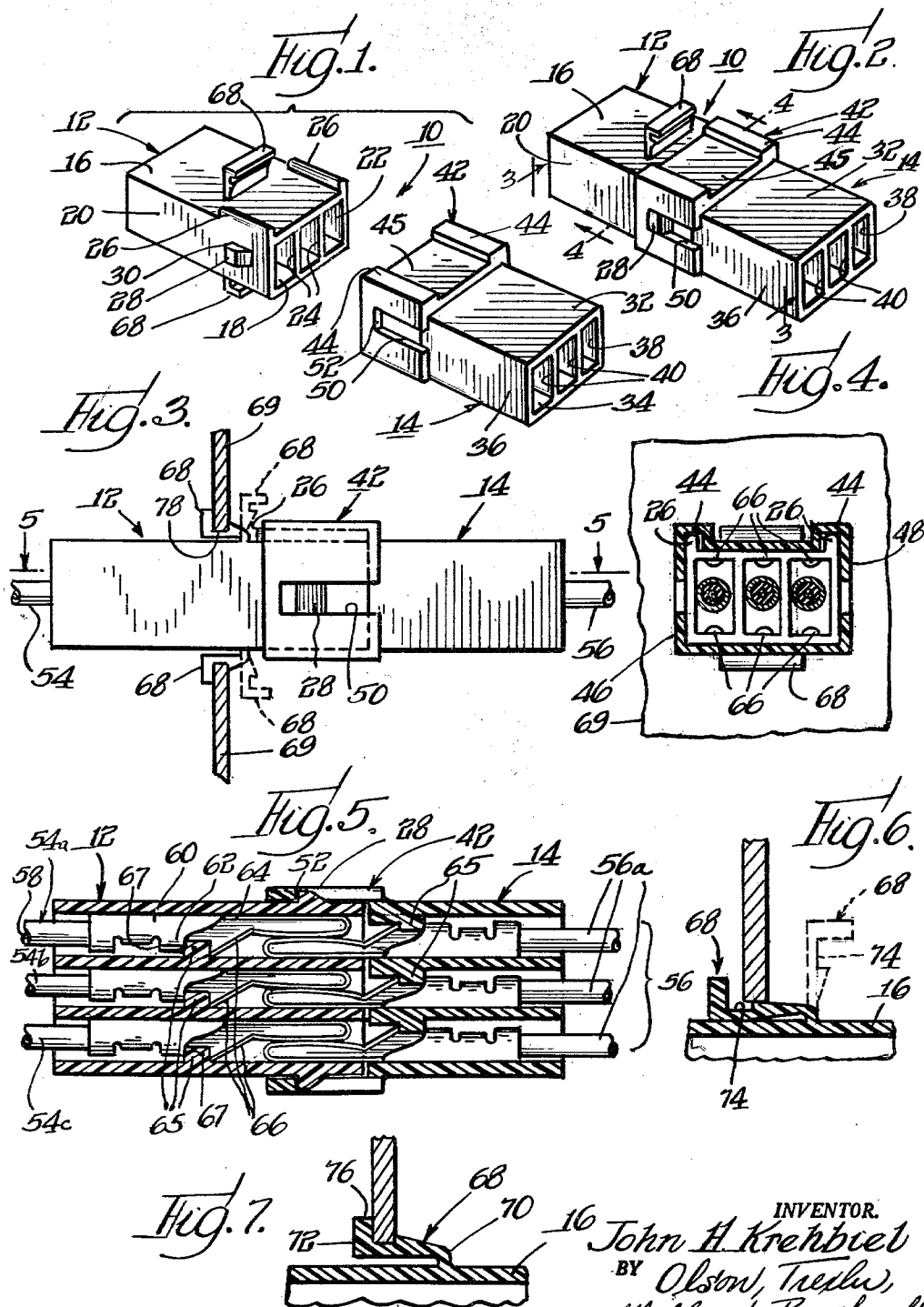


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ELECTRICAL CONNECTOR  
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## ELECTRICAL CONNECTOR

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This invention relates to electrical connectors, and particularly to an improved arrangement for securing electrical conductors in electrical connectors and for mounting such electrical connectors on panels.

In apparatus which comprises multiple sub-assemblies of electrical components, it is desirable to provide an electrical connector for interconnecting the various electrical conductors in groups rather than to join together individual pairs of wires. The interconnected groups of wires or the electrical connector itself, may then be secured to a mounting panel or the like to afford a predetermined location for each group of conductors thereby to present a systematized wiring layout which may be readily checked or serviced.

Prior means of securing electrical connectors to mounting panels include metal clips, lugs, screws, and other mechanical fasteners of various types. Since each of these required individual handling and the use of hand tools in assembling the fasteners and connectors to the mounting member, a significant amount of man hours was spent simply in searching for the proper fastener and in manipulating the appropriate hand tool. It is to be appreciated that if such assembly time could be eliminated while still effecting proper attachment of the electrical connector to the mounting panel, the assembly cost of the electrical apparatus would be reduced while leaving unaffected the quality of the product.

Accordingly, an important object of this invention is to provide an improved electrical connector which is readily mountable on a panel or the like without the aid of separate clips or other mechanical fasteners.

Another object of this invention is to provide an improved electrical connector incorporating mounting means therein which entirely eliminates the use of hand tools in attaching the connector to a mounting panel.

Yet another object of this invention is to provide an improved means to facilitate quick assembly and firm securing of electrical conductors in an electrical connector.

Still another object of this invention is to provide an improved electrical connector adapted to be fixedly mounted on an associated mounting panel through a complementary shaped opening therein in a fixedly mounted insulated manner.

A further object of the present invention is to provide an improved electrical connector of two-piece construction which is simple in design and construction, economical to manufacture, highly practicable in use, and which is adapted for rapid assembly in electrical components.

Further features of the invention pertain to the particular arrangement of the elements of the electrical connector whereby the above-outlined and additional features thereof are attained.

The invention, both as to its organization and method of operation, together with further objects and advantages thereof, will best be understood by reference to the following specification taken in connection with the accompanying drawing wherein like reference numerals have been used to designate like parts throughout, in which:

FIGURE 1 is an exploded, perspective view of an electrical connector made in accordance with and embodying the principles of the present invention;

FIG. 2 is an assembled, perspective view of the electrical connector shown in FIG. 1;

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FIG. 3 is an enlarged view of the electrical connector taken from the side in the direction of the arrows along the line 3-3 in FIG. 2, the connector being illustrated extending through an opening in an associated mounting panel;

FIG. 4 is an enlarged, vertical sectional view taken generally in the direction of the arrows along the line 4-4 in FIG. 2; the connector being shown with the mounting panel;

FIG. 5 is an enlarged, horizontal sectional view taken generally in the direction of the arrows along the line 5-5 in FIG. 3 and showing two groups of electrical conductors encased by the connector for electrical contact;

FIG. 6 is a greatly enlarged, fragmentary, vertical sectional view illustrating in broken lines the original position of a mounting ear of the connector and showing in solid lines the position of the ear immediately prior to the interlocking thereof with the edge of the panel opening; and

FIG. 7 is a view similar to FIG. 6 depicting the mounting ear in operative engagement with the edge of the panel opening.

Referring now to FIG. 1 of the drawing, there is shown an electrical connector generally designated by the numeral 10 made in accordance with and embodying the principles of the present invention. The electrical connector 10 includes a plug element 12 and a receptacle element 14.

The plug element 12 is of a hollow, generally box-like configuration having substantially planar, rectangular top and bottom walls 16 and 18 respectively, the long edges thereof being integrally joined at right angles with a pair of spaced side walls 20 and 22. Intermediate the side walls 20 and 22 there is arranged a spaced pair of partitions 24 extending between the top 16 and bottom 18 walls and disposed generally parallel to the side walls 20 and 22. The partitions 24 extend the full length of the plug element 12. The relationship of the partitions 24 to the walls 16, 18, 20, and 22 provides passageways of generally rectangular cross section extending between the opposite ends of the plug elements 12.

On the outer surface of the top wall 16 there is disposed a pair of longitudinally extending and laterally spaced apart guide members 26 which facilitates proper interconnection of the plug 12 with receptacle 14. Being generally rectangular in transverse cross section, each guide member 26 is arranged flush with a long edge of the top wall 16 and extends from the short edge thereof about one-third the length of the plug element 12. Below each guide member 26 there is arranged on each side wall 20-22 an outwardly protruding lug 28. Being wedge shape, the lug 28 has its thin edge portion disposed toward the entering end of the plug 12 and its thicker portion providing a shoulder 30 facing away from the entering end of the plug 12.

The receptacle element 14 is of a hollow, generally box-like configuration having substantially rectangular, planar top and bottom walls 32 and 34 respectively, the long edges thereof being integrally joined at right angles with a pair of spaced apart side walls 36 and 38. Intermediate the side walls 36 and 38 there is arranged a spaced pair of partitions 40 extending between the top and bottom walls and disposed generally parallel to the side walls 36 and 38. The relationship of the partitions 40 with the walls 32, 34, 36, and 38 provides passageways having generally rectangular, transverse cross section extending through the receptacle element 14. A housing or socket 42 is integrally joined to one end of the receptacle 14 and is adapted to receive therein the end of the plug 12 having the guide members 26 and the lugs 28 thereon. More particularly, the wall of the housing 42 contiguous the top wall 32 is provided with a pair of longitudinally

extending and laterally spaced apart inverted channel members 44 having an internal length and cross section of a size adapted to receive therein the guide member 26. A generally rectangular panel 45 interconnects the inwardly disposed sides of the channels 44, and is arranged in a plane disposed above the top wall 32 of the receptacle 14.

Disposed outwardly from and contiguous with the receptacle side walls 36 and 38, the side walls 46 and 48 of housing 42 are each provided with a rectangular slot 50 elongated longitudinally of the receptacle 14. An abutment 52 defines the edge of the slot 50 disposed adjacent to the free end of the housing 42, the abutment 52 being adapted to engage the shoulder 30 of the lug 28 in the assembled condition of the electrical connector 10.

In the assembled condition of the electrical connector 10 the pair of guide members 26 (FIG. 1) is received within the pair of channels 44 (FIG. 2) and the lugs 28 are received within the slots 50, the shoulder 30 of the lugs 28 being in firm engagement with the abutment end 52 of the slot 50. It is to be appreciated that the side walls 46 and 48 of the housing 42 are outwardly flexible so as to yield a small distance when the wedge shape lugs 28 are urged therealong in inserting the plug element 12 into the socket or housing 42. In the assembled condition the inserted end of the plug element 12 is disposed adjacent to the end of the receptacle 14 adjoining the housing 42 and the rectangular passageways in the elements 12 and 14 are in communication thereby to provide continuous passageways between the opposite ends of the electrical connector 10.

Means are provided on the electrical connector 10 for securely holding therein without the aid of auxiliary fasteners the terminal portions of electrical conductors. Referring now more particularly to FIG. 5, a first group of electrical conductors 54 is fixedly secured within the plug element 12 and a second group of electrical conductors 56 is fixedly secured within the receptacle element 14. Each of the two groups of electrical conductors 54 and 56 is composed of three insulated wires of identical construction and arrangement and, hence, the individual wires of the first group 54 are designated with suffix letters "a," "b," and "c" respectively. Similarly, the individual wires of the second group are also designated with corresponding suffix letters. One conductor of the group 54 will now be described as a conductor exemplary of both groups 54 and 56.

The conductor 54a includes an insulated wire 58 having a terminal clip 60 fixedly secured at the end portion thereof in a manner which effects an electrical path between the clip 60 and the wire 58. Being made of metal, the terminal clip 60 comprises a barrel-like portion 62 adapted to fixedly embrace the end of the wire 58. A first flat leg member 64 extends outwardly from the barrel 62 and merges at a curved end thereof with a second flat leg member 66 disposed in a spaced apart, superimposed relationship with the first leg 64. A free end portion of the second leg 66 extends toward a shoulder 67 on the barrel 62. It is to be appreciated that the free end of the second leg 66 confronts and is spaced apart from the shoulder 67 on the end of the barrel 62 thereby providing a gap therebetween.

To hold securely the first group of electrical conductors 54 within the plug 12, an abutment lug 65 is provided in each passageway of the plug 12, best shown in FIG. 5. The abutment lug 65 protrudes into the passageway from a side wall or partition and affords an arresting surface on one side thereof for engaging the shoulder 67 to limit inward movement of the clip 60 with respect to the plug element 12. The opposite side of the abutment lug 65 affords an arresting surface for engaging the free end of the leg 66 to limit outward movement of the clip 60 with respect to the plug 12.

When an electrical connector, 54a, 54b, or 54c, and the terminal clip 60 fixedly secured thereto is inserted into one

of the passageways in the plug element 12, the two leg portions of the terminal clip 60 slide beneath the abutment lug 65, the free end of the second leg 66 being urged downwardly by the lug 65 towards the first leg 64. When the abutment lug 65 has been passed by the second leg 66, the free end portion thereof springs away from the leg 62 to engage one face of the abutment lug 65 while the shoulder 67 provided by the barrel 62 engages the opposite face of the lug 65.

Similarly, each passageway in the receptacle element 14 is provided with an abutment lug 65 of identical construction and arrangement to the lug 65 on the plug 12. To hold securely the second group of electrical conductors 56 within the receptacle element 14, each conductor, 56a, 56b or 56c, having the terminal clip 60 fixedly secured thereto, is inserted into a passageway in the receptacle 14 wherein the clip 60 and the abutment lug 65 thereof cooperate in the manner described above. In this condition the legs 64, 66 of the terminal clip 60 extend outwardly from the passageway in the receptacle element 14 into the housing or socket 42. Thus, it will be seen that when the plug 12 is operatively inserted into the socket 42, the inwardly movable second leg 66 of the clip 60 on the conductor 54a engages the inwardly movable second leg 66 of the terminal clip attached to the conductor 56a of the second group 56 to effect an electrical path therebetween. The conductors 54b, 56b, and 54c, 56c cooperate in an identical manner. It is also to be appreciated that when the two elements of the connector 10 are in their inserted position, each passageway in the connector 10 has disposed therein a pair of abutment lugs 65 longitudinally spaced with respect to the connector 10 and extending into the passageway from confronting walls.

It is seen from the foregoing that the electrical connectors 54-56 with the terminal clips 60 fixedly secured to the ends thereof may be rapidly assembled within the electrical connector 10 without the use of hand tools of any kind. The removal of a terminal clip 60 from the plug 12 or from the receptacle 14 is effected by depressing the second or free leg 66 of the clip 60 toward the front leg 64 with a suitable tool such as a screwdriver. When the free end of the second leg 66 is moved toward the first leg 64 and thus free of the lug 65, the terminal clip and the wire may be withdrawn from the passageway in the connector 10.

To facilitate ready assembly of the electrical connector 10 on a mounting panel 69 or the like, a pair of mounting ears 68 is provided on the plug element 12. Referring to FIGS. 6 and 7 more particularly, each mounting ear 68 includes a resiliently bendable base portion 70 integrally formed with the outer surface of the top wall 16 and the bottom wall 18 respectively of the plug element 12. A gripping member 72 (FIG. 7) is formed integral with the bendable portion 70 and extends outwardly therefrom. At its free end the gripping portion 72 is provided with a recess 74 in one face thereof, one side of the recess being defined by a lip 76 extending at a right angle to the portion 72 flush with the free end thereof.

Prior to mounting the connector on the panel 69, the ear 68 extends at a right angle with respect to the contiguous surface of the plug 12. Subsequent to mounting the connector on the panel 69, the ear 68 is disposed at an acute angle or parallel to the surface of the plug 12, the recess 74 and lip 76 facing away from said surface. (It will be noted that the dashed line showing of ears 68 in FIGS. 3 and 6 is before insertion of the plug in the panel, and that these ears never extend at right angles on the right side of the panel.)

Referring now to FIG. 3, the mounting panel 69 is provided with an aperture 78 shaped complementary to the cross section of the electrical connector 10. To mount the connector 10 within the aperture 78, the pair of mounting ears 68 on the top wall 16 and the bottom wall 18 of the plug element 12 is urged in the direction toward

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the surface of the element 12 thereby to stress the bendable portion 70. Thereafter, the element 12 is inserted through the aperture 73 until the edges defining the opening 73 are registered with the recesses 74 in the mounting ears 68. The ears are then released and urged away from the plug 12 by the forces induced in the bendable portion 70 while moving the ears from their original upright position toward the plug 12. It is to be noted that the width of the recess 74 in each mounting ear 68 is of a size complementary to the thickness of the mounting panel 68 whereby the edge of the panel 69 will firmly engage the ear 68 within the recess 74. It is to be appreciated that by mounting the electrical connector on the panel 69 by means of the mounting ears 68 described above, there is provided an efficient, and vibration-proof connection between the connector 10 and the panel 69. Another advantage is that no hand tools or fasteners are required to mount the connector 10 or the panel 69, thereby obviating time consuming operations common heretofore. Furthermore, the ears readily take up production tolerances.

It will be understood that the member 12 described herein for the purposes of this specification as a plug member is also known in the electrical component industry as a "receptacle." The term, receptacle, is appropriate in that it describes the function of the member 12 in receiving the terminal clips 60 extending outwardly from the member 14. Conversely, the member 14 described herein as a receptacle is also known as a "plug." The function of the member 14 being to hold a group of outwardly extending prongs or clips 60 for their insertion into a mating member 12, the meaning of the term "plug" is sometimes used to describe the function of the member 14.

The electrical connector 10 may be mass-produced by molding from such flexible plastic materials as nylon which is ideally suited to provide low unit-cost plugs and receptacle units adapted to be quickly locked together for ready mounting in a shake-proof manner on a panel. Thus, it will be seen that there has been provided an electrical connector of improved construction and arrangement which fulfills all of the objects and advantages set forth above.

While there has been described what is at present considered to be the preferred embodiment of the invention, it will be understood that various modifications may be made therein, and it is intended to cover in the appended claims all such modifications as fall within the true scope and spirit of the invention.

The invention is hereby claimed as follows:

1. An electrical connector adapted to be mounted through an opening in a panel, comprising a receptacle element of plastic material adapted to encase the terminals of a first group of electrical conductors, said receptacle

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element having a receiving socket at one end thereof, a plug element of plastic material adapted to encase the terminals of a second group of electrical conductors, said plug element having an end portion complementary to and insertable in said receiving socket, means for locking said end portion in said receiving socket, and resiliently deformable integral ears on one of said elements extending outwardly from said one element substantially at right angles thereto and away from one another in substantial alignment prior to insertion in an opening in a panel and being resiliently deformable toward parallelism with said one element and parallel to one another extending in the same direction upon insertion in said opening, each ear being pivotable through substantially 90°, each of said ears having notch means respectively to engage the edges of the opening in the associated panel.

2. An electrical connector adapted to be mounted through an opening in a panel, comprising a receptacle element of plastic material adapted to encase the terminals of a first group of electrical conductors, said receptacle element having a receiving socket at one end thereof, a plug element of plastic material adapted to encase the terminals of a second group of electrical conductors, said plug element having an end portion complementary to and insertable in said receiving socket, means for locking said end portion in said receiving socket, and resiliently deformable integral ears on one of said elements extending outwardly from said one element prior to insertion in an opening in a panel and being resiliently deformable toward parallelism with said one element upon insertion in said opening, each of said ears having notch means respectively to engage the edges of the opening in the associated panel, each of said ears being of a minimum dimension longitudinally of said element prior to insertion in an opening and progressively increasing in dimension working out from said element to said notch means, whereby to provide a cam ramp facilitating insertion of said element in the opening in the associated panel.

3. An electrical connector as set forth in claim 2 wherein each ear has a terminating flange extending longitudinally of the element to a greater extent than the cam ramp and thereby resisting overinsertion of said element, said notch means being disposed between said flange and said cam ramp.

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