

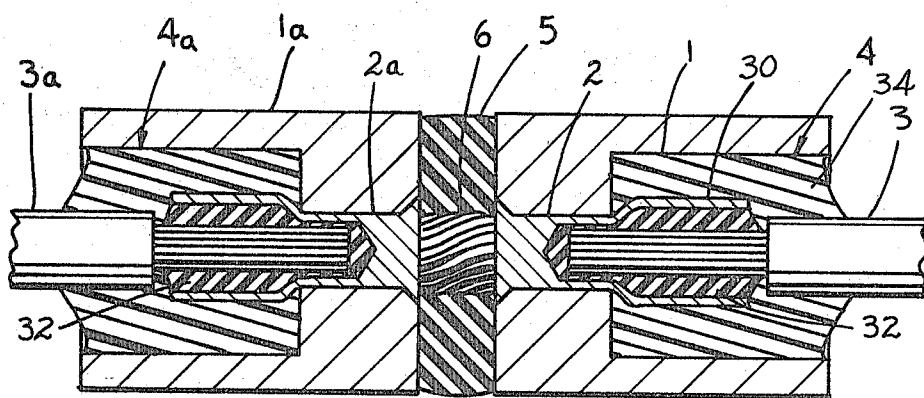
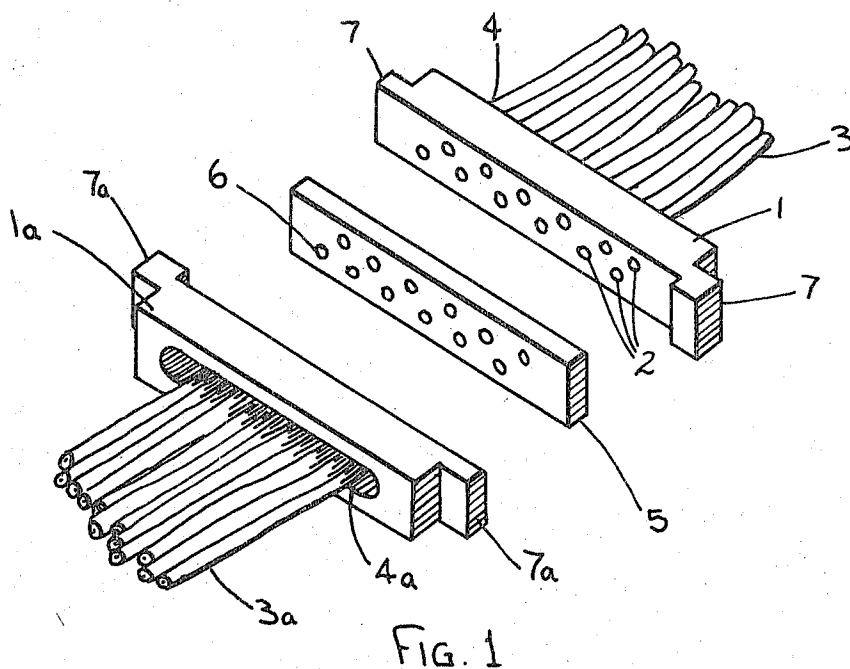
June 6, 1967

J. V. MILLER
ELECTRICAL CONNECTORS

3,324,445

Filed April 13, 1964

3 Sheets-Sheet 1



INVENTOR: Jack V. Miller

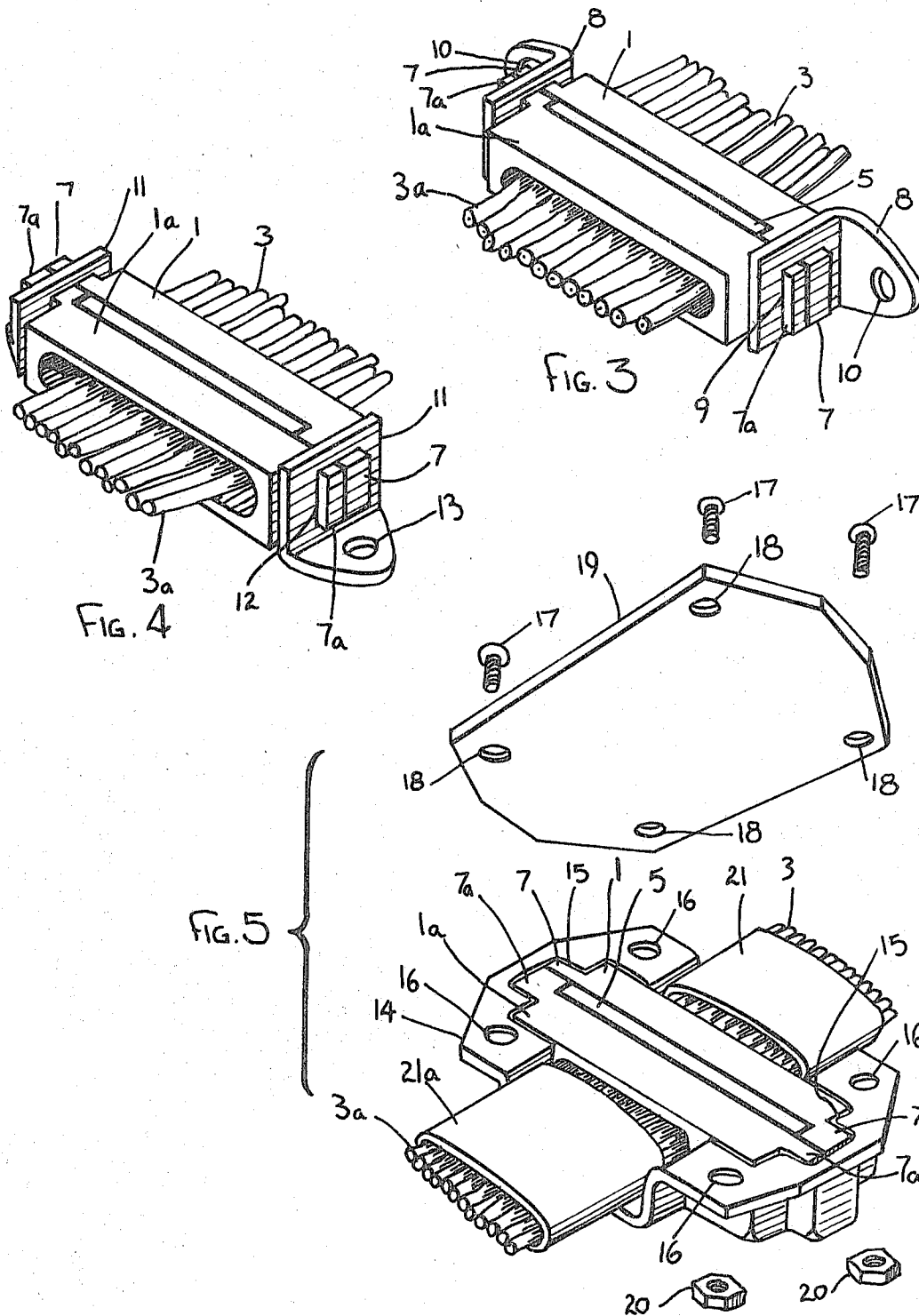
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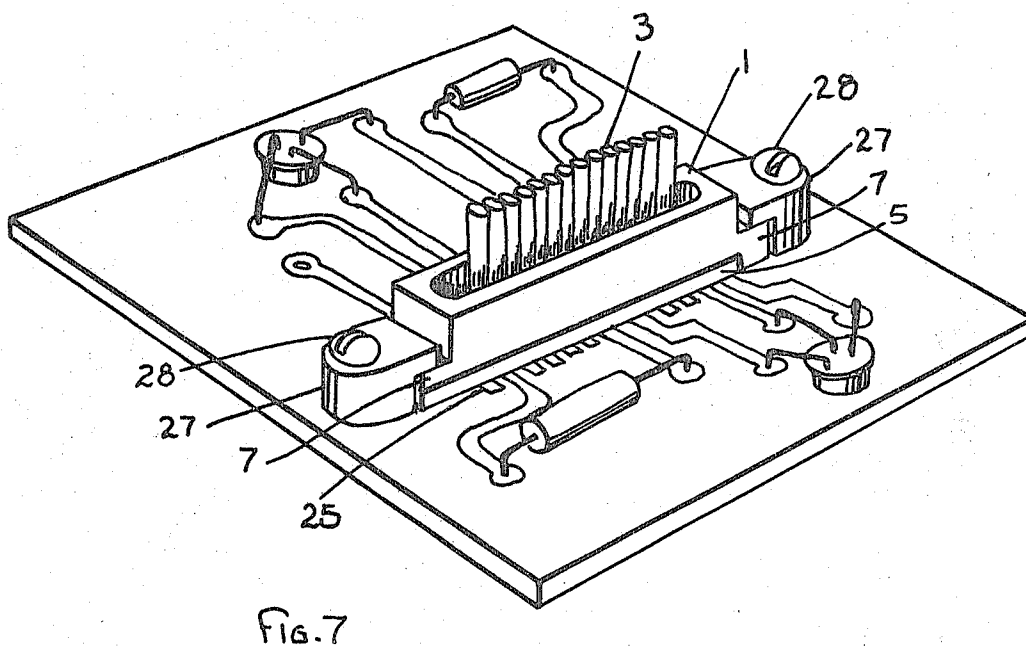
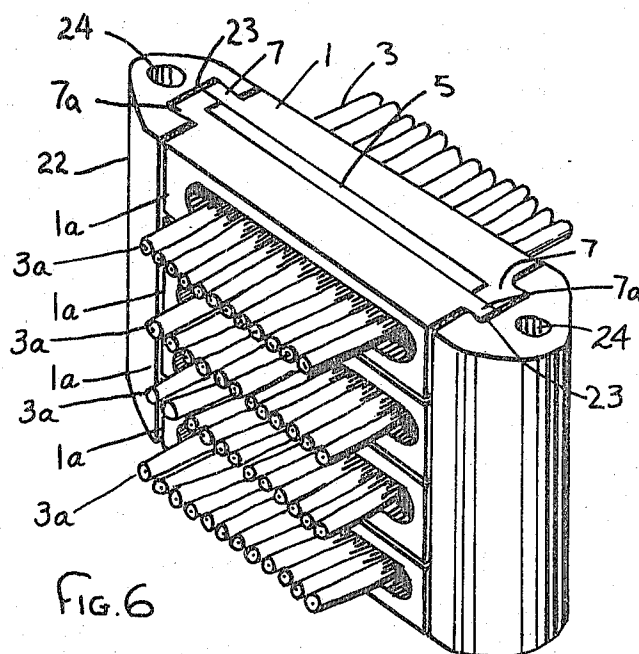
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ELECTRICAL CONNECTORS

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19 Claims. (Cl. 339—61)

This invention relates to electrical connectors, and more specifically to zero-entry electrical connectors, and included in the objects of this invention are:

First, to provide an electrical connector of the zero-entry type in which insertion and extraction forces are essentially eliminated.

Second, to provide an electrical connector in which reliable connections may be made without the need for close mechanical tolerances on pin spacing.

Third, to provide an electrical connector of modular design which through the use of adaptive means may be used as a line-to-line connector, a bulkhead-to-line connector, a printed circuit connector or an interconnection matrix connector.

Fourth, to provide an electrical connector in which two identical connector halves may be connected through an elastomeric pad having individual resilient conductors imbedded in the pad.

Fifth, to provide an electrical connector in which each pin is individually sealed from the adjacent pins when the connector is mated.

Sixth, to provide an electrical connector in which pin connections are sealed from the exterior of the connector when mated.

Seventh, to provide an electrical connector in which evidence of proper mating is readily visible from the exterior of the connector.

Eighth, to provide an electrical connector of modular design in which a plurality of smaller connectors may be easily assembled to comprise a larger connector.

Ninth, to provide an electrical connector capable of being mounted separably to a printed circuit board in any location where a proper printed conductor pattern is provided.

Tenth, to provide an electrical connector in which each connection is accomplished by a large number of contacts having high unit pressures.

Eleventh, to provide an electrical connector into which wires may be potted or bonded without the need for an added backshell, and without affecting insertion or extraction forces.

With the above and other objects in view as may appear hereinafter, reference is directed to the accompanying drawings in which:

FIGURE 1 is a perspective view of the two connector half shells separated from the resilient insert.

FIGURE 2 is a cross-section view of the assembled connector, taken across the connector at the centerline of a connection pin interface.

FIGURE 3 is a perspective view of the connector as adapted to use as a bulkhead connector.

FIGURE 4 is a perspective view of the connector as adapted to use as a surface-mounted connector.

FIGURE 5 is a perspective view of the connector as adapted for wire strain-relief and rough handling.

FIGURE 6 is a perspective view of an assembly of small connectors combined to form a large connector.

FIGURE 7 is a perspective view of the connector as adapted for use as a printed circuit connector.

It should be noted that the drawings are not indicative of size, which may range from a fraction of an inch to many inches in overall dimensions. It is not intended that all applications for the invention be shown herein, but instead only some of the preferred embodiments are illustrated and described. It will be obvious to those

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skilled in the art that the principles may be utilized in numerous applications which are not shown herein.

Reference is directed to the drawings in detail, and particularly to FIGS. 1 and 2. The connector shown therein comprises two generally identical connector halves having a resilient contact pad disposed between the two connector halves. Each connector half comprises a shell 1 of elongated rectangular insulator into which a multiplicity of pins 2 are rigidly affixed. The pins are mounted generally flush with one of the long sides of the shell, and extend through the shell to the opposite side wherein wires 3 may be attached by various means, such as crimping or soldering. Disposed between the connector halves is an elastomeric pad 5 in which a plurality of resilient contacts 6 are embedded in a pattern closely matching the pattern of the pins in the connector halves. Proper positioning of the pad 5 is facilitated by the constraining action of the polarizing bars 7.

In FIGURE 2, there is illustrated a cross-section view, taken normal to the long axis of an assembled connector, along the centerline of a connection pin interface. In this figure the generally square cross-section of shell 1 is evident, as well as the cavity 4 located on the side of the connector half opposite the connector pin faces. A multiplicity of pins 2 are spacedly disposed along the length of the shells. The pins 2 are configured as conductive closed end tubes preferably having a flange comprising the termination of the closed end. In one embodiment the tubular pins are inserted through a multiplicity of holes in the face of the shell and are yieldably deformed at the open end to form solder pots 30 which extend into cavity 4. The deformation of the open end of the pins also serves to retain the pins in place in the connector shells. In one embodiment the various wires 3 are stripped of their insulation and inserted into pots 30. The addition of solder 32 completes the electrical connection between pins 2 and wires 3. A potting compound 34 may thereafter be introduced into the unfilled space of cavity 4 for sealing and structural purposes.

The two connector shells 1 and 1a, with pins in place, are mated so as to compressably retain pad 5 in a coplanar disposition between the shells. The contacts 6 are spaceably arranged in and are retained by an elastomeric pad 5 in a suitable pattern closely matching the arrangement of the pins within the shells. In one embodiment pad 5 is a material which is molded around prepositioned contacts 6 to fixedly locate said conductors in proper arrangement. Each contact 6 comprises an electrical conductor extending through pad 5. In a preferred embodiment the conductor comprises a bundle of resilient conductors such as a length of braided wires, the axis of said bundle lying normal to the flat surfaces of the elastomeric pad 5. Each of the individual conductors or wires comprising the bundle passes through the thickness of the pad and in the braided configuration each conductor traces a twisted path through the embedding pad 5. The conductors terminate in a plane at each of the flat surfaces of the pad, so that the conductors make electrical contact with the pins at the time the elastomeric material 5 is sandwiched between and forms a seal against the flat mating surfaces of the two connector shells 1 and 1a.

Reference is directed to FIGURE 3, which is a perspective view of the basic connector adapted for bulkhead mounting. The connector shells 1 and 1a are mated together with the contact pad 5 disposed between the shells so as to connect the wires 3 to the wires 3a through the contacts contained within the pad 5. A bulkhead-mounting clip 8 is provided at each of the two ends of the connector. The mounting clip has an aperture 9 through it which is of such size and shape as to hold the connector

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halves in the mated position by applying a clamping action to the polarizing bars 7 and 7a, and a hole 10 which is provided for screw mounting to a bulkhead. The compressive force over the length of the connector halves which is applied by the installation of the two mounting clips serves to maintain both the contact pressure and the sealing pressure of the connector halves mutually against the contact pad 5.

Reference is directed to FIGURE 4, which is a perspective view of the basic connector adapted for use as a surface-mounted connector. The connector shells 1 and 1a are mated together with the contact pad 5 disposed between the shells so as to connect the wires 3 to the wires 3a through the contacts contained within the pad 5. A surface-mounting clip 11 is provided at each of the two ends of the connector. The mounting clip has an aperture 12 through it which is of such size and shape as to hold the connector halves in the mated position by applying a clamping action to the polarizing bars 7 and 7a, and a hole 13 which is provided for screw mounting to a surface. The compressive force over the length of the connector halves which is applied by the installation of the two mounting clips serves to maintain both the contact pressure and the sealing pressure of the connector halves mutually against the contact pad 5.

Reference is directed to FIGURE 5, which is a perspective view of the connector as adapted for wire strain-relief and rough handling. The connector shells 1 and 1a are mated together with the contact pad 5 disposed between the shells so as to connect the wires 3 to the wires 3a through the contacts contained within the pad 5. A housing 14 is provided having a cavity 15 of such size and shape as to conform generally to the outline of the mated connector and hold the connector halves in the mated position by applying a clamping action to at least the polarizing bars 7 and 7a, and a plurality of holes 16 through which screws 17 are passed. The screws 17 pass also through holes 18 in a flat cover 19, so that the screws 17, in conjunction with a plurality of nuts 20, serve to clamp the mated connector between the housing 14 and the cover 19. An elastomeric cushion or sheathing 21 and 21a may be provided so that in addition to clamping the mated connector in position the housing 14 and cover 19 cooperate to clamp the wires 3 and 3a to provide strain-relief for the said wires.

Reference is directed to FIGURE 6, which is a perspective view of an assembly of the basic connectors to form a larger and more complex connector. A plurality of connector shells 1 and a plurality of connector shells 1a are mated together with a plurality of contact pads 5 disposed between the respective shells so as to connect the wires 3 to the wires 3a through the contacts contained within the plurality of contact pads 5. An elongated bar 22 is provided having a lengthwise slot 23 of such size and shape as to engage the plurality of polarizing bars 7 and 7a and hold the plurality of basic connectors in the mated position by applying a clamping action to said polarizing bars. A second bar 22 is provided at the opposite ends of the mated basic connectors to perform a similar function so that in cooperation the two bars 22 apply compressive forces over the length of the respective connector halves to maintain both the contact pressure and the sealing pressure of the connector halves mutually against the plurality of contact pads 5. A hole 24 is provided lengthwise through each of the two bars 22 so that mounting screws may be readily employed to attach the composite connector to a surface.

Reference is directed to FIGURE 7, which is a perspective view of one half of the connector, which is used in conjunction with a contact pad, and is adapted for use as a printed circuit connector. A connector shell 1 and a contact pad 5 are employed cooperatively to connect a

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plurality of wires 3 respectively to a plurality of printed conductors 25, on a printed or etched circuit board 26. A toe clamp 27 is provided at each of the two ends of the connector. Each of the toe clamps has a hole through it in which a screw 28 is inserted normal to the surface of the circuit board 26. The screws 28, when in place, secure the toe clamps 27 against the polarizing bars 7 at each end of the connector, thereby holding the connector in proper position with respect to the conductor pattern on the circuit board and applying a compressive force over the length of the connector to maintain the contact pressure mutually between the connector 1, the contact pad 5 and the circuit board 26. Although it may in some instances be desirable to utilize the connector at the edge of a circuit board, it should be noted that one or more connectors may readily be mounted at any location on the circuit board wherein the proper conductor pattern is provided along with the screw holes. It should be further noted that a plurality of such connectors could be easily employed on either or both sides of a double-sided circuit board, so that the circuit board may serve at least in part as an interconnection matrix for a group of connectors.

While the foregoing has been described as some preferred embodiments of the invention, it is readily apparent that alterations and modifications may be resorted to without departing from the scope of this invention, and such alterations and modifications are intended to be included within the scope of the appended claims.

I claim:

1. An electrical conductor comprising in combination a substantially rigid insulative first contact supporting member having an aperture therethrough and a first elongated conductive pin located in said aperture, said pin being generally flush with a flat surface of the supporting member; a resilient conductive contact located generally in axial alignment with said first pin; an elastomeric pad of generally flat proportions, said conductive contact being peripherally surrounded by and extending through the elastomeric pad to be substantially flush with opposite flat surfaces of the elastomeric pad; a substantially rigid insulative second contact supporting member having an aperture therethrough and a second elongated conductive pin located in said aperture, said second pin being generally flush with a flat surface of the second supporting member and being located generally in axial alignment with said conductive contact, clamping means for compressing the pad and contact between the supporting members, the first supporting member, elastomeric pad and second supporting member being generally axially aligned such that the flush surfaces of the two pins compressably contact the opposite exposed surfaces of the resilient conductive contact.

2. An electrical connector according to claim 1 wherein said first and second pins are enlarged at the flat surface of said supporting members to preclude withdrawal away from the flat surface.

3. An electrical connector as described in claim 1, in which the flush surfaces of the two substantially rigid insulative supporting members compressively contact opposite sides of the flat elastomeric pad which peripherally surrounds said contact.

4. An electrical connector as described in claim 1, in which said rigid pin comprises a closed-end tube having a generally cylindrical length; the tube being provided with an enlargement at the closed end and being swaged into fixed position within the supporting member by at least a partial diametrical expansion of the open end.

5. An electrical connector as described in claim 4, in which a wire is soldered into the open end of the pin.

6. An electrical connector according to claim 1 wherein said first and second pins extend from the flat surface of the first and second supporting members through a surface opposite the flat surface and are at least partially enlarged to preclude withdrawal towards said flat surface.

7. An electrical connector according to claim 6 where-

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in the partially enlarged portions of said first and second rigid pins define wire attachment points.

8. An electrical connector as described in claim 7, in which each of said insulative members are provided with a cavity on the side opposite the flush surface, said cavities defining chambers for encapsulation of the wire attachment points.

9. An electrical connector as described in claim 1, in which the contact in said pad is resilient and comprises a confined plurality of adjacent elongated conductors extending normally through the flat elastomeric pad.

10. An electrical connector as described in claim 9, in which the resilient contact comprises a confined plurality of adjacent elongated conductors extending generally through the elastomeric pad normal to the flat surface of the pad, said individual conductors being twisted with respect to the normal axis through the pad.

11. An electrical connector as described in claim 1, wherein a generally rectangular longitudinal extension is provided on one end of each rigid pin support member and a generally rectangular longitudinal and lateral extension is provided on the opposite end of each rigid pin support member, said extensions being coengageable in a non-reversible manner to provide polarization of the connector.

12. An electrical connector as described in claim 11, wherein the compressive force for connector engagement is provided by restraining said polarization extension means in a mounting clip, said mounting clip having one or more screw clearance holes aligned generally with the axis of the pins to provide a bulkhead mounting means.

13. An electrical connector as described in claim 11, wherein the compressive force for connector engagement is provided by restraining said polarization extension means in a mounting clip, said mounting clip having one or more screw clearance holes aligned generally normal to the axis of the pin to provide a flat-plate mounting means.

14. An electrical connector as described in claim 11, wherein the compressive force for connector engagement is provided by restraining at least the polarization extension means between a cover which conforms generally to the outline of the connector in the engaged condition, and a screw-attached plate means.

15. An electrical connector as described in claim 11, wherein a plurality of similar connectors are assembled into a larger unit and the compressive forces for connector engagement are provided by restraining said polarization extension means of the plurality of connectors within a slotted elongated bar at each end of the plurality of connectors; each bar being provided with at least one screw-clearance hole to provide mounting means.

16. An electrical connector comprising in combination a substantially rigid insulative first contact supporting member having a plurality of apertures therethrough and a first plurality of elongated conductive pins located in said apertures, said first pins being generally flush with a flat surface of the supporting member; a plurality of resilient conductive contacts located generally in axial alignment with said first pins; an elastomeric pad of generally flat proportions, said plurality of contacts being separated and peripherally surrounded by and extending through the elastomeric pad to be substantially flush with opposite flat surfaces of the pad; a substantially rigid insulative second contact supporting member having a plurality of apertures therethrough and a second plurality of elongated conductive second pins located in said apertures, said sec-

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ond pins being generally flush with a flat surface of the second supporting member and being located generally in axial alignment with said conductive contacts; clamping means for compressing the pad and contacts between the supporting members, the supporting members and pad being generally axially aligned such that the flush surfaces of respective opposing pins compressably contact the opposite exposed surfaces of associated resilient contacts.

17. An electrical conductor comprising in combination a substantially rigid insulative first contact supporting member having an aperture therethrough and a first elongated conductive pin located in said aperture, said first pin being generally flush with a flat surface of the supporting member; a confined plurality of adjacent elongated conductors located generally in axial alignment with said first pin; a resilient pad of generally flat proportions, said conductors being peripherally surrounded by and extending through the pad to be substantially flush with opposite flat surfaces of the pad; a substantially rigid insulative second contact supporting member having an aperture therethrough and a second elongated conductive pin located in said aperture, said second pin being generally flush with a flat surface of the second supporting member and being located generally in axial alignment with said plurality of conductors, the first supporting member, pad, and second supporting member being generally aligned wherein the flush surfaces of the two pins compressably contact the opposite exposed surfaces of the plurality of the conductors and clamping means for compressing the pad and contacts between the supporting members.

18. An electrical connector as described in claim 17, in which the flush surfaces of the two substantially rigid insulative supporting members compressively contact opposite sides of the flat pad which separates and peripherally surrounds said conductors.

19. An electrical connector comprising in combination a substantially flat insulative member in which one or more conductive members extend therethrough, said conductive members being generally flush with one surface of said insulative member the opposite end of said conductive members being provided with an extension for the attachment of wires; a resilient conducting means aligned with a pair of said conductive members wherein the flush surface of each conductive member may contact one surface of a respective resilient conductor, the opposite surface of said resilient conductor being impressed against a conductor pattern of a circuit board, said pattern being axially in alignment with both the flush conducting members and the respective resilient conductors; and a clamp means to compressively load said resilient conductors between said flush conductors and said circuit board, said clamp means being disposed at each end of said connector.

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