

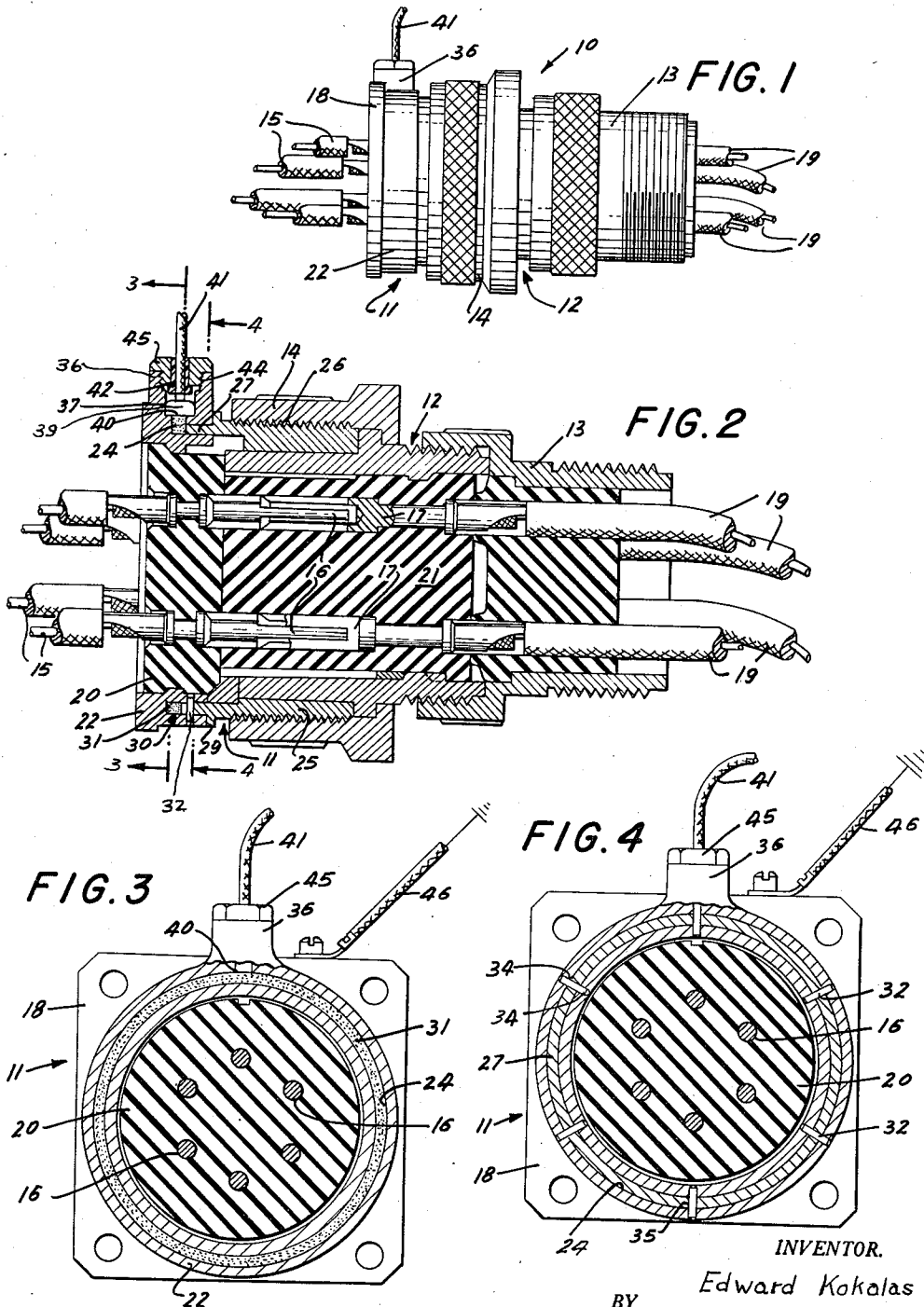
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ELECTRICAL CONNECTOR

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ELECTRICAL CONNECTOR

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This invention relates to a connector which may be broken by an explosive charge. The invention particularly relates to an electrical connector of the indicated type.

In many instances there is a need for an electrical connector, such as a power transmitting connector, which will remain secure and operative until the moment at which it is necessary to disconnect the power. Illustrative of such applications are mobile devices which require an outside source of power to start them, and which then move away from the source of starting power. Among such devices are rockets, and some airplanes, helicopters, and the like.

For the sake of safety, it is imperative that the power connection from the outside source to the device be broken before the device moves away or takes off. Thus if the power connection remains unbroken at such time, injury will result to the power cable, some part of which must break if the device is to move or fly away freely, and/or to the device itself and possibly to bystanders or operators of the device. Thus, in the case of airplanes, helicopters, and rockets, the tethering effect of the unbroken power cable to such device will cause such cable to be broken, and/or will cause the device to be appreciably diverted from its desired initial path.

The breakaway connector of the present invention has two main disconnectable parts, and is explosively operated to separate one main connector part from another. The construction of such connector is simple and rugged, and is such that the two main connector parts are driven apart substantially in a straight line by the force of an explosive acting directly between the connector parts and substantially uniformly around their peripheries. Thus the separation of the parts is positive. Neither of the two main connector parts is damaged by the separating explosion, such parts being operatively held together before the explosion by easily replaced connecting means. Accordingly, at least the part of the connector remaining behind is usable again, and the other part of the connector, which is connected to the movable device, is also usable if it returns in good condition with such movable device to the original starting or take-off position.

The invention has among its objects the provision of an improved explosive breakaway connector.

Another object of the invention resides in the provision of a connector of the type indicated which is characterized by its simplicity, ruggedness of construction, and the positiveness with which the connector parts are separated upon explosion of the charge therein.

A still further object of the invention resides in the provision of an improved explosive breakaway connector in which the main connector parts are undamaged by the explosive separation thereof, the only part or parts broken being small inexpensive replaceable means normally operatively connecting one connector part to the other.

The above and further objects of the invention will become more readily apparent upon consideration of the following specification, describing a preferred illustrative

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embodiment of the explosive breakaway connector of the invention, and of the drawing forming a part of such specification.

In the drawing:

Figure 1 is a view in side elevation of the illustrative embodiment of explosive breakaway connector of the invention.

Figure 2 is a fragmentary view in vertical axial section through the connector of Figure 1, certain parts of such connector being shown in elevation.

Figure 3 is a view in vertical section through the first main part of the connector, the section being taken along the line 3-3 of Figure 2.

Figure 4 is a view similar to Figure 3, but with the section being taken along the line 4-4 of Figure 2.

The illustrated embodiment of the explosively operated breakaway connector of the invention is designated as a whole by the reference character 10. Such connector, which in the embodiment shown generally resembles that shown in the patent to Uline et al., No. 2,563,762, has a first main part 12 which is connected to a source of electrical power supply (not shown). Part 11 is fixed to the movable device by attachment of a mounting flange 18 thereon to such device. Thus part 12 remains behind when the device to which the other, second connector part 11 is attached moves away from its starting position. Parts 11 and 12 of the connector are initially connected together in the operative relationship shown in Figure 2 by means including an internally threaded rotatable connecting sleeve 14, which is received upon a sleeve 25 externally threaded at 26. Sleeve 25 is a member of connector part 11 when the latter is initially assembled.

A number of wires 15 are connected to a similar number of prongs or male terminals 16 (six shown in Figs. 3 and 4) held in parallel spaced relationship in an insulating base member 20 of part 11. Preferably prongs 16 are spaced substantially uniformly over the area of member 20. A similar number of similarly spaced female or receptacle members 17, supported in insulating base member 21 of connector part 12, are connected by wires 19 to a source of power (not shown). Part 12 of connector 10 may be attached to a fixed support, if desired, by the externally threaded adapter 13, the insulating central insert of which also aids in mounting and sealing wires 19.

When connector parts 11 and 12 are operatively connected as shown in Figure 2, the inner end of member 21 lies within sleeve 25, being keyed thereto to prevent relative rotation therebetween by a radially inwardly projecting elongated rib (Fig. 2) received in a longitudinally extending slot in the edge of member 21. When the connector parts 11 and 12 are fully engaged with each other, prongs 16 extend deeply into their respective receptacle members 17, and the inner confronting faces of members 20 and 21 substantially abut each other. After parts 11 and 12 have been assembled by thrusting them together in the position shown, they are retained in such assembled relationship by screwing sleeve 14 onto sleeve 25.

As noted, the mating prongs 16 and receptacles 17 make connection with each other and are disconnected from each other by axial movement toward and away from each other. The breakaway connector of the invention is provided with explosively operated means whereby the main connector parts 11 and 12 may almost instantaneously be forced axially away from each other, whereby to disconnect prongs 16 from receptacles 17, and thereby to break the power connection through the connector 10 without injury to prongs 16, receptacles 17, or any other main parts of the connector 10.

As shown, connector part 11 has a generally annular shell 22, made of strong shock-resistant material such as metal, within which the insulating base 20 is mounted.

Member 20 is held from rotation with respect to shell

22 by a key connection therebetween, as shown, and against axial movement with respect to the shell by inter-engagement of an inner peripheral rib on shell 22 with an annular recess on the periphery of member 20, as shown in Figure 2. The edge of shell 22 which confronts connector part 12 has a relatively deep annular recess or channel 24 therein, in the embodiment shown such recess being rectangular in cross section. The above-mentioned externally threaded sleeve member 25, which mates with rotatable connecting sleeve 14, has the annular edge 27 thereof snugly fitting within the mouth of the annular recess 24. As shown in Figure 2, sleeve 25 is held coaxial of shell 22 by engagement of a radially outwardly directed flange 29 on the sleeve with the outer edge portion of the wall of shell 22 bordering recess 24.

Edge portion 27 of sleeve 25 extends for such distance beyond flange 29 as to form with the root of the recess an annular explosive-receiving space 30, which is at least substantially filled with an at least substantially continuous annulus of explosive 31. Preferably, as shown, the inner edge of sleeve 25 within the recess fairly snugly engages the explosive 31.

Sleeve 25 is mounted in operative position on shell 22, in the position shown in Figures 1 and 2, by a plurality of equally angularly spaced shear pins 32 which are positioned in radially directed holes 34 through the side walls of recess 24 in shell 22 and through aligned holes 35 in the end of sleeve 25 within recess 24.

Shell 22 of connector part 11 is provided with a boss 36 having a central recess 37 therein. Within recess 37 there is mounted an electrically discharged fuse or primer 39, which may be of a type similar to that shown and described in the application of Tognola, Ser. No. 459,380, filed September 30, 1954. A radially directed passage 40 is disposed within the root of boss 36, and is filled with further explosive material which, in effect, furnishes communication between the primer 39 and the annular main explosive charge 31. Primer 39 is fired or discharged by current supplied through a power wire 41, which projects through a rubber bushing 42 positioned within boss 36, the end of wire 41 inwardly of the bushing being bent sidewise or fanned out if it is of the stranded type, as in the embodiment shown, to make connection with a central contact of the primer. The bushing 42 and the inner end of wire 41 engaged thereby are retained in place, as shown in Figure 2, by a retaining nut 45 which is threadedly received in a counterbore 44 in the outer end of boss 36. Upon firing the charge, wire 41 is blown free of part 11 of the connector. The firing circuit to the primer 39 of connector 10 may be completed, unless the connector is otherwise grounded, by a ground lead wire 46, shown in Figures 3 and 4, which may be connected to the grounded frame of the movable device such as a rocket, airplane, or the like.

It will be assumed that the connector has been fired, and that its parts are now to be reassembled. The parts of shear pins 32 remaining in holes 34 in the walls of shell 22 are first knocked out. Explosive charge 31 is then placed in annular recess 24 in shell 22, after which the intermediate sleeve 25, which was disassembled from connector part 12 by the previous explosive separation, is inserted into recess 24 in the position shown in Figure 2. In such operation connector pins 16 of part 11 will be inserted in receptacles 17 of part 12 of the connector. New shear pins 32 are now inserted through holes 34 and 35 to retain the sleeve in place. Nut 45 and the fired primer 39 will have been removed from boss 36. Passage 40 in the boss is then filled with explosive to communicate with the explosive 31 in annular recess 24, following which a new electrically discharged primer 39 is placed in the cavity in boss 36. Power wire 41 and bushing 42 are then inserted and held in place by nut 45.

If desired, part 25 may have been initially removed from connector part 12 before sleeve 25 was reassembled

on shell 22 of part 11. If this is the case, after the above operations, the part 12 of the connector is then assembled with part 11, by inserting the prongs of the latter into the receptacles of the former, after which the connecting sleeve 14 is screwed home on the threads on intermediate sleeve 25.

The connector 10 is now in condition to transmit power therethrough to the movable device. After such source of power has served its purpose, as for instance to start the motor or motors of the device, and it is desired almost instantaneously to break the connector, the circuit from a source of power (not shown) through power lead 41 is closed, thereby discharging primer 39 and causing the explosive in passage 40 and in recess 24 to explode. Because the explosive is disposed substantially symmetrically around the periphery of the connector, and because the forces opposing the expanding gases caused by such explosion, namely, the friction of engagement between prongs 16 and receptacles 17, and the shear pins 32, are preferably also substantially symmetrically disposed with respect to the connector, the main portions of connector parts 11 and 12 are blown free from each other in substantially an axial direction. Part 12 and receptacles 17 of the connector remain behind. Part 11, in leaving, takes with it insulating support 21 and prongs 16. Such straight line separation of the parts not only causes all of the prongs 16 to separate substantially simultaneously from their receptacles 17, but also eliminates any possibility of bending of the prongs and receptacles, so that one or both parts 11 and 12 of the connector may be reassembled and used, providing, of course, that they are returned otherwise unharmed to the location of use.

It will be apparent from the above that the breakaway connector of the invention is simple, rugged, positive in its operation, and is economical to manufacture and operate. The explosive separation of the connector parts does not damage any of the main parts of the connector, so that the original connector parts may be used repeatedly. The explosive charge in the connector acts directly upon and substantially uniformly over the extents of the connector parts to be separated, so that the connector is sure and positive in its breakaway action.

Whereas for purposes of illustration one embodiment of the explosively operated breakaway connector of the invention has been shown and described, it is to be understood that such embodiment is illustrative only and that the invention is capable of considerable variation as to details. The invention, is, therefore, to be defined by the scope of the claims appended hereto.

What is claimed is:

1. An explosively operated breakaway connector which comprises two confronting bodies each carrying one of a cooperating pair of disconnectable electrical contacts, a recess in a first one of said bodies, said recess having a mouth confronting the second of said bodies, an explosive charge disposed in the recess, the second body having a projecting member thereon which fits within the mouth of the recess and overlies the explosive charge, a primer in communication with the explosive charge, and means breakable by explosion of the charge for holding the first and second bodies in assembled relationship.

2. An explosively operated breakaway connector which comprises two confronting bodies each carrying its respective contacts of at least one cooperating pair of disconnectable electrical contacts, an elongated recess in a first one of said bodies, said recess having a mouth confronting the second of said bodies, said recess being generally symmetrically disposed relative to the contacts on said bodies, an explosive charge disposed in the recess substantially throughout the length of the recess, the second body having a projecting member thereon which fits within the mouth of the recess and overlies the explosive charge, a primer in communication with the explosive charge, and means breakable by explosion of

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the charge for holding the first and second bodies in assembled relationship.

3. An explosively operated breakaway connector which comprises two confronting bodies each carrying its respective contacts of at least one cooperating pair of disconnectable electrical contacts, and elongated generally circumferentially extending recess channel in a first one of said bodies, said channel having a mouth confronting the second of said bodies, said channel being generally symmetrically disposed transversely of the contacts on said bodies, an explosive charge disposed in the channel substantially throughout the length of the channel, the second body having a channel-closing projecting member thereon which fits within the mouth of the channel and closely overlies the explosive charge, a primer in communication with the explosive charge, and means breakable by explosion of the charge for holding the first and second bodies in assembled relationship.

4. An explosively operated breakaway connector which comprises two confronting bodies each carrying one of a cooperating pair of disconnectable electrical contacts, means including a member disposed around the contacts for connecting the bodies in operative relationship, a circumferentially extending recess in the edge portion of a first one of said bodies, said recess having a mouth open toward the second of said bodies, an explosive charge disposed in the recess, the mouth of the recess snugly receiving an edge of the member therein outwardly of the explosive charge, a primer in communication with the explosive charge, and means breakable by explosion of the charge for holding the first body and the member in assembled relationship.

5. An explosively operated breakaway connector which comprises two confronting bodies each carrying one of a cooperating pair of disconnectable electrical contacts, means including a member disposed around the contacts for connecting the bodies in operative relationship, a circumferentially extending recess in the edge portion of a first one of said bodies, said recess having a mouth open toward the second of said bodies, an explosive charge disposed in the recess and substantially continuously therealong, the mouth of the recess snugly receiving an edge of the member therein outwardly of the explosive charge, a primer in communication with the explosive charge, and means breakable by explosion of the charge for holding the first body and the member in assembled relationship.

6. An explosively operated breakaway connector which comprises two confronting bodies each carrying one of a cooperating pair of disconnectable electrical contacts, means including a casing member enclosing the contacts for connecting the bodies in operative relationship, a circumferentially extending recess in the edge portion of a first one of said bodies, said recess having a mouth open toward the second of said bodies, an explosive charge disposed in the recess substantially continuously therealong, the mouth of the recess snugly receiving an edge of the casing member therein outwardly of the explosive charge, a primer in communication with the explosive charge, and breakable means which is sheared by explosion of the charge for holding the first body and the member in assembled relationship.

7. An explosively operated breakaway connector which comprises two confronting bodies each carrying one of a cooperating pair of disconnectable electrical contacts, means including a casing member enclosing the contacts for connecting the bodies in operative relationship, a circumferentially extending recess in the edge portion of a first one of said bodies, said recess having a mouth open toward the second of said bodies, an explosive charge disposed in the recess substantially continuously therealong, the mouth of the recess snugly receiving an edge of the casing member therein outwardly of the explosive charge, a primer in communication with the explosive charge, and angularly spaced shear pins breakable by

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explosion of the charge extending through a wall of the recess and into openings in the edge of the casing member for holding the first body and the casing member in assembled relationship.

8. An explosively operated breakaway connector which comprises two confronting parallel bodies each carrying one of a cooperating pair of disconnectable electrical contacts, means including a cylindrical member surrounding the contacts for connecting the bodies and holding them in operative position relative to each other, an annular circumferentially extending recess in the edge portion of a first one of said bodies, said recess having a mouth open toward the second of said bodies, an explosive charge disposed at the root of the recess continuously therealong, the mouth of the recess snugly receiving an edge of the casing member therein outwardly of the explosive charge, a plurality of angularly spaced shear pins connecting such edge of the casing to the first body, and a primer in communication with the explosive charge.

9. An explosively operated breakaway connector which comprises two confronting parallel bodies each carrying one of a cooperating pair of disconnectable electrical contacts, means including a circular cylindrical casing member enclosing the contacts for connecting the bodies and holding them in operative position relative to each other, an annular circumferentially extending recess in the edge portion of a first one of said bodies, said recess having a mouth open toward the second of said bodies, an explosive charge disposed at the root of the recess continuously therealong, the mouth of the recess snugly receiving an edge of the casing member therein outwardly of the explosive charge, a plurality of angularly spaced shear pins connecting such edge of the casing to the first body, and a primer in communication with the explosive charge.

10. An explosively operated breakaway electrical connector which comprises two confronting connector parts each carrying one of a cooperating pair of contacts which are disconnectable by axial movement away from each other, means including a circular cylindrical casing member enclosing the contacts for connecting the parts and holding them in operative position relative to each other, an annular circumferentially extending recess in the edge portion of a first one of said parts, said recess having a mouth open toward the second of said bodies, an explosive charge disposed at the root of the recess continuously therealong, the mouth of the recess snugly receiving an edge of the casing member therein outwardly of the explosive charge with such edge closely overlying the explosive charge, a plurality of angularly spaced shear pins connecting such edge of the casing to the first body, and a primer in communication with the explosive charge.

11. An explosively operated breakaway electrical connector which comprises two confronting connector parts each carrying one of a cooperating pair of contacts which are disconnectable by axial movement away from each other, means including a circular cylindrical casing member enclosing the contacts for connecting the bodies and holding them in operative position relative to each other, manually releasable means for connecting a first end of the casing member to a first one of the parts, an annular circumferentially extending recess in the edge portion of the second one of said parts, said recess having a mouth open toward the second of said parts, an explosive charge disposed at the root of the recess continuously therealong, the mouth of the recess snugly receiving therein the edge of the casing member at the second end thereof outwardly of the explosive charge with such edge closely overlying the explosive charge, a plurality of angularly spaced shear pins connecting such edge of the casing to the second part, and a primer in communication with the explosive charge.

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UNITED STATES PATENTS

2,563,762

Uline

Aug. 7, 1951