Jan. 27, 1970 B. E. OLSSON 3,492,631

ELECTRICAL CONNECTOR ASSEMBLY

Original Filed Sept. 20, 1963 2 Sheets-Sheet 1

Fig. 1

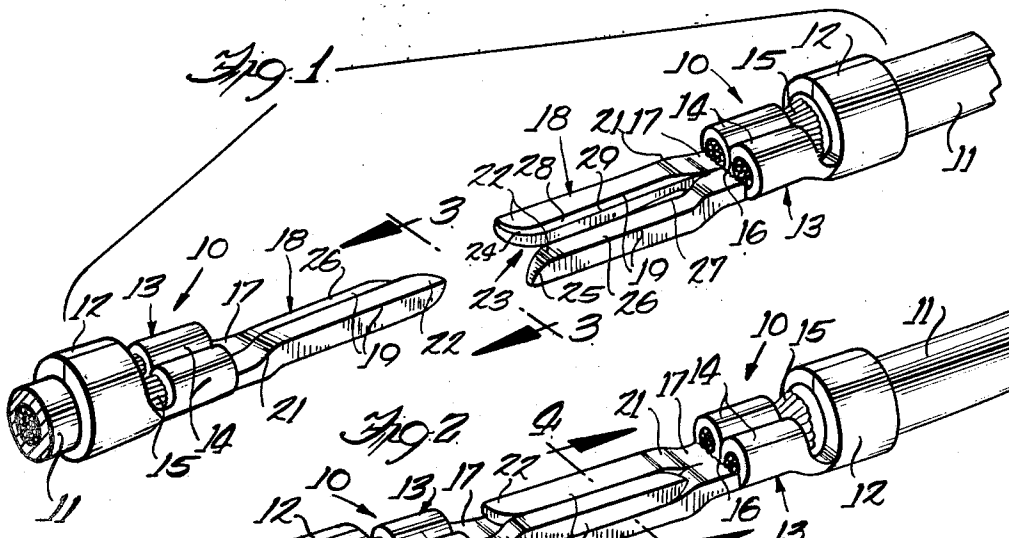


Fig. 2

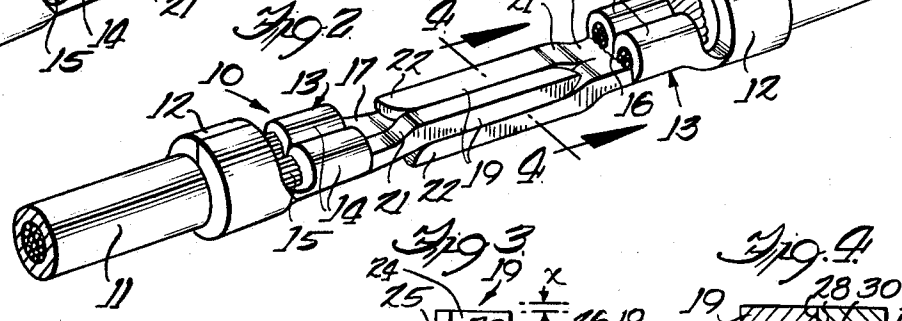


Fig. 3

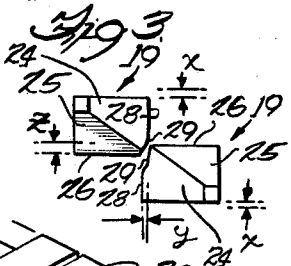


Fig. 4

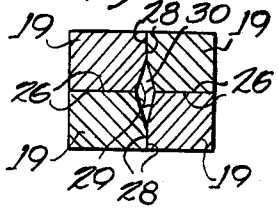


Fig. 5

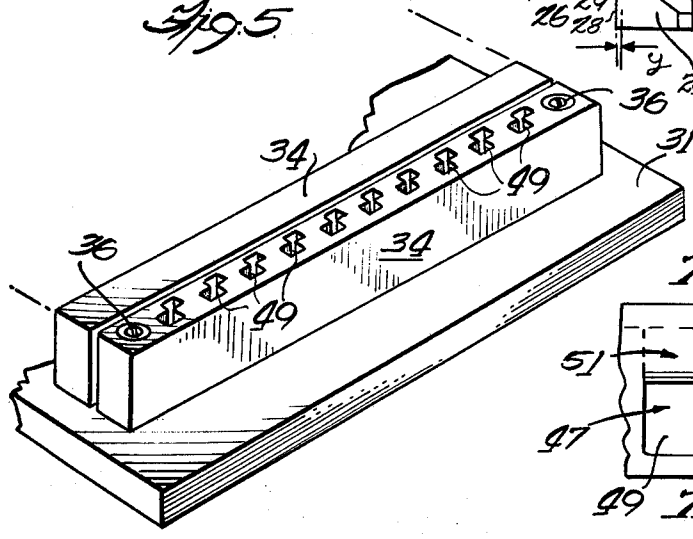
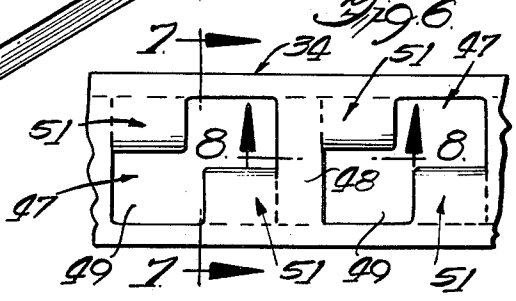


Fig. 6



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Fig. 7.

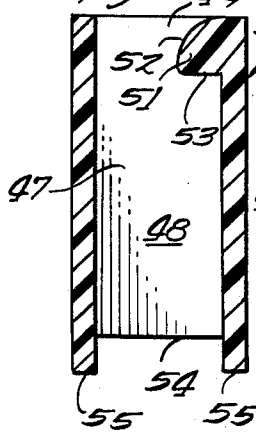


Fig. 8.

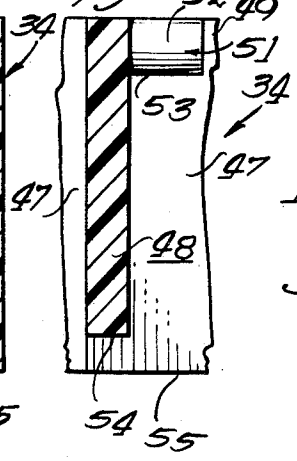


Fig. 9.

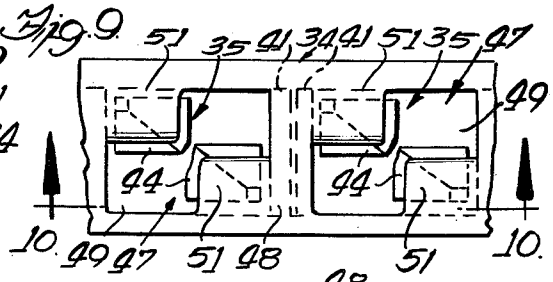


Fig. 10.

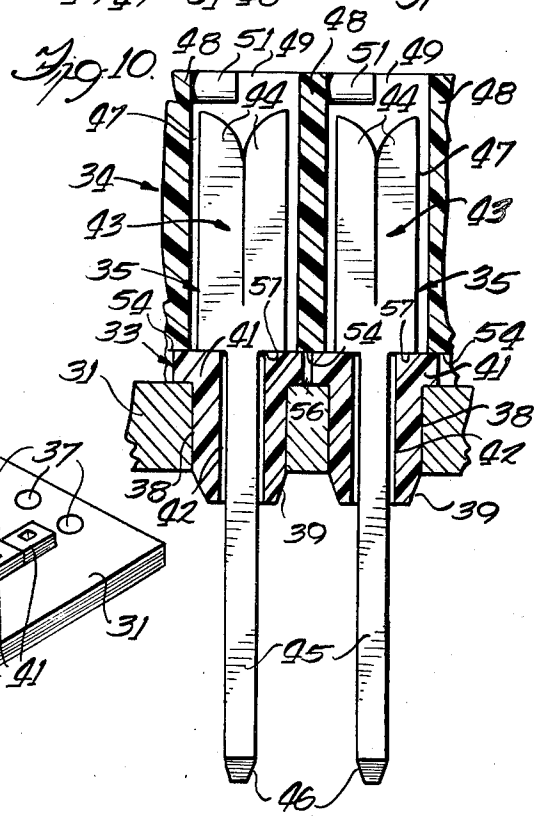


Fig. 11.

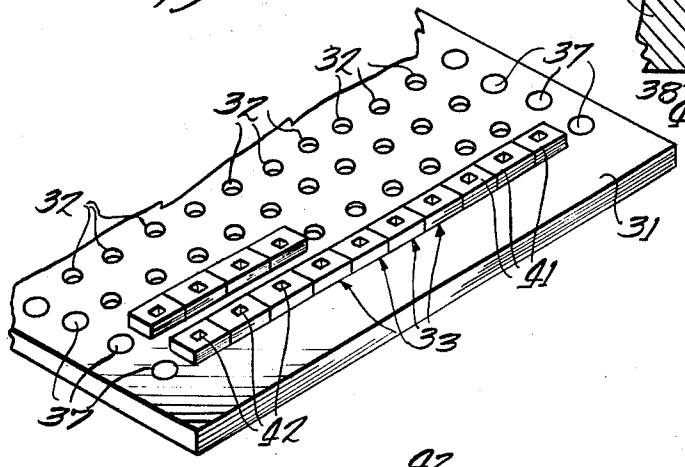
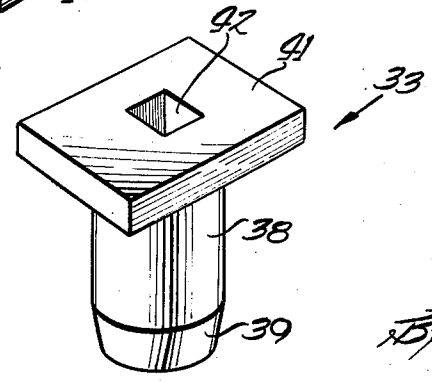


Fig. 12.



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3,492,631

ELECTRICAL CONNECTOR ASSEMBLY

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Original application Sept. 20, 1963, Ser. No. 310,308, now Patent No. 3,414,865, dated Dec. 3, 1968. Divided and this application July 15, 1968, Ser. No. 745,016
Int. Cl. H01r *23/04, 33/76, 13/28*
U.S. Cl. 339—176 10 Claims

ABSTRACT OF THE DISCLOSURE

An electrical connector assembly for use in multiple contact arrangements where a mounting board or metal plate has a plurality of openings therein normally arranged in rows. An insulator bushing has a cylindrical portion with a tapered end received in an opening in the mounting board, and, at the opposite end, a rectangularly shaped head; the head and cylindrical portion having an opening therethrough of a rectangular configuration. An electrical connector has a wire wrap portion extending through the opening in the bushing and a pair of offset fingers extending above the bushing head. An insulator block fits over a row of bushings and connectors and has plural cavities receiving the bushing heads and connectors and has an irregular upper opening for each cavity receiving a complementary connector.

This application is a division of my copending application Ser. No. 310,308, filed Sept. 20, 1963, for "Electrical Connectors," now Natent No. 3,414,865, issued Dec. 3, 1968.

The present invention relates to a device for connection in an electrical circuit and more particularly to electrical connectors which are detachably interengaged with one another. Two identical connectors of the hermaphroditic type are utilizied 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, artifical satellites, etc., the necessity for miniature connectors which may be utilized in a variety of installation 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 contact having a novel mounting arrangement for the usuage 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 be 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 apear and are inherently possessed thereby.

In the drawings:

FIGURE 1 is an enlarged perspective view of a pair of identical contacts severed from a continous 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.

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

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

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

FIGURE 5 is a perspective view of the electrical connector assembly having a support plate and a molded block thereon with a plurality of cavities accommodating the electrical contacts.

FIGURE 6 is an enlarged fragmentary top plan view of the molded block without the contacts.

FIGURE 7 is an enlarged vertical cross sectional view of the molded block taken on line **7—7** of FIG. 6.

FIGURE 8 is an enlarged vertical cross sectional view taken on the line **8—8** of FIG. 6.

FIGURE 9 is an enlarged fragmentary top plan view similar to FIG. 6 but with the electrical contacts in the molded block.

FIGURE 10 is an enlarged vertical cross sectional view taken on the line **10—10** of FIG. 9.

FIGURE 11 is a perspective view of the metal support plate of FIG. 5 with the plurality of insulator bushings inserted therein.

FIGURE 12 is an enlarged perspective view of an insulator bushing of the assembly.

Referring more particularly to the disclosure in the drawings wherein is shown an illustrative embodiment of the present invention, FIG. 1 discloses a pair of electrical connectors of contacts **10** which are crimped onto 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 non-ferrous metal having good electrical conductivity, such as brass, Phophor bronze or beryllium copper.

As seen in FIGS. 1 and 3, 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 FIG. 3, creates the necessary tension to insure firm engagement when mated with another identical connector. The 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 **23** 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 and 3 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**. 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** towards 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 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** of approximately 0.005 inch. As stated above, the spacing **27** may be formed by setting or forming the material at **21** or by a punching process. 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 properly be utilized and an improper contact between the surfaces **26** would result.

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

Referring to FIG. 4, not only do the mating contacts engage along the surfaces **26** but also there is contacts 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 the rough surfaces are achieved during the punching and forming operations. The reduction of wasted air space to a minimum is very important when 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 when one contact has been inverted (not shown).

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 the 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 as the area **21** of the mating portion when the connectors are engaged.

FIGS. 5–12 disclose a simple and easily assembled mounting board arrangement which adapts itself to mass production methods. This assembly includes a metal plate **31**, preferably formed of aluminum, having a plurality of openings **32** (see FIG. 11) which are adapted to receive insulator bushings **33**. A molded insulator block **34** fits over a row of the bushings **33** and houses a row of contacts **35** (FIG. 10). The insulator block **34** is secured to the plate **31** by screws or other suitable fastening means **36** (FIG. 5) engaging fastening openings **37** (FIG. 11) in the plate while the other components are loosely mounted in the plate.

The insulator bushing **33** is more specifically shown in FIGS. 11 and 12 and includes a cylindrical portion **38** having a tapered or conically shaped lower end **39**. The bushing has an upper portion or a rectangular shaped head **41** 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 **32** in the plate **31**. A rectangular or square shaped opening **42** extends axially through the bushing and is of a dimension to provide sufficient clearance for proper floating of the contact **35**. The bushing is preferably formed of a suitable plastic insulating material such as nylon.

The contact **35** has a mating portion **43** with mating fingers **44** and a wire wrap portion **45** which is generally square in cross section. The wire wrap portion **45** terminates in a pyramidal shaped tip **46** to facilitate easy entrance of wrapping tools (FIG. 10).

The molded insulator block **34** 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 **34** (see FIGS. 7 and 8) is provided with a plurality of cavities **47** divided by walls **48** to provide rectangular shaped holes or openings **49**, each provided with a pair of opposed guiding portions **51** located in opposite corners (FIG. 6). Each portion **51** covers an area slightly less than one-quarter of the area of opening **49**. 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 **49**.

The guiding portions or projections **51** (FIGS. 6 and 7) are each provided with a curved upper surface **52** and a flat lower or undercut surface **53**. The curved surfaces

52 aid in guiding the tips of the fingers of a mating portion of a complementary contact, such as contact 10 shown in FIG. 1, having any suitable mounting portion into the open space of opening 49 and the undercut surfaces 53 prevent removal of the contacts 35 housed within the cavities 47.

Each rib or wall dividing the cavities 47 has a lower surface 54 which is spaced above the lower surface 55 of the insulator block 34. This spacing is slightly greater than the thickness of the head 41 of the insulator bushings 33. FIG. 9 shows the contacts 35 in the insulator block 34 and FIG. 10 more clearly discloses the assembled unit on the support plate.

To assemble this novel structure, an operator takes a hand full of insulator bushings 33, places one in each opening 32 of the plate 31. The cylindrical portion 38 of the bushing 33 has about the same or slightly less diameter than the diameter of the opening 32 so that the bushings can be assembled very rapidly in the openings 32 as shown in FIG. 11. The bushing heads 41 guide and properly align the bushings leaving a very small space 56 between adjacent heads (FIG. 10).

After all the openings 32 have been filled, contacts 35 are similarly inserted into the square opening 42 in the bushings 33 with the shoulder 57 formed between the mating portion 43 and the wire wrap portion 45 resting on the upper surface of the head 41. The insulator block 34 is then placed over the contacts 35 and bushings 33 and firmly clamped to the plate 31 by fastening means 36. The openings 37 for the fasteners 36 may be internally threaded or the openings in the block 34 may be threaded for a screw fastener. The lower surface 54 of the walls 48 prevents the bushing 33 from being raised in the opening 32. Thus the metal panel 31 has been assembled with contacts 35 which are properly insulated from the panel 31 by the insulator bushings 33.

The configuration of the bushing head 41 and the square opening 42 makes it impossible for the contacts 35 and bushings 33 to twist or turn during the wire wrapping operation where a certain amount of torque is required. The contacts 35 while in floating engagement with the bushing 33 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 34 is shown with one row of cavities 47, this is not construed to be limiting as two or more rows of cavities in a block 34 will work equally well.

Having thus disclosed the invention, I claim:

1. An electrical connector assembly adapted for ease of mass production, comprising a support plate having a plurality of openings therein, insulator bushings received in said openings, floating electrical connectors received in said bushings, and an insulator block encompassing said bushings and said connectors and having openings adapted to receive mating connectors.

2. An electrical connector assembly as set forth in claim 1, in which each insulator bushing includes a cylindrical body and an enlarged head having a passage extending axially therethrough, and said electrical connectors include a mounting portion received in said passage and a mating portion extending above the enlarged head of said bushing.

3. An electrical connector assembly as set forth in claim 2, in which said passage in the bushing has a rectangular cross section and said mounting portion of the connector has a complementary rectangular cross section to maintain said connector in said passage against relative rotation therebetween.

4. An electrical connector assembly as set forth in claim 1, in which said insulator block includes an elongated body having a plurality of cavities therein, ribs separating said cavities and having their lower edges spaced from the lower surface of the body, and guiding projections at opposite corners of each cavity and forming opposed openings leading into each cavity.

5. An electrical connector assembly as set forth in claim 2, in which the mounting portion and mating portion of each connector is separated by a shoulder abutting the enlarged head of said bushing, said mating portion having a pair of fingers offset relative to each other, and said insulator block having a plurality of cavities encompassing at least one row of said bushings and connectors.

6. An electrical connector assembly as set forth in claim 5, in which said insulator block includes an elongated body secured to said plate and having upper and lower surfaces, said cavities extending between said upper and lower surfaces, a rib separating adjacent cavities and having a lower edge spaced from the lower surface of the body, and a pair of inwardly extending guiding portions at opposite corners of each cavity adjacent the upper surface of the body forming two oppositely disposed openings leading into said cavity.

7. An electrical connector assembly as set forth in claim 6, in which said lower surface of each rib is spaced from the lower surface of the body a distance substantially equal to the thickness of the enlarged head of said insulator bushing.

8. An electrical connector assembly as set forth in claim 6, in which each guiding portion in said insulator block body has an upper downwardly curved surface and a flat undercut surface, and said fingers of the mating portion of a connector are positioned under said guiding portions.

9. An electrical connector assembly as set forth in claim 5, in which said mounting portion of said connector and said passage in said bushing have complementary polygonal cross sections to prevent relative rotation therebetween.

10. An electrical connector assembly as set forth in claim 9, in which said cylindrical body of each bushing has a tapered depending end, and said mounting portion of each connector has a tapered depending end, said mounting portion of each connector extending below said bushing to form a wire wrap portion.

References Cited

UNITED STATES PATENTS

2,440,279	4/1948	Larkins.	
2,956,260	10/1960	Bennett.	
2,980,881	4/1961	McKee.	
2,995,617	8/1961	Maximoff et al.	
3,042,894	7/1962	Fox	339—49 XR
3,070,769	12/1962	Murphy	339—49
3,086,074	4/1963	Just et al.	
3,166,372	1/1965	Just	339—18 XR

FOREIGN PATENTS

1,089,838	9/1960	Germany.

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U.S. Cl. X.R.

339—49, 64, 221