

March 10, 1959

R. W. AVERY

2,877,439

ELECTRICAL SLIDE FASTENER CONNECTOR

Filed Sept. 22, 1953

3 Sheets-Sheet 1

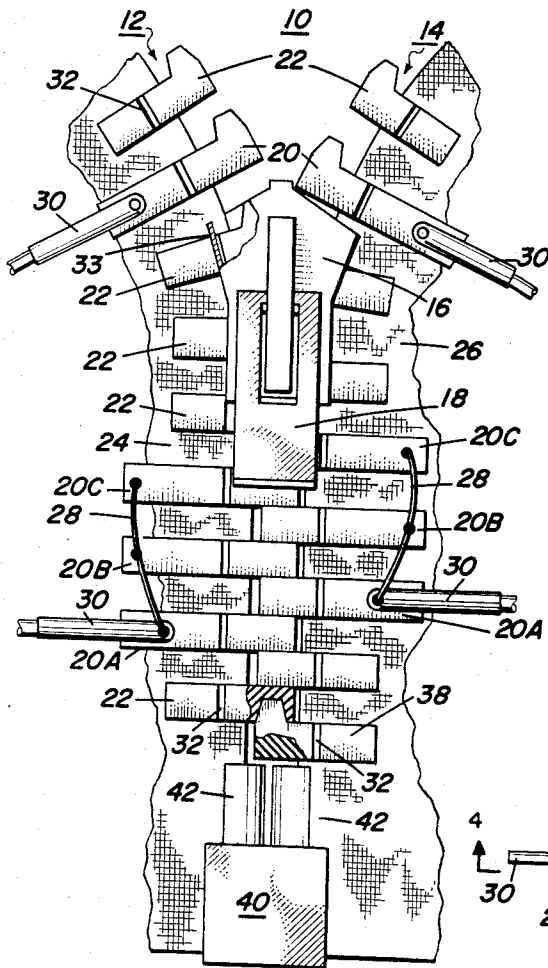


Fig. 1

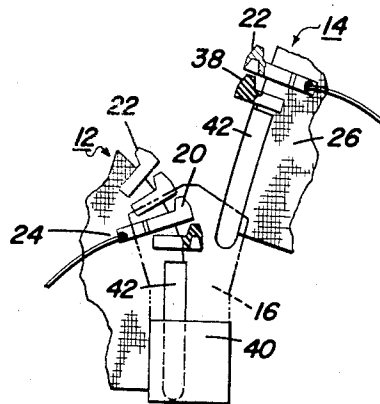


Fig. 2

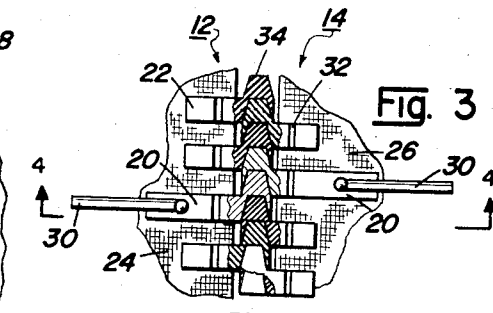


Fig. 3

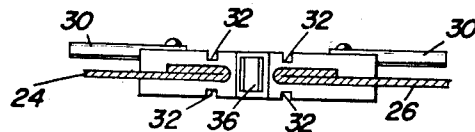


Fig. 4

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3 Sheets-Sheet 2

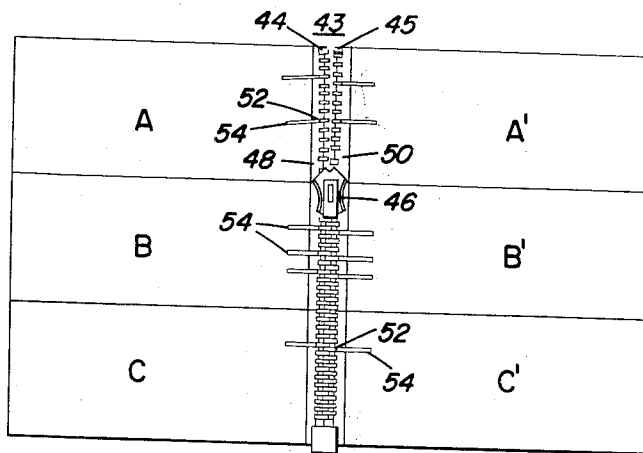


Fig. 5

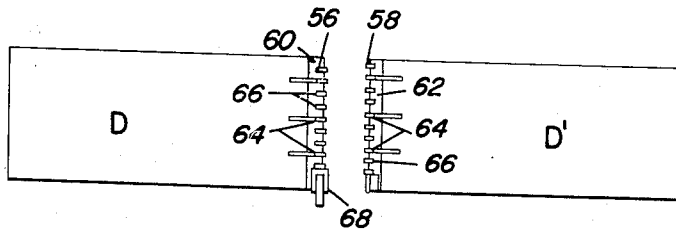


Fig. 6

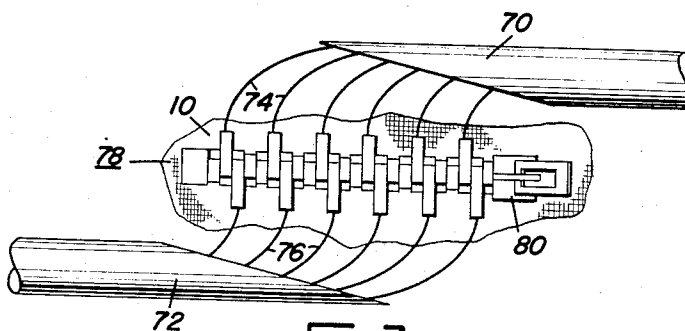


Fig. 7

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3 Sheets-Sheet 3

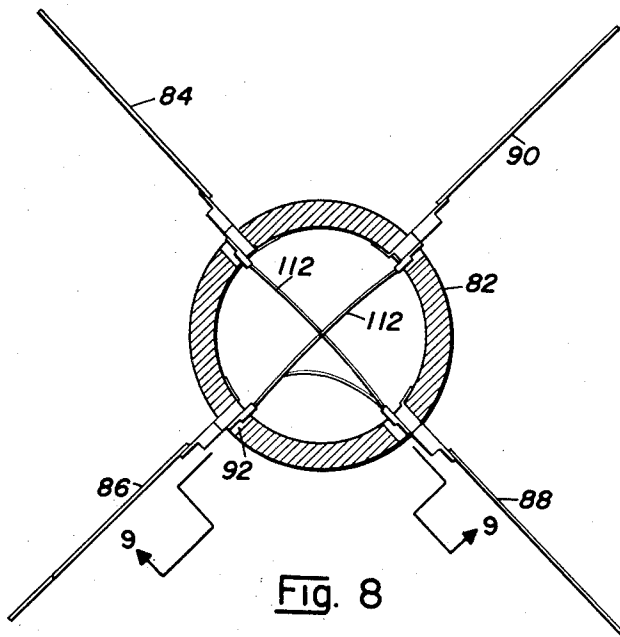


Fig. 8

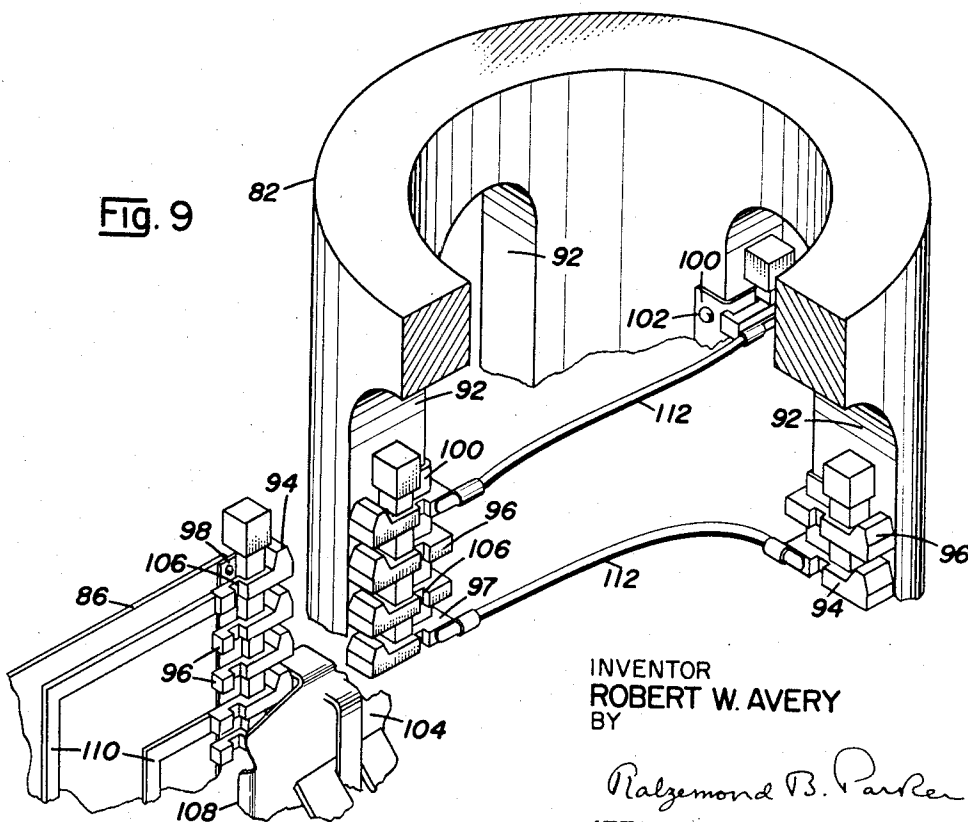


Fig. 9

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ELECTRICAL SLIDE FASTENER CONNECTOR

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3 Claims. (Cl. 339—151)

This invention relates to electrical connectors and particularly to an improved electrical connector employing the principle of the slide fastener.

Various electrical and electronic apparatus is designed in multiple units so that they may be electrically disconnected for repairs, replacement or test purposes as desired. The units are arranged so that it is advantageous in many types of equipment to disconnect one circuit from another without unsoldering or unscrewing a number of terminals. Therefore, provisions must be made for making the required electrical connection between the removable part and its associated equipment.

The electrical connection has usually been made in the past by multi-contact plugs having male and female members, associated with multi-conductor cables. There are several disadvantages incident to such connections. The plurality of contacts for the multi-conductor cables are usually located within a small area and large capacitances between the contacts necessarily result, the plug pressure necessary to make the connection also increases with the number of contacts and along with the probabilities of misalignment, and the initial cost of maintaining manufacturing tolerances between contacts. These disadvantages necessarily limit the number of contacts per connector. Accordingly, a multiple contact electrical connector is desired that is easily connected and disconnected and physically arranged so that it will minimize the problems of inter-conductor capacitances and tolerances without seriously limiting the number of contacts per connector.

This invention overcomes the disadvantages of these prior art connectors by adapting the slide fastener used on apparel, et cetera, for an electrical connector. The fastener elements are arranged in two opposed rows which are brought together and the elements overlappingly interlocked one another by movement of a sliding member in one direction and disengaged from one another when the member is moved in the opposite direction. The fastener elements are insulatively mounted on supporting media or panels and certain of the elements are joined by electric leads to form electrical contacts. Such elements are alternated with electrically insulated elements. The interconnection of the fastener elements is made with a minimum of force upon operation of the slider which causes the corresponding elements to be brought together and interlockingly engaged with one another. By spreading the elements over a large area the capacitance between the elements on the connector are minimized. This arrangement results in a relatively inexpensive flexible connector devoid of the disadvantages of the prior art connectors. The connector can be further adapted to operate as a switch as well as a connector by the use of an insulating material for the slider.

It is, therefore, an object of the invention to provide an improved electrical connector.

It is another object of the invention to provide an im-

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proved electrical connector employing the operating principle of a slide fastener.

It is still another object of the invention to provide an electrical connector having a minimum capacitance between the conductive elements.

It is a further object of the invention to provide an electrical connector so arranged as to have easily accessible connector terminals.

It is another object of the invention to provide an electrical connector adapted for use both as a switch and an electrical connector.

It is still another object of the invention to provide an electrical connector whereby electrical leads may be connected or disconnected upon partial operation of the connector.

In accordance with the teachings of the present invention, there is, therefore, provided an electrical connector, operating on the slide fastener principle of interconnecting elements, wherein the elements of the slide fastener are made up of alternate groups of conducting and insulating elements physically spread over a large area so as to minimize interaction between the connector terminals whereby said leads are readily connected and disconnected upon operation of the slide fastener.

Other objects and features of advantage of the present invention will be found throughout the following more detailed description of the invention particularly when considered in connection with the accompanying drawings, in which:

Fig. 1 is a plan view of an embodiment of the invention;

Fig. 2 is a plan view of the starting end section of the connector shown disconnected;

Fig. 3 is a partial section view partly broken away of a group of interconnected elements as shown in Fig. 1;

Fig. 4 is a bottom view of the interconnected elements as shown in Fig. 3;

Fig. 5 is a front view showing multiple units employing the invention;

Fig. 6 is a front view of single units adapted to be interconnected by the invention;

Fig. 7 is a plan view showing multi-conductor cables interconnected by the invention;

Fig. 8 is a plan view of another embodiment utilizing the invention; and

Fig. 9 is a perspective view, partly in cross section, taken along the line 9—9 of Fig. 8 showing the connector disconnected.

The invention utilizes the principle of the slide fastener and includes two rows of inter-engaging elements which are locked into engagement when a slide member is moved in one direction and which are unlocked and separated from one another when a slide member is moved in the opposite direction. Figs. 1 to 4 illustrate in enlarged scale certain portions of an electrical connector embodying the invention. The electrical connector is generally shown at 10 and like conventional slide fastening assemblies it comprises two rows 12 and 14 of interlocking elements which are brought together in an interleaving manner and locked into engagement with one another when a slide member 16 is moved in one direction and unlocked and disengaged from one another when the slide member is moved in the opposite direction. The slider 16 may be provided with the conventional pull-tab handle 18 for manually adjusting the same along the rows.

Each row of the slide fastening assembly is formed of elements 20 of electrically conducting material and elements 22 of electrically insulating material. Row 12 is fixed to a member or panel 24 of insulating material, and row 14 is fixed to a similar panel 26. Preferably,

the material of which the panels are formed is also sufficiently flexible to permit successive engagement and disengagement of the elements.

The conducting elements 20 are arranged opposite one another in their respective rows for interengagement when the slider 16 is moved in fastening direction and thus serve as disengageable electrical contacts. In each row the insulating elements 22 are arranged on opposite sides of the electrical contact elements 20 and insulate the latter from one another in the same row.

The contact elements 20 of one row are arranged opposite a companion contact element of the other row for overlapping interengagement when the rows are joined by the slider 16. Preferably these contact elements are arranged in a pattern which would be sufficient for most of the general applications for which the connector is designed. Certain of the electrical contact elements of each row may be grouped together in side by side relation such as indicated by 20a, 20b, 20c shown in Fig. 1. These grouped contact elements are connected together by a common electrical conductor 28 as hereinafter described which enables the connector assembly 10 to be used in high current circuits simultaneously with low current circuits.

Electrical leads are provided which run from one or more of the contact elements 20 of the slide fastener for connection to electrical circuitry or sources of electrical energy. To facilitate attachment of such leads, it is preferred to make the elements 20 longer than the insulated elements 22 and project them rearwardly further than the latter. As shown near the top of Fig. 1 a separate lead 30 runs from each of the two oppositely disposed engageable electrical contact elements 20—20. Near the bottom of Fig. 1, similar separate leads 30 run from each element 20a in the two rows of elements. The current carried by the electrical conductor 30 is distributed over the conductive elements 20a, 20b, 20c by the common electrical conductor 28 and thereby allows for usage of higher current densities than possible with a single pair of conductive elements.

The elements 20 and 22 of each row of the connector are brought together and interlocked with one another by the slide member 16 as in conventional slide fastener constructions. Each element is provided with a transverse groove in the same plane on each side thereof. The grooves of the elements in each row are disposed in alignment as is evident in Figs. 1 and 3. The slide member 16 has inwardly turned oppositely disposed flanges indicated at 33 which ride in the grooves 32. Each pair of flanges on the top and bottom side of the slider first extend in a converging relation then in a parallel relation and function in the fastening direction of travel of the slide to draw the elements together into interlocking engagement.

The inner ends of the elements 20 and 22 are identical and each has a laterally projecting head 34 and a recess 36 in the head which opens out through the base thereof. When interconnected by the slider 16, each head of one row enters the recess of the head of the next successive element of the opposite row. This forms a positive interlocking connection as is well known in the slide fastening art. Moreover, the arrangement will not allow the elements to become disengaged when the rows of the connector are flexed out of a straight line position.

It is evident that upon movement of the slider 16 in one direction the conductive elements of the connector 10 will be brought into overlapping relation and interlocked with one another in the manner shown in Fig. 3 to form an electrical connection therebetween. It is further evident that upon movement of the slider in the opposite direction the elements will become disengaged from one another breaking the electrical connections previously formed. To assure proper interconnection of the elements of two rows of the connector, there is provided, as shown in Figs. 1 and 2, a starting element 38

which does not have a recess in its head and is therefore capable of meshing only with the bottommost element 22 of the opposite row of elements.

As with similar conventional slide fasteners, a stop member 40 is provided for preventing the slider from complete dislodgement from the fastening elements and for setting the slider at its initial starting position. The stop member is attached to a corner at the starting end of its row of elements. In this instance it is attached to panel 24 at the lower end of its row of elements, 12. A rod-like member 42 is provided at the starting end of each row of elements. The rod for row 12 is usually permanently received in the stop member and projects thereabove for interfittng engagement with the slider when the latter is moved to starting position. The rod 42, for row 14 is removably insertable through the upper end of the slider and thence into the stop member as in conventional practice to preset the rows of elements for slider movement. When properly inserted, the two rods 42—42 will be disposed side-by-side as shown in Fig. 1. In this position, the special recessless element 38 is positioned as the starting element for the slide fastening assembly. Because of its dissimilar construction, element 38 can not assume any other position and interfit with the elements of the opposite row 12, thus serves as the starting element, thereby assuring proper connection of the electrical terminal elements 20.

Referring now to Figs. 5 and 6, the connector is shown associated with a multiple unit chassis to illustrate its adaptability to other electrical connecting functions. The units of the structure may be separate panels or box-like enclosures containing electrical equipment. The separate units of the chassis in Fig. 5 are identified by the reference characters A, B, and C on one side and corresponding units A', B' and C' on the other side. In the particular arrangement shown in Fig. 5, a single connector 43 is employed for the plurality of units. The connector is constructed as previously described, including two rows of interconnecting elements 44 and 45 and a slider member 46. Each row of elements is attached to a flexible base or strip which may be of fabric material in order that the elements of the row may be readily separated and spaced from the elements of the other row. The flexible strip to which the row of elements 44 is attached is indicated at 48; that for the other row of elements is indicated at 50. Like the previously described embodiment of the invention, the slider 46 will interlock the rows of elements when moved in one direction and disengage the rows of elements when moved in the opposite direction.

Certain of the elements of the rows 44 and 45 are formed of electrically conductive material and serve as the contacts for closing and opening electrical circuits. The remaining elements in the two rows are non-conductive. Such contacting elements are identified in Fig. 5 at 52. These electrical contact elements are arranged in their respective rows opposite one another for interengagement with one another when the slider is moved in the fastening direction. Each contacting element 52 is provided with a lead 54 extending across the fabric strip upon which it is mounted and into the adjacent chassis unit when it is detachably connected to the electrical equipment therein. In this manner, corresponding leads from the chassis units, may be directly attached to the connector 43 without the necessity of harnessing them into a cable as heretofore been required in the prior art. An added advantage of this construction is that one pair of units may be disconnected and removed from the chassis without disconnecting the other units. This is shown in Fig. 5, wherein the top units A and A' are disconnected while the remaining units of the chassis are still connected. It is also clearly evident that the units may be readily disconnected and removed for test purposes, replacement or repair.

The simplicity of the electrical connector illustrated by

the two embodiments of the invention described hereinabove is readily apparent over the prior art connectors. The force required to operate the slider is not large since the leads are connected one at a time rather than all at one time. The physical arrangement of the contacts being spread over a large area results in the number of contacts required for an average circuit being available at the point of utilization thereby doing away with the necessity of having conductors harnessed into a cable. This arrangement also illustrates the relatively large distance between the leads associated with the connector thereby minimizing any effect of cross-talk due to the capacitance between the leads. The leads arranged in this manner are exposed as in a terminal strip so as to facilitate circuit tracing or testing.

For applications similar to that illustrated in Fig. 5, it may be found desirable to provide a separate connector for each pair of chassis units. As shown in Fig. 6, this will allow the paired units, such as identified at D and D', to be removed from its chassis assembly without disconnecting the leads. In the arrangement shown in Fig. 6 the rows of interengaging elements are shown at 56 and 58 fixed to fabric strips 60 and 62 respectively or other suitable flexible insulating material. In the same manner as previously described, certain of the fastening elements, such as shown at 64, are formed of electrical conductive material while the remaining fastening elements 66 are formed of electrical insulating material. The slider 68 moves the length of the fastening track on the units D and D' and limits its distance of travel to the height thereof. In this arrangement it may be advantageous to provide the same color for the insulating fabric strips of the connector to assure joining the proper units together.

The connector of this invention may be adapted to operate as a switch. This desirable feature may be brought about by making the slider of insulating material. Thus formed it is possible to interconnect the individual units of the chassis design as shown in Fig. 5 without disconnecting the power source and thereby selectively energize the units.

Referring now to Fig. 7, the connector is shown in association with multiconductor cables. The cables 70 and 72 have their respective individual conducting strands or wires as indicated at 74 and 76 respectively disconnectively joined by a slide fastener connector generally indicated at 78. The slider fastener assembly is similar to that previously described and includes oppositely disposed rows of conducting and non-conducting elements capable of being brought into interlocking engagement by means of the slider 80. The ease of making the cable connection by the use of the connector is readily apparent.

A distinctly desirable embodiment of the invention is shown in Figs. 8 and 9. A supporting tubular-shaped member 82, in this case exhibiting a hollow cylindrical tube, carries a plurality of demountable circuit boards or panels arranged in a general radial disposition around the member. In Figs. 8 and 9 the tube 82 is shown with its axis extending vertically and as having four such circuit boards. These boards are identified by reference characters 84, 86, 88, and 90. Each circuit board or panel is arranged to be disconnectably coupled to the supporting tube by means of a slide fastener of the type previously described.

The supporting tube is provided with as many vertical slots 92 through its body as there are circuit boards. In each slot, as best shown in Fig. 9, one row of slide fastener elements is positioned. Fixed to one edge of each circuit board is a complimentary row of slide fastener elements. The two rows of elements are composed as in the manner previously described of electrical conductive elements 94 and electrically insulated elements 96. The conducting elements of the two rows are so arranged that they are capable of engaging one another and forming an electrical connection when the board is fastened to the supporting member. Preferably, in order

to provide movement of the elements toward and away from one another, each row of elements is mounted on a flexible base of insulating material. A flexible base for the row of elements 94 is indicated at 98 and may assume the form of a fabric strip attached to the adjacent edge of the circuit board. The flexible base for the row of elements in the slot of the tube is indicated at 100 and likewise may assume the form of a fabric strip. The inner margin of the strip 100 may be secured to the inner surface of the tube by rivets 102 or the like in the manner shown at the right of Fig. 9.

It is also shown in Fig. 9, that the row of elements on the selected circuit board may be joined to the row of elements in a selected slot of the supporting tube 82 by means of a slider 104 similar to those previously described. Each element may be provided with a transverse groove along its outer and inner faces as indicated at 106 which align with one another. The slider 104 is provided with inwardly turned side flanges corresponding to flanges 33 previously described, one of which is shown at 108. These flanges ride in the grooves 106 and either draw the rows of elements into interlocking engagement with one another to secure the circuit board to the supporting member or separate the rows from one another to permit removal of the board from the member.

Each circuit board may have printed circuitry thereon or provided with conducting strips. Such printed circuitry or conducting strips are indicated at 110 in Fig. 9. These conducting elements, whether printed or otherwise formed, are joined to the electrically conducting elements 94 of the slide fastener row on the circuit board. When attached to the supporting member, the circuit boards are arranged therearound in a radial fan-like manner as shown in Fig. 8, which provides a compact yet flexible disconnectable unit for purposes of test, replacement and repair. To electrically connect these circuit board to one another, the interior of the tube 82 is provided with a plurality of connecting leads 112. As shown in Figs. 8 and 9 these connecting leads may extend in criss-crossing relation in the tube to join the conducting elements in the different slots with one another. This eliminates the necessity of providing the wiring connections between the circuit boards. It also allows free movement of the boards similar to the pages of an open book standing on its edge.

Due to the similarity of most of the circuit boards, it becomes very easy to connect the wrong board to the improper point on the support. To provide for the positive interconnection of the circuit boards it may be found desirable to arrange each connector with intermeshing elements arranged in a different pattern. That is, not only does each connector have a positive starting element as in Fig. 2, but also every connector may be provided with an element of a different geometrical shape, positioned at a different point on the connector to assure the positive interconnecting. This arrangement will prevent damaging delicate equipment by connecting a low voltage circuit board to a point of high voltage.

It is, therefore, clear from the foregoing description that the present invention, by providing a slide fastener electrical connector for use as either a connector or connector-switch in various types of electrical circuits, has improved the state of the art so that there results an easily operated connector having a minimum of interaction between the leads along with the many other features and advantages.

Having therefore described detailed embodiments of the invention, setting forth their organization and their mode of operation, those features believed descriptive of the nature of the invention are defined with particularity in the appended claims.

What is claimed is:

1. The combination comprising a plurality of insulating panels provided with paths of electrically conductive material, a common supporting member for said panels hav-

ing the form of a hollow cylinder, slots through the body of said supporting member, a slot for each panel to be affixed, an electrical slide fastener connector for each of said panels including a pair of electrically insulating flexible carrier members, one being secured to an edge of a panel and the other to said supporting member within a slot, a row of electrically conducting and insulating fastener elements arranged in a pre-determined pattern and secured in uniformly spaced relation along opposing edges of each of said carrier members, said fastener elements having elongated heads formed adjacent one of their ends and having coupling recesses and projections, said fastener elements further formed to present slider guide surfaces, a slider member arranged thereon for longitudinal movement therealong for releasable interlocking engagement of said fastener elements with electrically conducting elements along one edge of a panel and contacting complementary like elements along the edge of the flexible carrier member attached to said supporting member within a slot, and flexible electrical conductors interconnecting selected electrically conducting fastener elements on the common supporting member with one another.

2. The combination as claimed in claim 1 wherein alignment means are provided by the first fastener element on the flexible carrier member within the slot of the supporting member, comprising omission of the coupling recess in its head.

3. The combination as claimed in claim 2 wherein the slots through the supporting member are longitudinal.

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UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 2,877,439

March 10, 1959

Robert W. Avery

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction and that the said Letters Patent should read as corrected below.

Column 1, line 33, for "result, the" read -- result. The --; line 35, for "contacts and along" read -- contacts. Along --; line 36, for "misalignment, and" read -- misalignment is --; line 45, for "inventiton" read -- invention --; line 63, for "are" read -- is --; column 4, line 10, after "elements" strike out the comma; line 16, after "42" strike out the comma; line 25, for "serves" read -- serving --; line 66, strike out "been" column 5, line 61, for "disconnectibly" read -- disconnectively --; line 68, for "complimentary" read -- complementary --; column 6, line 5, for "thet" read -- the --; line 36, for "board" read -- boards --; line 41, for "another," read -- another. --; line 58, for "pointof" read -- point of --.

Signed and sealed this 4th day of August 1959.

(SEAL)

Attest:

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Attesting Officer

ROBERT C. WATSON
Commissioner of Patents

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