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F. N. EATON

2,933,711

BREAKAWAY ELECTRICAL CONNECTOR

Filed June 28, 1955

2 Sheets-Sheet 1

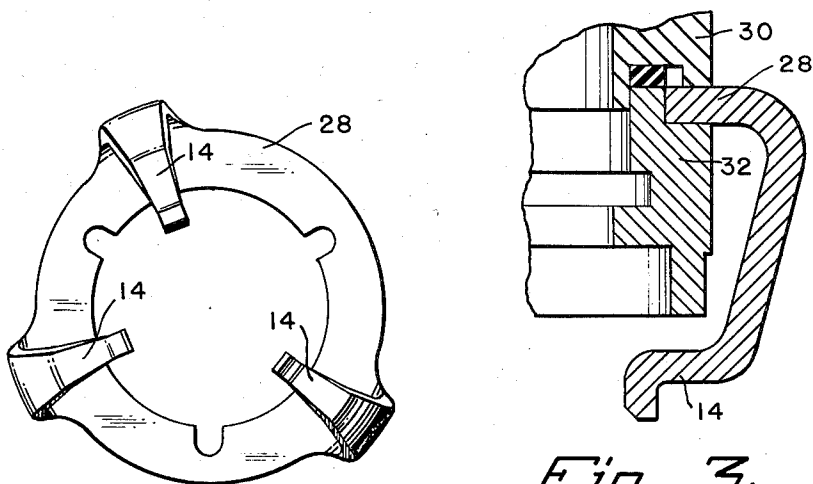
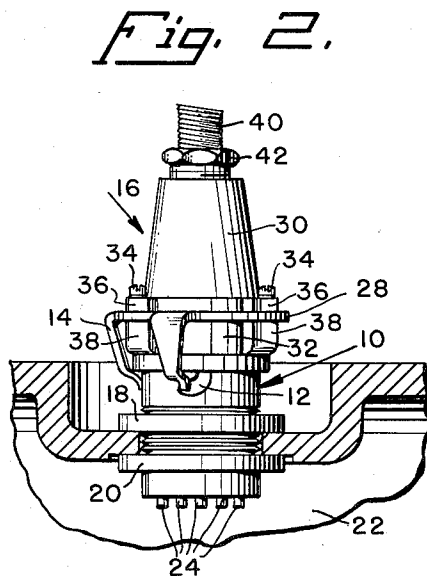
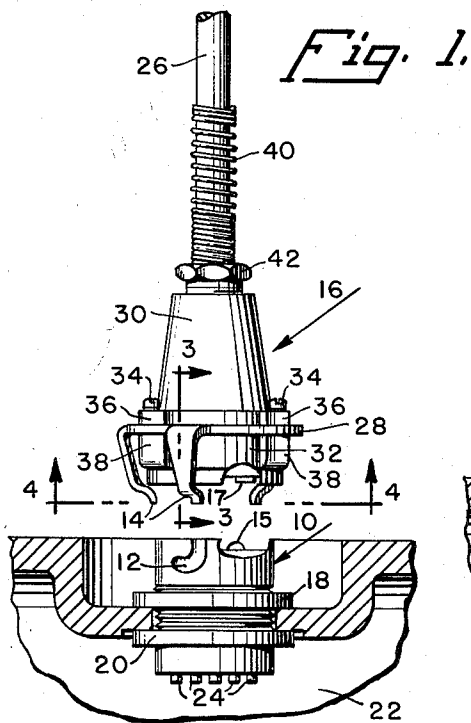


Fig. 4.

Fig. 3.

INVENTOR.
FREDERIC N. EATON

BY

L. H. C. Bin
V. C. Muller
ATTORNEYS

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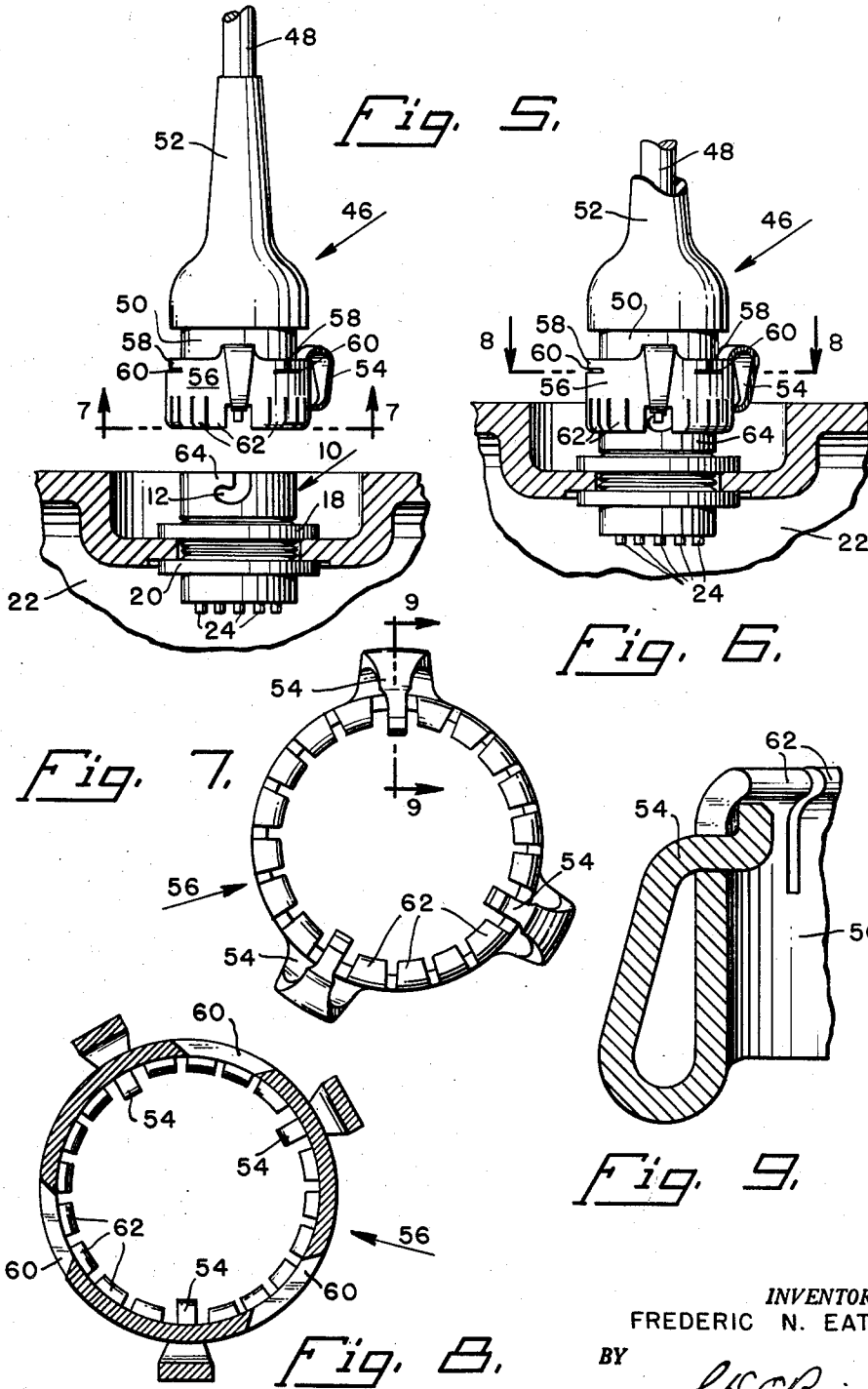
F. N. EATON

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2 Sheets-Sheet 2



INVENTOR.
FREDERIC N. EATON
BY
L. H. Brien
V. C. Muller
ATTORNEYS

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BREAKAWAY ELECTRICAL CONNECTOR

Frederic N. Eaton, Pasadena, Calif., assignor to the United States of America as represented by the Secretary of the Navy

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1 Claim. (Cl. 339—90)

(Granted under Title 35, U.S. Code (1952), sec. 266)

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.

This invention relates to electrical connectors and in particular to such connectors which can be uncoupled by essentially translational separation forces at any of various angles to the longitudinal axes of the assembled connectors.

Electrical connectors of conventional structure generally utilize plugs having contacts of pin-sleeve type which, apart from plug-unlocking motions, require axially-directed separation forces for disengagement, or plugs having contacts of butt-type and positive plug-locking means which prevent disengagement of the connectors except by relatively complex operations. There are, however, many electrical connector applications in which material improvement can be provided by connectors capable of quick or break-away disengagement by pull forces which are not limited to a single critical direction, and certain special applications in which such omni-directional break-away disengagement is in fact essential. The above-recited conventional types of connectors fail to satisfy the latter requirement.

It is therefore a primary object of the present invention to provide an electrical connector which can be disengaged by substantially translational separation forces at various angles to the longitudinal axis of the assembled connector.

A further object is to provide an electrical connector in which the separation force required for disengagement is substantially constant for various force direction angles.

Other objects and many of the attendant advantages of this invention will be readily appreciated as the same becomes better understood by reference to the following detailed description when considered in connection with the accompanying drawings wherein:

Fig. 1 is a side view of one embodiment of a connector in accordance with the present invention, the two mating parts thereof shown in disengaged status;

Fig. 2 is a similar side view of the same embodiment, illustrating the connector in assembled condition;

Fig. 3 is a sectional view of the upper connector plug taken on the line 3—3 of Fig. 1, detailing a portion of the plug and spring prong structure;

Fig. 4 is a face view of the spring prong plate, shown disassembled from the upper plug and as seen from the line 4—4 of Fig. 1;

Fig. 5 is a side view of another connector embodiment, the two mating parts thereof shown in disengaged and separated condition;

Fig. 6 is a similar side view of the above connector, illustrating it in fully engaged condition;

Fig. 7 is a face view of the detent ring forming a part of the upper plug of Figs. 5 and 6, as seen from the line 7—7 of Fig. 5;

Fig. 8 is a sectional view of the detent ring, taken on the line 8—8 of Fig. 6; and

Fig. 9 is a sectional view of the detent ring, taken on the line 9—9 of Fig. 7, detailing the spring prong configuration.

In accordance with the present invention, the improved electrical connector comprises a pair of plugs, having butt-type rather than pin-sleeve type electrical contacts, and having yieldably releasable plug-connecting means, for example spring prongs carried by one plug and adapted to engage with bayonet-locking grooves in the other plug, to mate the two plugs and the electrical contacts therein. Such a combination enables the plugs to be connected and releasably locked together by the combination of translational and rotational displacements involved in bayonet-type engagement, and enables disengagement by application of a pull or essentially translational separation force, this separation force not being limited to the axial direction of normal plug engagement.

Referring now to a first embodiment illustrated in Figs. 1 and 2, the lowermost plug 10, having several bayonet-locking grooves 12 which can be engaged by spring prongs 14 of the upper plug 16, and containing butt-type contacts 15 which can make wiping face engagement against similar contacts 17 carried by the upper plug, may in itself be entirely conventional in structure. The bayonet-locking grooves may be three in number, as indicated, having unequal spacings about the plug body for proper polarization of the assembled plugs. For mounting purposes, the body portion of plug 10 may, for example, be threaded as shown to accommodate a nut 18, and may be provided with a lower flange 20, so that the plug may be mounted and locked in place upon a shell structure 22. Where complete hermetic integrity is desired in such an assembly, plug 10 would be of pressure-tight construction, and lower flange 20 of plug 10 would be adapted to accept a rubber O-ring for compression between the said flange and the inner wall of shell structure 22. The contact terminals 24 shown protruding below the base portion of plug 10 are intended for wire connection purposes, for example to electrical equipment (not shown) carried within the shell structure 22.

Upper plug 16, containing the butt-type contacts 17 for electrical mating with similar contacts in plug 10 as previously mentioned, to which electrical connections are made through a cable 26 as indicated, includes three spring prongs 14 having circumferential spacings corresponding to those of the bayonet-locking grooves 12 in lower plug 10. These prongs 14 are in this instance formed as integral elements of a washer-type plate 28, as shown in Fig. 4, and hereinafter termed a detent member, designed to be retained between the body portion 30 and the clamping end 32 of plug 16, as indicated in Figs. 1, 2 and 3, by means of clamping bolts 34 in salient elements 36, 38 formed upon body 30 and clamping end 32, respectively. The clamping end 32 is internally grooved as indicated in Fig. 3 to accommodate a rubber grommet (not shown) as a sealing means for a molded dielectric plug insert (not shown) which carries the previously mentioned butt-type contacts. Cable 26 may be secured within body portion 30 in such manner that pull forces upon the cable will extend to plug 16 itself rather than to the points at which the cable wires connect to the contact elements. Plug 16 is further fitted with a spring helix 40, retained in position in known manner by means of a ferrule element 42, to provide resistance to abrasion of cable 26 as a result of pull forces at various acute angles to the normal axis of the assembly.

In the above described embodiment, upper plug 16 is engaged with lower plug 10 by the usual bayonet-locking movement, and the gripping force of the three spring

prongs 14 is sufficient to prevent unintentional separation. The described connector differs from conventional connectors, however, in that it can be uncoupled or disconnected by a forceful cable pull, not only in an axial direction but also in non-axial directions, by virtue of the described bayonet-locking grooves and the co-acting spring prongs. Further, by the use of three or more prongs as indicated, having suitable configuration and springiness, separation at various angles can be accomplished with pull forces having reasonably constant magnitudes.

A modified form of the connector in accordance with the present invention, as illustrated in Figs. 5 and 6, is capable of the described type of connector separation with still greater constancy of required pull force. In Figs. 5 and 6, the lower plug and mounting structure are the same as shown in Figs. 1 and 2 and are therefore designated in like manner. Upper plug 46 is provided with butt-type contacts, as in plug 16 of the Fig. 1 embodiment, to which electrical connections are made through cable 48. The lower portion of plug 46 is a metal shell 50 containing an insert (not shown) which carries the butt-type contacts, and the upper body 52 is of rubber composition molded about the upper end of metal shell 50 and a portion of the cable 48 connecting to the contacts therein, this structure thus functioning to relieve the contact-wire connections from strain during application of a pull-force to cable 48, and preventing abrading or wire-breaking action upon cable 48 as a result of repeated pulls upon cable 48 at various acute angles to the normal connector separation direction. Three spring prongs 54, having a configuration best illustrated in Fig. 9, are in this instance carried by a cylindrical sleeve structure 56 hereinafter termed a detent ring. Detent ring 56 is mounted upon plug 46 by crimping portions 58 of the ring, relieved by slots 60, against the metal shell 50. Metal shell 50 may for this purpose be provided with a lower flange or shouldered portion having slight depressions (hidden from view) therein against which the relieved portions 58 may be crimped, so that proper plug polarization may be maintained. Detent ring 56 is additionally provided with a number of spring fingers 62, so formed and dimensioned as to fit over shank 64 of lower plug 10 with a small clearance therebetween.

Upper and lower plugs 46 and 10, respectively, of the connector shown in Figs. 5 and 6, can be connected and disconnected in exactly the same manner as described with reference to the arrangement illustrated in Figs. 1 and 2, for the combination of butt-type contacts and resiliently releasable plug-engaging means is the basic concept of the connectors here disclosed. In the embodiment illustrated in Figs. 5 and 6, however, the use of spring fingers 62 in addition to spring prongs 54 yields greater constancy of

the breakaway forces required for separation of the two plugs at various acute angles to the normal direction. As before, the butt-type contacts offer no resistance to uncoupling. The three spring prongs 54 alone release with pull resistances which tend to lessen as the pull angle relative to the axial direction of the assembled plugs is increased. Since the multiple spring fingers 62, however, slide freely over shank 64 of lower plug 10 when the upper plug is pulled axially, but tend to bind increasingly as the pull angle is increased, a compensating action is obtained which results in a substantially constant pull force characteristic.

Obviously many modifications and variations of the present invention are possible in the light of the above teachings. It is therefore to be understood that within the scope of the appended claim the invention may be practiced otherwise than as specifically described.

What is claimed is:

An electrical connector comprising first and second plug members having cylindrical shank portions confrontingly associable along a reference axis, said plug members having butt-type electrical contacts therein, said first plug member having prong-engaging bayonet-locking grooves formed in the shank portion thereof and circumferentially spaced therein, said second plug member carrying spring prongs having like circumferential spacing, and also carrying a cylindrical array of closely spaced spring finger members for slidingly engaging the shank portion of said first plug member, whereby said plug members can be engaged in confronting relationship by bayonet-locking action of said prongs in said grooves, said prongs and finger members being yieldable, whereby said plug members can be separated by application of a breakaway pull force in any radial direction within a substantially hemispherical zone of action centered upon said reference axis, the resistance of the yieldable spring prongs to plug separation decreasing as the angle of pull force relative to said axis increases, and the resistance of said yieldable spring finger members to plug separation increasing as said angle increases.

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