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R. J. KINKAID ETAL

CONNECTOR WITH TAB TERMINAL LATCHING MEANS

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This invention relates generally to an improved printed circuit edge connector assembly of the type utilized to interconnect components mounted on a printed circuit card and to connect such components to individual or paired conductive paths interconnected with the assembly by removable tab terminals. The invention features a novel latching assembly having a utility aptar from printed circuit card use and includes a preferred embodiment of such a novel terminal connecting block. The wide variety of associated use of printed circuit cards has sponsored the development of the so-called edge type connector wherein a plurality of contact spring members are secured within a common insulating block member to define contact faces adapted to receive and interconnect each path of a number of parallel conductive paths mounted on the surface of an insulating card or panel.

Extensions from each spring member are usually positioned in the common block to provide connection points for associated circuit paths terminated thereto in some fashion. A typical construction of the prior art is shown in U.S. patent, No. 2,908,775 to L. Gilbert granted October 13, 1959. Further examples of the prior art devices are shown in U.S. patents, No. 2,935,725 to R. Fox granted May 3, 1960, No. 2,870,424 to E. E. Franz granted January 20, 1959, No. 3,001,171 to F. A. Shults, granted September 15, 1961 and No. 3,016,508 to G. J. Lallonde granted January 9, 1962.

While the connectors of the prior art have generally answered the limited needs for which they were designed, field experience has outlined new demands not met by prior art devices and has provided an assessment of major shortcomings understandably overlooked in the early days of development of edge type connectors.

A basic shortcoming has been the lack of structure to adequately provide removable associated leads in conjunction with means for latching such leads against accidental withdrawal. The typical approach has been to provide either a soldering tab which is, of course, not readily removable or a bare conductor or taper pin receptacle not suitable for repeated insertions and withdrawal. A shortcoming in common with the above approaches has been the lack of an insulating structure completely overlying the conductive portions of the connector. This lack practically bars use of such connectors in any environment crowded by other electrical components and leads; the typical environment found in aircraft, ships, and the like.

A further shortcoming has been the lack of a printed circuit card spring member which is readily producible and usable and which at the same time offers a sufficient contact area driven by sufficient contact spring pressure. In one prior art approach, for example, the contact surface for the printed circuit card is defined by raised indentations in the conductive contact member which reduces the total contact surface to that of a single point or at most a few points located along the indentation width. Through this approach contact pressures are of course maximized but unfortunately contact surface wear is so increased as to almost insure removal of precious metal plating from contact surfaces as well as damage to corresponding conductive paths on printed circuit cards. Other prior art efforts have extended the possible contact surface between card path and contact spring by the use of cantlevered arm members angled to coincide with the plane of the printed circuit conductive path. Yet other approaches have made use of bellows type spring members having a length sufficient to provide a relatively long trailing portion to define the contact area. Experience with such spring configurations has shown a tendency for the springs to become set following initial contact with contact terminals of a printed circuit card and in a manner to so reduce spring force as to reduce the qualities of electrical connection below that which is adequate. Additionally, with spring members of considerable length problems have been encountered in maintaining production tolerances to achieve proper positioning of contact surfaces which are well removed through a number of turns from the juncture of spring arm and supporting member. This adversely affects use and reliability. A still further shortcoming of certain prior art edge connectors has been the lack of any facility for changing the contact springs or the associated terminals to thus change the interconnection between card components or replace worn or damaged contact members. In the prior art edge connectors having a facility for replacing contact springs or the associated terminals, a shortcoming has been found with respect to the complexity of insulating and metal parts required to mount and lock the members within the insulating housing block. This has resulted in a complexity of insertion-withdrawal tooling as well as in extending the time required for such and the likelihood of contact damage due to the excessive manipulation required. Still further shortcomings include the required use of polarized terminals for associated leads, the possibility of terminal movement within the connector assembly, the provision of contaminant entry points and overall lack of adaptability to economical production and use.

Accordingly, it is an object of the invention to provide a multipole connector incorporating contact spring members mounted within a protective insulating housing.

It is further object to provide a connector for printed circuit cards incorporating an improved contact spring construction adapted to provide a substantial contact area and at the same time provide a spring contact force which is constant under repeated use.

It is a further object of invention to provide a printed circuit card connector having a contact assembly including card spring contacts, terminal spring contacts with a spring latch for terminals and a spring lock for the assembly all formed of a one-piece sheet stock member.

It is yet a further object of invention to provide a connector having an improved terminal and terminal spring construction in conjunction with an improved latch structure.

It is another object of invention to provide an improved multipole connector featuring terminals, terminal spring members, an associated latch structure and tooling amenable to rapid insertion and withdrawal of the terminal members without part damage.

It is yet another object of invention to provide an improved multipole connector wherein the configuration of contact assembly and insulating housing block is such as to reduce tolerance problems with respect to terminal assembly and use and thereby enhance cost or reliability.

The foregoing objects are achieved by the invention through the combination of an insulating housing block including a series of essentially straight walled transverse cavities having a single projection to cooperate with and retain a series of multipole surface contact spring members. The contact spring members are orientated to receive on one side through a slot the conductive paths of a printed circuit card and on the other side one or more tab terminals connected to associated circuit leads. The
spring contact members fitted within the block are of a unique configuration to both permit the use of a simple one-piece providing and yet provide a means whereby the members are locked therein against accidental withdrawal and relative movement. As an important aspect of the invention the contact members include a unique spring arm configuration for each of four separate functions of contact and mechanical connection. Each contact spring features an embossed stiffening spine and angular disposition to minimize tolerance and set problems and maximize contact area and pressure. The latching spring features a progressive stiffening action and an overtravel blocking feature which combine to provide a reliable but simple captivation of tab terminals and preclude terminal or contact member damage by simplifying tool requirements. Utilizing the above advantages of contact member construction an alternative embodiment is included for extending the utility of the invention to accommodate a greater number of associated conductive lead terminals. Yet a further embodiment is included utilizing certain of the principles of the block and spring construction of the invention to accomplish a commoning function for large numbers of associated conductive leads apart from printed circuit card use. Finally, a tool embodiment of simple construction is included which permits rapid terminal withdrawal of contact conductors shown in the drawings.

FIGURE 1 is a sectional perspective of one embodiment of the connector of the invention showing the general configuration of the insulating housing and contact member mounting features;

FIGURE 2 is an elevational section of the connector embodiment of FIGURE 1 depicting a contact member, its engagement within the housing block and its operation in receiving a printed circuit card;

FIGURE 3 is a section taken along lines 3—3 of the embodiment shown in FIGURE 2 further showing the cooperation of the contact member and housing cavity; and FIGURE 4 is another section showing the contact member of the embodiment shown in FIGURE 2 removed from the housing to depict its latching feature with a preferred construction of tab terminals;

FIGURE 5 is a section taken through the width of the contact along lines 5—5 of FIGURE 4, showing the tab terminal mounting members;

FIGURES 6 and 7 are sectional views taken along the length of the contact member, lines 6—6 and 7—7, respectively of FIGURE 5;

FIGURE 8 is a section taken along the length of the contact member, line 8—8 of FIGURE 9, showing a tab terminal inserted within the terminal spring member of the contact member;

FIGURE 9 is an elevational view of the contact member apart from the block including a fully inserted tab terminal and a partially inserted tab terminal to show the operation of the novel latching feature of the invention;

FIGURE 10 is an alternative embodiment of the connector of the invention showing a modified housing construction in section in conjunction with a modified contact spring member;

FIGURE 11 is an elevational section taken along lines 11—11 of the connector shown in FIGURE 10;

FIGURE 12 is an elevational section taken along lines 12—12 of FIGURE 10;

FIGURE 13 is an end-on view taken from lines 13—13 of the assembly of FIGURE 10;

FIGURE 14 is a perspective of yet a further embodiment of a contact sprung of the connector of the invention adapted for use as a commoning means for numbers of tab terminals and associated conductive leads;

FIGURE 15 is a sectional view of the block embodiment adapted for use with the commoning contact spring shown in FIGURE 14;

FIGURE 16 is an end elevation taken along lines 16—16 of FIGURE 15;

FIGURE 17 is a perspective of an extraction tool embodiment for use with a connector of the invention; and

FIGURE 18 is an elevation showing part of the connector assembly in conjunction with the tool shown in FIGURE 17 in use.

Turning now to a detailed description of the invention, FIGURE 1 shows a fragmentary length of one embodiment of the connector block member of the invention. This member labeled 10 is preferably a one-piece molding of dielectric insulating material of the thermo-setting type, such as, diallyl phthalate, epoxy, phenolic resin or the like. In an actual unit, a glass loaded diallyl phthalate resin was utilized. In practice, block members 10 are made up to accommodate standardized printed circuit card sizes and numbers of conductive paths such as for example, cards having eleven pairs of conductive paths located on the surfaces of the card. It is the usual practice to provide at the ends of block member 10, not shown, mounting flanges apertured to receive members for fastening the block through a suitable opening in a connector panel.

As can be visualized from FIGURE 1, the greater length of block member 10 is along a diagonal axis extending to the right of the figure. Along a side 12, of 10, is a centrally located slot 14 sized to accommodate the insertion of the printed circuit card shown. Reversing slot 14 are beveled ports 15 and 16 which serve the dual purpose of easing insertion of printed circuit cards and eliminating the most frequent point of block breakage.

The opposite edge of block 10 includes a series of rectangular apertures 18, individually defining entry to a series of cavities 20 which extend across the entire width of the block to join slot 14. As can be seen from FIGURE 1, each cavity 20 has a relatively simple interior configuration to thus permit block 10 to be molded in one piece. The relative simplicity of the construction of block 10 compares favorably to the constructions of prior art devices which include numbers of interiorly formed slots, projections and grooves and in certain instances anchoring apertures in the top and bottom walls of the block members. The block member 10, as shown, includes only apertures at the points of entry of conductive paths. The provision of a block having no apertures in the top or bottom walls improves overall connector operation by reducing access for dust, moisture and the like which may contaminate contact surfaces within the connector assembly.

Viewing FIGURE 1 further and additionally FIGURES 2 and 3, cavity 20 is seen to have bottom and top walls 22 and 24 and a side wall 26 which are straight and free of offsets, projections and the like. The end wall 28 partially closing one end of cavity 20 is also of a relatively simple configuration. The side wall 30 which is the other side of the wall 26 of an adjacent cavity has essentially a planar surface construction with a single raised projection 32 extending along a portion of its length with one end near aperture 18. Projection 32 includes a slightly rounded end portion 34 and an opposed abrupt face 36 which serve to lock a spring contact member within cavity 20 in a manner to be hereinafter described.

Wall 30 further includes at the other end a slot 38 aligned with slot 14. The portions 42 and 44 of wall 39 defining slot 38 are spaced apart by the width of slot 14 to accommodate insertion of a printed circuit board as shown in FIGURE 2.

Vertical face 40 of slot 38 is positioned with respect to slot length to serve as a stop to control the depth of insertion of printed circuit boards within the connector. The portions 42 and 44, respectively formed in wall 30 serve to provide printed circuit card support and electrical and mechanical isolation between spring arms of individual spring contacts within each cavity 20. Located between walls 26 and 30 are V grooves such as 48 shown extending out into bevel 15 in the lower part of wall 12. A similar V groove 46 is positioned in the upper walls.
The purpose of grooves 46 and 48 is to provide key-ways to cooperate with keying projections of the printed circuit board. It will, of course, be appreciated that each of the cavities 20 are as described and others would be provided adjacently thereto. As will be readily apparent hereinafter, the relatively straight and uncomplicated surfaces defining each cavity serve to simplify mounting and retaining contact spring members inserted within each cavity. The use of a single projection, such as 32, extending within each cavity 20 as will be hereinafter shown, additionally permits reduction in length during assembly of the contact spring members within the connector block and withdrawal procedures during the replacement of worn or broken parts as well as providing an important simplification of the tooling required for such procedures. All of these factors tend to make both production and use of the novel connector of the invention more economical and add to the over-all reliability of the connector by reducing the opportunity for failure.

The contact spring assembly which represents the embodiment of the invention utilized with the connector block 10 is shown as in FIGURES 2-9. Member 50 is, of course, of conductive metal and preferably of material having spring quality characteristics. In an actual embodiment, member 50 was formed of a piece of contact grade Phosphor bronze blanked, stamped and formed into the configuration shown and thereafter over-plated with a layer of nickel beneath a layer of gold.

Basically, the contact spring member 50 has four separate but related functions including, features to secure the member within cavity 20; spring arms of one configuration to connect with a printed circuit card; spring arms of another configuration adapted to connect with terminals inserted therein and, further spring arms adapted to mechanically latch terminals within member 50. As a first of these features, member 50 includes as shown in FIGURE 5 a centrally disposed wall 52 joined by intersecting walls 54 to define channel 56, considerably wider and slightly deeper than similar dimensions of projection 32 extending within cavity 20. Extending within channel 56 is a cantilevered spring member 58 struck inwardly from wall 52 to define a face 60 adapted to cooperate with face 36 of projection 32. Referring to FIGURES 2 and 3, limit the leftward axial movement of 50 within block 10. The width of face 60 is preferably made sufficiently large as to define a bearing area with face 36 so as to avoid tolerance problems and provide a sufficient area of contact to prevent excessive axial loading of 58 from causing 60 to bite into or break off portions of 32. The inward disposition of 58 is preferably sufficient to place 60 well down on face 36 for the same reason. The length of 58 relative to the thickness of the material is preferably made such as to define a still spring action since the principal function of 58 is to lock contact 50 within block 10 rather than to latch such member in a manner adapted for frequent use of spring characteristics. This may be better appreciated by considering that as a matter of practice member 50 would rarely be inserted, removed and reinserted since removal would only be for the purposes of replacing a worn or broken part.

As an extension of wall 52, a tapered portion 62 is provided extending longitudinally along the wall center line away from 56 and formed outwardly as shown in FIGURE 2. The taper will be characterized at an end 64 with a maximum excursion at a point 66. From point 66 extension 62 curves back inwardly through the plane of 52 to define a flange 68 having an interior face 70 adapted to cooperate with a face on the end of 34 of projection 32. As will be apparent from FIGURE 3, the distance between face 70 and face 60 of spring 58 is substantially that of the length of projection 32 to resist axial movement and thus hold member 50 within block 10 against the forces of insertion and withdrawal of the printed circuit board and tab terminals. Disposed along the center of extension 62 is a rib 72 struck inwardly with respect to channel 56. Rib 72 serves to strengthen portion 62 and to define a surface 73 within channel 56 which cooperates with the surface of 32 and with point 66 to lock member 50 against relative transverse movement to the walls of cavity 20. This is shown more clearly in FIGURE 3 wherein the combined width of the maximum excursion defined by point 66 and surface 73 is such as to hold spring 58 within cavity 20 between the faces of wall 26 and projection 32. As will be apparent from FIGURES 2 and 5, exterior portions of 60 forming the walls from which the spring members for the printed circuit card are extended and dimensioned in length and width to provide additional support for 50 through a bearing relationship with bottom and top walls 23 and 24 as well as with side walls 26 and 30. Thus, from the channel 56 formed by walls 54, the material of 50 extends outwardly parallel to 52 to form a wall 74, thence upwardly parallel to walls 54 to form a wall 76 and inwardly again parallel to wall 52 to form a wall 78. Walls 74, 76, 77 and 78 and with point 68 form receptacles 80 and 81 on either side of channel 56. In each wall 74 and 73, there is an embossment struck inwardly such as 75, shown in FIGURES 5 and 6, with respect to receptacle 60. Embossment 75 extends along a substantial portion of member 50 and along a substantial width of wall 74 and serves to strengthen the receptacle and member 60. Its most important function is however, to define a contact surface area for the engagement of a tab terminal inserted therein. From FIGURE 5 it should be apparent that the walls 73, 74, 75, 77, 78 and 79 define an external cross-sectional configuration of member 50 adapted to place considerable surface area against the walls of cavity 20 to secure 59 against relative transverse movement.

With the general features of member 50, with respect to maintenance within cavity 20 now in mind, the improved printed circuit contact spring of the invention will now be described. Referring to FIGURES 2, 3 and 4, a description of the upper contact spring arm will be given with the understanding that the lower spring arm is identical in structure and function. As can be seen from FIGURE 2, the arrangement of the printed circuit spring arms 84 and 104, is such as to define surfaces extending down within the path of travel of a printed circuit board and the conductive paths 112 and 114 on the top and bottom surfaces thereof. The related position of the spring arms as shown in FIGURES 4 and 9, is such that upon insertion of board 110, the conductive path 112 will engage and press against the upper spring member 84 and the lower path 114 will similarly work against the lower spring member 104 and provide interconnection to components electrically connected to such conductive paths.

As will be further apparent from FIGURE 2, spring arm 84 is an integral extension from wall 76; the wall being extended outwardly to define an overhang 86, a first arm portion 88, a bend 92 and a further arm portion 93 defining the contact surface areas. Arm 93 includes a section 94 joining a relief or pocket 96, a section 98 and a turned up portion 100. The contact surface areas for arm 84 are defined by the underside surfaces of sections 94 and 98.

At the juncture of arm 84 and extension 86 is a support portion 87 extending outwardly from wall 74, to point 84. Support portion 87 is included, particularly to ruggedize the spring members by strengthening the support of the arm at the point most likely to fail. Within the center area of extension 86 and extending out along the substantial length of arm portion 88 is a tapered embossment 98, shown in FIGURES 4 and 6. Embossment 98 serves to substantially stiffen not only
the point of juncture of arm portion 88 and extension 86, but also to strengthen 88 and provide improved spring characteristics therein. The provision of a reversed bend 82 along the surface of 88 toward 92 results in a stiffening action which is gradually reduced per unit of spring length. This has been found to provide a greater degree of bending of the outer portions of 88 which feature serves to maintain substantial contact pressure without permitting the spring member 88 to assume an unwanted set; particularly after use with oversized printed circuit cards.

As a most important advantage of the spring arms of the invention, each arm portion 88 includes a bow inwardly as shown in FIGURE 2. It has been found that the provision of even a slight inward bow greatly enhances the ability of the spring action to provide sufficient and constant contact pressure and at the same time act to reduce the stress which tends to set and even break the spring arm at its point of support. The inclusion of a straight section or an outward bow of the configuration of the arm when found to concentrate the bending moment and incident strains to the point of juncture of the arm, rather than at some point along the middle of the arm.

The bend 92, is maintained with a substantial interior radius characteristic as shown in FIGURE 32, for initial spring movement to a point toward the middle of arm portion 88. There is of course, a bending moment of arm 93 about bend 92, but the inclusion of a large radius bend has been found to effectively delay such until the board is substantially inserted. This operates as follows. Spring arm 92 carrying the contact surfaces has a relaxed configuration as shown in FIGURE 9, such that as board 110 is inserted, the end thereof strikes the section 94 first. This causes spring arm movement upwardly of the outer portions of 88, with little or no spring movement of 93 about bend 92.

Another point of board 110 engages section 98 of 93 effecting a slight further upward movement, of arm portion 88 and upward movement of 93 about 92, followed by a downward movement of 92 and 94 which action operates to bring both contact surfaces into firm contact with the printed circuit conductive path 112. The pocket 96 of the conductive path surfaces serve to define a reservoir to entrap dust particles and other loose material wiped from the contact surfaces during engagement of board 110. The turned up end 100 assures that no sharp edge or burr left from the blanking or stamping operation will damage the printed circuit conductive path during insertion, and particularly withdrawal of board 110.

By providing the inward bow in arm portion 88, the desired operation above described is assured. Additionally, by having a positive requirement of an inward bow, the presence of an outward bow is absolutely precluded, which would not be the case if the spring specifications called for a straight section at a given tolerance which could permit a slight outward bow. The outward bow condition is considered as the worse case with respect to causing spring set and incident reduction of contact surface pressure. It has been found that the presence of an outward bow in portion 88 will almost assure that only the forward section 98 will be in contact with the printed circuit card path 112; the section 94 being raised as the spring arm portion 88 bends about its juncture with extension 86.

The next bow to FIGURES 4 and 5, generally, and FIGURES 6, 7 and 8, specifically, the structure and operation of the spring contact members adapted to accommodate tab terminals will be described. As can be seen from FIGURES 4 and 5, assembly 50 includes two contact spring members 130 and 132, which are substantially identical in function and structure. As can also be seen from FIGURES 4 and 5, each spring arm is an extension of a wall portion adjacent wall 54, such as 78 with respect to member 120. The member 120 includes a cantilevered arm 122, having a substantial portion of its length, a tapered rib 124, with the taper extending toward the free end of the arm. The end of the arm is turned upwardly as at 126 to positively preclude damage to a tab terminal by burrs or sharp edges incident to stamping and blanking. Rib 124 is structured an outwardly extending portion of 122 at the point most likely to fail; namely the point of juncture of the arm with wall 78. Additionally, rib 124 operates to compound the spring moment of the spring arm by forcing the forward portion of the arm including the contact surface 130 to initially swing upwardly about the end of the taper prior to the arm moment about the juncture with wall 78 to force surface 130 against the surface of a terminal. As a further point, and as can be seen from FIGURE 8 the embodiment 75 opposite arm 120 is of a height such as to define travel for a tab terminal such as 140 along the center line of the receptacle 80 and of a length such that the insertion of 140 provides a spring operation wherein the rear portion of arm 120 including the contact surface, 128, is brought to bear against the surface area between spring and terminal. The provision of a bevelled entry point 144 to effectively facilitate insertion arrangement wherein the tab terminal 140 has a travel along the center line of the receptacle operates to ease insertion procedures.

The tab terminals utilized with spring member 50 are identical with respect to each other and engagement within receptacles 80 and 144. The preferred construction is shown in FIGURE 4, with respect to terminal 140 to include a blade 142 of rectangular cross-section, having a blade tip 144 bevelled inwardly from all four walls. At the opposite end are projections forming stops 146 and 147 extending outwardly beyond the width of the blade to define a width dimension from outer edge to outer edge approximating that of the receptacle 80 as measured from the outside of the walls 76 and 54. The forward and rear outer edges of stops 146 are abrupt surfaces perpendicular to the longitudinal axis of blade 142. The rear edges of each stop lead into a needed down extension of the strength at the point of juncture between the blade and an integral lead connecting portion including ears 150 adapted to be cramped inwardly against the conductive strands of a stripped cable 154. The extension includes a cable support barrel 152. The terminal 140 is formed of a flat-stock material, formed inwardly and blanked into a configuration with the ears 150 extended upwardly prior to crimping. In an actual unit the terminal was formed of brass, bronze or the like plated with nickel or plating with gold. After a suitable stripping of the end insulation of the conductor 154, and insertion through 152, ears 150 are formed inwardly as by crimping to terminate the conductor to the blade.

Turning now to the advantages of the immediately foregoing features and to a final feature of the member 50, FIGURE 9 shows the latching operation which serves to secure tab terminals against accidental withdrawal. Formed as an integral extension from 68 are two arms 162 and 172, which are identical to accommodate terminals 140 and 160. Describing only 162, there is included at the point of juncture with 68, a reverse bend 164 which extends inwardly toward the center axis of member 50 and then outwardly to include a spring section 166 having a face 167 adapted to cooperate with the rear stop 147 to lock 140 within receptacle 80. Proximate end face 167 there is included an outward projection 168, as better shown in FIGURE 4, which prevents arm 162 from being driven inwardly past the edge of tapered portion 62. This operates to preclude 162 from being disabled by excessive bending caused by insertion and withdrawal of a
terminal or through the tool blade used for such. The reverse bend 164 defines a point of contact 170 with the upper surface of projection 32 such that the spring moment of 162 is made sufficiently stiff to firmly latch 140 in position but yet permit repeated deflection for changing terminals. It has been found that the inclusion of the reverse bend 164 to define a spring action from point 170 substantially reduces the liability of deflecting a spring arm at the point of juncture with 68. In operation, as the terminal is inserted within receptacle 50 the edge of the stop 147 strikes the outer surface of the spring member 162 and cams the spring inwardly to permit complete insertion. As the terminal homes within the receptacle and the faces thereof abut the receptacle faces, the width of the stop permits the spring arm to snap outwardly against the back face of the stop to latch and snub the terminal against withdrawal.

An important feature of the terminal latching engagement of the invention is that the terminal members may be inserted without regard to polarization. The parallel blade construction of the terminals in conjunction with stops on both sides of the blade permits latching by 162 or 172 with the terminal oriented in either of the positions shown in FIGURE 4. Providing a terminal and latch configuration such that the terminal receptacle 130 is not regarded without regard to polarization, greatly facilitates assembly and withdrawal procedures as well as simplifying tooling requirements. This will be more fully described with respect to FIGURES 17 and 18 hereinafter.

Turning now to an alternative embodiment of the invention, FIGURES 10–13 show a connector having a pair of tab terminals for each printed circuit card conductive path. The alternative embodiment shown as connector 198 in FIGURE 10, is comprised of an insulating housing 161 of dielectric material having a rear terminal housing portion 152 and integral therewith, a forward spring arm housing portion 184. The rear portion 152 includes a pair of cavities 186 and 188, extending through the width of 182 to join a common cavity 190 within portion 184. The outer wall of 184 is provided with a slot 192 adapted to accommodate the insertion of a printed circuit arm 196, having upper and lower paths 198 and 200, respectively. Surrounding slot 192 is a beveled portion such as lower part 194 similar in function to the bevel 15 and 16, above described. Within cavity 190 are wall portions 202 and 204 extending inwardly to define a bearing surface for printed circuit board 196 and to isolate and insulate the contact spring members from adjacent contact members. Located within each cavity is a projection similar to the projection 32 described with respect to the embodiment of FIGURE 1. As can be seen from FIGURE 11 with respect to the pair of cavities 186 and 188, the projections 206 and 208 respectively extend from opposite walls of the cavities. This permits the use of an identical spring contact member for each cavity. Dividing cavities 186 and 188, is a common wall portion 219 extending along the length of 182 to define opposite slots 192 a bearing surface 212 as shown in FIGURE 10 adapted to receive and block inward movement of the spring arms of the contact members. Through the provision of the end 212, the spring arms are positively prevented from contacting each other to cause an electrical short between the circuit path in the upper part of the assembly and the path in the lower part. A vertical face 214 is provided at the end of 210 to act as a stop against which the end of printed circuit board 196 will operate.

Provided in the outside portion of each cavity is an offset such as 216 to define a face 218 adapted to serve as a locking surface to prevent withdrawal of a contact member from the cavity. Further included adjacent offset 216 is an aperture 220, adapted to receive a tool blade utilized to withdraw a contact member from the cavity. Cavity 188, of course, includes portions similar to 216, 218 and 220, as shown in FIGURE 10. A face 222 is provided extending up from each cavity projection to act as a stop against which each contact member is held against axial movement developed by withdrawal of a printed circuit board. Further included within each cavity and as better shown in FIGURE 13, is a projection 224 extending along the cavity centerline to join a raised ledge 226 which cooperates with the opposite wall of a cavity to support the latching portion of the spring member within the cavity. As can be seen from FIGURE 10, the connector block, 181 is of a construction which may be manufactured in a one-piece molding to assure integrity of the unit. Note also that there are no apertures on the top and bottom walls of the block section 182 to provide access for dust or other contact surface contaminants.

Within each cavity is an identical contact member such as 230 shown within cavity 186. The spring members include, referencing now FIGURES 10 and 11, a central wall 232 joined by side walls 234 to define a channel member 236 adapted to cooperate with center projection 206 to key insertion of the contact member and support such against transverse movement relative to the housing. From the ends of walls 234 extend walls 238, 240 and 242, to define on one side, a terminal receptacle 250 and a similar structure on the other side to define a terminal receptacle 252. The wall spacing is such as to define bearing surfaces with the appropriate cavity walls and the upper wall 240 shown in FIGURE 10 includes an extension having a reversely struck out spring member 254 relative to the material thickness, which is such as to define a relatively stiff spring action to lock rather than latch assembly 236 within the cavity 186.

As an extension of wall 232, there is provided as shown in FIGURE 13 an alternative latching construction consisting of a wall 260, having at its end a formed U-shaped portion 262 with each wall of the U including a spring member extending back toward the printed circuit spring arm 264 of the contact member. Each spring member 264 and 266 as shown in FIGURE 10 is formed inwardly such that the members are in light contact and then bow outwardly to define end faces such as 268, adapted to engage the stop of tab terminals inserted within the contact member 236. One such terminal member is shown engaged in the upper cavity 186. The latching embodiment shown in FIGURE 10 has the advantage of occupying less width than the embodiment shown and described relative to FIGURE 9. It has been found that the provision of the spring arms 264 and 266 contacting each other, the bowed portion operates with similar advantages to those of the embodiment above described; namely that a relatively stiff but workable spring action is defined with unwanted set or breakage at the point of juncture of the spring arm and its support 262 eliminated. The member 230 is adapted to receive tab terminals such as 270 in one or both of the receptacles 250 and 252 to contact terminal spring arms 272 and 274, respectively. Arms 272 and 274 are identical in structure and function to arms 130 and 132 described with respect to FIGURES 4–8. The printed circuit spring arms, shown in FIGURE 10 as 280, are essentially the same as the spring arms defined with respect to FIGURE 2, except that only a single spring arm is provided for each contact member 230 and the arm is oriented outwardly rather than inwardly. Additionally, the arm end 282, is formed as indicated to engage the forward portion 214 to prevent contact with the opposing spring arm of an adjacent member 230.

With the embodiment shown in FIGURES 10–13 and only a slight more complicated housing block plus a pair of identical spring members, the utility of the invention is considerably extended with respect to the number of circuit paths accommodated. The principal advantages hereforewith described with respect to the embodiment of FIGURE 2 are carried forth in the em-
bodiment shown in FIGURE 10. In both of the above embodiments, as well as in the following commoning block, all conductive material is disposed well within a protective overhang of dielectric material. In all embodiments the principal faces defining the latching of terminals are metal rather than one face metal and an opposing face dielectric.

Turning attention to yet a further embodiment of the invention, FIGURES 14, 15 and 16, show a connector commoning block adapted to accommodate members of terminal paths apart from any use with a printed circuit card. In FIGURE 14, a contact spring assembly 300 is shown to include a one-piece metal stamping with identical individual spring members 301 joined by an integral bus formed of bars 310 and 314. The composite assembly including numbers of members 30, is adapted to be fitted within a common insulating housing 330 shown in FIGURES 15 and 16. As can be seen in FIGURE 14, each member 300, is comprised of a body portion 302 having a central forward extension 303, including a locking spring 304 and a latching spring assembly 305, which is essentially identical in function and arrangement to the locking and latching structure shown in FIGURES 2, 4 and 8. Extending along each side of 303 are walls defining a receptacle similar in function to the receptacles 80 and 81, described with respect to FIGURE 5. Positioned within the receptacle formed by channel 306 is a terminal spring member 307 which is identical in structure and similar in function to the spring member 120 described with respect to FIGURE 4. The operation of each spring member such as 307, with respect to the contact of a tab terminal, is reversed from that shown in FIGURES 6, 7 and 8, in that the insertion is from the opposite end of the spring as indicated in FIGURE 14 by the dotted line, with respect to tab terminal 308. The channel 306, includes in its lower wall, an embossment similar to that shown in FIGURES 6, 7 and 8, to define an axis of insertion along the geometrical center of the channel in the same manner as shown in FIGURE 6. With the blade of the tab terminal 308 fully inserted within channel 306, the contact interface between the tab blade and the spring member and lower embossment is essentially as shown in FIGURE 8, with the blade, of course, relatively oppositely oriented. The latching feature is as shown in FIGURE 9, with the latching stop 309 engaged under the adjacent spring member of assembly 306. Formed from assembly 309, and extending out of the channels defining tab receptacles are integral bus members 310 and 314. The forward bus member 310 includes a bevelled and downwardly formed portion 312 to permit clearance at the point of insertion of the tab terminal and thus avoid any possibility of interference with terminal insertion. The rear portion of 302 includes a transverse wall 316 relieved as at 318 to cooperate with the interior surfaces of a complementary cavity in an insulating block housing.

The housing shown as 320 in FIGURES 15 and 16 is a one-piece molding of thermosetting material such as glass-filled dialyl phthalate comprised of the side walls 334 and 336 connected by a common back wall 335 and including a dividing wall 340. The housing 320 is, through such construction, capable of accommodating two assemblies 300 having members 301 in proper alignment being understood that the housing could be made in one half as along the dotted line of FIGURE 15 to accommodate a single strip of contact member. Extending inwardly from each outer wall 335 and 336, are projections such as 338 and 340 which are disposed to define faces 335 and 337 spaced to receive the inner face of each assembly 305 and a contact spring 304 to lock the contact member and strip within the housing. The operation of each projection is identical to projection 32 described with respect to FIGURE 2. Projections 344 from wall 340 are included to provide support for each contact member. As can be seen from FIGURES 15 and 16, each contact member or strip of contact members is inserted within the insulating block with the projections 344 fitted within the space between adjacent spring members 301 and with the projections 354 fitted within the relief 350 shown along member 300 to engage the contact spring 304 and the end of assembly 305 to lock the assemblies within the block. With assemblies of the type shown in FIGURES 14, 15 and 16, commonden interconnections are provided between conductive leads attached to tab terminals inserted in any contact assembly. As one of the advantages of the invention, attributable to the novel latching arrangement, the tooling required for insertion and withdrawal is greatly simplified. From the general description above given, it will be apparent that no special tool is required to insert the tab terminals within the assembly. The conductive lead portion adjacent a tab terminal may be gripped and the terminal inserted in the appropriate aperture until the terminal stop is engaged and latched by the spring member. Due to the arrangement of parts, this insertion procedure may be performed with regard only to the orientation of the blade with respect to the slot; an orientation which is identical to aperture length.

FIGURE 17 shows a tool prepared for use in withdrawing tab terminals from the connector assemblies herebefore described. The tool 350 is comprised of a metal channel U-shaped along a substantial portion of its length and including at one end, a pair of tynes 352 and 354. The tynne 352 is as shown in FIGURE 18, approximately twice the length of tynne 354, as measured from the body of the tool, and each is slightly less in width than an aperture such as 18 in FIGURE 1. Both tynes are relatively short as compared with prior art devices and for this reason tool breakage is substantially minimized and tool manipulation is simplified. As can be seen, the tool construction is quite simple although not fragile. In an actual embodiment, the tool was formed of spring steel sheet stock blanked to a flat configuration and folded into the channel shape and thereafter spring tempered and given a protective coating of gun metal bluing. It desired, a handle as shown by the dotted line in FIGURE 17, may be provided on the end of the tool opposite to tynes 352 and 354, although such is not necessary for its use.

FIGURE 18 shows the operation of the tool in a preferred manner to extract a tab terminal. In such use one terminal at a time is extracted by positioning the tool as shown in FIGURE 18, with the longer tynne 352 inserted in a block aperture against the terminal to be withdrawn. The adjacent terminal may be extracted by merely reversing the tool and procedure indicated in FIGURE 18. During the extraction, the preferred manner for use of the tool is to grip the tool between the thumb and forefinger and firmly insert 352 fully inwardly to butt against the stop of the terminal; against 364 of 362. In this position, the spring member such as 366 of the contact member will be depressed. Then, with forefinger pressing the lead against the tool the terminal and lead can then be withdrawn, the bottom portion of the tynes acting to parallel withdrawal of the terminal past the end face of the latching spring. As a part of the novel construction of tool 350, the lower tynne 354 serves to prevent misorientation of the tool such that 352 could be damaged to the latching spring member. The spacing between 352 and 354 is such to place 354 lightly against the lower portion of the latching spring as the tool is fully inserted. The latching assembly and tool arrangement is such as to avoid stressing the contacts of the printed circuit board at any time during the above procedure. In order to fully develop a preferred form of the in-
vention, the foregoing description has been in considerable detail and should enable one skilled in the art to readily practice the various embodiments following the specification and the drawings. As will be apparent to those skilled in the art, certain aspects of the invention may readily be directly employed to provide features identical in function and equivalent in structure. For example, with respect to the latching feature of the invention, the specification has detailed a receptacle and tab terminal configuration wherein the tab extends rectangular in cross-section and includes a blade contact surface. The concept of providing a latching spring which latches metal to metal rather than metal to a plastic part of a housing and includes a snubbing action may be adapted to receptacle and terminal configurations other than that shown. For example, the terminal blade could be of a cylindrical or even tapered shape such as a solid pin, with a complementing receptacle having interior surfaces such as to receive the pin and further including at the base of the pin, a rim operating as the stop of the device. In such event the block housing cavities would be of a configuration such as to receive the alternative receptacle configuration.

In each of the embodiments above given a dual assembly has been shown capable of accommodating a pair of terminals. It is fully contemplated that half of the structure shown could be utilized to accommodate and latch a single terminal per contact spring assembly. As modified, this unit could be utilized with the common block embodiment or could include a single printed circuit contact spring of the configuration shown. In such case the insulating block would merely be modified to support the assembly in a manner similar to that shown.

It has also been found useful to practice the invention in a form wherein there is a single cavity within an insulating block including a single contact spring member of the type shown in FIGURE 2 as a test probe to printed circuit board devices or as a common path from a board upper conductive path to a board lower conductive path through a common conductive lead having the terminals at each end inserted in the receptacles of the spring member.

Changes in construction will occur to those skilled in the art and various apparently different modifications and embodiments may be made without departing from the scope of the invention. The matter set forth in the foregoing description and accompanying drawings is offered by way of illustration only. The actual scope of the invention is intended in the following claims when viewed in their proper perspective against the prior art.

We claim:

1. An electrical connector comprising an insulating block having at least one cavity therein including oppositely facing transverse surfaces in said cavity, at least one conductive spring member of a geometry to fit within said cavity and engage cavity walls for bearing support and including a transverse surface and a locking spring adapted to bear against said oppositely facing surfaces to lock said member against axial movement in said block, each spring member further including at least two receptacles each having side walls and a bottom wall with a spring arm extending along the receptacle and proximate to the bottom wall at the end thereof, each spring member further including a rigid channel having a projection extending axially between said receptacles and outwardly from the entrance of said receptacles, a pair of latch members formed from the end of said projection to each extend obliquely back toward the receptacle entrance with the latch member end proximate and spaced from the receptacle entrance and in the path of travel of insertion of a terminal relative to said receptacle, a number of terminal members attached to conductive leads each including a contact surface portion adapted to fit within a receptacle to engage a receptacle spring member and bottom wall, each terminal member further including proximate the base thereof a transverse surface extending outwardly beyond a wall of the receptacle such as to be engaged by the latch member spring arm to latch the terminal within the receptacle.

2. An electrical connector comprising an insulating block having at least one cavity therein including oppositely facing transverse surfaces, at least one conductive spring member of a geometry to fit within said cavity and engage cavity walls for bearing support and including a transverse surface and a locking spring adapted to bear against said oppositely facing surfaces to lock said member against axial movement in said block, each member further including at least two receptacles each having side walls and a bottom wall with a spring arm extending along the receptacle and proximate to the bottom wall at the end thereof, each spring member further including a rigid channel having a projection extending axially between said receptacles and outwardly from the entrance of said receptacles, a pair of latch members formed from the end of said projection to each extend obliquely back toward the receptacle entrance with the latch member end proximate and spaced from the receptacle entrance and in the path of travel of insertion of a terminal relative to said receptacle, a number of terminal members attached to conductive leads each including a contact surface portion adapted to fit within a receptacle to engage a receptacle spring member and bottom wall, each terminal member further including proximate the base thereof a transverse surface extending outwardly beyond a wall of the receptacle such as to be engaged by the latch member spring arm to latch the terminal within the receptacle.

3. An electrical connector comprising an insulating block having a plurality of cavities in side-by-side relationship therein each including a projection centered in one of the side walls of the cavity and extending along a substantial portion of the cavity length, a contact spring member fitted within said cavity including a channel member of a dimension to fit over and in engagement with said projection to be supported thereby within said cavity, said spring member having means therein adapted to engage transverse surfaces formed in said block to lock said spring member within said block, a pair of receptacles disposed on either side of said channel member, each receptacle including a cantilever spring member biased inwardly of said receptacle to a point proximate a bottom wall of said receptacle and side walls defining at one end of said receptacle stop surfaces to limit the insertion of a terminal within said receptacle, the said channel member having a rigid projection axially extending in offset relationship between said receptacles outwardly from the entrance of said receptacles, a pair of receptacles including at the end of the end of said projection and each extending backward and outwardly toward the entrance of a receptacle with the other thereof in the path of travel of insertion of a terminal within a receptacle, terminal members adapted to be inserted in said receptacles having forward contact portions to engage the associated cantilever spring member therein and a rear transverse surface adapted to be engaged by the associated latching spring to hold said terminal within said block.

4. The connector of claim 3 wherein the said block includes an opening extending between each said cavity and each said spring member includes a portion extending through said opening to join an adjacent spring member to electrically common all of the spring members of said block.

5. An electrical connector comprising an insulating block having at least one cavity therein including oppositely facing transverse surfaces, at least one conductive spring member of a geometry to fit within said cavity and engage cavity walls for bearing support and including means to lock said spring member within said cavity by engagement of said transverse surfaces, each spring member further including a pair of receptacles including side walls and a bottom wall with a spring arm extending along the receptacle and proximate the bottom wall at the end of said projection and each extending backward and outwardly toward the entrance of a receptacle with the other thereof in the path of travel of insertion of a terminal within a receptacle, terminal members adapted to be inserted in said receptacles having forward contact portions to engage the associated cantilever spring member therein and a rear transverse surface adapted to be engaged by the associated latching spring to hold said terminal within said block.
thereof, the bottom wall of each said receptacle including an embossment struck inwardly of said receptacle and extending along a substantial portion of the receptacle length to stiffen said receptacle, a U-shaped channel formed between each said receptacle of an extension of the inside side wall of the receptacles, said channel including a projection extending axially outward of the entrance of said receptacles, said projection having an embossment extending therealong to stiffen said projection against bending movement toward the axis of insertion of a terminal member in each receptacle, said projection having formed as an integral part of the end thereof a pair of latching spring members each extending backward and toward the entrance said receptacle and outwardly of said projection such that the latching spring arm end is in the path of travel of a terminal inserted within said receptacle to engage said terminal and latch such within said receptacle.

6. An improved connector contact spring adapted to be fitted and held within the cavity of insulating block, said contact spring being a one-piece formed member of relatively thin metal stock to include a rigid channel having a web joining side walls adapted to fit over and be supported by a projection of the cavity in said block at points along the longitudinal portion of the channel length, a receptacle including a side wall formed of a side wall of said channel, a further and spaced side wall, a bottom wall, and a spring arm extending along said receptacle with the end proximate said bottom wall adapted to contact and hold a terminal member in engagement therewith, a channel web including a portion stiffened against bending relative to said channel and receptacle extending axially from the entrance of said receptacle and offset to the axis of terminal insertion within said receptacle, said portion including a spring latch extending back toward the receptacle entrance and angled obliquely to the axis of terminal insertion with the spring latch free end positioned proximate the receptacle entrance to engage and hold against a rear face of a terminal inserted within said receptacle.

7. A contact spring for use in an insulating block of the type adapted to receive and form a connection with a terminal having a forward contact portion and a transverse face at the rear thereof, the said spring including a receptacle having side walls and a bottom wall formed from a folded portion of one of said side walls to extend along said wall with the end thereof proximate the bottom wall and of the channel inserted in said receptacle, held such under spring pressure in engagement with said bottom wall, the other receptacle side wall being formed from a folded portion, the body of which extends in a plane parallel to said bottom wall to resist bending movement thereof in a transverse plane, the other side wall folded portion having a co-planar section extending outward axially from the entrance of said receptacle, said section including a further portion folded over and extending toward the entrance of said receptacle and in a plane oblique to said other receptacle side wall with a free end thereof proximate the receptacle entrance, said further portion forming a latching spring with said free end adapted to engage a transverse face of a terminal inserted in said receptacle and hold the terminal against withdrawal and in contact with said receptacle.

8. An improved electrical connector comprising an insulating block having a plurality of cavities each including a projection, a plurality of contact spring members each of a geometry to fit within a cavity and to engage the walls thereof in bearing relationship therewith and including a central channel having a transverse face at one end and a locking spring member positioned inwardly and spaced from said face by the length of said projection such that said face and locking spring member engage said projection to limit said axial movement of a contact spring member, said contact spring member further including a pair of receptacles each including a cantilever spring arm extending within the receptacle, terminal members including a forward portion of a geometry to fit within each receptacle engaging the cantilever spring arm thereof and a rear portion including stops extending outwardly beyond the width of the receptacle to limit insertion of the terminal member, a projection common to each receptacle extending outwardly in an axial sense relative to said receptacle and carrying said transverse face at the end thereof, a pair of latching springs integral with the material of said transverse face each having the free end thereof extending in the path of travel of the terminal member inserted within the receptacle to engage a rear face of a stop thereon and latch the terminal member within said receptacle.

9. An improved connector spring of the type adapted to receive terminals connected to conductive leads including a spring body having at least one terminal receptacle with wall members adapted to support an inserted terminal and a cantilever spring member carrying a contact surface extending along said receptacle and inwardly of said wall members to contact a terminal inserted therein, a rigid support member extending axially out from the said receptacle and integral with the material thereof, a latching spring member being positioned at the end of said rigid support portion and angularly disposed to the axis of insertion of a terminal member in said receptacle with the end of said latching spring member being positioned in the path of travel of said terminal and with the latching spring member being of a length as to be cammed about the fixed end of said support to snap outwardly against a back face of the terminal latching said terminal in said receptacle.

10. The connector spring of claim 9 wherein said latching spring member includes a portion proximate the end thereof of a side projection extending in overlying relationship to said rigid support portion to engage such upon deflection of said spring during insertion of a terminal to limit the inward movement of said latching spring member and prevent spring overstress.

11. An electrical connector spring adapted to be fitted into the cavity of an insulating block and to interconnect lead terminals to conductive paths on a printed circuit card, the said spring being comprised of a one-piece thin metal construction to include a central channel and a pair of receptacles, the channel having sidewalls each of which forms a side wall of a receptacle to structurally integrate the channel and receptacles, a rigid and integral projection extending from the channel centered between said receptacles and including formed proximate the projection end a pair of latching springs each within an end extending back and proximate the receptacle entrance to engage and latch a terminal inserted in said receptacle, at least one further spring extending outwardly from the end of said connector spring and integral therewith adapted to engage and contact the conductive path of a printed circuit card.

12. The connector spring of claim 11 wherein each receptacle includes an embossment extending axially therealong to stiffen the receptacle and the said further spring includes an embossment extending axially therealong and into and on a side wall of a receptacle to strengthen the point of juncture of the further spring and the remainder of the connector spring.

13. A connector for interconnecting terminal leads to printed circuit card conductive paths including an insulating block having upper and lower rows of parallel cavities disposed in side-by-side relationship, the upper row being separated from the lower row by insulating material on one side of the block and joining the lower row through a recess on the other side of the block, a slot in said block on said side adapted to receive on printed circuit card, a conductive spring member in each cavity including a pair of receptacles each adapted to receive a terminal attached to a lead, a projection integral with each spring member and common to each receptacle of a given spring, said projection having formed thereon a pair of
Latching springs adapted to engage the rear of a terminal and latch such within a receptacle, each spring member further including a contact spring member integral with a pair of receptacles and extending from an and opposite said projection through a said recess into a position in alignment with said slot to engage the conductive path of a printed circuit card.

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JOSEPH D. SEERS, Primary Examiner.

W. DONALD MILLER, Examiner.