This invention relates to an electrical connector.

The invention has for an object to provide a novel and improved electrical connector which may be economically manufactured and used with advantage for general use and which is provided with electrical contacts adapted to be engaged by contacts of an identical connector.

A further object of the invention is to provide a novel and improved structure of the electrical connector illustrated and described in my United States Patent No. 2,858,739, issued June 10, 1958.

With these general objects in view and such others as may hereinafter appear, the invention consists in the electrical connector hereinafter described and particularly defined in the claims at the end of this specification.

In the drawings illustrating the preferred embodiment of the invention:

FIG. 1 is a perspective view of a pair of identical two-pole connectors embodying the present invention;

FIG. 2 is a cross sectional view of a pair of two-pole connectors joined together;

FIG. 3 is an exploded perspective view of a two-pole connector showing the relationship of the various parts;

FIG. 4 is a cross sectional view taken on the line 4--4 of FIG. 2;

FIG. 5 is a cross sectional view taken on the line 5--5 of FIG. 2;

FIG. 6 is a perspective view of a pair of identical single-pole connectors;

FIG. 7 is a cross sectional view of a pair of identical single-pole connectors joined together;

FIG. 8 is a cross sectional view of a single-pole connector prior to assembling the contact member therewith;

FIG. 9 is a similar view showing the contact member assembled with the insulating housing; and

FIG. 10 is a cross sectional view taken on the line 10--10 of FIG. 8.

In general the present invention contemplates an electrical connector of novel construction of the type having one or more identical rigid contact or terminal members and which is adapted for longitudinal telescoping engagement with a second and identical connector. The present connector is provided with an insulating housing surrounding and enclosing the terminals for maximum insulating protection and in which provision is made for movably and yieldably mounting the terminals in a manner such that the terminals may be resiliently interlocked in their engaged position so as to prevent inadvertent disengagement thereof during normal usage. The present terminals are also adapted for self-cleaning during engagement and disengagement thereof and are shaped so that any pitting of the terminals caused by arcing at the extreme ends thereof during disengagement will not impair the efficiency of the terminals at the areas of contact in their engaged position. Also, with the present construction of connector, the connectors can be joined together in one position only so that when separate lines of fixed or non-changeable polarity are used, the same polarity may be maintained at all times. In practice, the polarity of the terminals may and preferably will be marked on the outer face of the insulating housing.

In accordance with the present invention novel provision is made for resiliently urging the terminal member into contacting engagement with the terminal member of a second connector. In the illustrated embodiment of the invention an elongated leaf spring loosely mounted in the housing and retained in a recessed portion of the housing is arranged to resiliently bear against the rear face of a terminal member and is also arranged to cooperate with a portion of the terminal member to prevent withdrawal of the same from its insulating housing. In assembling the electrical connector, the rigid terminal member may be extended into the assembled housing from the cable end thereof and snapped into locked position by the inner end of the leaf spring.

Referring now to the drawings, FIG. 1 illustrates a pair of two-pole electrical cable connectors indicated at 10, 12 comprising exact counter-parts adapted for longitudinal telescoping engagement to form an electrical connection. As herein shown, each connector includes an insulating housing split longitudinally to form two half sections comprising an upper half section 14 and a lower half section 16, as viewed in FIG. 3, and which are detachably connected together by bolts 18 and nuts 20.

In the embodiment of the invention illustrated in FIGS. 1 to 5, each insulating housing is arranged to support two identical rigid contact members 22, 24 in detached relation to the walls of the housing and forming the terminals of electrical cables 26, 28, respectively, and as herein shown, each terminal is provided with a cylindrical end portion 30 bored to receive the end of the cable into which it may be soldered. The contacting end of each terminal comprises an elongated flat portion 32 substantially rectangular in cross section provided with a rounded or convex end portion 34 projecting from one surface thereof. The opposite face of the contacting end of each terminal is provided with a laterally extended shoulder portion forming a notch 35 arranged to be engaged by the inner end of an elongated leaf spring 36. The elongated leaf spring 36 is loosely carried by the lower half section 16 of the insulating housing and, as herein shown, the rear end of the leaf spring is U-shaped in cross section having portions extended laterally and upwardly from the base of the leaf spring as indicated at 37. The laterally extended portions 37 are loosely fitted into a recessed portion 38 comprising opposed grooves formed immediately at the ends of the housing as shown. In practice, the walls of the grooves confine the U-shaped portion of the leaf spring to prevent longitudinal displacement of the spring in its housing. As herein illustrated, the forwardly extended portion of the elongated leaf spring is coextensive with the base of the U-shaped portion and parallel to the bottom wall of the housing for a short distance. A prestressed portion then extends upwardly at an incline to present the forward end of the leaf spring above the line of separation of the half sections and in a position to be engaged and depressed when the rigid terminal member is inserted through the cable opening. It will be observed that the upper ends of the legs of the U-shaped portion 37 will engage the ungrooved walls of the upper half section 14 when the forwardly extended portion of the leaf spring is thus engaged so as to prevent upward rocking of the rear end of the leaf spring when the forward end is depressed. It will also be observed that the grooved portion 38 provides a limited clearance about the U-shaped end 37 of the leaf spring so that the latter may be loosely fitted into the grooved portion and that the elongated leaf spring is supported in detached relation to the walls of the housing.

The illustrated insulating housing is substantially rectangular in form, each half section 14, 16 shown in FIG. 3 having a main or rearwardly extended body portion hollowed out semicircularly to form circular openings 40 in the assembled connector through which the cable ends of the terminals extend. The lower half sec-
tion 16 of the housing is provided with two spaced forwardly extended terminal receiving pockets 42, 44 substantially U-shaped in cross section and closed at their outer ends. The pockets 42, 44 are aligned with their respective cable openings 46, and the contacting end of each terminal may be inserted through the cable end pocket of the assembled insulating housing to present the convex contacting portion 34 into its pocket. During the inserting operation the end of the terminal member engages and presses downwardly against the upwardly inclined portion of the elongated leaf spring 36, and when the forward end of the terminal member, including the shoulder portion, passes beyond the free end of the leaf spring the end of the spring will snap upwardly into the notch 35 to prevent withdrawal of the rigid terminal member. In its assembled condition the elongated leaf spring 36 is interposed between the bottom wall of the pocket and the underside of the terminal member urges the convex contacting portion 34 of the terminal member to a position above the side walls of the pocket as shown. As thus far described, it will be seen that the contacting end of each terminal is enclosed in its respective pocket except for the engaging face thereof which is resiliently urged by the leaf spring 36 toward the cooperating terminal. As herein shown, the side and bottom walls of the pockets 42, 44 are recessed or offset from the main body portion of the lower half section providing shouldered portions 50 thereabout, the spaced relationship of the pockets providing a slot 52 therebetween extending to the plane of the shouldered portions.

The upper half section 14 of the insulating housing, as viewed in FIG. 3, is provided with a corresponding forwardly extended portion coextensive with the body portion and shaped to provide two inverted U-shaped sockets 54, 56 open at their outer ends and closed at their inner ends by transversely extended wall portions 58 defining the adjacent end of the body portion, the two sockets being formed and separated by a longitudinally extended central partition wall 60. The socket forming extension of the upper half section extends over the terminal receiving pockets 42, 44 of the lower half section, and the sockets 54, 56 are of a size such as to snugly receive the pockets 42, 44 of a second and identical connector, the end of the socket forming extension of one connector engaging the shouldered portion 50 of the second connector when the connectors are fully engaged. Also, when thus engaged, the central wall 60 of one connector fits into the slot 52 of the second connector, and the closed end walls of the pockets of one connector are engaged with the inner end walls 58 of the sockets of the second connector. In order to align the two half sections 14, 16 in registering relation for assembly, the lower half section 16 is provided with a raised circular portion 62 about one of the bolt openings and with a longitudinally extended raised portion 64 arranged to be fitted into correspondingly shaped recessed portions 66, 68, respectively, formed in the upper half section 14. Also, the bolt openings in the half sections may be countersunk, as illustrated, to present the heads and nuts of the bolts below the outer surface of the insulating housing. It will also be observed that the terminals of each connector are enclosed in the pockets 42, 44 with only the upper contacting portions exposed, and that the socket forming portions extending over the exposed portions of the terminals also provide a protective insulating wall above the terminals.

With this construction it will be seen that when two identical connectors are engaged by extending the pockets 42, 44 into the respective sockets 54, 56 of the second connector, the rounded contacting faces 34 of each spring pressed terminal are slingly engaged by each other, initial inward movement of the connectors effecting downward movement of the terminals in their respective pockets against the springs 36. Upon continued inward movement the high points of the curved portions pass by each other, and as the connectors approach full engagement, the springs 36 effect upward movement of the terminals in their pockets to present the curved portions 34 in hooked or interlocked relation to each other as illustrated. The cable openings 40 and the pockets 42, 44 are formed to provide ample clearance about the terminal that may be inserted through the cable end pocket of the assembled insulating housing to permit lateral movement of the terminals toward and away from each other, as described, and in practice the terminals may effect a slight rocking movement as the terminals are engaged. It will also be observed that the transversely extended wall portions 58 serve to limit the upward movement of the terminals in their respective pockets when the contacts are disengaged. In practice the metal terminals may be coated with silver to provide an efficient contact.

From the above description it will be seen that in operation any pitting of the terminals caused by arcing at the extreme ends thereof during disengagement will not impair the efficiency of the contacting surfaces when the terminals are in their fully engaged position, and that the sliding movement of the terminals against each other during engagement and disengagement will effect self-cleaning thereof. It will also be observed that the high points of the terminals may be marked on the housing and that the connectors may be engaged in one position only such as to maintain the same polarity at all times.

In practice when assembling the electrical connector shown in FIGS. 1 to 5, the elongated leaf springs 36 may be placed in position in the lower half section 16 of the insulating housing with the U-shaped end 37 of the spring resting in the grooved portion 38. The upper half section 14 of the housing may then be assembled with the lower half section 16 by the bolts 18 and nuts 20. The grooved portions 38 prevent longitudinal displacement of the leaf springs so that when the two half sections 14 and 16 are assembled the loosely held springs will be retained in the housing. Thereafter the rigid terminal members 22, 24 with their attached cables may be inserted through the openings 40 and into their respective pockets, and when the forward ends of the terminal members are fully inserted the free ends of the leaf springs will latch behind the notch 35 formed by the shoulder portions to lock the terminal members in their respective pockets.

Alternatively, the two half sections 14, 16 may be first assembled as described, and the leaf springs 36 may thereafter inserted through the openings 40 by resiliently squeezing the legs of the U-shaped portion inwardly by means of a suitable tool to fit through the openings 40, and when the U-shaped portion 37 is positioned in alignment with the grooved portions 38 the legs may be released to return to their original extended shape and the grooved portions. Thereafter, the rigid terminal members may be inserted, as above described, to complete the assembly of the connector.

In a modified form of the invention the two-pole connector insulating housing may be molded in a single piece, thus eliminating the connecting bolts and nuts. In such modified form the leaf springs 36 may be assembled in the housing in the manner above described, and the terminal members may likewise be inserted through the openings 40 and locked in position by the ends of the springs. While the terminal members thus locked in position in the housing cannot be retracted in use, in the event that it is necessary to remove a terminal member from its housing for repair or replacement, a flat, stiff length of metal may be inserted through the opening 40 underneath the cable to engage the upwardly bent engaging portion of the leaf spring to urge the free end thereof downwardly out of the notch 35 whereupon the terminal member may be removed. Also, while a two-pole connector is illustrated in FIGS. 1 to 5 it will be apparent that the connector may be designed to provide three or more poles as desired.

Referring now to FIGS. 6 to 10, the invention is therein illustrated as embodied in a single-pole connector wherein
the insulating housing is molded in a single piece. FIG. 6 shows a pair of single-pole connectors 70, 72 comprising exact co-axial parts adapted for longitudinal telescopic engagement to form an electrical connection. The structure of the single-pole connector may be similar to the structure of the connectors above described except that each connector is molded in one piece and is designed to support but one terminal member in each connector, indicated at 98, 92, may be of the same structure as above described, and the insulating housing may be provided with a cylindrical bore 94 through which the terminal member and its cable is extended. The lower portion of the one-piece insulating housing is provided with a forwardly extended terminal receiving pocket 96 recessed with relation to the main body portion, and the upper portion is provided with an extension coaxial with the main body portion forming an inverted U-shaped socket 98 extended over the terminal receiving pocket similar in construction and mode of operation to the corresponding portions of the double-pole connector described. The lower portion is also provided with similar grooves 100 arranged to receive the U-shaped end 102 of the leaf spring 103. The underside of the forward end of the terminal member is also provided with a shoulder portion forming a notch 104 for cooperation with the free end of the leaf spring as described.

The manner of assembling the single-pole one-piece housing electrical connector may also be similar to that above described wherein the legs of the resilient U-shaped portion 102 of the leaf spring 103 may be resiliently bent inwardly and extended through the opening 94 to position the U-shaped portion in alignment with the grooved portion 100 whereupon the legs may be released to enter the grooved portion as shown in FIG. 8. Thereafter, the rigid terminal member may be inserted through the opening 94 and locked in position by the free end of the leaf spring 103 engaged behind the notch portion 104 as shown in FIG. 9.

With this construction it will be seen that when two identical single-pole connectors 70, 72 are engaged by extending the terminal receiving pocket 96 of one connector into the socket 98 of the second connector, the spring pressed terminals 90, 92 will be slidingly engaged with each other, and that when the curved contacting portions of the terminals pass by each other they are resiliently engaged in hooked or interlocked relation, as above described and as illustrated in FIG. 7. From the above description it will be seen that the present insulated electrical connector is provided with novel resilient means loosely mounted and retained in the insulating housing for resiliently urging a terminal member into firm engagement with the terminal member of a second connector and wherein the resilient means also provides a latching means for locking the rigid terminal member in operative position within the housing. An important advantage of the present structure of electrical connector over the electrical connector shown in my Patent No. 2,838,739, above referred to, resides in the convenience afforded in being able to assemble the terminal members in the housing by inserting them through the cable end of the housing into operative relation to the loosely mounted leaf spring. In my prior connector the parts had to be placed in one half section of a longitudinally split member in operative position within while the second half section was being assembled therewith. The present novel structure enables a longitudinally split housing to be preassembled with its leaf springs without the terminal members and their extended cables and also renders it practicable to provide a single piece molded housing, thus eliminating the fastening elements.

While the preferred embodiment of the invention has been herein illustrated and described, it will be understood that the invention may be embodied in other forms within the scope of the following claims.

Having thus described the invention, what is claimed is:

1. An electrical connector comprising a hollow insulating housing having a connecting end and a cable end and adapted for longitudinal telescopic engagement with a second and identical connector, a rigid terminal member extended through the cable end in detached relation to the walls of the housing to present the contact end of the terminal member in operative relation to the connecting end, an elongated leaf spring carried by said housing in detached relation to the walls thereof and having a prestressed portion for resiliently urging the contact end of the terminal in a direction for cooperation with a terminal carried by a second connector, said hollow housing having a cylindrical bore provided with a U-shaped grooved portion, said leaf spring having a resilient U-shaped portion adapted to be yieldingly compressed inwardly and inserted in said bore prior to assembly of the terminal member, said compressed U-shaped portion being moved into alignment with said grooved portion and then released to engage the grooved portion to prevent longitudinal displacement of the spring, the contact end of said terminal member having a notch for latching engagement with the forward end of the leaf spring when the terminal member is subsequently inserted through the cable end of the housing to prevent longitudinal retraction of the assembled terminal member.

2. An electrical connector as defined in claim 1 wherein access is provided to permit disengagement of the end of the leaf spring from said notch to permit withdrawal and replacement of the terminal.

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