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Interface de câblage

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(56) References cited:
US-A- 2 098 321 **US-A- 3 700 786**
US-A- 4 320 261 **US-A- 4 583 215**
US-A- 4 776 529 **US-A- 4 972 298**
US-A- 5 659 655

EP 0 903 827 B1

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Description

[0001] The present invention relates to wiring installations and more particularly to wiring installations in aircraft electronics bays, main instrument panels or overhead panels which require extremely complex wiring of multiple systems.

[0002] In the patent literature U.S. patent No. 4,583,215 to Hargrave, et al, shows a telephone line access system for main distribution frame that employs access blocks comprising sockets and pins for coupling two rows of lightning protectors. One or more integrated circuit modules are attached to each access block and these may be readily affixed to and disconnected from a main distribution frame.

[0003] U.S. patent No. 4,320,261 to Scerbo, et al, shows a method for optimizing cable routing in the distribution panels for an office environment. Means are described for minimizing crossovers and cable lengths. Optimization is based on crossovers and length in contrast to the present method which considers separation requirements. Also Scerbo, et al, is hardwired in contrast to the present method of using connectors.

[0004] U.S. patent No. 4,972,298 to Casa, et al, is illustrative of high density circuit computer assemblies, while U.S. patent No. 2,098,321 to Treptow is illustrative of distributing frames in telephone systems.

[0005] US 4 776 529 discloses a method of using heat pads to preheat helicopter metallic components, oils and fuel. The heat pads are connected by a power cord to an electric source. The power cord follows the route of existing wire bundles. There is no redundancy to prevent simultaneously failure of heat pads. The connectors are used to connect the heat pads to the harness and the harness to a power source. If a cable was severed, all signals to the heat pad would fail causing complete failure of the system.

[0006] US 5 659 655 discloses a box for protecting Berg fiber optic fanouts, wherein a Berg-method is used to fanout and splice optical fibre cables with minimal optical loss. This document provides a method to protect the Berg fanout. If a cable was severed, all signals would fail causing complete failure of the system.

[0007] The problems of wiring separation, congestion, integration, routing, cross-connected wire bundles, disconnects in aircraft installations have been tolerated and accepted without solution, the traditional method of complex wiring of multiple systems being to hand wire from a connector at the peripheral device to another at e.g., an overhead panel or directly into the overhead panel. There has been no consistent system for achieving wire separation, avoiding cross-connects or minimizing connections or any attempts made to solve the congestion problem during aircraft final assembly.

[0008] According to the invention, there is provided a plural level wiring interface system and a method of providing such a plural level wiring interface comprising the features of claim 1 and 4.

[0009] This invention employs a plural-level system to achieve simplicity. Each panel is analyzed to assign wire separation categories for every required connection and then one or more connectors (designated separation dedicated connectors) is incorporated for each category. The opposite end of the system is composed of a set of "integration disconnects". The connections on these are determined by performing a wire separation category analysis on the wires coming into the instrument bay from the peripherals in a given physical area (called a destination area) and assigning at least one connector for each category. The third portion of the system is composed of the "integration wire bundles". These are designed with breakouts from the bundle body so that they connect the proper terminals of the dedicated separation connectors to the proper terminals of the integration disconnects. In addition to the above advantages, the present invention importantly practically eliminates the need for doing hand wiring at final assembly. The features, objects and advantages of the present invention will be apparent hereinafter from a detailed description of the invention and the appended claims taken in conjunction with the attached drawing of a preferred embodiment.

BRIEF DESCRIPTION OF THE DRAWINGS

[0010]

Figure 1 is a schematic block diagram of the present basic plural level wiring interface;

Figure 2A is an exemplary overlay of a present system wiring interface layout for an overhead panel;

Figures 2B and 2C are taken together on an enlarged view of the system of Figure 2A; and

Figures 3A and 3B are an exemplary representation of a typical bundle.

Figures 4A and 4B show examples of Integration Disconnects with and without wiring.

DETAILED DESCRIPTION

[0011] Initially upon reviewing the aircraft overhead panel or electronics bay of an aircraft, and due to its inherent wire congestion, complexity, and separation problems, efforts towards a solution of the problem have generally not been attempted or abandoned. The present invention however solves the separation problem by utilizing separation dedicated connectors. Using this method a wire is inserted into the connector meeting the wires separation requirement; should multiple connectors meet the wire's separation requirement, the wire is inserted into the connector also meeting the wire's destination requirements, thereby providing a solution to the separation routing congestion, cross-connected wire bundles, and complexity problems. A wiring matrix results in simplified discrete integrated wire bundles which are assembled and positioned on the module or

overhead panel before final assembly thereby completing a module or panel and wiring assembly. Routing integration previously achieved by end point aircraft final assembly wiring with complex integration wiring panels is eliminated in accordance with the present plural level wiring interface hereinafter described utilization which is a system utilizing separation dedicated connectors, integration disconnects (having no wiring, Ref. Fig. 4A and 4B), Ref. Fig. 1 and 2, modular integrated wire bundles and panels, destination dedicated connectors, and wire bundle breakouts from the bundle body (Ref. Fig. 1, 3A and 3B). The present system permits wire bundle production on foam boards including connectors and wiring as integral unitary modules.

[0012] Concern has been expressed with regard to the problem of cross-connected wire bundles at a connector (wiring more than one wire bundle to a single connector). This concern is expressed primarily due to production, installation and separation problems. The cross-connection problem is herein solved by the utilization of separation dedicated connectors on modules and panels.

[0013] Turning now to Figure 1, a plural level wiring interface system is shown in which the following symbols are representative of the interface components:

MP1,MP2,MP3 are modules or panels
 ID1,ID2,ID3 are integration disconnects
 IB1,IB2,IB3 are integration wire bundles
 DB1,DB2,DB3 are distribution wire bundles
 D1,D2,D3,D4,D5 are destination devices
 E1,E2 are assemblies
 A,B,C,N are dedicated separation categories at connectors
 1,2,3,4,5,6,7,8,9,10 are connectors

[0014] In the following, the method by which wiring interfaces are defined and developed will be described:

[0015] As shown in Figure 1; starting with the most complex module or panel integration assembly, the separation categories in the module or panel are determined; A,B,C, and N for example, where N is a neutral or non-critical separation; and for example Separation A is routed on the left side, B is routed on the right side, and C is redundant to A and/or B and routed away from A and B. The module or panel is assigned a connector for each separation category in the module or panel.

[0016] As shown in Figure 1; MP2 is assigned separation connectors A,B,C; MP3 is assigned separation connectors B, & C; and MP1 is assigned separation connector A/N (since separation category N may be combined with any other separation category). The internal wiring of the modules or panels are separation routed and connected to the separation dedicated connectors of the module or panel interface. Integration wire bundles IB1, IB2, IB3 are used to route wires of similar separation from the module or panel separation dedicated connector interface to an integration disconnect ID1 via

breakouts from the bundle body. Wires from separation dedicated connectors; A of MP2 and A/N of MP1 are combined into IB1; B of MP2 and MP3 are combined into IB2; and C of MP2 and MP3 are combined into IB3. Integration wire bundles IB1, IB2, and IB3 are kept separate from each other and routed to an integration disconnect ID1. (Thus a failure in one bundle will not affect the wiring in another bundle.). This integration disconnect is close to or part of the module or panel assembly E1. The integration disconnect provides a disconnect for the assembly E1 as well as an integration interface to the distribution wire bundles. IB1 mates with connector 1 (separation dedicated A/N) and connector 2 (separation dedicated N); [Note: The integration disconnect connector 2 is used to route a portion of the separation N wires based on destination, and eliminates the need for wiring at the integration disconnect to enter another distribution wire bundle, Ref. Fig. 4A and 4B). IB2 mates directly with DB2 and provides a disconnect function at connector 3. IB3 mates with connectors 4 and 5 to accommodate the volume of wires and provide the disconnect function. The distribution wire bundles are used to make long runs with breakouts from the bundle body (Ref. Fig. 1) to other integration or destination areas. DB1 routes separation category A wires direct from ID1 to ID2; (integration disconnect, ID2, is shown being used as a production break interface). DB2 routes separation category B wires to both ID2 and ID3 (ID3 being shown as an integration disconnect interface on an enclosed assembly E2). DB3 accepts separation category N wires from IB1 for routing to destination device D5 having a single C/N separation dedicated connector; DB3 also has routing breakouts from the bundle body (Ref. Fig. 1) for separation category C wiring to ID2 and ID3.

[0017] Turning now to Figure 2A there is seen a plural level wiring interface of the kind shown in Figure 1 however as adapted for an overhead panel. Only the elements of the present system are shown in heavy lines.

[0018] Referring to Figure 2A, and enlarged in Figures 2B and 2C, giving details the following symbols are representative of the interface components:

MP1 thru MP23 are modules
 ID1A and ID1B are integration disconnects
 IB1 thru IB5 are integration wire bundles
 DB1 thru DB7 are distribution wire bundles
 E1 is a panel assembly
 A thru G are dedicated separation categories at connectors
 1 thru 19 are connectors.

[0019] Separation categories D and E represent (in air/in space/at sea) and (on ground/at port) usage respectively, exclusive usage allows the combining of these wires into a single connector.

[0020] Separation categories F and G are redundant to categories A and B, and may be combined (provided they have protective shielding from A and B) to the first

distribution breakout.

[0021] Figure 2A (and 2B and 2C) is a detail of a complex panel, thus destination devices are not shown.

[0022] Modules MP22 and MP23 interface with both integration and distribution wire bundles.

[0023] Connectors (1,2,3), (4,5,6), and (10,11,12) are provided to handle the volume of wires.

[0024] Connectors 8 and 9 on integration disconnect ID1A are provided to separate and distribute separation category D and E wires.

[0025] Connectors 7 and 13 on integration disconnects ID1A and ID1B are provided to separate and distribute separation category A and B from F and G.

[0026] Connectors 1 thru 19 also provide a panel disconnect function.

[0027] It will be further understood that the plural level wiring interface arrangements and methods herein described is not limited to the specific embodiment disclosed by way of illustration, but may assume other embodiments limited only by the scope of the appended claims.

Claims

1. Plural level wiring interface system for making electrical circuit connections between a first set of terminals (MP1 A/N, MP2 A,B,C, MP3 B,C) and a last set of terminals (D1 A/N, D2 A, D3 B,C, D4 B,C, D5 C/N), comprising:
 - a plurality of separation category dedicated connectors, through which wires are separated and routed to prevent malfunction of a system, which are coupled to said first and last sets of terminals;
 - a plurality of integration disconnects coupled in said wiring interface system with intermediate set(s) of terminals (1-10);
 - and a plurality of integration wire bundles (IB1-IB3) for providing an integration function, and distribution wire bundles (DB-DB3) for providing a distribution function, including utilization of wire breakouts from a bundle body coupling between said plurality of separation dedicated connectors and said plurality of integration disconnects.
2. Plural level wiring interface system according to claim 1, wherein said integration disconnects have no internal wiring.
3. Plural level wiring interface system according to claim 1, wherein the structure of wire breakouts comprises one or more wires entering or leaving the bundle body.
4. Method of providing a plural level interface system

for connecting wire bundles to eliminate wiring integration areas, comprising the steps of:

- providing a plurality of integration wire bundles including wire breakouts from the bundle body, containing wires between separation category dedicated connectors and integration disconnects;
- providing a plurality of distribution wire bundles, containing wires between integration disconnects;
- mating a connector plug of an integration wire bundle directly with the connector receptacle of a distribution wire bundle whereby each of said plurality of integration disconnects have no wiring between the connectors of mating bundles.

Patentansprüche

1. Mehrfachebenenverdrahtungsschnittstellensystem zur Herstellung von Verbindungen elektrischer Schaltungen zwischen einer ersten Gruppe von Anschlüssen (MP1 A/N, MP2 A, B, C, MP3 B, C) und einer letzten Gruppe von Anschlüssen (D1 A/N, D2 A, D3 B, C, D4 B,C, D5 C/N), mit:
 - eine Mehrzahl von abtrennungskategoriezugeordneten Verbindern, durch die zur Verhinderung einer Fehlfunktion eines Systems Leitungen getrennt und geleitet werden, die mit der ersten Gruppe und der zweiten Gruppe von Anschlüssen gekoppelt sind;
 - eine Mehrzahl von Integrationstrennstellen, die in der besagten Verdrahtungsschnittstelle mit einer Zwischengruppe bzw. Zwischengruppen von Anschlüssen (1-10) gekoppelt sind;
 - und einer Mehrzahl von Integrationsleitungs-bündeln (IB1-IB3) zur Herstellung einer Integrationsfunktion, und Verteilungsleitungs-bündeln (DB-DB3) zur Herstellung einer Verteilungsfunktion, wobei die Verwendung von Leitungsverzweigungen von einem Bündelkörper eingeschlossen ist, die besagte Mehrzahl von abtrennungszugeordneten Verbindern und besagte Mehrzahl von Integrationstrennstellen koppeln.
2. Mehrfachebenenverdrahtungsschnittstellensystem nach Anspruch 1, wobei die besagten Integrationstrennstellen keine interne Verdrahtung aufweisen.
3. Mehrfachebenenverdrahtungsschnittstellensystem nach Anspruch 1, wobei die Struktur der Leitungsverzweigungen wenigstens eine Leitung aufweist, die in den Bündelkörper hineinverläuft oder ihn verlässt.

4. Verfahren zum Schaffen eines Mehrfachebenen-schnittstellensystems zur Verbindung von Leitungsbündeln zur Eliminierung von Verdrahtungs-integrationsbereichen, aufweisend die Schritte von:

- Bereitstellen einer Mehrzahl von Integrations-leitungsbündeln mit Leitungsverzweigungen von dem Bündelkörper, der Leitungen zwischen abtrennungskategoriezugeordneten Verbindern und Integrationstrennstellen enthält;
- Bereitstellen einer Mehrzahl von Verteilungs-leitungsbündeln, die Leitungen zwischen Integra-tionstrennstellen enthalten;
- Anpassen eines Verbindungssteckers eines In-tegrationsleitungsbündels direkt an die Verbinderaufnahme eines Verteilungsleitungsbündels, wobei keine der Mehrzahl der Integrati-onstrennstellen eine Verdrahtung zwischen den Verbindern von aneinander angepassten Bündeln aufweist.

Revendications

1. Système d'interface de câblage à plusieurs niveaux afin d'effectuer des connexions de circuits électriques entre un premier ensemble de bornes (MP1 A/N, MP2 A, B, C, MP3 B, C) et un dernier ensemble de bornes (D1 A/N, D2 A, D3 B, C, D4 B, C, D5 C/N), comprenant :

- une pluralité de connecteurs spécialisés de catégorie de séparation, par l'intermédiaire desquels des fils sont séparés et acheminés pour empêcher un dysfonctionnement d'un système, qui sont couplés auxdits premier et dernier ensembles de bornes ;
- une pluralité de déconnexions d'intégration couplées dans ledit système d'interface de câblage avec des ensembles intermédiaires de bornes (1-10) ;
- et un ensemble de faisceaux de fils d'intégration (IB1-IB3) pour assurer une fonction d'intégration, et des faisceaux de fils de répartition (DB-DB3) afin d'assurer une fonction de répartition, comprenant une utilisation de séparations de fils à partir d'un couplage de corps de faisceau entre ladite pluralité de connecteurs spécialisés de séparation et ladite pluralité de déconnexions d'intégration.

2. Système d'interface de câblage à plusieurs niveaux selon la revendication 1, dans lequel lesdites déconnexions d'intégration n'ont pas de câblage interne.

3. Système d'interface de câblage à plusieurs niveaux selon la revendication 1, dans lequel la structure de

séparations de fils comporte un ou plusieurs fils pénétrant dans ou quittant le corps de faisceau.

4. Procédé de réalisation d'un système d'interface à plusieurs niveaux afin de connecter des faisceaux de fils pour éliminer des zones d'intégration de câblage, comprenant les étapes consistant à :

- prévoir une pluralité de faisceaux de fils d'intégration comprenant des séparations de fils depuis le corps du faisceau, contenant des fils entre des connecteurs spécialisés de catégorie de séparation et des déconnexions d'intégration ;
- prévoir une pluralité de faisceaux de fils de répartition, contenant des fils entre des déconnexions d'intégration ;
- adapter une fiche de connecteur d'un faisceau de fils d'intégration directement au réceptacle du connecteur d'un faisceau de fils de répartition de telle sorte que chacune de ladite pluralité de déconnexions d'intégration n'ait pas de câblage entre les connecteurs de faisceaux en regard.

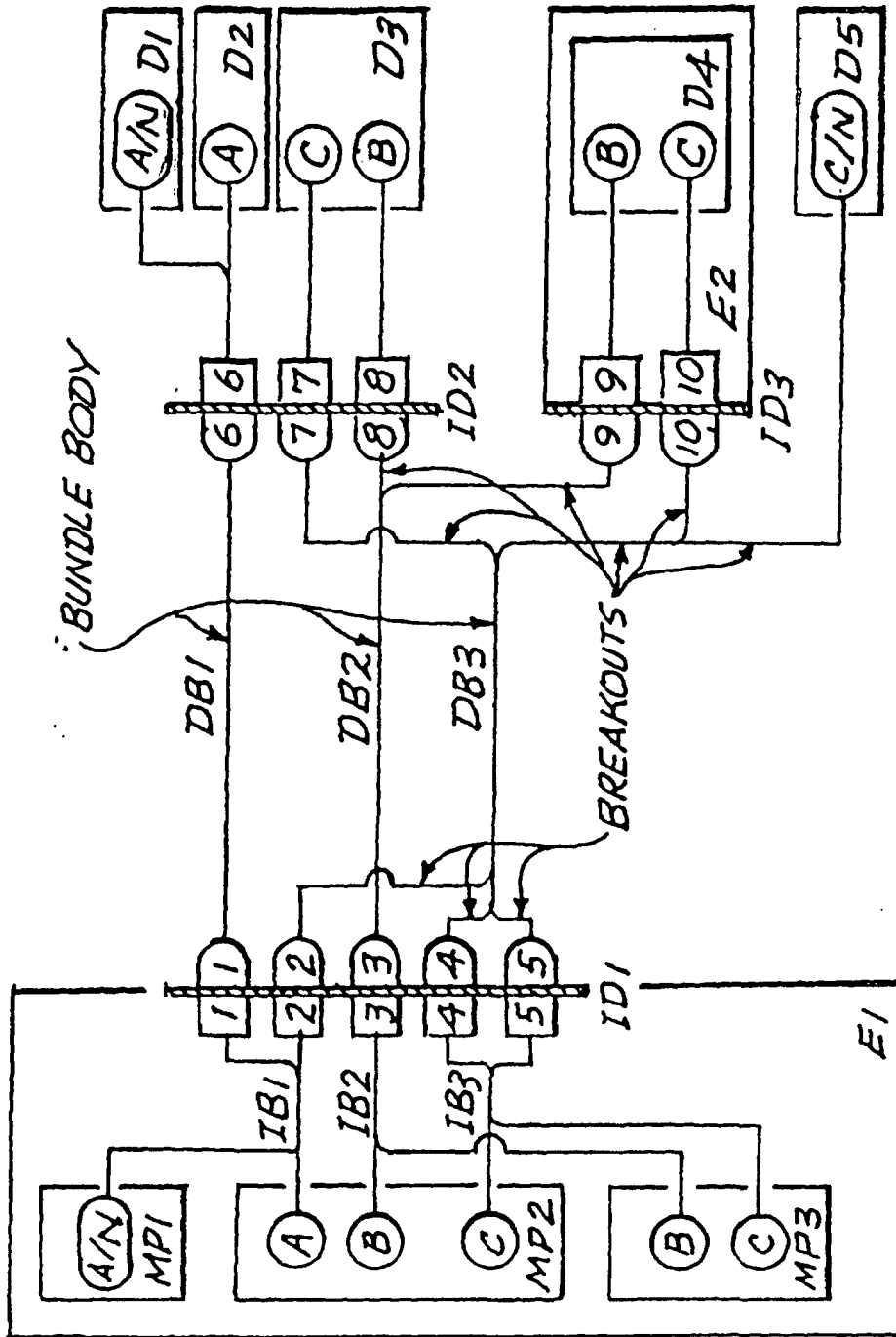


Fig. 1.

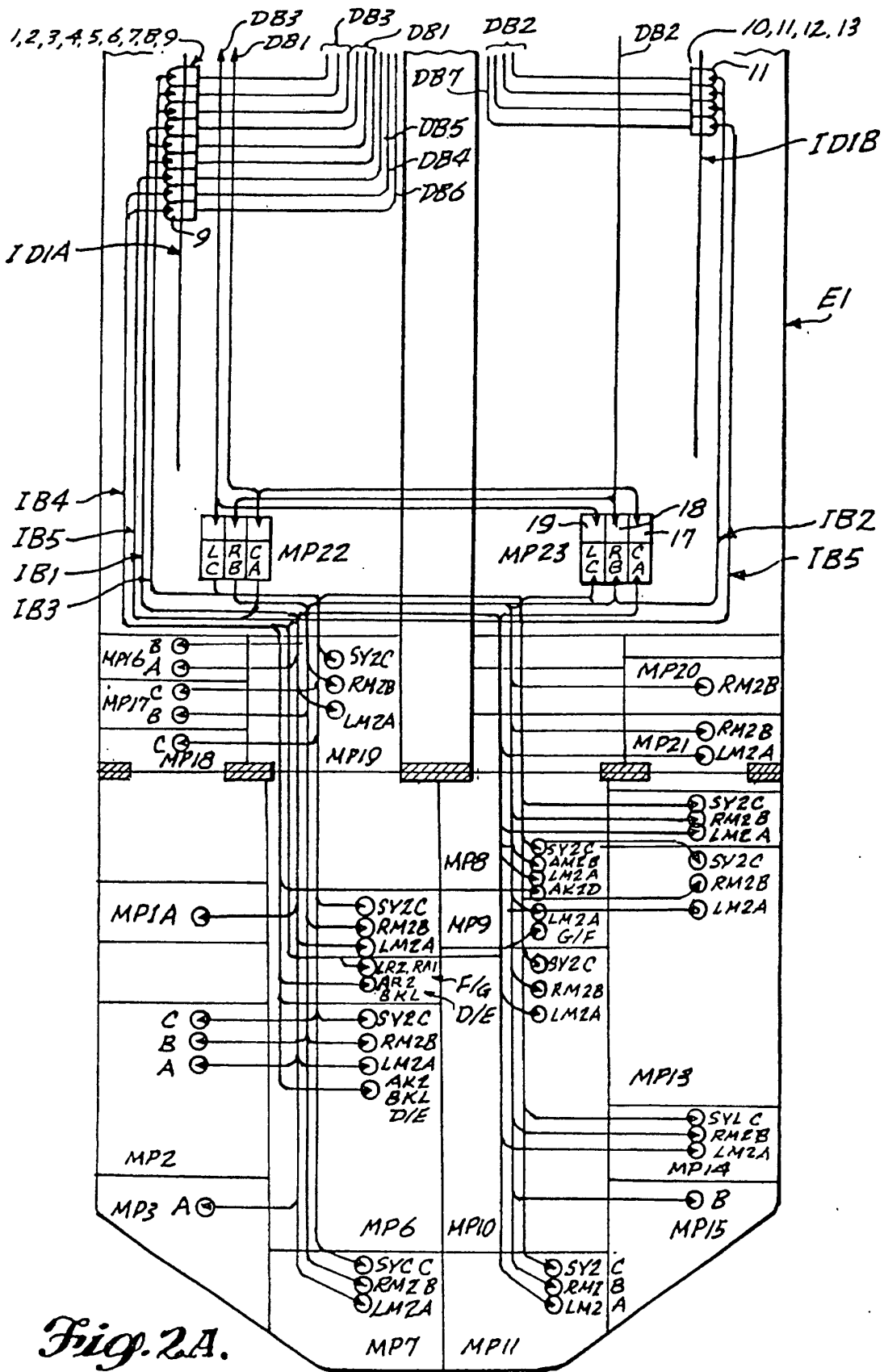


Fig. 2A.

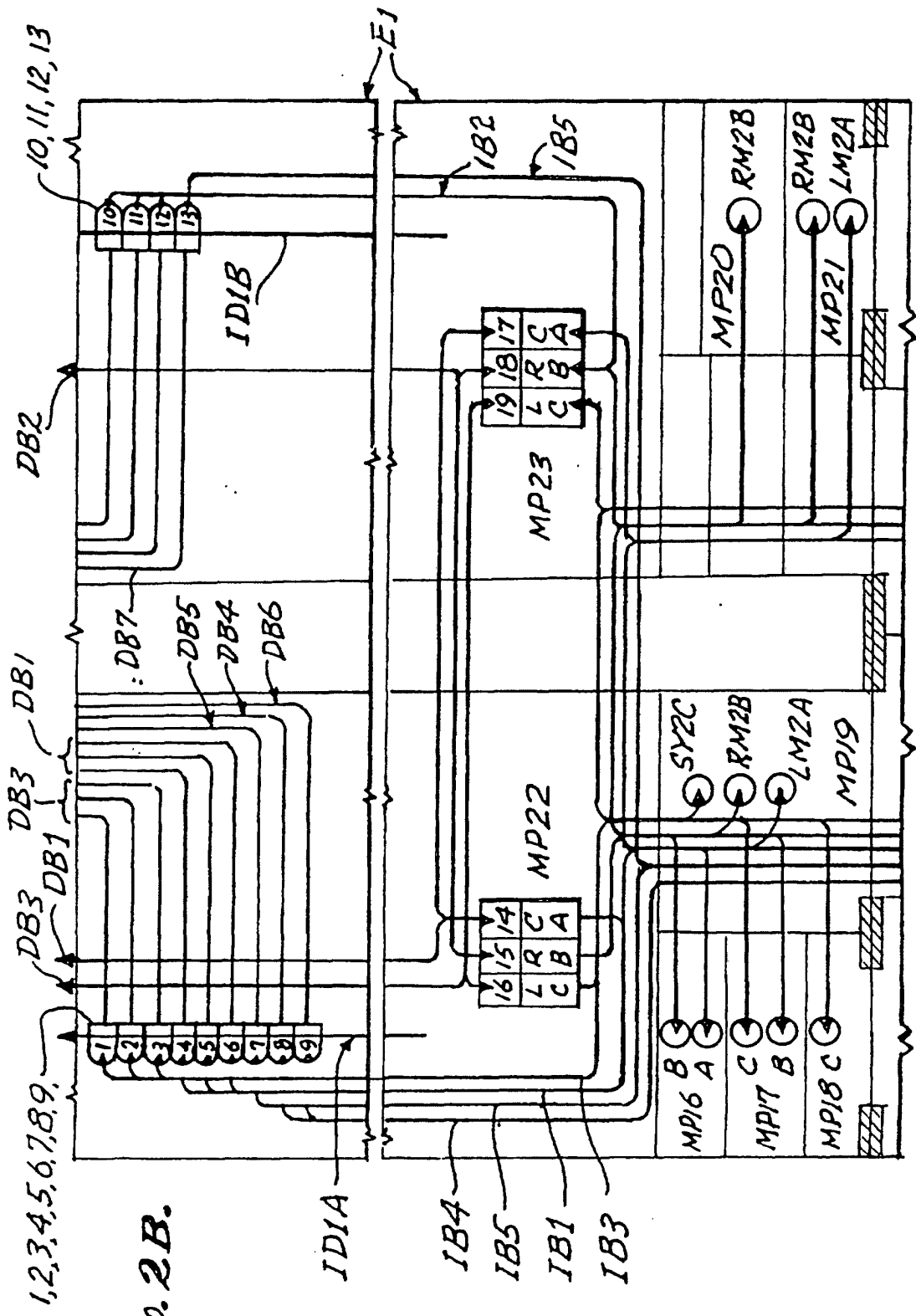


Fig. 2B.

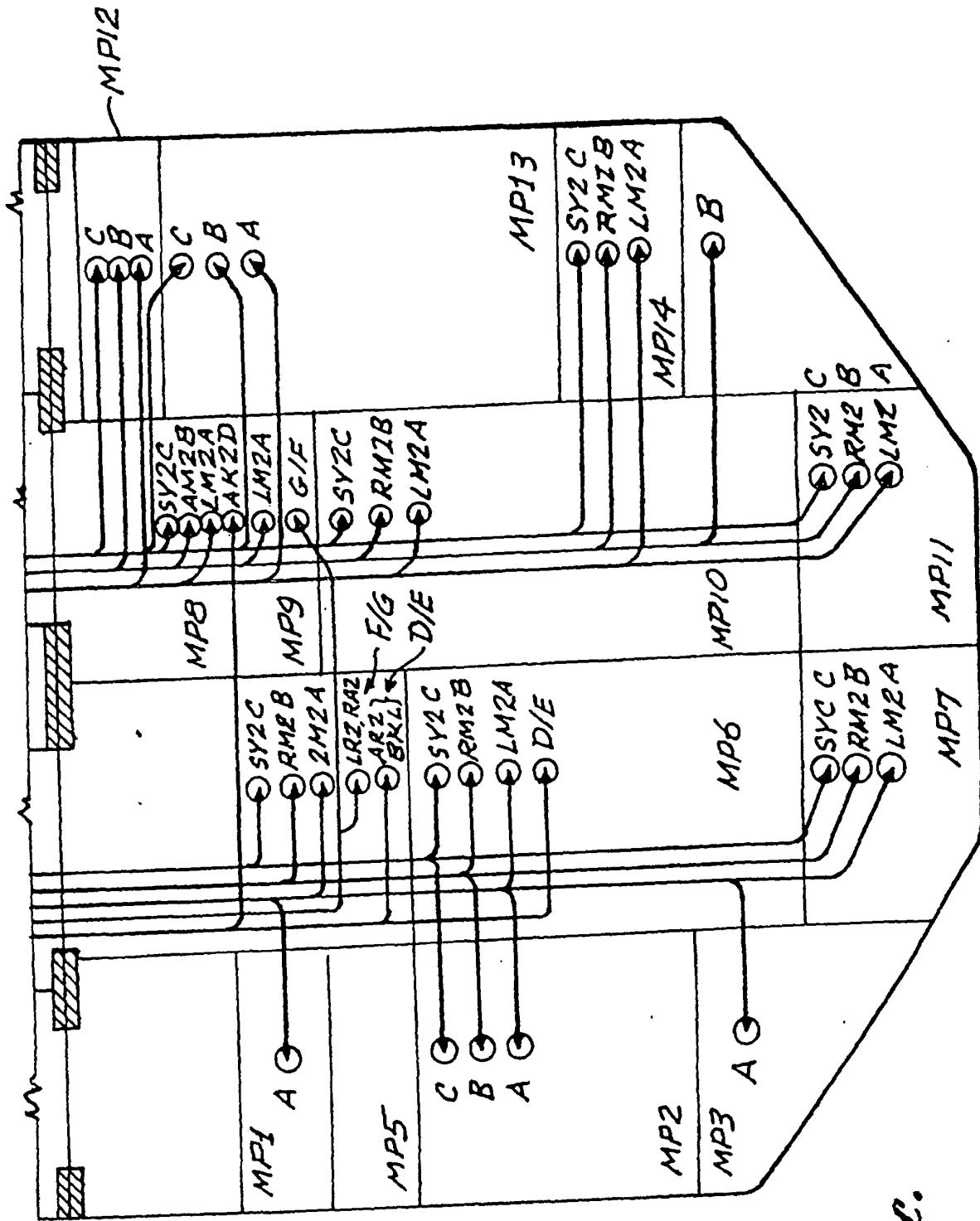


Fig. 2c.

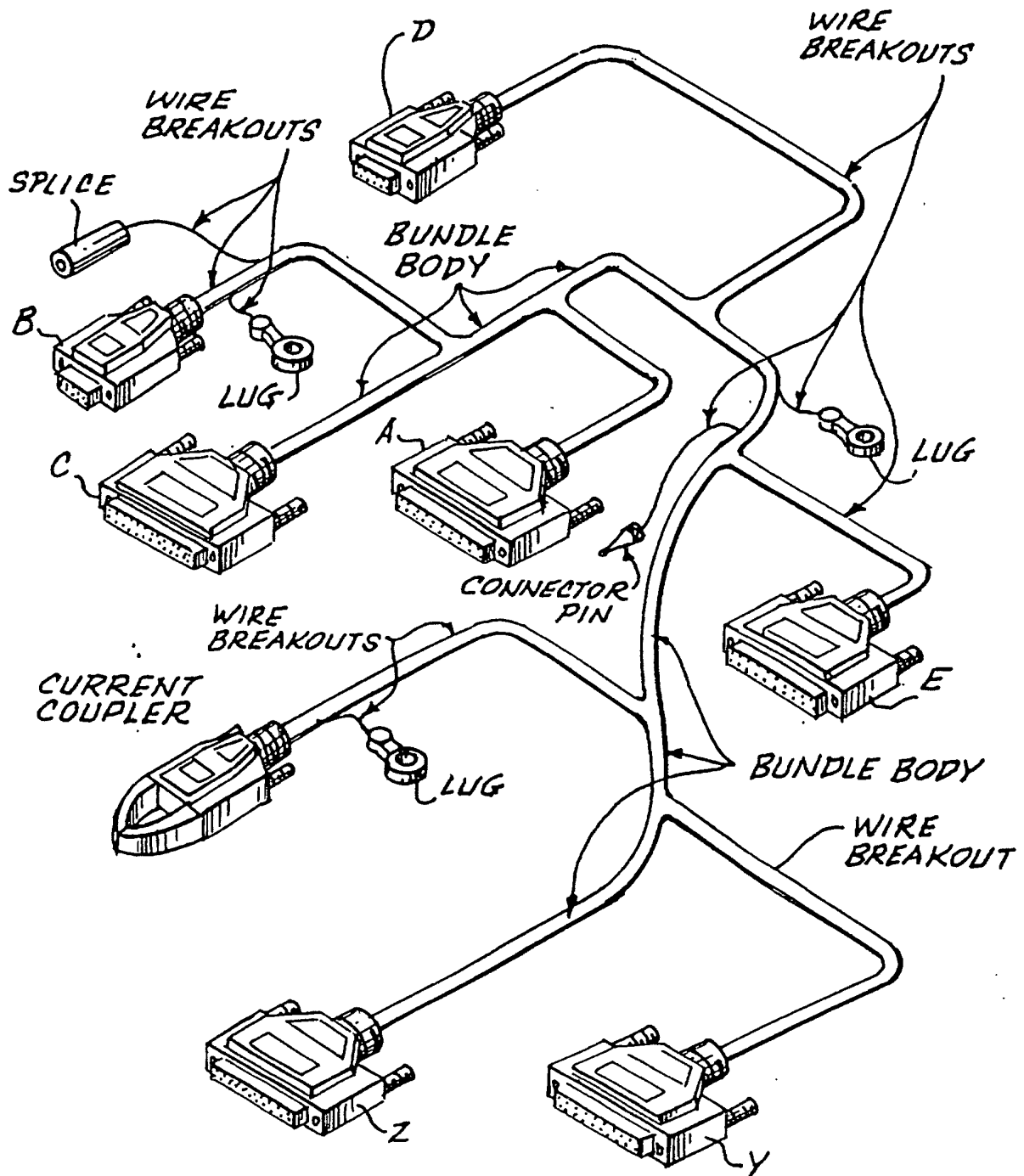


Fig. 3A.

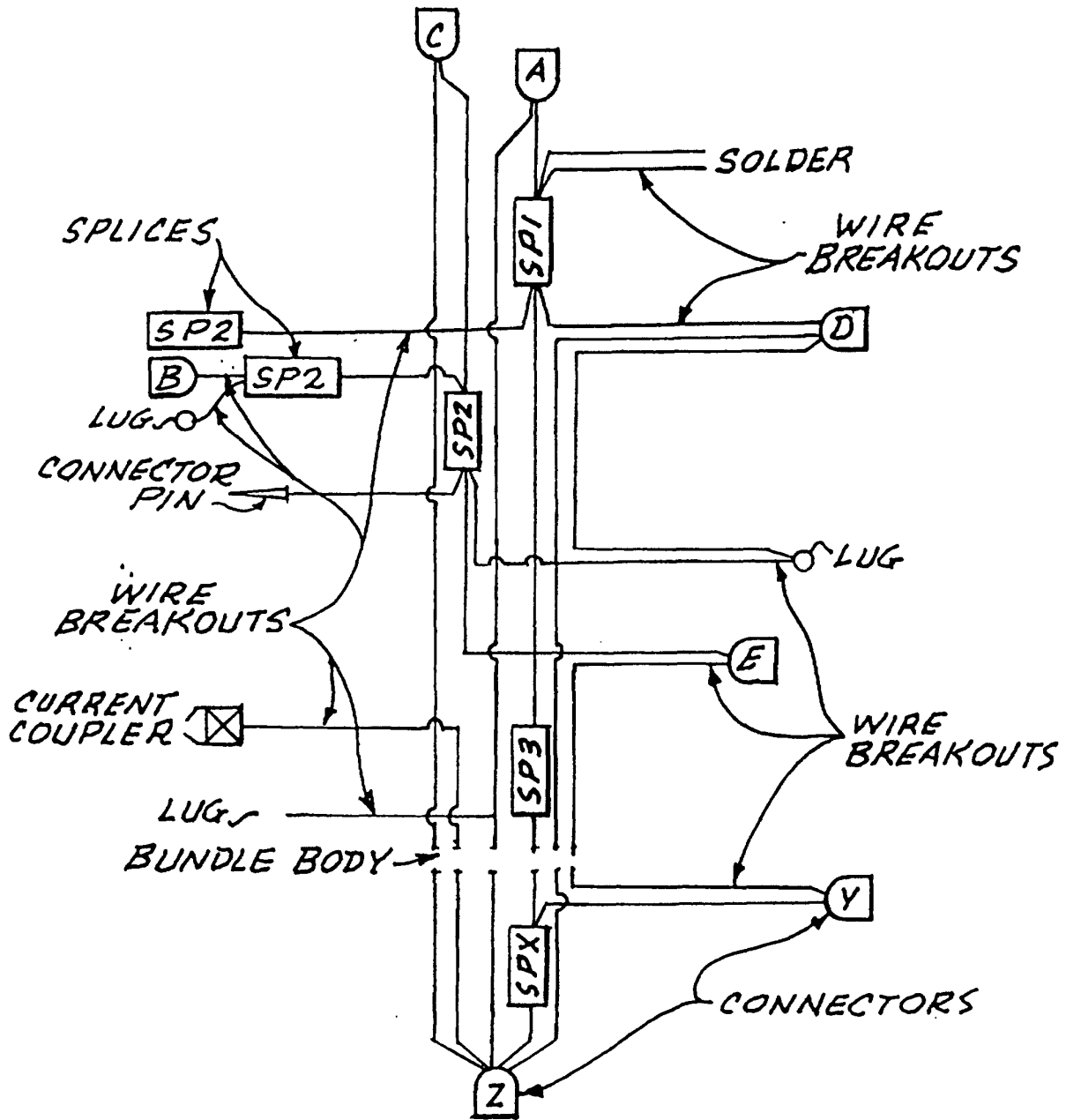


Fig. 3B.

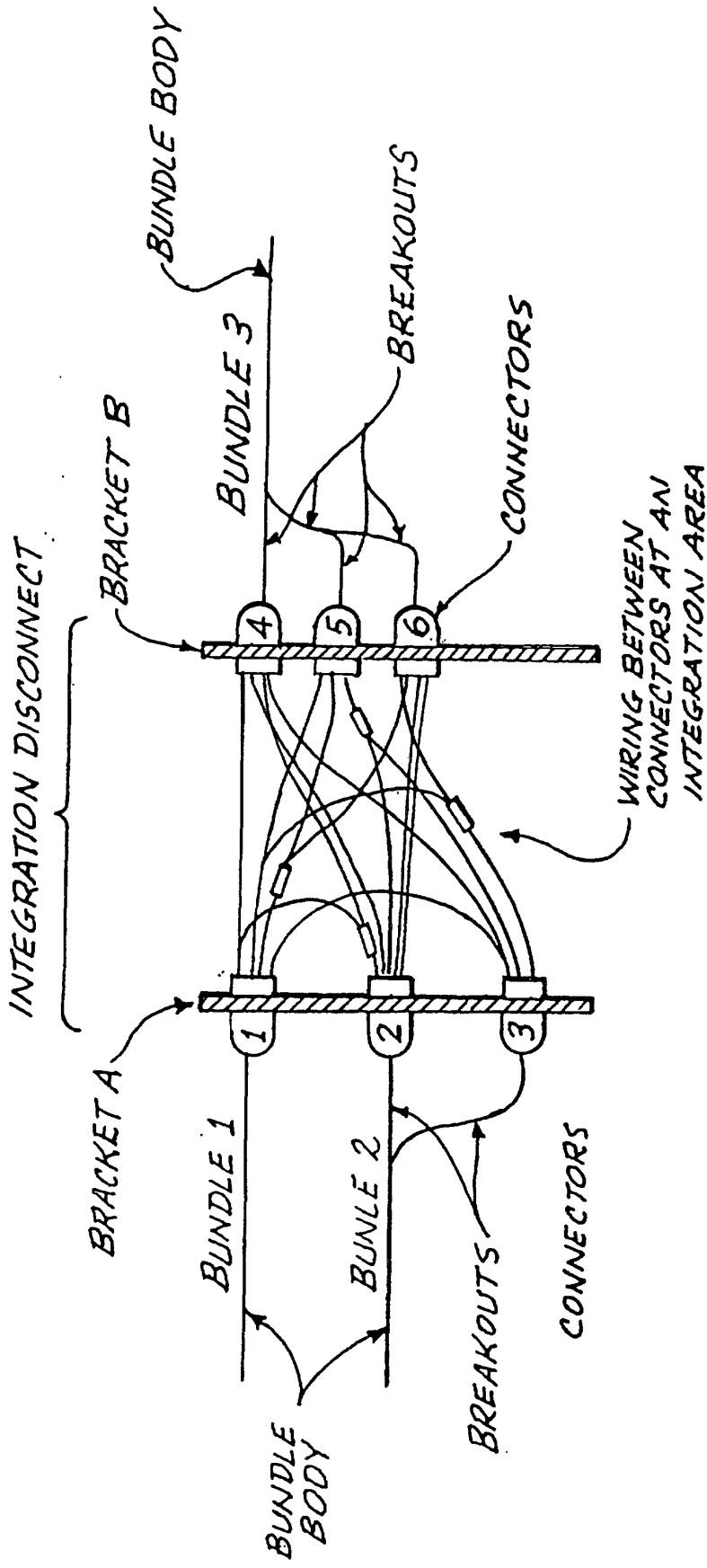


Fig. 4A.

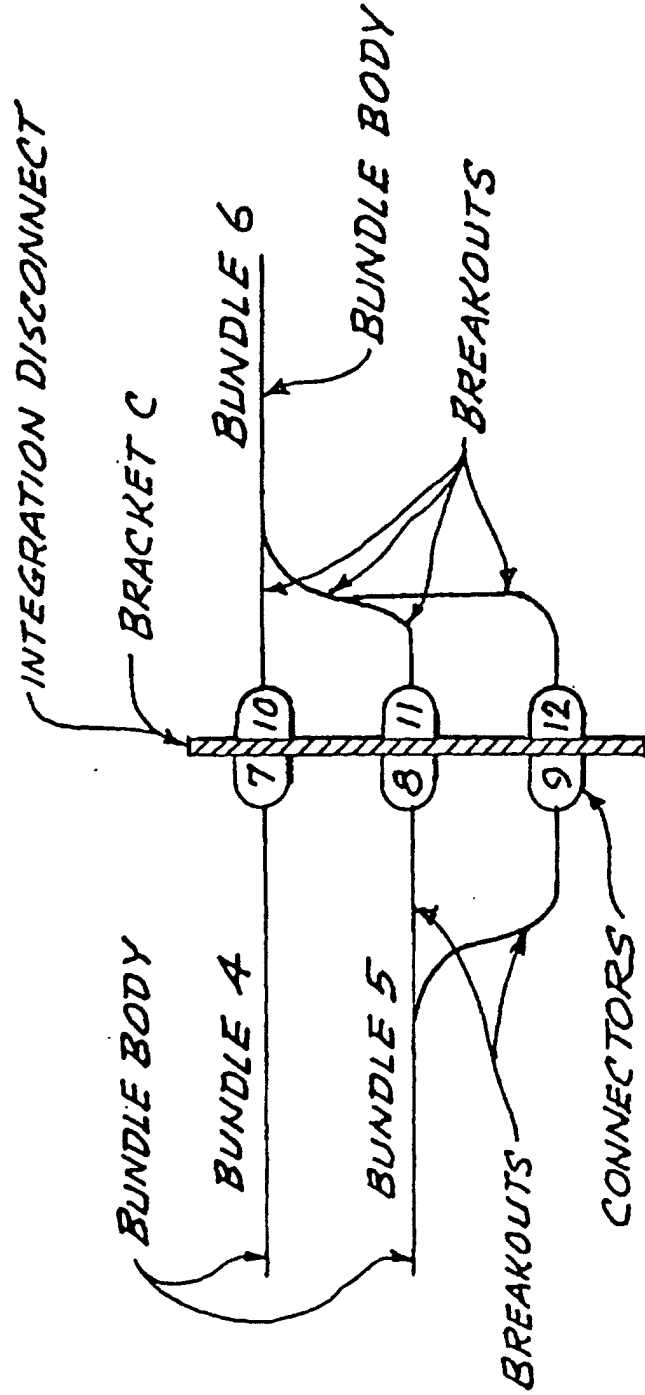


Fig. 4B.