ABSTRACT OF THE DISCLOSURE

A high pressure contact for electrical connectors wherein the male plug portion of the connector has a pre-stressed longitudinal length greater than the longitudinal length of the hollowed portion of the female receptacle and wherein the prestressed radial dimension of the male plug means is less than the cross-section dimension of the inside surfaces of the sidewalls of the female receptacle so as to facilitate easy insertion of the plug means into the receptacle. Stressing means are located adjacent to the closed end of the receptacle and act to stress the plug portion of the connector when the plug portion is forced into the receptacle by a very high clamping or compressive force. As the plug is stressed it expands radially within the receptacle so as to apply an extremely high mating pressure against the inner walls of the receptacle.

The invention described herein may be manufactured and used by or for the Government of the United States of America for governmental purposes without the payment of any royalties thereon or therefor.

The present invention relates generally to improvements in electrical connectors and the like and more particularly to new and improved electrical connectors which are adapted to be used in connector arrays. Insertion of the male plug portion of the connector of this invention into the female receptacle portion is extremely easy, and an extremely reliable, high-pressure, noise-free connection is attained after the portions of the connector are firmly mated together, such as by a conventional jack screw when the connectors are situated in a connector array.

In the field of electrical connectors it has been the general practice to employ bow pins, banana plugs, micropins, or the like which depend upon the forces supplied by inherent built-in spring tension to make electrical and physical contact with the conductive mating element, normally a tube or sleeve device of controlled inner diameter. Although such devices have served the purpose, they have not proved entirely satisfactory under all conditions of service for the reasons that if a pin or plug has lost its inherent effective spring tension by any means such as overheating, stressing beyond the elastic limit due to abuse, or if the pin or plug is slightly malformed in manufacturing, either no electrical connection is made or a noisy and ineffective electrical connection is made.

Other difficulties have been encountered in prior art connectors which depend upon the forces supplied by the built-in spring tension of the plug or pin to make electrical and physical contact with the conductive mating element or receptacle. Because the plug or pin of prior art connectors is larger in diameter than the inside diameter of the receptacle, insertion into the receptacle is difficult, particularly where the connectors are situated in an array, for the reason that the plug or pin immediately contacts the inner surface of the side walls of the receptacle and so restricts the relative movement between the plug and receptacle, thus requiring the application of a high initial insertion force. This high initial insertion force often results in the breaking or buckling of the plugs or pins, particularly where any small misalignment occurs between the plug and the receptacle.

The general purpose of this invention is to provide a reliable, high-pressure contact, noise-free, electrical connector which embraces all the advantages of similarly employed electrical connectors and possesses none of the aforementioned disadvantages. To attain this the present invention contemplates a unique electrical connector adapted to be used in connector arrays which comprise a plurality of the connectors of this invention whereby easy initial insertion of the plug or pin into the receptacle is achieved and whereby a reliable, noise-free, electrical connection results, even though the plug or pin has been stressed beyond the elastic limit, has lost its inherent tension, or has been malformed due to manufacturing.

An object of the present invention is the provision of a new electrical connector for providing a reliable, high-pressure, noise-free electrical connection.

Another object is to provide a new electrical connector which allows an overstressed or malformed plug or pin to form a reliable, high-pressure, noise-free electrical connection.

A further object of the invention is the provision of a reliable, high-pressure, noise-free, electrical connector in which the plug or pin portion is easily insertable within the receptacle portion of the connector. Still another object is to provide a reliable high-pressure, noise-free electrical connector which causes the plug or pin portion to be stressed in such a manner as to apply an extremely high mating pressure against the inner walls of the receptacle portion of the connector.

With these and other objects in view, as will hereinafter more fully appear, and which will be more particularly pointed out in the appended claims, reference is now made to the following description taken in connection with the accompanying drawings in which:

FIG. 1 shows a section of a properly mated prior art electrical connector.

FIG. 2 illustrates a section of a prior art electrical connector where there is no electrical connection due to abuse, stressing beyond the elastic limit, or malfunction of the plug or pin.

FIGS. 3A and 3B show sections of one embodiment of the invention.

FIGS. 4 and 5 illustrate sections of modified forms of the electrical connector of FIGS. 3A and 3B.

Referring now to the drawings wherein like reference characters designate like or corresponding parts throughout the several views, there is shown in FIG. 1 a conventional receptacle 11 containing a male plug or pin 12 which is properly mated to the female receptacle 11 at contact points 13 and 14.

FIG. 2 illustrates a conventional female receptacle 11 containing a plug or pin 12 which has been abused, stressed beyond its elastic limit or malformed in the manufacturing process to such an extent that there is no electrical connection such as at 13 and 14 in FIG. 1.

FIG. 3A, illustrating one concept of the present invention, shows a conventional receptacle 11 partially containing conductive plug or pin 12. Anvil block or stressing means 15 which is formed of rubber, plastic, metal or like compressible material, is located within receptacle 11 adjacent to the closed end of the receptacle.

FIG. 3B illustrates receptacle 11 completely containing plug or pin 12 so that the shoulder 16 of the plug or pin is seated firmly against the shoulder 17 of the receptacle, and so that plug or pin 12 is forced against the anvil block or stressing means 15 at contact area 18 and against the inner walls of receptacle 11 at contact areas 19 and 20.
In FIG. 4 there is shown another embodiment wherein the stressing means within receptacle 11 comprises anvil block 15 and a spring 24 located between the anvil block and the closed end of receptacle 11.

Referring now to FIG. 5 there is illustrated a receptacle 22, with a hollow portion 24 which has a longitudinal length shorter than the pre-inserted length of plug 12 which, when it is forced to be completely contained by the receptacle 22 so that the shoulder 16 firmly seats against shoulder 23 and its point is forced at contact point 25, the plug 12 radially expands and is forced against the inner walls of receptacle 22 at contact areas 26 and 27, thereby making secure electrical and mechanical engagement.

In the operation of one embodiment of the invention, as exemplified by FIG. 3A, the plug or pin 12 is easily inserted into the receptacle 11 up to the point at which the plug or pin strikes the anvil block 15, because the maximum diameter of the plug or pin is less than the inside diameter of the receptacle. This difference in diameters between the plug and receptacle eliminates the need of the very high insertion force required in prior art connectors, and thus eliminates damage to the plug or pin caused by this high insertion force or by the misalignment of the plug and receptacle.

Then, as shown in FIG. 3B, by the application of a very high clamping or compressive force, which may be generated by conventional means such as a jack screw (not shown), the plug's shoulder 16 is firmly seated against the receptacle's shoulder 17 and the plug 12 is forced against the anvil block 15 so as to stress below the elastic limit and radially expand the plug in such a manner as to apply an extremely high mating pressure against the inner walls of the receptacle 11 at areas 19 and 20 and against the anvil block 15 at contact area 18. This very high final mating pressure results in a reliable, low-resistance, electrical connection under extreme environmental conditions such as contaminated atmosphere heavy shock or vibration. The plugs are similarly forced, as aforesaid, in the FIGS. 4 and 5 embodiments.

In order to facilitate fabrication of the connector and to permit large manufacturing tolerance with respect to the length of the plugs or pins and with respect to the length of the hollow portion of the receptacle, the anvil block 15 is preferably made of a compressible material, such as rubber, plastic, or metal which will exert a controlled force against the plug or pin 12. For the same reason the anvil block 15 may be spring loaded as shown in FIG. 4.

A similarly reliable, high-pressure, noise-free, electrical connection results without the use of an anvil block or spring by shortening the axial length of the conventional receptacle 11, as illustrated in FIG. 5 by receptacle 22.

The invention provides a reliable, electrical connector which is effective under extreme environmental conditions. The connector has the advantage of a very low initial insertion force when plug and receptacle alignment is critical and when plugs or pins are susceptible to damage by buckling or breaking as a result of plug and receptacle misalignment. The connector has a very high final mating pressure which is attained even though the plug or pin portion has been previously damaged by over stressing or malformation and as a result a very reliable, low resistance, electrical connection is achieved.

It should be understood, of course, that the foregoing disclosure relates to only preferred embodiments of the invention and that numerous modifications or alterations may be made therein without departing from the spirit and scope of the invention as set forth in the appended claims.

What is claimed and desired to be secured by Letters Patent of the United States is:

1. An electrical connector providing a reliable, high-pressure, noise-free connection comprising:
   female receptacle means having a longitudinal hollow portion of predetermined longitudinal length defined by side-walls;
   radially stressable electrically conductive male plug means adapted to be received within said hollow portion of said receptacle means wherein said electrically conductive plug means has a prestressed longitudinal length greater than said predetermined longitudinal length and wherein the prestressed radial dimension of said electrically conductive plug means is less than the cross-sectional dimension of the inside surfaces of said side-walls in order to facilitate easy insertion of said electrically conductive plug means into said receptacle means; and
   stressing means located within said hollow portion of said receptacle means for stressing said electrically conductive plug means in such a manner as to apply an extremely high mating pressure between said electrically conductive male plug means and said side-walls of said receptacle means.

2. An electrical connector as defined in claim 1 wherein said hollow portion has a closed end, and wherein said stressing means comprises:
   a resilient anvil block which abuts said closed end of said hollow portion.

3. An electrical connector as defined in claim 2 wherein said resilient anvil block is comprised of rubber.

4. An electrical connector as defined in claim 2 wherein said resilient anvil block is comprised of plastic material.

5. An electrical connector as defined in claim 2 wherein said hollow portion has a closed end, and wherein said stressing means comprises:
   a spring which abuts said closed end of said hollow portion, and
   an anvil block abutting the end of said spring opposite that end which abuts said closed end.

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