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WITH CONTACT PROTECTING MEANS
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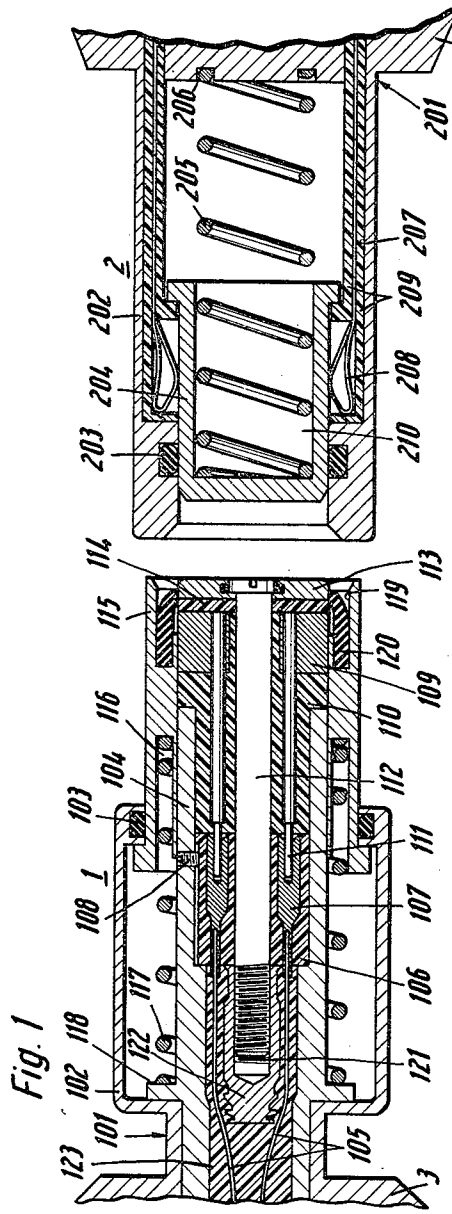

Fig. 1

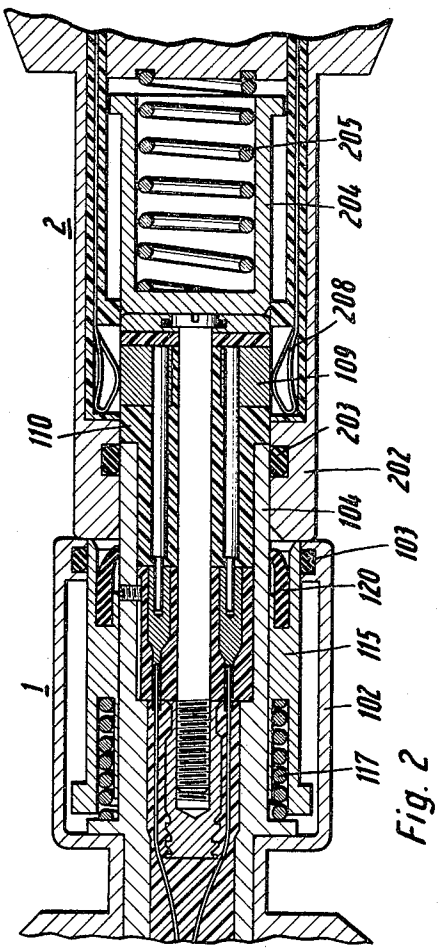

Fig. 2

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DISENGAGEABLE ELECTRICAL CONNECTOR WITH CONTACT PROTECTING MEANS

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ABSTRACT OF THE DISCLOSURE

A disengageable multi-circuit electrical connector includes a receptacle and a plug insertable axially into the receptacle. The plug has contacts disposed circumferentially therearound which engage mating circumferentially spaced contacts of the receptacle when the plug is inserted into the receptacle. Sealing means are provided in the plug and the receptacle to protect the entry of moisture or dust to the respective contacts, and spring biased closure means close the receptacle and the plug when the two are disengaged from each other and short circuit the respective contacts.

Background of the invention

Disengageable electric connectors for simultaneously interconnecting or disconnecting a plurality of conductors or a plurality of electric circuits are known. In such connectors, it is further known to so design either the plug or the receptacle, conjointly constituting the connector, that contact of the electric contacts, when the connector is disengaged or disconneced, is made impossible.

Thus, for example, German Patent No. 409,427 discloses a disengageable electric connector in which electric contacts are distributed around the circumference of the plug and also around the socket or receptacle. The plug, when not inserted into the receptacle, is protected both from contact and fouling by a protective cap which is screwed to the plug pin. The thread provided for that purpose on the plug shaft or pin is, at the same time, and on insertion of the plug into the receptacle, utilized in a known manner for securing the electrical connector by engagement with a corresponding thread provided on the receptacle.

German Auslegeschrift 1,071,800 discloses another disengageable electric connector wherein a plug, with individual plug pins, is covered by a so-called contact safety plate when the plug is not inserted into receptacle. This covering is effected in such a way that an unauthorized or accidental touching of electric contacts is not possible. Furthermore, the contact safety plate is so designed that it automatically releases or uncovers the plug pins upon insertion of the plug into the receptacle.

German Gebrauchsmuster 1,812,283 discloses an electrical connector wherein the receptacle, when the plug is not inserted therein, is secured or closed by a plate automatically closing the opening of the receptacle, and so designed that it automatically releases or uncovers the electric contacts of the receptacle upon insertion of a plug into the receptacle.

Such covering or protecting means provided on the known electrical connectors, for the electric contacts either of the plug or of the receptacle, serves primarily

for the purpose of preventing, for safety reasons, an unintentional or unauthorized touching of the electric contacts. At the same time, these devices attain a certain protection of the electric contacts against fouling. However, for special uses and especially for military purposes, electrical connectors are needed which will withstand extreme conditions when interengaged as well as when disengaged.

Thus, for example, for remote control missiles (which occupy a small space), light plug-in connectors, are required which must be absolutely dependable and watertight in any state, insensitive to extreme temperature fluctuations, and dirtproof, dustproof and resistant to contact with certain organic or inorganic liquids. Furthermore, the moving mechanical parts must also still be fully functional after very long periods of storage with widely varying temperatures and the most diversified weather conditions. In addition, and for reasons of safety, the electric contacts in at least one element of the electrical connector must be short circuited until such time as the parts of the electrical connector are interengaged.

Summary of the invention

This invention relates to disengageable electrical connectors for interconnecting a plurality of electrical circuits and, more particularly, to an improved disengageable electrical connector characterized by smooth working under extremely difficult conditions, extreme simplicity of the mechanical and electrical structure, and protection of the contacts against moisture and atmosphere both in the engaged condition and in the disengaged condition.

The disengageable electrical connector of the invention is of the type including a plug and a receptacle and in which the contacts to be engaged and disengaged are distributed circumferentially, with the contacts of the plug and the contacts of the receptacle being covered when the electrical connector is disengaged. In accordance with the invention, the contacts of the two parts of the disengageable electrical connector are enclosed, in both the engaged position of the electrical connector and the disengaged position thereof, in watertight manner. At least one of the contact covering means extends beyond the electric contacts to an extent such that, when the two parts of the electrical connector are engaged, the covering and sealing functions are performed by the other part of the electrical connector before the individual contacts of the two parts of the electrical connector are uncovered for interengagement.

In a preferred embodiment of the invention, a cylinder is axially displaceable within the receptacle and against the bias of a spring, and this cylinder cooperates with a sealing ring disposed in the inner peripheral surface of the receptacle adjacent the plug-receiving opening of the receptacle. A cylindrical sleeve surrounds the exterior surface of the plug and is movable axially of the plug against a spring bias. At its outer end facing the receptacle, this sleeve carries an annular lip seal, and the exterior circumferential surface of the cylindrical sleeve cooperates with a sealing ring mounted in the inner peripheral surface of a cylindrical case fixedly connected with the plug.

This design assures that both the receptacle and the plug, when disconnected, are sealed off so as to be liquid-tight and dustproof, by means of the covering means biased by springs into their effective position and which cooperate with sealing rings of the two parts of the connector. The sealing ring positioned in a groove in the inner surface of the receptacle cooperates, upon engagement of the plug in the receptacle, with the plug so that the latter, in the connected or engaged condition of the connector, is also sealed off in a liquid-tight and dustproof manner. Upon withdrawal of the plug from the

receptacle, the sealing cylinder of the receptacle and the cylindrical sleeve of the plug are biased immediately into their respective protecting positions by the associated springs, and hermetically seal the respective electrical contacts from the atmosphere. An particles of dirt or drop of liquid are simultaneously wiped off the parts during this movement of the covers to the sealing position.

With the mentioned preferred design of the electrical connector, it is further assured that no water is able to penetrate into the electrical contacts even with extremely moist weather, such as characteristic of heavy rain or snowstorms. This is important, in order to avoid any manifestations of corrosion at the contacts under all circumstances and which, with the very low electric power available for controlling and guiding of the missile, would lead to failures or breakdowns due to increase of the contact resistances.

The springs biasing the covering means, after disengagement of the two parts of the electrical connector, into their effective positions, have large magnitude elongations in order to bias the covering means quickly and safely into positions in which they cover and protect the respective electric contacts. The distances through which the respective covering means must be moved are correspondingly long, since the actual sealing off of the electrical connector parts is effected at the greatest possible distance from the circumferentially arranged electric contacts. In order to accommodate springs having large elongations and without disadvantageously increasing the size of the electrical connector, in accordance with a further advantageous feature of the invention the covering means are provided with recesses accommodating a considerable portion of the length of each associated spring.

As a further feature of the invention, the part carrying the electric contacts of the plug is designed as an exchangeable member having a threaded interconnection with the plug. Such a design is advantageous where the plug of the electrical connector is more subject to stresses than is the receptacle of the electrical connector. This is the case, for example, with an electrical connector used for remote controlled missiles and where the plug is fixedly positioned in operative association with the electronic means of a control and position-finding device, with respective receptacles fixedly positioned on launching tubes which are individual for each missile to be fired. With each new missile to be fired, there is thus a new receptacle which is joined with the same plug of the control device, so that the electric contacts of the plug, after a large number of missiles have been fired, show a certain degree of wear.

In accordance with a further feature of the invention, the receptacle, which is telescoped over the plug when the two parts of the electrical connector are interengaged, is so designed that, in addition to forming an electrical connection it also forms a mechanical connection absorbing considerable forces. Such a utilization of the connector as a mechanical supporting arrangement is also especially advantageous in connection with the control and position-finding device. This is due to the fact that the connector then joining the launching tube containing the missile with the control device can be utilized simultaneously as the sole or as an additional mechanical interconnection between the launching tube and the control device.

In a further development of the invention, the parts covering the electrical contacts when the electrical connection is disengaged are so constructed that they short circuit the respective electrical contacts of each part of the electrical connector. A provision of this type in an electrical connector used with remote control missiles is necessary since, for example, the electric ignition wires of the electrical connector, when not energized for firing, as with an open electrical connector, must be short circuited in order to prevent activation of the ignitors as by static charges, for example.

An object of the invention is to provide an improved disengageable electrical connector in which the electrical contacts of the two parts are sealed from the atmosphere in both the engaged and disengaged conditions of the electrical connector.

Another object of the invention is to provide such a disengageable electrical connector in which contact sealing means are provided on the two parts thereof, with the sealing functions of one part being assumed by the sealing means of the other part when the two parts are interengaged and before their respective contacts are uncovered for interconnection.

A further object of the invention is to provide such a disengageable electrical connector including respective covering means associated with a plug and with a receptacle, forming the two parts of the electrical connector, cooperate with sealing rings to provide an hermetic seal.

Another object of the invention is to provide such a disengageable electrical connector in which, responsive to disengagement of the two parts thereof, dirt and moisture are wiped off the parts automatically.

A further object of the invention is to provide such a disengageable electrical connector which is maintained watertight under extremely wet conditions and in both the engaged and disengaged conditions.

Still another object of the invention is to provide such an electrical connector in which the respective sealing means are under the bias of springs having large elongations, with the large elongations being accommodated by recesses in the sealing means in such a manner that the overall size of the electrical connector is not increased.

A further object of the invention is to provide such a disengageable electrical connector in which the contact carrying parts of the plug are interchangeable for replacement after a certain degree of wear.

Another object of the invention is to provide such a disengageable electrical connector which, in the engaged condition, serves as a mechanical support or connection for the parts.

A further object of the invention is to provide such a disengageable electrical connector in which, when the two parts thereof are disengaged, the respective contacts of the two parts are short circuited.

Brief description of the drawings

For an understanding of the principles of the invention, reference is made to the following description of a typical embodiment thereof as illustrated in the accompanying drawings.

In the drawings:

FIG. 1 is an axial sectional view of an electrical connector embodying the invention, with the parts being shown disengaged; and

FIG. 2 is a view similar to FIG. 1, but showing the two parts of the electrical connector interengaged.

Description of the preferred embodiment

The disengageable electrical connector embodying the invention, illustrated in the disengaged position in FIG. 1, includes a plug or plug element **1** having a shank or stem **101** rigidly or fixedly connected with a larger member **3**, which has not been further illustrated in the drawings. A cylindrical casing **102** is fixedly connected with shank **101** and, adjacent the open end of casing **102**, the inner surface thereof is formed to receive a sealing ring or gasket **103**. The core of plug **1** also comprises a cylindrical casing **104** into which extend insulated electrical conductors **105**, each of which is soldered with a respective plug socket **107** seated in an insulating or dielectric block **106** having its inner end engaging an internal shoulder on core part **104**. Block **106** is secured by a set screw **108** threaded through cylindrical casing **104**.

A structural part **110** of plug **1**, formed of insulating or dielectric material, carries the actual electrical contacts **109**, and is bored to receive plug pins **111** extending

through part **110** and electrically connected at their outer ends to respective contacts **109** and at their inner ends to respective sockets **107**, each receiving the reduced inner end of a pin **111**. Part **110** is held in position by means of a screw **112** threaded into a threaded recess **121** of plug **1**. Threaded recess **121** is formed in a further structural part **122** embedded in a sealing compound **123** in cylindrical case **104**. Thereby, the connecting and changing of the electric leads **105** within cylindrical case **104** is facilitated. Of course, recess **121** could be formed directly in the inner end of cylindrical case **1**. Screw **112** has its head engaged with a metallic cover plate **113** which is electrically isolated from member **110** carrying electric contacts **109** through the medium of a dielectric disk **114**.

A cylindrical sleeve **115** is telescoped over cylindrical case **104** of plug **1**, and its inner end, facing shank **101**, is formed with an annular recess of a substantial axial length. One end of a coil spring **117** is seated in recess **116**, and the opposite end of coil spring **117** engages a flange **118** on cylindrical case **104**. The forward or outer end of sleeve **115** is also formed with an annular recess receiving an annular lip seal **120** whose front edge firmly engages the exterior surface of plug part **110** carrying electric contacts **109**.

The disengageable electrical connector includes a receptacle **2** having a shank or stem **201** which is fixed to a relatively larger part or member **4** which has not been further illustrated in the drawings. Receptacle **2** includes a cylindrical casing **202** whose outer end is open to receive plug **1**. The edge of the outer opening in casing **202** is bevelled, as indicated, to form a conically enlarged surface. Inwardly of this beveled or conical surface, the inner surface of casing **202** is formed with a groove receiving a sealing ring **203**. A hollow cylinder **204** is telescoped within casing **202** and has an open inner end and a closed outer end. A spiral spring **205** has one end engaged within the inner space **210** of cylinder **204**, and the other end of spring **205** is engaged in an annular groove **206** in the inner end of cylindrical case **202** adjoining shank **201**.

The inner surface of cylindrical casing **202** is formed with a plurality of circumferentially spaced axially extending grooves **207** each receiving a respective contact spring **208**. Between springs **208** and shank **201**, the inner diameter of casing **202** is increased to form a shoulder limiting outward movement of hollow cylinder **204**. Each contact spring **208** is electrically isolated from casing **202** by means of a respective jacket **209** of dielectric material.

When the electrical connector is disengaged, hollow cylinder **204** of receptacle **2** is biased by spring **205** to a position in which its outer surface, in cooperation with sealing ring **203**, seals the interior of receptacle **2**, containing contact spring **208**, against atmosphere. Contact springs **208** snugly engage the outer cylindrical surface of hollow cylinder **204** and are thereby short circuited relative to each other.

When the electrical connector is disengaged, the cylindrical sleeve **115** of plug **1** is also biased by spring **117** to extend substantially completely beyond cylindrical casing **102**, so that lip seal **120** snugly engages the outer surface of metallic cover plate **113** and thereby seals member **110**, carrying electric contacts **109**, from the atmosphere. A part of the inner surface of sleeve **115**, adjacent annular recess **119**, snugly engages contacts **109** and short circuits these contacts. The inner space of cylindrical case **102** is sealed by sealing ring **103** engaging the outer surface of sleeve **115**.

In the asesmbled state of the electrical connector, as shown in FIG. 2, sleeve **115** has been pushed back, against the bias of spring **117**, into cylinder case **102** so that cylindrical case **202** of receptacle **2** is closely telescoped over the outer surface of cylindrical casing **104** of plug **1**. Contact springs **208** of receptacle **2** then snugly engage the respective associated electric contacts **109** of plug **1**. Also, hollow cylinder **204** of receptacle **2** is pushed back into cylindrical case **202** against the bias of its associated coil spring **205**. Sealing ring **203** in the inner surface of casing **202** snugly engages case **104** of plug **1**, and thus seals off from atmosphere the interior of the electrical connector, and the electric contacts.

By virtue of the relatively large contact surface between cylindrical casing **202** of receptacle **2** and cylindrical case **104** and the structural members **110**, **114** and **113** of plug **1**, considerable mechanical forces can be absorbed by the electrical connector. By a suitable mechanical locking means, which has not been shown, the electrical connector, when assembled as shown in FIG. 2, is held assembled against the bias exerted by springs **117** and **205**. After release of such a mechanical locking device, the electrical connector is automatically disengaged by the bias of springs **117** and **205**, these springs then acting as accumulators.

Lip seal **120** of plug **1** provides, during each movement of cylindrical sleeve **115**, both during engagement of the electrical connector and during engagement thereof, a cleaning of electric contacts **109**. This results in a relatively long service life of plug **1**, which is subjected to a greater wear than are the individual receptacles **2** selectively cooperable therewith.

The correct coordination and association of contacts **109** of plug **1** with contacts springs **208** of receptacle **2** is obtained by known means for assuring a proper angular interrelation of the plug and receptacle during interengagement thereof. Such means are well known and thus have not been shown in the drawings.

While a specific embodiment of the invention has been shown and described in detail to illustrate the application of the principles of the invention, it will be understood that the invention may be embodied otherwise without departing from such principles.

What is claimed is:

1. A disengageable electrical connector for interconnecting a plurality of electrical conductors, and of the type including a receptacle element, a plug element disengageably insertable into the receptacle element, with the two elements carrying respective circumferentially spaced contacts interengaged upon such insertion, and covering means on at least one of the elements resiliently biased to a contact covering position upon disengagement of the elements: said connector comprising, in combination, plug element including a part carrying circumferentially spaced first contacts; a receptacle element carrying circumferentially spaced second contacts each engageable with a respective first contact; a first contact covering means on said plug element; a second contact covering on said receptacle element; and respective resilient means biasing said covering means to respective covering positions covering the respective contacts; the covering means on at least one elcement, in the disengaged position of said elements, projecting outwardly beyond its associated contacts a distance such that, upon insertion of said plug element into said receptacle element, its associated contacts are covered by the other element before said first and second contacts are interengaged.

2. A disengageable electrical connector, as claimed in claim **1**, in which said receptacle element includes a receptacle casing having an open outer end and a cylindrical inner surface mounting said second contacts; said second contact covering means comprising a hollow cylinder telescoped in said cylindrical inner surface; said resilient means comprising a first spring biasing said hollow cylinder to a contact covering position; and a sealing ring mounted in said inner cylindrical surface adjacent the open outer end of said receptacle casing and engageable with the external surface of said hollow cylinder to form a seal therewith.

3. A disengageable electrical connector, as claimed in claim **1**, in which said plug part has an outer cylindrical surface mounting said first contacts; said first contact covering means comprising a cylindrical sleeve telescoped

over said outer cylindrical surface and displaceable axially relative to said plug part; an annular lip seal mounted at the open outer end of said cylindrical sleeve and engaging said outer cylindrical surface of said plug part to form a seal therewith; a cylindrical plug casing fixed axially with respect to said plug part; and a second sealing ring mounted in the inner surface of said plug casing and engaging the outer surface of said cylindrical sleeve to form a seal therewith; said resilient means comprising a second spring biasing said sleeve to contact covering position.

4. A disengageable electrical connector, as claimed in claim 2, in which said plug part has an outer cylindrical surface mounting said first contacts; said first contact covering means comprising a cylindrical sleeve telescoped over said outer cylindrical surface and displaceable axially relative to said plug part; an annular lip seal mounted at the open outer end of said cylindrical sleeve and engaging said outer cylindrical surface of said plug part to form a seal therewith; a cylindrical plug casing fixed axially with respect to said plug part; and a second sealing ring mounted in the inner surface of said plug casing and engaging the outer surface of said cylindrical sleeve to form a seal therewith; said resilient means comprising a second spring biasing said sleeve to a contact covering position.

5. A disengageable electrical connector, as claimed in claim 4, in which each of said hollow cylinder and said cylindrical sleeve has an axially deep annular recess in its inner end seating one end of the associated spring; said springs being characterized by substantial magnitudes of elongation.

6. A disengageable electrical connector, as claimed in claim 1, in which said plug part carrying said first contacts is designed as an exchangeable part; and threaded connector means securing said plug part to the remainder of said plug element.

7. A disengageable electrical connector, as claimed in claim 1, in which said plug element further includes a plug body in the form of a cylindrical member; said plug part carrying said first contacts being inserted into said cylindrical case; said plug part being formed with a plurality of pins extending longitudinally thereof and each electrically connected with an associated first contact, said pins projecting beyond the inner end of said plug part; means secured in said cylindrical case inwardly of said plug part and supporting respective sockets each engageable with the projecting end of a respective pin, said means being formed with a threaded axial recess; a screw extending through said plug part and having an end threaded into said recess to secure said plug part to said means and to said cylindrical case; and a sealing compound within said cylindrical case, said means being embedded in said sealing compound.

8. A disengageable electrical connector, as claimed in claim 1, in which said plug element and said receptacle element, when said plug element is telescoped within said receptacle element, having a degree of axial overlap sufficient to form a mechanical joint capable of absorbing substantial forces.

9. A disengageable electrical connector, as claimed in claim 1, in which each of said contact covering means is formed of electrically conductive metal; each contact covering means, when said plug element is disengaged from said receptacle element, electrically interconnecting its associated contacts to short circuit the latter.

10. A disengageable electrical connector, as claimed in claim 1, in which said respective resilient means comprises respective springs each associated with a respective contact covering means; said respective springs, when said plug element is engaged in said receptacle element, being compressed to serve as accumulators effective to automatically separate said plug element and receptacle element.

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