

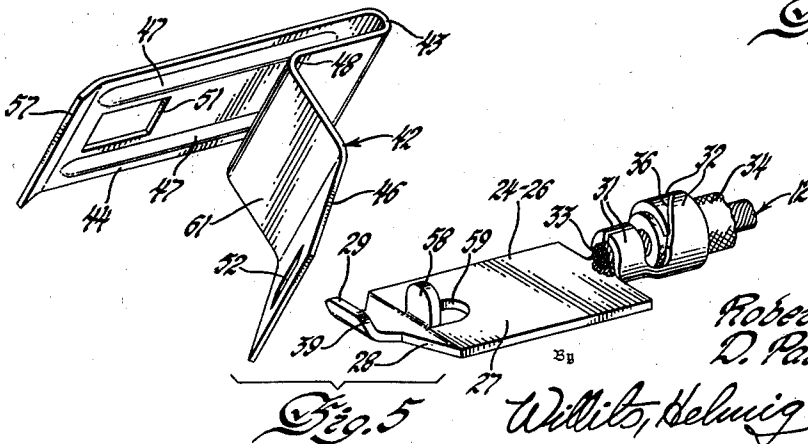
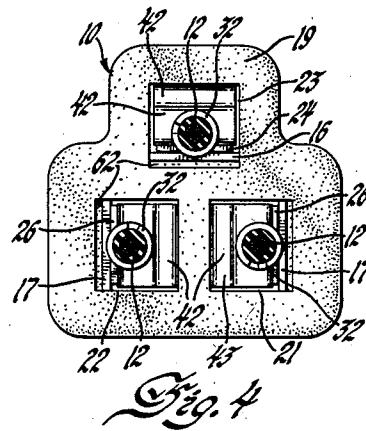
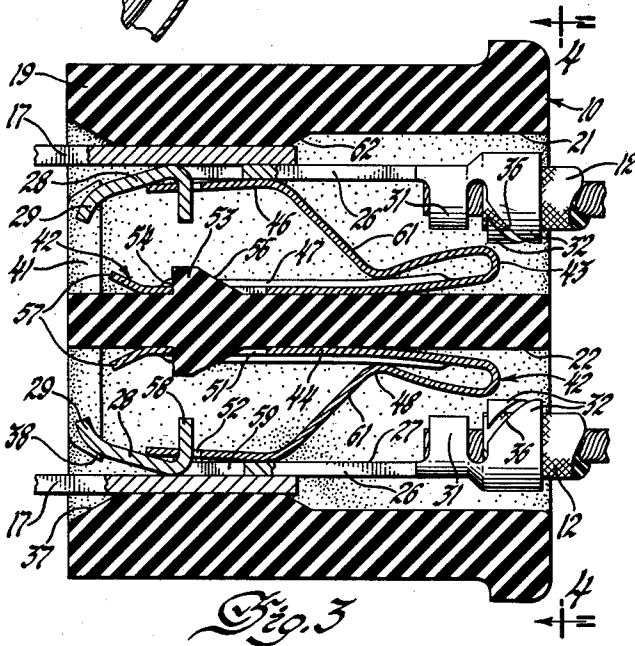
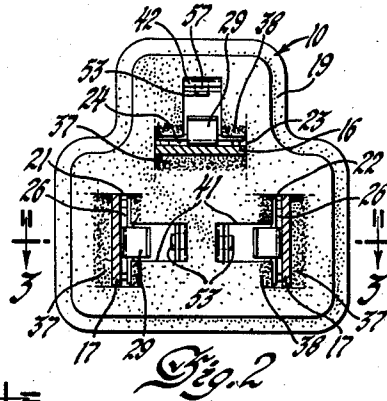
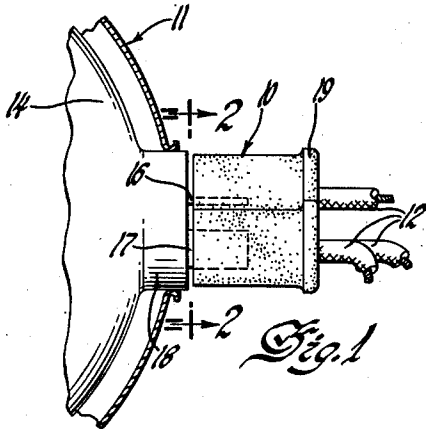
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ELECTRICAL CONNECTOR HAVING A SPRING-BIASED LINE TERMINAL

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ELECTRICAL CONNECTOR HAVING A
SPRING-BIASED LINE TERMINAL

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This invention relates to a device for connecting the terminal ends of electrical conductors and has particular relation to a connector device or fixture especially applicable for connecting the terminals of a sealed beam headlamp for automobiles to the line terminals supplying electrical energy for operating the headlamp.

In connectors of this type heretofore employed it has been customary to provide an insulative housing having passages formed therein for receiving line terminals in one end of the passages and lamp or electrical device terminals in the opposite ends thereof. The passages are provided with spring clips or fasteners for holding the terminals in electrically contacting relation, the spring clips also being required to perform the function of holding the line terminals within the passages at all times after the assembly of the apparatus is completed but permitting the removal of the lamp terminals whenever it is desired to disconnect the headlamp from the connector device. These spring clips must be constructed to facilitate the assembly of the connector device and at the same time they must be formed in such way that when the device is once assembled they will hold the line and lamp terminals together so that the terminals not only will not become separated or disconnected but they will be held firmly together to provide efficient electrical contacting areas. In order to assemble connectors of this type it is necessary first to compress the springs or fastener so that they can be inserted in the passages in the insulative body of the connector. Then after assembly it must be possible to further compress and expand the fasteners so as to permit insertion and removal of the lamp terminals. It will be apparent therefore that the fasteners should be relatively easy to compress in order to facilitate assembly of the device and they should be harder to compress in order to provide the most efficient electrical contact efficiency between the line and lamp terminals which the device is required to connect.

It is therefore an object of the invention to provide an electrical connector consisting of an insulative body having passages formed therein for receiving line and electrical device terminals, and to provide in such passages resilient fastener means requiring different amounts of effort to compress the same under different conditions.

Another object of the invention is to provide an electrical connector device with spring fasteners formed in such a way as to provide spaced and reversely related bends intermediate the

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ends of the fasteners so that certain operations of the fastener will affect one bend and other operations will affect another, thereby changing the spring characteristics of the fastener for different operative conditions of the fastener.

Other objects and features of advantage of the invention will be apparent from the following description and from the accompanying drawing, in which:

Figure 1 is a fragmentary view of an automobile headlamp, partly in elevation and partly in cross section, and illustrating an electrical connector embracing the principles of the invention.

Figure 2 is a view of the connector showing an end thereof adapted to have removably connected thereto a headlamp or other electrical device such as is illustrated by Figure 1. Figure 2 is taken on line 2—2 of Figure 1.

Figure 3 is an enlarged horizontal sectional view of the connector taken substantially in the plane of line 3—3 of Figure 2.

Figure 4 is an end elevational view of the line terminal end of the connector, this being the end thereof opposite that illustrated by Figure 2.

Figure 5 is an exploded view showing perspective illustrations of the spring fastener and line terminal parts of the electrical connector illustrated by the preceding figures.

For the purpose of illustrating the invention there is employed an electrical connector 10 which is adapted to supply electrical energy for operating a headlamp or other electrical device 11 through electrical conductors 12. One of the conductors 12 is a common ground connection for a pair of filaments such as may be employed in the headlamp 11, the other two being separate positive electrical supply conductors for each of the filaments so employed.

In the illustrated embodiment of the invention the headlamp 11 comprises a so-called sealed beam reflector indicated at 14 which contains either a pair of filaments or a two-filament bulb, these normally being constructed in such a way as to form integral parts of the reflector. The common ground terminal for the two filaments referred to is indicated by the left of the two numerals 17 shown by Figure 4 while the minor or lower beam filament terminal is indicated at 16 and the major or upper beam filament, by the other numeral 17. The terminals 16 and 17 project rearwardly from a radially projecting part 18 of the sealed beam reflector 14, the part 18 being adapted to contain insulative material for supporting the terminals 16 and 17 in spaced relation to one another. The terminal 16 pro-

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jects normally from the part 18 between but offset from the terminals 17, which also project normally from the part 18 in spaced and parallel relation to one another and to the terminal 16. The terminal 16 lies in a plane which is normal with respect to terminals 17.

The connector 10 is adapted to receive therein the lamp terminals 16 and 17 and to hold these terminals in the connector in such a way that they will not become displaced during the operation of the motor vehicle with which the headlamp 11 may be employed.

The connector 10 comprises an insulative body 19 through which is formed a plurality of parallel passages indicated at 21, 22 and 23. The passages 21 and 22 are adapted to receive adjacent one wall of each passage the parallel lamp terminals 17 while the passage 23 is adapted to receive adjacent a wall of this passage, the lamp terminal 16. One of the electrical conductors 12 projects into the end of the passage 23 opposite that receiving the lamp terminal 16 while the other two electrical conductors 12 project into the ends of the passages 21 and 22 opposite the ends receiving the lamp terminals 17. Within passages 21, 22 and 23 the electrical conductors 12 terminate in a line terminal 24 and a pair of line terminals 26, these being adapted to engage the lamp terminals 16 and 17 for supplying electrical energy to the headlamp 11.

The lamp terminals 16 and 17 comprise flat rectangularly shaped bars or prongs such as are clearly indicated in Figures 1 to 4 of the drawing while the terminals 24 and 26 comprise members such as that indicated at 24-26 in Figure 5. The terminals 24-26 comprise flat rectangularly shaped parts 27 having angularly turned ends 28 terminating in arcuate tips or tongues 29. The terminals 24-26 are provided with such configuration for the purpose of making it easy to laterally displace such terminals when the terminals 16 and 17 are projected into engagement with the electrical contacting surfaces thereof. Also the parts 27 of such terminal provide large areas for conducting electrical energy to the lamp terminals after the lamp terminals have been brought into electrical contacting engagement therewith.

At the opposite ends thereof the terminals 24-26 are transversely severed and slotted in such manner as to provide pairs of electrical-conductor securing lugs indicated at 31 and 32, the pairs of lugs 31 being adapted to be bent around and to engage the cable or wire parts 33 of the conductors while the lugs 32 engage the insulating sheath parts 34 thereof. After the lugs 31 have been bent into engagement with a wire or cable 33, a good electrical contact may be provided therebetween either by soldering the lugs to the wire or cable or by spot welding the parts together. The adjacent ends of the lugs 32 are cut diagonally as is indicated at 36 so as to permit the lugs to overlap one another when bent about the insulating sheath 34 of an electrical conductor to which the terminal is attached.

It will be apparent from examining Figure 3 that lamp terminals 16 and 17 are adapted to be inserted between the line terminals 24 and 26 and one wall of each of the passages 21-23.

The lamp terminal receiving ends of the terminal receiving passages each are formed in such a way as to provide an angularly disposed bevel 37 along the end of the passage wall against which a lamp terminal is adapted to be positioned when inserted in any of the passages of the connector 10 and this bevel is positioned oppositely

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with respect to the angularly bent and arcuate end indicated at 28 and 29 of the line terminal 24 or 26 in each of the connector passages. It will therefore be apparent that the bevel 37 and the angularly turned and arcuate ends 28 and 29 will provide a tapering slot indicated at 38 for facilitating the insertion of the lamp terminals within the passages of the connector.

The angularly turned ends 28 have converging side surfaces thereon in order to reduce the widths of the end portions relative to the contacting portions 27 and the arcuate portions 29 of the angularly turned ends 28 are formed at the end extremities of the angularly turned ends. To facilitate assembly of the device and to prevent interference upon the insertion of the lamp terminals within the connector, the arcuate ends 29 are relieved at the corners thereof as is indicated at 39.

The reduced and arcuate ends 29 of the line terminals 24-26 are adapted to be positioned between parallel closures formed as integral parts of the body 19 and indicated at 41. These are adapted to project partly across the lamp terminal receiving ends of the passages 21-23 for the purpose of closing the passages at such ends except for the space between the adjacent edges of the closures which is designed to permit the movement of the ends 28 therebetween. The closures 41 terminate adjacent one wall of each of the terminal receiving passages to provide the notches or lamp terminal receiving recesses 38 which project entirely across each of the terminal receiving passages.

After assembly of the connector 10 the line terminals 24 and 26 thereof are permanently retained within the passages 21-23 thereof during the normal operation of the device. However, the line terminals 24 and 26 are positioned in the terminal passages in such a way as to be laterally movable to permit the insertion of the lamp terminals 16 and 17 between the line terminals and one wall of each of the terminal receiving passages as previously described. The line terminals 24 and 26 are adapted to be resiliently held in such position by spring fasteners indicated generally at 42. One of the fasteners 42 is illustrated in the view shown by Figure 5.

Each of the fasteners 42 comprises a bend 43 formed intermediate the opposite ends thereof thus dividing the fastener into spring end parts indicated at 44 and 46. The ends 44 are reinforced by the formation therein of spaced and longitudinally disposed channel-shaped webs indicated at 47, these being formed adjacent the opposite edges of the end part 44 for the purpose of stiffening the fastener to decrease the tendency of the ends 44 to bend when the fasteners 42 are compressed.

The fastener ends 46 are provided with inwardly disposed bends indicated at 48 which approach but do not engage the ends 44 when the fasteners 42 are constructed and prior to the time the fasteners are inserted in the parallel passages formed in the body 19. However, when the connector device 10 is assembled and the fasteners 42 are compressed in such manner as to be insertable within the parallel passages in the body 19 the bends 43 are contracted in such manner as to permit the bends 48 to engage the reinforcing webs 47 of the fastener ends 44. When so assembled the fasteners 42 are constructed in such manner that the fastener ends 44 and the parts of the fastener ends 46 beyond the bends 48 lie in parallel relation within the passages and in

relatively parallel relation to oppositely disposed walls of each of the passages. The parallel parts of the ends 46 of the fasteners are adapted to be disposed upon the rectangular parts 27 of the line terminals 24—26, the ends 44 thereof being adapted to relatively closely engage the opposite walls of each of the passages throughout the greater part of the length of the fastener ends 44. The body 19, the fasteners 42 and the line terminals 24—26 are all provided with cooperating bayonet-slot means whereby the fasteners secure the line terminals within the passages of the body after the connector 10 is assembled. Such bayonet-slot means comprises openings 51 and 52 which are formed in the ends 44 and 46 respectively of the fasteners 42, at the extremities of the fastener ends remote from the bends 43. The openings 51 are adapted to receive lugs 53 which are formed on the walls of the terminal passages against which the ends 44 of the fasteners are adapted to be disposed. The lugs 53 have vertically disposed walls 54 and angularly disposed walls 56 for permitting the fasteners to be compressed within the passages and inserted therein from the line terminal ends of the passages but to prevent displacement of the fasteners when force is exerted thereon in a direction opposite that from which the fasteners were inserted in the passages during the assembly of the connector. The fastener ends 44 are turned across the ends thereof as is indicated at 57 to facilitate movement of the fasteners over the angularly disposed surfaces 56 of the lugs 53 when the fasteners are inserted in the passages during assembly of the connector. The line terminals 24—26 also are provided with laterally disposed lugs indicated at 58 which are adapted to be received in the openings 52 in the fasteners 42 upon assembly of the connector 10. The lugs 58 are struck out laterally from the rectangular part 27 of the line terminals as is indicated at 59 and the ends of the lugs 58 are made of semicircular formation as is illustrated by Figure 5, to facilitate insertion of the lugs into the openings 52 upon assembly of the connector.

When assembling the device, the fasteners 42 and the line terminals 24—26 are first assembled outside the body 19 by positioning the openings 52 in the fasteners 42 over the lugs 58 projecting from the line terminals 24—26 and with the bends 43 disposed directly opposite the lugs 31 and 32 in which the conductors 12 are secured. Then by compressing the fasteners 42 until the straight ends 44 of the fasteners are parallel to the rectangular parts 27 of the line terminals 24—26, it will be possible to insert both the line terminals and the fasteners within the terminal openings in the body 19 from the ends of the terminal passages opposite the lamp terminal receiving recesses 38. The subassembly so formed is thereafter positioned inwardly of the terminal passages until openings 51 pass over the lugs 53, thereby permitting the fasteners to expand and the openings 51 thereof to receive the lugs 53. The fasteners 42 have angularly disposed portions 61 formed in the ends 46 thereof which are adapted to provide recesses within the fasteners and beyond the bends 43 for receiving the relatively enlarged parts of the line terminals in which the electrical conductors 12 are secured. To provide for further enlarging such recesses, one wall of each of the passages 21, 22, and 23 is offset as is indicated at 62.

It will be apparent that the connector 10 may be completely assembled by so inserting one sub-

assembly consisting of a fastener 42 and one of the line terminals 24—26 into the line terminal end of each of the openings 21, 22, and 23. When the fasteners 42 are so compressed for assembly within the body 19, it will be apparent that the bends 43 will be brought into engagement with the reinforcing webs 47 of the relatively straight end parts of the fasteners indicated at 44. It will be easy enough initially to bend the fasteners at the bends 43 for so assembling the fasteners and the line terminals within the terminal passages, but the force thereafter required to bend the fasteners will be greatly increased upon assembly of the device and upon engagement of the bends 43 with the fastener ends 44. Such increased force will be required because the engagement of the bends 43 with the ends 44 decreases the effective length of the ends 46, thus making it virtually necessary to bend a shorter length of the same spring. When so assembled it will be relatively impossible to pull the terminals 24—26 out of the passages in the body 19 without first compressing the fasteners so as to relieve the openings 51 from the lugs 53. This of course may be done easily if desired by inserting a tool such as a screw driver under the bent ends 57 of the fastener ends 44 and prying upwardly thereon until the fastener ends are above the lugs 53. Then by pulling outwardly upon the electrical conductors for the connector the entire assembly of the fasteners 42 and line terminal ends 24—26 may be removed.

When using the connector 10 for the purpose of supplying electrical current to a lamp such as that indicated at 11 it is necessary only to project the lamp terminals 16 and 17 through the recesses 38 and against the laterally bent ends 28—29 of the line terminals 24—26. Then by pushing on the lamp the lamp terminals may be made to displace the line terminals laterally with respect to the adjacent walls of the terminal passages thereby permitting the lamp terminals to be inserted beneath the rectangular parts 27 of the line terminals and against the adjacent walls of the terminal passages. Such lateral displacement of the line terminals further compresses the fasteners 42 by bending the fasteners upon fulcrum points at the bends 43. Such bending of the fasteners upon the bends 43 requires considerably greater force than was required during the initial bending of the springs for assembly purposes and this greater force presses the adjacent surfaces of the line and lamp terminals in intimate contacting relation so as to provide a good electrical contact between the terminals.

It will be apparent that there will be critical relation between the force required for the lateral displacement of the line terminals and the force required to push the lamp terminals into the connector. In other words if the force required to compress the fasteners 42 about the bends 43 is too great it will be extremely difficult to insert the lamp terminals into the connector by pushing on the lamp. On the other hand if the force required for compressing the fasteners 42 is greatly reduced then it will be easy to displace the lamp relative to the connector to such an extent that a poor electrical contact will be formed between the lamp and line terminals of the connector. It is therefore proposed to make the fasteners 42 in such a way that they will be quite difficult to bend upon the bends 43 and then to reduce the force required to push the lamp terminals into the connector by providing relatively smooth and flat surfaces throughout the contacting areas of the

lamp and line terminals, to reduce the width of the laterally turned parts 28-29 of the line terminals and by making smooth edges and round corners on various parts that might interfere with the insertion of the lamp terminals.

By such expedients it will be apparent that the provision of good electrical contact may be provided between the lamp and line terminals without requiring excessive force to insert the lamp terminals into the connector.

Referring particularly to the springs such as those which are indicated by the numerals 42, it will be apparent that each of the springs is essentially two springs indicated at 44 and 46, and divided by a bend 43. The springs 44 are reinforced by the ribs 47 in such a way as to make the springs 44 actually stronger than the springs 46, and notwithstanding the fact that both are made out of the same material. Hence when a load is placed on the two ends of the spring 42 in such a way as to tend to bring the two ends together, it is apparent that the springs 46 will be stressed beyond the elastic limit before the springs 44 will be so stressed. The springs 46 therefore may be considered as being the critical parts of the springs 42 and the parts thereof which must be considered in the event the ends of the springs 42 are to be deflected toward one another to any great extent.

It will be further noted, upon examining the springs 42, that the parts of the springs which have been referred to as being the springs 46 are also divided into long and short springs, these being formed on opposite sides of the bends 48.

It has been previously stated in connection with the description of the assembly of the connector device 10 that it is easier to depress the springs 42 prior to the time the bends 48 engage the ribs 47 than it is to depress the springs thereafter. This is merely another way of saying that the full lengths of the springs 46 will be stressed to a greater extent by a given force before the bends 48 engage the ribs 47 than will the long lengths of the springs 46 be stressed by the same force after such engagement. What happens in the springs 42 as disclosed is that the short lengths of the springs 46 are subtracted from the total length of the springs 46 after the springs 46 have been deflected almost to the elastic limit of the material comprising the springs. When such event occurs the length of the springs 46 will then be decreased and since a part of the load on the springs is supported by the bends 48, thereafter a greater force will be required to deflect the ends of the springs 42 a given distance toward one another. Since a greater force than can be applied to the long lengths of the springs 46, then the springs will be stronger and thereafter will oppose any further deflection to a greater extent than before. The springs 42 therefore may be deflected to a given extent without stressing any part of the springs 46 beyond the elastic limit of the material thereof and a greater force will be required to so deflect the springs after the bends 48 have engaged the ribs 47 than would be required were the bends not so to engage the ribs.

This is particularly desirable in an electrical connector such as that indicated by the numeral 10, where dimensions have a limiting effect on the size of any spring that may be employed, and where a given force is required in order to provide a good electrical contact between the line and lamp terminals of the device. Such an elec-

trically contacting force may be obtained by dividing any given spring into a plurality of springs of shorter length as has heretofore been described, and then by stressing the successively shorter lengths of the spring almost to the elastic limit as has previously been described. As each shorter length of spring comes into action, a greater force will always be required to stress such new length of spring to the elastic limit of the material thereof and therefore a greater force can be applied by the spring for any desired purpose.

The spring 42 has been found in practice to perform in this manner as it is possible to obtain a greater electrically contacting force between the line and the lamp terminals of the connector 10 with a spring formed to include the bends 48 than it is possible to obtain with the same connector and the same spring and without the bends 48.

Also, it has been mathematically determined that the springs 46, which are assumed to be divided by the bends 48 into short and long springs having respective lengths equal to one-third and two-thirds of the length of the springs 46, will stand 1.75 times as much deflection without being stressed beyond the elastic limit as will similar springs without such division. From these computations, and from tests performed, it is apparent that a spring such as that disclosed may be divided into any desired number (as for example an infinite number) of shorter lengths with bends such as the bend 48 therebetween and with the bends and lengths so arranged that the bends will successively engage some relatively fixed part of the structure to successively decrease the effective length of the spring as the material of the spring is deflected almost to the elastic limit thereof. Under such conditions the strength of the spring will be increased and the spring will be capable of further deflection and a greater force will be required to produce such further deflection as the effective length of the spring is so decreased.

We claim:

1. An electrical connector comprising an insulative body having a plurality of parallel passages for receiving lamp terminals for removable disposition therein adjacent one of the walls of each of said passages and line terminals for engagement by said lamp terminals, spring fasteners disposed in said passages between said line terminals and an opposite wall of each of said passages and providing resilient engagement between said line terminals and said lamp terminals within said passages, said spring fasteners having a first bend intermediate the ends thereof to provide pairs of passage wall and line terminal engaging spring ends, said spring ends and said opposite passage walls and said line terminals being provided with associated interlocking means for normally retaining said fasteners and said line terminals within said body passages, said wall engaging spring ends being provided with reinforcing means throughout the length thereof for stiffening said wall engaging ends of said fasteners, and each of said terminal engaging spring ends being provided with further intermediate bends, at least one of said intermediate bends in each of said terminal engaging spring ends engaging said wall engaging ends whereby the resilient force applied by said fasteners to said terminals and said walls is increased when said one of said intermediate bends are so engaged, and angularly disposed portions between said intermediate bends in each of said

terminal engaging ends providing recesses in said fasteners for receiving the relatively enlarged line connecting ends of said line terminals.

2. An electrical connector comprising an insulative body having a plurality of parallel passages for receiving lamp terminals for removable disposition through one of the ends and adjacent one of the walls of each of said passages and line terminals for engagement by said lamp terminals, said line terminals having the line connecting ends of said terminals disposed adjacent and being received from the opposite ends of each of said passages, spring fasteners disposed in said passages between said line terminals and an opposite wall of each of said passages and providing resilient engagement between said line terminals and said lamp terminals within said passages, said spring fasteners having a first bend intermediate the ends thereof to provide pairs of passage wall and line terminal engaging spring ends, said spring ends and said opposite passage walls and said line terminals being provided with bayonet-slot means whereby said fasteners and said line terminals are normally retained within said body passages, said spring ends having openings adjacent the extremities of said ends to provide the slots of said bayonet slot means, said wall engaging spring ends being provided with reinforcing means throughout the length thereof for stiffening said wall engaging ends of said fasteners, and each of said terminal engaging spring ends being provided with further intermediate bends, at least one of said intermediate bends in each of said terminal engaging spring ends engaging said wall engaging ends whereby the resilient force applied by said fasteners to said terminals and said walls is increased when said one of said intermediate bends are so engaged, and angularly disposed portions between said intermediate bends in each of said terminal engaging ends providing recesses in said fasteners for receiving the relatively enlarged line connecting ends of said line terminals.

3. An electrical connector comprising an insulative body having a passage for receiving line and electrical device terminals therein at opposite ends thereof, a spring fastener disposed in said passage for resilient engagement with said body and with one of said terminals, said fastener having a first bend intermediate the ends thereof to provide terminal and body engaging spring ends for said fastener, said spring ends and said body and said one of said terminals being provided with associated interlocking means for normally retaining said fastener and said one of said terminals within said body passage, said body end being provided with longitudinal reinforcing means for stiffening said body end, said terminal end being provided with further intermediate bends, at least one of said further bends being inwardly disposed for engagement with said body end whereby the effective length of said terminal end is decreased when said fastener is disposed in said passage, and an angularly disposed portion between said further intermediate bends in said terminal engag-

ing end providing a recess in said fastener for receiving the relatively enlarged line connecting end of said line terminal and for maintaining said body end and said terminal end in parallel relation to one another whereby said terminals are maintained in good electrical contact.

4. An electrical connector comprising an insulative body having a passage for receiving line and electrical device terminals therein, said line terminal having an angularly bent end projecting toward the electrical device terminal receiving end of said passage, said angularly bent end being reduced in width and convexly curved and rounded at the corners adjacent the extremities thereof for facilitating the insertion of said device terminal in electrically contacting relation with a part of said line terminal beyond said angularly bent end, said part beyond said end being of elongated rectangular formation for providing an area of contact coextensive with respect to the configuration of the inserted and contacting portion of said device terminal, a spring fastener disposed in said passage for resilient engagement with said body and said terminals, said fastener having a first bend intermediate the ends thereof for providing terminal and body engaging spring ends for said fastener, said spring ends and said body and said line terminal being provided with associated interlocking means for normally retaining said fastener and said line terminal within said body passage, one of said ends being provided with longitudinal reinforcing means for stiffening said one of said ends against bending, the other of said ends being provided with further intermediate bends, at least one of said further bends being inwardly disposed for engagement with said one of said ends, and an angularly disposed portion between said further intermediate bends in the other of said ends providing a recess in said fastener for receiving the relatively enlarged line connecting end of said line terminal and for maintaining said one of said ends and said other of said ends in parallel relation to one another whereby said terminals are maintained in good electrical contact.

5. An electrical connector as defined by claim 4 wherein parallel closure members are provided adjacent the device terminal end of said passage, said closure members being disposed on opposite sides of said reduced line terminal end and permitting the operative movement of said reduced line terminal end in parallel relation to said closure members.

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