Sept. 27, 1966 G. D. FERDON ETAL 3,275,765

ELECTRICAL CONNECTING AND SWITCH DEVICE

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Fig. 1

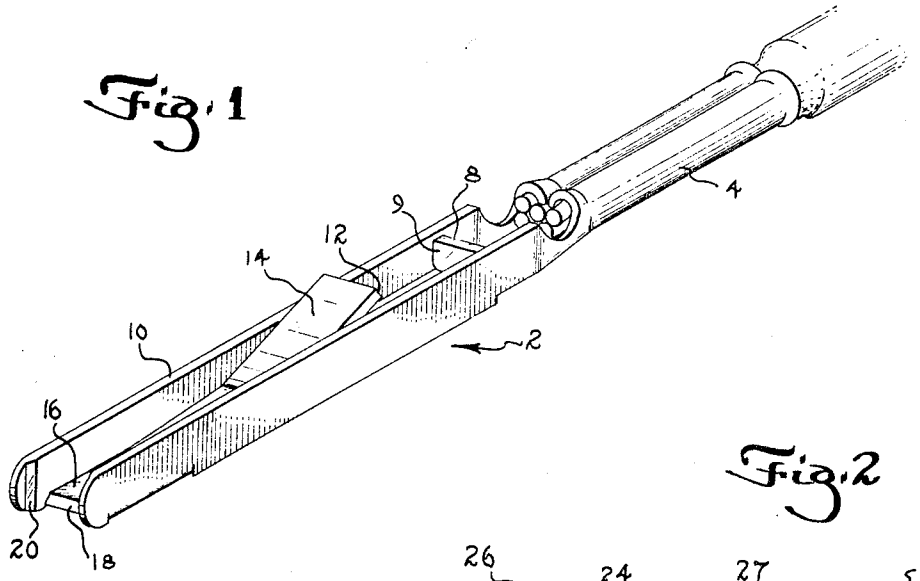

Fig. 2

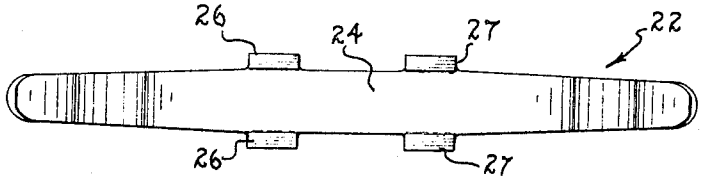

Fig. 2A

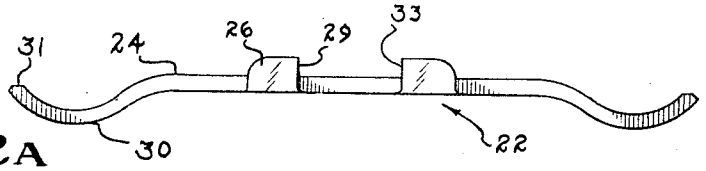

Fig. 3

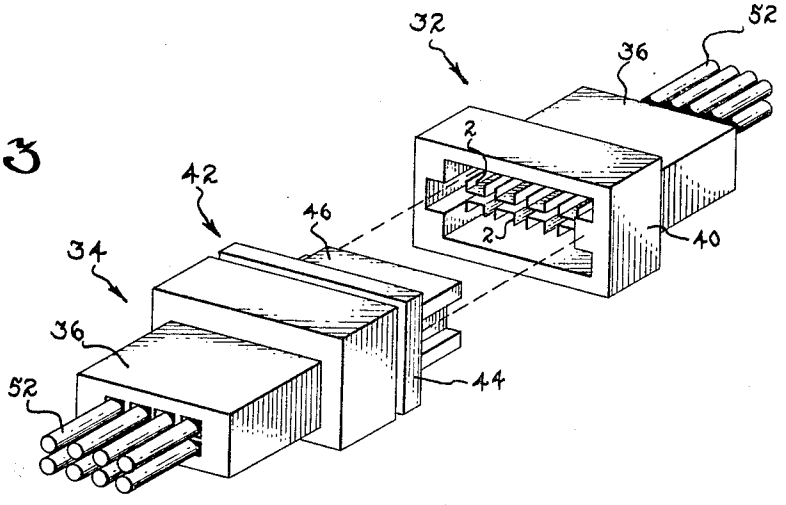

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Fig. 4

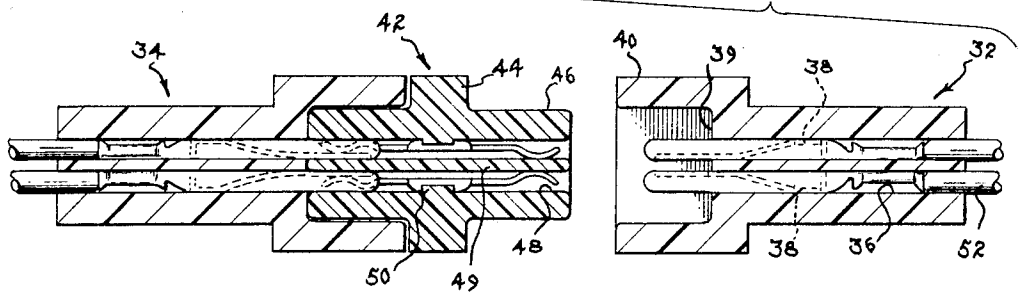


Fig. 5

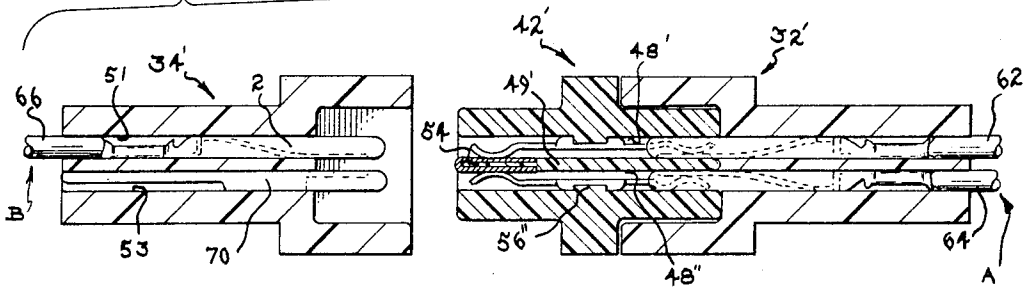
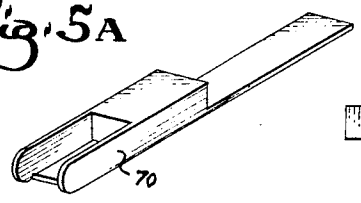


Fig. 5A



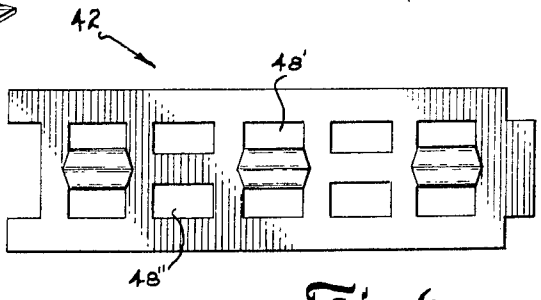
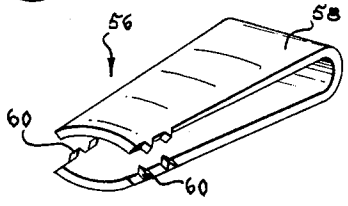


Fig. 6

Fig. 7



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3,275,765

ELECTRICAL CONNECTING AND SWITCH DEVICE

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2 Claims. (Cl. 200—51.1)

This invention relates to disengageable connecting and switch devices for electrical conductors.

It is an object of the invention to provide an improved disengageable electrical connecting device for relatively small diameter wires. A further object is to provide a disengageable connecting device which is of extremely small size and which has a high degree of invulnerability to damage during routine handling. A further object is to provide a small size contact terminal for electrical conductors which has exposed contact surfaces for care of electroplating, these contact surfaces also being protected from damage or contamination during handling. A further object is to provide disengageable contact terminal means for small diameter wires having a relatively simple and durable contact spring which achieves a predetermined reproducible contact pressure between contact terminals. A still further object is to provide a disengageable connecting device for two groups of electrical conductors which functions also as a switching device for forming circuit paths among conductors belonging to the same group and alternatively between predetermined conductors of the two groups.

These and other objects of the invention are achieved in a preferred embodiment comprising a pair of substantially identical connecting blocks, each of which has a plurality of contact cavities extending therethrough. Contact terminals which are secured to the ends of wires are disposed in the cavities of each block, each terminal having a channel-shaped cross-section with the inside surface of the channel functioning as a contact surface. The connector blocks are each adapted to be mated to a connecting block having leaf springs therein in a manner such that when the two connector blocks are engaged with the connecting block, each leaf spring engages the contact surface of two contacts, one of which is in each of the connector blocks. The springs thus function as conducting bridges between the contact terminals in the two connecting blocks.

The invention also contemplates the formation of circuit paths extending between two individual conductors in one group or bundle of conductors when only one of the connector blocks is mated to the connecting block. A circuit path of this type is established by means of a shunt device which electrically connects two individual contact springs mounted in the connecting block. The arrangement is such that when the second connector block is brought into engagement with the connecting block, the shunt is deactivated and the circuit path connecting the two individual conductors in the first group or bundle is interrupted. At the same time, one of these conductors is electrically connected to an individual conductor in the second group of conductors.

In the drawing:

FIGURE 1 is a perspective view of a preferred form of contact terminal in accordance with the invention.

FIGURE 2 is a plan view of a contact spring for forming a disengageable connection between terminals of the type shown in FIGURE 1.

FIGURE 2A is a side view of the spring of FIGURE 2.

FIGURE 3 is a perspective view of a complete connector assembly in accordance with the invention comprising a pair of connector blocks having contact terminals mounted therein and a connecting block having contact springs mounted therein, one of the connector blocks being engaged with, and the other connector block being disengaged from, the connecting block.

FIGURE 4 is a sectional side view of the connector assembly of FIGURE 3.

FIGURE 5 is a sectional side view of an alternative embodiment of the invention which achieves a switching function among conductors of one group or bundle as well as a connecting function between conductors of one group and conductors of a second group.

FIGURE 5A is a perspective view of a blank insulating insert used in the embodiment of FIGURE 5.

FIGURE 6 is an end view of the connecting block used with the embodiment of FIGURE 5.

FIGURE 7 is a perspective view of a shunt clip used with the embodiment of FIGURE 5.

A preferred form of contact terminal 2 in accordance with the invention is of channel-shaped cross-section and has sidewalls 4 at its rearward end which are crimped onto the stripped end of a wire positioned between these sidewalls. Intermediate its ends, a pair of tongues 8, 14 are struckup from the web, the tongue 8 extending substantially normally of the web adjacent to the ferrule forming sidewall portions 4 and providing a forwardly facing stop surface 9 for engagement with a boss in the connector block as described below. The tongue 14 is contained between the forward sidewall portions 10 of the terminal and slopes rearwardly from the plane of the web to provide a rearwardly facing stop surface 12. The portion 16 of the web which lies in front of the tongue 14 functions as a contact surface as described more fully below and the sidewalls advantageously extend forwardly beyond the end of the web and are bevelled on their inner sides as shown at 20 to facilitate the entry of a mating contact member. The leading edge of the web portion 16 is similarly bevelled on its upper side as shown at 18 for ease of engagement and disengagement.

A pair of contact terminals of the type shown in FIGURE 1 are adapted to cooperate with a connecting leaf spring 22 having a central flat section 24 and downwardly curved contact end portions 30 which advantageously are reversely curved towards the plane of the web at the extreme ends of the spring as shown at 31. Ears 26, 27 are provided on each side of the flat central section 24 extending from the edges thereof, the ears 26 being disposed in alignment with each other on one side of the center of the spring and the ears 27 being disposed on the opposite side of the center. The opposed edges 29, 30 of these ears cooperate with bosses in a connecting housing as described below to retain the contact spring in a cavity.

A connector assembly in accordance with the invention (FIGURES 3 and 4) comprises two substantially identical connector blocks 32, 34 and a central connecting block 42 with which the connector blocks are engageable. Each connector block has a plurality of cavities 36 extending therethrough which are dimensioned to receive a contact terminal 2. An intermediate boss 38 extends from one wall of each cavity for cooperation with the stop surfaces 9, 12 of the terminal to retain the terminals in the cavities. It will be apparent that after crimping a terminal onto a wire 52, the terminal can be inserted into one of the cavities 36 until the stop surface 9 is moved against the rearwardly facing side of the boss 38. The tongue 14 will be deflected during insertion but will return to its normal position after the end of the tongue has passed the boss 38 so that the edge 12 of the tongue will function to prevent any rearward movement of the terminal. The length

of the blocks 32, 34 is such that the forward ends of the contact terminals project beyond the mating face 39 of the block and are contained within a hood portion on the forward end of the block.

The connecting block 42 has an enlarged central section 44 and reduced cross section end portions 46 which conform to the interior surfaces of the hoods 40 of the connector blocks. Cavities 48 extend longitudinally through the connector block, each cavity having a central boss 50 on one of its walls which is adapted to lodge between the opposed edges 29, 30 of the ears of a contact spring 22. The curvature of the end portions 30, 31 of the contact springs 22 relative to the height of the cavities 48 is advantageously such that when an individual spring is inserted into a cavity, the curved ends will be plastically (i.e., permanently) deformed and after insertion the undersides of the ends 30 will bear against the floor of the cavity 48 and bias the ears 26, 27 upwardly against the top surface of the cavity. If these relative dimensional relationships are adhered to, the individual springs will be "set" when they are inserted into a cavity and the force exerted by the ends of the springs against the floor of a cavity will be generated by the spring-back effect in the spring. This arrangement assures a uniform contact pressure for all of the springs since this spring-back effect is highly predictable and reproducible when the cavity dimensions and the spring materials are maintained constant.

In use, an electrical connector assembly is formed by merely inserting appropriate contact terminals into cavities of a pair of connector blocks 32, 34 and the electrical connections are formed by merely mating each connector block with the connecting block 42. Connecting devices in accordance with the invention are partiularly intended for relatively small sized wires, for example, AWG 28–32. Where wires of this size range are involved, it is apparent that an extremely small disengageable connecting device must be used since the associated electrical apparatus will itself be relatively small and there will be severe space limitations imposed on the connecting devices used.

Although the connectors used for small diameter conductors must be relatively small, they must nonetheless satisfy the performance criteria generally applied to high quality electrical connectors of larger sizes and must, in fact, be relatively superior to connectors for larger diameter wires in at least some respects. For example, the contact terminals themselves should be capable of withstanding normal handling abuse during crimping and insertion, must be capable of having their contact surfaces plated since gold plating is usually employed on the better quality contact terminals, and finally must be capable of a level of electrical performance consistent with the intended usage. Electrical performance in the case of miniature contact terminals is of particular importance for the reason that where small diameter wires are employed, the voltages and currents involved are usually quite low so that the resistance imposed on the circuit by the terminal must be extremely low. Where larger wires, for example AWG 18, are being used the current and voltage conditions will be relatively higher and a somewhat higher contact resistance in the terminal can be tolerated.

By virtue of its channel-shaped cross-section, the disclosed type of terminal can be made of relatively thin stock (for example 0.008" thick) but will be extremely rigid and resistant to damage. The contact surfaces 16 can be plated with gold or other noble metal with ease since they are expose to the eledctrolyte in a plating bath; at the same time these contact surfaces are protected against contamination during handling since they are protected on each side by the sidewall portions 10 of the terminal. The contact pressure generated at the interface between the ends 30 of the springs and the contact terminals is uniform and controllable for the reason, explained above, that the contact springs are

set when they are inserted into the connecting block and generate their contact pressure as a result of their predictable and reproducible spring-back properties.

Referring now to FIGURES 5–7 under some circumstances it is desirable to establish circuit paths among individual conductors in the group A of wires which are crimped onto terminals mounted in the connector housing 32' when this group of wires is not connected to the conductors in the group B, that is when the connector housing 34' is disengaged from the connecting housing 42'. Under these circumstances it is usually desirable to break the electrical connection between and among the conductors of wire group A when these wires are connected to their intended counterparts in wire group B. This effect can be achieved by means of the embodiment of the invention shown in FIGURES 5–7 in which the modified connecting housing 42' has adjacent cavities 48', 48'' in which contact terminals extending from conductors 62, 64 of wire group A are lodged. The wall 49' which separates the cavities 48' and 48'' is of reduced thickness on its left-hand side as shown at 54 and a shunt clip (FIGURE 7) of brass or other conducting metal is fitted over this reduced thickness end section of the wall. This clip 56 is of U-shaped configuration and has relatively elongated sides 58 of arcuate cross-section. Sides 58 have spurs 60 extending from their edges adjacent to their free ends so that the clip can be assembled to the wall section 54 by merely being slipped over the end of the wall and flattened against the surface thereof until the arcuate legs bear against the surface and the spurs dig into the wall material. The shunt clip functions as a conducting path between the contact ends of the springs in the cavities 48', 48'' when the connector 34' is disengaged from the connecting housing 42' so that under these circumstances a conducting path will extend from the conductor 62 to the spring in the cavity 48', through the clip 56 and thence to the spring in the cavity 48'' and to the conductor 64.

The connector block 34' has cavities 51, 53 extending therethrough which are in alignment with the cavities 48', 48'' of the connecting block 42'. A contact terminal 2 which is crimped to a conductor 66 is positioned in the cavity 51 while an insert 70 is positioned in the cavity 53. The insert 70 comprises a blank composed of a suitable plastic insulating material, such as polycarbonate, having the same general shape as the contact terminals 2. When the connector block 34' is engaged with the connecting block 42', the insert blank 70 moves between the lower surface of the shunt clip 56 and the contact spring in the cavity 48'' thus interrupting the circuit path connecting the wires 62, 64. At the same time, the contact terminal 2 in the cavity 51 of block 34' moves into engagement with the contact spring in the cavity 48' thus establishing a circuit path connecting the conductor 62 and 66.

FIGURE 5 shows one possible switching arrangement which can be achieved by means of a specially designed connecting housing 42' used in conjunction with a pair of standard connector housings 32', 34' and one insert blank 70. The connecting block 42' has two rows of cavities 48', 48'' and the wall sections 49' between the upper and lower rows of cavities can be of reduced thickness in one of more instances with shunt clips 56 fitted over each of these wall sections. It follows that a number of possible switching combinations can be achieved by using standard connector blocks along with one specially constructed connecting block as regards the thickness of the wall sections 54 between the rows of cavities.

As an alternative, the connecting block can be provided with reduced wall sections between each pair of cavities and clips similar to the clip of FIGURE 7 but composed of an insulating material, for example, polycarbonate can be supplied, as well as metallic clips. Where a switching effect is desired between conductors, a metallic clip would be positioned over the reduced wall section 54 between

pairs of cavities to achieve the result of FIGURE 5. If a switching effect is not desired, an insulating type clip can be mounted on the reduced diameter wall sections to form conventional disengageable connections between pairs of conductors.

Change in construction will occur to those skilled in the art and various apparently different modifications and embodiments may be made without departing from the scope of the invention. The matter set forth in the foregoing description and accompanying drawings is offered by way of illustration only. The actual scope of the invention is intended to be defined in the following claims when viewed in their proper perspective against the prior art.

I claim:

1. A multi-contact electrical connecting device comprising: a pair of connector housings and a connecting housing, said connector housings each having a hood surrounding, and extending beyond, one end thereof, said connecting housing having opposite ends conforming to the internal configuration of said hoods whereby, said connector housings can be coupled to, and decoupled from, said connecting housing, a plurality of contact terminal cavities extending through each of said connector housings, contact terminals in at least some of said terminal cavities, said terminals each having a contact portion of channel-shaped cross-section disposed within the confines of said hoods, said connecting housing having contact spring cavities extending between said opposite ends, contact leaf springs disposed within said contact spring cavities, the ends of said leaf springs being engageable with said contact portions of said contact terminals upon coupling of said connector housings to said opposite ends of said connecting housing thereby to form conducting paths between individual conductors secured to said contact terminals, shunt means in said connecting housing extending from a first one of said contact spring cavities

to a second one of said contact spring cavities, said shunt means normally being in engagement with the contact leaf springs in said first and second contact spring cavities whereby, a continuous conducting shunt path is established between two conductors secured to contact terminals in one of said connector housings when said one connector housing is coupled to said connecting housing, and shunt circuit interrupting means in a corresponding contact terminal cavity in the other one of said other connector housings, said shunt circuit interrupting means being engageable with said shunt means for deactivating said shunt means when said other connector housing is coupled to said connecting housing thereby to break said conducting shunt path and to establish a conducting path between two corresponding contact terminals in said connector housings.

2. A device as set forth in claim 1 wherein said shunt circuit interrupting means comprises an insert blank in said corresponding contact terminal cavity, said insert blank being of an insulating material and being movable between said shunt means and one of said contact springs.

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