

Aug. 9, 1966

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3,266,009

MULTI-CONTACT ELECTRICAL CONNECTOR

Filed Dec. 8, 1961

3 Sheets-Sheet 1

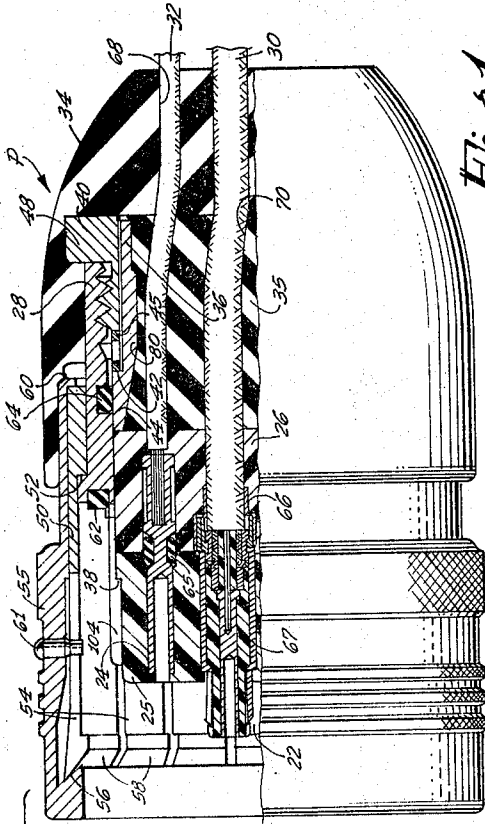


Fig. 1

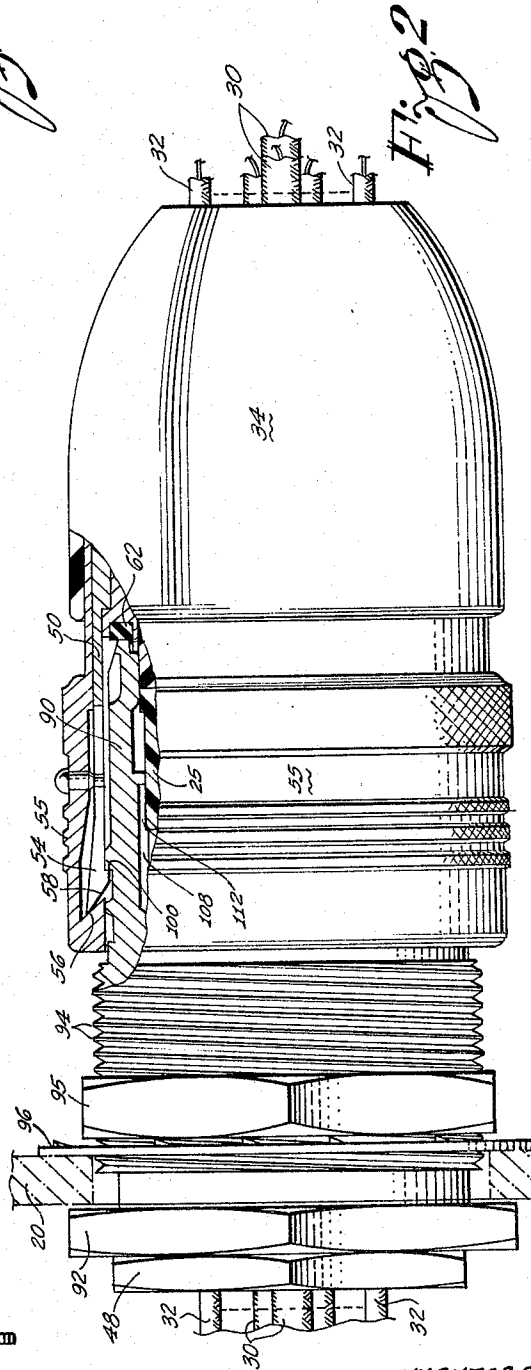
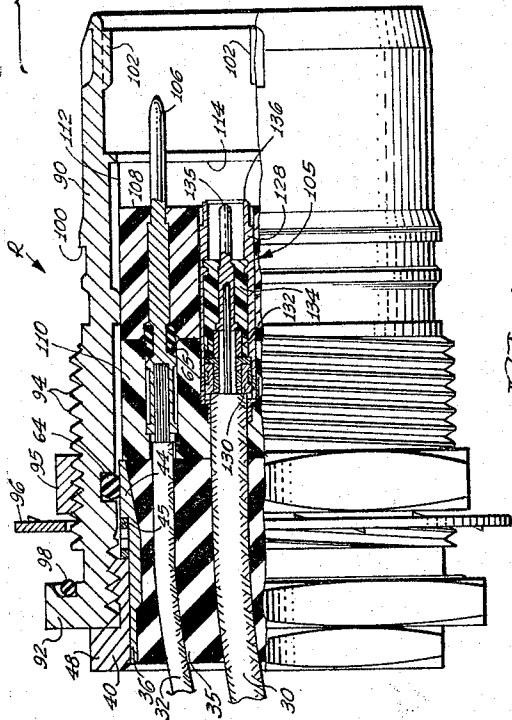


Fig. 2



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Fig. 3

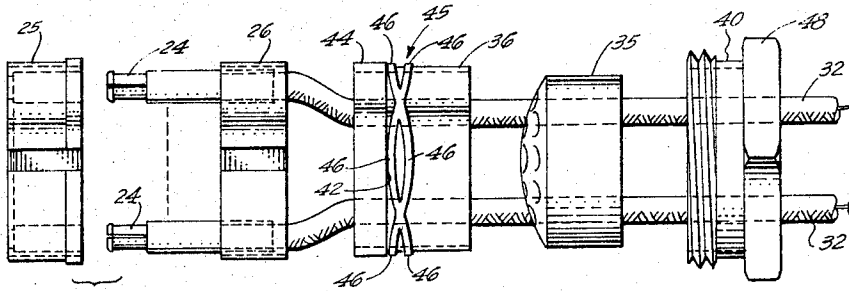


Fig. 4

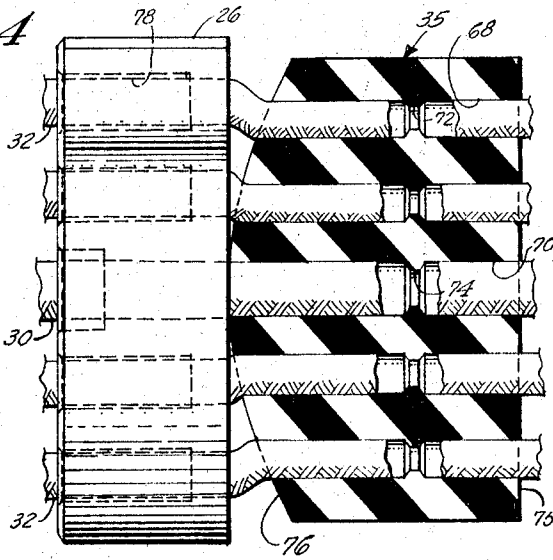


Fig. 5

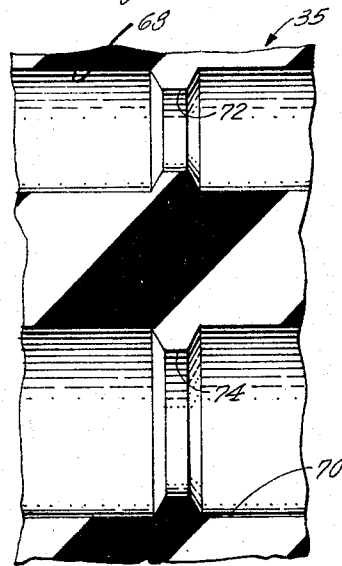
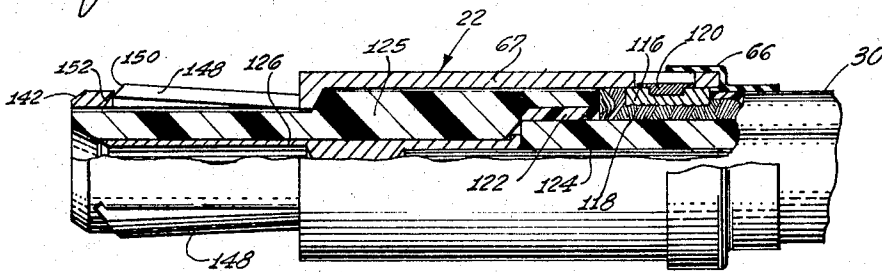


Fig. 6



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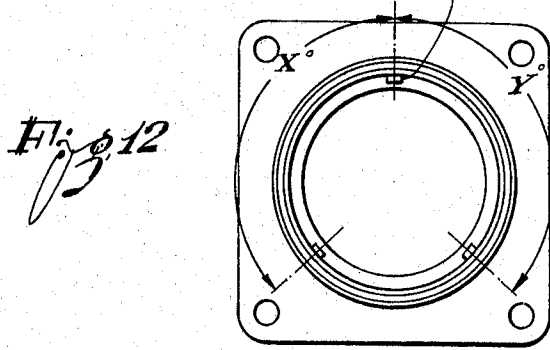
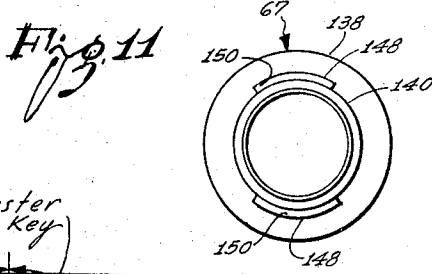
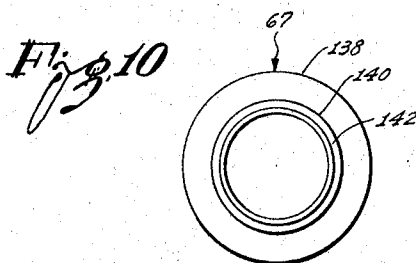
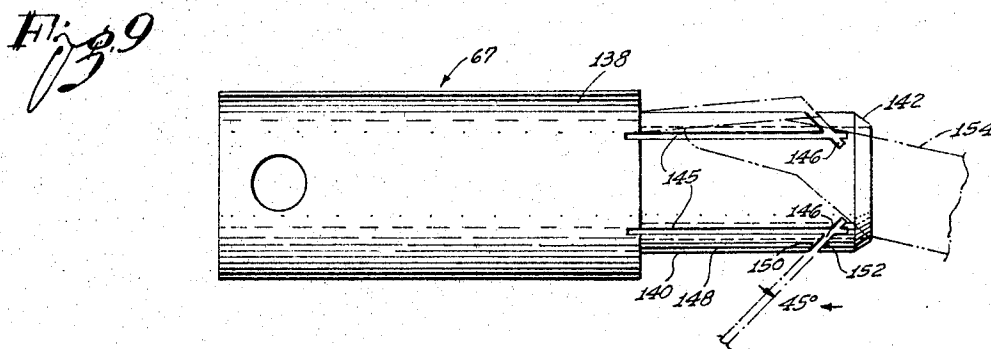
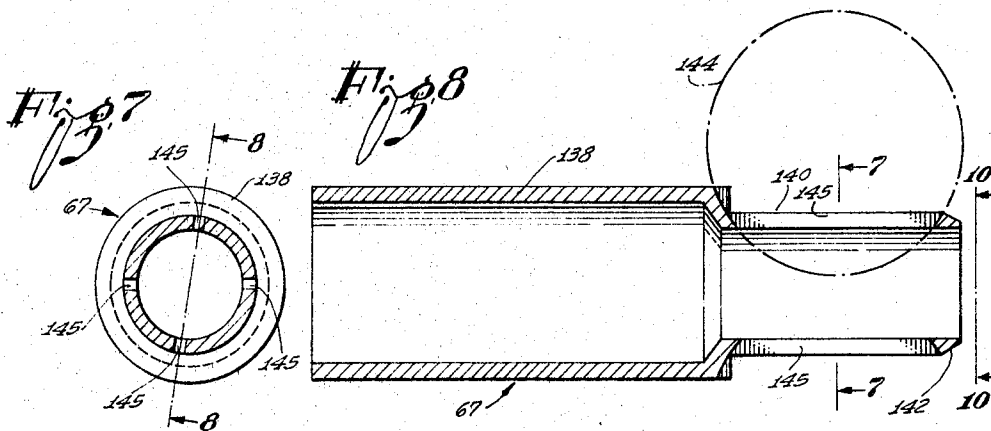
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MULTI-CONTACT ELECTRICAL CONNECTOR

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3 Sheets-Sheet 3



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3,266,009

MULTI-CONTACT ELECTRICAL CONNECTOR

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15 Claims. (Cl. 339-89)

This invention relates to a multi-contact electrical connector of the general type wherein a multi-contact plug assembly is engageable with a complementary multi-contact receptacle assembly with provision for releasably locking the two assemblies together. The invention is directed to certain problems that are encountered in the fabrication, installation and service life of such a connector.

Typically, a plug connector or a complementary receptacle assembly of such a connector includes a metal housing shell with a forwardly located rearwardly facing inner circumferential shoulder, a plurality of contact elements connected to a corresponding plurality of insulation-covered wires, insulating means comprising at least one body of dielectric material enclosing the contact elements and abutting the internal shoulder of the housing shell, a retaining nut or the equivalent engaging the housing shell and abutting the insulation means to hold the insulation means in assembled position against the internal shoulder of the housing shell.

One of the problem is to construct such a connector assembly in such manner as to resist the loosening effect of vibration on the retaining nut or equivalent that retains the insulation means inside the housing shell. It has been found that using a flanged retaining nut that screws into the housing shell and screwing the nut tight to force the flange of the nut against the housing shell results in a binding action between the retaining nut and the housing shell that effectively resists the loosening effect of vibration.

A difficulty arises in carrying out this concept, however, in that the length of the insulating means that is retained by the retaining nut may not be precisely of the dimension in length to permit the flange of the retaining nut to be tightened against the housing shell. If the insulating means is too long the retaining nut cannot be tightened against the end of the housing shell, and, on the other hand, if the insulating means is too short, tightening of the retaining nut leaves the insulating means loose in the assembly. The invention solves this problem by interposing annular spring means between the retaining nut and the insulation means. Since the annular spring means may be compressed axially to various degrees it permits the retaining nut to be tightened to the maximum with a wide range of tolerance with respect to the length dimension of the associated insulating means. In addition spring-loading of the insulating means is achieved to make the insulating means immune to the effects of vibration.

Another problem is to provide insulation means that will hold the plurality of contact elements in correct position and alignment for mating with the corresponding plurality of contact elements of the complementary connector assembly. Contact pin elements are commonly damaged because they are not correctly positioned and aligned with respect to the cooperating socket contacts when the two connector assemblies are brought together.

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The invention meets this problem by providing insulation means in the form of at least one body of hard rigid plastic material. In the initial embodiment of the invention a pair of plastic bodies may be of diallyl phthalate is used with the plastic material reinforced by imbedded glass fibres. Such insulating bodies are not only hard and rigid but are also capable of withstanding relatively elevated temperatures.

A feature of the present practice of the invention is the concept of forming the leading end of the hard insulating means of one of the two connector assemblies with a cylindrical skirt to telescope over the leading end of the insulating means of the other connector assembly to provide a devious leakage path when the two assemblies are telescoped together. The devious leakage path results in high resistance to arcing on the part of a multi-contact electrical connector of relatively small cross sectional dimension.

Still another problem is to provide a multi-contact electrical connector of effectively sealed construction. Effective seals are required at the juncture of the two cooperating housing shells of the two connector assemblies and between each housing shell and the corresponding insulating means. In addition, effective seals are required along the periphery of the plurality of insulation-covered wires that are connected to the plurality of contact elements in each of the two connector assemblies. Any solution to this sealing problem must take into account the fact that the insulating means is made of hard, rigid plastic.

The invention meets the sealing problem by a number of provisions as will be explained. One unique provision is a sealing and insulating means in the form of a relatively soft elastomer body or grommet with longitudinal passages therethrough for the individual insulation-covered wires. The relatively soft grommet is used with a surrounding follower sleeve that radially constricts the grommet against the enclosed insulation-covered wires. In addition the grommet is pressed against the hard plastic insulating means of the connector assembly in a highly effective sealing manner.

Since the follower sleeve that encloses the relatively soft grommet must abut the hard plastic insulating means to hold the insulating means against the internal shoulder of the housing shell of the connector assembly, the diameter of the relatively soft grommet must be smaller than the diameter of the insulating means. In addition, the longitudinal passages in the grommet for the individual insulated-covered wires must be confined to a smaller diameter than the longitudinal passages in the hard insulation means, the smaller diameter being necessary to provide adequate thickness of the material of the grommet for protecting the outermost wires.

The difficulties involved in assembling such a grommet are avoided by rounding the leading end of the grommet that abuts the hard plastic insulation means and further by constricting the grommet sufficiently by the surrounding follower to cause forward displacement of the material of the grommet to distort the rounded end of the grommet into conformity with the confronting end of the hard insulating means. The rounding of the leading end of the grommet eliminates any tendency for the follower sleeve to shear the grommet and the rounding of the leading end of the grommet to convex configuration also permits the insulation-covered wires to be offset radially outward from

the longitudinal passages of the grommet to the longitudinal passages of the hard insulation means before the follower sleeve is advanced to constrict the grommet.

A feature of the present practice of the invention is that the longitudinal passages of the relatively soft grommet that receive the insulation-covered wires are formed with inner circumferential ribs or restricting throat portions which are located in the radial region of maximum constriction of the grommet by the follower sleeve. The result is the creation of high magnitude localized pressure between the grommet and the individual insulation-covered wires for highly effective sealing action. In addition, suitable annular sealing means may be provided to embrace each contact element of each connector assembly. Other annular sealing means may be provided to embrace the follower sleeve for cooperation with the surrounding housing shell of the connector assembly and an additional annular sealing means may be compressed between confronting surfaces of the housing shells of the two connector assemblies.

A further problem met by the invention is to provide a simple polarizing or keying system to insure that a plug assembly will be plugged only into the correct complementary socket assembly. For this purpose the invention provides three longitudinal grooves or keyways on the outer circumference of the housing shell of the receptacle and provides three corresponding keys on the inner circumference of a cooperating coupling ring of the plug assembly. By using keyways of unequal circumferential spacing, it is a simple matter to provide 14 different permutations.

Finally, a problem met by the invention is in the construction of a housing of a coaxial plug contact for frictional engagement with a cooperating housing of a coaxial receptacle contact. To provide the frictional engagement, it is common practice to equip a coaxial plug housing with at least one outwardly flexed tongue which is resiliently deflected by entry of the coaxial plug housing into the coaxial receptacle housing. The difficulty is that too often the outwardly flexed tongue catches on the rim of the cooperative coaxial receptacle housing and is thereby bent outward to interfere with the telescoping engagement of the two housings. This difficulty is solved by using what may be termed a "captive" tongue, i.e., by providing the plug housing with a stop to limit the outward flexure of the tongue. An important feature of the invention in this regard is the simple method of fabricating such a coaxial plug housing. As will be explained, the method is characterized by the use of a rotary cutter to cut slots in a cylindrical housing member to form the required tongue, the slots being so directed as to provide the required stop for limiting the outward flexure of the tongues.

The various features and advantages of the invention will be understood from the following detailed description and the accompanying drawings.

In the drawings, which are to be regarded as merely illustrative:

FIG. 1 is an enlarged view partly in side elevation and partly in longitudinal section showing the two cooperating connector assemblies of a multi-contact electrical connector embodying the teachings of the invention;

FIG. 2 is a similar view showing the two connector assemblies engaged with each other;

FIG. 3 is a simplified enlarged side elevational view illustrating the procedure of assembling the parts of a connector assembly;

FIG. 4 is a greatly enlarged view partly in side elevation and partly in section showing the configuration of a relatively soft elastomer grommet before the grommet is constricted and deformed by an associated follower sleeve, the grommet being shown in abutment with an associated hard plastic insulating body;

FIG. 5 is a greatly enlarged fragmentary sectional view of a portion of the grommet showing how the

passages through the grommet for the insulation-covered wires are formed with inner circumferential ribs or restricting throats for sealing action on the insulation of the wires;

FIG. 6 is an enlarged view partly in side elevation and partly in longitudinal section showing the construction of a coaxial plug contact that is incorporated in the multi-contact electrical connector;

FIG. 7 is a transverse section of a coaxial plug housing at an intermediate stage in the fabrication of the housing, the section being taken along the line 7-7 of FIG. 8;

FIG. 8 is a longitudinal section of the incomplete coaxial plug housing taken along the line 8-8 of FIG. 7;

FIG. 9 is a side elevation of the incomplete coaxial plug housing illustrating the manner in which a tool may be inserted into the end of the housing to bend a tongue of the housing outward;

FIG. 10 is a front elevation of the incomplete coaxial plug housing as seen along the line 10-10 of FIG. 8;

FIG. 11 is a similar end elevation of the completed coaxial plug housing with the two tongues permanently bent outward; and

FIG. 12 is a front elevation of the housing shell of the receptacle assembly of the multi-contact electrical connector showing the positions of longitudinal polarizing slots on the outer circumference of the housing shell.

In the presently preferred embodiment of the invention shown in FIGS. 1 and 2, the multi-contact electrical connector comprises a plug assembly, generally indicated by the letter P and a receptacle assembly, generally designated by the letter R. The plug assembly P is illustrated as mounted on the end of a bundle of wires and the receptacle assembly R is illustrated as adapted to be fixedly mounted on a bulkhead.

The plug assembly P includes a plurality of contact elements which, in this instance, comprises a plurality of coaxial plug contacts, generally designated 22, arranged on an inner circle and a plurality of power socket contacts 24 arranged on an outer circle. All of the contacts 22 and 24 are encased by insulating means comprising a front insert or insulation body 25 and a rear insert or insulation body 26. In this example both of these inserts are rigid bodies, being made of diallyl phthalate with embedded glass fibers.

The insulation means comprising the two inserts 25 and 26 is confined by a cylindrical housing shell 28 and suitable means is provided to close the rear end of the housing shell in sealing contact with the coaxial cables 30 that carry the coaxial plug contacts 22 and the insulation-covered wires 32 that carry the power socket contacts 24. In the construction shown, the sealing means comprises an outer protective cap 34 and a relatively soft inner grommet 35 both of which have suitable longitudinal passages as shown to receive the coaxial cables 30 and the insulation covered wires 32. Both the protective cap 34 and the grommet 35 may be made of suitable elastomers, the material of the grommet having a relatively low Shore hardness.

The grommet 35 is constricted by a surrounding follower sleeve 36 that abuts the insulation means, i.e., the rear insert 26, the follower sleeve forcing and tightening the insulation means longitudinally against a rearwardly facing inner circumferential shoulder 38 of the housing shell 28. The follower sleeve 36 is retained by retaining means in the form of a retaining nut 40 acting against a rearwardly facing outer circumferential shoulder 42 of the follower-sleeve, the shoulder being formed by a peripheral portion of the follower sleeve that telescopes snugly into the housing shell 28. The retaining nut 40 acts on the outer shoulder 42 through the medium of a suitable annular spring 45 that surrounds the follower sleeve. While a coil spring may be used, preferably the annular spring 45 is a circular band of thin spring metal of the configuration shown in FIG. 3, the band being

formed with oppositely bowed pairs of spring segments 46. As shown in FIG. 1 the retaining nut 40 has external screw threads in engagement with internal screw threads of the housing shell 28 and has a heavy radial flange 48 of hexagonal configuration that is tightened firmly against the rear end of the housing shell 28.

The housing shell 28 is embraced by a cylindrical locking spring 50 in abutment against a circumferential shoulder 52 of the housing shell, the locking spring being longitudinally slotted to form a circumferential series of forwardly extending hook-shaped locking fingers 54. The locking spring 50 is, in turn, slidably embraced by a coupling ring 55 which is formed on its leading end with an inner circumferential cam 56 for cooperation with overhanging cam surfaces 58 of the respective locking fingers. The locking fingers 54 are biased radially inwardly for locking engagement with the receptacle assembly R and normally the cam surfaces 58 of the locking fingers press against the surrounding cam 56 of the coupling ring to hold the coupling ring at a normal forward position at which an inward flange 60 of the coupling ring abuts the rear end of the locking spring. The coupling ring 55 may be shifted longitudinally rearward from its normal position by manual force to cause the cam 56 acting on the cam surfaces 58 to lift the locking fingers to release positions. A key which may be in the form of a headed pin 61 extends radially inward from the coupling ring 55 between two of the locking fingers 54 to prevent relative rotation of the coupling ring.

The electrical connector incorporates suitable provisions to make it fluid tight. For this purpose the housing shell 28 is formed with a forwardly facing groove to seat an elastomeric ring 62 that is compressed between the plug assembly P and the receptacle assembly R. The housing shell 28 is further provided with another circumferential groove to seat an elastomeric O-ring 64 that embraces the peripheral portion 44 of the follower sleeve 36 for sealing cooperation with the follower sleeve and the housing shell. Another provision is a suitably shaped sealing ring 65 that embraces a reduced portion of each of the power socket contacts 24 at the juncture between the two insulating bodies or inserts 25 and 26. As best shown in FIG. 6, still another provision is an elastomeric sealing sleeve 66 of stepped configuration that embraces the juncture of each coaxial cable 30 with the corresponding coaxial plug contact 32, one portion of the sleeve embracing the coaxial cable and an adjacent portion embracing the rear end of the ferrule 67 of the coaxial plug contact. Still another sealing provision is found in the construction and method of installation of the soft elastomeric grommet 35.

When the grommet 35 is unrestrained, i.e., before it is constricted by the surrounding follower sleeve 36, it is of the general configuration shown in FIG. 4 and is dimensioned relative to the rear insert 26 in the manner indicated by the same figure. The grommet 35 has a longitudinal passage 68 therethrough for each of the insulation-covered wires 32 and has a longitudinal passage 70 of larger diameter for each of the coaxial cables 30. At the unrestrained configuration of the grommet 35, as best shown in FIG. 5, each of the longitudinal passages 68 is formed with an inner circumferential rib 72 and each of the longitudinal passages 70 is formed with a similar inner circumferential rib 74, the ribs forming restrictions or throats in the passages. At the unrestrained configuration of the grommet 35, the grommet has a flat rear face 75 and a rounded or convex front face 76 and, as indicated in FIG. 4, the diameter of the unrestrained grommet is appreciably less than the diameter of the associated rear insert 26.

Since the grommet 35 is constricted to a substantial extent by the follower sleeve 36 and a substantial thickness of the grommet material must intervene between

the outermost insulation-covered wires 32 and the follower sleeve, the longitudinal passages 68 through the follower that accommodate the insulation covered wires 32 are confined to a smaller diameter than the corresponding longitudinal passages 78 (FIG. 4) to the rear insert 26. Thus each of the longitudinal passages 68 of the grommet is offset slightly radially inwardly relative to the corresponding longitudinal passage of the rear insert 26. If the leading end of the grommet at its unrestrained configuration were flat to conform to the flat rear face of the rear insert 26 the necessary offset of the insulation covered wires 32 and the coaxial cable 30 would cause difficulties in the assembly procedure. These difficulties are avoided by making the front end of the grommet 35 convex or rounded as shown in FIG. 4.

When the follower sleeve 36 is advanced over the grommet 35, the restricting action of the follower sleeve has a number of effects. It can be seen in FIG. 1 that the interior of the follower sleeve 36 is progressively reduced in diameter from the leading end of the follower sleeve to a region indicated at 80 of minimum inside diameter. This region 80 of maximum constriction of the grommet 35 by the follower sleeve 36 is in the radial region of the restrictions 72 and 74 in the longitudinal passages 68 and 70 of the grommet sleeve. Thus the region of maximum diametrical compression of the grommet sleeve being at the inner circumferential passage ribs 72 and 74 causes highly effective compression of the inner circumferential ribs for sealing engagement with the insulation covered wires 32 and the coaxial cables 30.

Another effect of the constriction of the grommet 35 by the follower sleeve 36 is that the material of the grommet is displaced to distort the convex front face of the grommet into a planar configuration in intimate contact with the rear face of the rear insert 26. The axial dimension of the grommet 35 at its unrestrained configuration is appreciably less than the axial dimension of the follower sleeve 36 and still another effect of the constriction of the grommet by the follower sleeve is the displacement of the grommet material for elongation of the grommet to substantially the same axial dimension as the follower sleeve, as may be seen in FIG. 1.

The construction of the receptacle assembly R is similar to the construction of the plug assembly P. The receptacle assembly has a housing shell 90 with a radial flange 92 to engage one side of the bulkhead 20 and has an external screw thread 94 to receive a lock nut 95 to cooperate with a lock washer 96 for engaging the other side of the bulkhead. The radial flange 92 may be grooved to seat an O-ring 98 for sealing engagement with the bulkhead. The housing shell 90 of the receptacle assembly telescopes over the leading end of the housing shell 28 of the plug assembly and makes pressure abutment against the sealing ring 62 when the locking fingers 54 of the plug assembly make locking engagement with a rearwardly facing peripheral locking shoulder 100 of the housing shell 90 of the receptacle assembly as shown in FIG. 2.

The housing shell 90 of the receptacle assembly R has a set of three inner projections or polarizing keys 102 to enter a corresponding set of grooves 104 on the outer circumference of the housing shell 28 of the plug assembly P. As heretofore stated, the polarizing keys 102 and the corresponding grooves 104 are at unequal circumferential spacing, the intent being to keep a plug assembly P from being plugged into the wrong receptacle assembly R. It is to be noted that since the polarizing keys 102 are immediately adjacent the leading end of the housing shell 90 of the receptacle assembly R, a plug assembly P cannot even begin to telescope into the wrong receptacle assembly. Thus the described polarizing arrangement makes it impossible for mismatched connector assemblies to get close enough together for any arcing between the contact elements of the respective assemblies.

In FIG. 12 the circumferential spacing of one of the polarizing keys 102 from what may be termed a master polarizing key 102 is the angle X and the circumferential distance from the master polarizing key to the third polarizing key is the angle Y. Fifteen different permutations of the pair of spacings X and Y may be as follows:

X	Y
130	110
130	90
130	150
130	170
190	110
150	110
90	110
70	110
70	230
90	230
210	110
30	110
250	30
130	30
30	230

The receptacle assembly R has an inner circle of coaxial receptacle contacts 105 corresponding to the coaxial plug contacts 22 of the plug assembly and has an outer circle of power pin contacts 106 corresponding to the power socket contacts 24 of the plug assembly. The contacts 105 and 106 are encased by insulation means comprising a front insert or insulation body 108 and a rear insert or insulation body 110.

It will be noted that the front insert 108 has a forwardly extending peripheral skirt 112 which telescopes over the front insert 25 of the plug assembly P when the two assemblies are interconnected as shown in FIG. 2. Thus the provision of the peripheral skirt 112 provides a relatively long and devious leakage path to prevent arcing between the power contact elements and the metal housing shells of the assembled connector.

In the same manner as in the plug assembly P, the receptacle assembly R includes a retaining nut 40 with a radial flange 48 that is tightened firmly against the rear end of the housing shell 90. The retaining nut 40 acting through the usual annular spring 45 and a peripheral portion 44 of a follower sleeve 36 holds the insulation means comprising the front insert 108 and the rear insert 110 firmly against a rearwardly facing inner circumferential shoulder 114 of the housing shell 90, the skirt 112 of the front insert abutting the inner circumferential shoulder.

For sealing action the follower 36 constricts a soft elastomeric grommet 35 in the manner heretofore described. In addition, the receptacle assembly R includes a previously described O-ring 64 embracing a peripheral portion 44 of the follower sleeve 36. Reduced portions of the various power pin contacts 106 are embraced by sealing rings 65 and the power pin contacts 106 are provided with previously described sealing sleeves.

With reference to the resistance of the electrical connector to vibration it is to be noted that in each of the two connector assemblies the flange 48 of the retaining nut 40 is tightened firmly against the end of the corresponding housing shell and, in addition, the axial compression of the annular spring 45 not only preloads the retaining nut but also preloads the two inserts or insulating bodies that encase the various contact elements of the assembly. The annular spring 45 serves the further purpose of compensating for variations in longitudinal dimensioning of the insulating means and the surrounding housing shell, such compensation insuring that the flange 48 of the retaining nut may be tightened firmly against the housing shell.

As thus shown in FIG. 6, the coaxial plug contact 22 includes a jerk ring 116 that is crimped into engagement with the braided wire sheath 118 of the coaxial cable 30. The previously mentioned ferrule 67 surrounds the jerk ring and united therewith by solder 120. A backup ring

122 embraces the insulation 124 of the coaxial cable 30 in abutment against the jerk ring 116 and a bushing 125 encloses the axial socket member 126 of the coaxial plug contact. The backup ring and the bushing may be made of a suitable non-conducting plastic such as "Teflon."

As may be seen in FIG. 1 the coaxial receptacle contact 105 is of similar construction in that it includes a ferrule 128, a jerk ring 130, a backup ring 132, a nonconducting bushing 134 and an axial pin member 135. It will be noted that the leading end of the ferrule 128 is internally chamfered or tapered as indicated at 136.

As heretofore stated, a feature of the invention is the manner in which the ferrules 67 of the coaxial plug contacts 22 are constructed for frictional cooperation with the corresponding ferrules 128 of the coaxial receptacle contacts 105. This construction may be understood from a description of the method of fabrication of a ferrule 67.

Referring to FIGS. 7 and 8, a ferrule 67 has a rear or base portion 138 of relatively large diameter to receive the corresponding coaxial cable 30 and has a forward cylindrical portion 140 of smaller diameter to telescope into the ferrule 128 of a complementary coaxial receptacle contact 105. To facilitate entry, the nose or leading end of the forward cylindrical portion 140 of the ferrule 67 is formed with an external chamfer or taper 142. The first step in the fabrication procedure is to employ a rotary mill cutter, indicated in phantom by the circle 144, to cut two pairs of parallel longitudinal slots 145 in the forward cylindrical portion 140 of the ferrule 67, the two pairs of slots being diametrically opposite from each other. The two pairs of slots 145 terminates short of the leading end of the ferrule 67 so that the leading end is a solid ring of metal that is dimensioned to telescope into the complementary ferrule 128.

The next step is to employ the milling cutter to cut a transverse slot on each side of the ferrule 67 to intercept each of the two pairs of slots 145 whereby each pair of longitudinal slots 145 together with the intercepting transverse slot 146 forms a forwardly directed ferrule tongue 148. It is to be noted that the two transverse slots 146 are in planes that converge forwardly on the axis of the ferrule, the plane, for example, being at 45 degrees relative to the axis. This inclination of each of the two transverse slots 146 accomplishes two purposes in that it not only forms each ferrule tongue 148 with a tapered end shoulder 150 but also forms the leading end of the ferrule with a rearwardly inclined stop shoulder 152. The stop shoulder 152 overhangs the tapered end shoulder 150 of the corresponding ferrule tongue 148 and serves to limit the extent to which the leading end of the ferrule tongue may be flexed outward. At this stage in the fabrication procedure the leading end of the ferrule 67 has the configuration shown in solid lines in FIGS. 9 and 10.

The final step in the fabrication procedure is to insert a tool in the form of a probe 154 into the leading end of the ferrule 67 to flex the leading ends of the two ferrule tongues 148 outward, the new position of a tongue being indicated by the broken lines. The leading end of the ferrule 67 now has the appearance indicated in FIG. 11, the leading end of each of the two ferrule tongues 148 extending radially outward beyond the circumference of the forward cylindrical portion 140 of the ferrule. The ferrule 67 is untempered or only partially tempered during this fabrication procedure and is fully tempered after the two ferrule tongues 148 are flexed outward.

When the ferrule 67 is inserted into the ferrule 128 the chamfer 142 of the ferrule 67 cooperates with the chamfer 136 of the ferrule 128 to facilitate entry and, it is important to note, the two stop shoulders 152 positively prevent the ferrule tongues 155 for hanging up on the leading end of the ferrule 128. The tapered end shoulders 150 of the ferrule tongues 148 encounter the chamfer 136 of the ferrule 128 and continued insertion of the ferrule 67 results in the tongue 155 being cammed

radially inward to create the desired pressure contact between the two ferrules.

Our description in specific detail of the selected embodiment of the invention will suggest various changes, substitutions and other departures from our disclosure within the spirit and scope of the appended claims.

We claim:

1. In a multi-contact connector assembly for mating with a similar complementary multi-contact connector device of a multi-contact electrical connector, a housing shell formed with a rearwardly facing internal shoulder, insulating means comprising at least one body telescoped into said housing shell in abutment against said internal shoulder, a plurality of contact elements enclosed by said insulating means, a corresponding plurality of insulation-covered wires connected to the contact elements respectively, and

an elastomeric body abutting the rear end of said insulation means, said elastomeric body having a plurality of longitudinal passages therethrough embracing said insulation-covered wires, respectively;

an internally tapered follower sleeve constricting said elastomeric body into sealing engagement with said insulation-covered wires;

said follower sleeve abutting said insulating means and having a rearwardly directed peripheral shoulder at a position rearwardly of the internal shoulder in the housing shell;

retaining means disposed on the follower sleeve at the rearward end of the follower sleeve and in engagement with the rear end portion of the housing shell; and

annular spring means disposed on said follower sleeve and interposed between said peripheral shoulder of the follower sleeve and said retaining means under compression by the retaining means to exert a force against the follower sleeve in a direction for pressing the elastomeric body against the contact elements and for maintaining the insulating means under longitudinal compression and for providing a tolerance with respect to the longitudinal dimension of the insulating means.

2. A combination as set forth in claim 1 in which: said retaining means is a nut in threaded engagement with said housing shell and the nut is tightened into abutment against the housing shell to resist loosening by vibration.

3. A combination as set forth in claim 1 in which: said passages in the elastomeric body are formed with restricting throat portions under radial stress by the constricting follower sleeve for sealing the insulation-covered wires in the passages.

4. In a multi-contact connector assembly for mating with a similar complementary multi-contact connector device of a multi-contact electrical connector, a housing shell formed with a rearwardly facing internal shoulder and with an internally facing groove rearwardly of the internal shoulder, insulating means comprising at least one body telescoped into said housing shell in abutment against said internal shoulder, a plurality of contact elements enclosed by said insulating means, a corresponding plurality of insulation-covered wires connected to the contact elements respectively,

an elastomeric body abutting the rear end of said insulation means, said elastomeric body having a plurality of longitudinal passages therethrough embracing said insulation-covered wires respectively;

an internally tapered follower sleeve constricting said elastomeric body into sealing engagement with said insulation-covered wires, said follower sleeve abutting said insulating means and having a rearwardly directed peripheral shoulder;

retaining means disposed on the follower sleeve at a rearward position on the follower sleeve and in en-

agement with the rear end portion of the housing shell;

annular spring means disposed on said follower sleeve and interposed between said peripheral shoulder of the follower sleeve and said retaining means under compression by the retaining means to exert a force on the follower sleeve in a direction for pressing the elastomeric body against the insulation-covered wires and for maintaining the insulating means under longitudinal compression and for providing tolerance with respect to the longitudinal dimension of the insulating means; and

resilient annular sealing means disposed on said follower sleeve forwardly of said peripheral shoulder and rearwardly of the internal shoulder in the housing shell and within the groove in the housing shell and responsive to the exertion of the compression by the retaining means for producing a sealing cooperation between the housing shell and the follower sleeve.

5. A combination as set forth in claim 4 which includes: a plurality of annular resilient sealing means embracing said plurality of contact elements respectively in sealing cooperation with the surrounding insulating means.

6. A combination as set forth in claim 4 which includes: resilient annular sealing means positioned for compression between the housing shell and said complementary connector device to seal the juncture between the housing shell and the device.

7. In a multi-contact connector assembly for mating with a similar complementary multi-contact connector device of a multi-contact electrical connector, a housing shell formed with a rearwardly facing shoulder, a plurality of contact elements contained within said housing shell, a corresponding plurality of insulation-covered wires connected to said contact elements respectively,

insulating means in the form of at least one body of plastic with a plurality of longitudinal passages therethrough within a given diameter, said passages housing said contact elements, respectively, said insulating means being telescoped into said housing shell against said internal shoulder thereof;

a relatively soft elastomeric body abutting the rear end of said insulating means with a plurality of longitudinal passages through the elastomeric body with a diameter less than said given diameter, said passages in said elastomeric body embracing said insulation-covered wires respectively;

a follower sleeve telescoped into said housing shell and embracing said elastomeric body, the interior of the follower sleeve being progressively restricted rearward from its forward end to a cross section less than the unrestrained cross section of the elastomeric body, thereby constricting the elastomeric body for radial sealing pressure of the elastomeric body against said insulation-covered wire; and yielding means embracing the follower sleeve and providing a force in a forward direction against the follower sleeve to press the sleeve against the elastomeric body and the elastomeric body against the contact elements.

8. A combination as set forth in claim 7 in which said insulating means is formed with a forwardly extending skirt to telescope over the forward end of the insulating means of the complementary connector device to form therewith a devious leakage path from the plurality of contact elements of the assembled connector to the outer housing shell structure of the assembled connector.

9. A combination as set forth in claim 7 in which said insulating means comprises a pair of abutting bodies of diallyl phthalate with embedded glass fibres.

10. In a multi-contact connector assembly for mating with a similar complementary multi-contact connector device of a multi-contact electrical connector, a housing shell formed with a rearwardly facing internal shoulder,

insulating means comprising at least one body telescoped into said housing shell in abutment against said internal shoulder, a plurality of contact elements enclosed by said insulating means, a corresponding plurality of insulation-covered wires connected to the contact elements respectively,

an elastomeric body disposed at least partially within the housing shell adjacent the rear end of said insulation means, said elastomeric body having a plurality of longitudinal passages through the body to receive the insulation-covered wires, the elastomeric body having a particular thickness and a particular length and being shaped to expand in length upon the imposition of a force to constrict the body in thickness;

a follower sleeve disposed on the elastomeric body and at least partially within the housing shell and provided with an external shoulder at a position rearwardly of the internal shoulder in the housing shell and further provided with dimensions relative to the particular thickness of the elastomeric body to constrict the elastomeric body and to expand the body longitudinally into sealing engagement with the insulation-covered wires;

retaining means in engagement with the housing shell to exert a longitudinal force against the shell for retaining the follower sleeve at least partially within the housing shell; and

means having longitudinally compressible properties and disposed on the follower sleeve between the retaining means and the shoulder on the follower sleeve and responsive to the longitudinal force exerted by the retaining means against the shell to exert a corresponding longitudinal force against the follower sleeve for pressing the sleeve against the elastomeric body and the elastomeric body against the insulation-covered wires to produce a sealing relationship between the elastomeric body and the wires.

11. The connector assembly set forth in claim 10 wherein the elastomeric body is provided with a convex configuration at the end adjacent to the rear end of the insulation means.

12. The connector assembly set forth in claim 11 wherein the follower sleeve is internally tapered.

13. In a multi-contact connector assembly for mating with a similar complementary multi-contact connector device of a multi-contact electrical connector, a housing shell formed with a rearwardly facing internal shoulder, insulating means comprising at least one body telescoped into said housing shell in abutment against said internal shoulder, a plurality of contact elements enclosed by said insulating means, and a corresponding plurality of insulation-covered wires connected to the contact elements respectively,

an elastomeric body disposed at least partially within the housing shell adjacent the rear end of said insulation means, the elastomeric body having a plurality of longitudinal passages through the body to receive the insulation-covered wires, the longitudinal passages in the elastomeric body being provided with internal ribs to grip the wires, the elastomeric body being shaped to expand longitudinally upon the imposition of a force to constrict the thickness of the body;

a follower sleeve disposed at least partially within the housing shell and on the elastomeric body and pro-

vided with an external shoulder rearwardly of the internal shoulder in the housing shell and further provided with a configuration to exert a constrictive force of progressive magnitude on the elastomeric body upon the insertion of the follower sleeve on the body and to exert the maximum constrictive force at a position corresponding to the disposition of the internal ribs in the elastomeric body for an expansion of the body into sealing engagement with the insulation-covered wires;

retaining means adjustably positioned relative to the shell to exert an adjustable longitudinal force against the shell for retaining the follower sleeve at least partially within the housing shell; and

means longitudinally adjustable in accordance with the adjustments of the retaining means and disposed on the follower sleeve between the retaining means and the shoulder on the follower sleeve and responsive to adjustments in the longitudinal force exerted by the retaining means for providing corresponding adjustments in the force exerted against the shell and for producing a sealing engagement between the follower sleeve and the elastomeric body.

14. The connector assembly set forth in claim 13 wherein the elastomeric body is provided with a convex configuration at the end adjacent to the rear end of the insulation means and wherein the follower sleeve is internally tapered at a position corresponding to the internal ribs in the elastomeric body.

15. The connector assembly set forth in claim 14 wherein the longitudinally adjustable means includes a band of spring metal with pairs of segments oppositely bowed in the longitudinal direction.

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