

[54] **PRINTED CIRCUIT BOARD TERMINAL RECEPTACLE**[75] Inventor: **Peter Keith Townsend**, New Cumberland, Pa.[73] Assignee: **AMP Incorporated**, Harrisburg, Pa.[22] Filed: **Jan. 2, 1974**[21] Appl. No.: **430,371**[52] U.S. Cl. **339/97 R; 339/221 M; 339/258 S**[51] Int. Cl.² **H01R 9/08**[58] Field of Search **339/17 R, 17 C, 97 R, 97 P, 339/98, 99 R, 220 R, 220 T, 221 R, 221 M, 339/256 SP, 258 S**[56] **References Cited****UNITED STATES PATENTS**

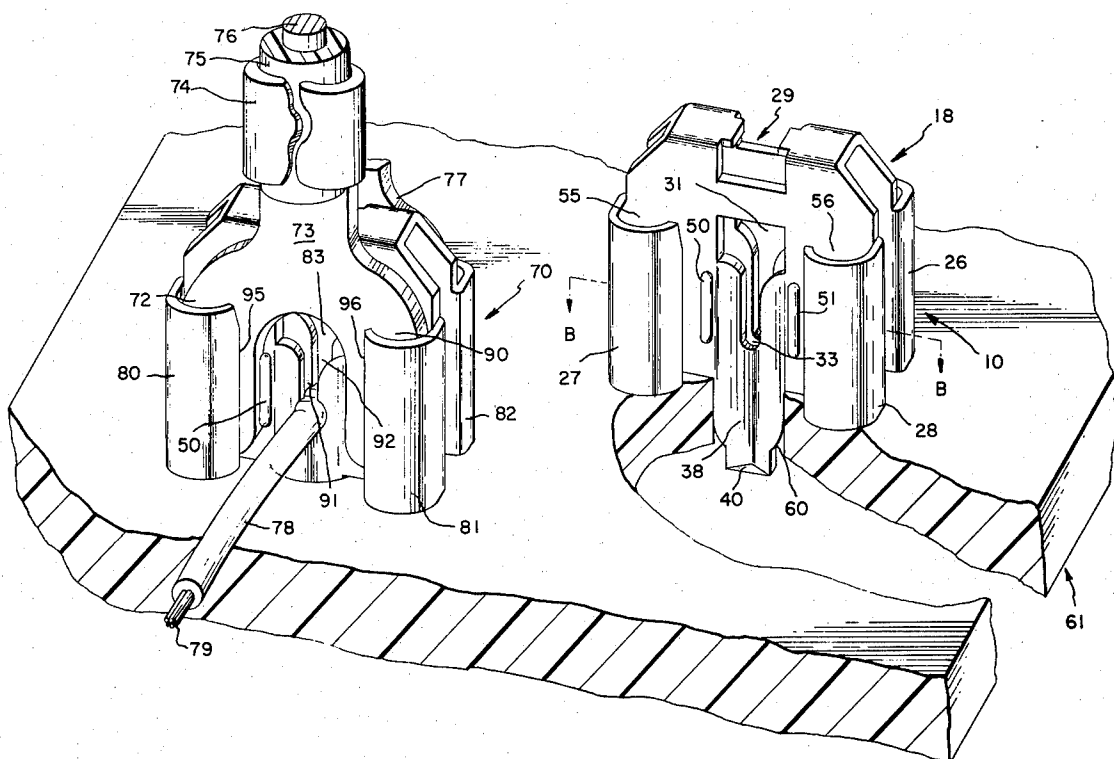
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ABSTRACT

A free standing contact constructed to be mounted upon a board and comprising a generally U-shaped structure having first and second leg portions with facing major surfaces and a transverse portion joining together one end of said first and second leg portions. Each of the two longitudinal edges of each of said first and second leg back portions are bent back around about 180° and away from the major surfaces of the opposite leg portion to form a pair of parallel elongated slots with the openings facing each other to form a guide for receiving a spade-like male terminal. Openings are formed in each of said major surfaces in substantial registration with each other, and with each opening comprising a portion for receiving a conductor, and a narrowed portion extending therefrom and into which said conductors can be laterally pushed to penetrate the insulation of said conductor and make electrical contact therewith. A securing element extends beyond the free end of each leg portion and is generally convex to and directly opposite the securing element of the opposite leg portion to maintain predetermined spacing between the facing major surfaces of said first and second leg portions. These securing elements are constructed to fit into openings provided therefore in the said board to secure the contact upon said board.

10 Claims, 5 Drawing Figures

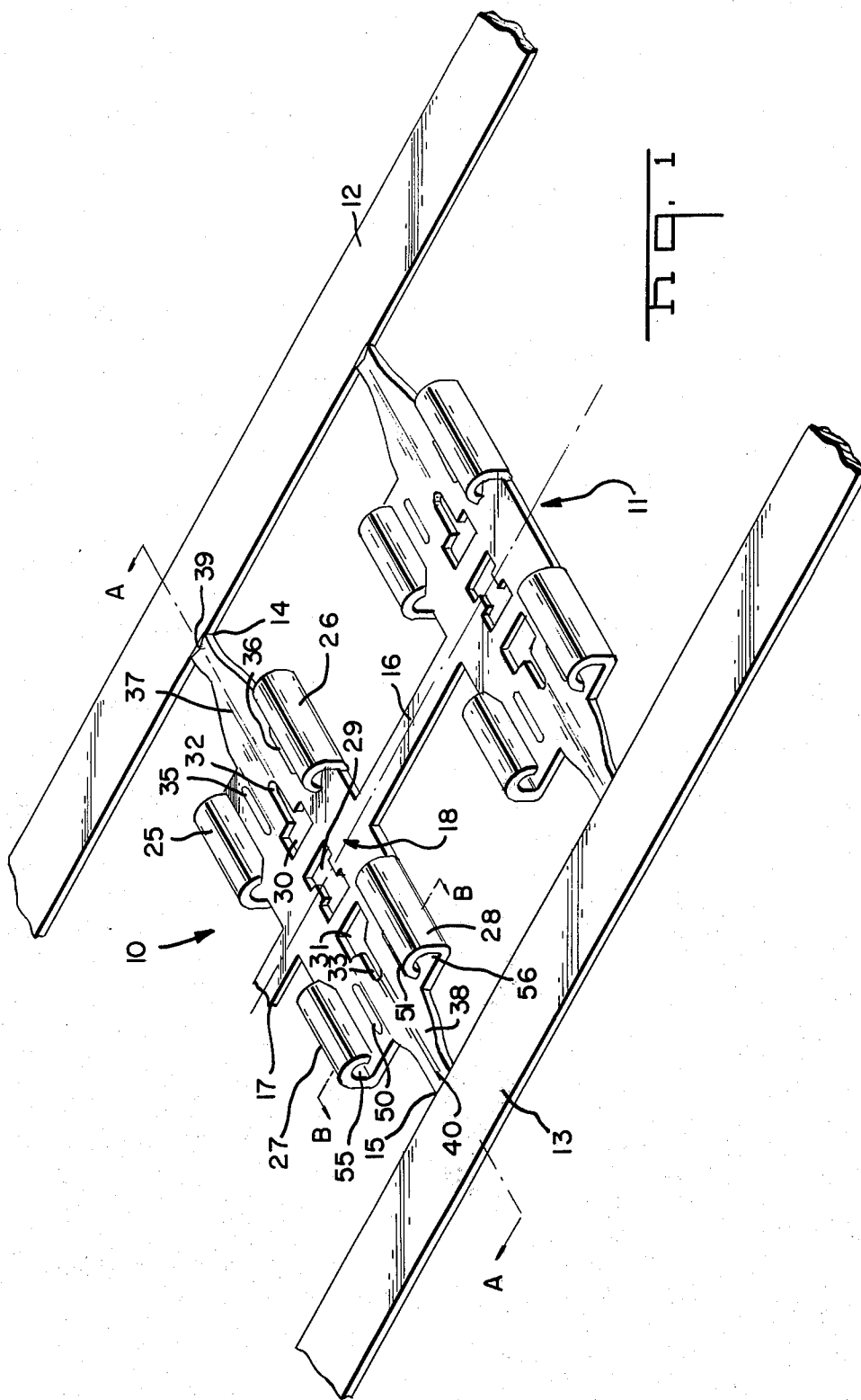
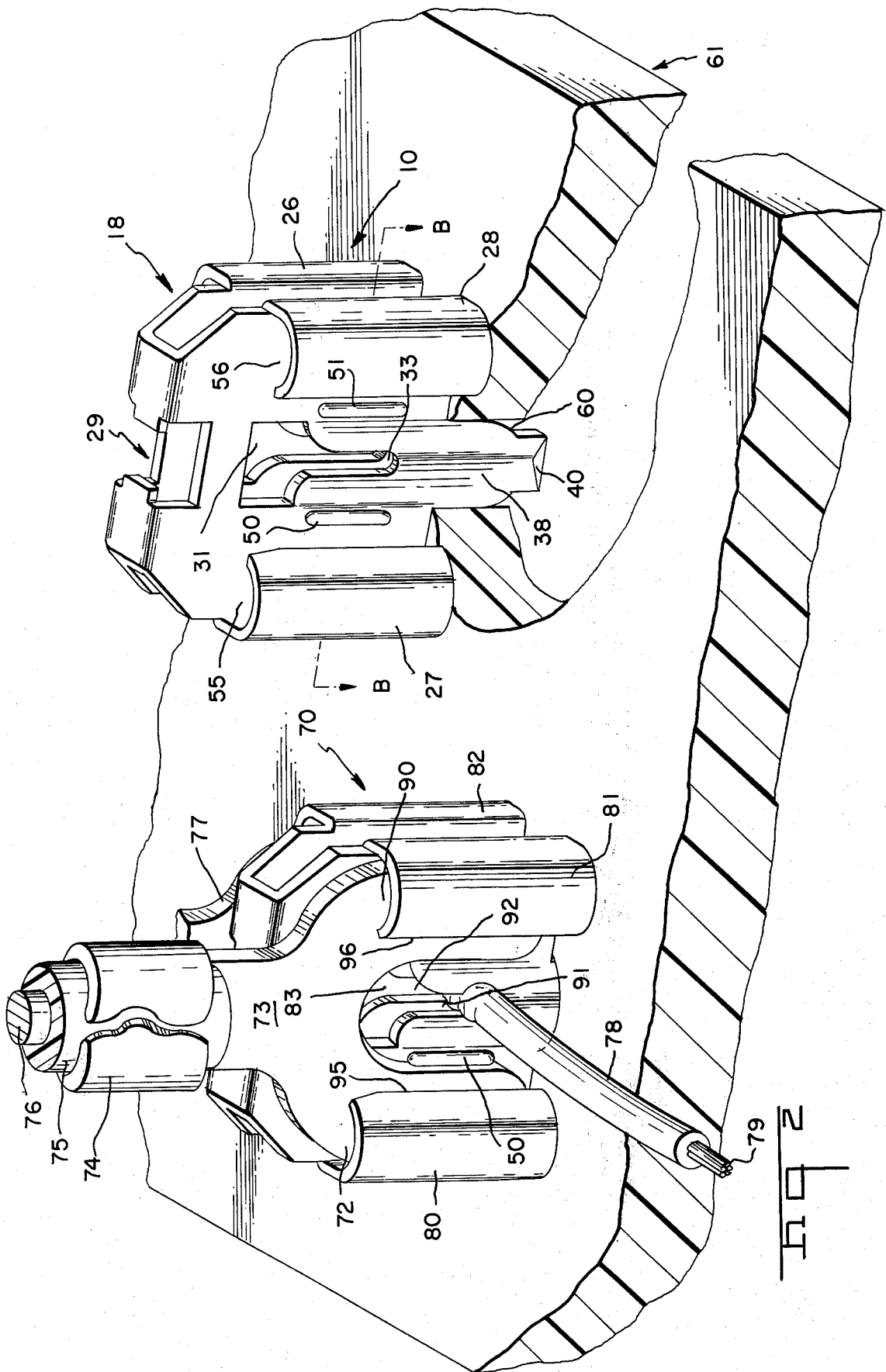
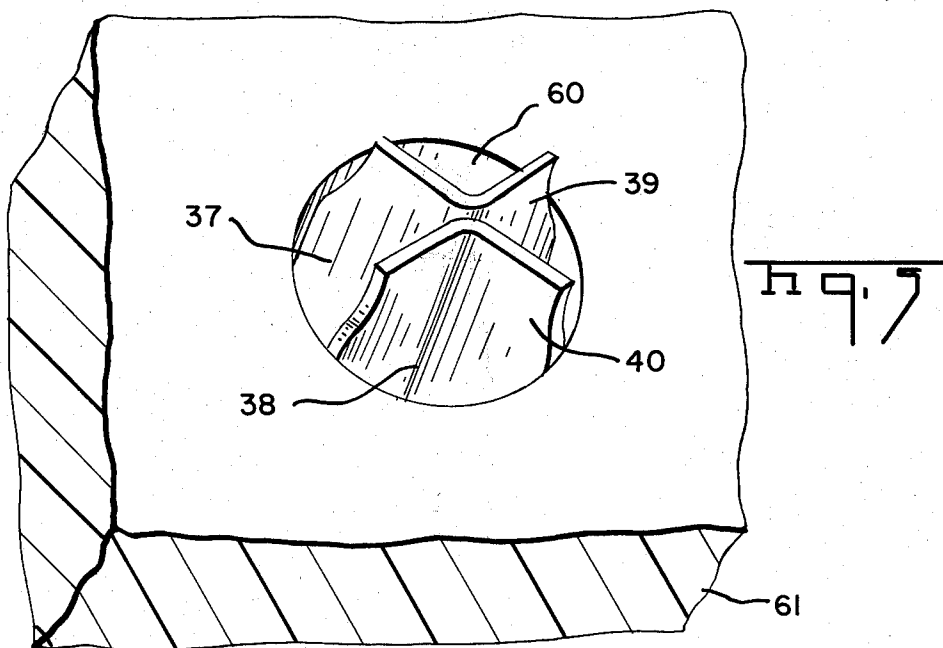
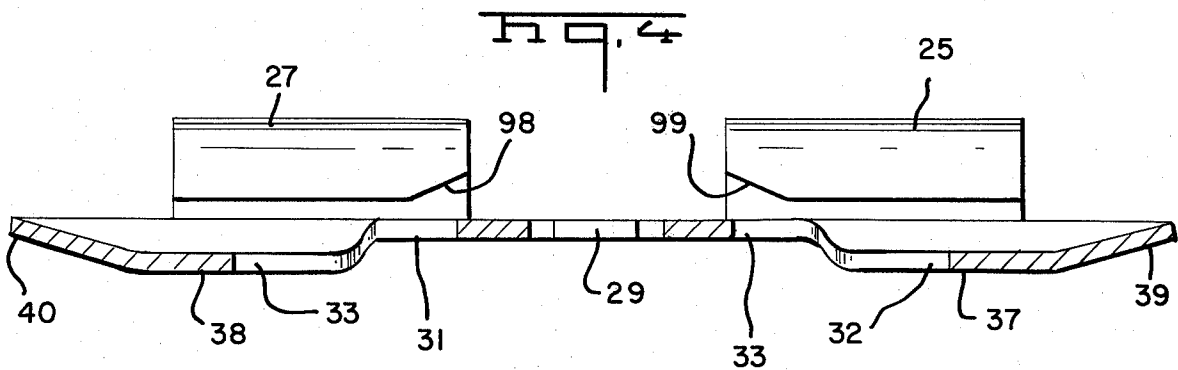
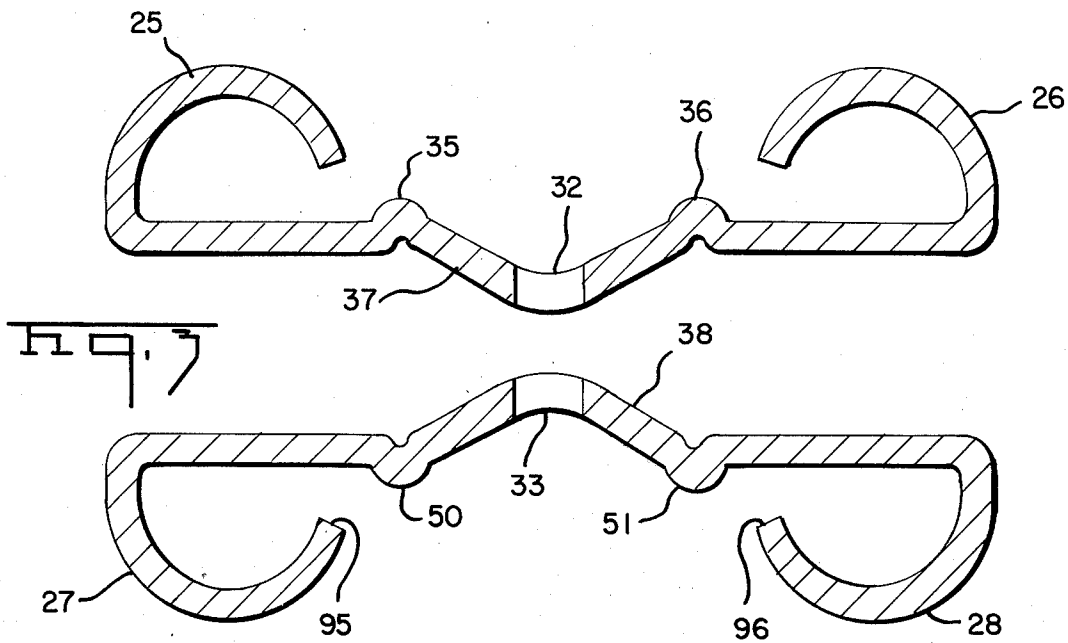


Fig. 1





PRINTED CIRCUIT BOARD TERMINAL RECEPTACLE

BACKGROUND OF THE INVENTION

This invention relates generally to printed circuit board receptacles of the type adapted to receive spade-like male terminals and more particularly it relates to an inexpensive, reliable and easy to manufacture and install printed circuit board receptacle which is capable of receiving at least two spade terminals and at least one unterminated wire lead.

Circuit boards and mounting plates used in electrical apparatus require many different types of terminals mounted thereon to receive many different types of mating terminals and connectors, and for many different purposes. For example, some printed circuit boards have post-like terminals secured thereon which receive wire wrap type terminations. Other type terminals are adapted to receive other circuit boards and in fact, constitute connectors for joining together two circuit boards. Still other terminals are constructed to receive individual wires, some of these wires being permanently attached and some being connections which can be disconnected easily. The latter type include male spade-like terminals and a female receptacles adapted to receive the spades. The female receptacle is frequently permanently mounted in a board, such as a printed circuit board, and is constructed to receive the spade-like male terminal. Often female receptacles consist of a pair of parallel U-shaped slots with the openings of the U's facing each other and constructed to receive the spade terminal which usually consists of a bifurcated metal element, with the two legs thereof sliding into the U channels in the female receptacle.

Frequently, the female receptacle must receive more than one spade male terminal, and in fact, in some applications it is desirable that the female terminal be capable of receiving a third, and perhaps a fourth connection, with the third and fourth connections being nothing more than the ends of insulated wires. Worded in another way, with any given spade receptacle, there is a maximum number of spade terminal connections that it can receive. If additional connections are to be made to that same female receptacle then it is desirable to provide means other than spade terminal receiving means to make such additional connections.

In the prior art there are devices whereby a plurality of spade terminals can be stacked, one upon the other, so that three, or even four or more spade terminals can be fastened under a single lug. Such an arrangement, however, is awkward in that it usually requires a bolt and nut arrangement to hold the spade terminals. Furthermore, in practice the securing of the spade terminals is not usually reliable. It is neither easy to install them nor is it easy to remove them.

BRIEF STATEMENT OF THE INVENTION

It is a primary object of the present invention to provide a female circuit board receptacle capable of receiving at least two spade terminals and at least one additional unterminated wire and to make good electrical contact with all three connections.

It is a second purpose of the invention to provide a board receptacle capable of receiving two spade terminals and having a slotted portion therein for receiving an insulated but unterminated conductor and for me-

chanically holding and making good electrical contact with said insulated conductor.

A third aim of the invention is a female receptacle which can be manufactured from a single strip into a strip of metal and which is easily mountable on a printed circuit board, and further which is constructed to have means for independently receiving at least two spade terminals, and a third conductor, with each of the two spade terminals and the third conductor being easily insertable or removable from said female receptacle.

A fourth object of the invention is a female circuit board receptacle containing two independent means each capable of receiving a spade-like terminal, and having means for mounting on a circuit board consisting of a pair of curved, semi-cylindrical legs with the convex portions facing each other to not only provide four outer edges for gripping a receiving hole in the printed circuit board, but also for separating the two independent spade terminal receiving means to thereby permit the forming of a pair of separated slots to be provided for receiving a third conductor connection which does not require a terminal thereon, but simply is forced down said pair of separated slots which provide both mechanical securement and electrical contact facilities.

A fifth object of the invention is the improvement generally of female type printed circuit board receptacles for receiving spade-like terminals.

In accordance with the invention a continuous strip of metal is advanced in discrete sections to a predetermined work area where each discrete section is stamped and shaped into the female receptacle of the present invention. The female receptacle is generally a U-shaped metallic element, with each side of the U having a width of several times as great as the distance between the two legs of the U. Furthermore, each side of the U converges at its open end into a narrowly configured and curved semi-cylindrical element, with the convex surfaces of the narrow, curved element facing each other and being closely adjacent to each other, and further being constructed to be inserted through an aperture or hole in a printed circuit board to hold the female receptacle upon said printed circuit board. These narrowly configured semi-cylindrical elements are in fact mounting posts which extend through holes in the circuit board and can be either force fitted or soldered in the board. Thus, in its installed position on the printed circuit board the U-shaped contact is in fact, inverted.

Both longitudinal edges of each leg of the U formed by the receptacle are bent to form semi-closed tubular elements running substantially parallel to the longitudinal axis of the legs of the U and having a cross-sectional C-shaped area, with the open end of the C on each leg of the U's facing each other so as to coact together to provide a receiving means for a spade terminal. Each pair of these semi-closed or C-shaped tubular channels are positioned on the outside surfaces of the U to facilitate the reception of a spade-like male terminal in each leg.

The central portion of the major surface of each leg of the U has a portion thereof stamped out in the general configuration of a slot, with the portion towards the upper or closed end of the U being enlarged to receive an insulated conductor. The two stamped-out portions in the two major surfaces of the legs of the U

are in registration with each other so that the conductor can be passed through the enlarged upper areas thereof and then forced downward into the narrow portions of the slots which extend toward the surface of the printed circuit board. The narrow portions of the slot have dimensions such as to cut through the insulation of the wire and make contact with the metallic conductor contained therein, thus establishing both a mechanical securement of the wire thereto, as well as establishing good electrical contact with the wire.

It is to be noted that the stamped-out portions on the major surfaces of the two legs of the U are positioned such that they fall within the open area between the two legs of the bifurcated ends of the spade-like terminals and thereby will not interfere with the insertion of said spade-like terminal into the two pairs of semi-closed tubular channels running down the side of the legs of the U.

A particular feature of the invention lies in the fact that the narrowed portions (the mounting posts or elements) on the ends of the legs of the U, and which engage the printed circuit board, are curved with their convex surfaces facing each other, thereby causing a spacing between the two legs of the U of the receptacle. Such spacing is necessary in order to ensure that the two slots which receive the insulated wire are spaced apart to provide the necessary mechanical supporting strength for the insulated wire and also to provide additional mounting strength for the female receptacle itself. More specifically, by spacing the two legs of the U-shaped element apart by means of the convex curved configuration of the printed circuit board mounting elements, there are at least four separated points on the open ends of the two legs of the U-shaped elements which rest upon the surface of the printed circuit board. These four points are spaced well apart, both along the width direction of the legs of the U as well as the direction of spacing between the legs of the U so that the overall effect is a female receptacle which is solidly supported upon the surface of the printed circuit board.

BRIEF DESCRIPTION OF THE FIGURES

The above-mentioned and other objects and features of the invention will be more fully understood from the following detailed description thereof when read in conjunction with the drawings in which:

FIG. 1 is a perspective view of two of the contacts before they are bent into their final U-shaped configuration but after the edges of the legs of the ultimately U-shaped configuration are formed into the C-shaped tubular cross-sectional configuration to receive the spade-type terminals;

FIG. 2 is a perspective view of two of the contacts mounted on a board;

FIG. 3 is a sectional view of the perspective view of FIG. 1 taken along the plane B—B and illustrating how the two sides of the U-shaped elements are spaced apart by the configuration or shaping of the portion thereof (the mounting elements) which engage the printed circuit board upon which the contact is mounted;

FIG. 4 is a sectional view of the perspective view of FIG. 1 taken along the plane A—A; and

FIG. 5 is a perspective view showing how the narrowed portions of the two legs of the U-shaped receptacle fit into a hole in a printed circuit board and grip the

sides of such hole to secure said contact in the board.

DETAILED DESCRIPTION OF THE INVENTION

Referring now to FIG. 1 there are shown two of the contacts at a certain stage in the manufacture thereof. In this stage of manufacture the two contacts 10 and 11 are connected to two carrier strips 12 and 13 and can also be connected together by center carrier strip elements such as 16 and 17. The one end of the center carrier strip 17 is shown connected at one end to the contact 10 and at its other end (not shown) to an adjacent contact to the left of contact 10 in FIG. 1, but not shown.

In FIG. 1 the two contacts 10 and 11 are the same so that only one of them, namely contact 10, will be described in detail. Such description is also applicable to contact 11.

In contact 10 the four cylindrical elements 25, 26, 27 and 28, each having a semi-closed C-shaped cross-sectional area, have been formed by a previous manufacturing operation. Also the stamped-out portions 30 and 31, each with a slot 32 and 33 extending therefrom, and also the center stamped-out portion 29, have been done by previous manufacturing operations.

The purpose of these three stamped out portions 30, 31 and 29 are as follows. The center stamped out portion 29 is provided to engage a chain or a sprocket, thereby establishing the spacing between the contacts along the carrier strip. More specifically, by means of such cut out portions 29 the contacts, such as contacts 10 and 11, are stepped from work station to station where the various manufacturing operations are performed thereon.

The two slots 30 and 31 are positioned so as to come into registration with each other when the contact 10 is removed from the two carrier strips 12 and 13, as well as a connector carrier strip 16 and 17, and then bent upon itself along the centerline 18 to form the general configuration shown in the right hand portion of FIG. 2.

The description of the completed contact 10 shown in FIG. 2 will be discussed in more detail later. For the meantime, however, the reader's attention is directed again to FIG. 1.

The two spoon-shaped elements 37 and 38 are concave in nature, that is with the concave portion appearing on the surface of the drawing. Each of these two spoon-shaped, concave portions terminates in a narrowed element, such as elements 39 and 40. These narrowed elements 39 and 40 can be either planar in nature or can be concave, as is shown in FIG. 5. FIG. 5 is an enlarged view showing the end elements 39 and 40, which are attached to the ends of spoon-like elements 37 and 38, respectively, extending through a circuit board 61.

The main purpose of the spoon-like or convex configuration of elements 37 and 38 is to provide a four edged insertion means which is inserted in a hole 60 (see FIG. 5) in the printed circuit board 61. The narrowed end elements 39 and 40 permit easy guidance of the larger spoon-like elements 37 and 38 into the hole 60. The diameter of the hole 60 is such that the edges of elements 37 and 38 will engage therewith and firmly hold the contact into printed circuit board 61. Reference is made to FIG. 2 where it is shown how the spoon-like element 38 fits into the aperture 60 in printed circuit board 61.

Returning again to FIG. 1, the four small elongated, embossed elements 35, 36, 50 and 51 constitute raised portions on the inner surface of the contacts and are dimensioned in such a manner that when a spade terminal is inserted in a pair of the semi-closed cylinders 27 and 28, for example, the embossed elements 50 and 51 will guide the inner edges of the two legs of the spade element into the contact and hold it firmly in place.

Reference is made to FIG. 2. It is to be noted that both the left hand contact 70 and the right hand contact 10 are shown mounted on board 61 in the circuit of FIG. 2. A portion of the circuit board 61 is broken away with respect to the right hand contact 10 to show more clearly how the spoon-like element 38 fits into aperture 60 in the board 61.

The right hand terminal 10 of FIG. 2 is shown as containing no spade-like male terminals nor does it have a wire lead connected into the slot 33 thereof. Only the terminal 10 mounted on board 61 is shown. It is to be specifically noted that the bottom surfaces of the four C-shaped cylindrical portions 27, 28, 26 and 25 (shown in FIG. 1) rest upon the surface of the printed circuit board 61 to provide a firm support for the contact 10. As mentioned above, the spoon-like elements 38 and 37 (shown in FIG. 1) retain the contact securely mounted to the board.

Referring now more specifically to the left hand contact 70 in FIG. 2, two male spade terminals 73 and 77 are shown as being inserted respectively in the oppositely positioned pairs of C-shaped cylindrical sections. More specifically, the spade 73 is inserted in the female cylindrical sections 80 and 81, and the spade 77 is shown as being inserted in the other pair of C-shaped cylindrical sections, such as cylindrical section 82. The other cylindrical section paired with cylindrical section 82 cannot be seen in FIG. 2. A barrel portion 74 on spade terminal 73 is crimped around the plastic insulation 75 of wire 76.

It will be apparent from an examination of contact 70 in FIG. 2 that the edges of the spade terminals are guided into the contact 70 by the raised embossed areas, such as raised embossed area 50. Furthermore, because of the C-shaped, cross-sectional configuration of the cylindrical section elements 80 and 81, a spring-like effect is created which maintains a constant force against the legs 72 and 90 of the spade 73, to hold it securely therein.

It will be observed from contact 70 of FIG. 2 that the stamped openings 83 therein are unimpeded by the legs 72 and 73 of spade terminal 73. Therefore, an insulated conductor 78 can be inserted through the openings 83, which are in registration, and then forced down into the two slots 91 and 92 below which extend from said openings 83.

The width of the slots 91 and 92 are such as to cut through the insulation of conductor 78 and to make contact with the metal conductor 79 therein. It is to be noted that one of the slots, such as slot 91, can be wider than the rear slot 92 so that the slot 91 simply presses deeply into the insulation and performs an anti-strain function, whereas the narrower slot 92 actually cuts through the insulation and bites into the metallic wire 79 to form the electrical connection. The foregoing is a matter of selection and choice by the application engineer.

Referring now to FIG. 3 there is shown a section of the contact of FIG. 2 taken along the plane B—B. The

C-shaped cross-sectional areas of the four cylindrical sections 25, 26, 27 and 28 can be plainly seen, as well as the raised embossments 35, 36, 50 and 51. Also, in FIG. 3, the spoon-shaped elements 37 and 38 and the slots 32 and 33 are readily apparent.

From the view of FIG. 3 it is evident that when a spade terminal is inserted into the pair of cylinders 27 and 28, for example, the raised embossed portions 50 and 51 will act in cooperation with the open ends 95 and 96 of the C-shaped elements 27 and 28 to actually entrap the two legs of the spade elements therein.

In FIG. 4 there is shown a section of the contact taken along the plane A—A in FIG. 1. The two cylindrical sections 25, 27 are shown, as well as the spoon-shaped elements 38 and 37, which are terminated respectively in the short end elements 40 and 39. Beveled portions 98 and 99 of the two cylindrical sections 27 and 25 are provided to permit easy entry of the spade.

In FIG. 4 the raised embossed portions 50 and 51 or 35 have been omitted for purposes of clarity.

It is to be understood that the form of the invention shown and described herein is but a preferred embodiment thereof and that various changes can be made in the specific details of the design without departing from the spirit or scope of the invention.

What is claimed is:

1. A contact constructed to be securely mounted upon a board, and to receive both bifurcated spade terminals and ends of conductors, and comprising:
 - a generally U-shaped structure with the legs of the U comprising a first element and a second element, with both said first and second elements comprising parallel central portions which are generally flat and rectangular in shape and further being, both in structure and in position, substantially mirror images of each other;
 - a transverse portion connecting said first and second elements together to complete the generally U-shaped configuration;
 - each of said first and second elements having securing elements extending from the free end thereof, with each securing element having two side edges and being generally convex in shape with respect to, and further being positioned oppositely to the securing element of the other element to provide a predetermined spacing between said flat, rectangular central portion;
 - each of said two securing elements being of a size to have the four side edges thereof press firmly against the walls of a hole in said circuit board in which they are inserted, and to thereby secure said contact to said circuit board;
 - each of said first and second elements further having the two side edges thereof bent back and towards each other in a direction away from the other element to form a pair of parallel, elongated slots, with the bent back portions having a curved cross-sectional area, with the concave side thereof facing the flat rectangular central portion to provide a spring-like force upon the legs of a bifurcated spade terminal insertable therein.
2. A contact in accordance with claim 1, comprising:
 - a cut-out portion in each of said flat central portions having a slot-like configuration of a width to receive a conductor forced laterally down thereinto and to make electrical contact with said conductor;

said cut-out portions in said first and second flat elements being in substantial registration with each other.

3. A contact in accordance with claim 1, in which each of said flat rectangular central portions has formed thereon a pair of elongated embossed strips extending longitudinally alongside the lengths of said elongated slots adjacent the inner edge of each leg of a bifurcated male spade terminal when inserted therein, to guide said legs of said spade terminal into said parallel elongated slots of said contact and to maintain the position and alignment of said spade terminals in said contacts.

4. A free standing contact constructed to be mounted upon a board, to receive a bifurcated spade terminal, and comprising:

a generally U-shaped structure having a first leg portion and a second leg portion with facing major surfaces, a transverse portion joining together one end of said first and second leg portions and with each leg portion having two longitudinal edges;

each of the two longitudinal edges extending outwardly of said transverse portion of each of said first and second leg portions and being bent back around about 180° and away from the major surface of the opposite leg portion to form a pair of parallel, elongated slots, with the slot openings facing each other to form a channel for receiving a spade-like male terminal;

an opening in each of said major surfaces in substantial registration with each other, with each opening comprising a portion for receiving a conductor, and a narrowed portion extending therefrom into which said conductors can be laterally pushed to grip said conductor and make electrical contact therewith; and

a securing element extending beyond the free end of each leg portion and being generally convex to and directly opposite the securing element of the other leg portion to maintain predetermined spacing between said facing major surfaces of said first and second leg portions;

said securing elements being constructed to fit into openings provided therefore in said board to secure said free standing contact upon said board.

5. A free standing contact in accordance with claim 4, in which each of said major surfaces has formed thereon a pair of elongated embossed strips extending longitudinally along the lengths of said elongated slots adjacent the edge of each leg of each half of one of said bifurcated spade terminals, when inserted in said channel, to guide said legs of said spade terminal into said parallel elongated slots of said free standing contacts and to maintain the position and alignment of said spade terminal in said free standing contact.

6. A free standing contact constructed to be mounted upon a circuit board, to receive bifurcated, spade-like terminals, and comprising:

a generally U-shaped structure having a first and second leg portions each with a pair of longitudinal edges and substantially parallel major surfaces facing each other, and a transverse portion joining together first ends of said first and second leg portions;

each of the two longitudinal edges of each of said first and second leg portions being curled around, away from the major surface of the opposite leg portion

and then back towards, but not meeting the outside surface of the leg portion to which it is attached, to form a pair of substantially parallel, tubular portions with longitudinal slots existing where the curled around edges do not meet said outside surface;

said longitudinal slots facing each other to form a guide for receiving a bifurcated spade-like male terminal;

a cut-away portion in each of said major surfaces in substantial registration with each other and each comprising an opening for receiving a conductor, and a narrowed portion into which said conductor can be pushed to grip said conductor and make electrical contact therewith; and

securing elements extending beyond the second end of each leg portion and having a portion thereof extend convexly towards the major surface of the opposite leg portion and in substantial registration with the extended portion of said opposing securing element to maintain a predetermined spacing between said facing major surfaces of said first and second leg portions;

said securing elements being constructed to fit into openings provided therefore in said circuit board to secure said free standing contact upon said circuit board.

7. A free standing contact in accordance with claim 6, in which each of said major surfaces has formed thereon a pair of elongated embossed strips extending longitudinally alongside the parallel tubular portions of the first and second leg portions adjacent the edge of each leg of each half of one of said bifurcated spade-like male terminals, when being inserted in said tubular portions, to guide said legs of the spade-like terminals into said tubular parallel tubular slots of said free standing contacts and to maintain the position and alignment of said spade terminals in said free standing contacts.

8. A contact constructed to be securely mounted upon a circuit board, to receive a bifurcated spade terminal, and comprising:

a generally U-shaped structure with the legs of the U comprising a first element and a second element, with both said first and second elements comprising central portions having facing inner surfaces which are generally flat and rectangular in shape and further being, both in structure and in position, substantially mirror images of each other;

a transverse portion connecting together first ends of said two elements to complete the generally U shaped configuration;

said first and second elements each having a securing element having a pair of longitudinal edges and extending longitudinally from the second end thereof for insertion in a hole in said circuit board and being generally curvilinearly shaped, with the convex sides thereof facing each other to provide, in cooperation with said transverse portion, a predetermined spacing between said flat rectangular central portions;

said two securing elements being of a size and configuration to have the four longitudinal edges thereof press firmly against the walls of said hole in said circuit board in which they are inserted, and to thereby secure said contact to said circuit board; each of said first and second elements further having the edges thereof rolled around and back towards

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said flat central portion in a direction away from the other element to form a pair of parallel tubular-like elements, each having a generally C-shaped cross-sectional configuration which is not completely closed upon the outer surface of said flat central portion of said element to provide a spring-like force upon the legs of a bifurcated spade terminal insertable therein.

9. A contact in accordance with claim 8, comprising: a cut-out portion in each of said flat central portions having a slot-like configuration of a width to receive a conductor forced laterally down thereinto and to make electrical contact therewith; said cut-out portions in said first and second flat ele-

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ments being in substantial registration with each other.

10. A free standing contact in accordance with claim 8, in which each of said flat rectangular central portions has formed thereon a pair of elongated embossed strips extending longitudinally alongside said tubular-like elements adjacent the edge of each leg of one of said bifurcated spade terminals, when being inserted in said tubular-like elements, to guide said legs of said spade terminals into said tubular-like elements of said free standing contacts and to maintain the position and alignment of said spade terminals in said free standing contacts.

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