figure 1, showing front and rear connections to cables;

Figure 3 is a perspective view of the patch panel of Figure 1, showing all of the connector modules extending parallel to the frame;

Figure 4 is a top view of the patch panel of Figure 3, showing front and rear connections to cables;

Figure 5 is a perspective view of the patch panel of Figure 1, showing all of the connector modules angled to the left side of the frame;

Figure 6 is a perspective view of the patch panel of Figure 1, showing all of the connector modules angled to the right side of the frame;

Figure 7 is an exploded perspective view of the patch panel of Figure 1;

Figure 8 is an exploded top view of the patch panel of Figure 1;

Figure 9 is a rear perspective view of the locking pin of the patch panel of Figure 1;

Figure 10 is a perspective view of the bracket of the patch panel of Figure 1;

5 Figure 11 is a perspective view of the connector module of the patch panel of Figure 1;

Figure 12 is a top view of the connector module of Figure 11;

Figure 13 is a front view of the connector module of Figure 11;

10 Figure 14 is a side view of the connector module of Figure 11, an opposite side being a mirror image;

Figure 15 is a rear view of the connector module of Figure 11;

Figure 16 is a bottom view of the connector module of Figure 11; and

Figure 17 is a rear perspective view of the circuit module of the connector module of Figure 11.

15

### **Detailed Description of the Preferred Embodiment**

Referring now to Figures 1 and 2, an embodiment of a patch panel 20 is shown for use in connecting telecommunications equipment. Patch panel 20 is especially useful to cross-connect equipment through one or more of patch panels 20 or other panels. Patch panel 20 mounts to a rack 22 of conventional construction, such as with fasteners 26 passing through holes 28 of patch panel 20 for receipt in holes 24 of rack 22. Patch panel 20 includes a plurality of connector jacks 30, such as RJ45 connector jacks, on a front side 21. Patch panel 20 further includes a plurality of connection locations 31, such as wire termination or connection blocks 31 mounted on an opposite rear side 23. Preferably, termination blocks 31 include 110 type insulation displacement connectors. Termination blocks 31 allow for connection of signal transmission cables 46, each containing a plurality of conductive wires 48. Connector jacks 30 allow for connection of signal transmission patch cables or cords 44 including conductive wires and further including connector end plugs 42. Circuitry electrically connects each termination block 31 to a connector jack 30.

Patch panel 20 includes a plurality of connector modules 32, where each connector module 32 includes a plurality of connector jacks 30. The connector modules 32 of patch panel 20 are arranged in a linear array. Each connector module 32 includes a linear array of connector jacks 30. One linear array of jacks 30 is shown per connector module 32. Two or more arrays could be provided. Alternative embodiments include patch panels 20 with a single connector module

32. Also, each connector module 32 may be constructed with a single connector jack 30.

As shown in Figures 1 and 2, each connector module 32 is mounted in an angled orientation relative to frame 34. Specifically, frame 34 includes a front plane or face 36, and each connector module 32 includes a front plane or face 37 where each front face 37 of the connector modules 32 is at an angle relative to front face 36 of frame 34. Connector modules 32a, 32b are angled to the left of frame 34, and connector modules 32c, 32d are angled to the right. Alternatively stated, connector modules 32a, 32b are angled clockwise, and connector modules 32c, 32d are angled counterclockwise, as viewed from a top of frame 34 as depicted in Figure 2. If patch panel 20 was oriented vertically, then connector module 32a, 32b would be angled upwardly (or downwardly), and connector modules 32c, 32d would be angled downwardly (or upwardly).

In the illustrated preferred embodiment, the angle of displacement of each connector module 32 relative to frame 34 is about 15 degrees. In the case of patch cords 44a, 44b angled to the left, and patch cords 44c, 44d angled to the right, such an angle provides strain relief so as to help prevent cable damage and/or loss of cable performance. The cable positioning provided by the angled connector modules 32 helps reduce the likelihood of falling below the minimum bend radius of the cable as each cable travels to other jacks or other equipment. Such strain relief is advantageous over a perpendicular mounting of the connector plug relative to the cable pathway, such as illustrated in Figure 4.

Figures 3 and 4 are provided to illustrate advantageous features of patch panel 20 in accordance with the invention. Preferably, connector modules 32 are rotatable relative to frame 34. In Figures 3 and 4, each connector module 32 has its front face 37 positioned generally parallel to front face 36 of frame 34. Such an arrangement is useful when using a termination tool (not shown) to mount wires 48 to each of termination blocks 31 in the case of insulation displacement connectors. A lock 40, shown generally in Figures 1 and 2, holds each connector module 32 to frame 34 during the termination operation. Lock 40 is releasable to allow rotation of each connector module 32 as desired. As shown in Figures 1 and 2, connector modules 32a, 32b are rotated to the left, and connector modules 32c, 32d are rotated to the right. One or more connector modules 32 can be left in the positions shown in Figures 3 and 4, if desired. Alternatively, all the connector modules 32 can be rotated to the left as shown in Figure 5, or to the right as shown in Figure 6. To maintain the connector modules in the rotated positions, lock 40 is reactivated. If desired, one or more of the connector modules 32 and frame 34 can be constructed in a permanently angled configuration relative to front face 36 frame 34.

In Figures 2 and 4, cables 44 are shown as being directed away from patch panel 20. It is to be noted that the opposite ends of cables 44 can be connected to other connector jacks 30 of patch panel 20. Also, patch panel 20 is useable in both cross-connect systems, and in inter-connect systems, as desired. Providing strain relief so as to not fall below minimum bend radii is also an issue with fiberoptic transmission cables. The telecommunications patch panel 20 of the present invention is also useful in fiber applications with appropriately configured fiberoptic connectors.

Lock 40 is a preferred feature for patch panel 20. However, a patch panel 20 where the lock is not activated, or a patch panel 20 where no lock is present are both advantageous arrangements. In those instances, each connector module 32 is positionable to the left (fully or partially), to the right (fully or partially) or parallel as desired. For connector modules which are freely rotatable, the modules 32 may move to a new position from an original position to provide the strain relief, as the patch cords 44 are added or changed.

Referring now to Figures 7 through 17, additional details of patch panel 20 are shown. Each connector module 32 includes pins 50 extending in opposite directions and defining a rotation axis 52 (see Figure 11). Each rotation axis 52 is generally perpendicular to the linear array defined by connector jacks 30. Pins 52 are received in holes 54 of frame 34. The rotatable mounting of each connector module 32 to frame 34 could also be accomplished with a fastener passing through holes 54.

Frame 34 generally includes a top portion 34a and an opposing bottom portion 34b. End bracket portions 34c, 34d on opposite ends of frame 34 include rack mounting holes 28 noted above. End struts 34e are continuous with end bracket portions 34c, 34d. Middle struts 34f extend between top and bottom portions 34a, 34b. Struts 34e, 34f and top and bottom portions 34a, 34b define a linear array of openings for each receiving a connector module 32. Holes 54 of frame 34 are positioned in top and bottom portions 34a, 34b for holding the independently rotatable connector modules 32 about each respective rotation axis 52. The rotation axes 52 extend transversely relative to the linear arrays of connector jacks 30, and also a linear array defined by the plurality of connector modules 32.

A plurality of locking pins 60, and brackets 76 are mounted to frame 34. Each locking pin 60 includes a shaft 62, two spaced apart tabs 64, 66, a first tool engageable end 68, and an opposite end 70. Each tab 64, 66 has two ends extending in opposite directions. End 70 is received in hole 56 in a respective end or middle strut 34e, 34f. Tool engageable end 68 is received in an aperture 80 of bracket 76. Bracket 76 is mounted to top and bottom portions 34a, 34b of frame 34 with two

fasteners 82 positioned through apertures 58. Each fastener 82 is received in a hole 78 of bracket 76. Once brackets 76 are mounted to frame 34, locking pin 60 is rotatable between an unlocked position, and a locked position. The locked position is shown in the Figures. The unlocked position is where shaft 62 is rotated 90  
5 degrees about its longitudinal axis, such as with a flathead screwdriver received in tool engageable end 68.

Each connector module 32 includes detents 84, 86 on each end. Lock 40 is constructed wherein tabs 64, 66 are received in detents 84, 86 when connector module 32 is locked in the position shown in Figure 3. When connector modules 32  
10 are rotated out of plane 36 of frame 34, only one tab 64, 66 is received in one of detents 84, 86. When lock 40 is rotated 90 degrees from the position shown in the Figures, none of tabs 64, 66 are received in any of detents 84, 86 so as to allow free rotation of connector modules 32. Locks 40 associated with middle struts 34f of frame 34 each lock two adjacent connector modules 32.

Each connector module 32 includes a circuit module 90 and a face plate 92. Circuit module 90 includes a printed circuit board 94 having a generally planar construction. As shown in Figure 17, pins 96 of each termination block 31 project through printed circuit board 94 and are soldered to the board. As shown in  
15 Figure 15, connector jacks 30 include pins 98 projecting through printed circuit board 94, and the pins are soldered to the board. Connector jacks 30 also include two tabs 102 which snap mount to printed circuit board 94 through apertures 100 as shown in Figure 15. Printed circuit board 94 includes circuit pathways to electrically link each connector jack 30 with one of the termination blocks 31. Connector jacks  
20 30 are shown in the Figures with the clip receiving portion of the jack facing vertically downwardly.

Face plate 92 preferably snap mounts to circuit module 90. Opposite ends 110 of face plate 90 include inner snaps 112 for snap fitting engagement of an edge of printed circuit board 94. (See, for example, Figure 12). Such a construction allows for repair or replacement of circuit module 90 or face plate 92, as desired.

Face plate 92 includes a central opening 108 for exposing connector jacks 30. Face plate 92 further includes outwardly facing stops 114 on each end 110 which limit the amount of rotation of connector module 32 during use. Each stop 114 engages one edge 116 of bracket 76 so as to limit the amount of rotation of connector module to approximately plus or minus 15 degrees in the preferred  
30 embodiment. Each face plate includes a front designation strip area 120 for labeling of connector jacks 30.



Examples of connector jacks 30 and termination blocks 31 are shown in U.S. Patent Nos. 5,700,167; 5,674,093; 5,639,261; 5,591,045; 5,310,363; 5,299,956; and 3,611,264.

5 The above specification and examples provide a complete description of the manufacture and use of the invention. Since many embodiments of the invention can be made without departing from the spirit and scope of the invention, the invention resides in the claims hereinafter appended.

**What Is Claimed Is:**

1. A telecommunications patch panel comprising:
  - a connector module having a front face and an opposite facing rear face, the front face of the connector module including a connector jack for receiving a plug of a first conductive wire, the rear face including a connection location for connecting to a second conductive wire, the connection location electrically connected to the connector jack, the connector module defining an axis of rotation generally parallel to the front face;
  - a frame member having a front face, the connector module rotatably mounted to the frame member for movement about the rotation axis, wherein the front face of the connector module is positionable in at least one of three selectable positions, a first position where the front face of the connector module is generally parallel to the front face of the frame member, a first angled position where the front face of the connector module is at a first angle relative to the front face of the frame, and a second angled position where the front face of the connector module is at a second angle relative to the front face of the frame in an opposite direction to the first angled position.
2. The telecommunications patch panel of claim 1, further comprising brackets extending from the frame member for mounting to a rack.
3. The telecommunications patch panel of claim 1, further comprising a lock for selective locking the connector module to the frame member in one of the three selectable positions.
4. The telecommunications patch panel of claim 1, further comprising a plurality of the connector jacks, wherein the plurality of connectors jacks are arranged in a linear array generally perpendicular to the axis of rotation.
5. The telecommunications patch panel of claim 4, further comprising a plurality of connector modules, each of the plurality of connector modules including a plurality of the connector jacks, the connector modules arranged in at least one linear array.
6. The telecommunications patch panel of claim 1, further comprising a plurality of connector modules.

7. The telecommunications patch panel of claim 1, wherein the connector jack is an RJ45 jack.
8. The telecommunications patch panel of claim 1, wherein the connection  
5 location is a wire termination block.
9. The telecommunications patch panel of claim 1, wherein the connector module includes a printed circuit board, a face plate, and a snap arrangement for snap fitting the face plate to the printed circuit board, the connector jack mounted to  
10 the printed circuit board on one side of the printed circuit board, the connection location including an insulation displacement connector mounted to the printed circuit board on an opposite side to the connector jack, the face plate including an opening for exposing the connector jack.
- 15 10. A telecommunications patch panel comprising:  
a plurality of connector modules, each connector module having a front face and an opposite facing rear face, each front face including a plurality of connector jacks defining at least one linear array, each rear face including a plurality of cable connection locations, the cable connection locations connected to the connector  
20 jacks for transmission of telecommunications signals therebetween, each connector module defining an axis of rotation generally parallel to the front face, the linear arrays of connector jacks generally perpendicular to the respective rotation axes of the connector modules;  
a frame member having a front face and a linear array of openings, each of  
25 the connector modules mounted to the frame member in one of the openings for rotatable movement about the respective rotation axes.
11. The telecommunications patch panel of claim 10, wherein each of the connector modules is positionable in at least one of three selectable positions, a first  
30 position where the front face of the connector module is generally parallel to the front face of the frame member, a first angled position where the front face of the connector module is at a first angle relative to the front face of the frame, and a second angled position where the front face of the connector module is at a second angle relative to the front face of the frame in an opposite direction to the first angled  
35 position.
12. The telecommunications patch panel of claim 10, further comprising brackets extending from the frame member for mounting to a rack.

13. The telecommunications patch panel of claim 10, further comprising a lock for selective locking the connector module to the frame member.
14. The telecommunications patch panel of claim 10, wherein the connector  
5 jacks are sized to receive plugs of copper telecommunications cables, and the cable connection locations include wire termination blocks configured and arranged for receiving wires of copper telecommunications cables.
15. A telecommunications patch panel comprising:  
10 a plurality of connector modules, each connector module having a front face and an opposite facing rear face, each front face including a plurality of connector jacks defining at least one linear array, each rear face including a plurality of wire termination blocks, the wire termination blocks electrically connected to the  
15 connector jacks, each connector module defining an axis of rotation generally parallel to the front face, the linear arrays of connector jacks generally perpendicular to the respective rotation axes of the connector modules;  
a frame member having a front face, each of the connector modules mounted to the frame member for rotatable movement about the respective rotation axes, each of the connector modules positionable in one of three selectable positions, a first  
20 position where the front face of the connector module is generally parallel to the front face of the frame member, a first angled position where the front face of the connector module is at a first angle relative to the front face of the frame, and a second angled position where the front face of the connector module is at a second angle relative to the front face of the frame in an opposite direction to the first angled  
25 position;  
a stop for limiting rotation of each of the connector modules to a predetermined range of motion;  
a plurality of locks for selectively locking each of the connector modules to  
30 the frame member in one of the three selectable positions.
16. The telecommunications patch panel of claim 15, wherein at least one lock locks two adjacent connector modules to the frame member.
17. A telecommunications patch panel comprising:  
35 a plurality of connector modules, each connector module including at least one linear array of connector jacks, each connector jack connected to a wire termination block;

a frame member having a front face defining a front plane, the connector modules mounted to the frame member, each of the linear arrays of connector jacks positioned at an angle relative to the front plane of the front face.

5 18. The telecommunications patch panel of claim 17, wherein the connector modules are rotatably mounted to the frame member.

19. A method for assembling a telecommunications patch panel comprising:  
providing a frame member including a plurality of connector modules, each  
10 connector module having a front face and an opposite facing rear face, each front  
including a plurality of connector jacks defining at least one linear array, each rear  
face including a plurality of connection locations, the connection locations  
electrically connected to the connector jacks, each connector module defining an  
axis of rotation generally parallel to the front face, the linear arrays of the connector  
15 jacks generally perpendicular to the respective rotation axes;  
mounting a cable to one of the plurality of connection locations on a selected  
one of the connector modules;  
mounting a patch cord to the connector jack on the selected connector  
module connected to the connection location mounted to the cable;  
20 unlocking the selected connector module from a locked condition relative to  
the frame member;  
rotating the selected connector module relative to the frame member to a  
rotated position; and  
relocking the selected connector module in a rotated position relative to the  
25 frame member.

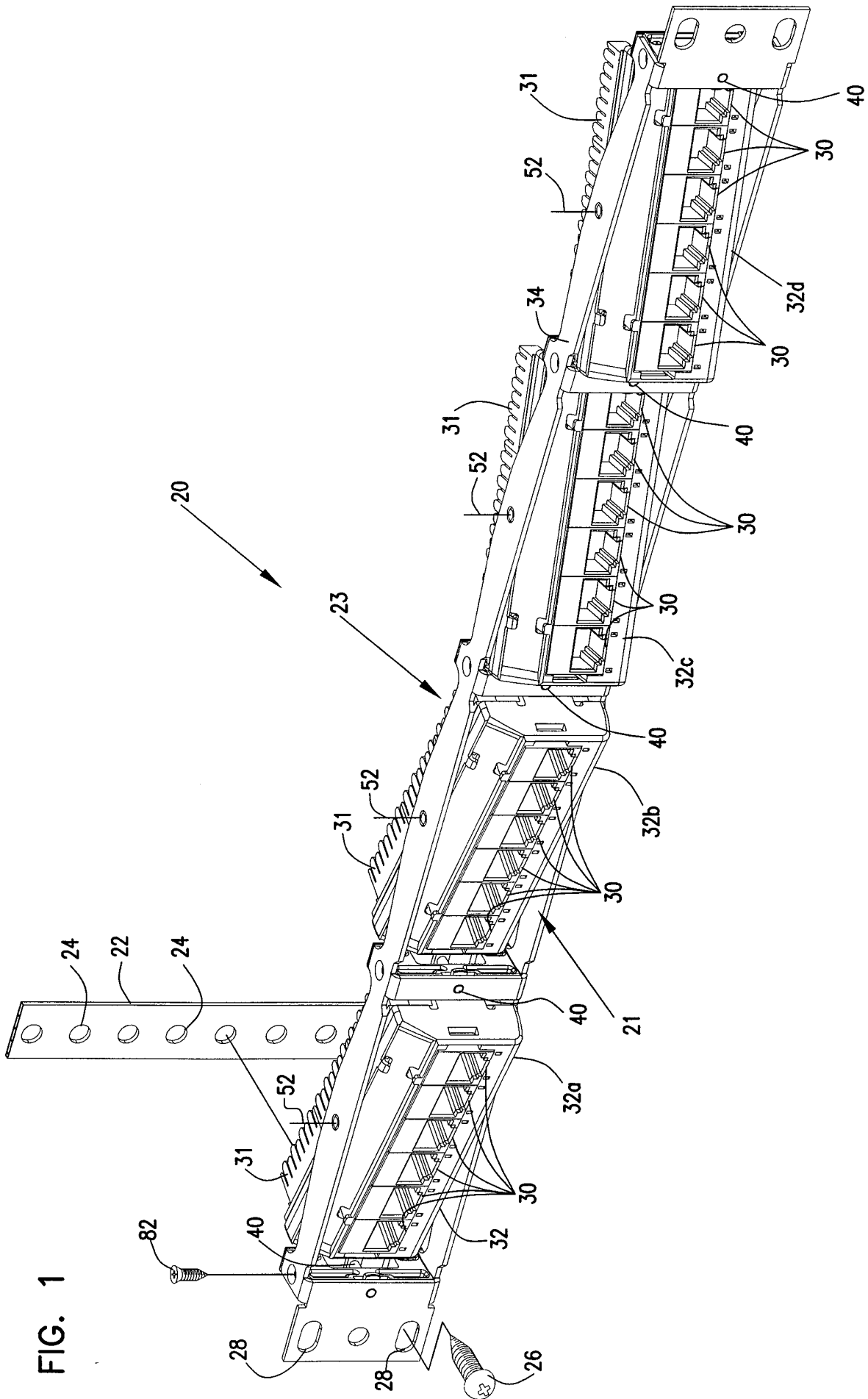


FIG. 1

FIG. 2

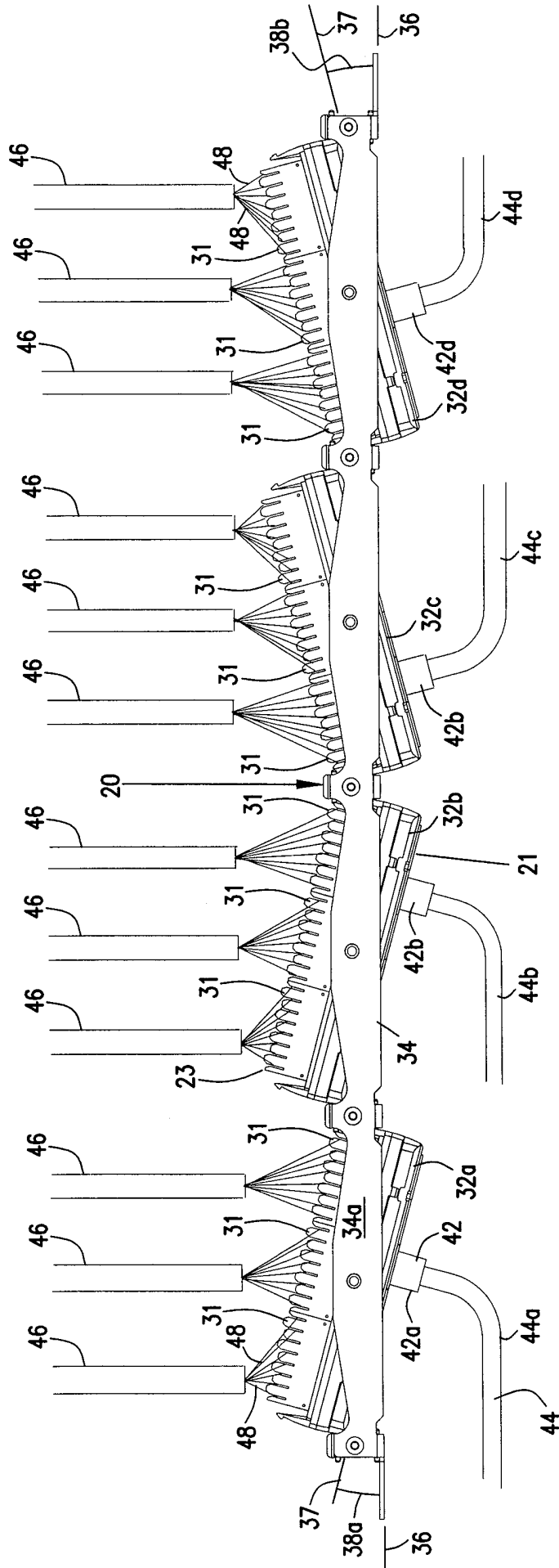


FIG. 3

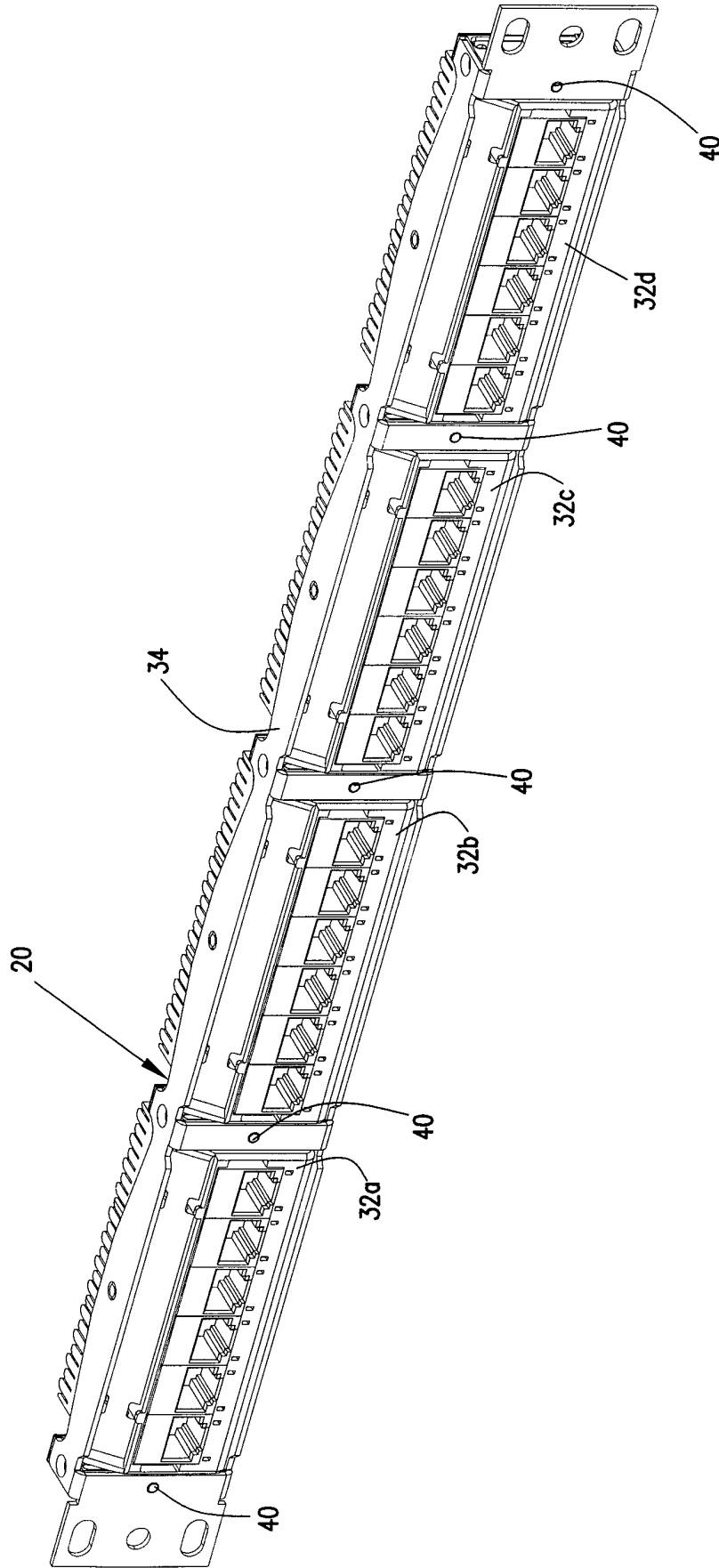




FIG. 4

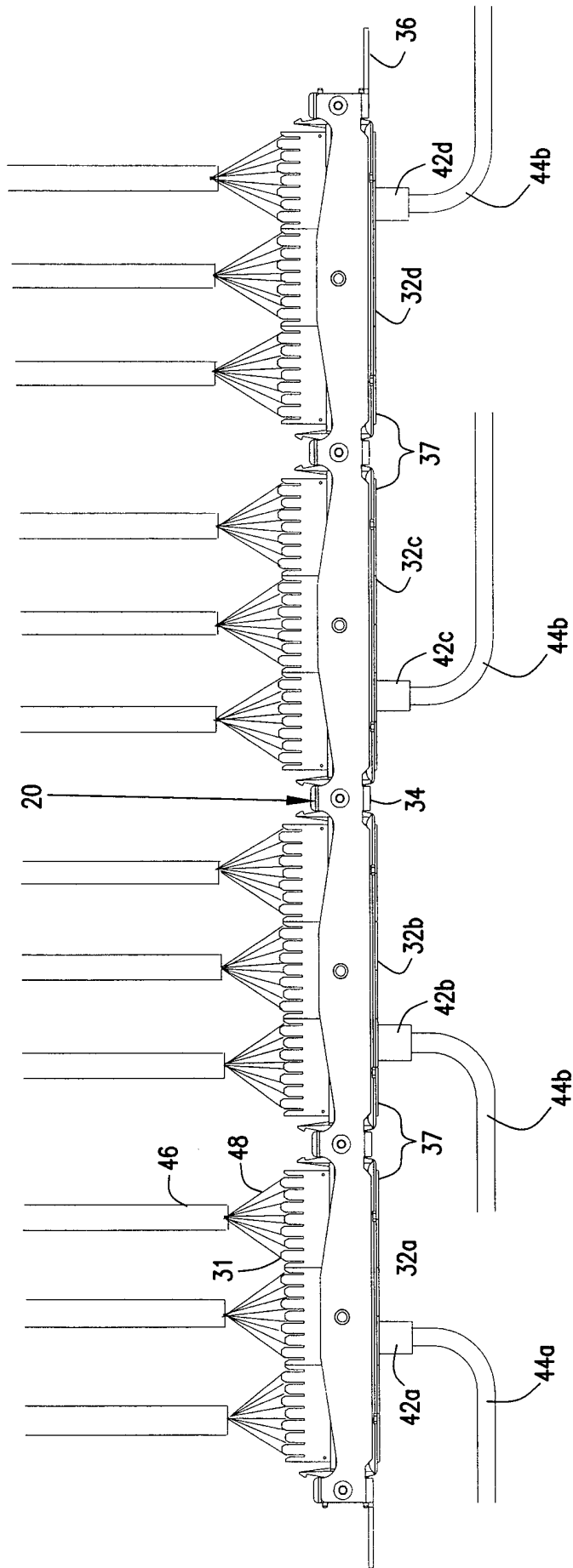


FIG. 5

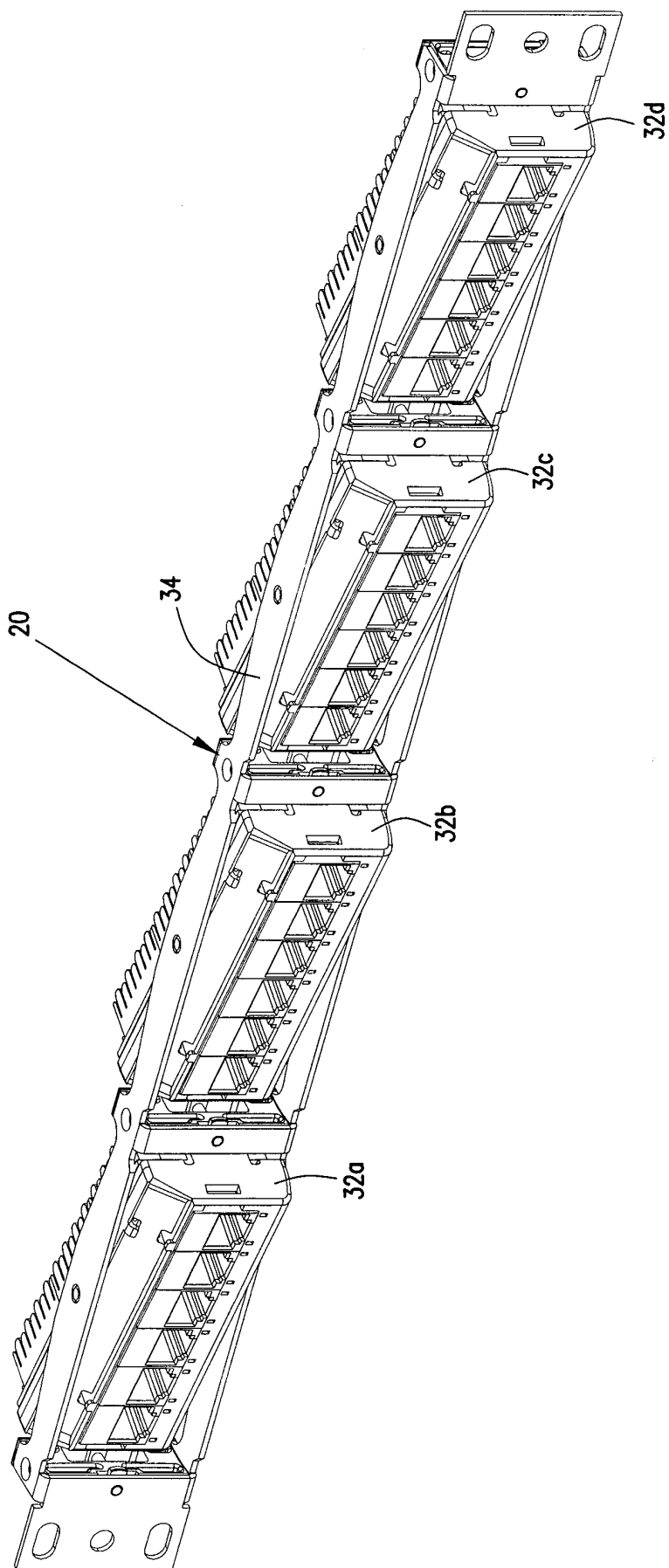
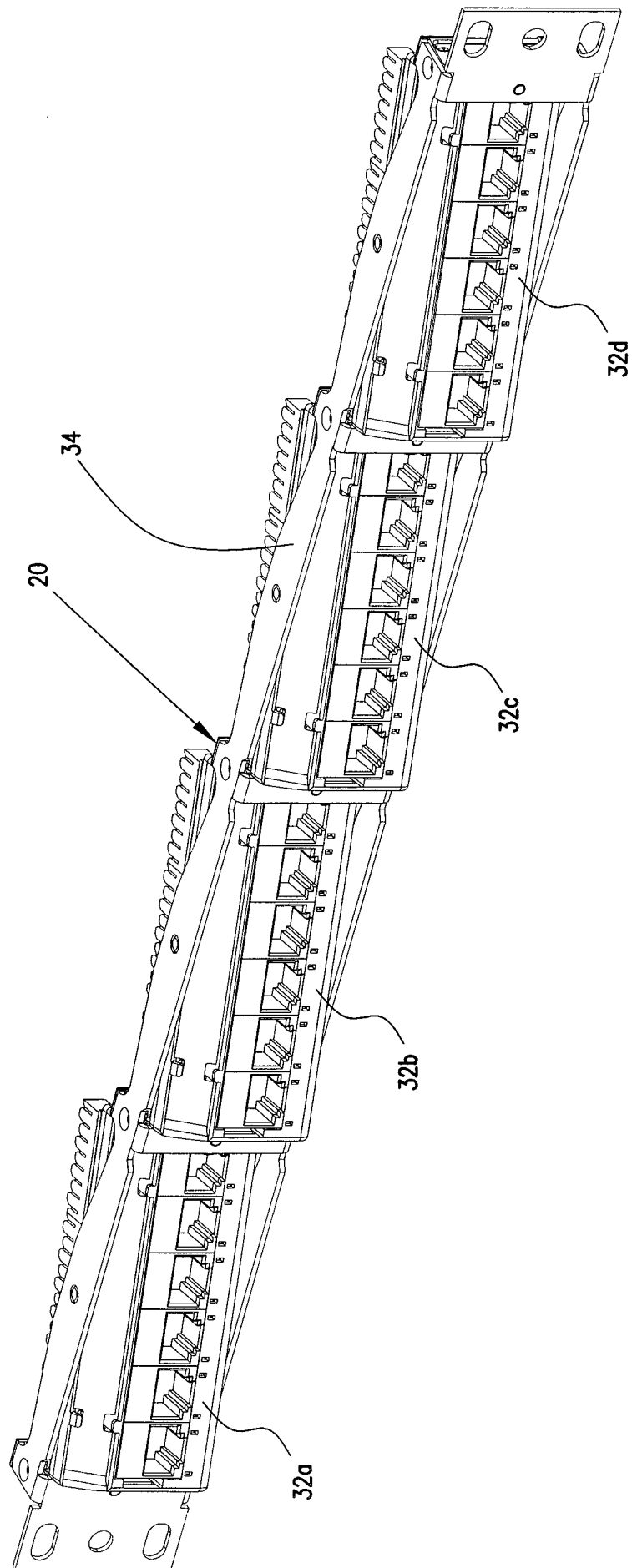


FIG. 6



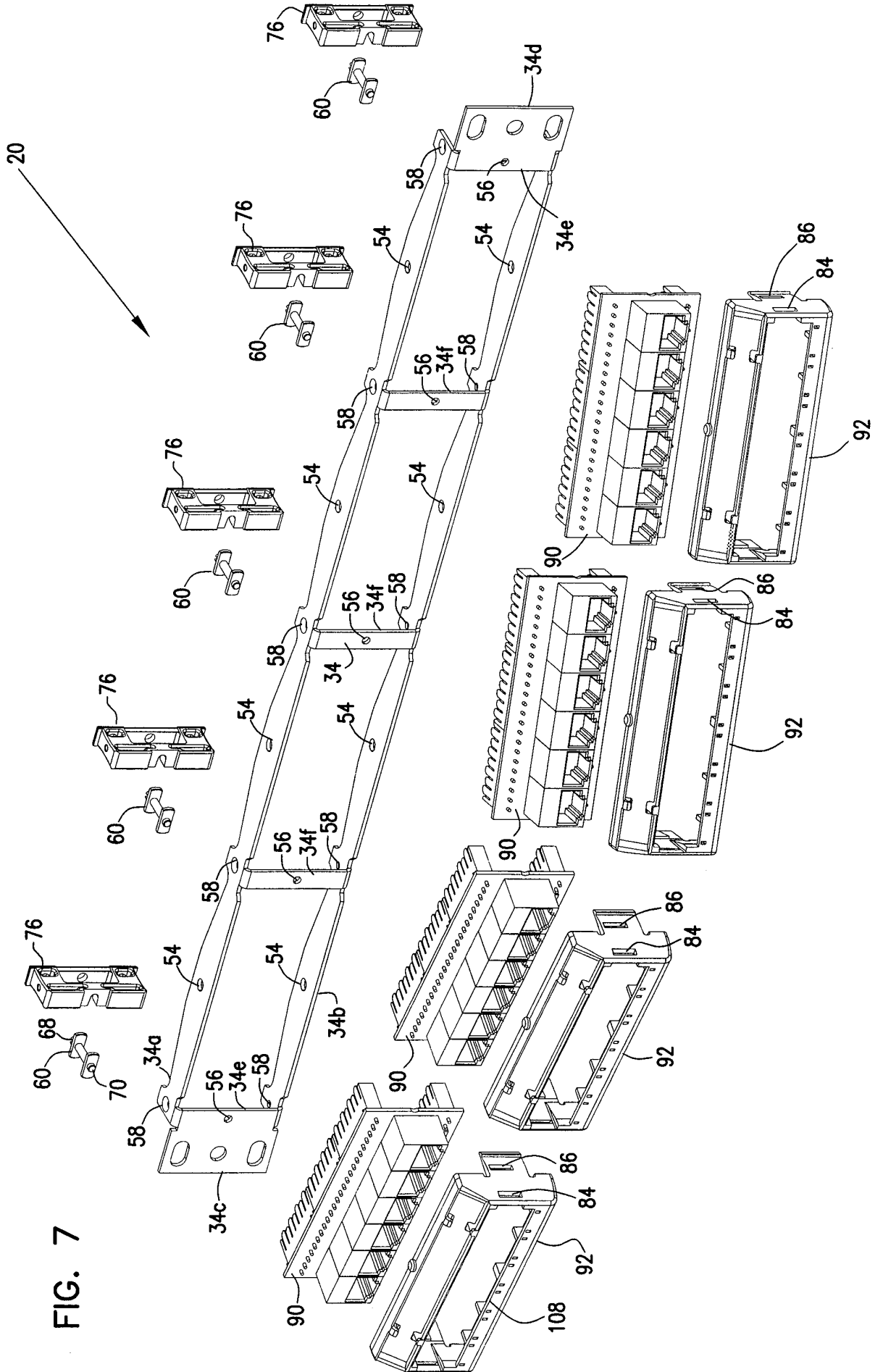


FIG. 7

FIG. 8

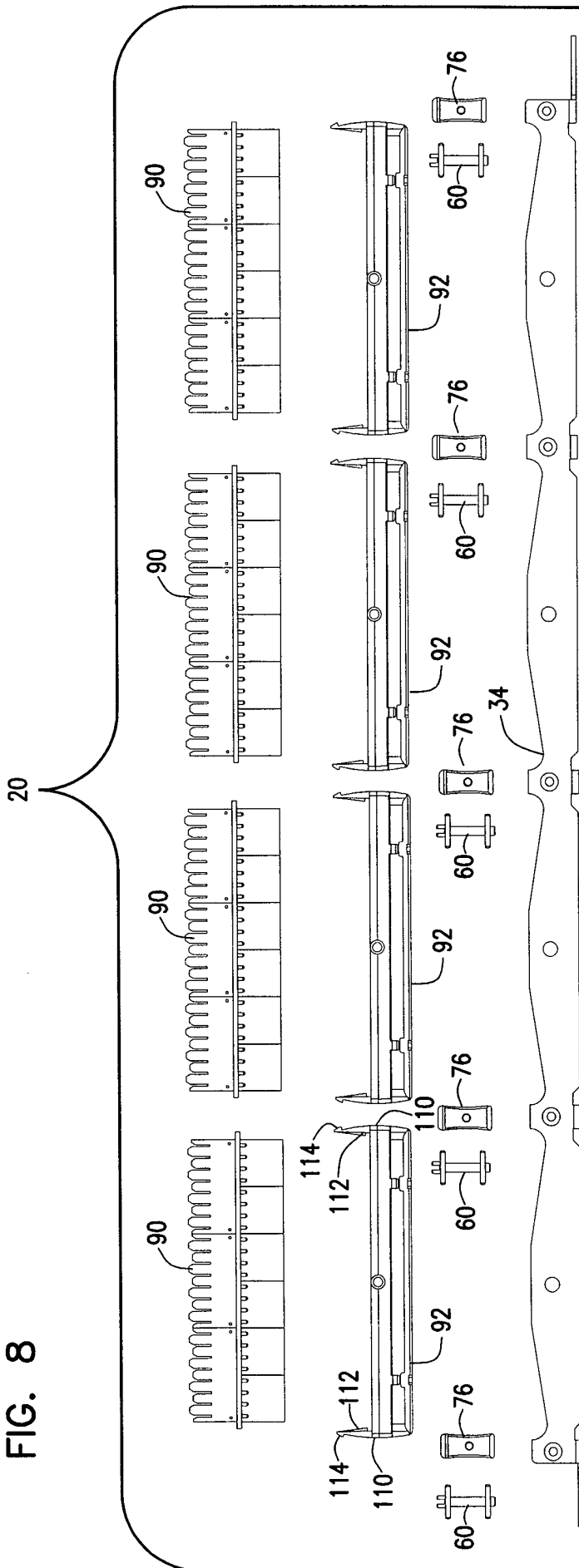


FIG. 9

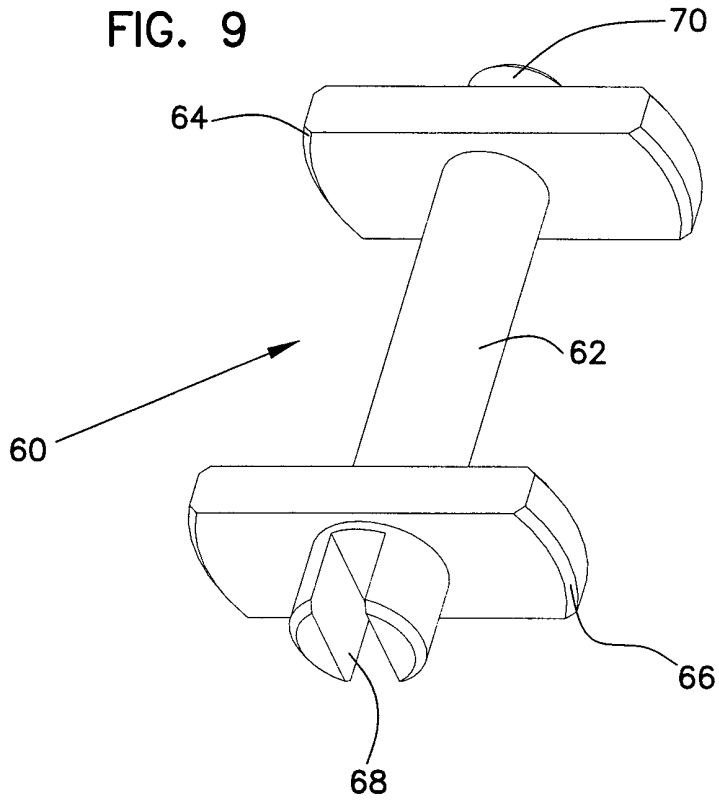
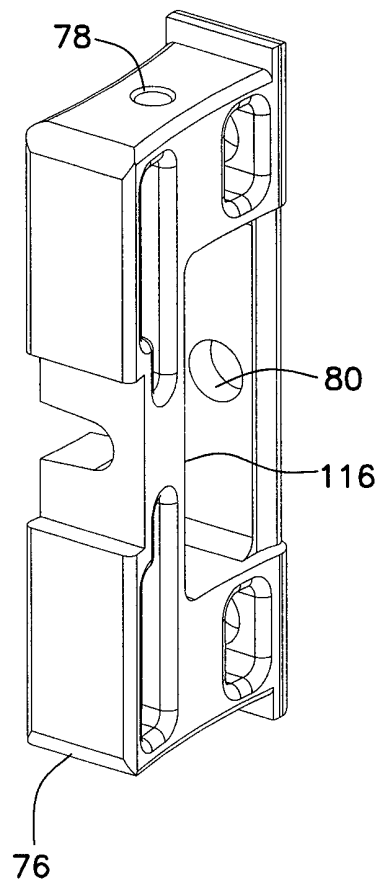


FIG. 10



10/12

FIG. 11

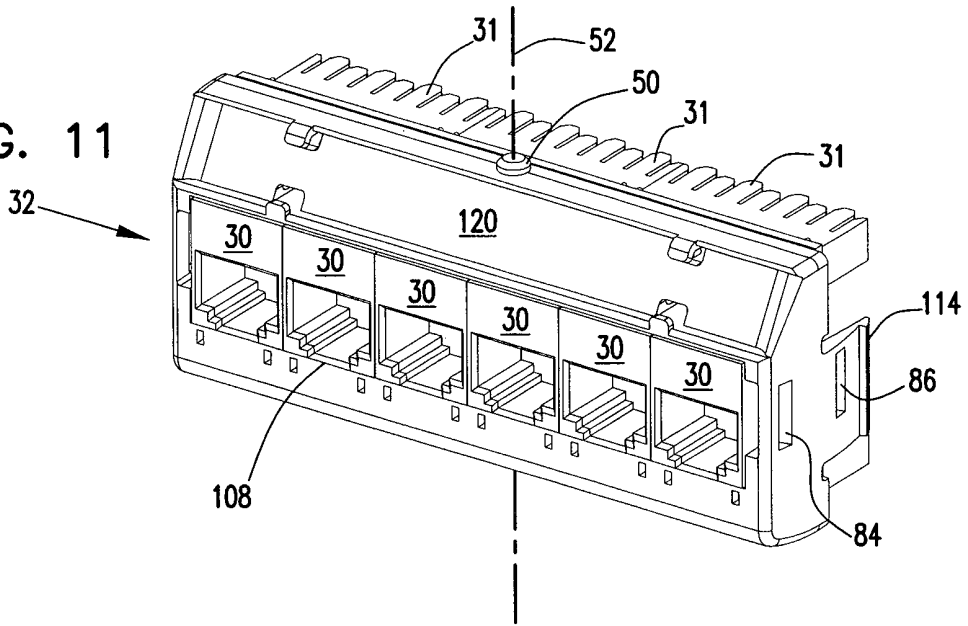


FIG. 12

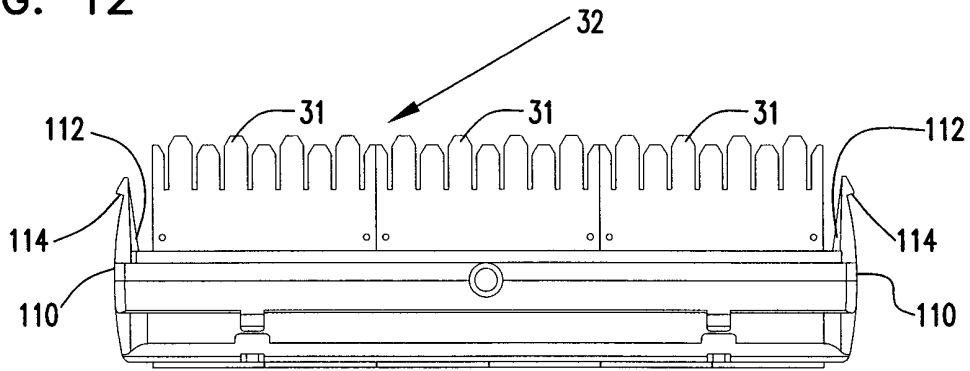
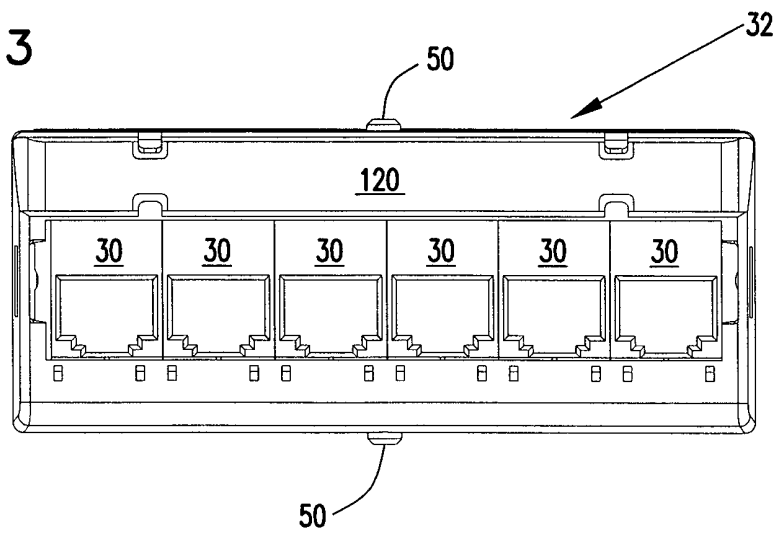


FIG. 13



11/12

FIG. 14

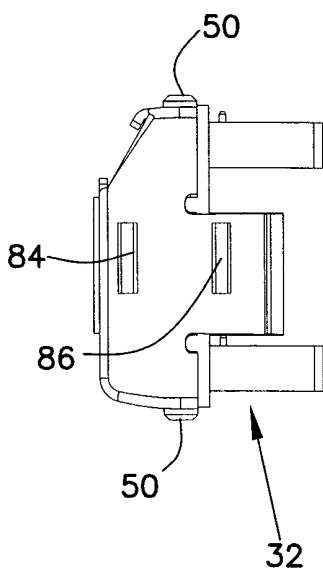


FIG. 15

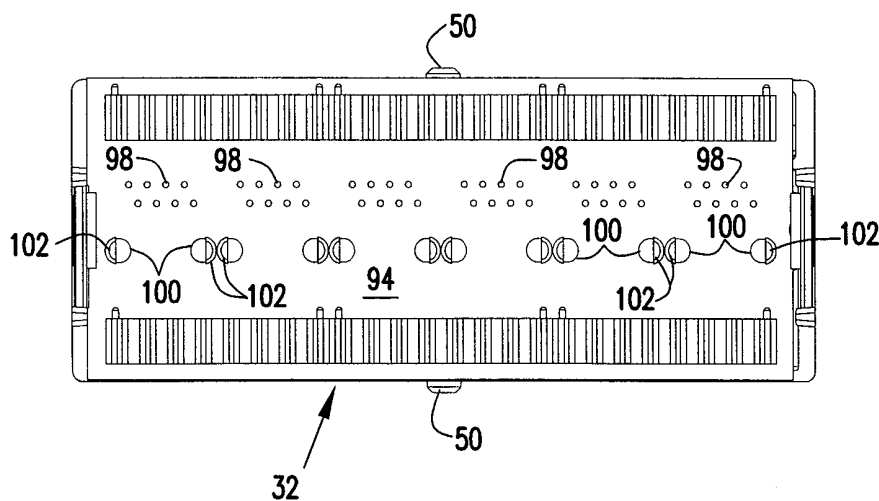


FIG. 16

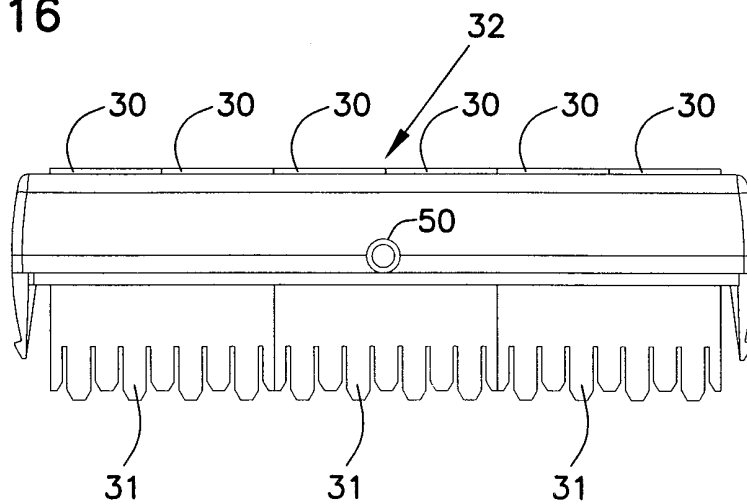
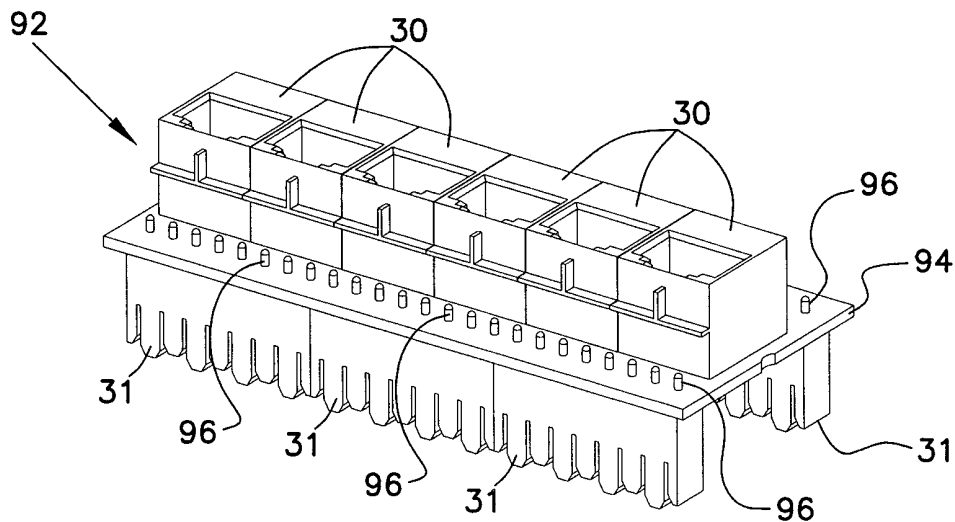




FIG. 17



## INTERNATIONAL SEARCH REPORT

International application No.

PCT/US 99/11120

## A. CLASSIFICATION OF SUBJECT MATTER

IPC6: H01R 13/518

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)

IPC6: 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 practicable, search terms used)

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	EP 0736937 A1 (ATREUS ENTERPRISES LIMITED), 9 October 1996 (09.10.96), figure 1, abstract  --	1,10,15,17, 19
Y	US 5178554 A (J.A. SIEMON ET AL), 12 January 1993 (12.01.93), figures 1,2, abstract  --	1,10,15,17, 19
A	US 4815104 A (W.E. WILLIAMS ET AL), 21 March 1989 (21.03.89), figures 3-6, abstract  -- -----	1-19

 Further documents are listed in the continuation of Box C. See patent family annex.

\* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"I" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance: the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance: the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&amp;" document member of the same patent family

Date of the actual completion of the international search

23 August 1999

Date of mailing of the international search report

01.10.99

Name and mailing address of the International Searching Authority  
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

Authorized officer

G. Adam

03403

Telephone No.

**INTERNATIONAL SEARCH REPORT**  
Information on patent family members

International application No.  
**PCT/US 99/11120**

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
EP 0736937 A1	09/10/96	NONE	
US 5178554 A	12/01/93	AT 132300 T AU 641282 B AU 8479291 A DE 69115863 D,T DK 487893 T EP 0487893 A,B ES 2082091 T GR 3018676 T US 5074801 A	15/01/96 16/09/93 30/04/92 30/05/96 20/05/96 03/06/92 16/03/96 30/04/96 24/12/91
US 4815104 A	21/03/89	CA 1316233 A EP 0330765 A JP 2005377 A	13/04/93 06/09/89 10/01/90