US00RE40375E

(19) **United States**

(12) **Reissued Patent**

Abel et al.

(10) **Patent Number: US RE40,375 E**

(45) **Date of Reissued Patent: Jun. 10, 2008**

(54) **BACK-END VARIATION CONTROL CAP FOR USE WITH A JACK MODULE**

(75) Inventors: **John N. Abel**, Avon, IN (US); **Bryan S. Moffitt**, Red Bank, NJ (US); **William T. Spitz**, McKinney, TX (US); **Ronald L. Wild**, Albuquerque, NM (US); **Timothy C. Miller**, McKinney, TX (US)

(73) Assignee: **CommScope, Inc. of North Carolina**, Hickory, NC (US)

(21) Appl. No.: **11/493,941**

(22) Filed: **Jul. 26, 2006**

(Under 37 CFR 1.47)

Related U.S. Patent Documents

Reissue of:

(64) Patent No.: **6,767,241**
Issued: **Jul. 27, 2004**
Appl. No.: **10/447,181**
Filed: **May 28, 2003**

(51) **Int. Cl.**
H01R 4/24 (2006.01)

(52) **U.S. Cl.** **439/417**; 439/540.1; 439/456

(58) **Field of Classification Search** 439/417, 439/540.1, 676, 404, 456, 395, 719
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

3,459,878	A	8/1969	Gressitt et al.	
3,772,635	A	11/1973	Frey et al.	
5,624,274	A	4/1997	Lin	
6,017,229	A	1/2000	Tulley et al.	
6,267,617	B1	7/2001	Nozick	439/417
6,302,699	B1	10/2001	Conorich et al.	
6,315,596	B1	11/2001	Chen	
6,325,671	B1	12/2001	Radliff	
6,338,643	B1	1/2002	Miller et al.	439/417
6,371,780	B1	4/2002	Aponte et al.	
6,488,525	B2	12/2002	Abel et al.	
6,565,375	B1	5/2003	Daoud et al.	
6,592,395	B2	7/2003	Brown et al.	
6,592,396	B2	7/2003	Pepe et al.	439/417
6,746,283	B2	6/2004	Arnett et al.	
6,752,647	B1	6/2004	Lin	
6,767,241	B1	7/2004	Abel et al.	
6,830,488	B2	12/2004	Bush et al.	
6,953,362	B2	10/2005	Mössner et al.	
7,025,621	B2	4/2006	Mössner et al.	
2002/0094715	A1	7/2002	Pepe et al.	

FOREIGN PATENT DOCUMENTS

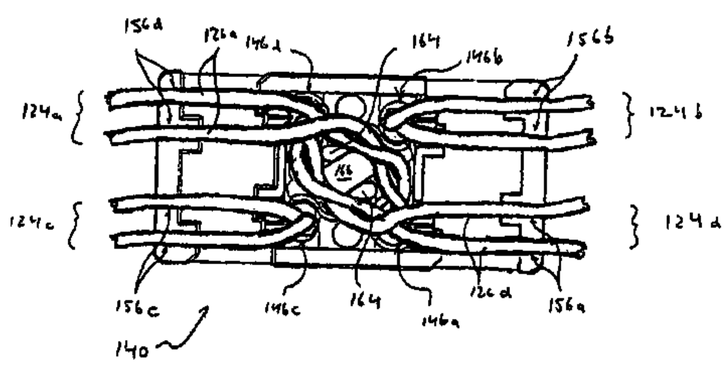
CA	2 429 765	A1	11/2004
EP	0 899 827	A2	3/1999
EP	0 982 815	A2	3/2000

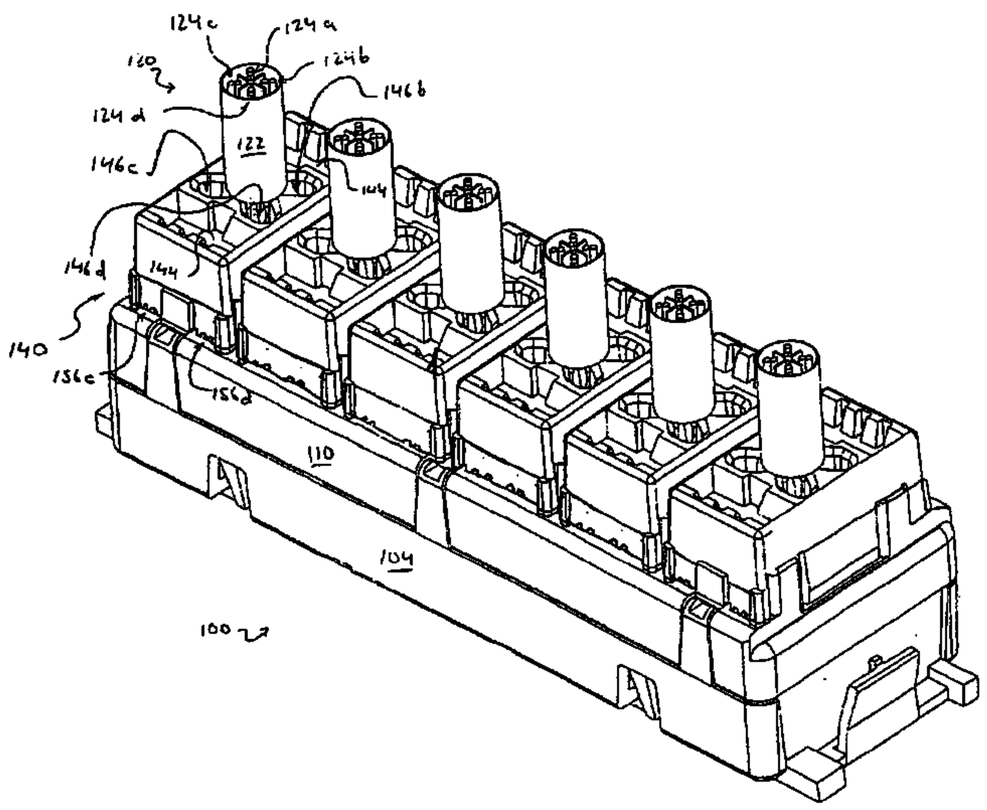
Primary Examiner—Tho D. Ta
(74) *Attorney, Agent, or Firm*—Myers Bigel Sibley & Sajovec

(57) **ABSTRACT**

A back-end variation control cap configured for use with a jack module including a plurality of insulation displacement connectors, the cap being configured for routing a plurality of twisted conductor pairs. The cap includes an upper portion, a bottom portion, a plurality of twisted pair channels extending between the upper portion and the bottom portion, and a pair of opposed end walls, each of the end walls including a plurality of wire constraints disposed thereon. Each wire constraint has opposed surfaces configured to retain one of the conductors and each twisted conductor pair extends through one of the twisted pair channels and the conductors of the twisted conductor pairs are disposed in the plurality of wire constraints such that each conductor is aligned with one of the insulation displacement connectors when the bottom portion is disposed adjacent the jack module.

37 Claims, 5 Drawing Sheets





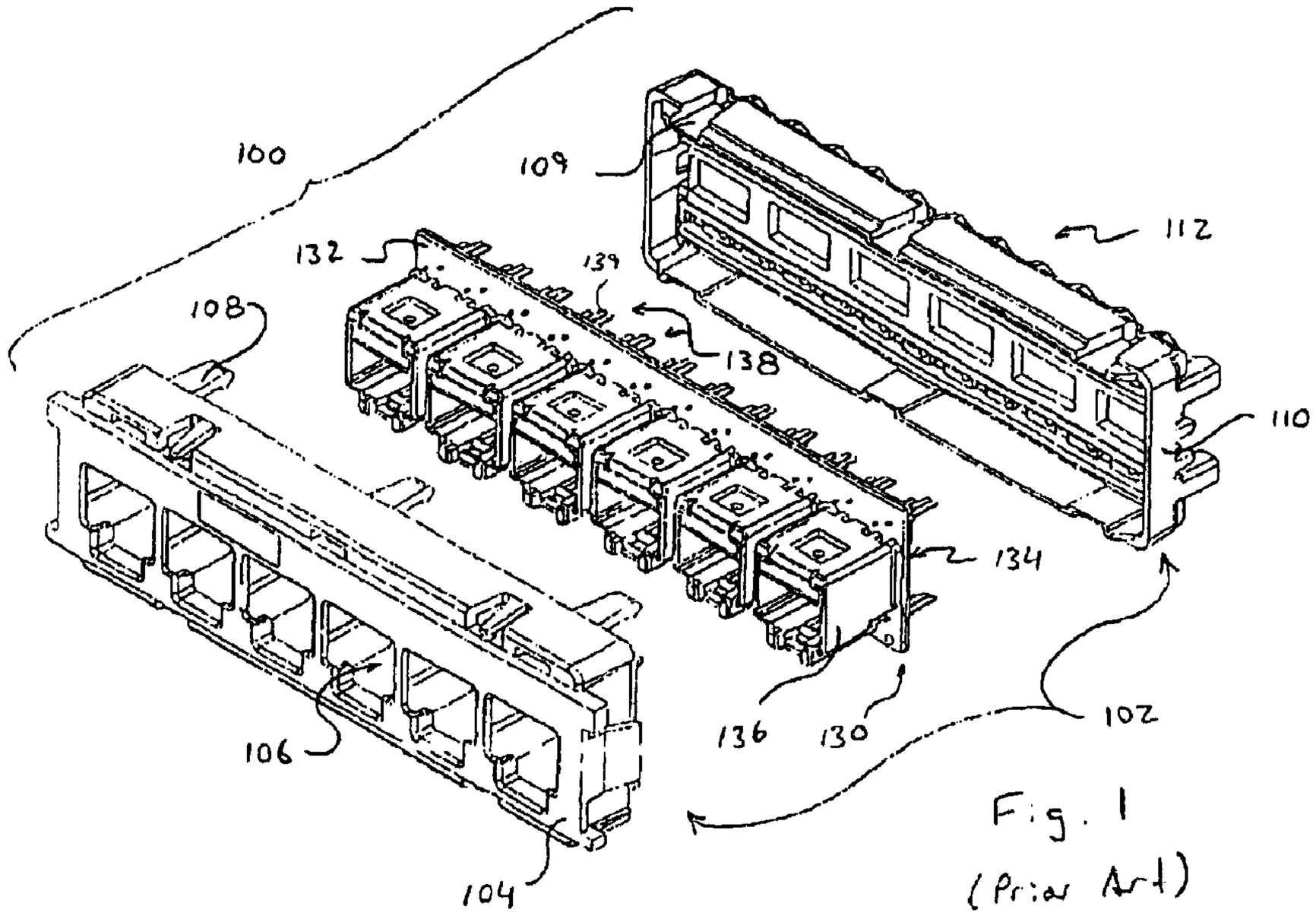


Fig. 1
(Prior Art)

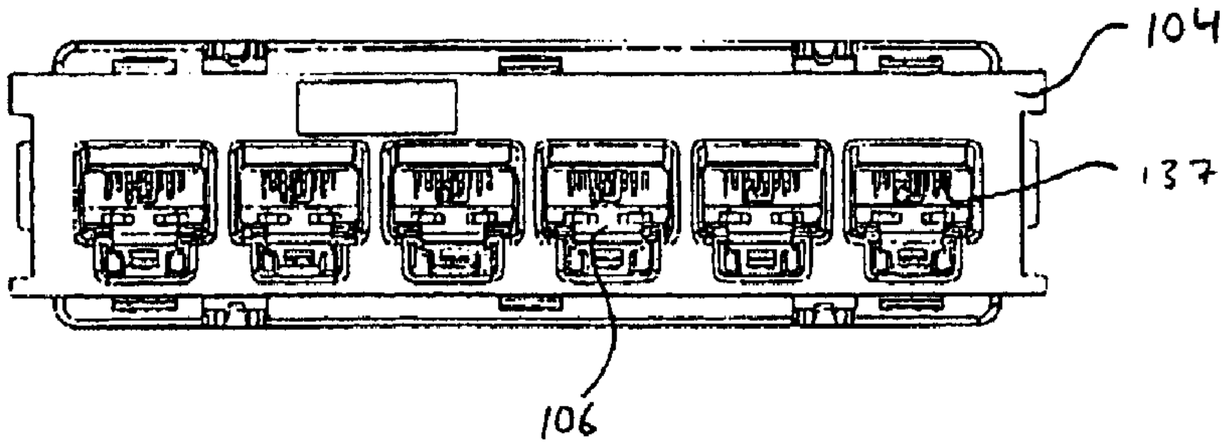


Fig. 2
(Prior Art)

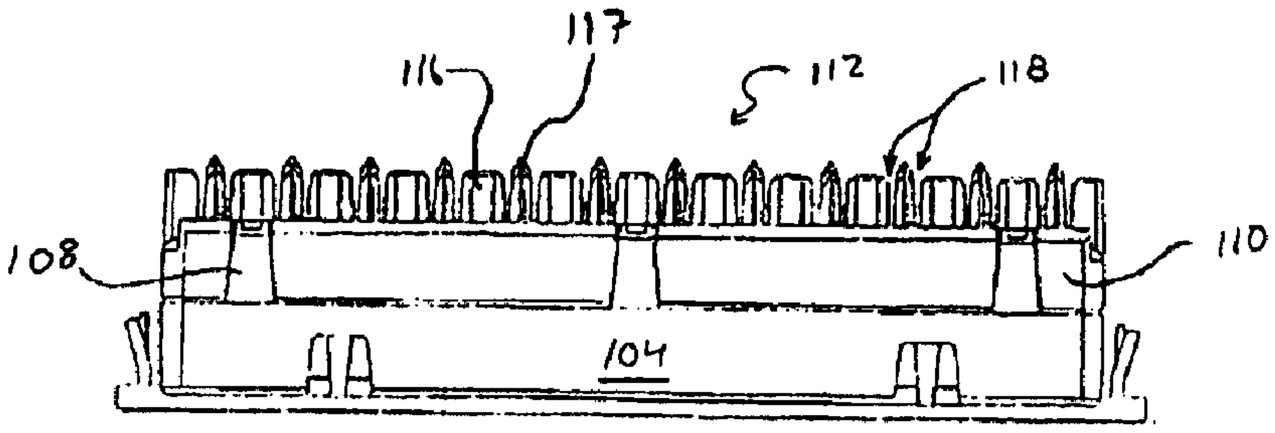


Fig. 3
(Prior Art)

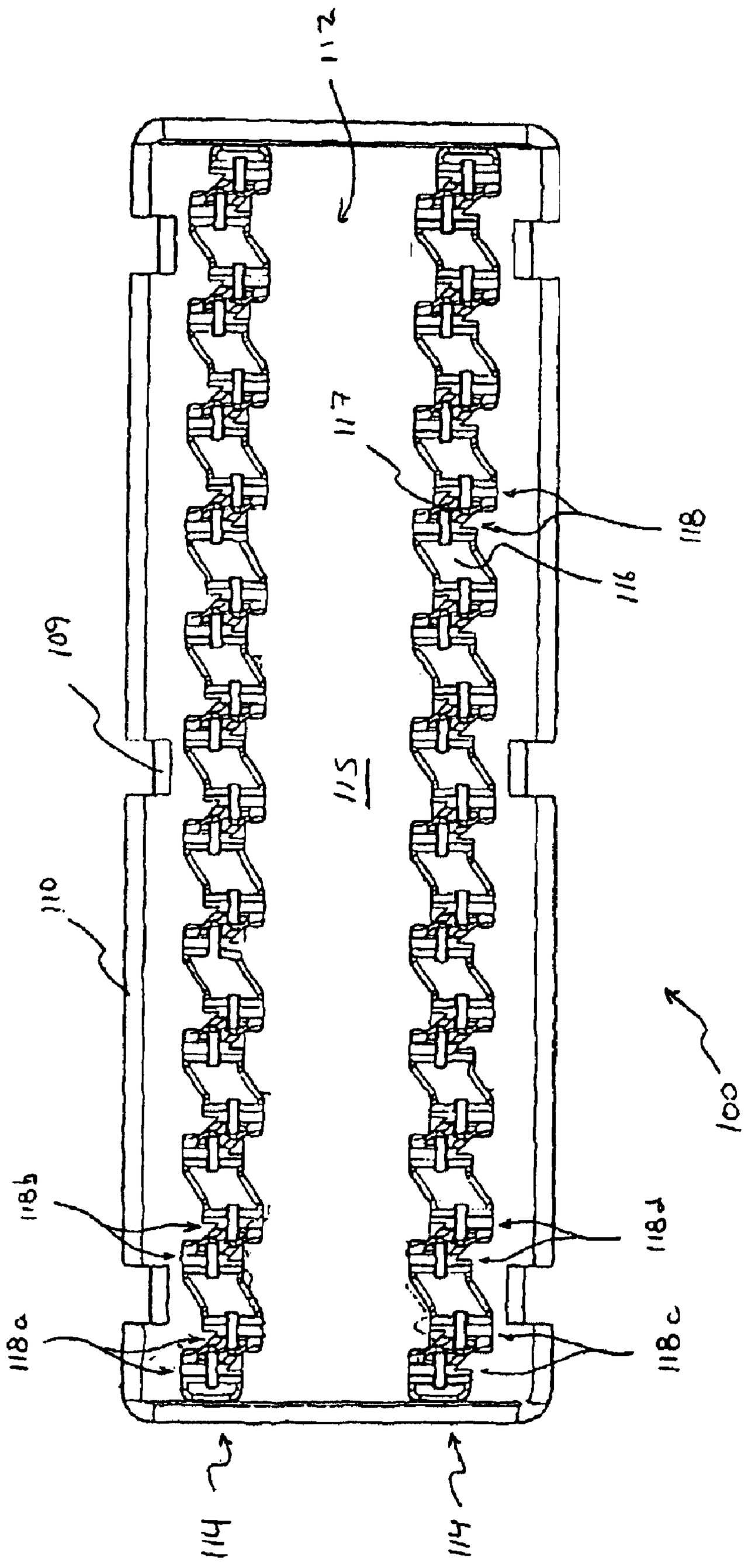


Fig. 4
(Prior Art)

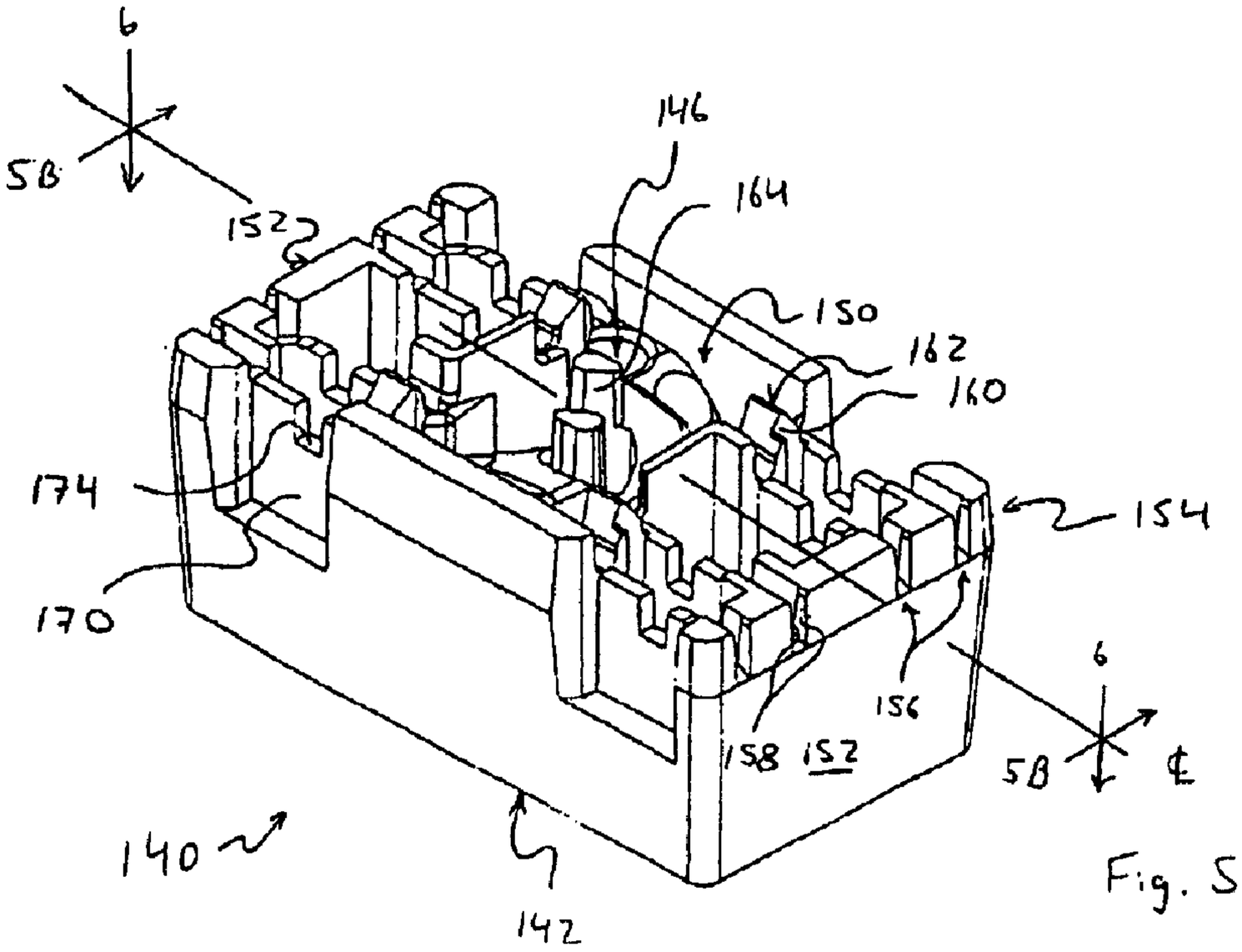


Fig. 5A

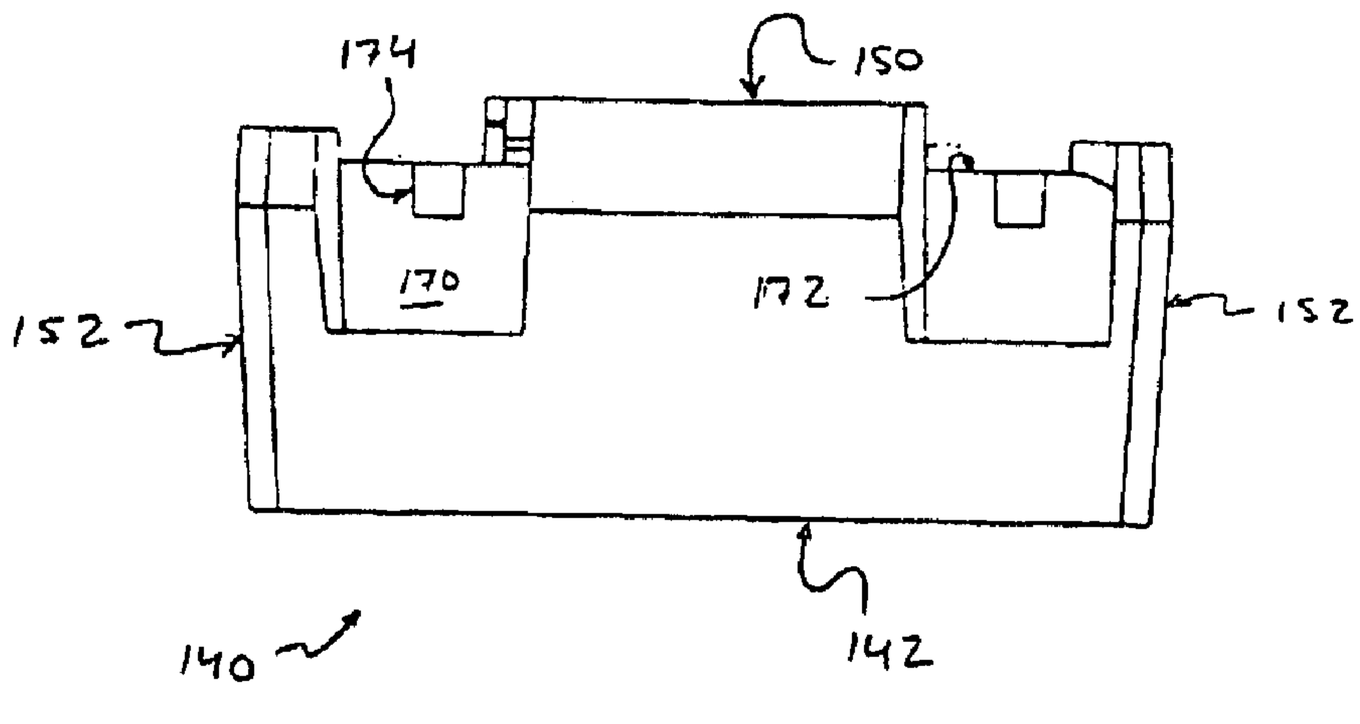


Fig. 5B

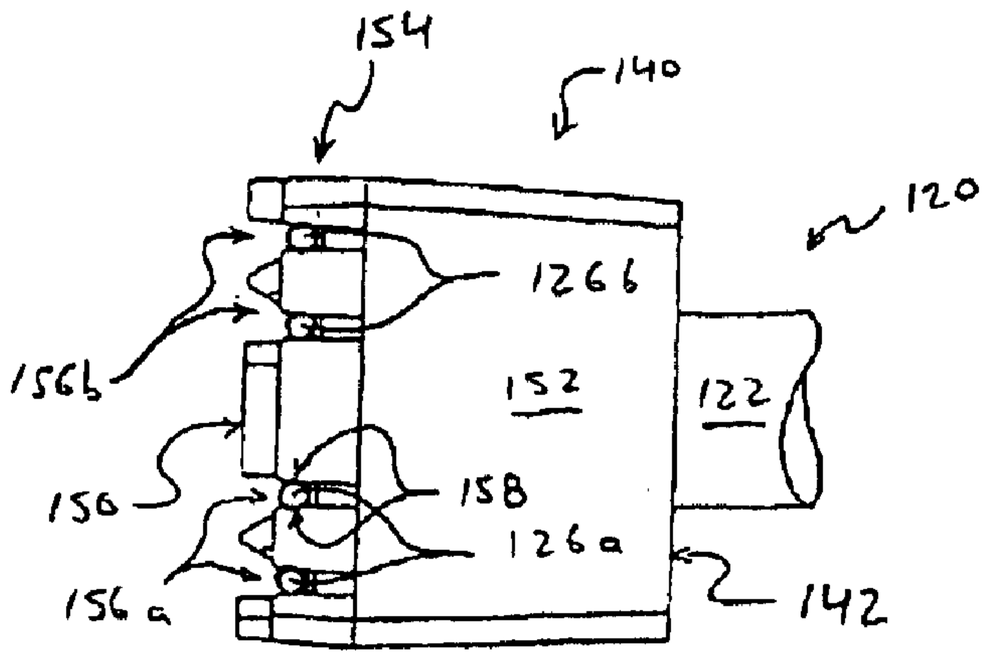


Fig. 6D

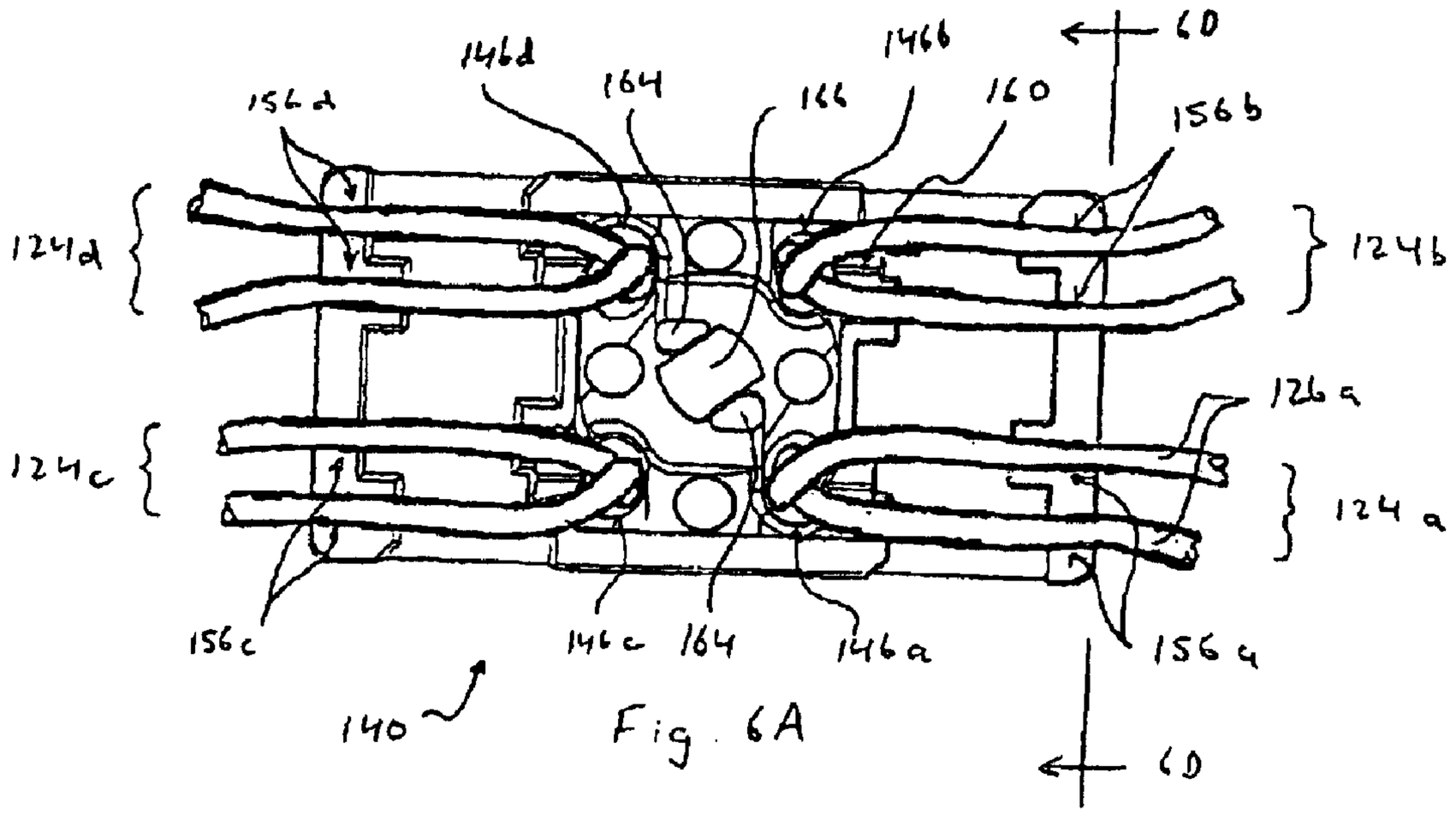


Fig. 6A

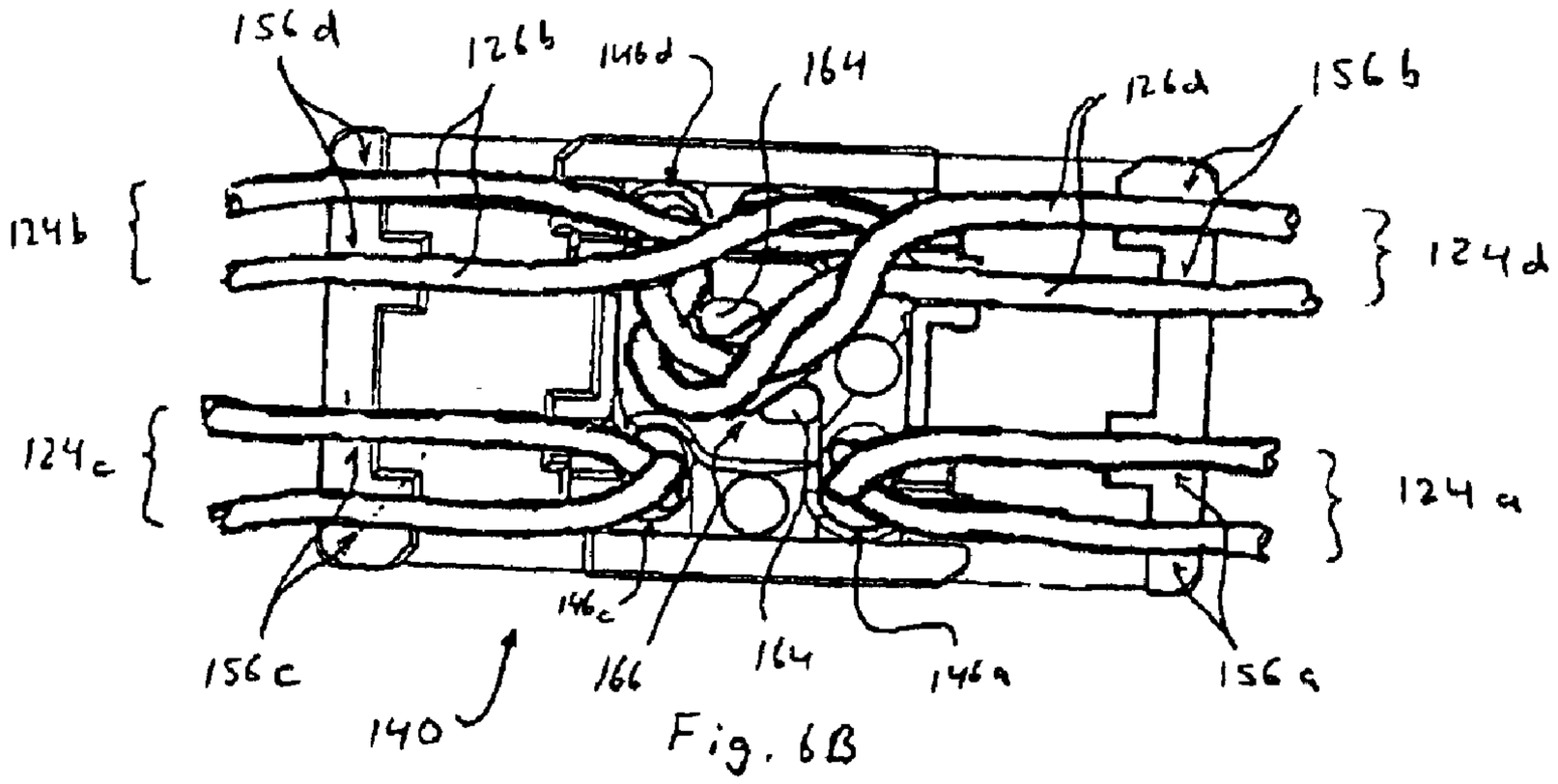


Fig. 6B

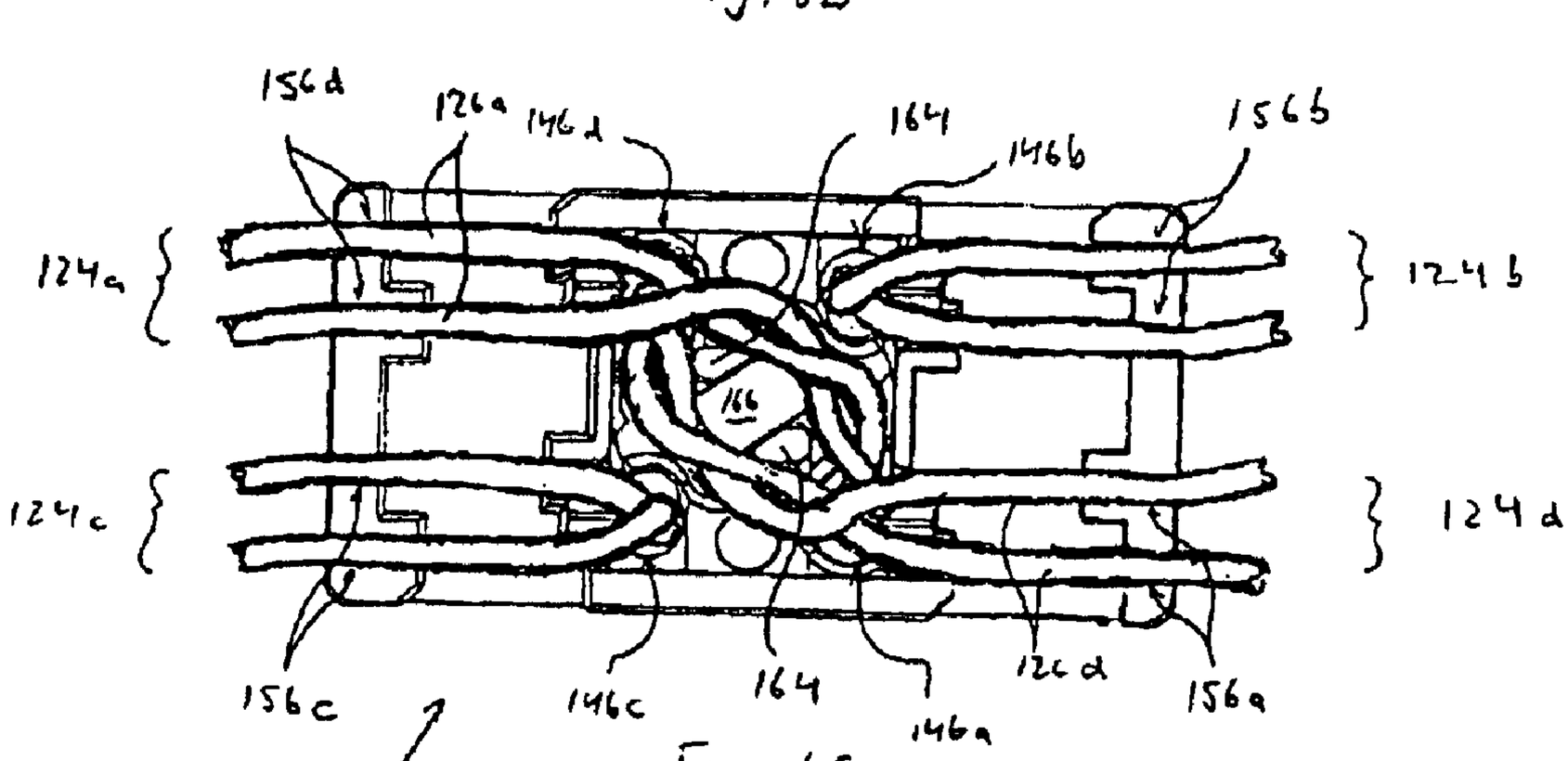


Fig. 6C

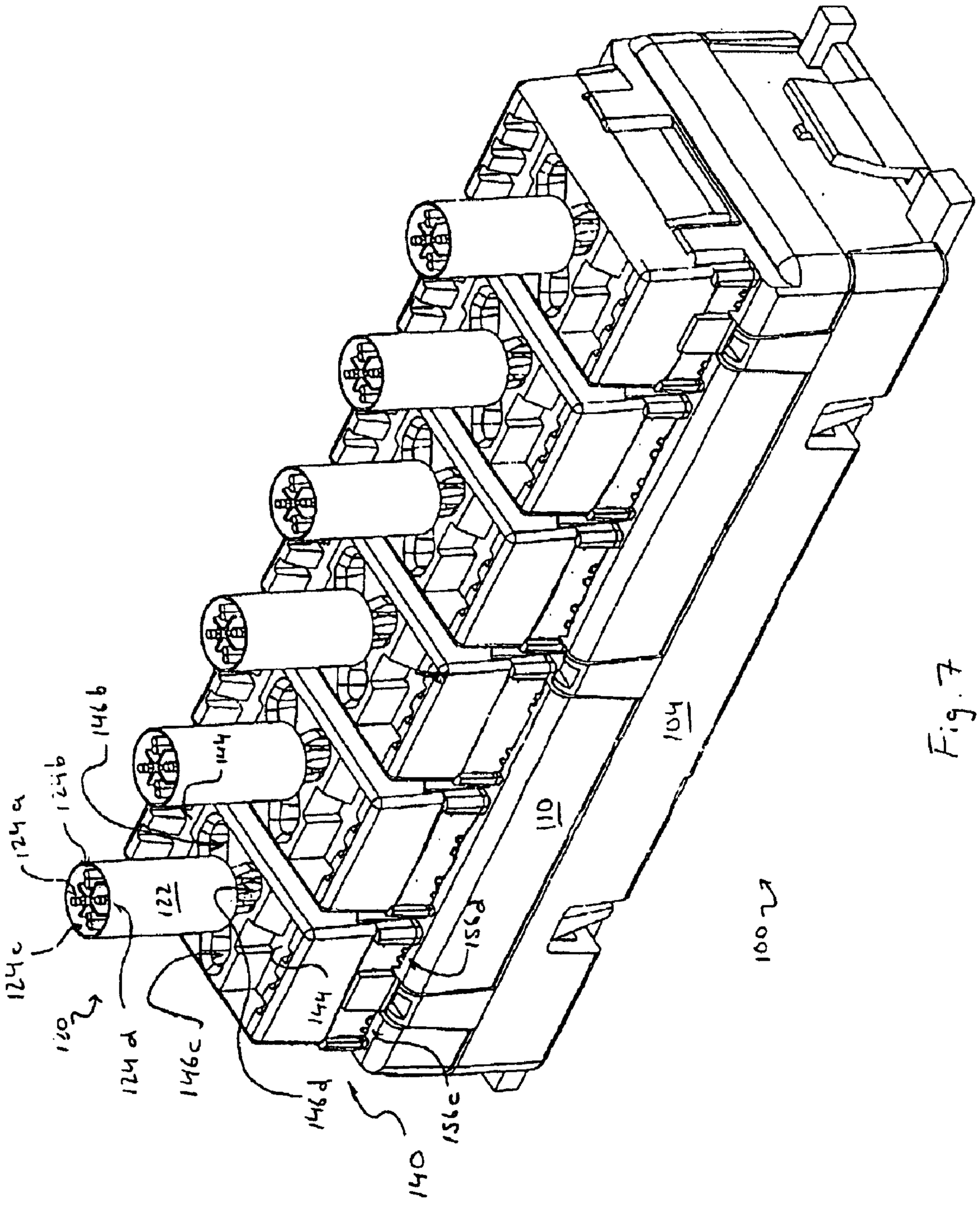

124a
124b
146b
144
122
124c
160
124d
146c
144
146d
140
156c
156d
110
104
100

Fig. 7

BACK-END VARIATION CONTROL CAP FOR USE WITH A JACK MODULE

Matter enclosed in heavy brackets [ ] appears in the original patent but forms no part of this reissue specification; matter printed in italics indicates the additions made by reissue.

TECHNICAL FIELD

The present invention generally relates to routing twisted conductor pairs of a cable to a jack module and, in particular, to devices, systems and methods for controlling the consistency with which the twisted conductor pairs are routed.

DESCRIPTION OF THE RELATED ART

As is known, communications patch panels frequently incorporate the use ofjack modules **100**, as shown in FIG. **1**, that can be readily attached to and removed from the patch panel. Typically, existing jack modules **100** include a housing **102** having a front portion **104** and a back portion **110**. The front portion **104** is visible to the user of the patch panel (not shown) and includes one or more jack openings **106** configured to receive a communication connector (not shown). The front portion **104** and the back portion **110** matingly engage each other and serve to protect a printed wiring board **130**, one or more jack receptacles **136**, and a plurality of insulation displacement connectors **138**. The jack receptacles **136** are mounted to the front side **132** of the printed wiring board **130** while the insulation displacement connectors (IDCs) **138** are mounted to the back side **134**. Traces (not shown) on the printed wiring board **130** electrically connect the IDCs **138** to the electrical contacts **137** (FIG. **2**) housed within the jack receptacles **136**. As assembled, each jack receptacle **136** aligns with a jack opening **106** in the front portion **104** of the housing while the IDCs **138** are aligned with a terminal connection region **112** disposed on the back portion **110**. As shown, the front portion **104** and the back portion **110** of the housing are held together with assembly tabs **108** on the front portion that engage assembly notches **109** on the back portion **110**.

FIG. **2** shows a front view of the jack module **100**, as would be seen by a user of a typical communications patch panel. FIGS. **3** and **4** show the terminal connection region **112** in greater detail. As shown in FIG. **4**, the terminal connection region **112** consists of two substantially parallel rows **114** of wire guide posts **116** and wire guide splitters **117**, alternatingly disposed along each row **114**. As best seen in FIG. **3**, adjacent wire guide posts **116** and wire guide splitters **117** have a terminal slot **118** disposed therebetween. Each terminal slot **118** allows access to one of the IDCs **138** disposed within the parallel rows **114**. Physical and electrical contact is made between a conductor (not shown) and an IDC **138** by urging the conductor into the terminal slot **118** until the conductor passes between the opposed portions of the IDCs contact tail **139** FIG. **1**). Opposed portions of the contact tail **139** cut through insulation disposed around the conductor, thereby making electrical contact.

Referring now to FIG. **4**, the manner of electrically connecting a cable including a plurality of twisted pairs to an existing jack module **100** is addressed. First, a technician determines which IDCs **138** are associated with the desired jack receptacle **136**. Here, the IDCs **138** of interest are accessed by way of the pairs of terminal slots labeled **118**a, **118**b, **118**c, and **118**d, each of the pairs of the terminal slots **118** being configured to receive the conductors from one of the cable's twisted conductor pairs. Once the desired IDCs **138** have been determined, the technician urges the desired conductor into the appropriate IDC, typically using a device such as a punch-down tool (not shown). As shown, one twisted pair would be inserted into each pair of terminal slots **118**A-D. The wire guide splitters **117** assist the technician in separating the conductors of each twisted conductor pair, thereby making it easier for the technician to insert the desired conductor into the desired IDC **138**.

Such methods of routing twisted pairs on the back of existing jack modules **100** have proved adequate for existing performance levels. This is because in the past variation of the routing of twisted pairs, from pair to pair, has had little effect if any on performance. However, recent developments, such as patch panels requiring category 6 performance levels, are much more sensitive to variations in twisted pair dress and routing.

Therefore, there is a need for improved devices, systems and methods that address variations in twisted pair dress and routing and/or other shortcomings of the prior art.

SUMMARY

Briefly described, the present invention relates to devices, systems and methods for reducing variations in how twisted pairs from a communications cable are routed to jack modules. In this regard, a preferred embodiment of a back-end variation control cap is configured for use with a jack module including a plurality of insulation displacement connectors, and the cap is configured for routing a plurality of twisted conductor pairs. The cap includes an upper portion, a bottom portion, a plurality of twisted pair channels extending between the upper portion and the bottom portion, and a pair of opposed end walls, each of the end walls including a plurality of wire constraints disposed thereon. Each wire constraint has opposed surfaces configured to retain one of the conductors and each twisted conductor pair extends through one of the twisted pair channels and the conductors of the twisted conductor pairs are disposed in the plurality of wire constraints such that each conductor is aligned with one of the insulation displacement connectors when the bottom portion is disposed adjacent the jack module.

Another embodiment of the present invention provides a method of routing twisted conductor pairs from a cable onto a jack module including insulation displacement connectors. The method includes the steps of: providing a cap having a top portion and a bottom portion; passing each of the twisted conductor pairs through the cap from the top to the bottom portion; engaging a portion of the cap with each of the conductors such that each conductor is immobilized; and disposing the cap on the jack module such that the bottom portion is adjacent the jack module and each of the conductors electrically engages one of the insulation displacement connectors.

Another embodiment of the present invention provides a jack module system configured to receive a plurality of twisted conductor pairs and at least one communication connector. The system includes a housing having a front portion including a jack opening configured to receive the communication connector and a back portion including a terminal connection region configured to receive the twisted pair conductors. A jack receptacle, a printed wiring board, and a plurality of insulation displacement connectors are disposed within the housing such that the jack receptacle is aligned with the jack opening and the plurality of insulation displacement connectors are accessible through the terminal connection region. The jack receptacle and the plurality of

insulation displacement connectors are disposed on opposite sides of the printed wiring board. The system further includes a back-end variation control cap including an upper portion, a bottom portion, a plurality of twisted pair channels extending between the upper and the bottom portions, and a plurality of wire constraints disposed on the bottom portion, wherein each wire constraint is configured to retain one of the conductors. Each twisted conductor pair extends through one of the twisted pair channels and the conductors are disposed in the plurality of wire constraints such that each conductor is aligned with one of the insulation displacement connectors when the bottom portion slidably engages the terminal connection region.

Other features and/or advantages of the present invention will be or may become apparent to one with skill in the art upon examination of the following drawings and detailed description. It is intended that all such features and/or advantages be included herein within the scope of the present invention, as defined in the appended claims.

BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWINGS

The invention can be better understood with reference to the following drawings. The components in the drawings are not necessarily to scale, emphasis instead being placed upon clearly illustrating the principles of the present invention.

FIG. **1** is an exploded, perspective view of a prior art jack module.

FIG. **2** is a front elevational view of the jack module as shown in FIG. **1**.

FIG. **3** is a top view of the jack module as shown in FIG. **1**.

FIG. **4** is a back view of the jack module as shown in FIG. **1**.

FIG. **5**A is a top perspective view of an embodiment of a back-end variation control cap shown in an inverted position.

FIG. **5**B is a side view of the embodiment of the back-end variation control cap of FIG. **5**A, taken along line **5**B-**5**B of FIG. **5**A.

FIG. **6**A is a bottom view of the embodiment of the back-end variation control cap of FIG. **5**A, taken along line **6**-**6** of FIG. **5**A, showing details of twisted pair routing.

FIG. **6**B is a bottom view of the embodiment of the back-end variation control cap of FIG. **5**A, taken along line **6**-**6** of FIG. **5**A, showing details of twisted pair routing.

FIG. **6**C is a bottom view of the embodiment of the back-end variation control cap of FIG. **5**A, taken along line **6**-**6** of FIG. **5**A, showing details of twisted pair routing.

FIG. **6**D is an end view of an embodiment of the back-end variation control cap of FIG. **5**A, as shown in FIGS. **6**A-**6**C.

FIG. **7** is a top perspective view of the embodiment of the back-end variation control cap of FIG. **5**A, as shown in FIGS. **5**A-B, mounted to an embodiment of a jack module.

DETAILED DESCRIPTION

Reference will now be made to the drawings wherein like numerals indicate corresponding parts throughout the several views. As shown in FIG. **5**A, an embodiment of a back-end variation control cap **140** is shown in an inverted position. The back-end variation control cap **140** includes an upper portion **142** and a bottom portion **150**, with a plurality of twisted pair channels **146** connecting the upper portion **142** and the bottom portion **150**. Preferably, each twisted pair channel **146** is configured to receive a twisted conductor pair **124** from a communications cable **120**, as shown in FIG. **7**. This particular embodiment includes four twisted pair channels **146** is for use with a communications cable **120** that includes four twisted conductor pairs **124** housed within a cable jacket **122**.

Referring now to FIG. **6**A, the bottom portion **150** of the back-end variation control cap **140** includes a plurality of wire constraints **156** disposed along the bottom edges **154** of a pair of opposed end walls **152**. Preferably, each wire constraint **156** is configured to frictionally engage an individual conductor **126** from a twisted conductor pair **124** (FIG. **5**C). In the embodiment shown, this is accomplished by providing a pair of opposed surfaces **158** that are separated by a distance that is slightly less than the outer diameter of each conductor **126**. The bottom portion **150** also includes a plurality of twisted pair splitters **160**. Preferably, each twisted pair splitter **160** includes a pointed, or knife-like, ridge **162** that allows a technician to separate the individual conductors **126** within each twisted conductor pair **124**. A twisted pair splitter **160** is disposed on the bottom portion **150** adjacent each of the twisted pair channels **146**. Therefore, in the embodiment shown, there are four twisted pair splitters **160**. A pair of routing posts **164** are centrally located on the bottom portion **150**. The routing posts **164** assist a technician to route the conductors **126** in a desired fashion.

A plurality of punch-down walls **170** also are included. One punch-down wall **170** is provided for each conductor **126** that is to be routed within the back-end variation control cap **140**. Preferably, the punch-down walls **170** are disposed in substantially parallel pairs, each pair including a punch-down wall **170** disposed on opposing sides of each twisted pair splitter **160** and extending to an associated wire constraint **156**. Preferably, as shown in FIG. **5**A, the punch down walls **170** are substantially parallel to the longitudinal center line of the back-end variation control cap **140** and are disposed such that two pairs of the punch-down walls **170** are on opposed sides of the center line. As shown in FIG. **5**B, each punch-down wall **170** includes a notch **174** which is configured to prevent excessive force from being applied to the portion of each conductor **126** that is being engaged with its associated IDC **138** (FIG. **1**).

In Operation

As previously noted, the embodiment shown is configured for use with a standard communications cable **120** that includes a cable jacket **122** and four twisted conductor pairs **124**, as shown in FIG. **7**. For ease of description, the four twisted conductor pairs are designated **124**a, **124**b, **124**c and **124**d.

During use, each twisted conductor pair **124**a-d is routed through the corresponding twisted pair channel **146**a-d, as shown in FIG. **7**. The twisted conductor pairs **124**a-d are pulled through the twisted pair channels **146**a-d until the cable jacket **122** abuts the upper portion **142** of the back-end variation control cap **140**. Next, as shown in FIG. **6**A, the individual conductors **126** of each twisted conductor pair **124**a-d are separated using the twisted pair splitters **160**. The twisted pair splitters **160** facilitate separation of the typically small diameter conductors **126**. As well, the twisted pair splitters **160** help ensure that the conductors **126** of each twisted conductor pair **124**a-d remain uniformly parallel to each other as the conductors **126** extend outwardly toward the wire constraints **156**, thereby helping to insure uniformity in the manner of routing of the twisted conductor pairs **124**a-d.

For ease of description, reference will now be made only to twisted conductor pair **124**a. After the conductors **126**a of twisted conductor pair **124**a have been separated at the twisted pair splitter **160**, each conductor **126**a is extended outwardly toward a corresponding wire constraint **156**a. The conductors **126**a are disposed adjacent the bottom ledge **172** of an associated punch-down wall **170** (FIG. **5**B). After the conductors **126**a have been routed along the punch-down walls **170**, the conductors **126**a are frictionally restrained by the wire constraints **156**a, thereby maintaining the conductors **126**a in the desired routing positions. As well, by frictionally engaging the conductors **126**a with the wire constraints **156**a, the communications cable **120** is held in place such that the cable jacket **122** remains adjacent the upper portion **142** of the back-end variation control cap **140**. By repeating the above steps discussed with regard to twisted conductor pair **124**a for twisted conductor pairs **124**b-d, the twisted conductor pair routing arrangement as shown in FIG. **6**A is achieved. FIG. **6**D is a view of the back-end variation control cap **140** taken along line **6**D-D of FIG. **6**A. Note, conductors **126**a are retained within wire constraints **156**a and conductors **126**b are retained within wire constraints **156**b.

After the twisted conductor pairs **124**a-d have been routed as desired, the back-end variation control cap **140** is positioned above the back portion **110** of the jack module, see, for example, jack module **100** (FIG. **4**), such that the twisted conductor pairs **124**a-d are aligned with the appropriate terminal slots **118**. For the routing configuration shown in FIG. **6**A, when the back-end variation control cap **140** is properly aligned with the back portion **110**, the twisted conductor pairs **124**a-d will be aligned with the terminal slots **118**a-d, respectively. The back-end variation control cap **140** is then urged into position adjacent the back portion **110** by engaging the punch-down tool sockets **144** (FIG. **7**) with a punch-down tool (not shown). As the back-end variation control cap **140** is urged into position adjacent the back portion **110**, the conductors **126** of the twisted conductor pairs **124**a-d are urged downwardly through the terminal slots **118**a-d and into both physical and electrical contact with the contact tails **139** of the IDCs **138** (FIG. **1**). FIG. **7** shows the back--end variation control cap **140** as assembled to jack module **100**. Preferably, the bottom portion **150** of the back-end variation control cap **140** is configured such that the wire guide posts **116** and wire guide splitters **117** nest therein. Note, physical contact between the conductors **126** and the IDCs **138** maintain the back-end variation control cap **140** in the desired position adjacent the jack module in this embodiment.

As shown in FIG. **6**B and FIG. **6**C, multiple routing options are possible for the twisted conductor pairs **124**a-d. FIG. **6**B discloses an arrangement wherein adjacent twisted conductor pairs **124**b and **124**d crossover one another. This arrangement is achieved by routing the twisted conductor pairs **124**a-d through the associated twisted pair channels **146**a-d, respectively. Next, twisted conductor pairs **124**a and **124**c are routed to their respective pairs of wire constraints **156**a and **156**c. To achieve crossover between adjacent twisted conductor pairs **124**b and **124**d, twisted conductor pair **124**b is routed to the twisted pair splitter **160** that is disposed adjacent twisted pair channel **146**d. Once twisted conductor pair **124**b has been separated with the twisted pair splitter **160**, the conductors **126**b are routed to wire constraints **156**d and are frictionally engaged therein. To complete the adjacent crossover arrangement, twisted conductor pair **124**d is routed through a gap **166** disposed between the routing posts **164**. The twisted conductor pair **124**d is separated into individual conductors **126**d with the twisted pair splitter **160** that is disposed adjacent twisted pair channel **146**b. The conductors **126**d are then routed to and secured in the wire constraints **156**b. Once the twisted conductor pairs **124**a-d have been arranged and secured within the back-end variation control cap **140**, the cap is ready for installing on the jack module **100** in the manner previously discussed with regard to FIG. **6**A. Once assembled, this routing arrangement results in twisted conductor pairs **124**b and **124**d being inserted into terminal slots **118**d and **118**b, respectively.

FIG. **6**C discloses an arrangement in which twisted conductor pairs **124**a and **124**d which are disposed diagonally to each other within the communications cable **120** are routed in a crossover fashion. To achieve this configuration, twisted conductor pairs **124**b and **124**c are separated into pairs of substantially parallel conductors **126** and secured within their respective wire constraints **156**b and **156**c. Next, twisted conductor pair **124**a is routed around the centrally disposed routing posts **164** and are separated into conductors **126**a with the aid of twisted pair splitter **160** disposed adjacent to twisted pair channel **146**d. The conductors **126**a are then extended outwardly in a substantially parallel fashion and are secured within wire constraints **156**d. Similarly, twisted conductor pair **124**d is routed around the centrally located routing posts **164** opposite twisted conductor pair **124**a. Twisted conductor pair **124**d is separated into conductors **126**d with the assistance of twisted pair splitter **160** which is disposed adjacent twisted pair channel **146**a. The conductors **126**d are then extended outwardly in a substantially parallel manner and engaged within wire constraints **156**a. With the twisted conductor pairs **124**a-d so arranged, the back-end variation control cap **140** is in condition for mounting to the jack module **100**. The routing arrangement shown in FIG. **6**C results in twisted conductor pairs **124**a and **124**da being inserted into terminal slots **118**d and **118**a, respectively.

The foregoing description has been presented for purposes of illustration and description. It is not intended to be exhaustive or to limit the invention to the precise forms disclosed. Modifications and/or variations are possible in light of the above teachings. The embodiments discussed, however, were chosen and described to illustrate the principles of the invention and its practical application to thereby enable one of ordinary skill in the art to utilize the invention and various embodiments and with various modifications as are suited to the particular use contemplated. All such modifications and/or variations are within the scope of the invention as determined by the appended claims when interpreted in accordance with the breadth to which they are fairly and legally entitled.

Therefore, having thus described the invention, at least the following is claimed:

1. A back-end variation control cap for use with a jack module including a plurality of insulation displacement connectors, the back-end variation control cap being configured for routing a plurality of twisted conductor pairs, said back-end variation cap comprising:

an upper portion;

a bottom portion spaced from the upper portion;

a plurality of twisted pair channels extending between the upper portion and the bottom portion;

a pair of opposed end walls, each of the end walls including a plurality of wire constraints disposed thereon, each wire constraint having opposed surfaces configured to retain one conductor of the plurality of twisted conductor pairs;

a plurality of twisted pair splitters, each twisted pair splitter extending downwardly from the bottom portion adjacent a different one of the twisted pair channels, each twisted pair splitter being configured to facilitate separating the conductors of one of the twisted pairs; and

wherein each of the twisted pair channels is sized and shaped to receive a respective one of the twisted conductor pairs such that, when retained by respective wire constraints, each conductor is aligned with one of the insulation displacement connectors.

2. The cap of claim **1**, wherein each of the opposed end walls further includes a bottom edge, each of the wire constraints is disposed along one of the bottom edges, and wherein each twisted pair splitter is further disposed between the twisted pair channel and the nearest of the opposed sidewalls.

3. The cap of claim **1**, further comprising a pair of punch-down walls extending longitudinally from each of the twisted pair channels toward a pair of the wire constraints, wherein each punch-down wall includes a bottom ledge configured to urge one of the conductors into one of the insulating displacement connectors.

4. The cap of claim **3**, wherein the punch-down walls of each pair are disposed on opposing sides of an associated twisted pair splitter, and the lower most portion of the twisted pair splitter is substantially knife-like.

5. A method of routing twisted conductor pairs from a cable onto a jack module including insulation displacement connectors, comprising the steps of:

providing a cap having a top portion and a bottom portion;

passing each of the twisted conductor pairs **[**through the cap**]** from the top portion to the bottom portion;

routing at least a first twisted conductor pair and a second twisted conductor pair such that the first and second twisted conductor pairs cross over one another on the bottom portion, the first and second twisted conductor pairs being adjacent within the cable;

engaging a portion of the cap with each of the conductors such that each conductor is retained; and

disposing the cap on the jack module such that the bottom portion is adjacent the jack module and each of the conductors electrically engages one of the insulation displacement connectors.

6. The method of claim **5**, further comprising the step of splitting each of the twisted conductor pairs prior to the engaging step such that the conductors of each pair are substantially parallel along the bottom portion.

7. The method of claim **5**, wherein the engaging step further comprises press fitting the conductors into wire constraints, thereby frictionally engaging the conductors.

8. A method of routing twisted conductor pairs from a cable onto a jack module including insulation displacement connectors, comprising the steps of:

providing a cap having a top portion and a bottom portion;

passing each of the twisted conductor pairs **[**through the cap**]** from the top portion to the bottom portion;

routing at least a first twisted conductor pair and a second twisted conductor pair such that the first and second twisted conductor pair cross over one another on the bottom portion, the first and second twisted conductor pairs being diagonally disposed within the cable;

engaging a portion of the cap with each of the conductors such that each conductor is retained; and

disposing the cap on the jack module such that the bottom portion is adjacent the jack module and each of the conductors electrically engages one of the insulation displacement connectors.

9. A jack module system configured to receive a plurality of twisted conductor pairs and at least one communication connector, comprising:

a housing having a front portion including a jack opening configured to receive the communication connector and a back portion including a terminal connection region configured to receive the twisted pair conductors;

a jack receptacle, a printed wiring board, and a plurality of insulation displacement connectors disposed within the housing such that the jack receptacle is aligned with the jack opening and the plurality of insulation displacement connectors are accessible through the terminal connection region, the jack receptacle and the plurality of insulation displacement connectors being disposed on opposite sides of the printed wiring board;

a back-end variation control cap comprising:

an upper portion;

a bottom portion; a plurality of twisted pair channels extending between the upper and the bottom portions;

a plurality of wire constraints disposed on the bottom portion, each wire constraint being configured to retain one of the conductors; a twisted pair splitter depending downwardly from the bottom portion adjacent each of the twisted pair channels, each twisted pair splitter including a pointed ridge configured to facilitate separating the conductors of the twisted pairs; and

wherein each twisted conductor pair extends through one of the twisted pair channels and the conductors are disposed in the plurality of wire constraints such that each conductor is aligned with one of the insulation displacement connectors when the bottom portion slidably engages the terminal connection region.

10. The jack module system of claim **9**, wherein the terminal connector region further comprises two substantially parallel rows housing the plurality of insulation displacement connectors.

11. The jack module system of claim **9**, wherein the back-end variation control cap further comprises a pair of opposed end walls, each of the end walls including two pair of wire restraints.

12. The jack module system of claim **11**, wherein the plurality of twisted pair channels further comprises four twisted pair channels.

13. A jack module system configured to receive a plurality of twisted conductor pairs and at least one communication connector, comprising:

a housing having a front portion including a jack opening configured to receive the communication connector and a back portion including a terminal connection region configured to receive the twisted pair conductors;

a jack receptacle, a printed wiring board, and a plurality of insulation displacement connectors disposed within the housing such that the jack receptacle is aligned with the jack opening and the plurality of insulation displacement connectors are accessible through the terminal connection region, the jack receptacle and the plurality of insulation displacement connectors being disposed on opposite sides of the printed wiring board;

a back-end variation control cap comprising: an upper portion; a bottom portion; four twisted pair channels extending between the upper and the bottom portions, the four twisted pair channels defining a rectangle

therebetween; a plurality of wire constraints disposed on the bottom portion, each wire constraint being configured to retain one of the conductors;

at least one routing post extending downwardly from the bottom portion, the at least one routing post being disposed in the rectangle defined by the four twisted pair channels; and

wherein each twisted conductor pair extends through one of the twisted pair channels and the conductors are disposed in the plurality of wire constraints such that each conductor is aligned with one of the insulation displacement connectors when the bottom portion slidably engages the terminal connection region.

14. A back-end variation control cap for use with a jack module including a plurality of insulation displacement connectors, the back-end variation control cap being configured for routing a plurality of twisted conductor pairs, said back-end variation cap comprising:

an upper portion;

a bottom portion spaced from the upper portion;

a plurality of twisted pair channels extending between the upper portion and the bottom portion;

a pair of opposed end walls, each of the end walls including a plurality of wire constraints disposed thereon, each wire constraint having opposed surfaces configured to retain one conductor of the plurality of twisted conductor pairs;

a plurality of punch-down walls, each of the punch-down walls including a proximal end adjacent one of the twisted pair channels and a distal end adjacent one of the wire constraints, and each of the punch-down walls is configured to urge an associated wire conductor into electrical contact with an associated insulation displacement connector; and

wherein each of the twisted pair channels is sized and shaped to receive a respective one of the twisted conductor pairs such that, when retained by respective wire constraints, each conductor is aligned with one of the insulation displacement connectors.

15. The cap of claim **14**, further comprising a twisted pair splitter disposed adjacent each of the twisted pair channels and extending downwardly from the bottom portion, each twisted pair splitter being configured to facilitate separating the conductors of the twisted conductor pairs, wherein the plurality of punch-down walls further comprises a pair of punch-down walls extending from each of the twisted pair channels, the punch-down walls of each pair being disposed on opposing sides of an associated splitter.

16. A back-end variation control cap for use with a jack module including a plurality of insulation displacement connectors, the back-end variation control cap being configured for routing a plurality of twisted conductor pairs, said back-end variation cap comprising:

an upper portion;

a bottom portion spaced from the upper portion;

a plurality of twisted pair channels extending between the upper portion and the bottom portion;

a pair of opposed end walls, each of the end walls including a plurality of wire constraints disposed thereon, each wire constraint having opposed surfaces configured to retain one conductor of the plurality of twisted conductor pairs;

four twisted pair channels; at least one routing post extending downwardly from the bottom portion, the at least one routing post being disposed within a rectangle defined by the twisted pair channels; and

wherein each of the twisted pair channels is sized and shaped to receive a respective one of the twisted conductor pairs such that, when retained by respective wire constraints, each conductor is aligned with one of the insulation displacement connectors.

17. The cap of claim **16**, wherein the at least one routing post further comprises a pair of routing posts including a routing gap disposed therebetween, the routing gap being configured to receive at least one twisted conductor pair therein.

18. A method of routing conductors of a plurality of conductor pairs from a jacketed cable to respective ones of a plurality of contacts of a jack module, the method comprising:

providing a cap having a plurality of twist separation points;

routing the conductors of each conductor pair along the cap, wherein each conductor pair is routed through a respective one of the plurality of twist separation points;

maintaining the wires of each conductor pair in a twisted configuration on a cable side of each respective twist separation point;

untwisting the wires of each conductor pair on a contact side of each respective twist separation point;

routing a first of the conductor pairs and a second of the conductor pairs such that the first and second twisted conductor pairs cross over one another;

mounting the cap on a dielectric housing of the jack module that houses the plurality of contacts; and

electrically connecting each of the conductors to a respective one of the contacts.

19. The method of claim 18, wherein the first and second of the conductor pairs are adjacent within the cable.

20. The method of claim 18, wherein the first and second of the conductor pairs are diagonally disposed within the cable.

21. The method of claim 18, wherein the cap further includes a plurality of channels that each route at least one of the conductor pairs from a first side of the cap to a second side of the cap, and wherein the conductors of each conductor pair are twisted as they pass through their respective channel.

22. The method of claim 21, wherein a first of the conductor pairs passes through one of the plurality of channels that is adjacent a first pair of the plurality of contacts, and wherein the conductors of the first of the conductor pairs electrically engage a second pair of the plurality of contacts.

23. The method of claim 18, wherein the cap is configured to control the routing of each conductor along its respective path from an end of the cable jacket to an end of the conductor.

24. The method of claim 18, wherein the dielectric housing of the jack module encases a wire connection end of each of the plurality of contacts, and wherein the dielectric housing of the jack module includes a plurality of terminal slots that provide wire connection access to respective ones of the plurality of contacts.

25. The method of claim 18, wherein the cap further includes a plurality of channels that each receive at least one of the conductor pairs, wherein a first of the conductor pairs passes through a first of the plurality of channels that is adjacent first and second of the plurality of contacts and a second of the conductor pairs passes through a second of the plurality of channels that is adjacent third and fourth of

the plurality of contacts, and wherein the conductors of the first of the conductor pairs electrically engage, respectively, the third and fourth of the plurality of contacts.

26. The method of claim 25, wherein the conductors of the second of the conductor pairs electrically engage, respectively, the first and second of the plurality of contacts.

27. The method of claim 18, wherein the dielectric housing of the jack module includes a plurality of wire guide posts and a plurality of wire guide splitters, and wherein the wire guide posts and the wire guide splitters within a bottom side of the cap.

28. The method of claim 23, the method further comprising inserting a portion of each conductor in a respective one of a plurality of wire constraints provided on the cap, wherein each of the wire constraints comprises a pair of opposed surfaces that are separated by a distance that is slightly less than the outer diameter of each of the conductors.

29. The method of claim 18, wherein at least some of the twist separation points comprise a projection that has a point or ridge on its distal end.

30. A back-end variation control cap for a connector jack module, the back-end variation control cap comprising:

a top side;

a bottom side;

a plurality of openings extending through the top side to the bottom side, wherein each of the openings is configured to receive at least one of a plurality of pairs of conductors that are twisted together as the conductors pass through the opening; and

a plurality of twist separation structures on the control cap, wherein each of the twist separation structures is configured to define a point where the conductors of one of the plurality of pairs of conductors transition from a twisted configuration to an untwisted configuration,

wherein the control cap is configured to mate with a dielectric contact housing of the connector jack module.

31. The back-end variation control cap of claim 30, further comprising a plurality of routing channels on the bottom side of the control cap that are each configured to route one or both conductors of a pair of conductors.

32. The back-end variation control cap of claim 30, wherein the plurality of twist separation structures are provided on the bottom side of the control cap.

33. The back-end variation control cap of claim 30, wherein the dielectric contact housing encases a wire connection end of each of a plurality of insulation displacement contacts, and wherein the dielectric contact housing includes a plurality of terminal slots that provide wire connection access to respective of the plurality of insulation displacement contacts.

34. The back-end variation control cap of claim 30, the control cap further comprising a plurality of wire constraints, wherein each of the wire constraints comprises a pair of opposed surfaces that are separated by a distance that is slightly less than the outer diameter of each of the conductors.

35. The back-end variation control cap of claim 30, wherein the dielectric contact housing includes a plurality of wire guide posts and a plurality of wire guide splitters, and wherein the wire guide posts and the wire guide splitters nest within a bottom side of the control cap.

36. The back-end variation control cap of claim 30, the control cap further comprising at least one routing post that is configured to allow crossing two of the plurality of pairs of conductors.

37. A method of routing a plurality of twisted conductor pairs from a cable onto a jack module including insulation displacement connectors, the method comprising:

passing each of the plurality of twisted conductor pairs from a first side of the cap to a second side of a cap;

routing at least a first of the plurality of twisted conductor pairs and a second of the plurality of twisted conductor pairs such that the first twisted conductor pair crosses the second twisted conductor pair along the cap; and

mounting the cap on the jack module such that the second side of the cap is adjacent the jack module and each of the conductors electrically engages one of the insulation displacement connectors.

* * * * *