

[72] Inventor **Robert L. Lovrenich**
 Novi, Mich.
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 [73] Assignee **Magnum Electric Corporation**
 Erie, Mich.

2,101,287	12/1937	Tinnerman	248/361 TF
2,581,481	1/1952	Hartman et al.	24/73 SC X
2,825,010	2/1958	Silverschotz	317/101 CC
2,968,780	1/1961	Roswell	339/17
3,404,366	10/1968	Sekerson	339/119

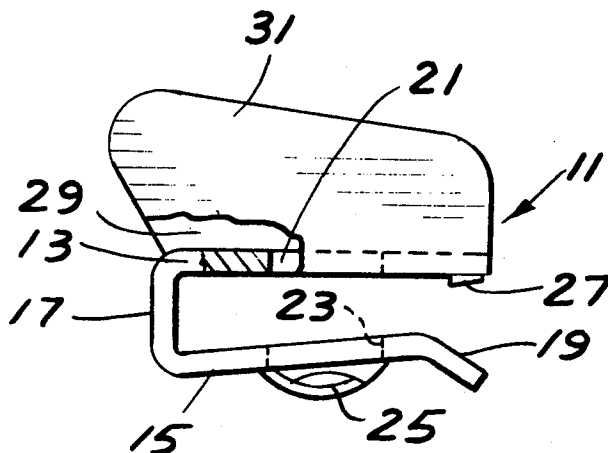
Primary Examiner—Stephen J. Novosad
 Assistant Examiner—Terrell P. Lewis
 Attorney—Earl F. Kotts

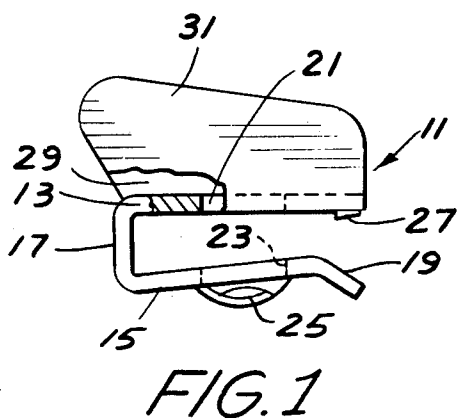
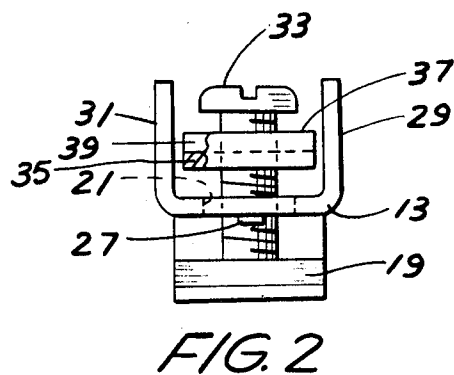
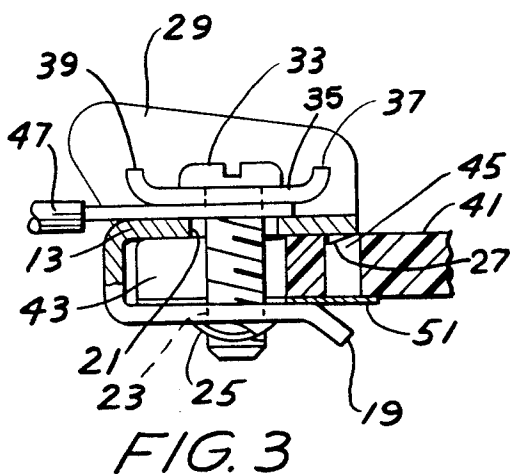
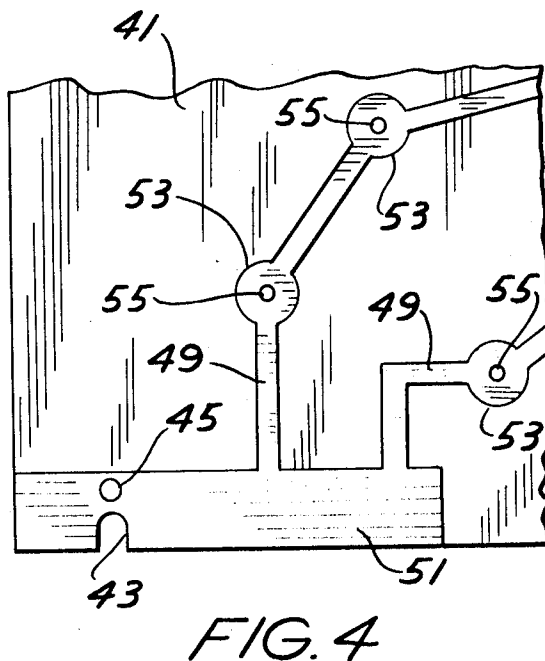
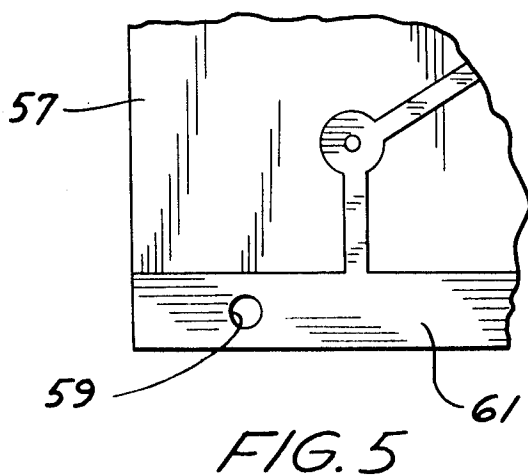
[54] **COMPLETELY MECHANICAL SOLDERLESS
 ELECTRICAL TERMINAL ASSEMBLY FOR
 CONNECTING A WIRE TO A CIRCUIT BOARD**
 3 Claims, 17 Drawing Figs.

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 [51] Int. Cl. **H05k 1/07**
 [50] Field of Search 339/17,
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[56] **References Cited**
 UNITED STATES PATENTS
 1,847,738 3/1932 Weigand 339/271

ABSTRACT: The invention relates to an electrical terminal assembly including a clip of electrically conducting material having one portion in engagement with a conductor on a circuit board, such as a printed circuit board, and having another portion associated with a threaded screw member, the assembly making possible a rapid, easy electrical connection between a relatively large wire affixed to the screw member, and the small conductor positioned on the relatively thin circuit board. The assembly is completely mechanical and requires no soldering.



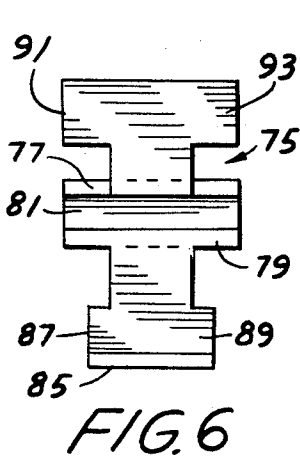
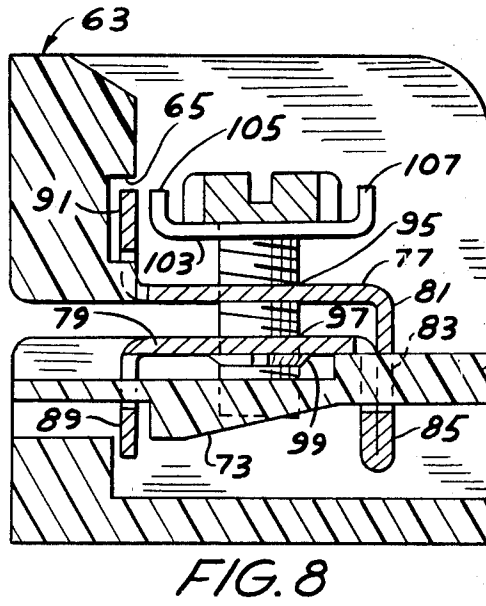
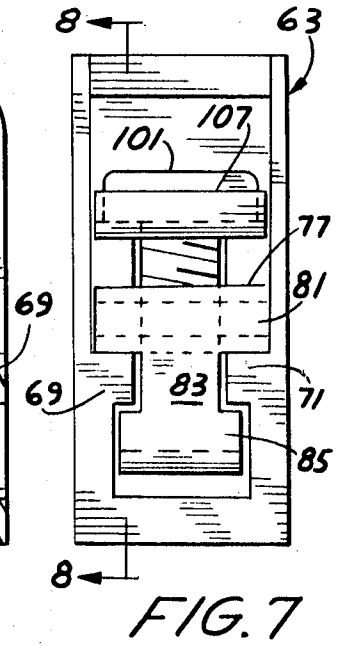
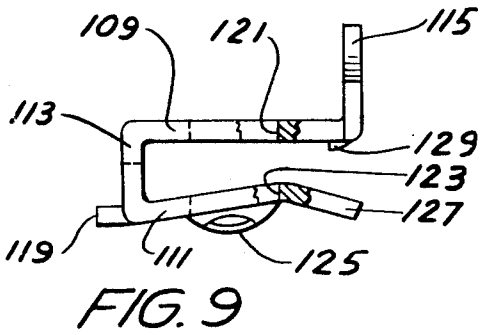
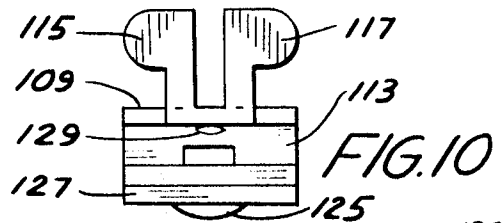
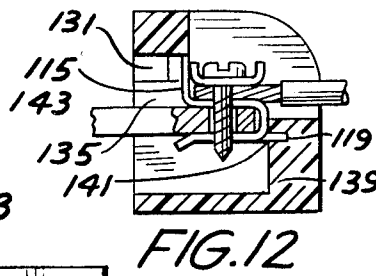
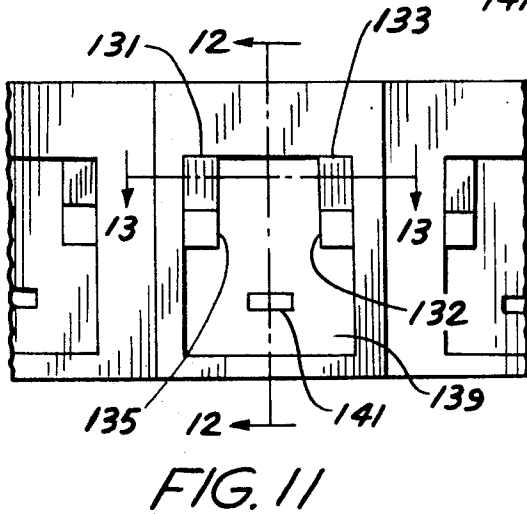
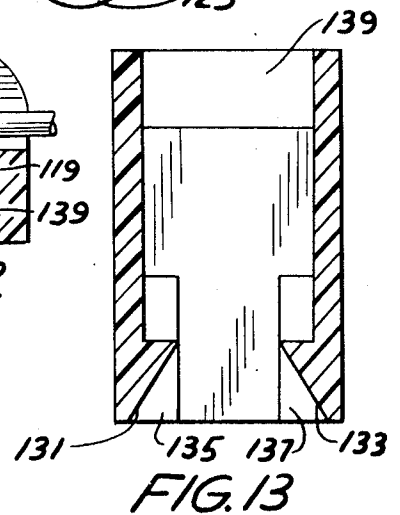


ROBERT L. LOVRENICH
INVENTOR.

BY

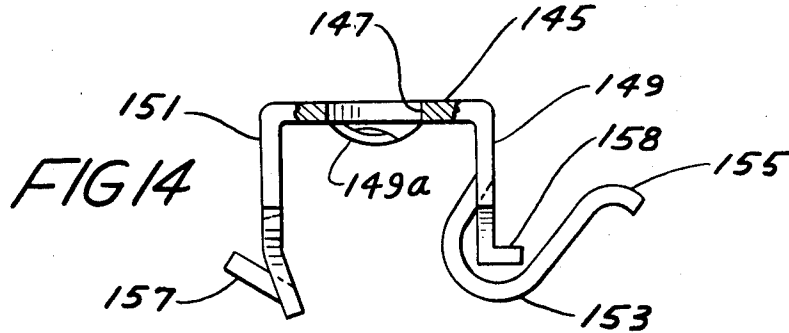
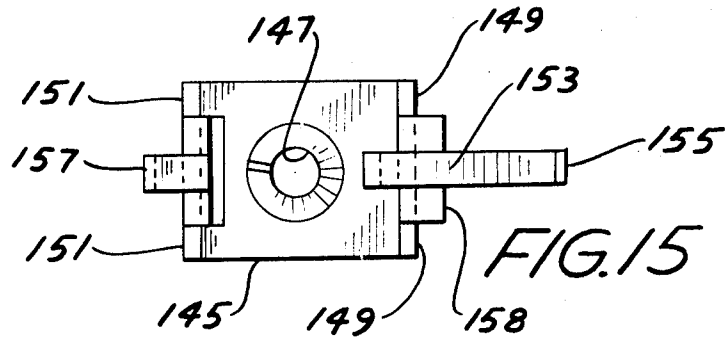
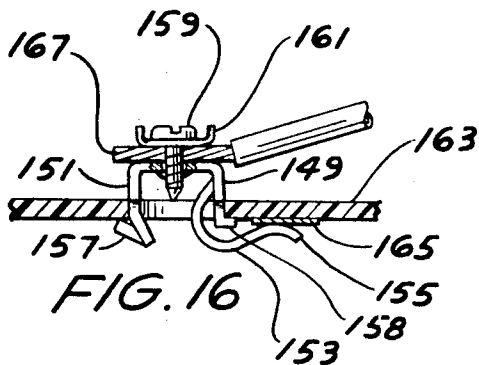
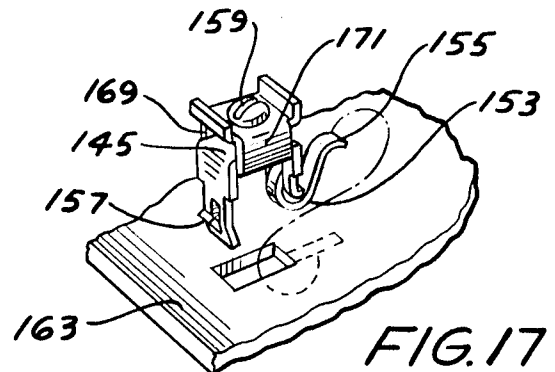
Earl F. Kottler

ATTORNEY



ROBERT L. LOVRENICH
INVENTOR.

BY *Earl F. Kott*
ATTORNEY



ROBERT L. LOVRENICH
INVENTOR.

BY *Earl F. Kolls.*

ATTORNEY

COMPLETELY MECHANICAL SOLDERLESS ELECTRICAL TERMINAL ASSEMBLY FOR CONNECTING A WIRE TO A CIRCUIT BOARD

BACKGROUND OF THE INVENTION

Circuit boards, such as printed circuit boards, are becoming more popular for use in control panels of devices such as machine tools for example. Such printed circuit boards take up less room and permit more efficient control of panel design. One drawback is that relatively heavy wire leads must be connected to the very thin circuit board buses. Conventional terminals on the market are not adapted to make a secure connection to the circuit board without soldering. Another type of device requires that the connector be riveted to the printed circuit buss with a spade extending outwardly so that a bayonet-type connector, affixed to the end of the wire lead, can be inserted on the spade. This, of course, requires that the leads have bayonet connectors fixed to them and that a riveting operation be performed on the circuit board.

The present invention eliminates all of these complications and provides an efficient terminal assembly which is completely mechanical and requires no soldering, riveting, or special-type connectors on the wire leads.

It is a principal object of the present invention to provide a simple and easy to use terminal assembly which will permit quickly connecting a wire lead to a circuit board buss without soldering.

It is another object of the present invention to provide such a terminal assembly including a threaded screw member wherein rotation of the screw member simultaneously affixes the end of the wire lead to the terminal assembly and at the same time creates a tight connection with the circuit board buss.

It is another object of the present invention to provide such a terminal assembly which takes the form of a substantially U-shaped clip which can be quickly and easily inserted into a terminal block.

It is a further object of the present invention to provide a snap-in terminal assembly for use in an opening in a circuit board, wherein the terminal can be quickly and easily inserted into place, and the wire lead is affixed and the conductor is engaged by the clip in one simple fastening operation.

Other objects and features of the present invention will be readily apparent to those skilled in the art from the following specification and appended drawings, illustrating a preferred form of the invention.

DRAWINGS

In the drawings:

FIG. 1 is a side elevation, partly broken away and sectioned, of a terminal clip for use in the terminal assembly according to the first embodiment of the present invention.

FIG. 2 is a front elevation of the clip shown in FIG. 1 with the other elements of the assembly shown.

FIG. 3 is a side elevation, partly in section, and with the near sidewall removed, showing the clip assembly of FIG. 1 and 2 fastened in place on a circuit board.

FIG. 4 is a fragmentary plan view of a circuit board prepared to receive the terminal assembly of FIG. 2.

FIG. 5 is a view similar to FIG. 4 showing another manner of preparing the circuit board to use the terminal assembly of FIG. 2.

FIG. 6 is a front elevation of a terminal clip used in the terminal assembly of the second embodiment.

FIG. 7 is a rear elevation of an insulated terminal assembly using the clip shown in FIG. 6.

FIG. 8 is a sectional elevation taken along the line 8—8 in the direction of the arrows, FIG. 7.

FIG. 9 is a side elevation of a terminal clip used in the third embodiment of the present invention.

FIG. 10 is a front elevation of the clip shown in FIG. 9.

FIG. 11 is a front elevation of a barrier strip adapted to utilize the clip shown in FIGS. 8 and 9.

FIG. 12 is a sectional elevation taken along the line 12—12 in the direction of the arrows, FIG. 11, with a clip inserted in position.

FIG. 13 is a sectional view taken along the line 13—13 in the direction of the arrows, FIG. 11.

FIG. 14 is a side elevation of a snap-in terminal clip according to the fourth embodiment of the present invention.

FIG. 15 is a bottom view of the terminal clip shown in FIG. 14.

FIG. 16 is a side elevation, partly in section, showing the terminal clip of FIGS. 14 and 15 included in a terminal assembly and affixed to a circuit board.

FIG. 17 is a perspective view of a terminal assembly similar to that shown in FIG. 16, but with a modified screw plate.

The first embodiment of the present invention is shown in FIGS. 1-5 of the drawings. The terminal assembly includes a substantially U-shaped clip 11 of resilient electrically conductive material. The clip includes an upper leg 13 and a lower leg 15 joined at one end by a connecting portion 17. The lower leg 15 slants toward the upper leg 13 from the connecting portion 17 to the free end of leg 15. This provides a firm engagement with a circuit board as explained later. A downward flange 19 is formed on the end of lower leg 15 to facilitate sliding the clip over the edge of a circuit board.

Upper leg 13 has a hole 21 therein, and lower leg 15 has a hole 23 which aligns with upper leg hole 21. A thread-engaging means such as the tang 25 surrounds lower leg hole 23.

A downward struck boss 27 extends downward from the forward part of the upper leg 13 and is adapted to seat in a hole in a circuit board. The upper leg also includes upward extending substantially parallel retainer sidewalls 29 and 31.

The screw member 33 and screw plate 35 complete the terminal assembly, as shown in FIG. 2. The screw plate is fixed to the screw member, by staking for example, in a manner which permits the screw plate to rotate relative to the screw member. The screw plate is substantially flat and has upward extending sidewalls 37 and 39.

FIG. 3 shows the terminal assembly fixed in place on a printed circuit board 41. The circuit board is first provided with an edge slot 43 and a boss-receiving hole 45. The clip 11 is placed on the circuit board 41 by sliding the body of the screw member 33 into the circuit board slot 43. The lower leg flange 19 facilitates this operation, and the clip legs 13 and 15 spread as they are inserted over the edge of the circuit board 41. When the upper leg boss 27 reaches the boss-receiving hole 45 in the board, it snaps into place to make a secure connection.

Next a wire lead 47 is placed with its bare end on the upper clip leg 13, and screw member 33 is screwed down into the clip.

The printed circuit board 41 is shown with typical conductor paths 49 leading from a bus 51 to component connection sections 53 (FIG. 4). These component connection sections 53 have holes 55 therein to connect leads from electrical components such as resistors, capacitors and the like in conventional fashion.

With but one action, screwing the screw member into the bottom leg of the clip, the wire lead 47 is secured in place and the inside surface of the lower clip leg 15 is pulled firmly against the bus 51 of the printed circuit board. This single action makes a good electrical connection between the wire lead 47 and the circuit board bus 51. It will be noted that if the U-shaped clip were placed upside down on the board the screw would clamp the leg of the clip adjacent the wire to the board conductor. If a double-sided board (conductor on both sides of the board) were used, the clip would connect both sides of the conductor together and the sides to the clip.

The terminal assembly shown in FIGS. 1-3 of the drawing can also be used with a circuit board 57 as shown in FIG. 5. In this application, a single hole 59 is provided in the circuit board 57, and the screw member 33 is passed through this hole. When used in this manner the boss 27 can be eliminated from the clip, and the boss-receiving hole 45 in the board

(FIG. 4) becomes unnecessary. In brief, the screw member 33 passes through the hole 59 rather than being moved into a slot in the edge of the circuit board, such as the slot 43 shown in FIG. 4. Again, a simple tightening action of the screw member 33 makes an efficient electrical connection between a wire lead 47 and the circuit board bus 61.

The second embodiment of the invention is shown in FIGS. 6-8. It includes a block 63 of electrical insulating material. A single block is shown, but the block may be lengthened to provide a barrier strip with as many terminals as desired. The block is preferably formed of a polycarbonate because it is tough and flexible, thus avoiding chipping and breakage. The block 63 has two shoulder notches 65, one at each side portion, formed therein to seat shoulders formed on the terminal clip. The block also includes a pair of tracks 69 and 71. Each track has a cam portion, such as the cam portion 73 on track 69, which slopes toward the front of the block and then terminates abruptly.

The terminal clip 75 is formed of resilient electrically conductive material and has a substantially U-shaped body with an upper leg 77 and a lower leg 79 joined by a connecting portion 81. The connecting portion extends downward below the lower leg to form a rear downward extending flange 83 terminating in a sidewise extending spade 85. The forward portion of the lower leg 79 is bent down to provide two sidewise extending ears 87 and 89. The forward portion of the upper leg is bent up to provide two sidewise extending ears 91 and 93.

A hole 95 is formed in the upper clip leg, and a hole 97 is formed in the lower clip leg. The lower clip leg has a thread-engaging tang 99 formed therein. The clip assembly is completed by a threaded screw member 101 which has a screw plate 103 fixed thereon and rotatable relative thereto. The plate has substantially parallel upward extending ends 105 and 107.

The terminal clip assembly is positioned in the block by inserting it from the back of the block. The lower leg ears 87 and 89 ride along the cams on the tracks 69 and 71, and snap over the cam terminations to the position shown in FIG. 8. In this position, the spade 85 and the ears 87, 89, 91 and 93 prevent the clip from moving up. The ears 87, 89, 91 and 93 prevent the clip from moving forward. The ears 87 and 89 prevent the clip from moving back. The ears 91 and 93 and the lower clip leg 79 prevent the clip from moving down.

This terminal assembly may be used with circuit boards either as shown in FIG. 4 or as shown in FIG. 5 of the drawings. If the board configuration of FIG. 4 is used, the upper clip leg 77 is provided with a downward extending boss similar to boss 27 shown in FIG. 3.

The third embodiment of the invention is disclosed in FIGS. 9-13 of the drawings. This terminal assembly is also of the insulated block type which can be provided in a single terminal assembly or several terminal assemblies side by side in a single elongated block. FIG. 11 shows a single block adapted to accommodate three terminal assemblies.

The terminal clip is formed of resilient electrically conductive material and includes upper leg 109 and lower leg 111 joined by a connecting portion 113. As in FIG. 1, the lower leg slants upward toward its free end so that there is a smaller distance between the free ends of the legs than between the connected portions. A pair of sidewise extending ears 115 and 117 are provided at the front of upper leg 109. A backward extending locating flange 119 is struck from the joining portion 113. The upper leg has a hole 121 therein. The lower leg 111 has a hole 123 therein and a thread-engaging tang 125 adjacent the hole. The forward end thread-engaging lower leg 111 slants downward to form a ramp 127, and the upper leg 109 has a downward extending boss 129 thereon.

The block has an open face with a pair of slanted tracks 131 and 133 at each side. Below said slanted tracks are a pair of supporting ledges 135 and 137. The back of the block has an upward extending backwall 139 which has a locating flange-receiving slot 141 therein.

The unit is assembled from the front by inserting the clip and squeezing the ears 115 and 117 inward toward each other. As the ears pass the ends of tracks 131 and 133, they spring back in behind the tracks and seat on the ledges 135 and 137. At the same time the locating flange 119 on the back of the clip slips into the locating flange-receiving slot 141 in the backwall 139. The clip is now firmly in position. The device is used as in the previous embodiments by placing the edge of a circuit board between the upper and lower legs. If the screw member is to go through the board as in FIG. 12, the board configuration of FIG. 5 is used, and the boss 129 on the upper leg may be eliminated.

The fourth embodiment of the present invention is shown in FIGS. 14-16 of the drawings. It is useful within the confines of the board rather than along the edge. It is a snap-in-type terminal assembly used with a rectangular opening in a circuit board adjacent a conducting portion on the board.

FIGS. 14 and 15 demonstrate the clip which is formed of resilient electrically conductive material. It includes a substantially flat deck 145 having a hole 147 therein with a thread-engaging tang 149a adjacent the hole 147. The clip has a front downward extending leg 149 and a rear downward extending leg 151. A circuit board conductor-engaging finger 153 is struck from the front leg and curves back and down below said front leg 149 and then projects up and forward, terminating in a curved end 155. The back of the clip has a rearward and upward extending clamp 157 struck therefrom. A bottom flange 158 extends forward from the bottom of the front leg 149.

A threaded screw member 159 with a screw plate 161 fixed thereon and movable relative thereto completes the terminal assembly.

FIG. 16 shows the terminal assembly in place on a circuit board. The terminal assembly is positioned by inserting the finger 153 forward and downward through the hole in the circuit board 163. The front clip leg 149 engages the wall adjacent the hole in the circuit board, and the rear leg 151 is brought down toward the board. The clamp 157 is compressed toward the front leg 149 and snaps into position beneath the circuit board. At this point, the bottom flange 158 on the front clip leg 149 also engages the bottom of the circuit board. The end 155 of finger 153 now engages the bus or conductor portion 165 of the circuit board. A wire lead 167 is placed beneath the screw plate 161 and on the clip deck 145, and the screw member 159 is tightened. The result is a firm electrical connection between the wire lead 167 and the conductor 165 on the circuit board 163.

A modification of the structure of FIGS. 14-16 is shown in FIG. 17 of the drawings. This construction is similar to that shown in FIGS. 14-16. However, in this modification the screw plate 161 has downward extending sides 169 and 171 which form a saddle member. The distance between the inner walls of the sides 169 and 171 is slightly greater than the width of the clip deck 145 (FIGS. 14 and 15) so that the lower ends of the sides can slip down over the deck when the screw member is tightened. In this embodiment, the wire lead is placed between a side of the saddle member and the screw member. Of course, more than one wire lead can be accommodated within the confines of the saddle member.

It is recognized that the screw plates and screws do not need to be a staked assembly, but it is a preferred embodiment for convenience of wire installation. Likewise a screw alone could be employed without a screw plate if the wires were wrapped around the screw prior to tightening it down.

I claim:

1. A solderless, completely mechanical terminal assembly for connecting a wire to a circuit board having a conductor thereon, comprising:

a substantially U-shaped clip of electrically conductive material having an upper leg and a lower leg spaced apart and joined at one end by a connecting section, and the inner surfaces of said legs providing circuit board-engaging portions;

wherein the distance between the free ends of the legs is less than the distance between the legs at the joined ends;

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substantially parallel, upwardly extending sides on said upper leg;

wire retaining means lying between said sides in assembly;

wherein a thread-engaging means is formed in the lower leg around a hole therein and aligned with a hole in the upper leg;

and wherein a threaded screw member extends through the hole in the upper leg and into the hole in the lower leg, the screw member thread engaging the thread-engaging means in the lower leg;

the free end of the bottom leg slanting downwardly to provide an entry ramp for the edge of the circuit board;

whereby a wire can be connected to the top surface of the upper leg and in engagement with said wire retaining means by screwing said screw member into the thread-engaging means in said lower leg, this same action pulling the legs into firm engagement with the circuit board and providing an effective electrical connection with a conductor on the circuit board.

2. A solderless, completely mechanical terminal assembly for connecting a wire to a circuit board having a conductor thereon, comprising:

a substantially U-shaped clip of electrically conductive material having an upper leg and a lower leg spaced apart and joined at one end by a connecting section, and the inner surfaces of said legs providing circuit board-engaging portions;

substantially parallel, upwardly extending sides on said upper leg;

wire retaining means lying between said sides in assembly; wherein a thread-engaging means is formed in the lower leg around a hole therein and aligned with a hole in the upper leg;

and wherein a threaded screw member extends through the hole in the upper leg and into the hole in the lower leg, the screw member thread engaging the thread-engaging means in the lower leg;

whereby a wire can be connected to the top surface of the

upper leg and in engagement with said wire retaining means by screwing said screw member into the thread-engaging means in said lower leg, this same action pulling the legs into firm engagement with the circuit board and providing an effective electrical connection with a conductor on the circuit board.

3. A preassembled, solderless, completely mechanical terminal assembly for connecting a wire to a circuit board having a conductor thereon, a slot in the edge thereof open at said edge, and a hole therethrough spaced inwardly from the closed end of said slot, comprising:

a substantially U-shaped clip of electrically conductive material having an upper leg and a lower leg spaced apart and joined at one end by a connecting section, and the inner surfaces of said legs providing circuit board-engaging portions;

substantially parallel upwardly extending sides on said upper leg;

wherein a thread-engaging means is formed in the lower leg around a hole therein and aligned with a hole in the upper leg;

a threaded screw member extending through the hole in the upper leg and into the hole in the lower leg, the screw member threads contacting the thread-engaging means in the lower leg and providing a slot wall engaging portion on the screw member between the clip legs for engaging the wall of the slot in the circuit board;

wire retaining means associated with said screw member; and

a boss on one of said clip legs extending between the legs; whereby said preassembled terminal assembly can be connected to the circuit board by merely inserting the screw member into the circuit board edge slot with said threaded member slot wall engaging portion contacting the wall of said slot, said boss dropping into the circuit board hole to retain the clip securely in position on the board.

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