United States Patent

Rundle

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[54] **MINIATURE CONNECTOR CONSTRUCTION—ADJUSTABLE OR FLOATING**

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[73] Assignee: **The Bunker-Ramo Corporation,** Oak Brook, Ill.

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[52] **U.S. Cl.**.....**339/64 M,** 339/176 M, 339/217 S

[51] **Int. Cl.**.....**H01r 21/28**

[58] **Field of Search**.....339/1, 6, 7, 9, 64, 176, 217 S, 339/156, 157, 65, 5, 48, 49

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[57] **ABSTRACT**

Miniature connector plug of the kind utilized in a package or assembly incorporating a large number of connectors, for use with a socket assembly incorporating the like number of sockets, all of the plugs and all of the sockets being arranged in planes, each plug having portions shiftable transversely for accommodating misalignment between the respective plugs and sockets in a progression of such large numbers of the connectors.

12 Claims, 10 Drawing Figures

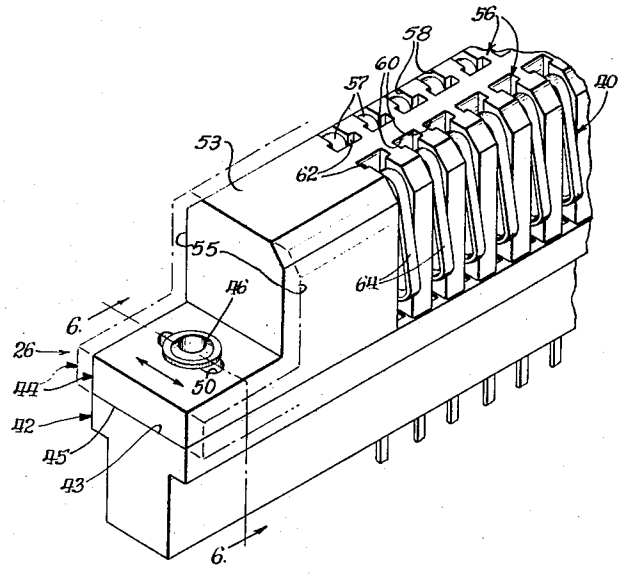

Fig. 1.

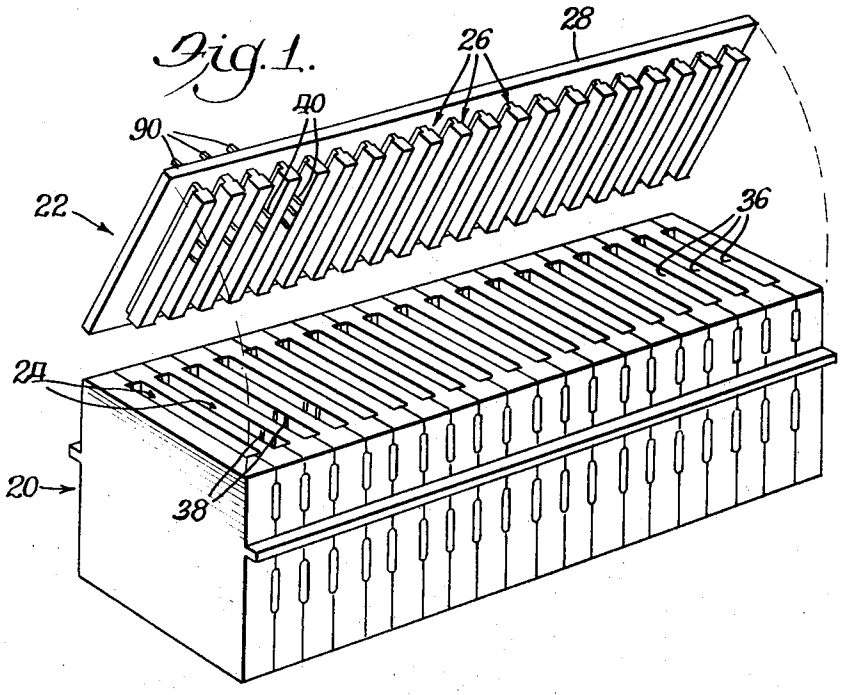

Fig. 2.

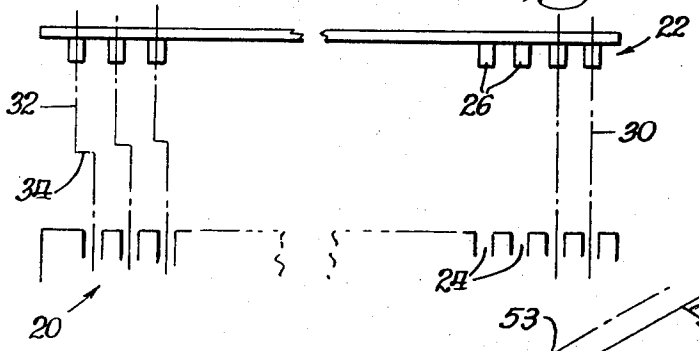

Fig. 3.

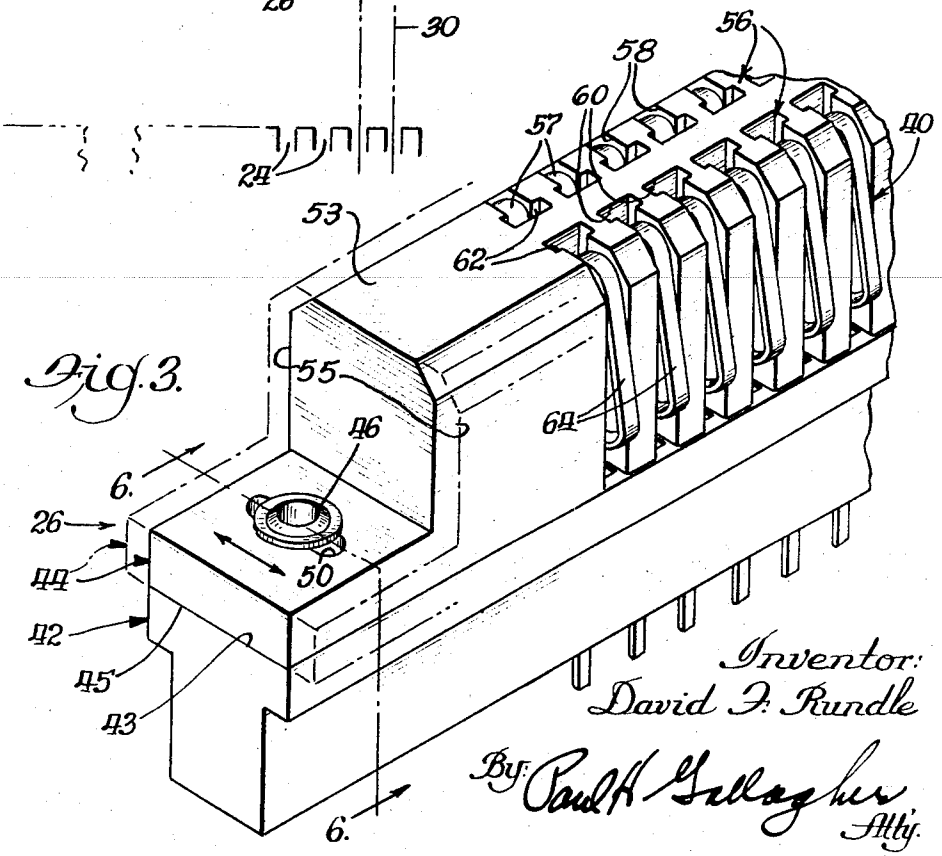

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Fig. 5.

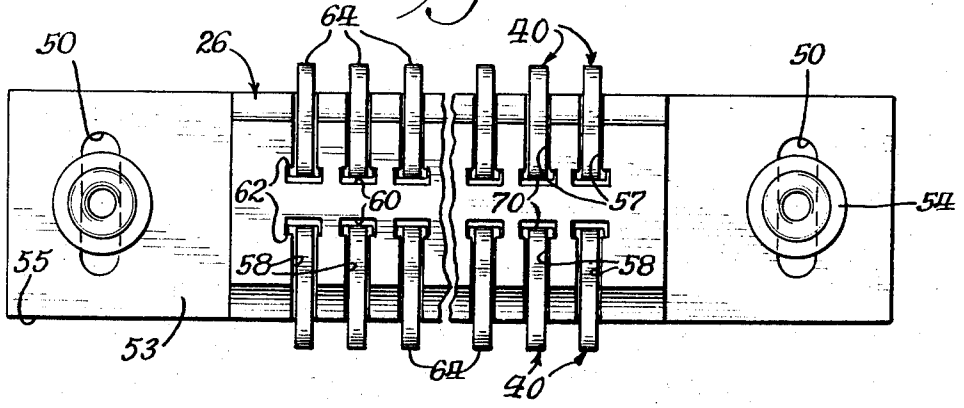
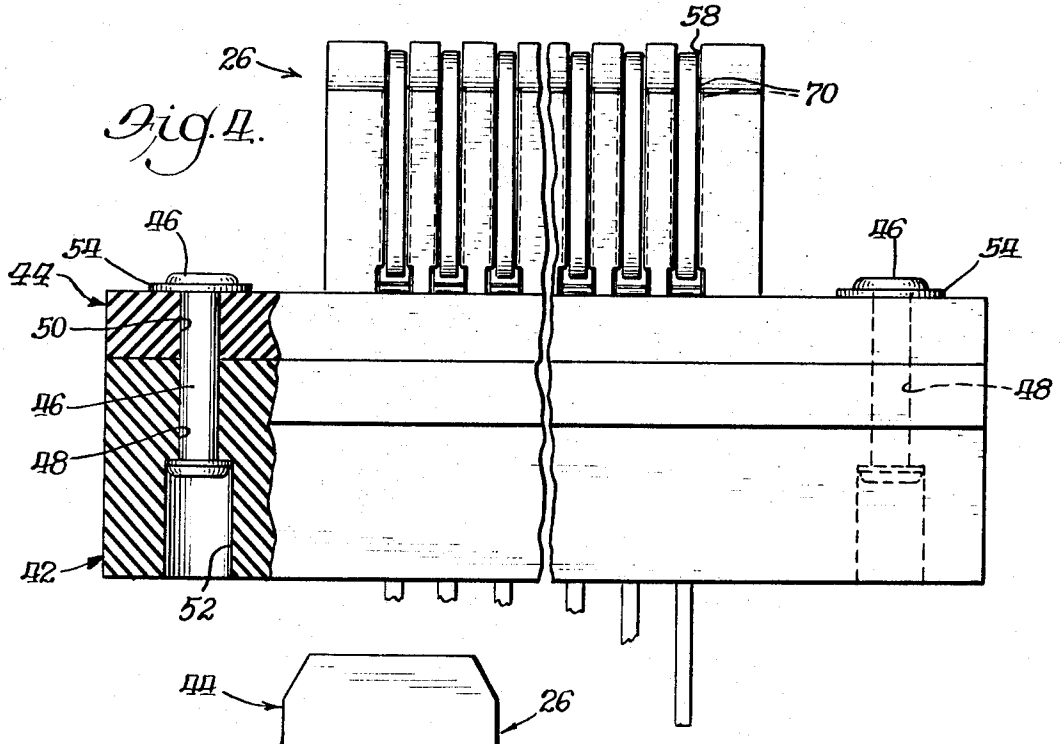


Fig. 4.



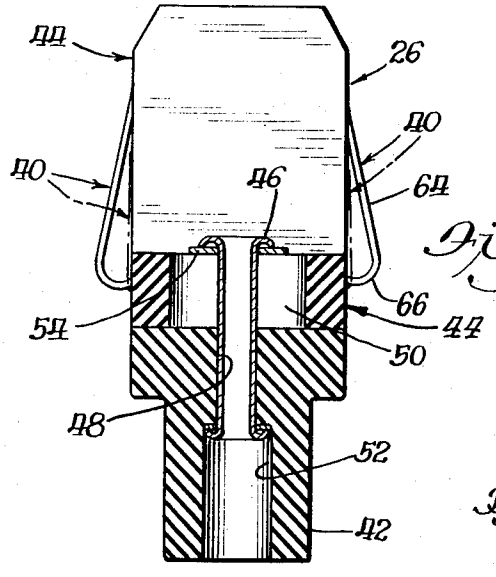


Fig. 6.

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Fig. 7.

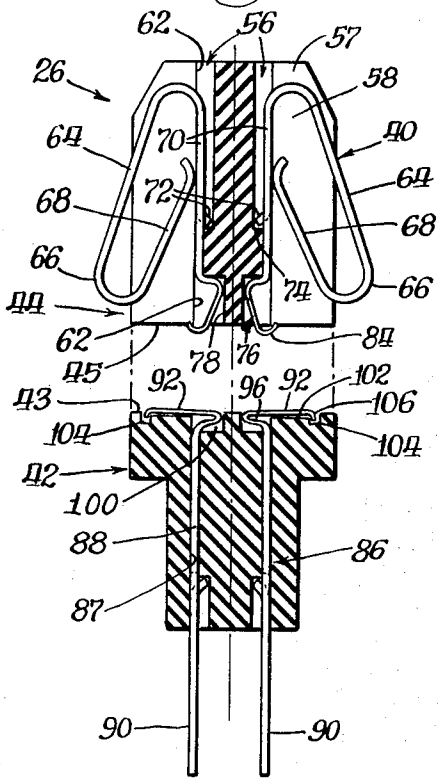


Fig. 8.

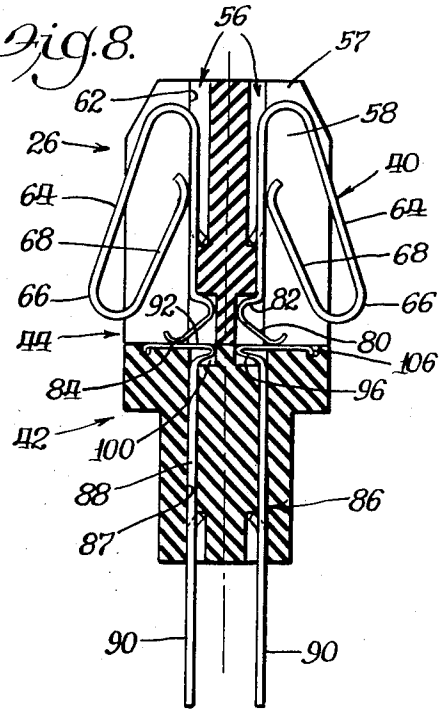


Fig. 9.

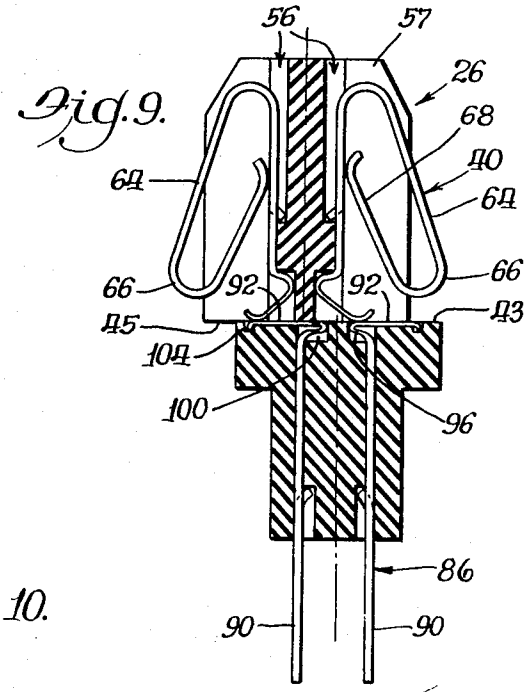
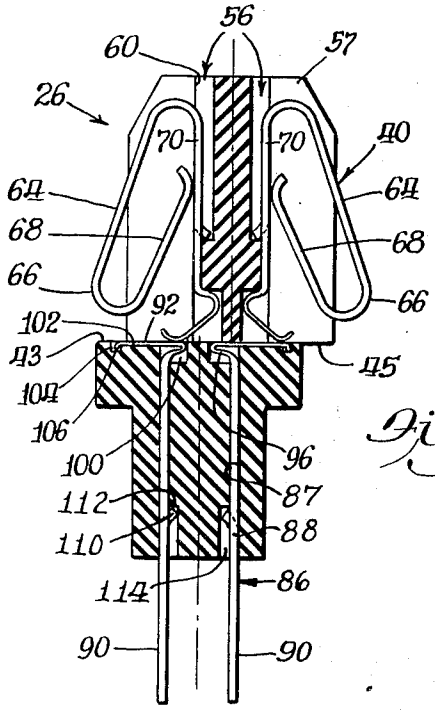


Fig. 10.



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MINIATURE CONNECTOR CONSTRUCTION—ADJUSTABLE OR FLOATING

BACKGROUND

The present invention relates to miniature connector construction of the kind including a plug assembly and a socket assembly, each having a large number of connector members respectively related, i.e., the assembly having a plurality of plugs arranged in a series and a corresponding plurality of sockets arranged in a similar series; the plugs and sockets are arranged in a predetermined pattern, normally they are arranged in relatively great numbers, so that any inaccuracies that may occur, although of random character may at times accumulate so that the cumulative effect thereof at one end of the series may be substantial and beyond the normal range of tolerance permitted in the case of a single connector member.

More specifically an example is presumed in which a plug assembly has a large plurality of plugs, e.g. 24, arranged in a row, and the socket assembly has a corresponding number of sockets arranged in a similar row; the plugs and sockets are pre-arranged in a common pattern designed for interconnection, but due to normal tolerances, the nominal spacing between elements may not persist throughout the full range of those elements, i.e., a plug and the corresponding socket at one end of the series may be in alignment, but the tolerances or respective misalignment would accumulate to the other end where at that point the misalignment may be greater than the normal tolerance permitted in connection with a single plug and socket.

OBJECTS OF THE INVENTION

A broad object of the invention is to provide a miniature connector construction having novel features effective for overcoming the disadvantages referred to above.

Another object is to provide a miniature connector construction of the character referred to wherein each of the plugs includes a body made of two parts, connected together for relative shifting movement in transverse directions, for accommodating misalignment between the plugs and sockets that may normally occur in case of the character referred to above.

A still further object is to provide a miniature connector construction of the kind referred to of such novel arrangement as to assure electrical engagement between the interrelated contacts in the two relatively shiftable parts of the body of the plug.

A still further and specific object is to provide in a connector construction of the foregoing character, simple construction of connector bodies, or blocks, and novel means for mechanically interconnecting them for enabling physical shifting therebetween and to provide novel physical shape of the electrical contacts and securement thereof in the blocks, as well as to provide effective sliding engagement between the contacts in the different blocks.

DESCRIPTION OF A PREFERRED EMBODIMENT

In the drawings:

FIG. 1 is a perspective semi-diagrammatic view of a connector assembly or construction including a plurality of the connectors incorporating the features of the present invention;

FIG. 2 is a diagrammatic, and greatly exaggerated, illustration of the parts of the connector assembly shown in FIG. 1, arranged with the respective connector plugs and sockets in mating position with certain of the members in possible maximum misalignment;

FIG. 3 is a perspective view of a connector plug, isolated from its mounting and related elements, and inverted relative to its position in FIG. 1;

FIG. 4 is a side view partially in section, taken from the right of FIG. 3;

FIG. 5 is a view from the top of FIGS. 3 and 4;

FIG. 6 is a sectional view taken at line 6—6 of FIG. 3;

FIG. 7 is a sectional view oriented according to line 7—7 of FIG. 4 but with the two blocks of the connector in separated and spaced relation;

FIG. 8 is a view oriented according to FIG. 7 and with the two parts of the connector plug in interfitted relation;

FIG. 9 is a view similar to FIG. 8 but with the blocks relatively shifted in one direction; and

FIG. 10 is a view similar to FIG. 9 but with the blocks relatively shifted in the other direction.

Referring in detail to the drawings, FIG. 1 shows a connector assembly or construction including a socket part 20 and a plug part 22, the former having a plurality of sockets or units or components 24 and the latter having a plurality of plugs or units or components 26. The socket part 20 may be of any desired physical construction, while the plug part 22 includes a backboard 28 generally known as a circuit board on which the plugs 26 are directly mounted. This overall kind of connector construction is known, and it is to be pointed out that a large plurality of plugs 26 and sockets 24 are provided in an assembly or construction, such as 24, 30, 50, etc. The individual plugs and sockets may be accurately dimensioned and constructioned, but in the assembly of them (FIG. 1), the different units may be positioned slightly inaccurately, progressing from one to the next. For example as shown in FIG. 2 the plugs 26 at the right end may be directly in line with the corresponding sockets 24 as indicated by the dot-dash lines 30 but due to inaccuracies in spacing of the plugs 26, or the sockets 24, or both, the spacing may be cumulative so that at the other end the respective plugs and sockets may not be in line, as indicated by the dot-dash lines 32 which will be seen are off center from the end sockets 24 as indicated at 34. It will be understood that the inaccuracies are random and in many cases are mutually compensating, but in many cases also the inaccuracies are cumulative and the construction of the present invention is designed for accommodating this cumulative effect.

The overall cooperation between the plug part 22 and socket part 20 is known (FIG. 1), the sockets 24 having side surfaces 36 upon each of which are mounted contact elements, such for example as printed circuit members bearing such elements, and the plugs 26 contain contact elements on each of opposite sides engageable with respective ones of the contact elements in the sockets. These contact elements are spaced along each socket and plug as will be understood, the contact element in the sockets being identified at 38 (FIG. 1) and the contact elements in the plugs being identified at 40 (FIG. 3) which will be referred to in detail hereinbelow.

The plugs 26 are constructed each with a pair of blocks, relatively shiftable laterally, while the sockets 24 are in fixed position. Attention is next directed to FIGS. 3, 4 and 5 showing the construction of an individual plug. Each plug includes a rigid block 42 and a floating block 44, having interengaging sliding surfaces 43, 45 respectively, the blocks being interconnected by float bushings 46 at the ends extended through apertures 48 (FIG. 4) in the rigid block 42 and through transversely elongated slots 50 in the floating block. The ends of the float bushing are peened over at one end in a counterbore 52 in the rigid block and at the other end over a washer 54 on the upper surface of the floating block and of course traversing the width of the slot. The floating block 44 is thus shiftable transversely of its length, along the length of the transverse slots 50, between opposite limits indicated in dot-dash lines in FIG. 3.

The floating block 44 has an entry end surface 53 and opposite side surfaces 55, and is provided with a plurality of slots or grooves 56, T-shaped as viewed in plan (FIG. 5) extending through both the entry end surface 53 and the lower or sliding surface 45 of the block, as well as opening laterally outwardly through the side surfaces 55. Each slot includes a first portion 57 having side surfaces 58 and a wide portion 60 forming shoulders 62 between the two portions. Each contact element 40, or pressure spring, as best shown in FIGS. 7–10, includes a resilient outer loop portion 64 defining a lateral contact sur-

face 66, the loop portion also including an inner leg element 68. The contact also includes a shank or main body portion 70 which is for the most part wider than the loop portion 64 as shown in FIGS. 4 and 5, and wider than the narrow portion 57 of the slot, the body portion 70 also includes a struck out downwardly extending tang 72 engageable with an upwardly facing shoulder 74 formed in the wide portion 60 of the slot. The lower end of the body portion 70 has a terminal extension 76, which for functional purposes in the assembly may be of smaller gauge than the remainder of the member. The portion 76 extends into a cavity or niche 78 and includes a first leg 80 and a second leg 82 at an abrupt angle thereto having a convex contact surface 84 adjacent its extreme end which extends slightly beyond the sliding surface 45.

The contact or pressure spring 40 is put in position by inserting it downwardly into the slot 56, with the body portion extending into the wide portion 60 of the slot and the loop portion 64 extending laterally beyond the slots; in this movement the lower terminal portion 76 may be flexed toward the longitudinal, and upon that portion reaching the cavity 78, it reassumes its original position and projects into the cavity, the movement of the contact or pressure spring continuing until the tang 72 engages the shoulder 74, which provides a positive limit to such movement. The extension of the terminal portion 76 into the cavity 78 provides a limiting means against removal of the contact longitudinally of the slot, while the shoulders 62 prevent removal transversely outwardly.

The rigid block 42 is provided with termination contacts 86 corresponding in number and position to the contacts or pressure springs 40, positioned in apertures 87. Each termination contact 86 includes a main body or shank 88 having a lower terminal portion 90 adapted for connection in the electrical system to which the present construction is adapted. The lower terminal portions 90 extend through the backboard 28 (FIG. 1) for connection with lines related to the individual contacts in the plugs and sockets. The termination contact 86 includes a terminal contact element 92 disposed generally transverse to the body portion, and approaching the perpendicular thereto, extending from another portion 96, both preferably of lighter gauge than the shank 88 and providing a degree of resilience in directions along the length of the body portion. The details of construction of this portion may be varied within wide limits, but in the present instance, the rigid block 42 includes a cavity 100 receiving the portion 96, and another shallow groove 102 receiving the transverse element 92 and terminating in a depression or hole 104 receiving a downturned hook 106 of the element 92. The element 92 provides an upper surface at least as high as, and preferably higher than, the upper sliding surface 43 of the rigid block 42.

The shank 88 of the contact 86 is provided with an upwardly extending struck out tang 110 engageable with a downwardly facing shoulder 112 in a cavity 114 formed as an extension of the aperture 87. The tang 110 as will be observed prevents normal removal of the contact from the aperture (upwardly, FIG. 7).

In the use of the connector, made according to the present invention, the parts 20, 22 (FIG. 1) are interfitted in the usual way; in this operation the plugs 26 are inserted into the sockets 24 and the contacts or pressure springs 40 engage with the corresponding and registered contact elements 38. These related contacts are aligned in transverse direction, i.e., transverse to the length of the individual plugs and sockets, or as viewed in FIG. 1, from lower left to upper right. Upon insertion of the plugs into the sockets, the contacts or pressure springs 40 are compressed to the inner or dot-dash line as indicated in FIG. 6, as confined by the side surfaces of the sockets 24. This engagement is established in firm and positive relation in each of the plug-socket instances, and in this relation, the inaccuracy referred to above is accommodated by the construction of the present invention—any inaccuracy that may exist between the plugs and sockets that may occur, and that may accumulate along the progression of those members, is accommodated by transverse shifting of the floating blocks 44 (FIGS. 3, 9 and 10). As noted above this shifting is permitted by the transversely elongated slots 50 receiving the bushings or rivets 46 so that the floating blocks may shift the full extent of the length of the slots, less the diameter of the bushings.

When the two parts of the connector are fitted together, the contact elements 40, through their surfaces 84, engage the portions 92 of the contact elements 86 in or near the plane of the interengaged surfaces 43, 45. The contact elements 92 are at least as long in transverse direction as the maximum shifting movement of the floating block, and throughout that maximum shifting movement, the contact elements 84 remain in contact engagement with the contact elements 92.

FIGS. 7–10 show in detail the relation between the contact elements in the two parts of the connector. FIG. 7 shows the parts in separated position but in such juxtaposition as exists just before interconnection; FIG. 8 shows them interconnected and in neutral position where they would be in ideal and accurate positioning; FIG. 9 shows them interconnected but in a maximum shifted position in one direction to accommodate corresponding inaccuracy in that direction where the contacts 86 are disposed adjacent corresponding ends of the elements 92; while FIG. 10 shows them in a maximum shifted position in the other direction where the contacts 86 are disposed adjacent the corresponding ends, but opposite ends, of the elements 92.

The construction thus described accommodates inaccuracies in interfitting of the plug-socket constructions while maintaining a full and complete and electrical contact through the connector.

In line with the miniature nature of the connector construction, it is pointed out that a single connector may be for example 0.2 inch in width and the latitude of shifting may be 0.043 inch in each direction, or a total of 0.086 inches shifting movement. Although the invention finds particular adaptation to miniature connectors, the principles of the invention are applicable to connectors of other types.

I claim:

1. A connector plug comprising a body having a first block and a second block and means connecting them together for limited transverse relative movement therebetween, the second block forming a lead-in portion for insertion into a socket, the first block having contact members exposed for connection to other conductors, the second block having contact members arranged for sliding engagement with the contact members in the first block throughout the whole range of relative movement therebetween, and the contact members in the second block having elements disposed on laterally opposite sides and yieldingly biased outwardly away from each other for engaging corresponding elements in the socket.

2. A connector plug according to claim 1 wherein the connector blocks are provided with a plurality of spaced contact elements respectively interengaging and distributed along a direction transverse to the direction of movement between the blocks.

3. A connector plug according to claim 2 wherein the connector blocks are elongated and the plurality of contact elements are spaced along the direction of elongation, and the connector blocks are interconnected at the ends beyond the contact elements, one of the blocks being provided with slots elongated in directions transverse to the elongation of the blocks and the other block having connecting elements extending through the slots.

4. An electrical connector comprising a first supporting member and a plurality of plugs mounted thereon in transverse side-by-side relationship, a second supporting member and a plurality of sockets mounted thereon in transverse side-by-side relationship and individually in register with the plugs and adapted to receive them, the plugs and sockets constituting members, and one of the members each including blocks connected together for limited transverse relative shifting movement, and having interengaging sliding surfaces, contact members in the blocks having external portions for connec-

tion with other conductors, and the contact members having respectively interengaging elements arranged for sliding engagement during said transverse shifting movement and lying substantially coextensively with said sliding surfaces, whereby the contact members are held in interengagement in the interengaged relation of the blocks, whereby to accommodate inaccuracies in alignment between the members.

5. Connector construction comprising a mounting member, a plurality of plugs mounted in a row on the mounting member, adapted for insertion into sockets in a corresponding arrangement, the plugs having rigid blocks directly secured to the mounting member and floating blocks mounted to the rigid blocks for limited shifting movement relative to the rigid blocks in the direction of the rows, the rigid blocks including contact elements having terminals extending through the mounting member and also contact surfaces presented to the floating blocks, and the floating blocks including contact elements having terminals exposed for engaging contact elements in the sockets and contact surfaces presented to the rigid blocks, the contact surfaces in the blocks being in siding contact engagement throughout said shifting movement.

6. A connector member comprising a connector body including a rigid block and a floating block having interengaging surfaces, the blocks having a series of contact elements in each block respectively interrelated, the contact elements in the rigid block each including a series of contact elements spaced therealong and those in the two blocks being respectively interrelated, the contact elements in the rigid block each including a shank portion extending through the block in a direction away from its said interengaging surface and having a transverse element exposed in its said interengaging surface, each of the contact elements in the floating block including an element exposed in the said interengaging surface of that block and engaging the transverse element of the corresponding contact element in the rigid block, and also including a terminal element exposed beyond the confines of the floating block on the surface other than its said interengaging surface for contact engagement with a corresponding contact element in a socket into which the floating block is inserted, and means interconnecting the blocks for limited movement therebetween in a direction transverse to the elongation of the blocks, and the interengaging portions of the contact elements in the two blocks remaining in such interengagement throughout the said movement between the blocks.

7. An electrical connector member comprising blocks connected together for limited transverse relative shifting movement, and having interengaging sliding surfaces, contact members in the blocks having external portions for connection with other conductors, and the contact members having respectively interengaging elements arranged for sliding engagement during said transverse shifting movement and lying substantially coextensively with said sliding surfaces, whereby the contact members are held in interengagement in the interengaged relation of the blocks, one of the blocks including slots for insertion of said contact members, at least one of said slots having a surface with a shoulder directed reversely to the direction of insertion of the contact member, and the contact member having a tang yieldably passing by the shoulder upon insertion of the contact member and movably to a position forming a shoulder engaging the shoulder in the surface of the slot.

8. An electrical connector member according to claim 7, wherein the contact members in one of the blocks are insertable into slots therein in direction toward its sliding surface.

9. An electrical connector plug comprising an elongated block having an entry end surface, and a sliding surface opposite thereto adapted for engaging a sliding surface of a counterpart block, and also having opposite side surfaces, the block having a series of pairs of slots extending through the entry end surface and the sliding surface, the slots being T-shaped and being arranged so that the slots in each pair have broad portions disposed adjacent each other and narrow portions extending laterally outwardly through the opposite side surfaces, a contact member in each slot, each contact member having an elongated shank of relatively wide dimensions inserted in the wide portion of the slot and of such width as to be precluded from withdrawal laterally through the slot, the contact member having a yieldable contact element exposed at said sliding surface, contact members having loop portions extending outwardly through the side surfaces of the block with inner legs extending into the slot, the outer ends of the loop portions forming contact surfaces, whereby the contact members on the opposite sides of the block are yieldable laterally inwardly toward each other for contact engagement with correspondingly positioned contact elements in a socket into which the contact block is inserted, the shanks of the contact members and the slots having interfacing shoulders limiting movement of the contact member into the slot.

10. An electrical connector plug according to claim 9 wherein each slot has a shoulder adjacent the sliding surface and facing that surface, and the contact member has a resilient spring element engaging that shoulder normally preventing withdrawal of the contact member from the slot in direction of the entry end surface.

11. An electrical connector plug according to claim 10 wherein the contact member is insertable through said entry end surface, and the slot has shoulders normally preventing the removal of the contact member in longitudinal and transverse directions.

12. A male connector member adapted for mounting on a mounting member, comprising a fixed block adapted for direct securement to the mounting member and having a series of termination contacts therein, each termination contact having a shank and a transverse element, positioned with the shank inserted in an aperture in the fixed block and extending therebeyond through the mounting member for securement with a conductor, the block having a shoulder in each aperture and each shank having a tang engaging it when the termination contact is in the aperture for normally preventing its removal in direction opposite its insertion, the transverse element of the termination contact lying in an aperture in the block and having substantial transverse extension, the connector member also including a floating block having a series of slots registering with the termination contacts in the fixed block, each slot being T-shape and having a large and a small portion with shoulders therebetween and extending toward the fixed block, contact members in the slots and each including a wide shank in the wide portion of the T-shape slot and restricted against removal laterally by said shoulders, the shank of each contact member having a terminal portion exposed against the transverse element of the termination contact in the fixed block, the slot and shank of the contact member having oppositely facing and interengaging shoulders preventing normal removal of the contact element in direction opposite insertion of the contact member, the contact members also having loop portions forming laterally yieldable contact elements for engagement with corresponding elements in a socket into which the member is inserted, and means mounting the blocks together for limited movement in directions of the extension of the transverse element of the termination contacts in the fixed block.

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