June 20, 1967 O. I. THOMPSON 3,327,173

DEVICE FOR CONSTRUCTING ELECTRICAL APPARATUS

Filed Oct. 9, 1963 4 Sheets-Sheet 1

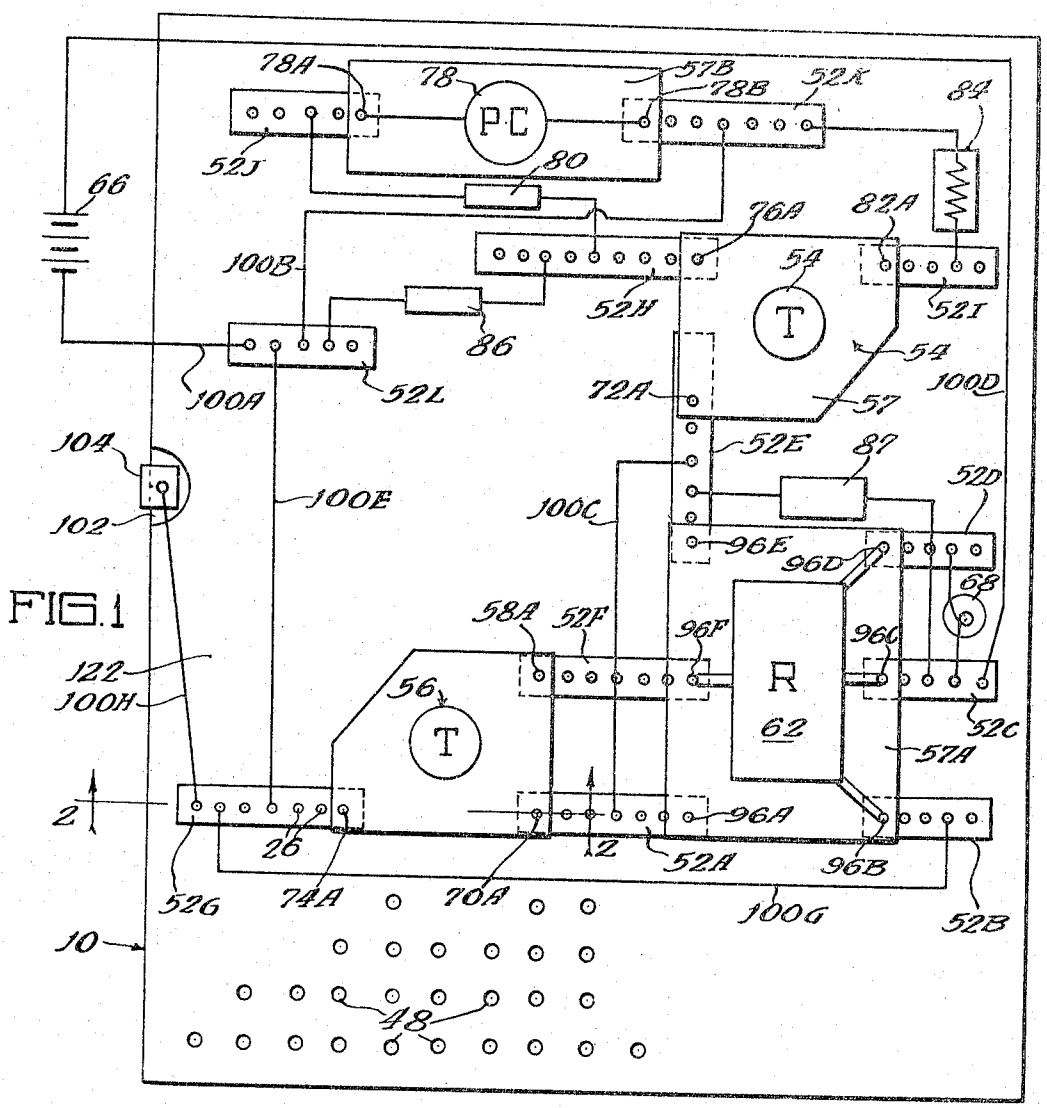


FIG. 1

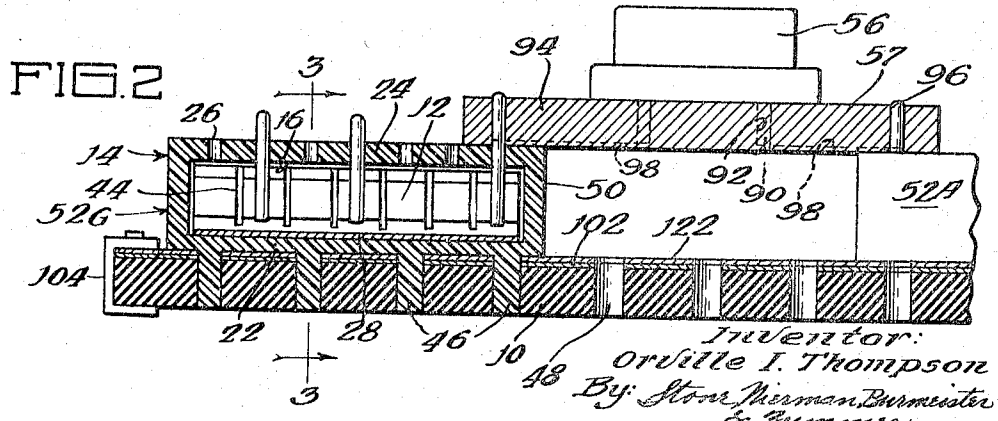


FIG. 2

Inventor:
Orville I. Thompson
By: Stone, Sherman, Burmeister & Zemmer
Attorneys

June 20, 1967 O. I. THOMPSON 3,327,173

DEVICE FOR CONSTRUCTING ELECTRICAL APPARATUS

Filed Oct. 9, 1963 4 Sheets-Sheet 2

FIG. 3

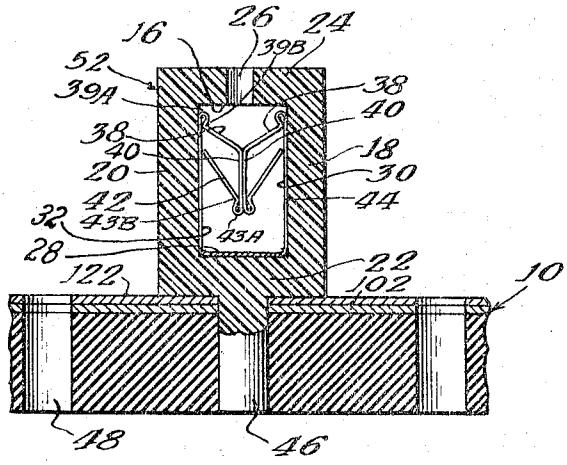


FIG. 4

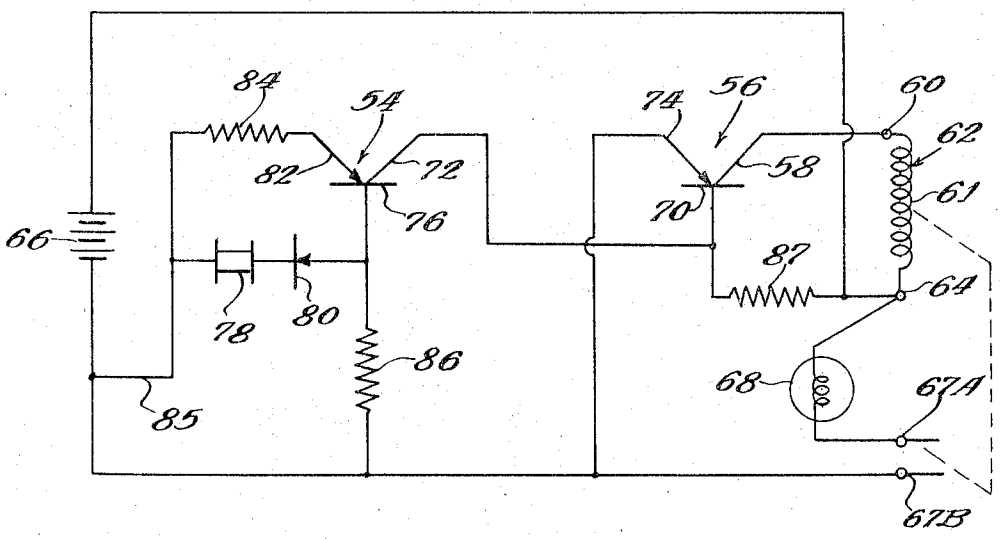
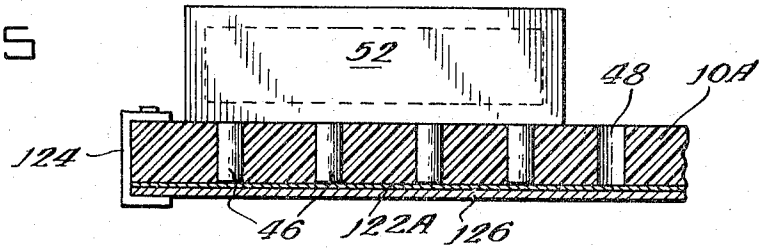


FIG. 5



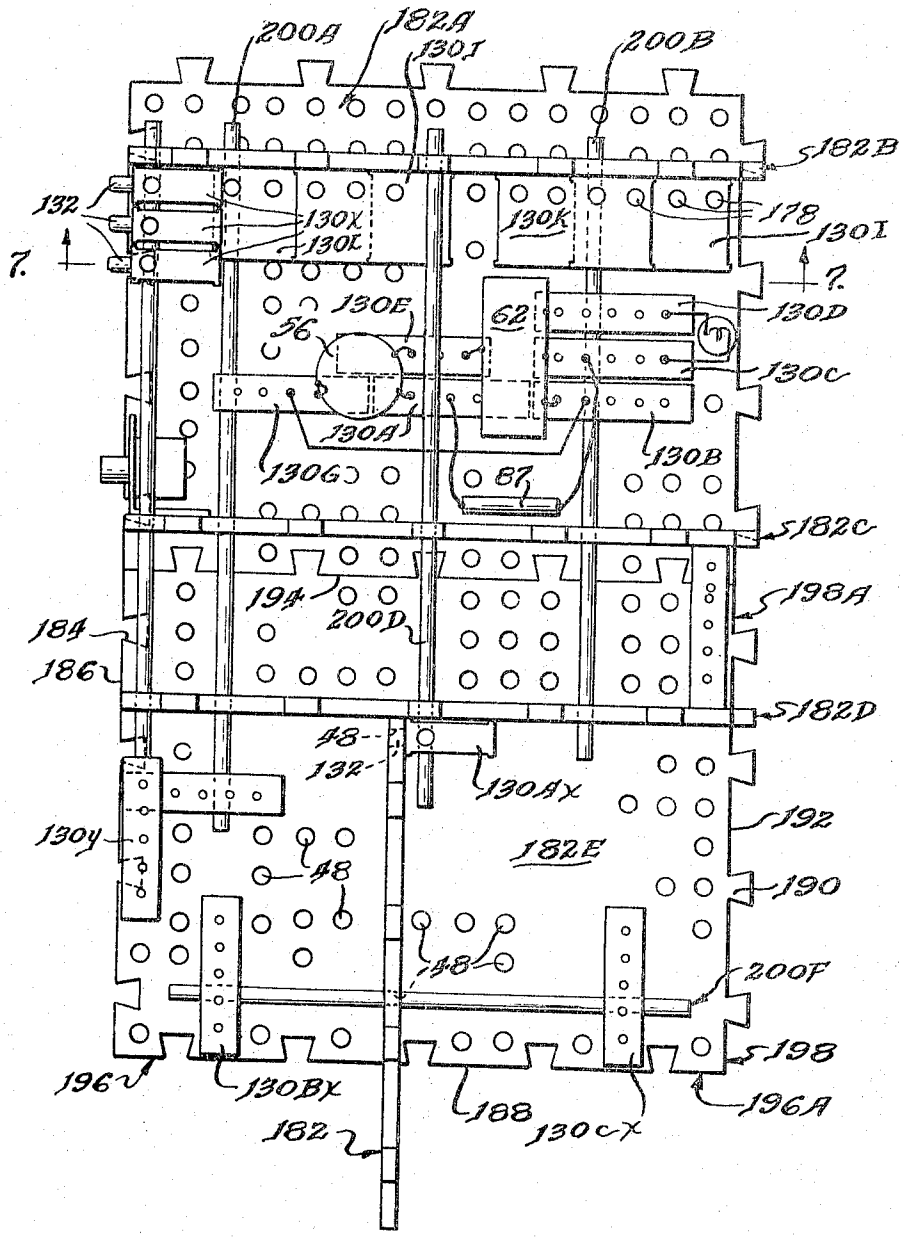
Inventor:
Orville I. Thompson
By: Stone, Nierman, Burmeister & Zummer
Attorneys

June 20, 1967 O. I. THOMPSON 3,327,173

DEVICE FOR CONSTRUCTING ELECTRICAL APPARATUS

Filed Oct. 9, 1963 4 Sheets-Sheet 3

FIG. 6



Inventor
By: Orville I. Thompson
Attorneys

June 20, 1967 O. I. THOMPSON 3,327,173

DEVICE FOR CONSTRUCTING ELECTRICAL APPARATUS

Filed Oct. 9, 1963 4 Sheets-Sheet 4

FIG. 7

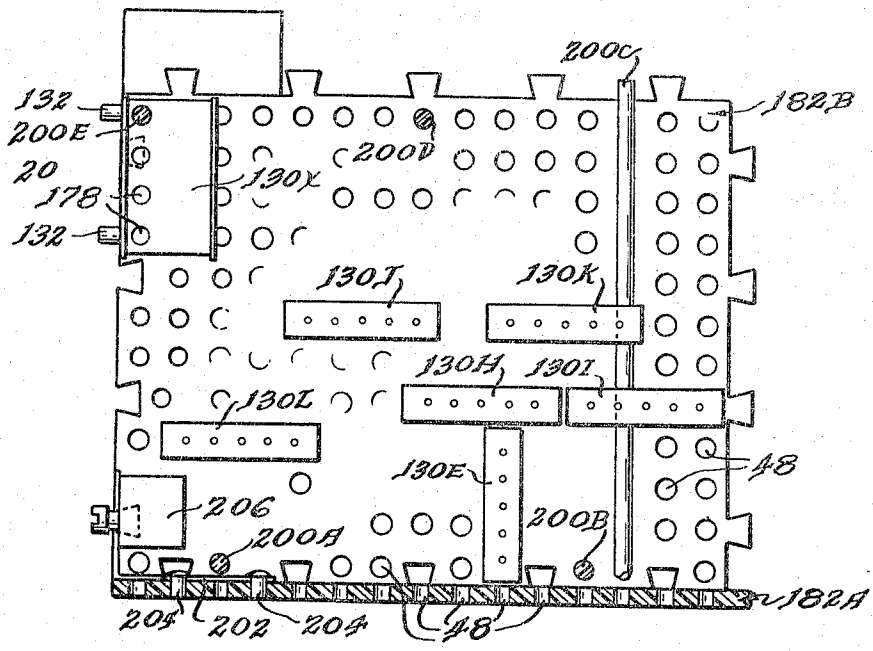


FIG. 8

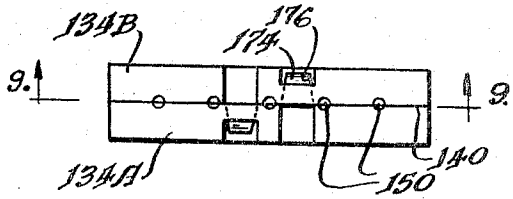


FIG. 9

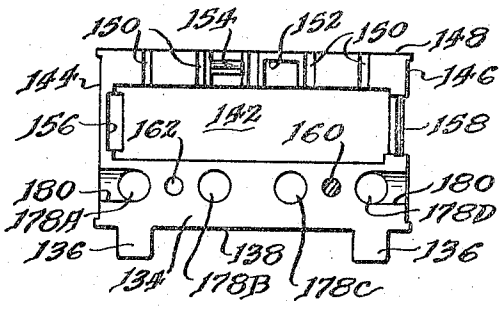
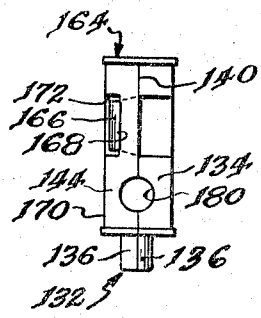


FIG. 10



Inventor
Orville I. Thompson
By: Stone, Pierce & Brumbaugh
Attorneys

United States Patent Office 3,327,173 Patented June 20, 1967

3,327,173
DEVICE FOR CONSTRUCTING ELECTRICAL APPARATUS

Orville I. Thompson, Deerfield, Ill., assignor, by mesne assignments, to Bell & Howell Company, a corporation of Illinois

Filed Oct. 9, 1963, Ser. No. 314,968
15 Claims. (Cl. 317—101)

This application is a continuation-in-part of Patent No. 3,011,269 entitled Electronic Construction Device, filed Sept. 24, 1958, Patent No. 3,043,021 entitled, Electronic Constructing Device, filed Nov. 19, 1958, Patent No. 3,085,177 entitled, Device for Facilitating Construction of Electrical Apparatus, filed July 7, 1960, Patent No. 3,205,407, entitled, Device for Constructing Electrical Apparatus, filed Mar. 5, 1962, and Patent No. 3,199,065 entitled, Electrical Contact Device, filed Apr. 28, 1961.

The present invention relates generally to devices for facilitating construction of electrical equipment, and particularly to supporting structures for electrical apparatus of the bread board or temporary type.

Patent No. 3,085,177 of the present inventor, filed July 7, 1960, entitled, "Device for Facilitating Construction of Electrical Apparatus," discloses a board of electrically insulating material which is provided with a plurality of spaced cavities which contain elongated jaw type contact members. In the device disclosed in Patent No. 3,085,177, electrical contact may be achieved between two or more conductors by inserting the conductors through openings into a single cavity of the multicavity board, each conductor thereby engaging a common contact member. Components are mounted on the board by the electrical terminals of the component in the form of prongs or pins mounted on the component. The cavities are spaced so that each of the prongs or pins of a component may enter a different cavity, thereby providing a separate contact member for electrical connection to each of the prongs of the component.

It is an object of the present invention to provide a board and contact member assembly for constructing electrical apparatus which has greater flexibility than the devices heretofore known to the art.

It is a further object of the present invention to provide a contact unit which contains an electrical contact member disposed within an electrically insulating housing and which is readily mountable on a mounting board or on a similar mating contact unit by a common mounting element.

It is a further object of the present invention to provide a plurality of contact units having mounting elements and a mating flat board which may support the contact units on both sides thereof.

It is a further object of the present invention to provide a plurality of flat boards and mating contact units which may be utilized to mount one flat board on another.

Another object of the present invention is to provide a foundation structure for an electrical device employing a board and electrical contact units which permit the circuit components to be assembled on the board in three dimensions.

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 an electrical device constructed by means of a board and contact members in accordance with the teachings of the present invention;

FIGURE 2 is a fragmentary sectional view taken along the line 2—2 of FIGURE 1;

FIGURE 3 is a sectional view taken along the line 3—3 of FIGURE 2;

FIGURE 4 is a schematic electrical circuit diagram of the electrical device illustrated in FIGURE 1;

FIGURE 5 is a fragmentary sectional view of a further embodiment of the present invention;

FIGURE 6 is a plan view of another embodiment of the present invention utilized to construct the same electrical device illustrated schematically in FIGURE 4;

FIGURE 7 is a sectional view taken along the line 7—7 of FIGURE 6;

FIGURE 8 is an enlarged plan view of one of the contact units illustrated in FIGURES 6 and 7;

FIGURE 9 is a sectional view of the contact unit of FIGURE 8, the electrical contact having been removed; and

FIGURE 10 is an end elevational view of the contact unit illustrated in FIGURES 6 through 9.

The embodiment of the invention illustrated in FIGURES 1, 2 and 3 employs a perforated board of electrically insulating material of the type generally referred to as a pegboard, designated **10**. The board **10** is a commercially available board and may be obtained in a wide range of sizes and shapes. A plurality of contact members **12** are mounted on this board **10** by means of a casing **14** which surrounds the contact member.

The casing **14** is best illustrated in FIGURES 2 and 3, and is constructed of electrically insulating material, such as polyethylene plastic. The casing **14** is in the form of an elongated quadrangular bar with an elongated quadrangular cavity **16** disposed therein. The casing **14** has a pair of parallel side walls **18** and **20**, a bottom wall **22**, and a top wall **24**. The walls **18** and **20**, **22** and **24** form the cavity **16**, which is rectangular in shape. The top wall **24** has a plurality of apertures **26** arranged in a line confronting the axis of elongation of the casing **14**. The contact member **12** is disposed within the cavity **16** of the casing and is adapted to receive pins or prongs and contact wires inserted into the cavity through the apertures **26**. The contact member **12** is preferably of the type disclosed in patent application Serial No. 41,290, entitled "Device for Constructing Electrical Apparatus," and patent application Serial No. 106,225 entitled "Electrical Contact Device" of the present inventor. Other types of contact members, such as that disclosed by Hoberg in Patent No. 2,922,135, are also suitable.

As illustrated in FIGURES 2 and 3, the contact member **12** is constructed of resilient electrically conducting material, such as copper coated spring steel, and is fabricated from a flat sheet of this material. The contact member **12** has a flat base **28** which is disposed on the surface of the bottom wall **22** of the casing **14**. A pair of walls **30** and **32** extend from the base **28** of the contact member **12** and are spring biased outwardly to engage the parallel side walls **18** and **20** of the casing **14**. The edge of the walls **30** and **32** of the contact member **12** opposite the base **28** thereof connect with a leaf portion **38** by means of 180 degree bends **39A** into the cavity and reverse bends **39B** of less than 90 degrees. The leaf, or face portions of the contact member extend toward the center of the cavity **16**, and at approximately the center thereof are bent at right angles to the flat base **28** and extends toward the base **28**, this section of the leaf portion being designated **40**. The leaf portion **38** attached to the wall **30** and the leaf portion **38** attached to the wall **32** abut each other in the sections **40** thereof, referred to as flat strip portions, and a terminating support portion **42** extends from the end of the flat strip portion **40** confronting the base **28** to abut the wall **30** or **32** in order to aid in spring biasing the flat strip portions **40** toward each other. Support portions **42** are connected to the flat strip portions **40** by a

bend 43A of approximately 180 degrees and a bend 43B of less than 90 degrees.

The contact member 12 has a longitudinal axis slightly less than the axis of elongation of the cavity 16, and is provided with slots 44 (FIGURE 2) 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 apertures 26 confronting the cavity 16 so that each aperture immediately confronts one pair of abutting portions 38 of the contact member 12, or one pair of jaws.

Each casing 14 has at least one peg 46 extending normally from the bottom wall 22 on the side thereof opposite the contact member 12. These pegs 46 removably but snugly engage the perforations 48 in the pegboard 10. In conventional pegboards, the perforations 48 are disposed along normally intersecting lines at equal distances from each other, as illustrated in FIGURE 1. Accordingly, the pegs 46 of a given casing 14 are disposed on a common line and spaced from each other by the same distance as the spacing between perforations of the board 10. As illustrated, the casing 14 is provided with four pegs 46 which extend normally from the wall 22 thereof at equal distances in common line, although it is to be understood that the casing 14 may contain more or fewer pegs 46, and may even contain pegs oriented along lines disposed normal to each other or two or more parallel lines. Further, the casing 14 is provided with pegs extending normally only from the bottom wall 22, and pegs may also be provided to extend normally from the side walls 18 or 20, or from the ends thereof, designated 50.

The contact member 12 and its associated casing 14 may be referred to as a contact unit, designated 52, and a plurality of contact units are employed with a pegboard 10 and circuit components and connecting links to form an electrical device. FIGURE 1 illustrates such a device, and is merely exemplary of what can be accomplished by means of pegboards 10 and contact units 52. In FIGURE 1, eleven contact units are mounted on a conventional pegboard 10, and by means of connecting links, components, and adaptors, form a photocell excited transistor switching circuit. It is to be understood that the present invention may be practiced with other electrical circuits in order to assemble and construct virtually any type of electrical device, such as a receiver, amplifier, oscillator, trigger circuit, battery charger, power supply, and the like.

The schematic electrical circuit diagram of FIGURE 4 illustrates the circuit of the photocell switching device shown in FIGURE 1. The circuit uses two transistors 54 and 56 connected in an amplifier and a grounded emitter switching circuit, respectively. The transistor 56 of the switching circuit has a collector 58 connected to one terminal 60 of the coil 61 of a relay 62. The other terminal 64 of the coil 61 is connected to the positive terminal of a power source 66. The relay 62 has a pair of switch contacts 67A and 67B, and one of the switch contacts 67A is connected to the terminal 64 of the coil 61 through a lamp 68. The other contact 67B is connected to the negative terminal of the power source 66.

The transistor 56 also has a base 70 which is connected to the collector 72 of the transistor 54. The transistor 56 has an emitter 74 which is connected to the negative terminal of the power source 66.

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. A resistor 86 is connected between the negative terminal of the power source 66 and the base 76 of the transistor 54. A resistor 87 is connected between the collector 72 and the terminal 64 of the relay 62.

In the physical construction of the photocell switching circuit illustrated in FIGURES 1 and 2, each of the transistors 54 and 56 is mounted on an adaptor. The transistors are provided with depending lugs 90 which extend through apertures 92 in a thin board 94 of electrically insulating material, such as fiberboard or Bakelite. 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 of the transistor by an electrically conducting strip 98. The pins 96 are illustrated as positioned adjacent to the corners of the board 94, although due to the versatility of the apparatus of the present invention it is not necessary that the pins be so located. It is also to be understood that the transistors 54 and 56 may be mounted in sockets which are affixed to the board 94, so that the transistor may be replaced. FIGURES 4 and 6 of the application Serial No. 41,290 of the present inventor disclose such a construction. Further, it is to be recognized that other components in addition to transistors may be mounted on adaptor boards of the type here disclosed, such components including coils, relays, vacuum tubes, and other elements which are not provided with pigtails or which possess excessive weight for adequate support by the provided pigtails.

FIGURE 1 illustrates a relay mounted on an adaptor board designated 57A. This board is provided with six contact units designated 52A, 52B, 52C, 52D, 52E and 52F which support the relay 62 and provide the means for electrical contact with the coil 61 and contacts 67A and 67B. The coil 61 is electrically connected to a pin 96C which is mounted on contact unit 52C. The coil 61 is also connected electrically to the pin 96F which is mounted on the contact unit 52F. The contact 67B is electrically connected to the pin 96B which is mounted on the contact unit 52B. The contact 67A is electrically connected to the pin 96D which is mounted on the contact unit 52D.

Each of the contact units 52A, 52B, 52C, 52D, 52E, and 52F have their pegs 46 securely disposed within perforations 48 in the pegboard 10, thereby providing adequate support for the relay. Further, the contact units 52A and 52F are utilized in mounting the transistor 56. The collector 58 of the transistor 56 is connected to a pin 58A which is mounted on the contact unit 52F, and the base 70 of the transistor 56 is electrically connected to a pin 70A which is mounted on the contact unit 52A. The third element of the transistor 56 is the emitter 74 which is connected to a pin 74A, and the pin 74A is mounted on a contact unit 52G.

In addition to the contact unit 52E, described above, the transistor 54 is mounted on two contact units 52H and 52I. The base 76 of the transistor 54 is electrically connected to a pin 76A which is mounted on the contact unit 52H, while the emitter 82 of the transistor 54 is connected to a pin 82A which is mounted on the contact unit 52I.

Two contact units 52J and 52K are utilized to mount the photocell 78. The photocell 78 is mounted on an adaptor plate 57B which contains two pins 78A and 78B, and the pin 78A is mounted on the contact unit 52J while the pin 78B is mounted on the contact unit 52K. There is an additional contact unit 52L which is utilized for mounting electrical conductors and the pigtails of the resistor 86.

It will be seen from comparing FIGURES 1 and 4, that the apparatus illustrated in FIGURE 1 employs the circuit schematically illustrated in FIGURE 4. The negative terminal of the power source, or battery 66, is connected to the contact unit 52L by an electrical conductor 100A and the resistor 86 extends from the contact unit 52L to the contact unit 52H, thereby making electrical contact to the base 76 of the transistor 54. One pigtail of the diode 80 is mounted on the contact units 52H, and the other pigtail of the diode 80 is mounted on the contact unit 52J, there-

by connecting the diode **80** in series with the photocell **78**. The pin **78B**, which is mounted on the contact unit **52K** and connected to the photocell **78**, is connected to the negative terminal of the battery **66** by means of a conductor **100B** which extends between the contact units **52K** and **52L**. The resistor **84** is also connected to the contact unit **52K** and to the contact unit **52I**, thereby connecting the resistor **84** between the negative terminal of the power source and the emitter of the transistor **54**. The collector **72** of the transistor **54** is connected to the base **70** of the transistor **56** by an electrical conductor **100C** which extends between the contact unit **52E** and the contact unit **52A**. It is to be noted that both of these contact units provide support for the relay **62**, but pins **96A** and **96E** of the relay **62** are not connected to electrical elements of the relay. The collector **72** of the transistor **54** is also connected to the positive terminal of the power source by means of the resistor **87** mounted between the contact unit **52E** and the contact unit **52C**, an electrical conductor **100D** connecting the positive terminal of the power source **66** to the contact unit **52C**.

The collector **58** of the transistor **56** is directly connected to one end of the coil **61** of the relay **62** by the contact unit **52F**. The emitter **74** of the transistor **56** is connected to the negative terminal of the power source **66** by an electrical conductor **100E** which extends between the contact unit **52L** and the contact unit **52G**. An electrical conductor **100G** extends between the contact unit **52G** and the contact unit **52B** to connect the negative terminal of the power source to one of the contacts **67B** of the relay **62**. The lamp **68** is directly mounted between the contact units **52C** and **52D**.

A coating **102** of electrically conducting material is disposed on the board **10** to form an electrostatic shield, as shown in FIGURE 2. This coating **102** is preferably in the form of a silver film which will not materially change the diameter of the perforations **48** of the board **10**. The coating **102** may also be provided by an electrically conducting foil, such as copper, which is cemented or otherwise secured to the surface of the board **10**. This foil is preferably connected to a fixed potential in the circuit, such as the negative terminal of the battery **66**. For this purpose, a clip **104** is mounted about the perimeter of the board, and an electrical conductor **100H** extends between the clip **104** and the contact unit **52G**. Because of the fact that the only contact of the electrical components to the board **10** is through the casing **14** of the contact units, the electrically conducting layer **102** will not complicate the wiring of the electrical circuit.

It is often desirable to provide circuit diagrams, either of the schematic type illustrated in FIGURE 4, or of a symbolic type which may appear substantially identical to that shown in FIGURE 1, to aid the technician constructing the electrical device. This is particularly true if the technician is a student undertaking a course of training in electrical circuits and the like. FIGURES 1 through 3 illustrate such a diagram plate **122** mounted between the metal coating **102** and the casing **14** of the contact units **52**. In order to permit the pegs **46** of the contact units to extend into the perforations **48** of the board **10**, the diagram **122** must also be perforated. By perforating the diagram **122** only in the proper locations, the diagram will be maintained in its proper position on the board and the student will be required to mount the contact units **52** in the proper locations. It is of course to be understood that it is not necessary to employ a metal layer **102**, and the diagram **122** may be disposed in immediate contact with the perforated board **10**.

FIGURE 5 illustrates a construction in which the circuit diagram, which may be either schematic or symbolic, is positioned beneath the board and viewed through the board. In the construction of FIGURE 5, the board **10A** is transparent, but otherwise identical to the board **10** illustrated through FIGURES 1, 2, and 3. The board may be constructed of transparent plastic, such as polyethylene, and contains the same perforations **48** illustrated in FIGURE 1. Also, the same contact units illustrated in FIGURES 1 through 3 are employed in the embodiment of FIGURE 5, the pegs **46** extending into the pegboard **10A**, but not beyond the surface of the board remote from the casing **14** of the contact units **52**. The diagram, which is identical to the diagram disclosed in the embodiment of FIGURES 1 through 3 except it is not perforated, carries the reference numeral **122A** and is positioned in abutment with the surface of the board **10A** opposite the contact units **52**. The diagram is of sufficient stiffness to be maintained in position by a plurality of U-shaped clamps **124** positioned at intervals about the perimeter of the board **10A**. If of insufficient strength, the diagram may be provided with a backing board **126** which provides the desired structural rigidity. The backing board **126** is of identical size and shape as the perforated board **10A** and the diagram **122A**, and is positioned on the side of the diagram **122A**, remote from the board **10A**. The backing board **126** is preferably constructed of electrically conducting material, since the metal foil or layer positioned between the board and the contact units **52** cannot be used in this construction due to the fact that such foils are opaque. When the backing board **126** is constructed of electrically conducting material, the U-shaped clamps **124** should also be constructed of electrically conducting material, and at least one of the clamps should form the function of the clamp **104** disclosed in FIGURE 1, that is, provide an electrically conducting link to a fixed potential point in the circuit to provide an effective ground.

FIGURES 8, 9, and 10 set forth a modified form of contact unit. This contact unit, designated **130**, is designed for use on a pegboard, such as the pegboard of FIGURE 1, or the pegboards illustrated in FIGURES 6 and 7, and has a pair of depending pegs **132** which are cylindrical in shape and spaced between central axes by a distance equal to a multiple of the distance between centers of adjacent perforations in the mounting board **10**; in the particular construction, a distance equal to three times the spacing between adjacent holes so that the pegs **132** are adapted to engage every fourth hole of the peg board **10**. The contact unit **130** has a casing **134** which is elongated and formed of two mating identical sections **134A** and **134B**. One of the sections **134B** is illustrated in FIGURE 9. Each of the sections **134A** and **134B** is formed of a flat rectangular slab of electrically insulating plastic material, and since these slabs are identical the reference numeral **134** has been assigned thereto. A pair of spaced semi-cylindrical stubs **136** extend outwardly from one of the elongated edges **138** of the slab **134**, each of the stubs having a flat surface coincident with one of the flat surfaces of the slab, designated **140**. These stubs **136** have their central axis spaced by a distance equal to a multiple of the distance between adjacent perforations of the peg board **10** to form the pegs **132**.

The slab **134** also has a rectangular recess **142** which extends inwardly from the surface **140** along an axis parallel to the edge **138**. The recess **142** terminates at a small distance from each of the ends **144** and **146** of the slab, and is also disposed parallel to the flat surface **148** opposite and parallel to the surface **138**. A plurality of semi-cylindrical grooves **150** extend from the surface **148** to the recess **142** and are disposed in the surface **140** of the slab **134**. The semi-cylindrical grooves **150** are disposed normal to the surface **148**.

In the embodiment illustrated, five semi-cylindrical grooves **150** are disposed in the surface **140**, and a rectangular orifice **152** extends from the surface **140** through the slab **134** between the central channel **150** and the channel **150** shown at the right side thereof in FIGURE 9. In like manner, a tab **154** extends outwardly from the surface **140** and normal to said surface between a central groove **150** and the groove illustrated in FIGURE 9 to the left of the central groove. A second rectangular aperture

156 extends through the slab 134 normal to the surface 140 and adjacent but spaced from the end 144. This orifice 156 partially extends through the recess 142 and has a longitudinal axis parallel to the end 144. A second tab 158 extends outwardly from the surface 140 adjacent to the end 146 and spaced from the surface 138 by a distance equal to the spacing of the orifice 156 from said surface. A cylindrical pin 160 extends normally from the surface 140 in the portion of the slab 134 between the recess 142 and the edge surface 138. A cylindrical bore 162 extends through the slab 134 in the same portion between the recess 142 and the edge surface 138, in a direction normal to the surface 140, and the pin 160 and bore 162 are spaced the same distance from the edge surface 138. The pin 160 is spaced from the end surface 146 by the same distance the bore 162 is spaced from the end surface 144.

Two slabs are assembled into a single casing or body designated 164 for the contact 130. The pin 160 of one slab 134A is disposed within the bore 162 of the other slab 134B in a snug fashion. The tab 158 of one slab 134A is disposed within the orifice 156 of the other slab 134B. In the like manner, the tab 158 of the slab 134B is disposed within the orifice 156 of the slab 134A. Also, the tab 154 of the slab 134A is disposed within the orifice 152 of the slab 134B and the tab 154 of the slab 134B is disposed within the orifice 152 of the slab 134A. The end wall 144 has a recess 166 which communicates with the orifice 156 and provides a flat surface 168 parallel to the side wall 170 of each of the slabs 134A and 134B, and the tab 158 is provided with a flange 172 which extends from the tab 158 normally and toward the surface 146. The flange 172 thus engages the flat surface 168 to secure the two slabs 134A and 134B together. In like manner, the slabs 134A and 134B are provided with a recess 174 in the surface 148 remote from the surface 140 which communicates with the aperture 152, and the tab 154 is provided with an outwardly extending flange 176 which engages the surface of the recess 174. Engagement of the tabs 154 and 158 with the flat surfaces of the mating slab and engagement of the pins 160 with the bores 162 of the mating slabs maintains the two slabs 134A and 134B in engagement, and forms a cavity within the body 164 as a result of the confronting recesses 142. An electrically conducting contact member, which may be identical to the contact member 12 of the embodiment of FIGURES 1 through 5 is disposed within the cavity formed by the recesses 142 and adapted to engage pins or wires disposed into the channels formed by the mating semi-cylindrical grooves 150.

The body 164 of the contact unit 130 is provided with four equally spaced channels 178A, 178B, 178C, and 178D which extend normal to the surface 140 through the region of both slabs 134A and 134B disposed between the recess 142 and the surface 138. The diameter of these channels is slightly larger than the diameter of the pegs 132 so that a peg may be inserted into any one of the channels 178A, 178B, 178C, and 178D and be held in engagement. In like manner, the diameter of the channels is equal to the diameter of the perforations 48 of the Peg Board. Also, a cylindrical channel 180 extends from each of the end surfaces 144 and 146 into the adjacent channel 178A and 178D, respectively. These channels 180 are also equal in diameter to the diameter of the perforations 48 of the Peg Board and adapted to receive pegs 132 of other contact units 130.

The contact units 130 may be utilized with the board 10 illustrated in FIGURES 1 through 3, but preferably are utilized with the board construction as illustrated in FIGURES 6 and 7. In FIGURE 6, five identical perforated boards designated 182A, 182B, 182C, 182D, and 182E are shown mounted in an assembly, although it is to be understood that the present invention may be practiced with any number of boards of this construction, and the boards may be mounted in a virtually limitless number of configurations.

Each of the boards is rectangular in shape and has a plurality of spaced indentations 184 extending therein from two of the sides designated 186 and 188. The other two sides are provided with a plurality of spaced protruding tabs 190, and these sides are designated 192 and 194. As illustrated, there are fifteen rows of equally spaced perforations, designated 48 disposed on axes parallel to the sides 186 and 192, and these perforations 48 are disposed in twelve equally spaced parallel rows parallel to the sides 188 and 194. The row of perforations parallel to the side 186 and immediately adjacent thereto, designated 196 is spaced from the side 186 by a distance equal to one-half the distance between adjacent rows parallel to said side 186, and the same relationship holds true for the row of perforations 196A disposed adjacent to the side 192. Further, the distance between the center of the perforations 48 in the rows 196 and 196A and the adjacent edges 186 and 192 of the boards 182 is the same as the distance between the surface 138 and the center of the channels 178A, 178B, 178C, and 178D of the contact units 130. Also, the distance between the channels 178A and 178B, as well as the distance between other adjacent channels, of the contact units 130 is identical to the distance between perforations 48 in the rows on the boards 182. In like manner, the perforations 48 in the rows 198 and 198A which are disposed parallel to the edges 188 and 194 of the boards 182 are spaced by a distance equal to one-half of the distance between adjacent perforations in any given row and one-half the distance between the channels of the contact units 130.

The tabs 190 and recesses 192 are designed to mate, and are spaced at equal intervals along the edges of the boards. The end tabs on each side 192 and 194 are spaced from the corners of the board by a distance equal to one-half the distance between centers of the tabs, and the end perforations on the edges 186 and 188 are likewise spaced by a distance equal to one-half the distance between indentations. In this manner, the boards 182A and 182E have been meshed together by disposing the tabs 190 of the board 182E within the mating indentations 184 of the board 182A. Additional boards may be mounted in like manner to the edges of the boards 182A and 182E to provide a continuous flat board, similar to the board 10 of FIGURE 1.

The transistor switching circuit diagrammatically illustrated in FIGURE 4 as including the transistor 56 and a relay 62 has been constructed on the board 182A. It is to be noted that contact units corresponding to the contact units 52A, 52B, 52C, 52D, 52F, and 52G have been mounted on the board 182A and designated by the reference numeral 130 followed by the same initial employed in FIGURE 1. In like manner, the same elements employed in FIGURE 1 have been illustrated as mounted on the contact units and designated by this same reference numeral.

It is to be noted that the pegs 132 of the contact units 130 are aligned with the end channels 178A and 178B so that each of the channels 178A, 178B, 178C and 178D of the contact units 130 is aligned with a row of perforations 48 in the board 182A. A rod 200A having the same diameter as the pins 132 is disposed within the channel 178A of the contact unit 130G, and a second rod 200B of the same diameter, is disposed within the channels 178B of the contact units 130B, 130C, and 130D. In this manner, the contact units mounted on the board 182A support the rods 200A and 200B in alignment with one of the rows of perforations 48 of the board 182A. The board 182B is mounted on the board 182A by positioning the side 188 having the indentations 184 therein in abutment with the upper surface of the board 182A and positioning the rods 200A and 200B in the row of perforations of the board aligned with the rods. It is to be noted that the rods 200A and 200B are spaced from the surface

of the board 182 by a distance of one-half the distance between perforations 48, and that the first row of perforations adjacent to the edge 188 (or the edge 186 for that matter) is positioned by the same distance so that the board 182B has its edge 188 in abutment with the surface of the board 182A and the edges 186 and 192 of the board 182B are in alignment with the corresponding edges of the board 182A.

FIGURE 7 illustrates contact units mounted on the board 182A which correspond to the contact units 52E, 52I, 52H, 52K, 52J, and 52L of FIGURE 1, these units bearing the same letter after reference numeral 130. It is apparent that the circuit components including transistor 54, resistor 84, photocell 78, resistor 86, resistor 80, and battery 66 may be mounted on these contact units in the manner shown in FIGURE 1. Thus, a portion of the photocell switching circuit schematically illustrated in FIGURE 4 may be mounted on the board 182A, and a portion of this circuit may be mounted on the board 182B disposed normal thereto. In this manner, the electrical circuit may be fabricated using the third dimension to a greater extent than can be done with a simple Peg Board such as illustrated at 10 in FIGURE 1. Additional support for the board 182B, relative to the board 182A may be achieved by positioning one or more rods 200C through channels in the contact units 130I and 130K and into one of the perforations 48 of the board 182A, thereby preventing the board 182B from translating along the rods 200A and 200B.

The rods 200A and 200B are shown in FIGURE 6 to support boards 182C and 182D perpendicularly relative to the board 182A. The boards 182C and 182D may also be used to support contact units 130 and circuit components forming an electrical circuit. The boards 182C and 182D may be completely wired prior to insertion on the rods 200A and 200B so that each of the boards may simulate a card electronic assembly. In addition, rods 200D and 200E may be mounted in perforations 48 of the boards 182B, 182C and 182D remote from the board 182A to aid in maintaining the boards 182B, 182C, and 182D in parallel relation. The rod 200E is illustrated as supporting three contact units designated 130X which may be utilized in any desired manner to interconnect other electrical components. Further, the end of the rod 200E is shown supporting a contact unit 130Y by means of the channel 180 disposed in the end wall 144 of the contact unit. It is also to be noted that the pegs 132 of the contact units 130 may engage the channels 178 or 80 of other contact units, and the contact unit 130Z is illustrated in FIGURE 7 as mounted on one of the contact units 130X by means of the channel 180 thereof.

FIGURE 6 illustrates a board 182F mounted on the board 182E perpendicularly thereto and on the board 182D perpendicularly thereto. A contact member 130AX is mounted on the end of the rod 200D and the pegs 132 of the contact member 130AX engage perforations of the board 182F. A rod 200F is disposed normal to the board 182F and passes through a perforation 48 thereof, and the rod 200F is anchored to the board 182E by means of contact members 130BX and 130CX which have pegs 132 disposed within perforations 48 of the board 182E. This freely standing board 182F, as well as the other boards 182A, 182B, 182C, 182D, 182E are suitable to support contact units 130 on both of their parallel surfaces. Both the boards 182 and the slabs or casings 134 of the contact units are constructed of electrically insulating plastic. The boards are preferably constructed in a different color, such as red, and may be constructed of molded resilient Cycolac, or polyethylene. The contact units are also constructed of resilient plastic material such as polyethylene or Cycolac and are preferably of a contrasting color, such as white.

It is to be noted that mounting boards, such as the board 57 illustrated in FIGURE 1 may also be used with the contacts 130. In addition, brackets 202 may be mounted on the boards by means of pins 204 for supporting components such as electrical resistors of the potentiometer type or variable capacitors, designated 206.

From the foregoing disclosure, those skilled in the art will readily devise many modifications and utilities for the present invention beyond those heretofore set forth. It is therefore intended that the scope of the present invention be not limited by the foregoing disclosure, but rather only by the appended claims.

The invention claimed is:

1. A foundation structure for an electrical device comprising a board, a plurality of contact units having a casing and means mounted on the casing for electrically interconnecting two electrical conductors, each of said contact units having an opening in the casing thereof and the openings in a plurality of contact units being of the same size and shape, manually actuable means for mounting each contact unit on the board in any one of a plurality of positions, and a rod adapted to be disposed within the opening of a plurality of contact units, whereby the rod may be disposed in the openings of a plurality of contact units which are not all mounted on the board, thus forming a mounting means for any unit not mounted on the board.

2. A foundation structure comprising a plurality of flat rectangular pegboards, each pegboard having a cylindrical perforation disposed at each point of intersection between two groups of parallel equally spaced axes, one group of axes being parallel to two of the edges of the board and the other group of axes being parallel to the other two edges of the board and the distance between axes of both groups being the same, the perforations adjacent to each edge of the board being spaced from the adjacent edge by a distance equal to one-half the distance between adjacent axes, a plurality of units having a quandrangular casing and a peg extending normally from one side of the casing, said peg having a diameter approximating the diameter of the perforations of the boards and being adapted to snugly engage the perforations of the pegboards, each of said units having a cylindrical channel extending therethrough normal to the axis of the peg thereof and having the same diameter as the perforations of the pegboards, and a cylindrical rod having the same diameter as the pegs of the units, said rod being adapted to be snugly disposed within the channels of the units and the perforations of the boards to mount units on units, units on boards, and boards on boards.

3. A foundation structure comprising a plurality of flat rectangular pegboards, each pegboard having a plurality of tabs extending from two edges thereof each of, the tabs being spaced by the same distance from adjacent tabs and each of the end tabs on each edge being spaced from the adjacent edge by a distance equal to one-half the distance between tabs, each pegboard having a plurality of recesses equal in number to the number of tabs disposed on the other two edges of the pegboard, the recesses being spaced from each other by the same distance as the tabs and each of the end recesses on each edge being spaced from the adjacent edge by a distance equal to one-half the distance between tabs, each pegboard having a cylindrical perforation disposed at each point of intersection between two groups of parallel equally spaced axes, one group of axes being parallel to two of the edges of the board and the other group of axes being parallel to the other two edges of the board and the distance between axes of both groups being the same, the perforations adjacent to each edge of the board being spaced from the adjacent edge by a distance equal to one-half the distance between adjacent axes, a plurality of units having a quadrangular casing and a pair of pegs extending normally from one side of the casing, said pegs being spaced by a multiple of the distance between the adjacent

parallel axes of the pegboard and having a diameter approximately equal to the diameter of the perforations of the boards and being adapted to snugly engage the perforations of the pegboards, each of said units having a cylindrical channel extending therethrough normal to the axes of the pegs thereof and having the same diameter as the perforations of the pegboards, and a cylindrical rod having the same diameter as the pegs of the units, said rods being adapted to be snugly disposed within the channels of the units and the perforations of the boards to mount units on units, units on boards, and boards on boards.

4. A fundation structure for electrical device comprising the elements of claim 2 wherein each of the units is provided with a cavity therein and includes means for electrically connecting a plurality of electrical conductors inserted into said cavity.

5. A foundation structure for an electrical device comprising the elements of claim 3 wherein the casing of the units is constructed of electrically insulating material and is provided with an elongated cavity disposed therein parallel to the side thereof remote from the pegs, said casing having orifice means in said side remote from the pegs for admitting electrical conductors into the cavity, in combination with an elongated electrically conducting member having a pair of confronting jaws disposed adjacent to the orifice means of the casing for receiving electrically conducting pins.

6. A foundation structure comprising the elements of claim 3 wherein the casing of the unit is provided with a plurality of cylindrical channels extending therethrough normal to the axis of the pegs, said channels being parallel to each other and spaced from each other by the distance between axes of the pegboard, one of said channels being disposed on the axis of each of the pegs of the casing, thereby aligning each of the channels with one of the axes of a pegboard when the pegs of the casing engage perforations of said pegboard.

7. A foundation structure comprising the elements of claim 6 wherein each of the units is provided with a cylindrical recess having the diameter of the channels of the unit, said recess being disposed in the plane of the channels and normal to the axes of the channels.

8. A contact unit adapted to be mounted on a pegboard having perforations disposed in rows and spaced by a common distance comprising a six-walled elongated quadrangular casing of electrically insulating material provided with an elongated quadrangular cavity therein with surfaces parallel to the walls of the casing, said casing having orifice means in one of the walls of the casing adapted to receive a plurality of pins inserted into the cavity, said casing being provided with a plurality of equally spaced pegs extending from the wall of the casing opposite the wall having the orifice means, said pegs being adapted to mate with the perforations of the pegboard, an electrical contact disposed in the cavity comprising a sheet of electrically conducting resilient material having a flat base disposed in abutment with the surface of the cavity opposite the wall of the casing having an orifice means, said sheet having a pair of flat walls extending normally from the edges of the base in abutment with the confronting surfaces of the cavity normal to the orificed wall of the casing, said sheet having a flat face extending from the end of each of the flat walls adjacent to the orificed wall and disposed at an acute angle to the wall thereof, said sheet having a pair of confronting strip portions normal to the base portion and extending from the two face portions, said strip portions being aligned with the orifice means in one of the walls of the casing.

9. A contact unit adapted for mounting on a pegboard having perforations disposed in rows and spaced by a common distance comprising a six-walled elongated quadrangular casing of electrically insulating material provided with an elongated quadrangular cavity therein with surfaces parallel to the walls of the casing, said casing having a plurality of equally spaced apertures disposed along the central axis of one wall thereof, each of said apertures being adapted to receive an electrically conducting pin, an electrical contact disposed in the cavity comprising a sheet of electrically conducting resilient material having a flat base disposed in abutment with the surface of the cavity opposite the apertured wall thereof, said sheet having a pair of flat walls extending normally from the edges of the base parallel to the axis of elongation of the casing and disposed in abutment with the confronting surfaces of the cavity normal to the orificed wall of the casing, said sheet having an approximately 180 degrees bend toward the axis of the casing at the edge of each wall opposite the base and a bend in the opposite direction of less than 90 degrees disposed immediately adjacent to each of the 180 degree bends, said 180 degree bends and 90 degree bends forming two flat faces extending from the bends into the cavity of the casing, the interior edge of each of said flat faces terminating in an obtuse angle forming a strip portion disposed parallel to the wall of the sheet, the two strip portions being disposed in abutment with each other and each strip portion terminating at the ends opposite the obtuse angle in a 180 degree bend toward the walls of the sheet, said sheet having bends in the reverse direction of less than 90 degrees immediately adjacent to each of the latter 180 degree bends forming support strips which extend into abutment with the walls of the sheet, a plurality of equally spaced pegs extending from the wall of the casing opposite the apertured wall, said pegs being disposed in a common plane and adapted to mate with perforations in the pegboard.

10. A mounting assemblage for electrical devices comprising a plurality of contact units including the elements of claim 9 in combination with a pegboard having a plurality of perforations disposed on a plurality of equally spaced parallel rows, the perforations in each row being disposed on axes spaced by the same distance as the distance between rows and normal to said rows, and the distance between rows being equal to the distance between pegs of the contact units.

11. A contact unit adapted for mounting on a pegboard having perforations disposed in rows and spaced by a common distance comprising a quadrangular casing having an axis of elongation, a cavity disposed within the casing having an axis of elongation parallel to the axis of elongation of the casing, a plurality of channels in one side of the casing extending into the cavity normal to the axis of elongation thereof, an electrically conducting member disposed within the cavity having a pair of jaws confronting each channel and adapted to engage a pin inserted into the cavity, a pair of pegs extending normally outward from the side of the casing opposite the side of the channels, said pegs being spaced by a distance equal to a multiple of the common distance between perforations, and a channel extending through the casing between the cavity and the side carrying the pegs, said channel being disposed in a plane spaced from said side carrying the pegs by a distance of one-half the common distance between perforations.

12. A contact unit comprising the combination of claim 11 wherein a plurality of channels extend through the casing in said plane, each of said channels being spaced from adjacent channels by the common distance and two of the channels being on the axes of the pegs.

13. A contact unit comprising the combination of claim 11 wherein the casing is formed by two identical rectangular slabs, each of said slabs having a surface with an elongated recess disposed parallel to the axis of elongation of the slab and being provided with an orifice in said surface at one end of the recess extending through the slab and a tab protruding normally from said surface at the other end of the slab, a plurality of equally spaced grooves disposed in said surface extending normally from one

edge of the slab into the recess, said slab having a second orifice between two of the grooves extending through the slab and a second tab extending normally from said surface between two other grooves, each of said slabs having a pair of semi-cylindrical pins extending from the side thereof opposite the grooves with the flat side thereof on the plane of the surface of the slab, said casing being formed by two slabs disposed with the surfaces thereof in abutment, the first tab of each slab engaging the first orifice of the other slab and the second tab of each slab engaging the second orifice of the other slab.

14. A foundation structure for an electrical circuit comprising the combination of claim **10** in combination with a flat sheet disposed in contact with the board having a plurality of perforations aligned with perforations of the board, said sheet carrying markings on its surface opposite the board schematically diagramming an electrical device and having perforations only in locations for pegs of contact units desired for assembling the electrical device on said schematic diagrams.

15. A mounting assemblage for electrical devices comprising a board, said board being provided with a plurality of spaced perforations, a plurality of contact units, each unit having a casing of electrically insulating material provided with a cavity therein and orifice means adapted to receive the ends of a plurality of electrically conducting pins inserted into the cavity, said casing being provided with a peg extending from the casing and mating with a perforation of the board, electrically conducting means disposed within each cavity for engaging a pin inserted into said cavity and electrically interconnecting said pin with another pin inserted into said cavity, a flat sheet disposed in contact with the board having a plurality of perforations aligned with perforations of the board, said sheet carrying markings on its surface opposite the board schematically diagramming an electrical device and having perforations only in locations for pegs of contact units desired for assembling the electrical device on said schematic diagram.

References Cited

UNITED STATES PATENTS

1,841,736	1/1932	Jones	339—217
2,820,211	1/1958	Batcheller	339—258
2,885,602	5/1959	Emerson et al.	317—101
3,008,245	11/1961	Meuche	35—19
3,078,596	2/1963	Sweeton	35—19
3,085,177	4/1963	Thompson	317—101
3,199,065	8/1965	Thompson	339—149

FOREIGN PATENTS

344,668	3/1931	Great Britain.

OTHER REFERENCES

Electronic Circuit Trainer, J. Kingan, RCA TN No. 314, November 1959, sheets 1 and 2.

ROBERT K. SCHAEFER, *Primary Examiner.*

R. S. MACON, J. J. BOSCE, *Examiners.*

UNITED STATES PATENT OFFICE

CERTIFICATE OF CORRECTION

Patent No. 3,327,173 June 20, 1967

Orville I. Thompson

It is certified that error appears in the above identified patent and that said Letters Patent are hereby corrected as shown below:

Column 9, line 10, "182A" should read -- 182B --; line 64, after "182D" insert -- and --. Column 10, line 54, after "thereof" insert a comma; same line 54, after "each of" cancel the comma. Column 12, line 18, before "90" insert -- less than --; line 29, after "sheet," insert -- and --.

Signed and sealed this 20th day of January 1970.

(SEAL)
Attest:

Edward M. Fletcher, Jr.
Attesting Officer

WILLIAM E. SCHUYLER, JR.
Commissioner of Patents