

Sept. 27, 1966

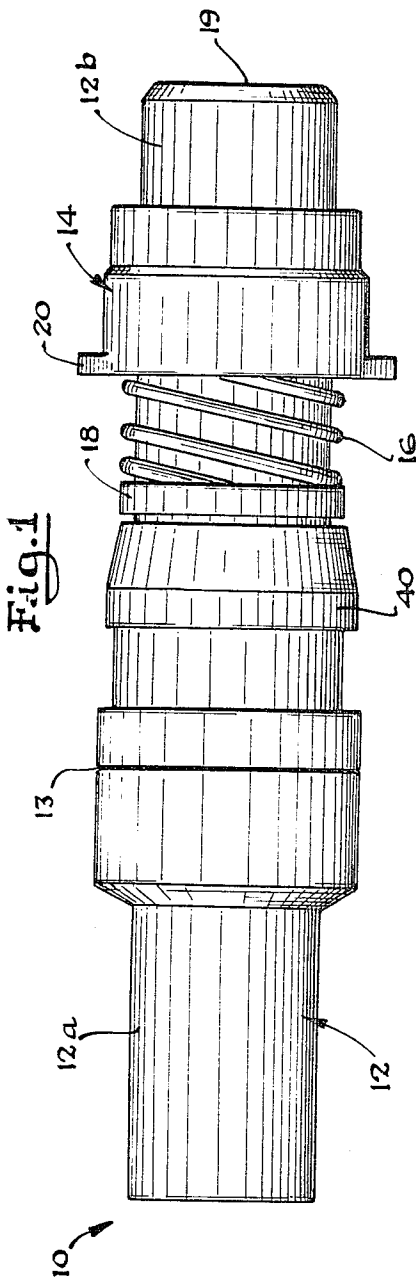
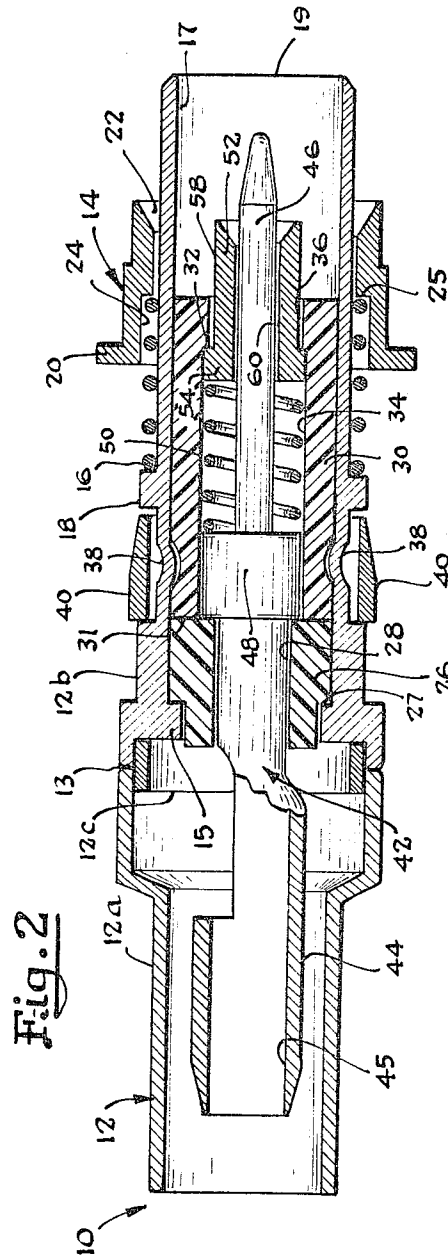
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3,275,970

CONNECTOR

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3 Sheets-Sheet 1



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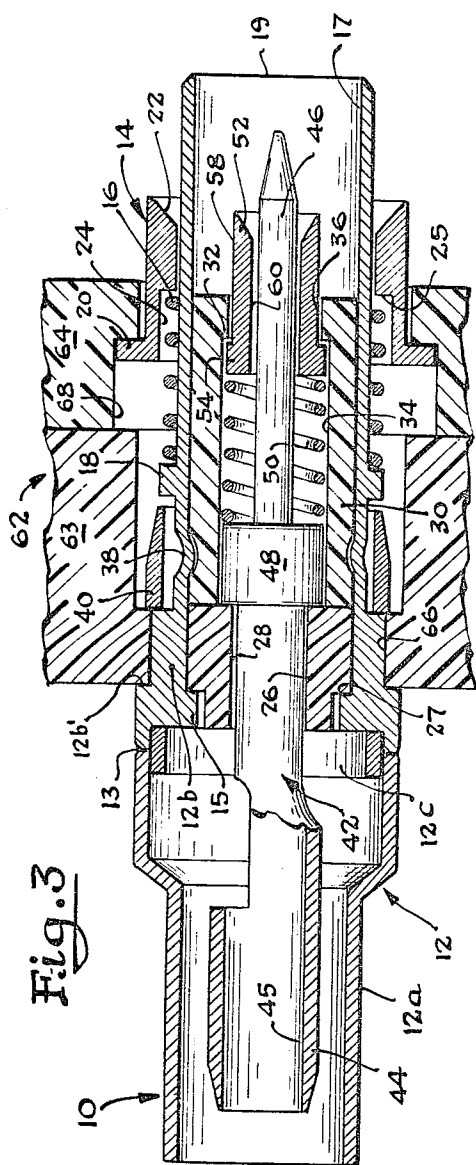


Fig. 3

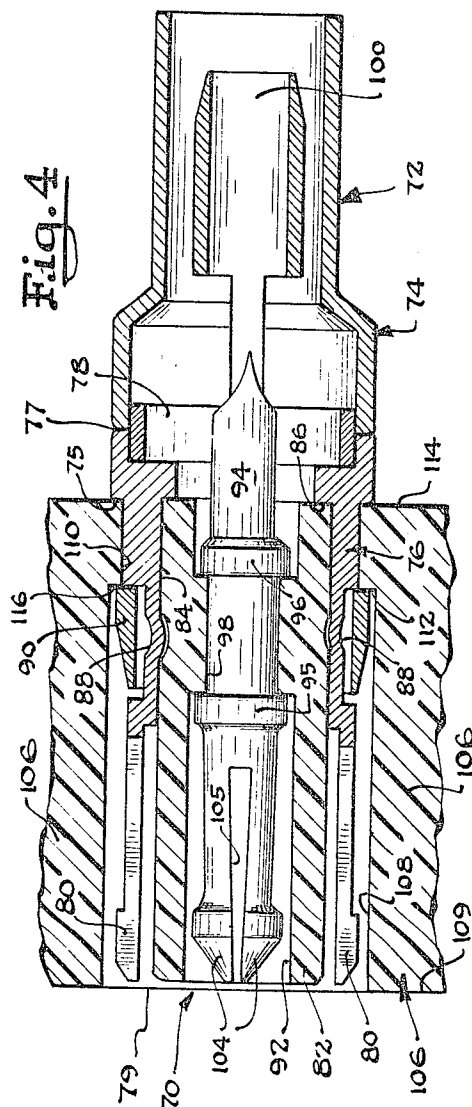


Fig. 4

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3 Sheets-Sheet 3

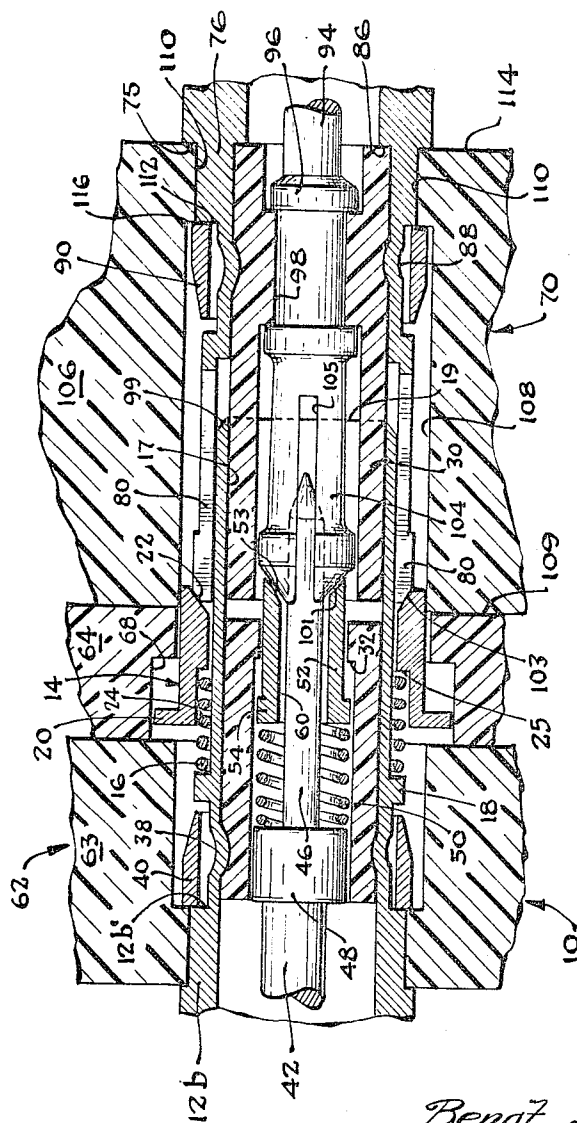


Fig. 5

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CONNECTOR

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1 Claim. (Cl. 339—143)

The present invention relates to an electrical connector and more specifically it relates to an improved electrical connector having means to assure provision of a positive and reliable electrical path between mating elements of the connector.

The need for improved reliability in electrical connectors has increased significantly with the development of missiles and rockets and the requirement for highly reliable components therefor. It can readily be seen that missile components, even though used only once, must function as required for that limited use period in order to be acceptable for service. There are, of course, many other fields where high reliability connectors are required. Such connectors also are desirable generally to avoid service problems on equipment. Further, users of such equipment are beginning to expect service and reliability from their components which approaches the characteristic level of missile components.

One of the recurrent problems in the connector field resides in the provision of a reliable electrical connection. In the connector art it is common practice to employ a male-female connecting arrangement where one electrical terminal is received within another. If the female connector element is not withdrawn carefully from the male the contact portion of the female element may take a permanent set and be distorted from its original configuration. In this case the opening of the female element may be enlarged or in some manner changed from the preferred configuration and may not be in the best form to provide an efficient electrical path during the next connection or period of use. In some connectors resilient connecting elements are used to obviate the condition noted above since the elements are resiliently biased to preferred contact position and may be deflected away therefrom a predetermined amount during use. Such constructions, however, are expensive to manufacture, assemble and maintain and to that extent are not economical for general use even though they may be reliable.

The present invention is directed to the provision of an improved electrical connector that includes the desirable characteristic of spring biasing of the connector element toward each other while at the same time providing a connector construction that is economical both in manufacture and assembly and that is durable in use. In accord with the present invention coil spring elements in combination with sleeves having truncated conical faces are employed to urge the female contact elements into efficient, highly reliable electrical connection with the male terminal of the connector.

It, accordingly, is a general object of the present invention to provide an improved electrical connector.

Another object of the present invention resides in the provision of an improved jack-type electrical connector wherein the elements are resiliently urged into physical contact.

A further object of the invention resides in the provision of an improved electrical connector defining highly reliable electrical contact characteristics.

An additional object of the present invention resides in the provision of an improved electrical connector wherein mating connector element are provided with complementary inclined faces to define means for positive control of physical engagement of the contact elements.

Another object of the present invention resides in the

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provision of an improved electrical connector that is economical to manufacture from elements that are economical to produce, that is durable in use and that provides highly reliable electrical and physical connection between mating elements.

Still another object of the present invention resides in the provision of an improved electrical connector that is economical to manufacture from elements that are economical to produce, that is durable in use and that provides highly reliable electrical connection between electrical leads during each use.

The novel features which are believed to be characteristic of the invention are set forth with particularity in the appended claims. The invention itself, however, together with further objects and advantages thereof, will best be understood by reference to the following description taken in connection with the accompanying drawings, in which:

FIGURE 1 is a plan view of the electrical connector of the present invention;

FIGURE 2 is a view partially in section of the electrical connector of the present invention illustrating in detail the spring biased contact engaging means;

FIGURE 3 is a sectional view of the connector of the present invention mounted in a suitable insulating base;

FIGURE 4 is a partially sectioned view of the mating connector element for the component of FIGURE 3 as mounted in a suitable insulating base; and

FIGURE 5 is a partially sectioned view of the complete connector of the present invention in mating electrically engaging relation.

Referring more particularly now to FIGURE 1 of the drawings, one component of the connector of the present invention is indicated generally at 10. Component 10 of the connector of the present invention includes a shield 12 which is adapted to be electrically engaged with a mating shield portion from the mating component of the connector (described below) to provide continuous shield connection through the assembled connector with simple plug-in type assembly. A sleeve 14 is telescopically mounted about the shield 12 along a portion of the length thereof, one end of said sleeve 14 adapted to abut against one end of spring 16 which is coiled about the end. The other end of said spring being in abutting relation with and axially positioned on the shield by shoulder 18 of said shield. The sleeve, thus, is mounted for axial movement along said shield toward and away from the shoulder portion 18 thereof.

As seen in greater detail in FIGURE 2 of the drawings, the shield 12 of the connector of the present invention is comprised of a three-part construction including tube shield elements 12a and 12b with a conductive sleeve 12c in conducting relation with members 12a and 12b at the joint therebetween. The collar 12c assures a good conductive interconnection between members 12a and 12b. The shield members 12 are made in the three-part construction illustrated for economy both in manufacture and assembly thereof.

Sleeve 14 defines a base flange 20, a frusto-conical collet engaging face 22 and a recessed channel-like portion 24. The spring 16 of the assembly, as noted above, abuts the shoulder 18 at one end thereof. The other end of the spring 16 is received within the channel-like recess 24 of the sleeve 14 and abuts against the shoulder 25 at the base of said recess. It can readily be seen that the spring 16 will tend to extend to its full relaxed length (static position) in the characteristic spring action of seeking to restore itself to an equilibrium condition in its sphere of action. With no load acting against the sleeve 14 the spring will be urged to a fully extended position thereby moving the sleeve 14 to its static posi-

tion (as seen in FIGURES 1 and 2) along the shield member 12b in spaced relation to the right-hand end of said shield member, as seen in FIGURE 2. As seen in FIGURES 3 and 5 of the drawings, the entire assembly is mounted in a suitable insulating material and the components thereof retained in working relation. Thus the sleeve 14 is mounted such that it will be retained on the shield without dropping thereof as might otherwise be indicated from viewing the assembly of FIGURE 2 separate from its insulating body.

A radially inwardly extending flange 15 is provided on the tube-like shield member 12b near the joint end 13 thereof, as seen in FIGURE 2. An insulating member 26 is disposed within the shield member 12b said insulating member having a shoulder 27 thereon adapted to abut the flange 15 of the member 12b for axial positioning of the member 26 within the member 12b. The insulating member 26 further defines a central contact element receiving bore 28 axially aligned with the central axis of the shield member 12 when assembled therein. A second insulating member 30 is disposed within the central bore 17 of the shield member 12b one end 31 thereof abutting against the insulating member 26, said insulating member 30 extending from said end 31 toward the free end 19 of member 12b but terminating in spaced relation thereto. The insulating member 30 defines a shoulder 32 therein defining the juncture between a first central bore 34 and a second central bore 36 thereof. The bore 34 is of larger diameter than the central bore 36 of the insulating member 30. The tube-like shield member 12b is deformed inwardly at spaced intervals about the periphery thereof, as at 38. The wall of member 12b is deformed sufficiently inwardly to displace a portion of the insulating material (if the insulating body is not otherwise preformed in this area) to cause an interference fit between the insulating body and the shield 12b thereby axially affixing the insulating bodies 30 and 26 within the shield member 12b. A protective collar 40 is disposed about the shield over the deformed portions thereof.

An electrical connector element 42 is received within the assembly wholly within the shield 12. The element 42 is disposed within the central bore 28 of insulating member 26 and the bores 36 and 34 of insulating member 30. It is seen, therefore, that the connector element 42 is electrically insulated from the shield 12 by mounting within the insulating members 26 and 30 and otherwise by being in spaced relation to the shield 12 along the exposed portions of said connector.

As seen in FIGURE 2 the connector 42 defines opposed ends 44 and 46. End 44 is hollow and tube-like and defines means for convenient connection of an electrical lead to the connector 42. When a lead is inserted into the channel 45 of end 44 it may be affixed therein by crimping the wall of end 44 to define a restrictive frictional engagement between the wall and the electrical lead (not shown) that may be disposed therein. A collar portion 48 intermediate the terminals of the connector element 42 is in abutting relation to the insulating member 26 to define axial positioning of the element 42 with respect to movement in one direction. The outside diameter of the collar 48 is larger than the central bore 28 of insulating member 26 and thus the collar 48 cannot move axially beyond said insulating member. The diameter of the bore 34 is larger than the collar diameter to permit free movement of the collar 48 into bore 34. It can readily be seen that the unit construction of the component 10 of the present invention permits economical manufacture and assembly thereof.

A spring 50 is received about the terminal 46 of connector element 42. One end of the spring 50 abuts the collar 48 to axially position said spring with respect to the terminal 46.

A sleeve 52 is telescopically received on the terminal 46. The sleeve 52 includes a flange 54 and a main body

portion 56. The outside diameter of the flange 54 is smaller than the diameter of bore 34 but larger than the diameter of bore 36, to define a sliding fit within the bore 34. The flange 54 prohibits movement of the sleeve 52 beyond the shoulder 32 defined between bores 34 and 36 of the insulating member 30. The diameter of the outer periphery 58 of the main body portion 56 of the sleeve is smaller than the diameter of bore 36, said main body portion being axially slidably disposed within said bore. The sleeve 52 is provided with a central bore 60 of sufficient diameter to receive the terminal 46 without interference.

As seen in FIGURE 3 of the drawings, the component 10 of the present invention is received within a split insulating block 62 having two sections 63 and 64 for ease of assembly. Insulating section 63 is received over the tube shield element 12b adjacent the joint 13 and defines a radially inwardly extending flange 66 which rests upon the outer periphery of the shield element 12b. Section 63 is axially positioned on the element 12b by the shoulder 12b' thereof, said flange 66 being in abutting relation thereto. The insulating block section 64 is placed against section 63 during assembly and may be affixed thereto with clamps, bolts, screws, or other equally suitable fastening means. Section 64 is provided with a recess 68 of larger diameter than the diameter of flange 20 of the sleeve 14. Thus, the flange 20 of sleeve 14 is axially slidably disposed in the recess 68. It can readily be seen in FIGURE 3 that the sleeve 14 is axially movable against the spring 16 the full length of the recess 68 and until the flange 20 moves against the insulating section 63 of the assembly.

A side elevation, partially in section, of the mating component of the assembly is shown in FIGURE 4 of the drawings. As shown the component, generally 70, includes a shield member 72. The shield member 72 is defined by a first tube-like section 74 and a section tube-like section 76 in abutting mating relation defining a joint 77 therebetween. A collar 78 is disposed on the inner tube wall in overlapping relation across the joint 77 between sections 74 and 76 and defines an electrical path across said joint. The shield member 72 of component 70 may be identical in form to the shield of component 10 if desired. A modified shield member is illustrated in FIGURE 4 of the drawings, however with a shorter barrel length from the end 79 of the tube (which corresponds to end 19 of the shield 12) to the shoulder 75 (which corresponds to the shoulder 12b' of tube 12). There is no requirement for provision of a spring member or an axially slidable shield on the component 70 of the connector. Shield section 76 of the component 70 is provided with a plurality of finger elements, such as illustrated at 80. These finger elements 80 are formed by cutting slots into the shield element from the end 79. The slots are of a predetermined width to permit the desired flexure of the finger elements 80 when the shield member 70 is inserted over the mating shield element 12 of the component 10.

A sleeve 82 of a suitable insulating material is disposed within the central opening 84 of the shield section 76 and is axially positioned therein by abutment of the inner terminal thereof with the shoulder 86 of the central bore of said shield section 76 said depressions 88 extending into the insulating material to define means for rigidly affixing the insulating material 82 within the central bore 84 of the shield section 76. A protective collar 90 is received over the depressions 88.

A central bore 92 is defined in the insulating sleeve 82 within which is received an electrical connector element 94. The electrical connector element 94 is axially affixed within the central bore 92 by flanges 95 and 96 extending along either side of a radially inwardly extending flange 98 on the insulating block 82. One end 100 of the connector element 94 defines electrical lead connecting means. The end 100 is adapted to be crimped upon an

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electrical lead (not shown) to affix said lead to the electrical connector element. Other fastening means well known in the art may be employed to affix an electrical lead to the terminal 100. The other end 102 of the connector defines a plurality of finger elements 104 being separated by a slot 105 extending from the outer extremity thereof inwardly of the connector to permit flexure of the fingers 104 to accommodate the terminal 46 over which they are received when the mating components 10 and 70 are in mating electrically interengaging relation. The diameter of the central bore 92 is sufficient to permit outward radial flexure of the fingers 104 to permit said fingers to adapt to the prong of the mating component of said electrical connector assembly.

The component 70 is received within a suitable insulating base, as indicated at 106 in FIGURE 4. The base 106 defines a component receiving opening 108 extending in from face 109 thereof. A second bore 110 of smaller diameter than bore 108 extends from the inner terminal 112 of bore 108 to the opposite face 114 of the base 106. A shoulder 116 is defined between the bore 108 and bore 110 of the insulating base. The shoulder 75 of shield element 76 abuts about the face 114 of the insulating base 106. The collar 90, when assembled on the connector assembly, abuts the shoulder 116 of the base 106.

The connector components of the present invention are shown in electrically interengaging relation in FIGURE 5 of the drawings. The components 10 and 70 are interengaged by a sliding or jack-type connection. Component 70 (mounted in an insulating base) is moved into engaging relation with component 10 by sliding the fingers 104 over terminal 46 and the fingers 80 over end 19 of shield element 12b. It should be noted that the fingers 80 or 104 may become spread, bent or otherwise deviate from the preferred orientation for said fingers. In conventional connectors there is no way to assure contact between the fingers of the one component and the mating elements of the other component and to this extent when the fingers become bent or distorted the effectiveness of the electrical connector is impaired. If the connector is employed in an assembly that requires high reliability such deficiencies must be obviated. The assembly of the present invention is directed to provision of a connector construction that will assure positive, controlled, electrical contact between the mating components of the assembly even though the static finger positions may depart from the preferred orientation for same.

As the fingers 104 move onto the terminal 46 the front tapered face 101 of said fingers engages the inclined face 53 of the sleeve 52. The sleeve 52 is resiliently biased to extended position along the terminal 46 by the spring member 50. As the fingers 104 are forced upon the terminal 46 of the component 10 the mating inclined faces 53 and 101 will act to force the fingers 104 radially inwardly and into positive electrical contact with the outer periphery of the terminal 46. It is readily apparent that this radially inward deflection of the fingers 104 will occur whether the fingers 104 are bent away from their preferred positions or not since once they engage the inclined face 53 of the sleeve 52 they will begin to slide down that face toward the terminal 46 to frictionally engage the terminal with a predetermined force dependent, in part, upon the spring rate of spring 50. The elastic counteraction of the spring 50 against the sleeve 52 must be below the level of frictional engagement of the fingers 104 with the terminal 46. Otherwise the spring will tend to move from its compressed toward its static position and in so doing will move the fingers at least partially off the terminal 46. It should be observed that this spring rate of spring 50 must be below the frictional engagement force when the spring is substantially fully compressed. A further advantage occurs with the above noted arrangement in that if there is a tendency for the fingers 104 to stick upon the terminal 46 during interengagement the spring force will reduce the total force required for

removal since the spring, in effect, is pushing the fingers 104 off of the terminal 46 at the same time that a pulling force occurs upon the fingers 104 through the component 70. Thus, release of the fingers 104 from frictional engagement with the terminal 46 is made easier due to the characteristic action of the spring 50 in the assembly.

The fingers 80 of the shield connector engage the sleeve 14 at substantially the same position of partial assembly as engagement of fingers 104 with sleeve 52 occurs. The fingers 80 of the shield element 76 are radially flexible to accommodate engagement with the outer periphery of the shield element 12b of the mating component 10. The end 19 of the shield element 12b is inclined to provide means for moving the fingers 80 to the outer periphery of the element 12b if said fingers are flexed inwardly to define a smaller diameter than the outer diameter of said element 12b. The inclined face 103 of the fingers 80 engages the inclined face 22 of the sleeve 14 upon movement of the components 10 and 70 into engaging relation. The sleeve 14 is resiliently biased toward extended position on the element 12b by spring 16. As the fingers 80 are moved onto the element 12b to move the sleeve 14 away from the end 19 of element 12b the spring 16 is compressed. The characteristic spring rate of the spring 16 preferably is sufficient to force the fingers 80 radially inwardly into positive engagement with the element 12b before full compression of the spring occurs. It also should be observed that the compressed spring rate must be below the level of the frictional force holding the fingers 80 in engagement with the element 12b thereby to assure that the spring will not move the fingers 80 away from full engagement with the element 12b. In one embodiment of the present invention a spring of 26 gauge wire (.0181 inch wire diameter), AISI 302 stainless steel, with 4 coils and an effective free or static length of $1\frac{3}{4}$ inch and an outside diameter of .220 inch required 8 ounces for deflection to $\frac{7}{16}$ inch at which position the fingers 80 were fully engaged with the element 12b.

In summary, therefore, it should be noted that the present invention includes an electrical connector having the desirable characteristic of a sliding-type connection provides electrical connection by sliding interengagement not only of the current carrying element of the connector but also of the shield element of the cable. Thus a connector of this assembly is effectively shielded entirely through the connector and the need for a screw on or clamp on shield connection is eliminated while still providing a highly reliable connection.

While a specific embodiment of the present invention is shown and described it will, of course, be understood that other modifications and alternative constructions may be used without departing from the true spirit and scope of the invention. It is intended by the appended claim to cover all such modifications and alternative constructions as fall within their true spirit and scope.

What we claim as new and desire to secure by Letters Patent of the United States is:

An improved shielded electrical connector defined by mating connector components which provide an assured continuous electrical path between the components, said connector comprising:

a shield associated with each of said mating connector components, the shield of one of said components having a collar thereon and terminating in a conical face, a portion of the shield of the other of said components having a plurality of flexible finger elements each terminating in a truncated conical face, the truncated conical face of said finger elements defining an obtuse angle with respect to the longitudinal axis of said shield;

a spring member mounted on said one component, one end of said spring engaging the collar extending from said one component end;

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a radially rigid sleeve element telescopically mounted on the shield of said one component, one end of said sleeve engaging the other end of said spring element, the other end of said sleeve having a truncated conical face, the truncated conical face of said sleeve defining an acute angle with the longitudinal axis of said shield, the conical face of said sleeve deflecting the flexible finger elements of the other shield into positive electrical contact with said one shield, said spring element biasing the sleeve into positive engagement with the fingers to maintain a radially inward force component on the fingers to maintain positive electrical contact between the connector components.

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