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ELECTRICAL CONNECTOR GROUNDING APPARATUS

Filed May 31, 1962

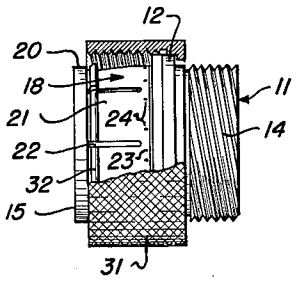

Fig. 1

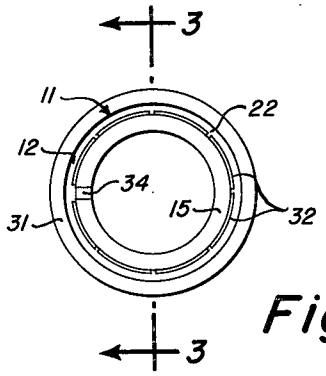

Fig. 2

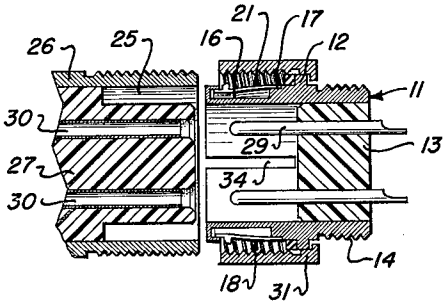

Fig. 3

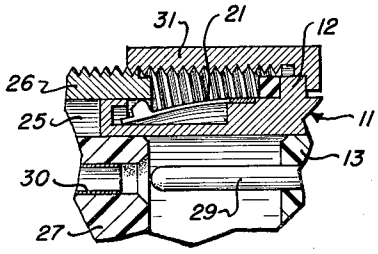

Fig. 4

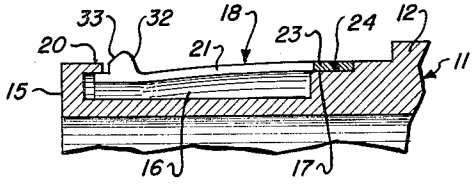

Fig. 5

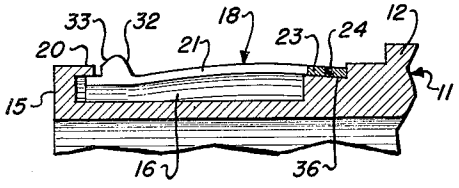

Fig. 6

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ELECTRICAL CONNECTOR GROUNDING APPARATUS

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The present invention relates generally to electrical conductors and connectors and more particularly to a device which is adapted to insure proper grounding through a connector body when mating electrical conductors.

Electrical connectors normally comprise a pair of mating portions joined with conductors and in many instances the mating portions comprise a plug and a receptacle with the latter being provided with an annular groove adapted to receive an annular barrel member on the plug portion. As the barrel enters the groove current conducting contacts within the barrel are adapted to engage and mate with a like number of contacts in the receptacle portion so as to establish electrical flow through the connector to a point of use. A key-way in one part and a key on the other part may be provided to correctly orient the contacts. The accepted manufacturing tolerances for the plug and receptacle portions are such that the space between the outer diameter of the barrel member and the inner diameter of the receptacle may vary a few thousandths of an inch to several thousandths of an inch from the desired diameter. Thus in many instances when the barrel member is first received in the annular groove there may be a very loose and relatively non-contacting relationship therebetween so as to provide little or no electrical grounding or shielding through the connector body. Under normal circumstances such a loose fit may not be detrimental or interfere with the normal operation of the connector or with the electrically operated components being coupled through the connector; however, in the presence of an electromagnetic field such as radio frequency energy such a loose fit may be highly undesirable since if the plug and receptacle are not properly contacted or "grounded" prior to engagement of the current carrying contacts the electromagnetic field may cause a discharge to occur through the contacts and damage electrical circuitry or effect the operation of electrical components prematurely or in an undesired manner.

It has been found that where electromagnetic field generating means are present, such as, for example, radar, which produces radio frequency energy, that high and low potentials between various components or systems frequently exist in the area of the field. Thus, if it is desired to electrically couple through a suitable connector a pair of components or systems which may be at different potentials, precautions must be taken to thoroughly "ground" such components or systems to the same potential prior to engagement of the contacts and thereby avoid the deleterious effects of the electromagnetic field causing a discharge through the contacts of the connector as described above. It is therefore a principal object of the present invention to provide an improved device in combination with electrical conductors or connectors which are capable of providing proper "grounding" between components or systems prior to engagement of electrical contacts.

Another object of the present inevntion is to provide a new and improved grounding device of relatively simple and inexpensive construction.

Another object of the present invention is to provide on one part of an electrical connector a plurality of improved finger-like spring segments with projections adjacent one end thereof and utilize such projections for contacting another part of the connector and provide the desired grounding.

A further object of the present invention is to provide an improved connector grounding device capable of contacting a receptacle portion about substantially the entire periphery thereof.

A still further object is to provide lip means for maintaining contacting spring segments in pre-stressed and correctly oriented positions.

Other and further objects of the invention will be obvious upon an understanding of the illustrative embodiment about to be described, or will be indicated in the appended claim, and various advantages not referred to herein will occur to one skilled in the art upon employment of the invention in practice.

A preferred embodiment of the invention has been chosen for purposes of illustration and description. The preferred embodiment illustrated is not intended to be exhaustive nor to limit the invention to the precise form disclosed. It is chosen and described in order to best explain the principles of the invention and their application in practical use to thereby enable others skilled in the art to best utilize the invention in various embodiments and modifications as are best adapted to the particular use contemplated.

In the accompanying drawing:

FIG. 1 is a side elevation view, partly cut away, showing a connector part embodying the present invention;

FIG. 2 is a front elevation view of the part shown in FIG. 1;

FIG. 3 is a longitudinal sectional view taken along line 3—3 of FIG. 2, together with a longitudinal sectional view showing a typical cooperating connector part;

FIG. 4 is an enlarged fragmentary view similar to a portion of FIG. 3 showing the contact between the grounding elements and the inner surface of a receptacle;

FIG. 5 is an enlarged fragmentary view showing a grounding spring segment in greater detail; and

FIG. 6 is an enlarged fragmentary view similar to FIG. 5 but showing a slightly different spring segment arrangement.

The present invention is illustrated in the drawings embodied, by way of example, in the plug portion of a mating plug and receptacle electrical connector. The plug portion as best shown in FIGS. 1–3 may comprise an annular shell or barrel member or part 11 having a shoulder 12 about its periphery intermediate the ends thereof and a contact carrying insulating insert 13 therein. The barrel part 11 may be provided with a threaded outer surface 14 adjacent one end thereof for facilitating the engagement of a cable attaching device or the like (not shown) while adjacent the other or distal end 15 of the plug barrel 11 there may be stepped recesses 16 and 17 (FIG. 5) provided in the outer surface of the barrel for retaining grounding elements 18 as will be described in detail below. The term annular as used herein with reference to the shapes of various connector components is not intended to be limited to ring-like configurations but is used in the sense of encompassing all space enclosing configurations such as round, square, rectangular, etc.

The stepped recesses 16 and 17 in the barrel 11 may be formed or machined in any suitable manner, such as, for example, by a lathe or the like, so that recess 16 which has the deeper or innermost surface extends from a point on the barrel adjacent to the shoulder 12 to a point immediately adjacent the forward or distal end 15 of the barrel 11. The recess 16, which may have a surface generally parallel to the surface of the barrel 11, may be undercut into the barrel 11 adjacent the for-

ward end 15 in such a manner that a recess-overlying portion or lip 20 is formed. The recess 17, which may have an inner surface somewhat shallower and generally parallel to the surface of recess 16 (FIG. 5), may be "cut" into the barrel intermediate the shoulder 12 and the recess 16 in such a manner that the surface of recess 17 communicates with the recess 16. Since the recesses 16 and 17 may extend through a substantial thickness of the barrel member 11 it may be desirable to make the barrel 11 from a relatively strong electrical conducting material such as stainless steel or the like to insure that the recesses do not overly weaken the barrel so as to impair its normal mating function.

The grounding elements 18, as best shown in FIGS. 1 and 5 may comprise a plurality of finger-like spring segments 21 which are adapted to be secured to the barrel against the surface of the recess 17 so as to bridge or extend in a cantilevered fashion substantially across the recess 16 so that the free ends thereof may abut against the underside of the lip 20. The spring-fingers or spring segments 21 may be conveniently formed from a single piece of thin, relatively rigid sheet material, having good electrical conducting properties, such as, for example, stainless steel or beryllium-copper. The sheet material may be machined or in any other suitable manner provided with a plurality of slots or grooves 22 which communicate with one end of the sheet and axially extend through a substantial portion of the width thereof so as to provide a plurality of similar spring segments 21 projecting from a common base 23.

To attach the grounding elements 18 to the barrel 11 so that the distal end of each segment 21 is pre-stressed in an outward direction, the sheet material may be first formed in an annular configuration generally corresponding to the shape of the barrel 11, then the distal or free end of each segment 21 may be placed within the recess 16 underneath the lip 20 and thereafter the common base 23 may be moved inwardly into the recess 17 and attached to the barrel 11 in any suitable current conducting manner such as by spot-welding or riveting, as generally indicated at 24. With the grounding elements 18 so attached to the barrel 11 the base 23 may be on substantially the same horizontal plane as the lip 20 while the distal ends of the segments 21 are disposed beneath the lip 20, thus causing the distal ends of the segments to continuously tend to "spring" outwardly in an effort to return to the horizontal plane common with the base 23.

Desired "pre-stressing" of the segments 21 may be easily determined by preselecting the thickness of the lip 20 and the depth of the recess 17. However, the depth of the recess 17 may be normally such that with the base 23 mounted therein the outer surface of the base 23 has substantially the same outer diameter as the lip 20, thus insuring that no objectionable obstruction which may interfere with the mating of the plug and receptacle connector portion, is present at the point where the base 23 is attached to the barrel.

To provide an electrical coupling through the connector, the barrel part 11 of the plug portion is adapted to be received in an annular groove 25 within a mating electrically conducting receptacle portion 26 which normally contains an insulating insert 27 having contact elements 30 therein which are adapted to mate with the contact elements 29 in the plug portion to complete the electrical coupling through the connector. As shown in FIGS. 3 and 4, the contact elements 29 in the plug portion and the contact elements 30 in the receptacle portion are in the form of pins and sockets respectively; however, it will appear clear that the contacts 29 or 30 may be in either mating portion. After the barrel 11 is received within the groove 25 and the pins 29 engage the sockets 30, the mating portions may be secured together by a barrel encircling sleeve 31 having an inwardly extending flange adapted to abut the shoulder 12 and which is adapted to mate with a threaded surface on the receptacle portion 26 for providing a secure connection betwen the connector portions.

To provide the desired contacting or grounding between the mating parts prior to engagement of the contact elements 29 and 30, each spring segment 21 may be provided with a radially extending projection 32 on the outer surface and adjacent to the distal or free end thereof. These projections 32 come into positive contact with the receptacle body somewhat before the mating of the contacts 29 and 30 to insure that the connector portions are properly contacted or grounded before the engagement of the contact elements 29 and 30. After contact is made between the projections 32 and the leading edge of the receptacle body, a slight axial pressure exerted on either mating portion causes the spring fingers or segments 21 to be moved inwardly a sufficient distance so as to permit the barrel 11 to enter into the groove 25 and yet maintain an interference fit with the inner surface of the receptacle (FIG. 4). While the contacting elements 18 are shown in the connector plug portion it will appear clear that such elements may be provided in the inner surface of the connector receptacle portion 26.

The thickness or height of each projection 32 should be such that it will engage the leading edge of a receptacle portion having the maximum manufacturing tolerance or inner diameter. Thus after determining the necessary height of the projections 32 the depth of the recess 16 may be determined so that if the plug portion is used with receptacle portion having a minimum manufacturing tolerance or inner diameter the projections 32 and the spring segments 21 will be able to move inwardly into the recess 16 sufficiently to allow the mating of the connector portions. In FIG. 4 the distal end of a segment 21 is shown abutting against the surface of recess 16; however, it will appear clear that the distal end of the segments 21 may be at any point between the inner surface of the lip 20 and the surface of recess 16.

While the projections 32 may be integral with or attached to the spring segments 21 in any desired manner and be of any desired shape, satisfactory results have been attained by having the projections 32 integral with the spring segments 21 and formed in a generally lobe-like configuration with a slightly slanted leading edge 33 for easing the mating of the connector portions.

With a connector plug portion embodying the present invention the leading edge 15 of the barrel is solid or unbroken except for the axially extending slot or keyway 34 (FIG. 3), thus insuring proper mating by allowing the technician coupling the connector to seek out a key (not shown) in the receptacle portion prior to placing a load on the spring segments 21. Also by using a plurality of such spring segments 21 and projections 32 about the periphery of the plug barrel, grounding is effected in a more desirable manner in that the projections 32 contact the receptacle body around substantially its entire annular leading edge prior to permitting the engagement of the contact elements 29 and 30. This feature of grounding about the entire periphery of the connector is important in that the electrical field is capable of causing a discharge through the contact elements of the connector even though a portion of the connector is already grounded. While eight spring segments and projections are illustrated in FIG. 3 it will appear clear that any desired number of such segments and projections may be used.

If it is desired to increase the pressure exerted by the spring segments 21 against the inner surface of the receptacle body a slight rearward slant 36 may be given to the surface of recess 17 (FIG. 6) so as to cause the spring fingers 21 to be more of an arcuate shape and thereby increase the "spring" or biased effect of the segments 21.

It will be seen that the apparatus of the present inven-

tion sets forth a highly desirable structure for effecting proper contacting or grounding between components or assemblies so as to obviate or substantially minimize contacting or grounding problems heretofore known. Providing a substantially solid or unbroken leading edge and lip on the plug portion, the spring segments are maintained in proper positional relationship to each other by preventing deformation of the spring segments by a carelessly inserted or placed screwdriver or test probe. Also, due to the unique relationship of the spring segments to the substantially solid leading end, rough handling, such as dropping the connector and impacting it against a concerete floor or the like, does not deform the spring segments so as to prevent proper connector assembly. Unequal "pre-stressing" of the segments **21**, i.e., where one or more segments **21** tend to provide a greater "spring" effect, is compensated for by the overlying lip **20** in that the latter confines the segments to predetermined positions and thus evens out the "pre-stressing." The lip **20** also assures that segment inaccuracies such as spreading and the like which may easily occur when using non-confined individual barrel segments are obviated because of the novel segment position retaining features provided by the lip **20**.

As various changes may be made in the form, construction and arrangement of the parts herein without departing from the spirit and scope of the invention and without sacrificing any of its advantages, it is to be understood that all matter herein is to be interpreted as illustrative and not in a limiting sense.

We claim:

An electrical connector mating portion having a contacting element and an annular metal grounding shell encircling said element and insulatively spaced therefrom comprising an axially elongated recessed surface peripherally disposed about said shell and extending to a location adjacent one end thereof, another peripherally disposed recessed surface in said shell communicating with and laterally outwardly spaced from the first mentioned recessed surface at a location remote to said one end, a generally annular retaining lip on said shell adjacent said one end thereof and laterally spaced from and overlying a section of the first mentioned recessed surface, spring means comprising a base portion disposed against and secured to said other recessed surface and essentially encircling the shell with an outermost surface of said base portion having essentially the same perimetric dimensions as an outermost surface of said retaining lip, a plurality of axially disposed flexible segments spaced about the first mentioned recessed surface and extending from said base portion in cantilever fashion across essentially the entire first mentioned recessed surface to a location beneath said retaining lip with the distal ends of said segments being constrained generally laterally inwardly from the base portion by said retaining lip and thereby effecting the continuous urging of said distal ends towards said retaining lip while resisting movement towards the first mentioned recessed surface, and a laterally outwardly extending projection on each of said segments at a location adjacent said retaining lip and disposed closer to said one end of the shell than said contacting element for contacting a surface on a metal shell of another mating connector portion prior to the establishment of an electrical path from said contacting element to a mating contacting element in said other mating connector portion.

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