April 9, 1963 O. I. THOMPSON 3,085,177

DEVICE FOR FACILITATING CONSTRUCTION OF ELECTRICAL APPARATUS

Filed July 7, 1960 2 Sheets-Sheet 1

Fig. 1

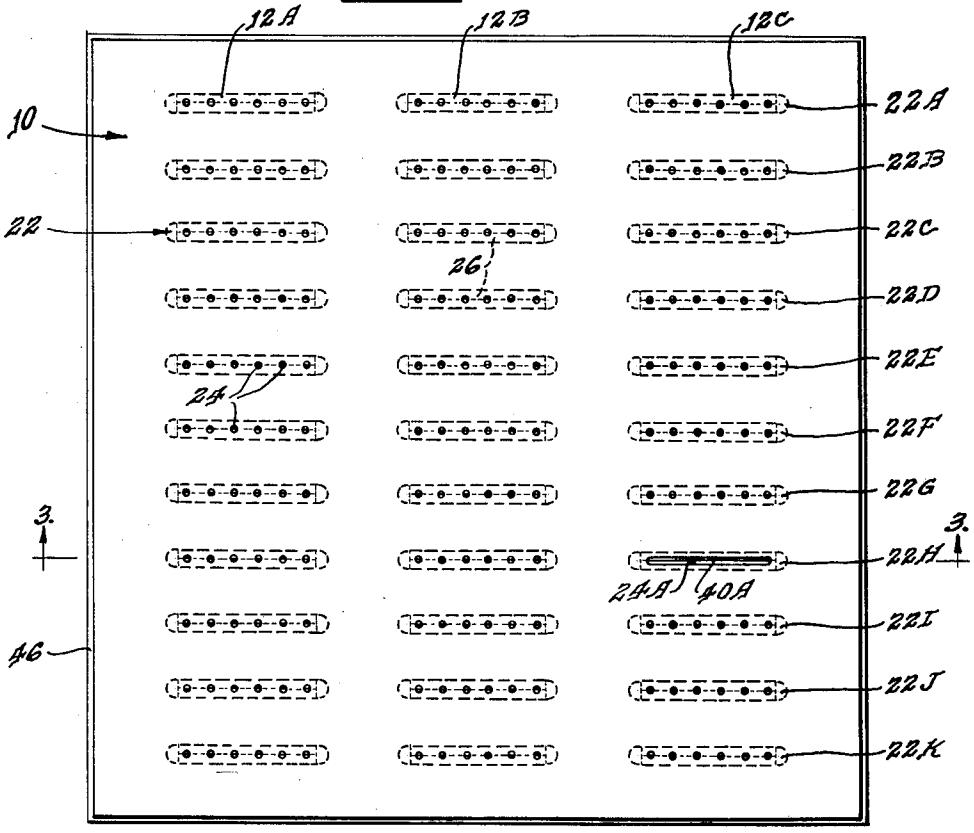


Fig. 3

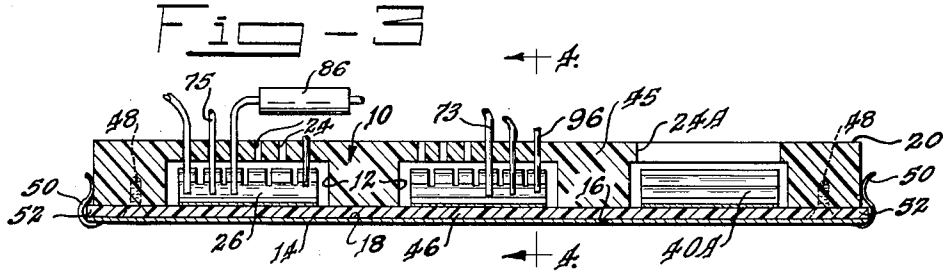
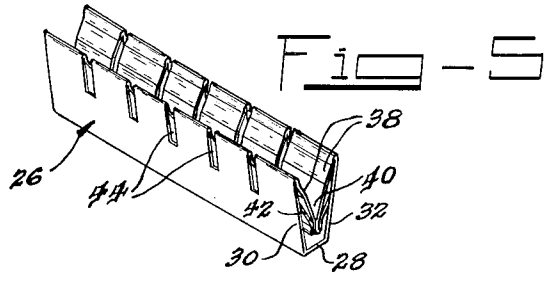


Fig. 5



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April 9, 1963 O. I. THOMPSON 3,085,177

DEVICE FOR FACILITATING CONSTRUCTION OF ELECTRICAL APPARATUS

Filed July 7, 1960 2 Sheets-Sheet 2

Fig - 2

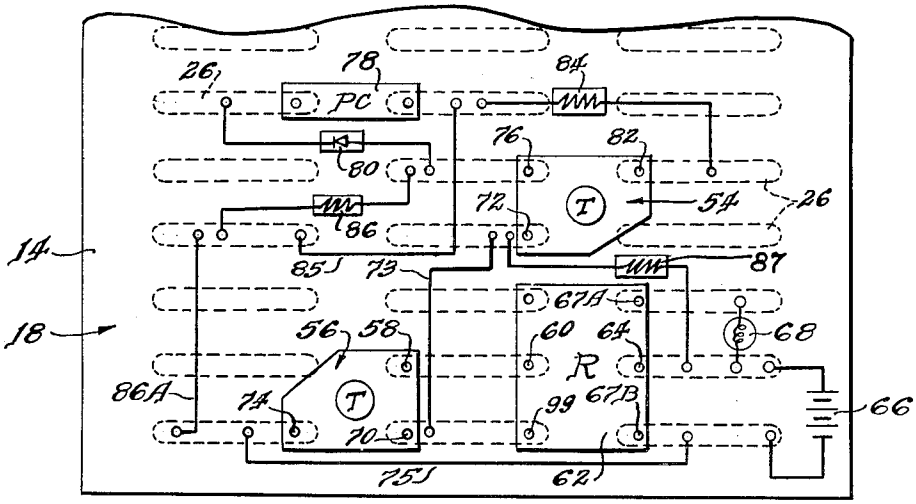


Fig - 6

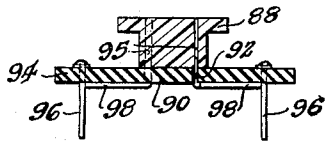


Fig - 7

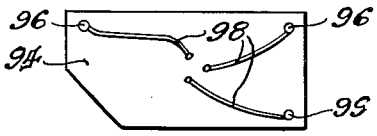


Fig - 4

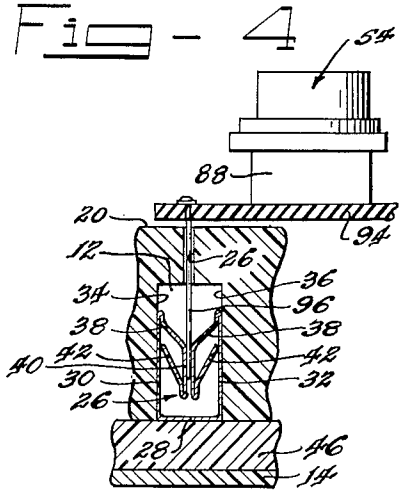
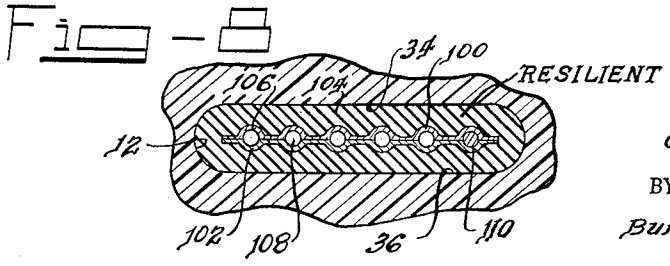


Fig - 8



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DEVICE FOR FACILITATING CONSTRUCTION OF ELECTRICAL APPARATUS

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11 Claims. (Cl. 317—101)

The present invention relates generally to devices for facilitating construction of electrical equipment, and particularly to devices facilitating construction of electrical apparatus for instruction of students of electronics.

Patent application Serial No. 775,035, filed November 19, 1958, now Patent No. 3,043,021, by the present inventor discloses a device for facilitating construction of electrical circuits in which a plurality of parallel bars of insulating material are employed and means are provided to secure electrical conductors therebetween. The bars are provided with an electrically conducting surface confronting the electrical conductors of the electrical circuit, and these electrically conducting surfaces function to interconnect the electrical conductors. This device also requires a means for forcing the bars into engagement with each other in order to lock the electrical conductors between adjacent bars.

One of the difficulties which has been experienced with the device for constructing electrical circuits disclosed in the above patent application is that it is difficult to engage electrical conductors of varying diameters. One solution of this problem requires the bars to possess sufficient resilience in order to yield to the larger conductors and grip the smaller conductors. It is one of the objects of the present invention to provide a device for constructing electrical circuits in association with a support base or board in which means are provided to interconnect a plurality of conductors and in which the electrical conductors can vary substantially in diameter.

Another object of the present invention is to provide a device for constructing electrical circuits in which means are provided within cavities in a support base or body for engaging and interconnecting the ends of electrical conductors, the conductors entering the cavities through openings in the body. Confining the electrically conducting means for engaging and interconnecting the ends of the electrical conductors to cavities within the body of the device has the advantage of providing a body surface which is entirely free of electrically conducting surfaces.

It is a further object of the present invention to provide a device for constructing electrical circuits in which the ends of a plurality of electrical conductors may be interconnected by merely inserting them into a contact member, thus avoiding any step to lock them into place. This is accomplished in the present invention by means of contact members disposed in cavities of an insulating board having confronting jaws biased together and confronting an opening in the board.

Further, it is an object of the present invention to provide a device for constructing electrical circuits of the type described above in which an instruction diagram may be viewed through the board. With such a construction, the diagram may be used to aid in construction of the electrical circuit in the manner disclosed in the present inventor's Patent No. 2,882,618, entitled "Educational Device for Training Electronic Technicians."

These and further objects of the present invention will become readily apparent to those skilled in the art from a further consideration of the present disclosure particularly when viewed in the light of the drawings, in which:

FIGURE 1 is a plan view of a board-type device for facilitating construction of electrical circuits;

FIGURE 2 is a plan view of a template for use with the board-type device of FIGURE 1 showing the schematic diagram of an electrical circuit and the manner of assembling the circuit on the device of FIGURE 1;

FIGURE 3 is a sectional view taken along the line 3—3 of FIGURE 1 with the circuit elements shown in FIGURE 2 fragmentarily illustrated mounted on the board of FIGURE 1;

FIGURE 4 is a sectional view taken along the line 4—4 of FIGURE 3;

FIGURE 5 is an isometric view of one of the contact members employed in the device shown in FIGURES 1, 3 and 4;

FIGURE 6 is a sectional view of an adapter unit for use with vacuum tubes, condensers, or transistors for the purpose of adapting them for use with the device for constructing electrical circuits of FIGURES 1, 3 and 4;

FIGURE 7 is a bottom view of the adapter shown in FIGURE 6; and

FIGURE 8 is a sectional view illustrating a modified construction of a device for construction of electrical circuits according to the present invention.

Referring to FIGURES 1, 3 and 4, the device for constructing electrical circuits here disclosed utilizes a base member or body in the form of a flat board **10** of electrically insulating material which is provided with a plurality of elongated cavities **12** therein. The board **10** is preferably of material transparent to light, and a template **14** is removably mounted adjacent to one surface **16** of the board **10**. In this manner, an electrical circuit diagram **18** on the surface of the template **14** confronting the board **10**, such as illustrated in FIGURE 2 and which will be described more fully hereinafter, is visible when viewed from the surface **20** of the board opposite the surface **16**.

The cavities **12** are elongated and of equal length, and the cavities **12** are aligned in a plurality of rows **22**, FIGURE 1 illustrating rows 22A, 22B, 22C, 22D, 22E, 22F, 22G, 22H, 22I, 22J, and 22K. Each of the rows **22** has three cavities 12A, 12B, and 12C, and these cavities are spaced from each other by common distances. The cavities 12A of all of the rows **22** are aligned on an axis normal to the axes of the rows, as are the cavities 12B and 12C. A plurality of openings **24** extend between the surface **20** of the board **10** and each of the cavities, the openings **24** being aligned with the axes of the cavity.

Each of the cavities **12** is provided with a contact member **26** which is illustrated in FIGURES 3, 4 and 5. The contact member **26** is constructed of resilient electrically conducting material, such as copper coated spring steel, and is fabricated from a flat sheet of this material. As best illustrated in FIGURE 4, each of the contact members **26** has a flat base **28** which is disposed on the surface of the cavity **12** remote from the surface **20** of the sheet. A pair of walls **30** and **32** extend from the base **28** and are spring biased outwardly to engage the parallel side walls **34** and **36** of the cavity. The edge of the walls **30** and **32** of the contact members **26** opposite the base **28** thereof connect with a leaf portion **38** which extends toward the center of the cavity and at approximately the center thereof is bent at right angles to the flat base and extends toward the base, this section of the leaf portion being designated **40**. The leaf portion **38** of the wall **30** and the leaf portion **38** of the wall **32** abut each other in the sections **40**, and a terminating support portion **42** extends from the end of the leaf portions **38** confronting the base **28** to abut the wall **30** or **32** in order to aid in spring biasing the sections **40** toward each other.

The contact members 26 have a longitudinal axis slightly less than the axes of elongation of the cavities 12, and are provided with slots 44 which extend through the walls 30 and 32 and the portions 38, 40 and 42 so that the portions 40 which abut each other are essentially independently sprung jaws. The slots 44 are disposed between the openings 24 confronting each cavity 12 so that each opening immediately confronts the one pair of abutting portions 38 of the contact member 26, or one pair of jaws.

The cavities 12 are conveniently formed in the board 10 by molding or cutting indentations from one surface in a first sheet of insulating material, designated 45, and a thin sheet 46 of electrically insulating material is secured to the sheet 45 in any conventional manner, such as cementing the sheets 45 and 46 together or utilizing screws 48. Preferably, the sheets 45 and 46 are of transparent material, such as Lucite or other transparent plastic or glass, so that the schematic diagram 18 is visible through the surface 20 of the resulting board 10. The schematic diagram may be secured to the assembly of sheets 45 and 46 by any removable means such as clips 50 mounted on the template 14 and spring biased against the edges of the sheet 45. The sheet 46 may be slightly longer than the sheet 45 to provide protuberances 52 which engage the clips 50.

FIGURE 2 illustrates the schematic circuit diagram 18 disposed on the template 14 for a photocell excited transistor switching circuit. It is to be understood that this particular circuit is illustrated to show a typical application of the invention, and that the invention may be practiced with other electrical circuits in order to assemble and construct virtually any type of electrical device, such as receivers, amplifiers, oscillators, trigger circuits, battery chargers, power supplies, and the like. Since the manner of mounting the physical components shown schematically in FIGURE 2 is clear from the diagrammatic showing, the physical components of this circuit have not been illustrated. It is to be noted that the schematic circuit diagram of FIGURE 2 shows the connections which are required to complete the circuit and, in dotted lines designated 26, the contact members which form the interconnecting electrical links.

The circuit uses two transistors 54 and 56 connected in an amplifier and a grounded emitter switching circuit, respectively. The collector 58 of the transistor 56 is connected to one terminal 60 of the coil of a relay 62, the other terminal 64 of this relay coil being connected to the positive terminal of a power source 66. The relay 62 has a pair of switch contacts which are connected to pins 67A and 67B. Pin 67B is connected to the negative terminal of power source 66, and a lamp 68 is connected between pin 67A and the positive terminal of the power source 66. It is to be noted that at least one electrical connection is provided by the contact members 26 directly extending between components and without additional wiring. The collector 58 of the transistor 56 is connected in this manner to the terminal 60 of the relay coil.

The transistor 56 also has a base 70 which is connected to the collector 72 of transistor 54 by a wire 73 and an emitter 74 which is connected to the negative terminal of the power source by a second wire 75. These wires and the pig tails of components are merely cleaned of insulation and inserted into the contact members 26 through the openings 24.

Transistor 54 serves as an amplifier and has a base 76 which is connected to a photocell 78 through a diode 80. The photocell 78 is connected in series with the emitter 82 of the transistor 54 through a resistor 84 and is also connected to the negative terminal of the power source 66 by a wire 86A. A resistor 86 is connected between the negative terminal of the power source 66 (through wires 86A and 75) and the base 76 of transistor 54. A resistor 87 is connected between the collector 72 and the terminal 64 of the relay 62.

Each of the transistors 54 and 56 is mounted on an adapter illustrated in FIGURES 6 and 7. Each adapter has a socket 88 with depending lugs 90 which extend through apertures 92 in a thin board 94 of electrically insulating material, such as Bakelite. The socket 88 has grippers 95 adapted to accommodate the pins of the transistors 54 and 56 and which are electrically connected to the lugs 90. In circuits employing vacuum tubes, the socket 88 is designed to accommodate the pins of a vacuum tube. Also, a coil, relay, or other component of an electrical circuit may be mounted on the board 94 for adaptation to the constructional device here disclosed.

At least two pins 96 are anchored within the board 94 and extend normally therefrom. Each of the pins 96 is connected to one of the lugs 90 by an electrically conducting strip 98. The pins 96 are disposed adjacent to corners of the board 94 and spaced from each other by a distance equal to the distance between the opening 24 of the conducting member 26 disposed in a cavity 12A and an opening 24 disposed in the same row for a cavity 12B. The same dimensional relationships exist between the cavities 12B and 12C. As a result, one of the pins 96 of the adapter is adapted to contact a conducting member 26 in a cavity 12B while the other pin 96 is adapted to contact a conducting member 26 in a cavity 12C.

As illustrated in FIGURE 7, the adapter has a third pin 99 located in a third corner of the board 94. The pin 99 is spaced from the pin 96 in the adjacent corner by the same distance that separates the openings 24 of adjacent rows of openings. In this manner, the pin 99 engages a contact member one row removed from the adjacent corner pin 96, and the other pin 96 engages a contact member in the same row as the first pin 96 but a different contact member. Also, the distance between rows of contact members is such that two pins 96 cannot be positioned between adjacent rows, but must be positioned in the same row, and also between adjacent contact members and not the same contact member. Not all of the pins 96 and 99 need be utilized in adapting the particular component to the constructional device, since one or more of the pins may be utilized solely for supporting purposes. The pin 99A of the relay 62 is used solely for supporting the relay for example.

The particular light responsive switching circuit shown in FIGURES 1 and 2 results in current flowing through the coil of the relay 62 in response to light impinging upon the photocell 78, thus closing the relay contacts. The lamp 68 is connected in series with the contacts of the relay 62 and the power source 66, and lights as a result of current flowing through the relay closing the contacts.

FIGURE 3 illustrates the manner in which the pins 96 of the adapter for the transistor 56 and relay 62 contact the abutting portions 40 of the contact member 26, and also the manner in which the end of the wire or conductor 73 is secured within the contact member 26, and thus connected to the pins 96 of the two adapters. It is thus clear that electrical components possessing lugs 90 may be directly mounted to the constructional device without requiring adapter units, and in the event the lugs 90 of the components are spaced by a distance different from the spacing of the openings 24 in the constructional device, or the diameter of the lugs 90 is excessive, an adapter such as shown in FIGURES 6 and 7 may be employed.

The plurality of openings 24 confronting each cavity 12 may be replaced by a single elongated slot parallel to the axis of the cavity, as indicated for cavity 12C, row 22H in FIGURE 3, the slot being designated 24A. When the slot 24A is employed, it is preferable to omit the slots 44 in the contact members and utilize continuous abutting jaws, as indicated at 40A in FIGURE 3.

The contact member 26 provides a spring bias between the plurality of portions or jaws 40 which engage the

pins and wire ends to provide electrical contact and to anchor these elements to the board. The spring bias may be replaced by resilient material for forcing a pair of confronting electrically conducting strips toward each other to achieve these ends. FIGURE 8 is a sectional view parallel to the plane of the surface **20** of a modified board constructional device in which resilient or compliant material is utilized for this purpose. Within the cavity **12**, which is identical to the cavities shown in the first embodiment of the present invention and bears the same reference numeral therefor, a pair of elongated strips **100** and **102** are disposed in confronting relationship. The strips **100** and **102** are disposed with their longitudinal axes parallel to the axes of the cavity, and a mass of resilient material **104** is disposed between the strips **100** and **102** and the walls **34** and **36** of the cavity. The strips **100** and **102** are provided with semicircular bent portions **106** which are equal in number to the apertures confronting each cavity and disposed in alignment with the apertures, and the curved portions **106** of each strip confront the curved portions in the other strip of that pair to form relatively small openings **108**. Upon insertion of a pin or wire end into an opening **108**, the strips **100** and **102** are forced apart, the compliant material **104** maintaining pressure on the strips to grip the pin or wire end. In practice, it has been found that rubber or resilient plastics such as polyvinyl chloride are particularly suitable for the compliant mass **104**.

It is apparent that an unskilled technician is capable of constructing electrical devices of considerable complexity by use of the construction device here disclosed since the circuit diagram of the template assures proper circuit connections. It is also apparent that electrical devices of an experimental or temporary nature can be very readily and more rapidly constructed with the construction device here disclosed than in the manners known prior to the present invention. Further, permanent equipment can be constructed with a construction device of the type here disclosed by providing permanent anchoring means for the contact members **26**. One type of permanent anchoring means for the contact members **26** constitutes an electrically conducting cement which may fill the cavities **12** or simply be disposed within the openings **108** of the curved portions of the strips **100** and **102**, this cement being shown at **110** in FIGURE 8. After construction, the electrically conducting cement hardens and permanently secures the pins and wire ends in position.

Those skilled in the art will readily devise many further and additional devices utilizing the present invention and many modifications employing the present invention. It is, therefore, intended that the present invention be not limited by the foregoing disclosure, but rather only by the appended claims.

The invention claimed is:

1. A device for interconnecting electrical components comprising a body of electrically insulating material having a face surface and a plurality of elongated cavities within the body adjacent to the face surface, the longitudinal axes of said cavities being disposed parallel to the face surface of the body in a plurality of parallel rows, a plurality of cavities being disposed in each row, an elongated electrically conducting contact member disposed in each cavity with its longitudinal axis parallel to the longitudinal axis of the cavity, said contact member being provided with at least one pair of confronting jaws disposed adjacent to the face surface, the jaws of said pair being disposed on opposite sides of and parallel to the longitudinal axis of the contact member, and spring bias means for forcing the pair of jaws into abutment, said body having an opening extending between each cavity and the face surface of the body confronting each of the jaws, whereby an electrical component having a plurality of pin-shaped terminal members may be mounted on the body by disposing each terminal member between a pair of jaws of a different contact member and electrical connection may be achieved between the terminal members of said electrical component and other electrical components by disposing the pin-shaped terminal members of the other electrical components in the same contact member engaging the terminal member of said electrical component.

2. A device for interconnecting electrical components comprising the elements of claim 1, wherein the contact member is provided with a plurality of jaws extending from the base toward the face surface in confronting pairs, each pair of said jaws being adapted to engage a pin-shaped terminal member.

3. A device for interconnecting electrical components comprising the elements of claim 2 wherein the pairs of jaws of each clip member are disposed on a straight line and a single opening extends between the face surface of the body and each pair of jaws.

4. A device for interconnecting straight wire-shaped terminal members of electrical components comprising the elements of claim 1 wherein the flat sheet is constructed of transparent material in combination with a template removably secured to the surface of the sheet opposite the face surface, said template having a schematic circuit diagram thereon confronting the face surface of the sheet.

5. A device for interconnecting straight wire-shaped terminal members of electrical components comprising the elements of claim 1 in combination with an adapter for a component having a plurality of parallel lugs including a flat board having a plurality of straight wire-shaped electrically conducting pins spaced from each other to enter openings of different cavities, a socket mounted on said board having an electrically conducting gripper adapted to engage each lug of the component and having an electrically conducting strip electrically interconnecting each lug and one of the pins.

6. A device for electrically interconnecting wire-shaped terminal members comprising, in combination, a flat sheet of electrically insulated material having a face surface and a plurality of elongated cavities disposed therein adjacent to the face surface, said cavities being disposed with their axes of elongation in a plurality of parallel rows with the axes of elongation of each cavity on the axis of a row, each row having a plurality of cavities therein, and the cavities in each row being spaced from each other, said sheet having a plurality of spaced openings between the face surface and each cavity, the openings confronting a given cavity being disposed on an axis parallel to the axis of elongation of the cavity, a contact member disposed in each cavity having an elongated electrically conducting base with its axis of elongation disposed parallel to the axis of elongation of the cavity, said contact member having a plurality of pairs of electrically conducting jaws extending from the base, the jaws of each pair being disposed on opposite sides of the axis of elongation of the contact member and confronting one of the openings in the face surface, whereby a wire-shaped terminal member may be inserted into a given cavity through one of the openings and electrically interconnected with other wire-shaped terminal members inserted into said cavity through other openings.

7. A device for electrically interconnecting wire-shaped terminal members comprising the elements of claim 6 in combination with an adapter havin a flat board, a plurality of parallel straight electrically conducting pins mounted on said board and extending normally therefrom, the pins mating with openings of different cavities, and an electrical component mounted on said adapter board and having a plurality of electrically conducting terminal lugs, each of said terminal lugs being electrically connected to one of the pins of said board.

8. A device for electrically interconnecting wire-shaped terminal members comprising the elements of claim 6 wherein the distance between the axes of the rows of

cavities is greater than the distance between the openings in the face surface communicating with a given cavity.

9. An electrical device comprising, in combination, a plurality of electrically conducting elongated contact members, each having a plurality of jaws extending from an electrically conducting base in confronting pairs, the jaws of each pair abutting each other, means for mounting the contact members in a common plane with the axes of elongation of the contact members disposed in a plurality of parallel rows, each row having a plurality of spaced contact members therein and electrically insulated from each other, means defining a thin sheet of electrically insulating material disposed parallel to the plane of the contact members and adjacent to the contact members, said plane having an opening confronting each pair of jaws of each contact member, a plurality of electrical components disposed at the side of the sheet opposite the contact members, each component having two wire-shaped terminal members extending through different openings in the sheet and being engaged by a pair of jaws of two different contact members, a plurality of contact members engaging terminal members of more than one electrical component to connect the components in an electrical circuit.

10. An electrical device, comprising the elements of claim 9 wherein the means for mounting the contact members in a common plane and the means defining a thin sheet of electrically insulating material are constructed of transparent material, in combination with means for mounting a template on the means for mounting the contact members generally parallel to the flat sheet, whereby a template having instructional material may be mounted on the assembly.

11. An electrical device comprising the elements of claim 9 wherein each contact member is provided with a plurality of jaws extending from a base toward the flat sheet in confronting pairs, each pair of said jaws being adapted to engage a wire-shaped terminal member, and the flat sheet being provided with a separate opening confronting each pair of jaws of each contact member, the openings looesly engaging the wire-shaped terminal members of the electrical components.

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