July 7, 1964 P. J. CADE 3,140,425

ELECTRICAL CONNECTOR APPARATUS

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Fig. 1.

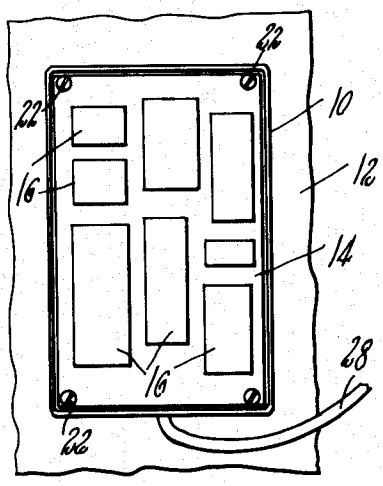


Fig. 2.

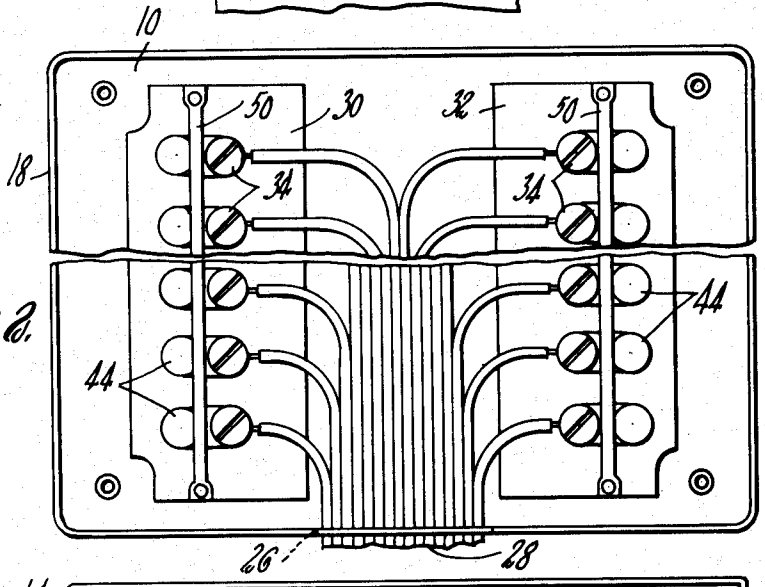
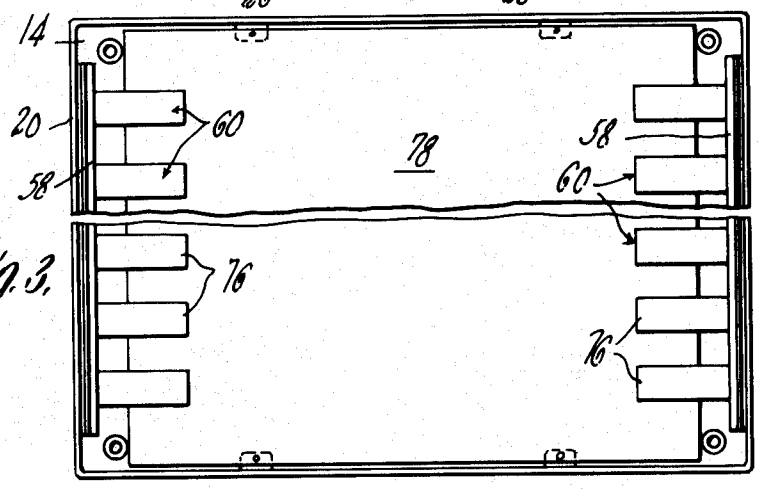


Fig. 3.



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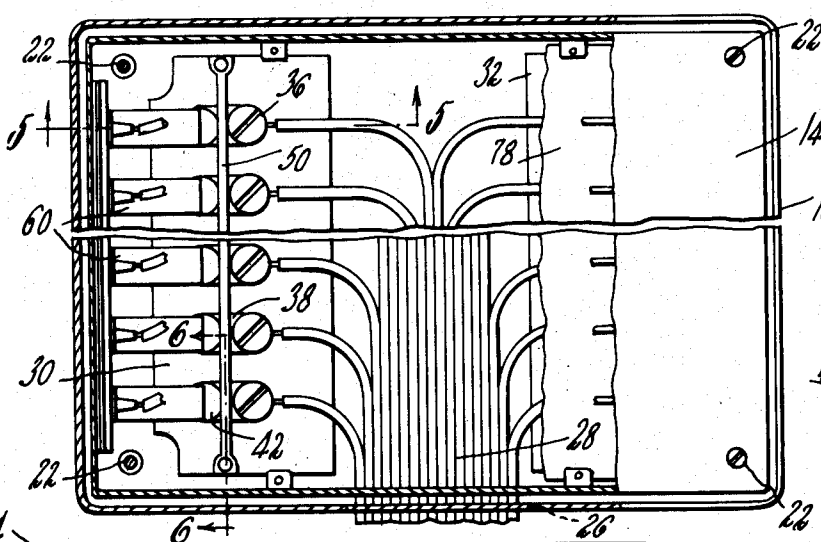


Fig. 4.

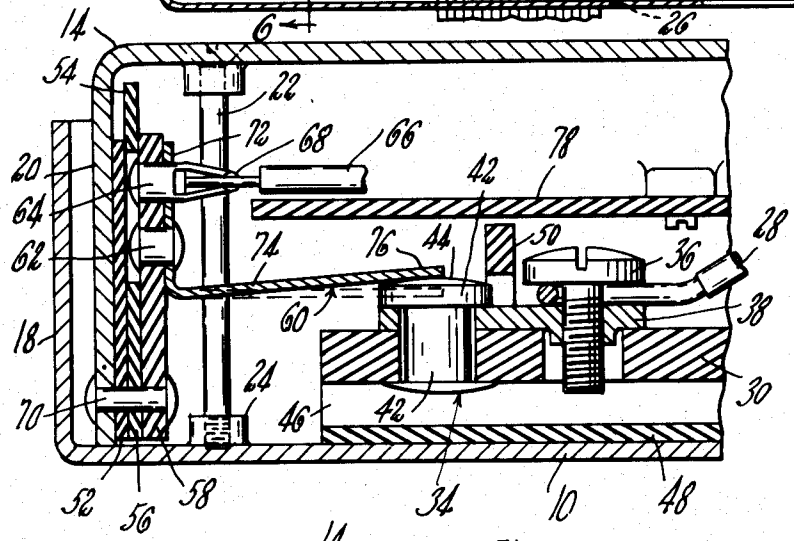


Fig. 5.

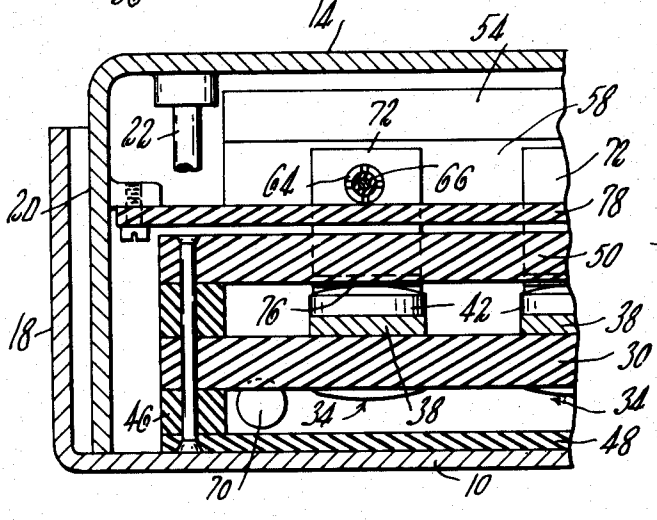


Fig. 6.

United States Patent Office 3,140,425 Patented July 7, 1964

3,140,425

ELECTRICAL CONNECTOR APPARATUS

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Filed Feb. 9, 1962, Ser. No. 172,176
6 Claims. (Cl. 317—101)

This invention relates to electrical connection devices and more particularly to connector arrangements which enable a multiplicity of electrical circuits to be completed substantially simultaneously.

Such multiple connector arrangements find frequent use in pluggable units or quick disconnect arrangements where a plurality of electrical components are mounted in supported array for connection to an electrical system via a cooperating base element so that they may be replaced quickly on the failure of a component for example, or where the types of components in the unit are desired to be changed without undue interruption in the operation of the system. A typical arrangement of this type employs male-female type contact arrangements, the male contacts being slid axially with a wiping movement between the female contacts and into firm frictional engagement to complete the electrical circuit. Such contact arrangements require a substantial amount of space for the required axial movement to make the necessary electrical connection. In addition, where there are a substantial number of contacts they are difficult to disconnect and connect and auxiliary mechanisms, such as jacks, are often necessary. Further, the contact structures, particularly the female contacts, are often difficult to reach for maintenance purposes due to their mounting within a casing of electrical insulation.

Accordingly, it is an object of this invention to provide an improved electrical contact arrangement which enables the substantially simultaneous completion of a multiplicity of electrical circuits.

Another object of the invention is to provide an improved electrical contact arrangement for a multiplicity of electrical circuits which is easy to connect and disconnect and in which the problem of alignment for connection purposes between cooperating sets of contacts is minimal.

Still another object of the invention is to provide a novel and improved electrical connector arrangement which is compact and affords space saving advantages.

A further object of the invention is to provide a novel and improved pluggable unit assembly in which the contact members are easily accessible for maintenance and which enables circuit adjustments to be quickly made.

Still another object of the invention is to provide an improved pluggable unit assembly which provides reliable circuit completing elements and is inexpensive to manufacture.

In apparatus constructed in accordance with principles of the invention there is provided an electrical unit including a base and a cooperating removable chassis that is adapted to be secured to the base. The base includes a set of fixed terminals aligned in insulated relation to one another and secured to the base, each fixed terminal having a substantially flat contact surface. The chassis carries a corresponding set of movable terminals, each including a flat resilient leaf contact, supported at one end only by an electrical insulator. The leaf contacts extend away from the insulating support in a direction substantially perpendicular to the direction of chassis movement toward the base for circuit making purposes. The remote ends of the several leaf contacts are unsupported and in the disclosed embodiment they are aligned in a plane. The several electrical circuits are completed simply by moving the chassis towards the base in a direction substantially perpendicular to the plane of the leaf contacts until the remote ends of the leaf contacts engage the flat fixed terminal surfaces so that they are flexed and complete electrical circuits. When the chassis is locked in circuit completing position on the base the flexed contact leaves are stressed so that each exert substantial pressure on the cooperating flat fixed terminal surface and excellent electrical conductivity is achieved. As each fixed terminal is characterized by a flat contact surface it requires very little space. The arrangement of fixed terminals affords orderly, accessible and easy connection to a cable of conductors brought into the base. Similarly, the flat leaf contacts, also disposed so that they require a minimal space in the chassis, permit diverse electrical connections to be easily made. In the disclosed embodiment two rows of cooperating terminals are employed, each row of leaf contacts being secured to and extending inwardly from a wall of the chassis with the two cooperating aligned rows of fixed terminals being spaced to define a cableway which accommodates a cable of conductors between them. This apparatus provides a simple, neat and compact arrangement of electrical connections in which both sets of contacts are easily accessible for inspection and maintenance and which provides an inexpensive yet reliable electric circuit connector arrangement in which the circuits are readily connected and disconnected. Cooperating guide structures mounted in the chassis and base provide any necessary alignment control, which is minimal as the aligned relation of the two sets of contacts is not particularly critical.

Other objects, features and advantages of the invention will be seen as the following description of a preferred embodiment of the invention progresses in conjunction with the drawings, in which:

FIG. 1 is a top elevation of a chassis with electrical components mounted on it and a cooperating base structure, constructed in accordance with principles of the invention;

FIG. 2 is a top view of the base structure showing details of the fixed terminals;

FIG. 3 is a bottom view of the chassis structure showing details of the movable terminals;

FIG. 4 is a top view of the apparatus shown in FIG. 1, with portions thereof broken away to show details of a connector arrangement constructed in accordance with principles of the invention;

FIG. 5 is a sectional view taken along the line 5—5 of FIG. 4 showing additional details of the connector arrangement; and

FIG. 6 is a sectional view taken along the line 6—6 of FIG. 4 showing additional details of the connector arrangement.

With reference to FIG. 1 there is shown a base **10** secured to a wall or a suitable supporting structure **12** which is dimensioned to receive within it a chassis **14** that carries a plurality of electrical components **16** such as relays or other components for special circuit use. The base unit has an upstanding outer wall **18** which is adapted to surround a corresponding vertical wall or skirt **20** of the chassis, so that the chassis may be secured within the upstanding wall **18**. Suitable securing means such as bolts **22** cooperate with threaded receptacles **24** in the base unit to secure the chassis to that unit. The base unit has an opening **26** in the wall **18** through which a cable of conductors **28** are received. Mounted in the base unit are two insulating supports **30**, **32**, each of which carries a plurality of aligned fixed terminal units **34** disposed in a row on either side of the cable entrance aperture **26** so that a group of the electrical conductors may be brought into the unit in orderly fashion and connected by means

of a suitable fastening means such as terminal screws **36** to the fixed terminal units **34**.

As best shown in FIG. 5, each fixed terminal includes a cadmium plated brass connector element **38** which receives the terminal screw **36** in threaded relation and which is mounted on the phenolic insulating board and secured by means of a rivet **42**. Each rivet has a substantially flat upper surface **44** that functions as a contact surface. In the illustrated embodiment the top of the rivet **42** is slightly domed so that there is a small degree of convexity to the contact surface **44**. Each terminal board **30, 32** which supports an aligned row of fixed terminals is supported in spaced relation from the base **10** by means of phenolic end walls **46** mounted on an insulating spacer **48** of similar material that is suitably secured to the base as by rivets. A barrier member **50** extends across the entire length of each support **30, 32** between the contact surface **44** and the terminal screw **36** to provide additional physical safeguard and isolation between wires **28** and the contact leaves that cooperate with surfaces **44**.

Each chassis contact structure includes an electrically insulating base member **52** of a suitable material such as phenolic secured against the skirt **20** of the chassis and a set of insulating spacers **54, 56** which provide spacing for the contact mounting board **58**. Each contact mounting board carries a row of flexible and resilient flat leaf contacts **60** secured to it by means of rivets **62** and eyelets **64**. Each eyelet receives a component conductor **66** which is secured to it in electrically conductive relation by means of solder **68**. The rivet **62** is the principal fastening member and secures the corresponding leaf contact **60** to the mounting board **58**. The mounting board and spacers are secured to the chassis skirt wall **20** by suitable means such as rivets **70**.

The leaf contacts **60** in this embodiment are manufactured from phosphor bronze which affords a flexible electrical conductor leaf of excellent resiliance characteristics. In unstressed condition, each leaf contact has a vertical portion **72** which is secured against the insulating support by a rivet **62** and which also receives an eyelet **64** that is soldered to it to insure the adequacy to the electrical connection. A horizontal portion **74** extends from the lower end of the vertical portion **72** inwardly in a substantially horizontal direction away from the wall **20** and defines a contact surface **76** at its remote end. A corresponding mounting board **58** and similar set of leaf contacts **60** aligned in a row is secured on the opposite chassis wall. These sets extend inwardly toward one another as indicated in FIG. 3 and their contact surfaces **76** are disposed so that they are positioned over the corresponding fixed contact surfaces **44** when the chassis unit is placed in the base unit. Disposed immediately above the inwardly extending leaf contacts is an insulating barrier **78** which is interposed between the component conductors **66** and the leaf contacts, and accordingly between the electrical circuitry associated with the base unit and the component circuitry mounted on the chassis.

In use, the base unit **10** is secured to a wall or other suitable support structure and the several conductors in the cable are connected by means of the terminal screws **36** to the fixed terminal units as indicated in FIG. 2. As noted in that figure all the terminals are easily accessible for adjustment of the connections as necessary.

The cooperating chassis unit, having its connections predetermined or established through the leaf contacts by means of the eyelets **64**, is suitably guided and mated with the base so that the ends **76** of the leaf contacts are aligned with contact surfaces **44** of the fixed terminals. As the chassis is secured in position in the base **10** with the bottom of the skirt wall **20** seating on the floor of the base **10** the leaf contacts **60** are flexed from their horizontal position (indicated by dotted lines in FIG. 5) and stressed so that a substantial force is exerted between each leaf contact **76** and the fixed contact surface **44** to assure completed

electrical circuits between the components and the cable conductors. In this position the barrier **50** affords additional safeguard in preventing the leaves **60** from contacting the terminal screws **36**.

Thus it will be seen that the invention provides a simple, compact, multiple terminal connector arrangement which may be inexpensively assembled by mass production methods and provides adequate spacing for reliable operation of the electrical circuits. The chassis element is easily positioned on the base element and the completion of electrical connections is facilitated due to the arrangement of the movable leaf contacts relative to the fixed contacts. Provision is made for adequate space and easy connection of the conductors into the base unit and the arrangement is susceptible to assembly by mass production techniques. While a preferred embodiment of the invention has been shown and described, various modifications thereof will be obvious to those skilled in the art and therefore it is not intended that the invention be limited to the disclosed embodiment or to details thereof and departures may be made therefrom within the spirit and scope of the invention as defined in the claims.

I claim:

1. An electrical connector assembly for ready connection and disconnection of a plurality of electrical circuits, comprising a base,

a removable component carrying chassis adapted to be moved with straight line motion toward said base and secured thereto to complete said plurality of electrical circuits,

first and second electrical insulator supports disposed in parallel spaced relation and secured to said base to define a cableway therebetween,

a plurality of fixed terminal members aligned in a row and secured in insulated relation to one another on each of said supports, said two rows of fixed terminal members being disposed in planes normal to the direction of connecting motion of said chassis toward said base,

each said fixed terminal adapted to form a first portion of an electrical circuit and having a substantially flat contact surface disposed in a plane normal to the direction of connecting motion of said chassis toward said base, a terminal connector disposed in substantially the same plane as its contact surface and located inwardly thereof immediately adjacent said cableway, and a conductor connecting said contact surface with said terminal conductor,

and two rows of movable terminal members adapted to cooperate with said rows of fixed terminal members,

each row of said movable terminal members being secured to said chassis,

each said movable terminal member adapted to form a second portion of an electrical circuit and including a flat resilient contact leaf supported in electrically insulated relation from said chassis wall at one end only and having a cantilever portion extending away from said supported end in a direction normal to the direction of connecting movement so that the cantilever portion end is aligned with and in contact with said contact surface when said chassis is positioned on said base,

each said contact leaf being fixed from its unstressed condition when said chassis is in locked position on said base due to engagement of the cantilever portion with the cooperating contact surface so that substantial pressure is exerted between each said contact surface and the leaf contact in engagement therewith to complete an electrical circuit therebetween.

2. A pluggable unit structure including a base housing,

an electrically insulating support positioned within said base housing,

a plurality of fixed terminal members mounted on said insulating support in spaced relation one to another,

each said fixed terminal member including a connector member,
a riveted contact member securing said connector member to said insulating support,
said contact member having a substantially flat upper surface,
and a terminal screw disposed in threaded relation to said connector member to receive an electrical connector for secured electrical relation relative to said fixed terminal,
a chassis adapted to be secured in position within said base housing,
said chassis carrying a plurality of electrical components,
a plurality of movable terminal members disposed in position corresponding to said fixed members and disposed on a vertical electrical insulating member secured to said chassis,
each said movable terminal member including a connector adapted to receive an electrical conductor connected to one of said electrical components,
and a flexible flat leaf contact member having a first portion electrically connected to said connector and secured in parallel relation to said vertical insulating support and a second portion extending horizontally from said vertical insulating support,
the unsupported end of said second portion extending to engage a contact surface of a cooperating fixed terminal in said base housing when said chassis is positioned within said base housing and said second portion being flexed into stressed condition to complete an electric circuit between the terminal screw of said fixed terminal member and the connector of said movable terminal member when said chassis is secured in said base housing.

3. A pluggable unit structure including a base housing,
two electrically insulating supports positioned within said base housing, in spaced relation to define a cableway therebetween,
a plurality of fixed terminal members mounted in a row on each said insulating support in spaced relation one to another,
each said fixed terminal member including a connector member, a terminal screw disposed in threaded relation to said connector member immediately adjacent said cableway to receive an electrical conductor for secured electrical relation relative to said fixed terminal, and a riveted contact member securing said connector member to said insulating support at a point more remote from said cableway than said terminal screw,
said contact member having a substantially flat upper surface,
an electrical insulator barrier carried by said base housing and disposed between said terminal screw and said contact surface,
a chassis adapted to be secured in position within said base housing,
said chassis carrying a plurality of electrical components,
two rows of movable terminal members disposed in position corresponding to said fixed terminal members on vertical electrical insulating members secured to opposite outer walls of said chassis,
each said movable terminal member including a connector adapted to receive an electrical conductor connected to one of said electrical components,
and a flexible flat leaf contact member having a first portion electrically connected to said connector and secured in and extending parallel to said vertical insulating support and a second portion extending horizontally from said vertical insulating support, and inwardly from the chassis outer wall,
the unsupported end of said second portion extending to engage a contact surface of a corresponding fixed terminal in said base housing when said chassis is positioned within said base housing and said second portion being flexed into stressed condition to complete an electric circuit between the terminal screw of said fixed terminal member and the connector of said movable terminal member when the bases of said chassis outer walls are seated in said base housing.

4. A pluggable unit structure including a base housing,
two electrically insulating supports positioned within said base housing, in spaced relation to define a cableway therebetween,
a plurality of fixed terminal members mounted in a row on each said insulating support in spaced relation one to another,
each said fixed terminal member including a connector member, a terminal screw disposed in threaded relation to said connector member immediately adjacent said cableway to receive an electrical conductor for secured electrical relation relative to said fixed terminal, and a riveted contact member securing said connector member to said insulating support at a point more remote from said cableway than said terminal screw,
said contact member having a substantially flat upper surface,
an electrical insulator barrier carried by said base housing and disposed between said terminal screw and said contact surface,
a chassis adapted to be secured in position within said base housing,
said chassis carrying a plurality of electrical components,
two rows of movable terminal members disposed in position corresponding to said fixed terminal members on vertical electrical insulating members secured to opposite outer walls of said chassis,
each said movable terminal member including an eyelet adapted to receive an electrical conductor connected to one of said electrical components,
and a flexible flat phosphor bronze leaf contact member having a first portion electrically connected to said eyelet and secured in parallel relation to said vertical insulating support and a second portion extending horizontally from said vertical insulating support and inwardly from the chassis outer wall,
the unsupported end of said second portion extending to engage a contact surface of a cooperating fixed terminal member in said base housing when said chassis is positioned within said base housing,
and said second portion being flexed into stressed condition to complete an electric circuit between the terminal screw of said fixed terminal member and the eyelet of said movable terminal member when the basis of said chassis outer walls are seated in said base housing,
the horizontal portions of said movable terminals in one row being aligned in the horizontal positions in the second row and all of said horizontal portions being disposed in a plane,
and a horizontal barrier sheet of electrical insulation secured to said chassis and disposed between said leaf contact members and said eyelets to provide isolation therebetween.

5. A pluggable unit structure including a base,
two electrically insulating supports positioned within said base in spaced relation to define a cableway therebetween,
a set of fixed terminal members mounted on each said insulating support in spaced relation one to another,
each said fixed terminal member including connector means to connect an electrical conductor disposed in said cableway to said terminal member and a contact member having a substantially flat upper surface, dis-

posed in substantially the same plane as said connector means,

a chassis adapted to be secured in position on said base,

said chassis adapted to carry a plurality of electrical components,

two sets of movable terminal members disposed in position corresponding to said sets of fixed terminal members on electrical insulating members adjacent outer surfaces of said chassis,

each said movable terminal member including connector means adapted to receive an electrical conductor connected to one of said electrical components,

and a flexible flat leaf contact member having a first portion electrically connected to said connector means and secured to said insulating member and a second portion extending horizontally from said insulating member and inwardly from the chassis outer surface,

the unsupported end of said second portion extending to engage a contact surface of a cooperating fixed terminal member in said base when said chassis is positioned on said base,

and said second portion being flexed into stressed condition to complete an electric circuit between said fixed terminal member and said movable terminal member when said chassis is secured in said base.

6. A pluggable unit structure for use with a base structure having two electrically insulated supports positioned within said housing, in spaced relation to define a cableway therebetween,

a plurality of fixed terminal members mounted in a row on each said insulating support in spaced relation one to another,

each said fixed terminal member including a connector member, a terminal screw disposed in threaded relation to said connector member immediately adjacent said cableway to receive an electrical conductor in secured electrical relation relative to said fixed terminal, and a riveted contact member having a substantially flat upper surface, and securing said connector member to said insulating support at a point more remote from said cableway than said terminal screw,

and an electrical insulator barrier carried by said base housing and disposed between said terminal screw and said contact surface,

said pluggable unit structure including a chassis adapted to be secured in position within said base housing,

said chassis carrying a plurality of electrical components,

two rows of movable terminal members secured in position corresponding to said fixed terminal members to said chassis,

each said movable terminal member including a contact member having a first portion adapted to receive an electrical conductor connected to one of said electrical components, and a second portion extending away from said first portion,

the unsupported end of said second portion extending to engage a contact surface of a cooperating fixed terminal in said base housing when said chassis is positioned with said base housing and said second portion being urged into stressed condition to complete an electric circuit between the terminal screw of said fixed terminal member and the first portion of said movable terminal member when said chassis is secured in said base housing.

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