

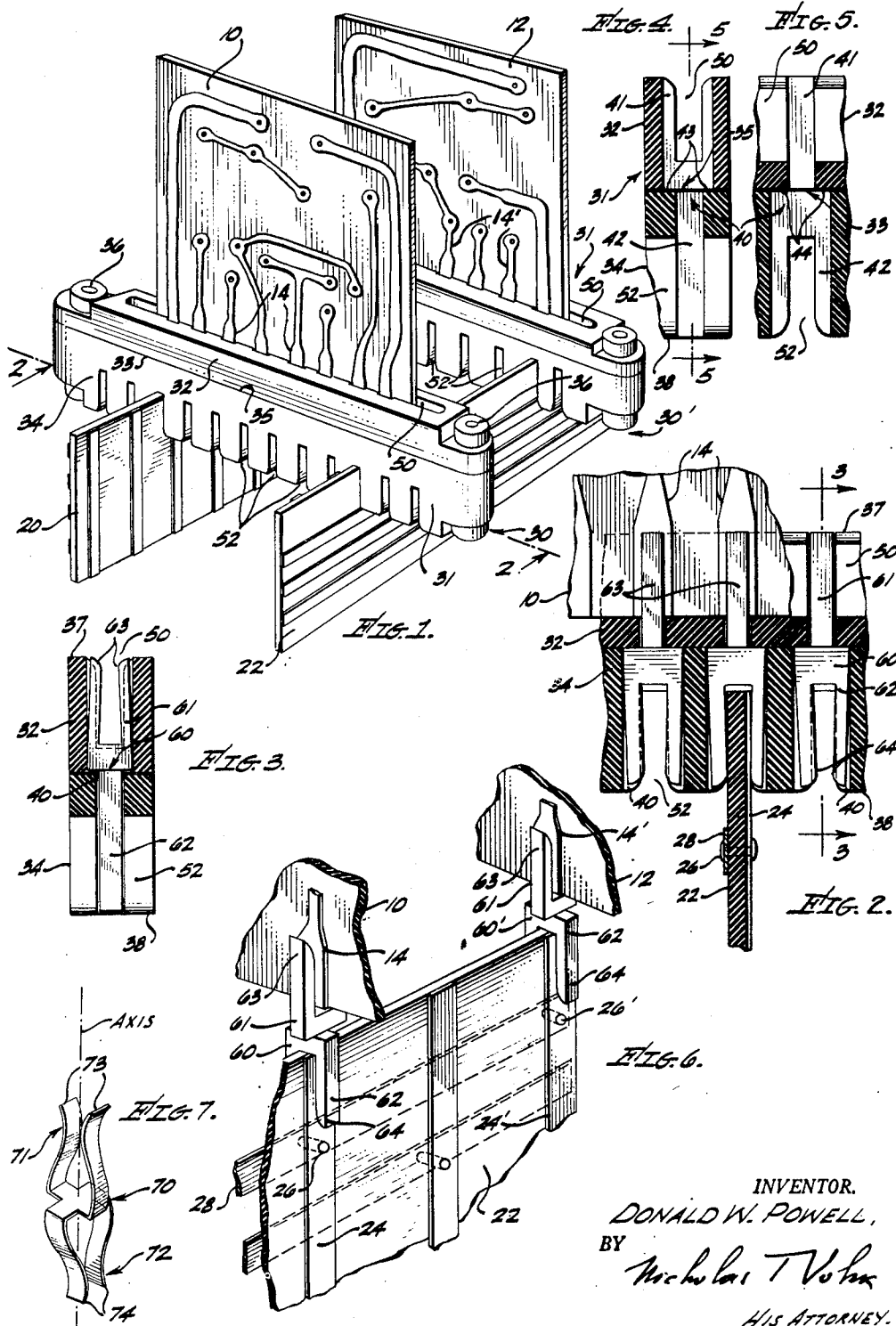
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CONNECTOR FOR CIRCUIT CARDS

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1

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CONNECTOR FOR CIRCUIT CARDS

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This invention relates to push-type connectors for electrical circuits, and, more particularly, to such connectors which facilitate the interconnection of a plurality of separate circuits printed or etched on separate circuit cards of dielectric material.

In miniaturizing electronic equipment, etched circuitry cards are used extensively. Such cards are relatively small; hence, in a complex electronic circuit, a number of cards are arranged in a compact group with each card containing its own circuit elements so as to form a separable component of the more complex circuit. Because of the compactness of the group of cards, interconnections between the circuit or circuits on one card and the circuits on other cards are difficult to provide and, at the same time, retain the important feature of removability of each card.

The present invention contemplates a single and inexpensive solution to this problem by providing bus bar cards and a connector for each circuit card whereby the bus bar cards are connected to the circuit cards. Each connector includes a plurality of connector elements adapted to conductively engage terminal tabs arranged along one edge of the circuit cards and to similarly engage terminal tabs similarly arranged on the bus bar cards. The conductive engagements are easily achieved by manually pushing the cards into suitable openings in the connectors causing the connector elements to frictionally grip the cards and the proper terminal tabs. This arrangement eliminates soldering of interconnecting leads between the circuitry on the circuit cards or the use of binding screws for fastening such leads.

Accordingly, it is an object of this invention to provide a connector suitable for use in connecting the circuit or circuits on one card to the circuit or circuits on other cards without the use of solder or terminal screws.

It is another object to provide circuit cards with terminal tabs along one edge connected to circuitry on the cards, and to provide a multiple contact connector for interconnecting the circuits of one card to the circuits of a second card and for holding the cards in circuit connecting relationship.

It is a further object to provide such a connector whereby the interconnections between the circuits of the different cards are accomplished by the simple operation of manually pushing each card into a suitable opening in the connector.

It is an additional object to provide a solderless circuit connector having a plurality of connector elements with spring contacting fingers on each end of each element for gripping an edge of a circuit card and conductively engaging a terminal tab fixed to the edge of the card and connected to circuitry printed, etched, or otherwise attached thereto.

It is also an object to provide such a circuit connector in which the connector elements are retained within cavities extending laterally through the body of the connector between a pair of opposite walls of which one wall is provided with a longitudinal opening that intersects one end of each cavity, and the other wall is provided with a plurality of transverse openings, each transverse opening intersecting the other end of one of said cavities, and both the longitudinal and the transverse openings being adapted to receive an edge of the circuit cards.

It is a further object to provide such a circuit connector in which the cavities and the connector elements are constructed to mutually cooperate in maintaining the

2

spring contacting fingers within their respective cavities and in proper alignment with the longitudinal and transverse openings. An additional object is the provision of a two-piece body structure which is simple and inexpensive to manufacture and which affords easy access to the cavities for assembling the connector elements therein.

The novel features which are believed to be characteristic of the invention both as to its organization and method of operation, together with further objects and advantages thereof will be better understood from the following description considered in connection with the accompanying drawings. It is expressly understood, however, that the drawings are for the purpose of illustration and description only, and are not intended as a definition of the limits of the invention.

Fig. 1 is a perspective view of an embodiment of this invention;

Fig. 2 is a fragmentary sectional view taken on a plane indicated by line 2—2 of Fig. 1;

Fig. 3 is a cross-sectional view taken on line 3—3 of Fig. 2;

Fig. 4 is a view similar to the view of Fig. 3;

Fig. 5 is a sectional view taken on line 5—5 of Fig. 4;

Fig. 6 is a perspective view schematically illustrating the interconnections between the circuits on the circuit cards of Fig. 1; and

Fig. 7 is a modification of the connector element shown in perspective in Fig. 6.

In the embodiment of this invention illustrated in Fig. 1, reference characters 10 and 12 designate, respectively, two circuit cards having etched circuitry thereon interconnected in cooperative relationship by means of bus bar circuit cards 20 and 22, and connectors 30 and 30'. Each connector is constructed to include a nonconductive body member 31 formed of two sections such as upper section 32 and lower section 34 having, respectively, abutting surfaces 33 and 35 held in abutment by screws 36. Extending through the body member between its upper and lower side walls 37 and 38 is a series of cavities 40 in spaced and parallel relationship with respect to each other as shown in the fragmentary sectional view of Fig. 2. Each cavity 40 includes upper and lower portions 41 and 42 formed, respectively, in upper and lower sections 32 and 34 of body member 31, as illustrated in Figs. 4 and 5, where it is shown that abutting surface 35 of section 34 forms shoulders 43 at the bottom of upper cavity 41, and that abutting surface 33 of section 32 forms shoulders 44 at the top of lower cavity portion 42.

Intersecting upper cavity portions 41 of the series of cavities is a slot or opening 50 extending lengthwise through upper side wall 37 into upper body member section 32, and intersecting lower cavity portions 42 of the series of cavities is a corresponding series of slots or openings 52 extending transversely through lower side wall 38 into lower body member section 34. Openings 50 and 52, clearly illustrated in Figs. 1 through 5, are dimensioned to receive, respectively, circuit cards of the character identified by reference numerals 10 and 12, and bus bar circuit cards of the character identified by reference numerals 20 and 22. This condition is indicated in Fig. 1, where circuit cards 10 and 12 are shown in position with the lower edge of each card in opening 50 of their respective connectors, and where circuit cards 20 and 22 are shown in position with the upper edge of each card in an opening 52 in each of the connectors 30 and 30'.

Retained within each cavity 40 of body member 31 is a connector element 60 shown in perspective in Fig. 6, where the body members have been omitted for the sake of clarity. Each connector element 60 consists of upper and lower U-shaped portions 61 and 62 which are joined at their bases, oriented substantially ninety degrees with respect to each other about a common vertical axis, and dimensioned to conform to and loosely fit cavity 40 with the base of portion 61 adapted to bear against shoulders 43 and the base of portion 62 adapted to bear against shoulders 44, as illustrated in Figs. 2 through 5, of which Figs. 4 and 5 clearly identify the shoulders previously described.

The legs of upper and lower U-shaped portions 61

3

and 62, biased toward each other, form spring fingers 63 and 64 which are adapted to grip, respectively, the lower edges of circuit cards 10 and 12, and the upper edges of bus bar circuit cards 20 and 22, and to conductively engage terminal tabs mounted along these edges. As indicated in Fig. 1, and clearly shown in Fig. 6, circuit cards 10 and 12 are provided with terminal tabs 14 and 14' fixed along the lower edges of the cards and connected to the circuitry thereon; similarly bus bar circuit cards 20 and 22 are provided with conductive strips of the character of strips 24 and 24' which are fixed across one side of the cards with the upper ends of the strips acting as terminal tabs along the upper edges of the cards. Strips 24 and 24' are electrically interconnected by means of one of several bus bar strips fixed to and extending lengthwise of the other side of card 22, such as strip 28, and rivets 26 and 26' which pass through strip 28, card 22, and strips 24 and 24'.

When circuit cards 10 and 12 are positioned in openings 50 of connectors 30 and 30', and when bus bar circuit cards are positioned in openings 52 of connectors 30 and 30', as shown in Fig. 1, terminal tab 14 on card 10 is electrically interconnected with a similar terminal tab 14' on card 12, as illustrated in Fig. 6, where the spring fingers of identical connector elements 60 and 60' are shown in conductive engagement with the terminal tabs 14 and 14' of cards 10 and 12, and conductive strips 24 and 24' of card 22. In other words, spring fingers 63 of both connector elements not only grip the lower edges of cards 10 and 12, but they also grip terminal tabs 14 and 14', and, similarly, spring fingers 64 grip the upper edge of card 22 and the strips 24 and 24'. Although not shown in Fig. 6, bus bar card 20 is provided with conductive strips of the same design as strips 24 and 28, and these conductive strips are interconnected with terminal tabs 14 on circuit cards 10 and 12 by connector elements in connectors 30 and 30' of the same character as connectors 60 and 60'. Bus bar circuit cards 20 and 22 may be constructed of any desired length and width, and may be provided with any desired number of bus bar strips and terminal tab strips as required. Moreover, the number of bus bar cards employed may vary to suit requirements; in other words, the number of circuit elements on one circuit card requiring connection to circuit elements on another circuit card determines the number of bus bar cards required. It is also to be noted that both the bus bar circuit cards and circuit cards 10 and 12 may be constructed by any of the methods well known in the art for making such cards.

Connector 30 is assembled by placing a connector element 60 in each portion of each cavity 40 in one of the two sections of body member 31; then the other section of the body member is placed over the elements 60 and the abutting surfaces 33 and 35 are brought together and held in abutment by screws 36 placed in holes provided in the ends of each body member section. Because of the fact that connector element 60 conforms to the shape of cavity 40, fingers 63 and 64 of each connector element 60 are in alignment with their respective openings 50 and 52 when connector 30 is assembled.

A modification of connector element 60, identified by reference numeral 70, is illustrated in Fig. 7. Connector element 70 is formed from a blank punched from relatively thin sheet metal, such as spring tempered copper or other material having suitable electrical and mechanical properties. Element 70 includes spring fingers 73 and 74 which respectively form upper and lower U-shaped portions 71 and 72 which are oriented substantially ninety degrees with respect to each other about a common vertical axis. The U-shaped portions are adapted to cooperate with the upper and lower portions 41 and 42, and shoulders 43 and 44 of cavities 40 in the manner described for U-shaped portions 61 and 62 of connector element 60 (Figs. 2 through 5). It is to be noted that spring fingers 73 are biased toward each other, as are spring fingers 74, to provide the spring pressure required for gripping the edges of the circuit cards and for conductively engaging the terminal tabs mounted along the edges of the cards; in other words, fingers 73 and 74 operate in exactly the same manner as fingers 63 and 64 previously described in connection with connector element 60.

Although body member 31 of each connector 30 and 30' is illustrated with only one longitudinal slot or opening 50, it is obvious that a body member equivalent in

4

function to this body member 31 can be constructed with a plurality of longitudinal slots or openings which are interconnected with the transverse slots by cavities containing connector elements so that a plurality of circuit cards, such as cards 10 and 12, can be arranged for interconnection by one or more circuit cards of the same type, or by one or more circuit cards, such as cards 20 and 22, in a manner similar to that shown in Fig. 1. Input and output connections to the circuitry on cards 10 and 12 can be provided, when required, by conductors soldered or otherwise connected to terminal tabs of a circuit card, similar to cards 10 and 12, and/or to bus bars on cards 20 and 22, or to bus bars on a single bus bar card which, like the circuit card, may be provided exclusively for the purpose of making external connections.

By separating a complex electrical circuit into subdivisions and arranging the subdivisions on circuit cards of the nature of cards 10 and 12, a relatively large number of such subdivisions may be interconnected through a wide selection of bus bar circuit cards constructed according to cards 20 and 22, and connectors having the structural characteristics of connector 30. These are important features of the invention, since they not only permit complex circuits, having many components, to be divided into unitary sections which are cooperatively interconnected without the use of solder or binding screws, but they also permit the removal and replacement of each section without disturbing adjacent sections.

What is claimed as new is:

1. An apparatus for interconnecting a plurality of circuits, said apparatus comprising: a plurality of first cards each having electrical circuitry thereon; first terminal tabs fixed to one edge of each first card and connected to said circuitry; a second card having conductive strips thereon; second terminal tabs fixed to one edge of said second card and selectively connected to said conductive strips; and means for connecting the conductive strips on said second card to the circuitry on said first cards; said means including a nonconductive body member having side walls, a plurality of cavities extending through said body member between said side walls, a longitudinal opening in one of said side walls intersecting a portion of each of said cavities and dimensioned to receive the one edge of said first cards, and a plurality of transverse openings in another of said side walls, each transverse opening being arranged to respectively intersect another portion of each of said cavities and being dimensioned to receive the one edge of said second card; said means also including connector elements disposed within the cavities of said body member; each of said connector elements having a first contacting portion adapted to conductively engage a first terminal tab when one of said first cards is positioned in the longitudinal opening in the one side wall of said body member, and having a second contacting portion adapted to conductively engage a second terminal tab when said second card is positioned in one of the transverse openings of the other side of said body member.

2. In an electrical system having first cards containing electrical circuits with first terminal tabs on one edge of each first card, and second cards containing electrical circuits with terminal tabs on one edge of each second card, the combination of connectors for providing selective connections between the circuits on the first cards and the circuits on the second cards, each connector comprising: a nonconductive body member having side walls, a plurality of cavities extending through said body member between said side walls, a longitudinal opening in one of said side walls intersecting a portion of each cavity and dimensioned to receive the one edge of one of said first cards, and a plurality of transverse openings in another of said side walls arranged to intersect other portions of said cavities and dimensioned to receive the one edge of one of said second cards; and connector elements disposed within the cavities of said body member, each of said connector elements having a first contacting portion adapted to conductively engage a first terminal tab when one of said first cards is positioned in the longitudinal opening in the one side wall of said body member, and having a second contacting portion adapted to conductively engage a second terminal tab when one of said second cards is positioned in one of the transverse openings in the other side wall of said body member.

3. An apparatus for interconnecting a plurality of

5

circuits, said apparatus comprising: a plurality of first cards containing electrical circuitry having first terminal tabs fixed to one edge of each card; a second card having conductive strips and second terminal tabs fixed along one edge of said second card and selectively connected to said strips; and a plurality of connectors for connecting the conductive strips on said second card to the circuitry on said first cards; each of said connectors including a nonconductive body member having first and second side walls, a plurality of cavities extending through said body member between said side walls, a longitudinal opening in said first side wall intersecting one end of each cavity and dimensioned to receive the one edge of said first cards, and a plurality of transverse openings in said second side wall, each transverse opening intersecting the other end of one of said cavities and being dimensioned to receive the one edge of said second card; each of said connectors also including connector elements disposed within the cavities of said body member, each of said connector elements having a first contacting portion adapted to conductively engage a first terminal tab when one of said first cards is positioned in the longitudinal opening in the first side wall of said body member, and having a second contacting portion adapted to conductively engage a second terminal tab when said second card is positioned in one of the transverse openings in the second side wall of said body member.

4. In an electrical system having first cards containing electrical circuits and first terminal tabs on one edge of each first card, and second cards containing conductive strips and second terminal tabs on one edge of each second card selectively connected to said conductive strips, the combination of connectors for providing solderless connections between selected terminal tabs on the first cards and selected terminal tabs on the second cards, each connector comprising: a non-conductive body member having first and second side walls, a plurality of cavities extending through said body member between said side walls, a longitudinal opening in said first side wall intersecting one end of each cavity and dimensioned to receive the one edge of the first cards, and a plurality of transverse openings in said second side wall, each transverse opening intersecting the other end of one of said cavities and being dimensioned to receive the one edge of the second cards; and connector elements disposed within the cavities of said body member, each of said connector elements having a first contacting portion adapted to conductively engage a first terminal tab when one of the first cards is positioned in the longitudinal opening in the first side wall of said body member, and having a second contacting portion adapted to conductively engage a second terminal tab when one of the second cards is positioned in one of the transverse openings in the second side wall of said body member.

5. A circuit connector for interconnecting electrical circuitry on first and second circuit cards, having first and second terminal tabs fixed, respectively, to one edge of each of said cards, said connector comprising: a non-conductive body member having first and second side walls oppositely disposed, a plurality of elongated cavities extending through said body member between said side walls, a longitudinal opening in said first side wall intersecting one end of each cavity and dimensioned to receive the one edge of a first card, and a plurality of transverse openings in said second side wall, each transverse opening intersecting the other end of one of said cavities and dimensioned to receive the one edge of a second card; and connector elements retained within the cavities of said body member, each of said connector elements including first contacting fingers constructed and arranged to grip the one edge of a first card and conductively engage a first terminal tab when one of the first cards is positioned in the longitudinal opening in the first side wall of said body member, and including second contacting fingers constructed and arranged to grip the one edge of a second card and conductively engage a second terminal tab when one of the second cards is positioned in a transverse opening in the second side wall of said body member.

6. The circuit connector defined in claim 5 in which said body member comprises first and second sections having respectively first and second abutting surfaces and means for holding said surfaces in abutting relationship; said first section being constructed to provide said

6

first side wall, a first portion of each of said cavities, and said longitudinal opening; and said second section being constructed to provide said second side wall, a second portion of each of said cavities, and said transverse openings.

7. The connector defined in claim 6 in which each of said first and second cavity portions are constructed and arranged to provide, respectively, first and second oppositely-facing shoulders in each of said cavities when the first and second abutting surfaces of said first and second sections are held in abutting relationship; and in which each of said connector elements includes oppositely-facing portions adapted to engage the first and second shoulders in each of said cavities; the shoulders in each of said cavities and the oppositely-facing portions of each of said connector elements operating to retain each of said connector elements within each of said cavities when the first and second abutting surfaces of said first and second sections are held in abutment by said holding means.

8. The connector defined in claim 7 in which the first and second sections comprising said body member are constructed to provide cavities which conform to the shape of said connector elements to permit cooperation between the cavities and said connector elements for maintaining said first and second contacting fingers of said connector elements in alignment with the longitudinal and transverse openings, respectively, for receiving the terminal tabs on the one edges of the first and second circuit cards when said cards are placed in said openings.

9. An electrical connector comprising an insulating member having an upper portion and a lower portion; a longitudinal slot in the upper portion of said member, said slot having a longitudinal axis; a plurality of transverse slots in the lower portion of said member, the respective axes of said transverse slots being at right angles to the longitudinal axis of said longitudinal slot; a first set of connector elements mounted within said transverse slots, said first set including one connector element for each transverse slot, and a second set of connector elements mounted within said longitudinal slot, said set including a plurality of elements uniformly spaced and insulatively mounted with respect to each other along the longitudinal axis of said longitudinal slot, one element for each of said elements of said first connector set, said second set of elements being metalically connected to said first set of elements, respectively.

10. The electrical connector defined in claim 9 wherein said upper and lower portions of said insulating member comprises first and second sections having first and second abutting surfaces, respectively; and means for holding said surfaces in abutting relationship.

11. An electrical connector for electrically interconnecting a first circuit board having a plurality of first circuit terminals contiguous with one edge thereof with a plurality of second circuit boards each having at least one terminal contiguous with one edge thereof, said connector comprising: a nonconductive body member having an upper portion and a lower portion; a longitudinal slot in the upper portion of said member, said slot having a longitudinal axis and being adapted to receive said one edge of said first circuit board; a plurality of transverse slots in the lower portion of said member, the respective axes of said transverse slots being at right angles to the longitudinal axis of said longitudinal slot, each transverse slot being adapted to receive said one edge of said second circuit board; a corresponding plurality of first connector elements disposed within said plurality of transverse slots, respectively, for making electrical connection to said one terminal of said second circuit board; a plurality of second electrical connector elements positioned within said longitudinal slot for making electrical connection with said plurality of terminals of said first circuit board, respectively; and conductive means within said body member for interconnecting each of said second connector elements with an associated first connector element.

12. A connector comprising a plurality of uniformly spaced metallic U-shaped terminals uniformly distributed along a longitudinal axis, whereby said first set of U-shaped terminals form a longitudinal slot, each of said terminals having a second U-shaped terminal, said second U-shaped terminal being in an inverted position with respect to the first, and lying in the plane which is at 90° with respect to the plane of the first terminal, and an insulating member integrating all of said terminals into a

unitary structure and holding said terminals in uniformly spaced and insulative relationship with respect to each other.

13. A connector comprising an insulating member having an upper portion and a lower portion, a longitudinal slot in the upper portion in said member, said slot having a longitudinal axis: a first set of connector elements mounted within said slot, uniformly spaced and insulatively mounted with respect to each other along the longitudinal axis of said slot; a corresponding plurality of transverse slots in the lower portion of said member, the respective axes of said slots being at right angles to the longitudinal axis of said longitudinal slot; a second set of connector elements mounted within said transverse slots, one connector element per each transverse slot, and a metallic connection between the terminals of the first set and the terminals of the second set, the terminals of the first set being symmetrically oriented with respect to said longitudinal axis, and the terminals of the second set being oriented symmetrically with respect to the axes of the respective slots.

14. An electronic circuit connector for interconnecting circuits mounted on circuit cards, said connector comprising: a nonconductive body member having first and second opposite sides with a first slot in said first side and a plurality of second slots in said second side arranged transversely with respect to said first slot, and openings through said body member interconnecting said first slot with each of said second slots, said first and second slots being adapted to receive the circuit cards; and metallic connector elements positioned in said openings, each connector element including first and second oppositely disposed generally U-shaped portions constructed and arranged to conductively engage the circuits on said circuit cards when said cards are received by said first and second slots, and including means for maintaining said each connector in its respective opening with the first and second U-shaped portions in alignment with the first and second slots.

15. An electrical system including first cards containing electrical circuits with first terminal tabs on one edge of each first card, second cards containing electrical cir-

uits with second terminal tabs on one edge of each second card, and means for interconnecting the electrical circuits on said first and second cards, said means including a unitary metallic connector element comprising first and second generally U-shaped portions having intersecting bases, a common axis passing through the intersection of said bases, and legs oppositely extending along said axis; said U-shaped portions being oriented at an angle, with respect to each other, about said axis; and the legs of each U-shaped portion being so constructed and arranged, along said axis, as to constitute spring fingers for gripping one edge of one of said cards and conductively engaging one of the terminal tabs.

16. An electrical system including first cards containing electrical circuits with first terminal tabs on one edge of each first card, second cards containing electrical circuits with second terminal tabs on one edge of each second card, and means for interconnecting the electrical circuits on said first and second cards, said means including a connector comprising a first metallic member having a first base element and a first pair of semielliptical spring elements, said spring elements constituting metallic continuations of said first base element bent at angles with respect to said base, the outer ends of said spring elements being bent outwardly to form a first wedge-shaped opening of said connector; and a second metallic member having a second base element and a second pair of semielliptical spring elements, said second base element intersecting said first base element at an angle and in common plane, and said second pair of semielliptical spring elements being bent in a direction opposite to the direction of the first pair of spring elements with their outer ends bent to form a second wedge-shaped opening of said connector, whereby said connector is capable of electrically interconnecting the first and second terminal tabs on said first and second cards.

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