An electrical connector adapted for connecting a coaxial cable to the firing system of aircraft-carried rockets is provided which features a plug contact member for crimping an engaging a coaxial cable, a receptacle having a substantially tubular shell threadably engageable with an aircraft housing, a cap member at one end to be positioned inside the housing, a non-conductive member movably disposed in the shell for preventing rocket exhaust flow into the receptacle, a spring disposed between the non-conductive member and the cap member and an elongate contact pin extending axially through the cap member and the non-conductive member to engage the coaxial cable center conductor upon insertion of the plug contact member into the receptacle, and means for normally securing the plug contact member within the receptacle.
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FIRE RESISTANT PLUGGABLE CONTACT AND RECEPTACLE

BACKGROUND OF THE INVENTION

This invention relates generally to electrical connectors and more particularly to a connector for coaxial cables of the type known in the art as “breakaway” connectors wherein a plug of the connector is held firmly within a receptacle, yet the parts are so constructed that when a sufficient separating force is applied, the connection is almost instantly released.

Breakaway connectors of the character described are widely employed in military guided missiles and similar areas, wherein they function to maintain electrical communication between external control apparatus and the missile until the instant of departure, such as for connecting the coaxial cable from an aircraft electrical control system to the firing system of aircraft-carried rockets, yet are violently jerked apart when the rockets are fired. One of the problems with present breakaway connectors is that the rocket exhaust that flows over the receptacle portion as the rocket moves away from the aircraft causes such considerable damage to the receptacle that the receptacle generally must be replaced after only a few firings. Because of this, the receptacles are now designed for ready replacement in the aircraft housing or panel.

SUMMARY OF THE INVENTION

Accordingly, it is an object of the present invention to provide an improved breakaway connector for connecting a coaxial cable to the firing system of an aircraft-carried rocket having a receptacle portion which is resistant to rocket exhaust damage and thereby is designed for extending the life thereof over many rocket firings.

Another object of the present invention is to provide an improved connector for coaxial cable having a receptacle and a detachable plug wherein the parts are so related to each other that the plug may be instantaneously withdrawn from the receptacle, yet wherein they are coactive to protect the interior of the receptacle from the outside environment upon withdrawal of the plug.

A further object of this invention is to provide an improved breakaway connector having a fire resistant pluggable contact and receptacle.

The foregoing objectives are achieved by the invention through a connector assembly comprising a receptacle having a substantially tubular loading socket shell which may be threadably engaged with an aircraft housing panel, a cap member fastenable to the shell for substantially closing one end thereof, a non-conductive member movably disposed within the tubular shell and sealingly engaging the interior wall surface thereof, a spring compressed between the cap member and the non-conductive member and an elongate contact pin extending through the cap member and through the non-conductive member. A plug member forming part of this invention has portions near one end thereof for grippingly engaging the outer insulative sheath of a coaxial cable and the inner protective braid thereof, respectively, and a portion insulatingly housing the center conductor of the coaxial cable being suitably constructed for permitting insertion into the loading socket shell of the receptacle to provide contact between the coaxial cable center conductor and the elongate contact pin. According to one embodiment of the invention, the plug contact is maintained within the receptacle by locking a compressible shoulder on the plug behind a positive stop provided within the loading socket shell. In another embodiment, the plug and receptacle are kept together by a boot member which is shrunk down over the crimping tabs of the plug and over a lip portion of the loading socket shell.

BRIEF DESCRIPTION OF THE DRAWINGS

Various other objects, features and attendant advantages of the present invention will be more fully appreciated as the same becomes better understood from the following detailed description when considered in connection with the accompanying drawings, wherein like reference numerals are used to designate like or corresponding parts in the several embodiments and in which:

FIG. 1 is an exploded perspective view of a plug member constructed according to this invention and showing its cooperative relation with a coaxial cable to which it is adapted to be connected;

FIG. 2 is a longitudinal cross-sectional view of the plug member illustrated in FIG. 1 being assembled with the coaxial cable;

FIG. 3 is an end view of the assembled plug member;

FIG. 4 is a cross-sectional view of one embodiment of a receptacle formed in accordance with the present invention;

FIG. 5 is a cross-sectional view of another embodiment of a receptacle according to this invention; and,

FIG. 6 is a cross-sectional view of a connector assembly illustrating the plug of FIG. 1, the receptacle of FIG. 5, and a boot retaining member securing the plug and receptacle together.

DESCRIPTION OF THE ILLUSTRATIVE EMBODIMENTS

Referring now to the Drawings, and more particularly to FIGS. 1, 2 and 3 thereof, there is shown a plug contact generally designated by the numeral 10 comprising an elongate crimping member having a front end portion 11 which is substantially tubular and is axially split along at least a portion thereof at spaced circumferential intervals, as indicated at 12. The split front end portion 11 terminates in a generally conical exterior exposure being formed of a plurality of flat, substantially triangular-shaped parts 13, shown as four in number, inwardly inclined toward the axis from the rear to the front, and having formed in each a small dome 15 providing a smooth bearing surface for the plug member 10, as will be set forth hereinafter.

The rear end portions of the conical surface-forming Parts 13 provide upstanding circumferential locking shoulders 17 at the junctures thereof with the main tubular exterior surface of the front end portion 11.

A rear end portion 18 and an intermediate portion 19 are integrally formed with the front end portion 11 to complete the plug contact member 10. Both the rear end portion 18 and the intermediate portion 19 are formed in a substantially semi-tubular configuration, with the intermediate portion having a smaller radius of curvature than the rear end portion such that a coaxial cable 20 may be received therein with an outer protective and insulating sheath 21 thereof positioned in the rear end portion 18 and an outer braided jacket 22 disposed immediately below the insulating sheath being
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positioned in the intermediate portion 19. The rear end portion 18 is provided with crimping tabs 23 and the intermediate portion 19 is provided with crimping tabs 24 for permitting these portions of the plug contact 10 to be crimpingly engaged with the outer insulation 21 and the braid 22, respectively, of the coaxial cable 20.

The front end portion 11 of the plug contact 10 is adapted to receive an inner, or center, conductor 25, being stripped of its various protective and insulative jackets and extending beyond these portions of the coaxial cable 20 which are received in the rear and intermediate portions of the plug contact 10. A tubular conductive receptacle 26, preferably being slit at spaced circumferential intervals adjacent one end thereof, and having an inside diameter substantially equal to the diameter of the center conductor 25, is crimped about the center conductor and is disposed in the front end portion 11 of the plug contact 10 with the split portions being bent radially inward to provide improved contact with a receptacle contact element, as will be set forth hereinbelow. Between the receptacle 26 and the front end portion 11 of the plug 16, a non-conductive sleeve 27 is disposed for insulative purposes.

The plug contact 10 and the insulating sleeve 27 may of course be constructed from a variety of suitable materials, such as, by way of example, a soft metal like brass in the case of the plug contact 10 and a silicone tubing in the case of the sleeve 27.

A receptacle for the plug contact 10 for completing a coaxial connector assembly is shown in FIG. 4, being generally designated by the numeral 30. The receptacle has a loading socket shell 31 which is externally threaded at 32 along an intermediate portion to facilitate mounting of the same in a panel and has tiny barbs 33 in its exterior wall at one end thereof for securely engaging the shell in a cap member 34 constructed of a soft material, such as, for example, nylon, when the same is forcefully fitted thereon, the barbs being angularly pointed in the direction of the opposite end of the shell to readily permit insertion of the end of the shell into the cap member, but resisting subsequent separation thereof by digging into the soft cap inner wall when the elements are urged away from each other.

A bore 35 is provided in one end of the loading socket shell 31 and a counter bore 36 of slightly greater diameter is provided in the other end thereof, thereby forming a shoulder, or stop, 37, shown being tapered, within the shell 31. A coil spring 38 is disposed within the receptacle 30, being compressed between the cap member 34 and an annular disc 39 of dielectric material, such as, for example, Teflon, which fits slidably but tightly within the counter bore 36 of the loading socket shell 31 and is normally held against the shoulder 37 under the force of the spring. An elongate contact pin 40 which is adapted to plug into a coaxial cable socket in the panel and is designed for ready replacement, if such is required, may be inserted through an opening in the end wall of the soft cap member 34 and friction fitted within the central opening of the annular dielectric disc member 39, so that one end thereof extends beyond the disc 39 to engage the center conductor 25 of the coaxial cable 20 upon insertion of the plug contact 10 within the receptacle 30. The elongate contact pin 40 is provided with an integral flange 41 being tapered at one end to facilitate pressing of the pin 40 through the cap member end wall opening and has a square shoulder at the other end which resists pin movement in the opposite direction within the receptacle 30 upon engagement with the inner surface of the cap end wall. Another shoulder on the pin 40 spaced from the flange 41 and positioned adjacent the end of the pin which is adapted to plug into the panel socket determines the extent to which the pin 40 should be inserted through the end wall of the cap member 34.

Accordingly, when placed in use, the receptacle 30 is threaded into a panel, not shown, which may, as indicated, be carried on an aircraft, and the tapered front end of the plug contact 10, which may be secured to a rocket, is inserted into the bore 35 of the receptacle 30, pushing the dielectric disc 39 back against the action of the spring 38 until the shoulders 17 on the front end portion 11 of the plug contact 10 which are slightly compressed during their passage through the bore 35 passes the shoulder 37 inside the receptacle 30. At this time, the shoulder portions 17 naturally resume or spring back so that when an installing force is no longer being applied, the spring 38 operates to urge the shoulders 17 against shoulder 37 thereby positively locking the plug contact 10 in the receptacle 30, with the contact pin 40 being engaged by the center conductor 25 through the fingers of receptacle 26 to establish an electrically conductive path between the aircraft and the rocket firing mechanism. When the rocket is fired, it pulls the plug 10 from the receptacle 30 and the exhaust gas generated by the rocket as it moves away flows over the receptacle from left to right, as viewed in the Drawings. The spring 38, however, is immediately operative upon removal of the plug to push the dielectric disc 39 back to the left against the shoulder 37, thereby resisting the gas pressure of the rocket exhaust and preventing damage to the interior of the receptacle.

Turning now to FIGS. 5 and 6, there is shown another embodiment of the receptacle 30 in which, instead of retaining the plug 10 in the receptacle by locking it behind a positive stop, a separate boot member is utilized for securing the elements together. Thus, the receptacle 30' comprises a loading socket shell 31' having a through-bore 50, a cap member 34' secured to one end thereof by tiny barbs 33' and being adapted to threadably engage a panel on the aircraft through a threaded portion 32'.

A dielectric skirt 39', which in this case is a cylindrical member of approximately the same outside diameter as the diameter of the throughbore 50, has a bore 51 in its inner end for receiving a compressed spring 38', a central opening through which an elongate contact pin 40' may be friction-fitted, and a flange 52 extending radially outward at the inner end for engaging the inner annular end surface of the loading socket shell 31' to keep from being ejected the spring 38', and is appropriately positioned within the shell 31' and the cap member 34'. An O-ring seal 53 is provided in the bore 50 between the skirt 39' and the loading socket shell 31', and another O-ring seal 54 is positioned in a groove in the elongate contact pin 40' to provide a seal between the pin 40' and the dielectric skirt 39' upon movement of the skirt against the action of the spring 38'. The outer end surface of the skirt 39' is provided with a circular groove or cavity 55 and a flared or outwardly tapered circumferential periphery 56.

In operation, the plug contact 10 is inserted into bore 50 of the receptacle 30' and is secured therein by a boot member 57 which may be formed of silicone rub-
ber, for example, and is shrink-fitted over the crimp tabs 23 and 24 of the plug 10 and a lip 58 on the outer end of the shell 31'. As in the previous embodiment, the dielectric skirt 39' is pushed back against the action of the spring 38' when the plug 10 is inserted, and upon withdrawal of the plug from the receptacle 30', the spring is operative to push the skirt 39' forward to prevent damage to the interior of the receptacle. The forward motion of the skirt 39' is limited by the flange 52 thereon which engages the inner annular end surface of the socket shell 31'. Thus, the forward end wall of the skirt 39' is used to positively receive and flare out the gas pressure from the rocket exhaust through the annular cavity 55 formed therein.

In both embodiments, a substantial force is required to separate the plug from the receptacle, to unlock the plug from the positive stop in the first case and to free the boot in the second case.

Thus, it may be seen that the fire resistant pluggable contact and receptacle of the present invention has important advantages over known prior art structures in that a breakaway connector is provided wherein the plug may be easily and quickly attached or detached yet wherein the parts are of such design and construction that they tend to reduce the chances of damage to the interior of the receptacle by such external environmental factors as the rocket exhaust gas.

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

What is claimed as new and desired to be secured by letters patent of the United States is:

1. An electrical connector useful for connecting a coaxial cable from a rocket to the firing system of an aircraft or the like which comprises:
   a. a loading socket shell having a bore therethrough, and a cap member secured to one end thereof, said bore having a shoulder stop therein;
   b. a non-conductive member slidingly disposed in said bore in said shell;
   c. a compression spring positioned in said bore between said non-conductive member and said cap member and adapted to urge said non-conductive member away from said cap member;
   d. an elongated contact pin axially disposed through said bore and extending through said cap member at one end and said non-conductive member at another end;
   e. a conductive plug adapted to be inserted into said bore and having a compressible shoulder thereon for engaging said shoulder stop in said bore whereby said plug is retained therein, said plug further adapted for being connected to said coaxial cable at one end; and
   f. a tubular conductive receptacle positioned in said plug and adapted for being crimped to the center conductor of said coaxial cable at one end and for telescoping receiving said elongated contact pin at another end thereby effecting an electrical contact between said coaxial cable and said contact pin.

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