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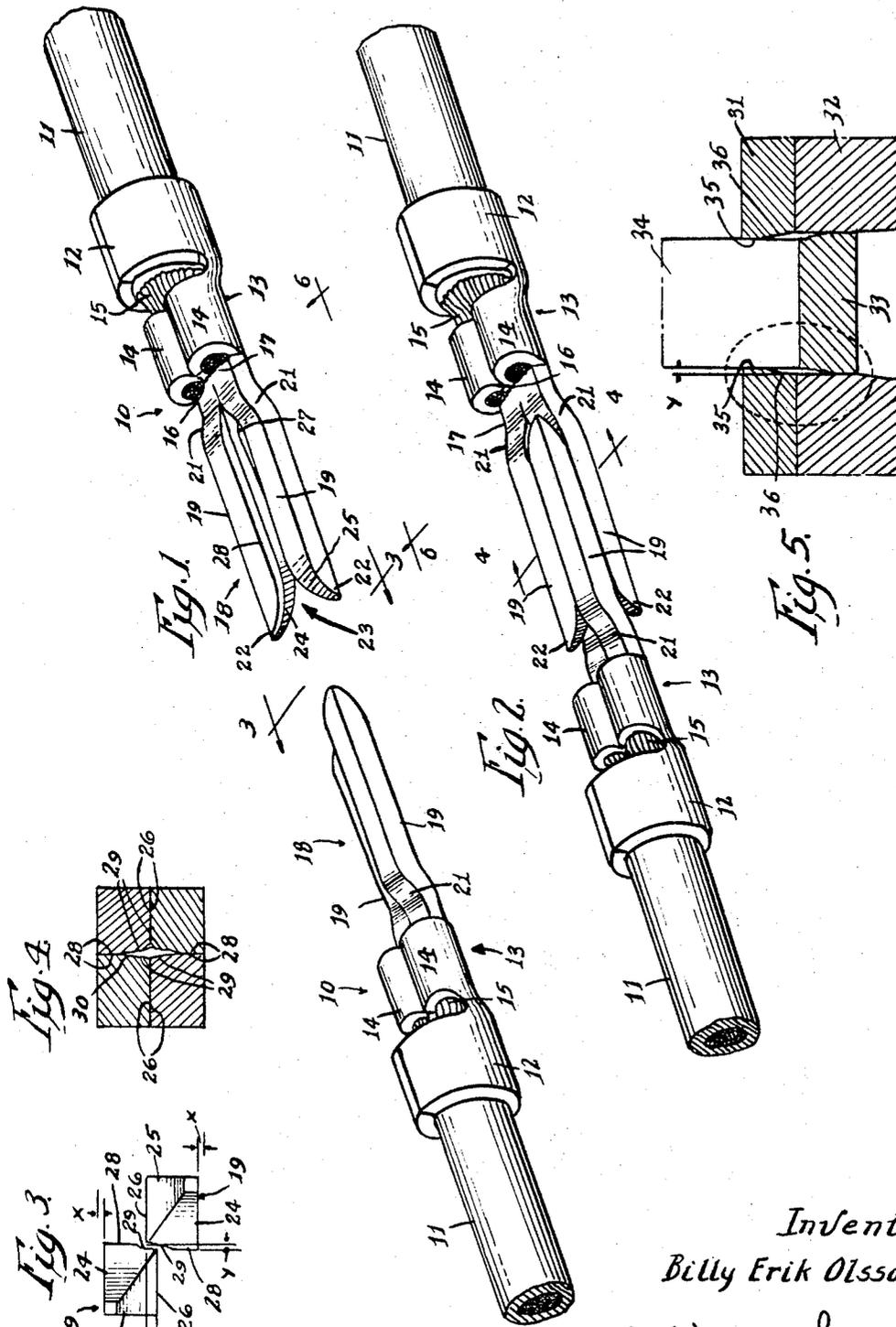
B. E. OLSSON

3,414,865

ELECTRICAL CONNECTORS

Filed Sept. 20, 1963

4 Sheets-Sheet 1



Inventor:
Billy Erik Olsson
By Wilson & Dapper
Attorneys

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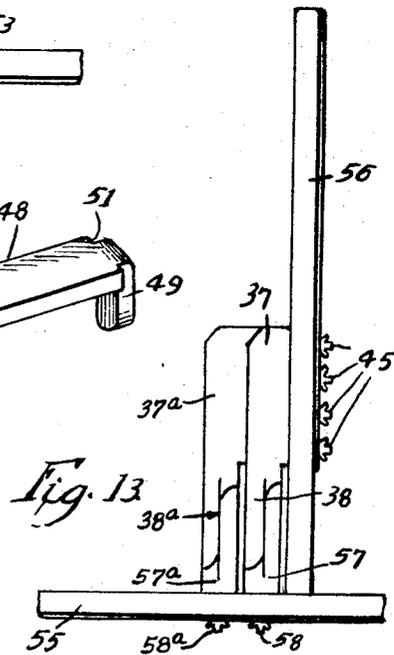
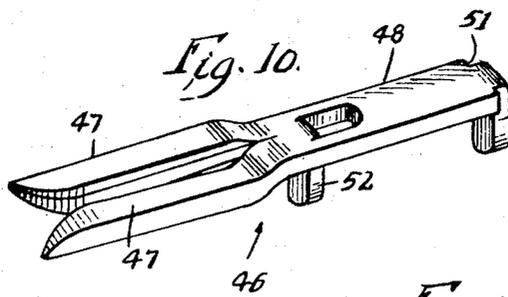
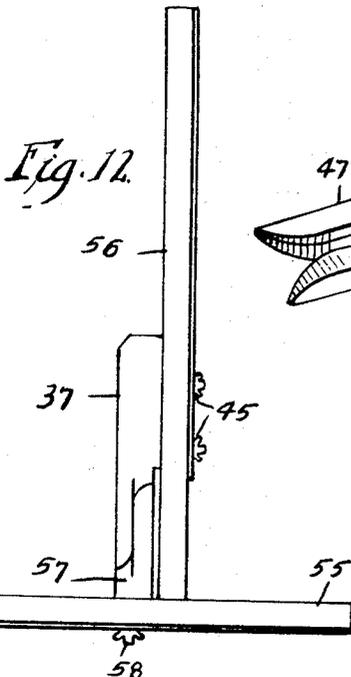
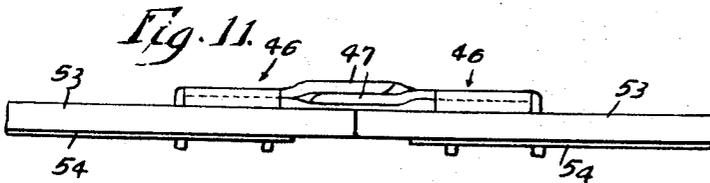
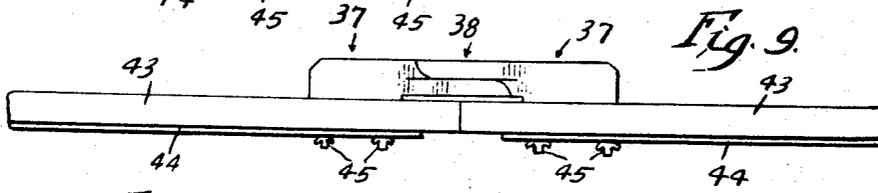
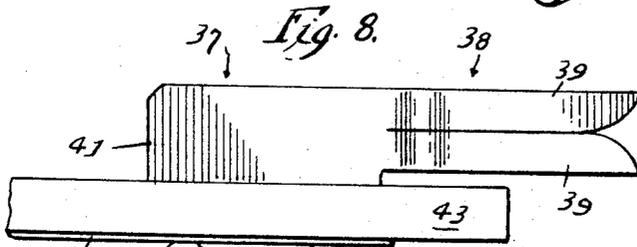
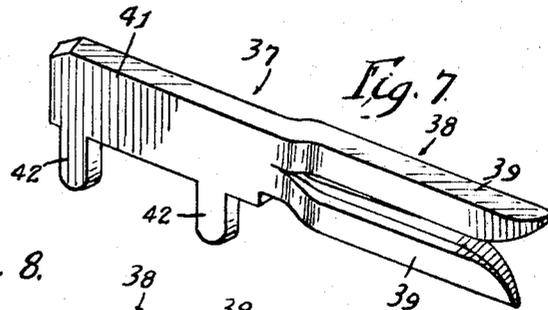
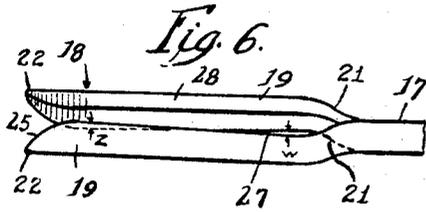
B. E. OLSSON

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ELECTRICAL CONNECTORS

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4 Sheets-Sheet 2



Inventor:
Billy Erik Olsson
By Wilson & Lippert
Attorneys

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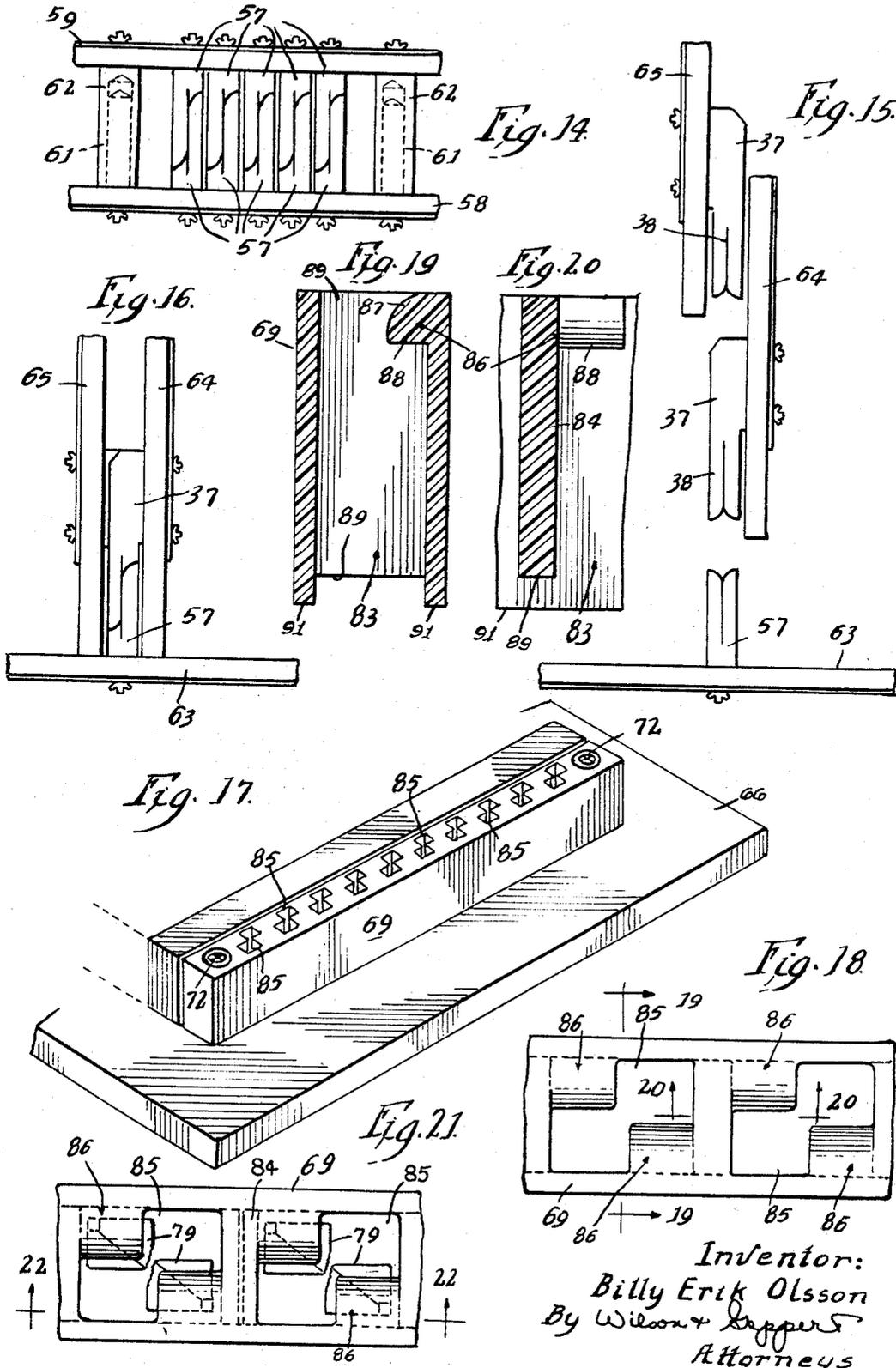
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4 Sheets-Sheet 3



Inventor:
Billy Erik Olsson
By Wilson & Lippert
Attorneys

1

3,414,865

ELECTRICAL CONNECTORS

Billy Erik Olsson, Chicago, Ill., assignor to Wauconda Tool and Engineering Company, Inc., Algonquin, Ill., a corporation of Illinois

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10 Claims. (Cl. 339—47)

The present invention relates to a device for connection of an electrical circuit and more particularly to electrical connectors which are detachably interengaged with one another. Two identical connectors of the hermaphroditic type are utilized for engagement with each other to form a separable connection.

Electrical coupling members generally employed involve a pair of complementary connectors, generally referred to as male and female, so that quantities of the two connectors would have to be kept in stock. With the advances in electronics and control systems for computers, missiles, artificial satellites, etc., the necessity for miniature connectors which may be utilized in a variety of installations has increased greatly. The present invention provides an electrical connector which is of the pull-apart type and is simple, compact, inexpensive and easily manufactured and is capable of usage in a variety of installations through minor alterations in the mounting portion of the connector. As the two mating portions of the connector are identical in configuration, the number of parts which must be stocked is very materially reduced.

Among the objects of the present invention is the provision of an electrical connector which is simple, compact, inexpensive and reliable having a high current carrying capacity with very low contact resistance at the separable connection. This type of contact permits miniaturization to a degree not possible with other types of hermaphroditic connectors having the same voltage and current capacities.

Another object of the present invention is the provision of an electrical connector which can be manufactured from sheet metal stock in continuous strip form and which may be subsequently severed from such strips and pressure crimped onto wires by automatic connector applying machines.

A further object of the present invention is the provision of an electrical connector where the contacts mate with each other over the entire length of the mating portion. The connectors provide a unique wiping action resulting in a spring contact which retains positive pressure and contact under any and all operating conditions. The contact fingers cannot be overstressed or overstrained in making or holding the connection and maintain substantially continuous pressure in the contact areas. The contacts are not affected by vibration of the connection or by repeated insertions and withdrawals or by lateral or longitudinal stresses.

The present invention further comprehends the provision of an electrical connector which will substantially eliminate inventory problems as there are no male and female parts. The contacts are identical in configuration so as to reduce by one-half the number of contacts to be stocked and tool requirements are also reduced. The contacts of the present invention provide their own inherent electrical contact pressure, are mechanically strong, easy to manufacture and highly efficient in operation.

The present invention also comprehends the provision of an electrical connector which is completely flexible from an assembly standpoint, making it possible to assemble from the standard components connectors with substantially any number of contacts. The contacts have such electrical and mechanical characteristics as to allow their use in almost any type of circuit. Furthermore, the con-

2

tacts require minimum insertion or withdrawal pressure consistent with the degree of contact pressure developed.

A further object of the present invention is the provision of an electrical contact which is adaptable to all standard mounting positions, either horizontally or vertically, upon printed circuit boards which may be disposed in abutting relation, perpendicular or parallel to each other. The contacts are adapted for use with the basic mounting shapes or extensions.

Another object of the present invention is the provision of an electrical contact having a novel mounting arrangement for the usage of a plurality of contacts on a metal mounting plate. The mounting arrangement includes a molded insulator block having a plurality of cavities adapted to receive insulation bushings with an electrical contact for each bushing. This arrangement is adapted to be mounted onto a metal support plate with the wire wrap portion of each contact extending from the side of the plate opposite to the connector portion.

The present invention further comprehends the provision of an electrical contact having a part which is longitudinally split to form a pair of identical fingers that are vertically offset from their unitary base or mounting portion and are offset from each other. These fingers are slightly tapered and overlap toward the forward portion so that engagement between two of these identical contacts will slightly spread the fingers apart to provide a positive connecting pressure or tension. The fingers are chamfered at their forward ends to provide ease of assembly. When assembled, the two contacts have a pair of horizontally disposed and a pair of vertically disposed contact surfaces.

Further objects are to provide a construction of maximum simplicity, efficiency, economy and ease of assembly and operation, and such further objects, advantages and capabilities as will later more fully appear and are inherently possessed thereby.

In the drawings:

FIGURE 1 is an enlarged perspective view of a pair of identical contacts severed from a continuous strip of contacts and pressure crimped onto electrical conductors; the contacts placed in end-to-end mutually reversed positions from which they are ready for slidable engagement.

FIG. 2 is an enlarged perspective view similar to FIG. 1 but with the contacts slidably interengaged.

FIG. 3 is an end view of one of the two contacts taken on the line 3—3 of FIG. 1.

FIG. 4 is a vertical cross sectional view taken on the line 4—4 of FIG. 2 and showing the contact surfaces of the connectors.

FIG. 5 is an enlarged partial cross sectional view illustrating the stamping operation of a strip of metal to form a slug.

FIG. 6 is a partial side elevational view of the connector taken on the line 6—6 of FIG. 1 and showing the length and configuration of the contact fingers.

FIG. 7 is an enlarged perspective view of another type of contact embodying the mating portion of FIG. 1 with a different mounting portion adapted to be directly staked to a printed circuit board.

FIG. 8 is a side elevational view of the contact of FIG. 7 staked to the printed circuit board.

FIG. 9 is a side elevational view showing two printed circuit boards as shown in FIG. 8 mounted to provide a reliable electrical connection.

FIG. 10 is an enlarged perspective view of another contact similar to that shown in FIG. 7 but having a horizontally disposed mounting portion with depending staking projections adapted to be mounted on a printed circuit board with the mating portion 90° from the position shown in FIG. 8.

FIG. 11 is a side elevational view of the contact of FIG. 10 properly staked to a printed circuit board and mated with another identical unit making a positive electric connection.

FIG. 12 is a side elevational view of one or more contacts perpendicularly staked to a printed circuit board and mated with a printed circuit connector as shown in FIG. 8 with the second board disposed perpendicular to the first board.

FIG. 13 is a side view similar to FIG. 12 but showing the circuit boards equipped with double rows of contacts.

FIG. 14 is a side elevational view of two parallel circuit boards having plural properly mated contacts staked perpendicular to their respective circuit boards.

FIG. 15 is a side elevational view of two identical parallel and reversed circuit boards having contacts mating with a single row of contacts staked on a third circuit board perpendicular to the first two boards; the boards being shown disassembled.

FIG. 16 is a side elevational view similar to FIG. 15, but with the circuit boards and contacts assembled to form a proper electrical connection.

FIG. 17 is a perspective view of another embodiment of electrical connector having a support plate and a molded block thereon with a plurality of cavities accommodating the novel contacts of the present invention.

FIG. 18 is an enlarged fragmentary top plan view of the molded block without the contacts.

FIG. 19 is an enlarged vertical cross sectional view of the molded block taken on the line 19—19 of FIG. 18 and viewed in the direction of the arrows.

FIG. 20 is an enlarged vertical cross sectional view of the block taken on the line 20—20 of FIG. 18.

FIG. 21 is an enlarged top plan view similar to FIG. 18 but with the electrical contacts inserted therein.

FIG. 22 is an enlarged vertical cross sectional view taken on the line 22—22 of FIG. 21.

FIG. 23 is a perspective view of the metal support plate shown in FIG. 17 with the molded blocks removed.

FIG. 24 is an enlarged perspective view of an insulator bushing utilized for the metal support plate of FIG. 23.

Referring more particularly to the disclosure in the drawings wherein are shown illustrative embodiments of the present invention, FIG. 1 discloses a pair of electrical connectors or contacts 10 which are crimped on the wires 11 by an insulation crimping portion 12 and a wire crimping portion 13. The wire crimping portion 13 includes side walls 14 which are curled inward around the exposed ends 15 of the wires and the longitudinal end edges 16 are driven or pressed against the wire. Each connector has a base or mounting portion 17 including the crimping portions and a mating portion 18 with mating fingers 19.

The connector or contact 10 is of the hermaphroditic type and is manufactured from sheet metal stock in continuous strip form. The material utilized is preferably a nonferrous metal having good electrical conductivity such as brass, phosphor bronze or beryllium copper.

As seen in FIGS. 1, 3 and 6, the mating portion 18 is longitudinally split and formed in such a manner that the two identical fingers 19 are offset at 21 relative to each other and slightly tapered together from the area of greatest offset at 21 to the slightly overlapping portion toward the ends or tips 22 of the fingers. The overlapping portion, as more clearly seen in FIGS. 3 and 6, creates the necessary tension to insure firm engagement when mated with another identical connector. Two connectors in mating engagement are shown in FIG. 2 and provide unique guiding surfaces and wiping contact for the interengagement operation.

The end of the connector is provided with a V-shaped opening 23 between the tips 22 of the fingers 19 which form outwardly curved vertical walls 24 as seen in FIG. 1. A chamfer 25 is also formed on each finger to provide ease of entrance when engaged with a second connector.

The fingers have contact making surfaces 26 which are

shown in FIGS. 1, 3 and 4 in a horizontal plane and provide the major contact areas between interengaging connectors. As shown in FIG. 3, the two surfaces 26 on the fingers 19 are inwardly offset, and when two connectors are interengaged, the surfaces 26 will be aligned horizontally as the fingers flex to provide a properly tensioned connection (see FIG. 4). When mating occurs between two identical connectors, reversed connector pressure will be exerted on the fingers 19 until the two surfaces 26 line up horizontally.

The thickness of the mating portion 18 is slightly greater than twice the stock thickness in the offset area at 21 where the longitudinal cut begins, as evidenced by the narrow spacing 27 as clearly shown in FIG. 6. Thus, the full depth of cut separates the two fingers 19 at the offset area 21. Each finger is tapered from the narrow spacing 27 toward the center of the fingers 19 by an approximate distance x (see FIG. 3). The fingers are further designed to overlap each other by a distance y in the vertical plane and by a distance z in the horizontal plane.

The necessary pressure required to properly connect the contacts 10 can be easily controlled by setting the offset fingers at 21 where the fingers 19 are integrated thereby controlling the amount of offset of the surfaces 26, all depending on the requisite insertion and retention pressure.

When properly designed, the fingers 19 should be separated by the narrow spacing 27 for a small distance w , approximately 0.005 inch. As stated above, the spacing 27 may be formed by setting or forming the material at 21 or by the punching process to be later described. However, this spacing has been found to be very important as it prevents binding of the contacts 10 so that the flexibility of the fingers 19 could not be properly utilized and an improper contact between the surfaces 26 would result.

As shown in FIG. 6, as the fingers 19 taper down slightly, the very tip of the connector has an approximate overall dimension of twice the material thickness minus the two x dimensions shown in FIG. 3, or the fingers 19 overlap by a distance z .

Referring to FIG. 4, not only do the mating contacts engage along the surfaces 26 but also there is contact between the burnished vertical surfaces 28 which results in the surfaces 28 forming a straight vertical plane. When mated, the connection shows no wasted air space except the central area defined by the rough surfaces 29. Both the burnished and rough surfaces are achieved during the cutting and forming operations. The reduction of wasted air space to a minimum is very important where miniaturization of components is concerned. The connectors of the present invention provide a degree of compactness not realized in prior known devices which allows a much higher density of contacts in a predetermined area than with other known contacts.

As shown in FIGS. 1 and 2, the contacts 10 can be mated with each other after they have been mutually reversed but not inverted, as well as where one contact has been inverted (not shown).

In FIG. 5, an illustrative punching operation is shown to illustrate the principles involved in the formation of the contacting surfaces which will provide an efficient electrical connection. The punching operation involved a piece of metal 31 resting on a die 32 with a central slug 33 being stamped out by a punch 34. Such a slug can be either round or rectangular in shape. It is well known to one skilled in the stamping art that a punch and die clearance must exist for an efficient operation and the heavier the material to be stamped out, the greater the clearance between the punch and die is required. In an ideal cutting operation, the punch penetrates the material to a depth equal to approximately one-third to one-half of the material thickness before fracture occurs.

The portion 35 of the thickness of the material 31 so penetrated by the punch 34 will be highly burnished, appearing on the cut edge as a bright band around the en-

5

fire contour of the cut. Likewise, the same highly burnished bright band appears around the entire contour of the slug 33 and, as it was caused by the die 32 cutting edge, it will appear on the lower side portion of the cut out slug.

The area located within the oval ring shown in FIG. 5 shows two identical parts or portions of parts; both having dimensionally the same fracturing band 36 and the same burnished band 35. If a vertical line is drawn upward along the burnished surface 35 of the lower part or slug 33, the same surface 35 of the metal 31 is inwardly offset from that line by a distance y , which is the clearance between the punch 34 and the die 32. For proper interengagement, the burnished surfaces 28 should be in substantial vertical alignment and preferably inwardly offset a distance y as seen in FIG. 3. Without the inwardly offset of the burnished surfaces 28, it would not be possible to mate two connectors of this type and expect proper pressure to be applied over the entire area of the surfaces 26.

Considering FIGS. 3 and 4, the burnished inwardly offset surfaces 28 on both connectors 10 will, when mated with each other as insertion pressure is applied, spring apart slightly until they form a vertical line as shown in FIG. 4. At that moment, the two connectors can be mated with the main purpose of the burnished sides 28 being to act as guides for the fingers 19 making it impossible for the fingers to turn axially during insertion. In accomplishing this guiding function, the other contact surfaces 26 can always be mated parallel to each other under firm pressure utilizing its contact area to substantially 100%. Besides their primary function as guides, the burnished sides 28 also provide an excellent additional contact area. In FIG. 4, the exaggerated opening 30 is surrounded by the four breaksides or rough surfaces 29 from the stamping operation when fracture occurs. This is the only place in the mated connectors where electrical contact is not made.

When two connectors 10 are properly mated, the overlapping of the fingers 19 in both the horizontal and vertical planes creates the necessary tension which results in excellent contact pressure between the contact surfaces 26 and the burnished guide surfaces or sides 28. The overall dimension of the two fingers at their tips as the fingers flex outwardly approaches and reaches approximately the same dimension as that shown at the area 21 of the mating portion shown in FIG. 6 when the connectors are engaged.

With reference to FIG. 7, a different type of contact or connector 37 is shown with its mating portion 38 having fingers 39 identical to the embodiment of FIGS. 1 and 2. The opposite or mounting ends or base of the various embodiments of contacts shown herein may be provided with a substantially unlimited variety of shapes such as the taper tab, conventional solder terminal, wire wrap, welding tab, etc. The embodiment of FIG. 7 shows a mounting end 41 having a pair of depending extensions 42 which lie in the same plane as the end 41 and extend at right angles to the contact fingers 39. The positioning of the mating portion 38 is at right angles to the showing of FIGS. 1 and 2.

The extensions 42 are utilized to mount the contact 37 upon a printed circuit board 43 and to provide electrical engagement with conductive strips 44 (see FIG. 8). The extensions 42 project through the printed circuit board 43 and are spread or splayed in a known manner to provide tabs 45 which are firmly pressed against the conductive strip or strips 44 to provide an excellent electrical connection as well as accurate spacing of the contact 37 in a predetermined position. FIG. 9 shows an end pair of contacts 37 of rows of contacts each mounted on one of two printed circuit boards connected in tandem.

Another embodiment of the present invention is shown in FIG. 10 where a connector or contact 46 having mating fingers 47 is provided with a horizontally disposed

6

mounting end or body 48 with a tongue 49 on the edge 51 of the end 48 and bent at right angles and a spaced second tongue 52 shear formed out of the body and also bent downwardly so that the tongues 49 and 52 depend from the mounting body 48. These tongues serve the same purpose as the extensions 42 in FIG. 7 except that this terminal is staked to a printed circuit board 53 in such a manner that the mating portion will be axially located 90° from the form shown in FIG. 8.

FIG. 11 discloses two printed circuit boards 53 in tandem with the fingers 47 of two contacts 46 engaged together with the tongues 49 and 52 engaging conductive strips 54. In dip soldering the printed circuit boards, the staked portions or tongues 45, 49, 52 are additionally connected to the board circuitry resulting in an even higher degree of reliability for continuity between the contact and the board circuitry.

FIG. 12 discloses another arrangement for a pair of printed circuit boards 55 and 56 with the board 56 mounted perpendicular to the board 55. A plurality of contacts 37 are arranged in a row and staked to the board 56 by contact tabs 45 and a row of mating contacts 57 are mounted perpendicular to the board 55 and adapted to engage and mate with the contacts 37. The contacts 57 have a single depending projection 58 on the mounting end of the contact which projects through and is staked to the board 55.

In FIG. 13, the two printed circuit boards 55 and 56 are provided with two rows of alternately arranged or staggered contacts. The board 55 has two rows of contacts 57 and 57^a and the board 56 has two rows of contacts 37 and 37^a. The contacts 37^a are identical with contacts 37 (as in FIGS. 7, 8 and 9) except that the width of the mounting end is approximately twice that of end 41. These contacts 37 and 37^a have the mounting ends arranged in a single row and their mating portions 38 and 38^a shown in two rows as seen in FIG. 13.

FIG. 14 shows two printed circuit boards 58 and 59 having conductive strips 54 and mounted in parallel relation with guide pins 61 staked to board 58 and hollow guide bushings 62 receiving the guide pins 61 staked or otherwise fastened to the board 59. Each board is equipped with rows of contacts 57 mounted perpendicular to each board and mating together. Instead of two rows of contacts such as shown in FIG. 13, each board has been equipped with five rows of contacts and may be equipped with additional rows as may be necessary.

FIGS. 15 and 16 show another embodiment for the utilization of three printed circuit boards 63, 64 and 65, with the boards 64 and 65 both mounted perpendicular to the board 63 and parallel to each other. Board 63 is equipped with a single row of contacts 57 while the boards 64 and 65 each have a single row of contacts 37 spaced apart sufficiently so that contacts 37 from one board fit between contacts of the opposite board. FIG. 15 shows the boards prior to final assembly and FIG. 16 shows the contacts of the boards mated together. Obviously, the arrangements shown in FIGS. 9, 11, 12, 13, 14, 15 and 16 are only a few of the variety of arrangements which may be used with the present contacts having various mounting body configurations.

In FIGS. 17 to 24, another embodiment of the present novel contact is shown with a simple and easily assembled mounting board arrangement which adapts itself well to mass production methods. This assembly includes a metal plate 66, preferably formed of aluminum, having a plurality of openings 67 (see FIG. 23) which are adapted to receive insulator bushings 68. A molded insulator block 69 fits over a row of the bushings 68 and houses a row of contacts 71 (FIG. 22). The insulator block 69 is secured to the plate 66 by screws or other suitable fastening means 72 (FIG. 17) engaging fastening openings 73 (FIG. 23) in the plate while the other components are loosely mounted in the plate.

The insulator bushing 68 is more specifically shown in

FIGS. 23 and 24 and includes a cylindrical portion 74 having a tapered or conically shaped lower end 75. The bushing has an upper portion or a rectangularly shaped head 76 with the length of the head being slightly less than (approximately 0.0015 to 0.002 of an inch) the distance between any two adjacent openings 67 in the plate 66. A rectangular or square shaped opening 77 extends axially through the bushing and is of a dimension to provide sufficient clearance for proper floating of the contact 71. The bushing is preferably formed of a suitable plastic insulating material such as nylon.

The contact 71 has a mating portion 78 with mating fingers 79 and a wire wrap portion 81 which is generally square in cross section. The wire wrap portion 81 terminates in a pyramidal shaped tip 82 to facilitate easy entrance of wrapping tools (FIG. 22).

The molded insulator block 69 is extremely simple in design and therefore easy and inexpensive to manufacture, with the design aimed toward ease of assembly and disassembly by unskilled workers. The block 69 (see FIGS. 19 and 20) is provided with a plurality of cavities 83 divided by walls 84 to provide rectangular shaped holes or openings 85, each provided with a pair of opposed guiding portions 86 located in opposite corners (FIG. 18). Each portion 86 covers an area slightly less than one-quarter of the area of opening 85. The remaining area forms two open spaces opposite each other and each having an area of slightly more than one-quarter of the total area of opening 85.

The guiding portions or projections 86 (FIGS. 18 and 19) are each provided with a curved upper surface 87 and a flat lower or undercut surface 88. The curved surfaces 87 aid in guiding the tips of the fingers 39 of a mating portion 38 of a contact 37 such as shown in FIG. 8 into the open spaces of opening 85 and the undercut surfaces 88 prevent removal of the contacts 71 housed within the cavities 83.

Each rib or wall 84 dividing the cavities 83 has a lower surface 89 which is spaced above the lower surface 91 of the insulator block 69. This spacing is slightly greater than the thickness of the head 76 of the insulator bushings 68. FIG. 21 shows the contacts 71 in the insulator block 69 and FIG. 22 more clearly discloses the assembled unit on the support plate.

To assemble this novel structure, an operator takes a hand full of insulator bushings 68, places one in each opening 67 of the plate 66. The cylindrical portion 74 of the bushing 68 has about the same or slightly less diameter than the diameter of the opening 67 so that the bushings can be assembled very rapidly in the openings 67 as shown in FIG. 23. The bushing heads 76 guide and properly align the bushings leaving a very small space 92 between adjacent heads (FIG. 22).

After all the openings 67 have been filled, contacts 71 are similarly inserted into the square opening 77 in the bushings 68 with the shoulder 93 formed between the mating portion 78 and the wire wrap portion 81 resting on the upper surface of the head 76. The insulator block 69 is then placed over the contacts 71 and bushings 68 and firmly clamped to the plate 66 by fastening means 72. The openings 73 for the fasteners 72 may be internally threaded or the openings in the block 69 may be threaded for a screw fastener. The lower surface 89 of the walls 84 prevents the bushing 68 from being raised in the opening 67. Thus the metal panel 66 has been assembled with contacts 71 which are properly insulated from the panel 66 by the insulator bushings 68.

The configuration of the bushing head 76 and the square opening 77 makes it impossible for the contacts 71 and bushings 68 to twist or turn during the wire wrapping operation where a certain amount of torque is required. The contacts 71 while in floating engagement with the bushing 68 are securely retained in operative position. No special tools are required for assembly and a damaged or faulty contact is easily and quickly removable from the

assembly. Although the insulator block 69 is shown with one row of cavities 83, this is not construed to be limiting as two or more rows of cavities in a block 69 will work equally well. The printed circuit board 56 of FIG. 12 or FIG. 13 show the common type of printed circuit connectors which would mate properly with the insulator connector block 69 of FIG. 17.

Obviously, the tips of the mating fingers can be curved outwardly to be farther apart if necessary for easy engagement between mating connectors. Although the preferred method of forming the contacts is by the stamping operation shown in FIG. 5, the contact may be stamped out of a metal sheet with the fingers separated a small distance due to a small area of metal being removed from between the fingers. Then the fingers are pressed together to the final desired configuration. The end result and functioning are substantially the same but there is only one burnished side which will provide the novel guiding function disclosed for the contacts shown in FIGS. 1 and 2.

Having thus disclosed my invention, I claim:

1. An electrical connector for detachable frictional interengagement with a like connector comprising a mounting portion and a mating portion, said mating portion including a pair of longitudinally extending contact fingers positioned relatively offset to each other, a pair of generally parallel guiding surfaces having oppositely disposed burnished bands and fracture bands therein, a pair of contact surfaces at right angles to said burnished bands, said fracture bands being adjacent said contact surfaces, and a pair of outwardly extending tips on said fingers curving away from each other on both the contact surfaces and said guiding surfaces.

2. An electrical contact as set forth in claim 1, in which said burnished bands are located in inwardly offset position and said contact surfaces are spaced adjacent said mounting portion and taper inwardly in an inwardly offset position toward said tips.

3. An electrical connector as set forth in claim 2, in which said burnished bands are in inwardly offset relation but said fracture bands on the guiding surfaces adjacent said contact surfaces are slightly spaced so that the fingers do not contact each other.

4. An electrical connector as set forth in claim 2, in which the burnished bands prevent twisting of a pair of connectors during interengagement, and the fingers of the connectors in interengagement are tensioned outwardly.

5. An electrical connector as set forth in claim 4, in which the contact surfaces and burnished bands of the fingers are aligned in perpendicular planes when the connectors are interengaged.

6. An electrical connector for detachable frictional interengagement with a like connector comprising a mounting portion and a mating portion, said mating portion including a pair of longitudinally extending contact fingers positioned relatively offset to the mounting portion and each other, said fingers having a pair of generally parallel and overlapping guiding surfaces with oppositely disposed burnished bands and fracture bands thereon, a pair of generally flat contact surfaces at right angles to said guiding surfaces, and a pair of outwardly curved tips, said contact surfaces being slightly spaced adjacent said mounting portion and converging inwardly to an inwardly offset position toward said tips, said burnished bands being positioned in inwardly offset position but said fracture bands located adjacent said contact surfaces are overlapping but slightly spaced adjacent the longitudinal axis of the connector so that the fingers do not contact each other.

7. An electrical connector as set forth in claim 6, in which said tips curve away from each other on the guiding surfaces and are chamfered in opposite directions on said contact surfaces.

8. An electrical connector for detachable frictional interengagement with a like connector comprising a mounting portion and a mating portion, said mating portion

9

including a pair of axially extending fingers offset relative to each other and having tips curving outwardly from each other, said fingers having a pair of contact surfaces and a pair of generally parallel guiding surfaces on said fingers, said guiding surfaces overlapping each other and positioned generally perpendicular to said contact surfaces with the guiding surfaces including axially extending burnished bands adjacent the outer surfaces of the fingers and axially extending fracture bands adjacent said contact surfaces, and said contact surfaces being slightly spaced adjacent the mounting portion and tapering to an inwardly offset position toward said tips.

9. An electrical connector as set forth in claim 8, in which the complementary contact and guiding surfaces of like connectors engage for substantially the entire length of the fingers when in interengagement to provide maximum contact between the connectors with minimum contact resistance.

10. A detachable electric connector contact comprising a blade of resilient electric conducting material having a base portion at one end and a longitudinally split multiplanar mating head at the opposite end, said mating head comprising a single pair of flat fingers each having a planar

10

contacting face with the contacting faces lying in substantially parallel planes and oppositely positioned on said fingers, said fingers being disposed in closely spaced parallel edge-to-edge relation and being relatively offset perpendicular to their contacting faces, the adjacent inner edges of said fingers being broken away to form portions inclined toward their associated contacting faces, said inclined portions being disposed in slightly overlapping relation.

References Cited

UNITED STATES PATENTS

| | | | |
|-----------|---------|-------------|---------|
| 2,713,154 | 7/1955 | Bilsborough | 339—47 |
| 3,011,143 | 11/1961 | Dean | 339—49 |
| 3,125,816 | 8/1938 | Reynolds | 339—47 |
| 3,115,379 | 12/1963 | McKee | 339—47 |
| 3,070,769 | 12/1962 | Murphy | 339—49 |
| 3,086,188 | 4/1963 | Ross | 339—49 |
| 2,799,237 | 7/1957 | Martines | 113—119 |
| 2,996,026 | 8/1961 | Batcheller | 113—119 |

MARVIN A. CHAMPION, *Primary Examiner.*

PATRICK A. CLIFFORD, *Assistant Examiner.*