Sept. 19, 1961 F. A. SCHULTZ 3,001,171

ELECTRICAL CONNECTOR

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FIG. 1

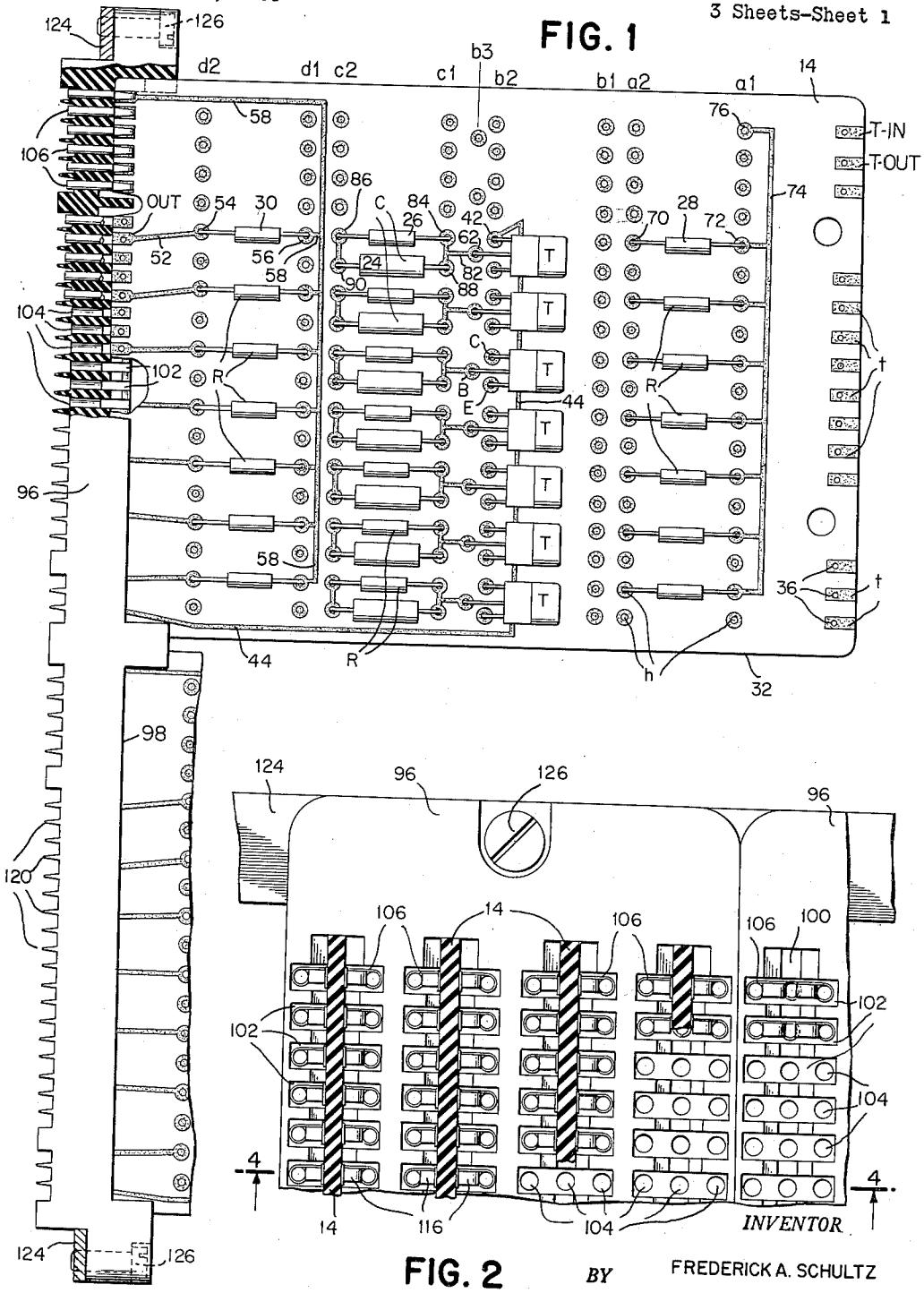


FIG. 2

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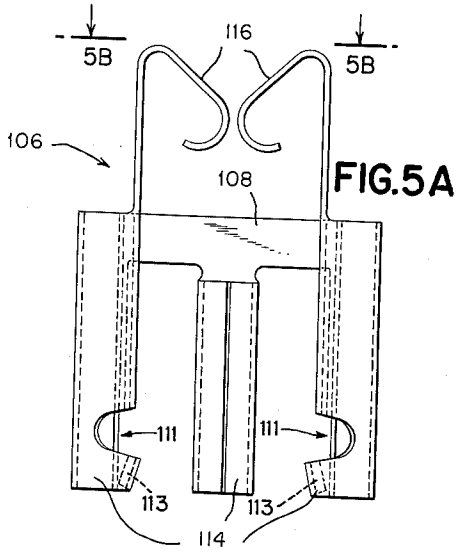


FIG. 5A

FIG. 5B

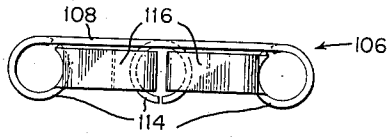
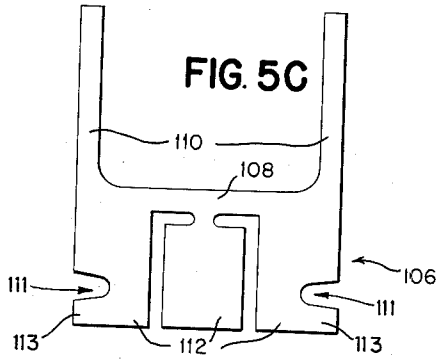


FIG. 5C



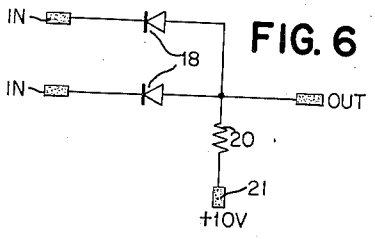
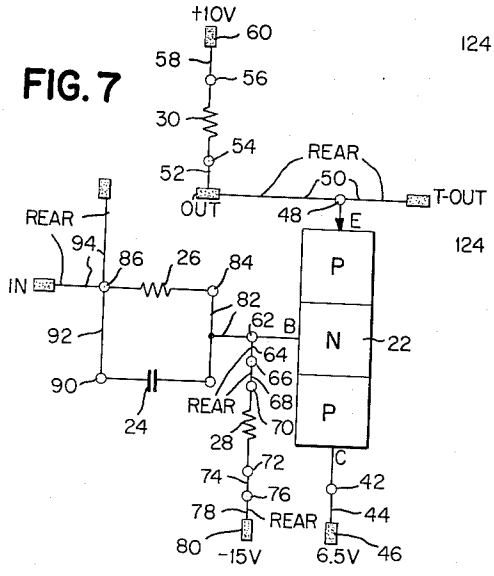


FIG. 6

FIG. 7



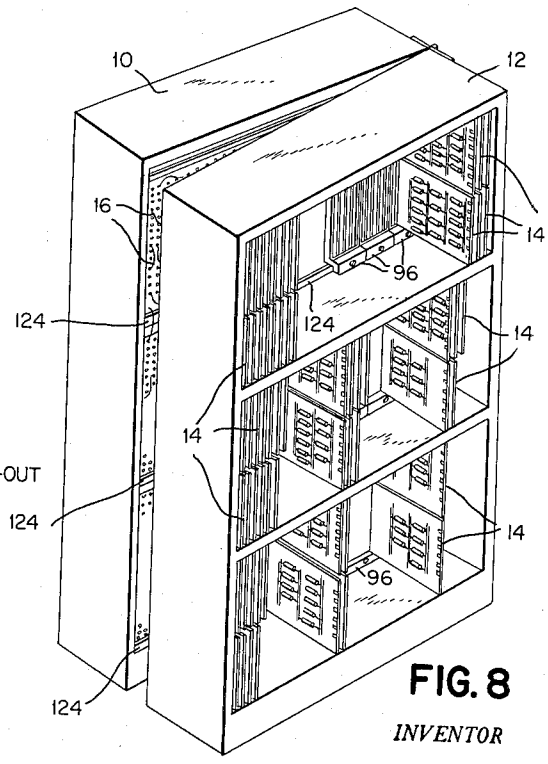


FIG. 8

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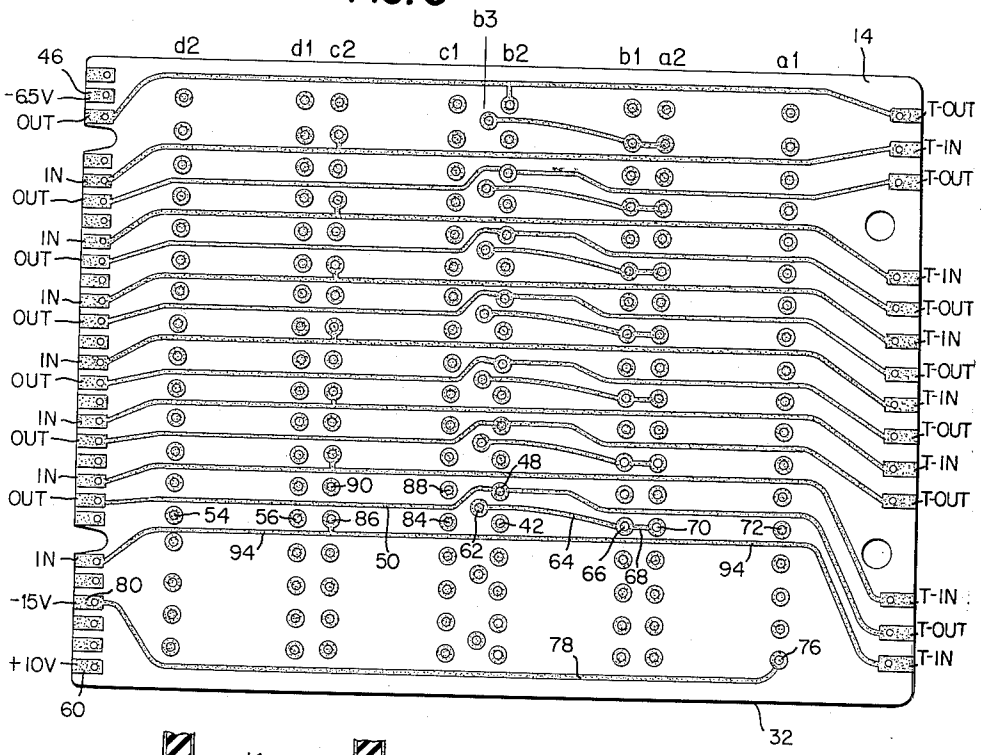
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FIG. 3



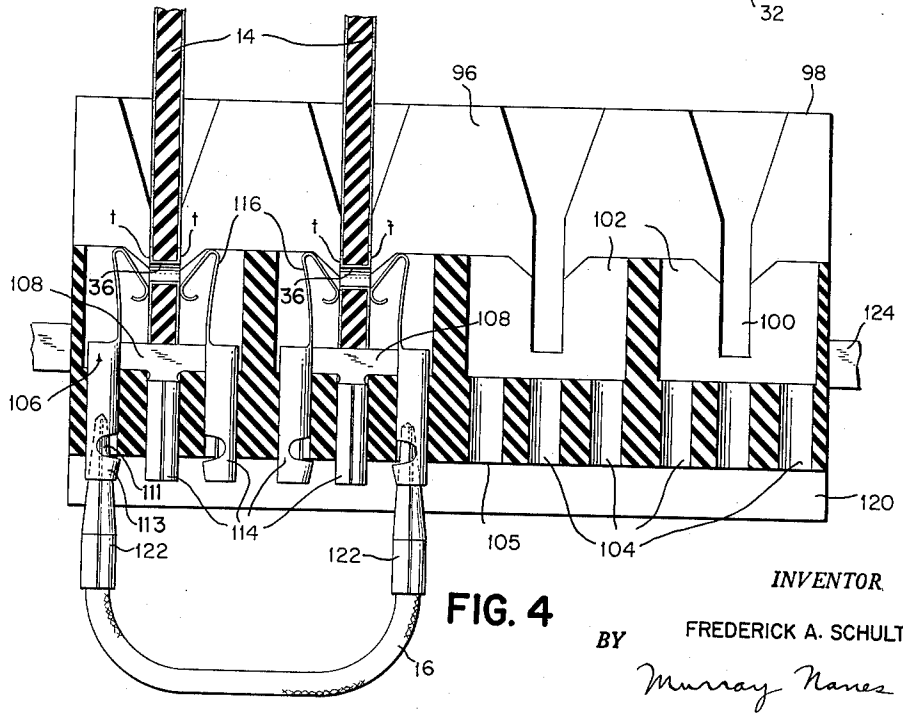


FIG. 4

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3,001,171

ELECTRICAL CONNECTOR

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Filed Dec. 27, 1955, Ser. No. 555,456
1 Claim. (Cl. 339—217)

This invention relates to electrical connectors and more particularly to electrical connectors used for connecting a multiplicity of lead wires to a corresponding multiplicity of electrical contact elements on an edge of a circuit card.

Due to the complexity of present day electronic computers, a very large number of electronic components must be utilized and space saving considerations become important in order to limit the excessive size of the equipment. These computers are generally comprised of circuits utilizing fairly standard basic circuits such as flip-flops, emitter followers, inverters, AND circuits, and OR circuits which now may make use of components such as small germanium diodes, transistors, resistors and condensers. It is desirable to have the circuits organized so that they may be accessible for servicing in the machine, and also may be removed as units for servicing at a place remote from the piece of electronic equipment itself. To make the circuit removable as a unit, the circuit components are usually permanently connected to circuit cards, each of which is made detachable as a unit.

These basic circuits lend themselves to compact arrangement on the circuit cards, whereon conductive tabs on one edge are used for external connection thereto. By inserting the tabs of the circuit cards in novel sockets which have plug sleeves, plug wires may be utilized to make the interconnections between the cards and it then becomes possible to use automation processes. The automation process permits the programming of a machine which inserts the plug wires, to make possible mass production of computers and yet provide for slight changes or additions to standard computer circuitry as required.

It is, therefore, an object of this invention to provide selective flexible connections between circuits on a circuit card or cards.

A further object of the invention is to provide a conductive connector for electrically connecting a circuit card equipped with conductive tabs to a plurality of pin terminals of electrical plug wires.

A still further object of the invention is to provide an electrical conductive connector between the circuit card and the plug wire made of an inexpensive unitary strip of metal.

A still further object of the invention is to provide a non-conductive socket having a plurality of first channels, each of which is dimensioned to receive the terminal tabs on the edge of said cards.

Another object of the invention is to provide a non-conductive socket having a plurality of second channels intersecting each first channel and adapted for supporting, isolating, and protecting the conductive connectors.

Other objects of the invention will be pointed out in the following description and claim illustrated in the accompanying drawings, which disclose, by way of example, the principle of the invention and the best mode which has been contemplated of applying that principle.

In the drawings:

FIG. 1 is a side view of a non-conductive socket-indicating the front face of a circuit card mounted therein, and having portions of the socket broken away to show internal parts thereof.

FIG. 2 is a partial detail front view of the non-conductive socket indicating in section, the circuit cards mounted therein.

FIG. 3 is a rear face view of the circuit card of FIG. 1.

FIG. 4 is a sectional view taken on the line 4—4 in FIG. 2.

FIG. 5A is an enlarged front elevational detail of the conductive connector.

FIG. 5B is a top detail view of the conductive connector taken on the line 5B—5B of FIG. 5A.

FIG. 5C is a developed view of the conductive connector drawn on a smaller scale.

FIG. 6 is a circuit diagram of a typical diode AND circuit.

FIG. 7 is a circuit diagram of a typical transistor emitter follower.

FIG. 8 is a view in perspective illustrating the structure of a computer unit with one of its gates partially opened.

Before describing the details of the invention, a general description will be given. Generally, the circuit cards of the invention have a specific standard arrangement of plated holes, printed terminal tabs and printed wiring which results in a most compact arrangement of electronic components thereon for all different types of computer basic circuits. The plated holes are arranged in rows across the circuit card and the leads of the electronic components are inserted therein preparatory to connection thereto by dip soldering. The dip soldering of the entire circuit card is made possible by the placing of the electronic components on the front face only, of the circuit card, which fact, in turn, is made possible by the plated hole arrangement and the fact that the wiring is printed parallel to the rows of plated holes on the front face of the card, and perpendicular thereto on the rear face.

A non-conductive socket for the circuit cards contains a plurality of first channels each first channel being dimensioned to receive an edge of a circuit card, and each of the first channels being intersected by a plurality of second channels. The second channels contain conductive connectors, each of which engages a terminal tab at the edge of the card. The conductive connector is a unitary strip of metallic stock having a shoulder carrying a spring contact oppositely disposed to a plurality of sleeves. The sleeves extend through holes in the rear of the socket and are engageable with plug wires for electrical inter-connections between circuit cards. The cards are closely arranged front face to rear face in the first channels of the socket and so test terminal tabs are provided on the outside edge of the circuit card to permit testing of the circuits while in the machine. The sockets are supported side by side at their ends by a pair of mounting rails.

Referring now to FIG. 8, a standard main frame for a computer or other large scale electronic apparatus may be observed. The main frame consists of two gates **10** and **12**, one of which, gate **12** is swingable on hinges **13** forwardly away from gate **10**. Each gate contains a number of rows of circuit cards **14**, only the edges of which can be seen in FIG. 8. The inside of gate **10** shows the plug wiring **16** which are used to make the electrical connections between the circuit cards **14** in gate **10**, and there is similar plug wiring **16** at the rear of gate **12** which is not shown. Before describing the structure for mounting the circuit cards, the nature of the card itself and the usual circuitry thereon will be described.

FIGS. 6 and 7 illustrate two typical circuits that are utilized in computer circuitry. FIG. 6 shows an AND circuit consisting of components such as germanium diodes **18** and a resistor **20**, connected to a terminal tab **21** which is externally connected to a supply voltage of +10 volts D.C. An AND circuit requires that there be two input signals placed on terminal tabs In, in order to get an output signal on the terminal tab Out. FIG. 7 indicates an emitter follower which is ordinarily used to increase the power of a signal without distortion or in-

version, and comprises a PNP transistor 22, a condenser 24 and resistors 26, 28 and 30. Other basic circuits may be utilized which contain inductances.

Referring to FIG. 1, there is illustrated the front face of a circuit card 14 comprising a component mounting wafer 32 made of any suitable insulating material such as phenolic. The wafer 32 has holes *h* punched therethrough in a standard pattern, to be presently described. The holes are conductively plated around the inside circumference and also so as to have a rim of conductive material on both faces of the wafer, by any well known printed circuit fabrication technique, such as metal spraying, photoetching, etc. Smaller holes 36 at the edges are also conductively plated around the inside circumference but instead of a rim, the conductive material on the face are rectangularly shaped and extended to the edge of the circuit card 14, to form terminal tabs *t*. At the same time, any wiring between plated holes *h*, between tabs *t*, and between holes *h* and tabs *t* are plated on the wafer. This printed wiring may be placed on either face of the card 14, the rear face of the card being shown in FIG. 5. It has been determined that a standard arrangement of the printed wiring permits a more flexible and compact arrangement, as will be more fully described presently.

Referring to FIG. 3, a number of rows of plated holes are shown labeled rows *a*1, *a*2, *b*1, *b*2, *b*3, *c*1, *c*2, and *d*1, *d*2. Each hole in a row is spaced only far enough apart from the next one in that row so that a printed wire may be placed between them without contacting the rim of the plated holes 34. Rows *a*1 and *a*2 are spaced far enough apart from each other to permit the circuit components such as resistors, condensers, inductances and diodes, to be placed between them in a manner so that the leads of the circuit components may be inserted in horizontally aligned plated holes (FIG. 1). This standard hole arrangement also lends itself to automatic insertion of the components into the plated holes. Generally, the resistors, condensers and inductances are placed between rows *a*1, and *a*2, rows *c*1 and *c*2, or rows *d*1 and *d*2. In circuits utilizing diodes, the diodes are generally placed between rows *b*1 and *b*2, but it is apparent they may be placed in the other rows. A row *b*3 is placed on the card, having plated holes *h* placed close to row *b*2, each of the holes of which is placed just below and between holes in each pair of plated holes in row *b*2. The pair of holes of row *b*2 and the respective adjacent plated hole of row *b*3 are utilized as connections to a socket 40 (FIG. 1) of a transistor T. When transistors are mounted in the plated holes of rows *b*2 and *b*3, the holes of row *b*1 are not used. It is to be noted that the components are all mounted on the front face of the wafer 32, thus permitting the back face to be lowered into solder, in the well known dip soldering process, which by capillary action draws the solder up into the plated holes to provide soldered connections to the circuit component leads mounted therein.

To illustrate the use of the standard hole pattern and explain the standard wiring arrangement, the circuit card of FIGS. 1 and 3, which carries seven of the emitter follower circuits of FIG. 7, will be described in more detail. FIG. 7 shows the schematic connections of an emitter follower, all the wires shown in FIG. 7 running at the front face of the circuit card, unless noted "rear." The collector C of a transistor 22 is connected to a plated hole 42, and via a wire 44 on the front face of the circuit card to a −6.5 volt terminal tab 46. The emitter E is connected to a plated hole 48 which is connected to a wire 50 printed on the rear face and electrically connected to a terminal tab Out and to a test terminal tab T-Out. The terminal tab Out is connected via front face wire 52, a plated hole 54, the resistor 30, the plated hole 56, front face wire 58 to a +10 volt terminal tab 60. The base B is connected via a plated hole 62 and via a rear face wire 64, plated hole 66, rear face wire 68, a plated hole 70, resistor 28, a plated hole 72, front face wire 74, plated hole 76, rear face wire 78 to a −15 volt terminal 80. Plated hole 62 is connected by a front face wire 82, a plated hole 84 and resistor 26 to a plated hole 86. Condenser 24, which has its leads connected to plated holes 88 and 90 is parallel with resistor 26 because of the front face wire connection 82 between plated holes 84 and 88, and a front face wire connection 92 between plated holes 86 and 90. Plated hole 86 is connected via rear face wire 94 to terminal tab In and test terminal tab T-In.

From FIG. 1 it can be observed that there are seven similar emitter followers on the one card. The terminal tabs *t* in the middle are generally for input and output signals, while the terminal tabs *t* on either side of the signal voltages are for service voltages. This permits the service voltages to be brought up vertically on either side of the card, to the plated hole row it will be connected to, and then on the front face a printed wire may be run parallel to the plated hole rows, as do for instance leads 74, 44 and 58. With wires parallel to the hole rows, all other long wires to be run perpendicular to the rows will be run on the rear face. In FIG. 3, it can be observed that all the printed wires run substantially perpendicular to the plated hole rows.

The circuit cards 14 are mounted in non-metallic sockets 96 (FIGS. 1, 2 and 4), each of which has cut into a top surface 98 thereof first channels 100. Each of the first channels is made wide enough to accommodate an edge of a circuit card 14, and there are eight first channels 100 in each socket 96. The non-metallic socket 96 is long enough to accommodate two circuit cards 14 side by side (see FIG. 1) and wide enough to accommodate four circuit cards 14 front face to rear face (see FIGS. 2 and 4). Each first channel 100 has a plurality of second channels 102 intersecting it and perpendicular thereto. The bottom of the second channel 102 is set a little deeper into the socket 96 than the bottom of the first channel 100. There are three cylindrical openings 104 through the socket 96 from the bottom of the second channels into the bottom surface 105 of the socket 96. The second channels 102 and the openings 104 are arranged in this manner to accommodate a conductive connector 106. The sides of second channels act to electrically isolate the conductive connectors 106 from each other and to physically protect them.

Conductive connector 106 shown in FIG. 5C as it is stamped out, is a unitary metallic strip having a shoulder 108 supporting three legs 112 oppositely disposed to two tongues 110. Connector 106 has its legs 112 rolled to form cylindrical sleeves 114 and its tongues 110 are then bent into the position clearly indicated in FIG. 5A to form a spring clip 116. In FIG. 5C, the two outside legs 112 are shown to have slots 111 cut into the outside edges close to the lower portion of the legs 112. When the cylindrical sleeves 114 are formed, the little tabs 113 below the slots 111 are tapered as shown in FIG. 5A and act as locking tabs.

Each of the connectors 106 is inserted into a second channel 102 until the bottom edge of the shoulder 108 rests at the bottom of the second channel 102. The sleeves 114 project through the bottom surface 105 of the socket 96 but they are protected by ridges 120 across the bottom surface 105 of the socket 96. When the sleeves 114 are inserted into the openings 104, the tapered locking tabs 105 make the insertion process very easy. As the tab moves into the opening 104, the locking tab 105 is compressed and when the locking tab 105 comes through the bottom of the opening, the locking tab snaps back and its upper edge locks against the lower surface of the socket 96. In this position, when the circuit cards 14 are inserted into the first channels 100, the spring clips 116 make contact with the terminal tabs *t* on the two faces of the circuit card. FIG. 4 shows the

plugs **122** of a plug wire **16** connected between two sleeves **114** to thereby make connections between the circuits of different circuit cards **14.**

From FIGS. 2 and 8, it can be observed that each socket **96** is mounted on rails **124** by screws **126** through a hole on each end thereof. Thus, in FIG. 8, the gates **10** and **12** have a plurality of rails **124** which carry the sockets **96**, which in turn, support the circuit cards **14.** Interconnection between the circuit cards are made by plug wires **16**, and any testing of the circuits of the circuit cards can be done by putting test clip leads on the test terminal tabs *t* at the edge opposite to the edge in the socket **96.**

While there have been shown and described and pointed out the fundamental novel features of the invention as applied to a preferred embodiment, it will be understood that various omissions and substitutions and changes in the form and details of the device illustrated and in its operation may be made by those skilled in the art without departing from the spirit of the invention. It is the intention, therefore, to be limited only as indicated by the scope of the following claim.

What is claimed is:

A connector for electrically connecting, within a non-metallic socket, a pair of electrically connected conductive edge strips on each side of a circuit card to three external electrical wire terminals: comprising a non-metallic socket having a plurality of equi-diameter holes therethrough; a unitary strip of conductive flexible metallic stock having a shoulder; three sleeves extending in parallel relation from said shoulder; each sleeve engageable with one of said electrical wire terminals; said center

sleeve being connected to the center of said shoulder and notched on each side in a position near said shoulder; each of the outer two sleeves having a notch close to its end; the portion of each outer sleeve below said notch being bent in the form of a locking tab; the outside diameter of the locking tab just below the notch being greater than the diameter of the socket hole and tapering downwardly to a diameter less than the socket hole; said locking tab adapted to be depressed as said connector is inserted forwardly, sleeve end first, into the holes of said socket; said locking tab adapted to restore to a position, when the connector is in the fully inserted condition, so that the top of the locking tab at the notch bears against the non-metallic socket to lock the connector against backward movement in the non-metallic socket; and a pair of tongues; each tongue extending from the side of the outside sleeve facing the center sleeve; said tongues curled inwardly towards each other to form a conductive spring contact engageable with said pair of conductive edge strips.

References Cited in the file of this patent

UNITED STATES PATENTS

2,540,037	Vough et al.	Jan. 30, 1951
2,575,161	Deakin	Nov. 13, 1951
2,707,272	Blitz	Apr. 26, 1955
2,707,274	Kough	Apr. 26, 1955
2,711,523	Willis	June 21, 1955
2,754,453	Noell	July 10, 1956
2,937,357	Kennedy	May 17, 1960