

[54] QUICK-RELEASE ELECTRICAL CONNECTOR

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 [22] Filed: **Aug. 6, 1970**
 [21] Appl. No.: **61,763**

[52] U.S. Cl. 339/46, 285/316, 339/45 M, 339/90, 339/91 R
 [51] Int. Cl. H01r 13/62
 [58] Field of Search 285/18, 24, 26, 27, 29, 33, 285/81, 82, 158, 160, 276, 277, 303, 308, 313-317; 287/87, 103, 104; 339/45, 46, 60, 63, 65, 66, 67, 68, 75, 89, 90, 91, 94, 176, 184

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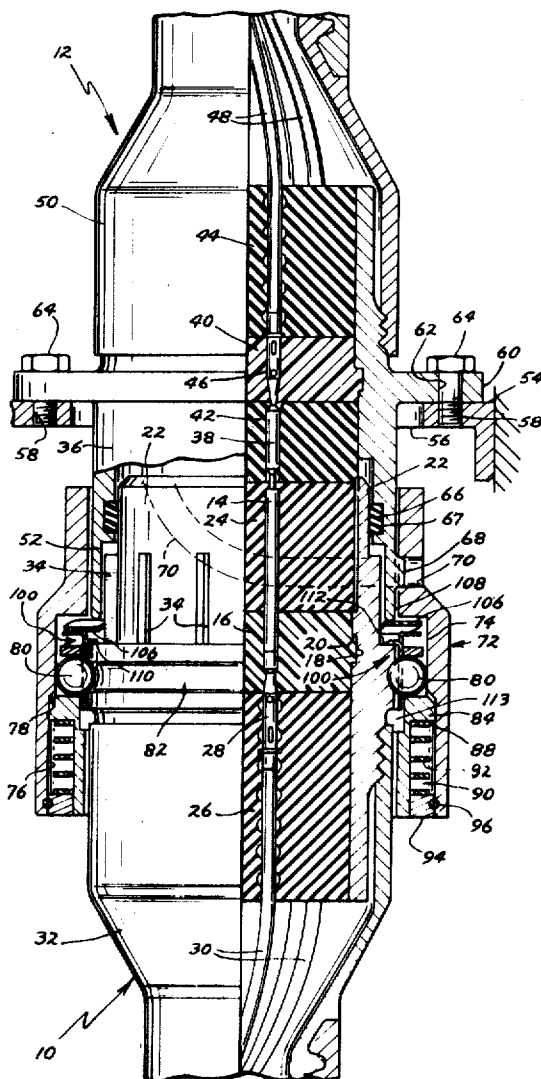
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[57] ABSTRACT

Twisting a coupling ring in the usual manner causes mating of the two components of an electrical connector. Normally, several balls, more specifically segments thereof, are confined in a circumferential groove formed on one of the components by the encircling coupling ring. When a sufficient axial force is applied, a carrier sleeve causes the balls to be displaced from the circumferential groove, the carrier sleeve overcoming the biasing action of a coil spring. The dislodgment of the balls is assured by means of a camming sleeve which also assists in returning the balls to the groove for remating the connector.

12 Claims, 5 Drawing Figures



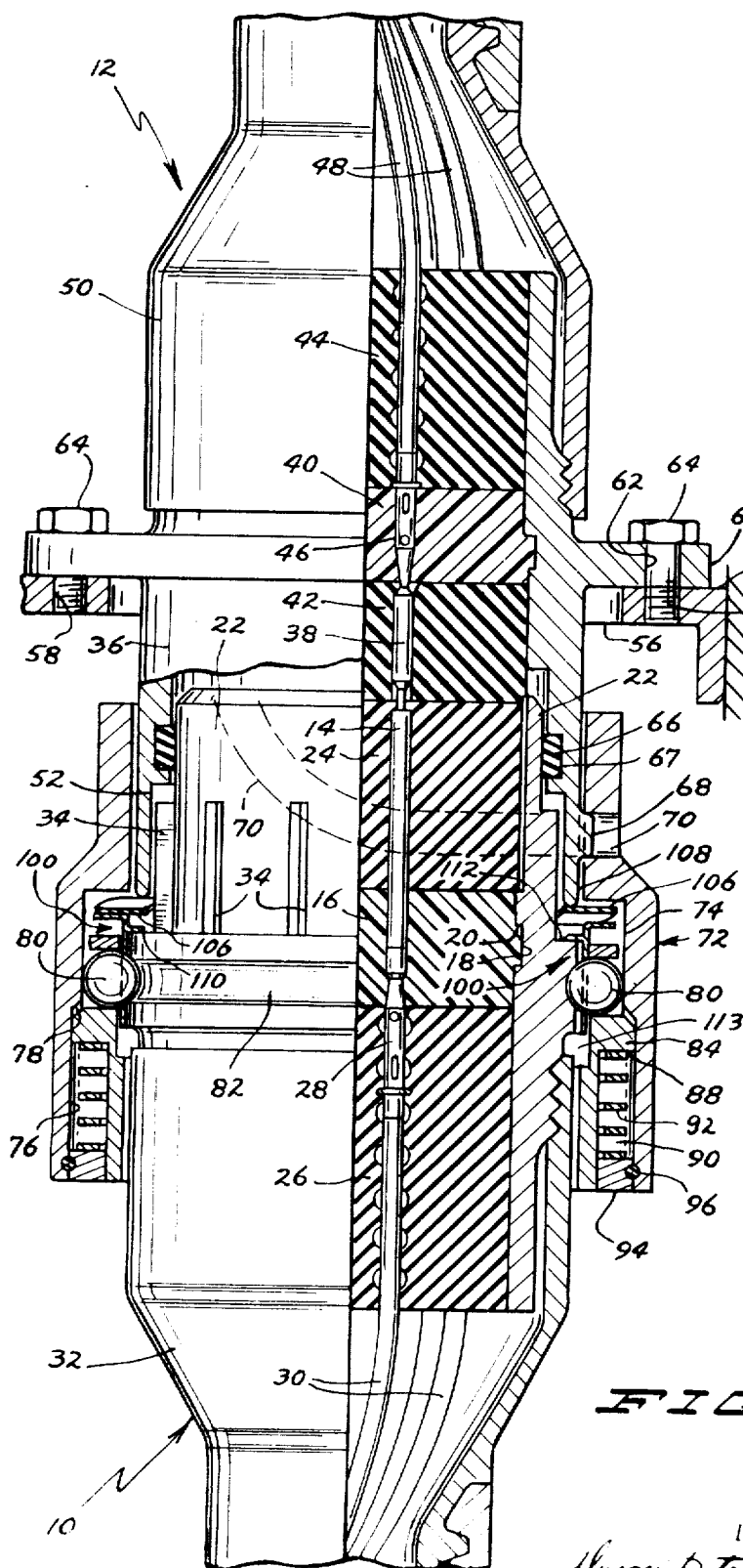


FIG. 1

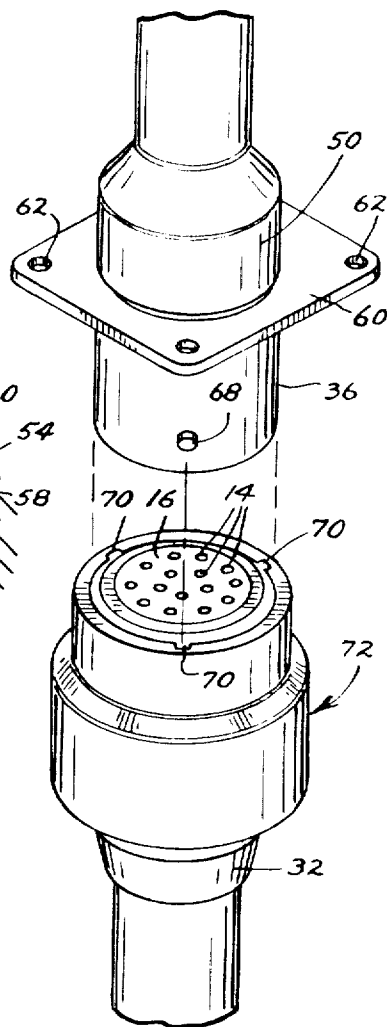


FIG. 2

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FIG. 3

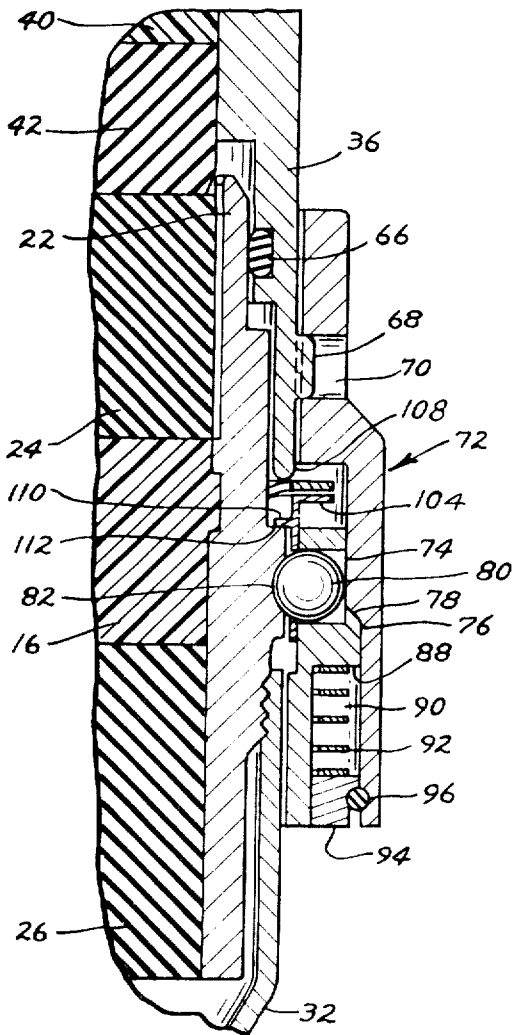


FIG. 4

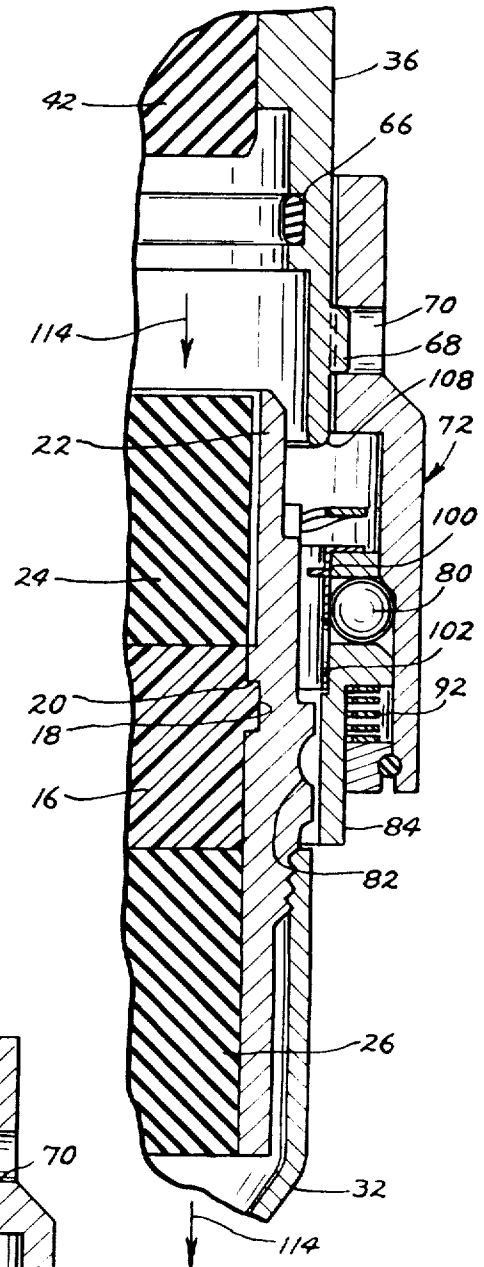
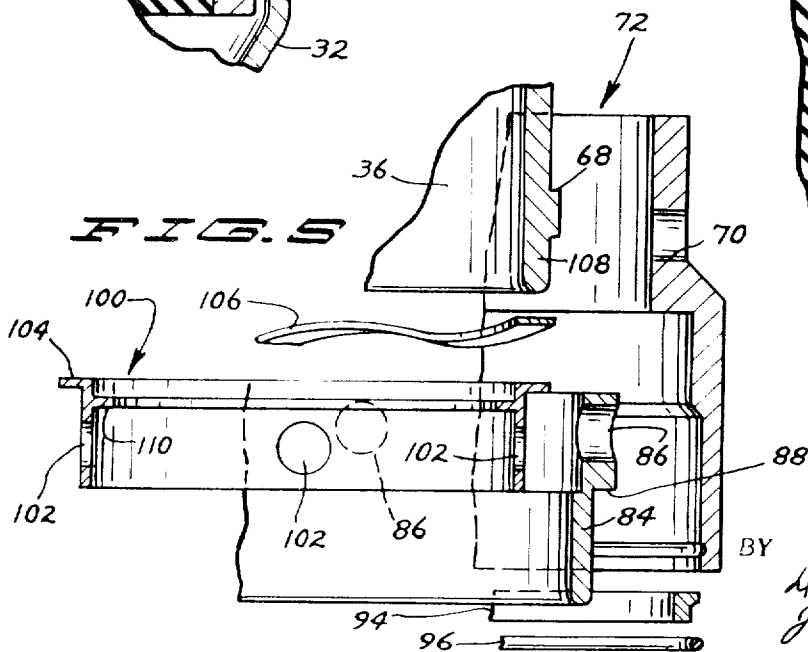


FIG. 5



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QUICK-RELEASE ELECTRICAL CONNECTOR

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates generally to electrical connectors, and pertains more particularly to a connector in which its components can be quickly separated.

2. Description of the Prior Art

Various quick-release connectors have been devised. For the most part, such connectors are relatively complicated, frequently relying upon pivotal pawls that must be forced from their latched engagement with cooperable lugs. Other types require a rotation of one member with respect to another before any release can be effected. A need, therefore, still exists for a connector that is both simple as far as its construction is concerned and also highly reliable as far as its operation is concerned.

SUMMARY OF THE INVENTION

Accordingly, one object of the invention is to provide a simple connector which will possess a high degree of reliability, both as to its ability to provide good circuit completion and its ability to release.

Another object of the invention is to provide a quick-release connector that is rotatably coupled or mated, yet which can be separated with a direct axial pull. Thus, the present invention has for an aim the provision of a connector that does not embody a different mode of coupling from prior art constructions but which can be easily released when a straight line force is applied having the requisite magnitude.

A further object of the invention is to provide a quick-release connector utilizing balls as detents for effectively maintaining the components mated plus an outward camming of the balls to their release position by the continuing pull. In other words, it is within the contemplation of this invention to provide a connector that can be rapidly released irrespective of its spatial orientation, the various balls in no way depending on gravity for displacement from their latching to unlatching position.

Yet another object of the invention is to provide an electrical connector that will be especially suited for use on aircraft. As examples, various electrical circuits must remain completed between the pilot and the aircraft or between the aircraft and missile, but be broken immediately when the pilot is ejected or the missile launched, as the case may be.

Inasmuch as in some situations it will be necessary or desirable to re-use the components, the provision of a release mechanism that can be re-employed is highly desirable as a matter of economics. It is an aim of this invention to provide a connector having such an attribute.

In furtherance of the foregoing, an additional aim of the invention is to provide a connector having no loose parts when released, there then being only two separated halves or units that can be recoupled without resort to either assembly or disassembly of any parts at any time.

Briefly, my invention employs a coupling ring that is rotated or twisted in the usual manner to effect the mating of the two connector components. During the coupling, the balls are already received in a circumferential groove, and act as mechanical intermediary to advance the associated connector component into its mated condition with the other component. A simple axial pull of sufficient magnitude is all that is required to achieve the release. The balls, during the connector's release or separation, move with the grooved component and are then cammed outwardly, thereby providing positive assurance that the balls no longer interfere with the full release. The same camming means permits the balls to be later shifted back into the groove for subsequent re-use of the connector. Any recoupling of the connector is then performed in the same manner as initially done.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a perspective view of my connector, the two components being depicted in a spaced relation prior to effecting a coupling thereof;

FIG. 2 is an enlarged elevational view of the components in a mated or coupled relationship, portions of the connector being shown in section in order to expose to view parts that would otherwise be concealed;

FIG. 3 is a fragmentary sectional view corresponding generally to the right portion of FIG. 2, the view being on a somewhat larger scale but still illustrating the relationship of the parts before a downward axial pull has been applied to the lower connector components;

FIG. 4 is a view corresponding to FIG. 3 but with the release of the lower component completed so that it can continue downwardly without interference, and

FIG. 5 is an exploded view of several important members but with the balls of FIGS. 2, 3 and 4 omitted.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Although the connector exemplifying my invention may be oriented in any spatial position, the various views show the connector disposed vertically. As far as understanding the present invention, the lower half or connector component is denoted generally by the reference numeral 10, this being the more important half of the overall connector. The other connector component has been given the reference numeral 12.

Describing the connector component 10, it will be discerned from FIG. 2, more specifically the right half of FIG. 2, that a plurality of socket contacts 14 are employed, only one of such contacts appearing. The socket contacts 14 are held in a rigid dielectric contact retainer 16 that possesses a flange at 18. The flange 18 abuts against a shoulder 20 formed internally of a metallic barrel 22. A resilient insert 24 confronts one face of the contact retainer 16, whereas a resilient grommet 26 confronts the other face.

The socket contacts have tubular portions at 28 for anchoring the bared ends of a plurality of cable conductors 30. A backshell 32 is threadably engaged with the barrel 22 and encases the conductors 30 as they enter the component 10 via the grommet 26. As can be seen from the left portion of FIG. 2, several keys 34 are provided and the function of these keys will presently be described.

Referring now to the construction of the second connector component 12, it will be perceived that it includes a barrel 36 containing therewithin a plurality of pin contacts 38 corresponding in number to the previously mentioned socket contacts 14.

The pin contacts 38 are held in a rigid dielectric contact retainer 40 which functions in the manner of retainer 16. A resilient insert 42 confronts one side of the retainer 40 through which the contacts 38 extend, whereas a resilient grommet 44 confronts the other. As with the contacts 14, the contacts 38 have tubular portions 46, the bared ends of conductors 48 being crimped or otherwise anchored therein. A backshell 50 encircles these conductors 48 as they enter the grommet 44. It might be explained with respect to the keys 34 that one keyway identified by the numeral 52 appears at the left in FIG. 2; additional keyways are provided to accommodate therein the other keys 46 but are not visibly located.

Owing to the fact that the lower component 10 is to be pulled downwardly in separating it from the component 12, a fixed bracket or supporting plate 54 has been included in FIG. 2, this bracket having a relatively large central opening 56 therein and a number of tapped mounting holes 58. An outer flange 60 formed on the barrel 36 confronts the plate 54 and prevents downward movement of the upper component 12 during separation, the flange having untapped mounting holes 62 therein through which bolts 64 extend.

Disposed between the barrels 22 and 36 is a resilient O-ring 66, being located in a groove 67 formed internally of the barrel 36. Projecting radially from the barrel 36 are conventional

bayonets or lugs 68 that extend into helical ramp grooves or slots 70 formed on the interior of a coupling ring 72. Thus, when the coupling ring 72 is rotated or twisted in one direction, the ring 72 is moved toward the connector component 12.

Describing now the salient parts that enter into the practicing of my invention, it is to be noted that the coupling ring 72 has a first bore portion 74 that is somewhat smaller in diameter than a longitudinally displaced second bore portion 76. Intermediate the bore portions 74, 76 is a third bore portion 78 that provides a sloping surface angling between the portions 74 and 76 for a purpose that will be explained later.

Any preferred number of balls 80 function as detents, the inner segments of the balls 80 being received in a circumferential groove 82 formed around the barrel 22. A cage or ball-carrying sleeve 84 has a number of radial openings 86, there being one such opening 86 for each ball 80. Longitudinally adjacent the openings 86 is an external shoulder 88 on the carrier sleeve 84. Actually, an annular space 90 exists between the larger diameter bore portion 76 and the portion of the sleeve 84 extending from said shoulder 88. It is within the annular space 90 that a coil spring 92 is confined, one end thereof abutting against the shoulder 88 and the other end against a stop member 94 fixedly held within the coupling ring 72 by a circular wire or washer 96.

Attention is now called to a camming sleeve 100 of relatively thin stock having circular openings 102 of a diameter less than the diameter of the balls 80, these openings 102 having an angular spacing corresponding to that of the openings 86 in the carrier sleeve 84. In this way, the balls 80, more specifically the inner segmental portions thereof, can be normally received in the circumferential groove 82, yet easily dislodged or displaced therefrom when the camming sleeve 100 is shifted in an axial direction as will be made manifest below. In the accomplishing of the shift action, an outwardly directed flange 104 abuts a wave washer 106 which in turn abuts the end of the barrel 36 that has been labeled 108. The camming sleeve 100 also has an inwardly directed flange 110 normally engaging a shoulder 112 formed on the barrel 36. The wave washer 106 performs two functions. First, it presses against the end 108 of the barrel 36, forcing this member upwardly (in the position in which the components 10, 12 have been illustrated) so that the bayonets or lugs 68 integral therewith are urged against the detent or closed ends of the ramp grooves 70. In this way, the coupling ring 72 is retained in engagement with the component 12, more specifically the barrel 36 thereof, after the component 10 has been pulled or separated therefrom. Secondly, the wave washer 106 holds the camming sleeve 100 downwardly after the components 10, 12 have been pulled apart so that the balls 80 cannot return to the smaller diameter bore portion 74, thereby making it possible to re-insert the barrel 22 of the component 10, as will be better understood when considering the hereinafter presented operational description.

There is a counterbore at 113 in the carrier sleeve 84 that extends sufficiently lengthwise so as to permit axial shifting of the camming sleeve 100.

FIG. 5, which is an exploded view, shows to better advantage the details of the coupling ring 72, the carrier sleeve 84, the camming sleeve 100, and the wave washer 106, as well as portions of the elements 94, 96 for holding the coil spring 92 captive; the spring 92, however, is not illustrated in FIG. 5. It will be understood that the elements appearing in FIG. 5 have been spatially displaced, as the term "exploded" denotes, in several directions in an effort to portray the respective configurations of these specific elements.

OPERATION

Having presented the foregoing description, the manner in which my electrical connector operates will now be given. Accordingly, when the connector components 10 and 12 are to be coupled together, the lower component 10 is moved up-

wardly from the position illustrated in FIG. 1 so that the lugs 68 enter the helical ramp grooves 70, the ends of the grooves 70 being visible in FIG. 1. Also, the various keys 34 enter the keyways 52 (only one being visible in FIG. 2). The keys 34 thereby assure rectilinear movement and the necessary alignment of the contacts 14, 38 during the coupling or mating of the components 10, 12.

During the coupling of the connector components 10, 12 by means of the coupling ring 72, the balls 80 reside in the circumferential groove 82, being held thereby by reason of the diameter of the first bore portion 74 being such that the balls 80 cannot move out of the groove 82. FIGS. 2 and 3 pictorially show the balls 80 in such a confined condition. Hence, the twisting of the coupling ring 72 causes the component 10 to be advanced upwardly with respect to the component 12 in the effecting of an engagement of the contacts 14 with the contacts 38.

Whereas rotating or twisting the coupling ring 72 mates the components 10 and 12, the component 10 can be pulled axially, that is downwardly, from the component 12 to separate the two connector halves. Comparison of FIGS. 3 and 4 shows this action, the disengagement nearing completion in FIG. 4.

Describing now what transitionally takes place, it will be recognized that the condition or position of the balls 80 as set forth in FIG. 3 is changed from that condition to the condition appearing in FIG. 4. In other words, as the component 10 is pulled downwardly, as indicated by the arrows 118 in FIG. 4, the groove 82 causes the balls 80 to move therewith and act against the sides of the radial openings 86 formed in the carrier sleeve 84 so that the sleeve 84 moves downwardly too. The biasing action of the coil spring 92 is overcome as the detachment progresses, this spring compressing sufficiently so that the balls 80 can move into the larger diameter bore portion 76.

Actually, it is the function of the camming sleeve 100 to force the balls outwardly into the larger diameter bore portion 76. This is done under the influence of the wave washer 106, the spring action supplied by the wave washer 106 acting against the outwardly directed flange 104 (and reacting against the end 108 of the barrel 36) to shift the camming sleeve 100 from the position in which it appears in FIGS. 2 and 3 to that in which it appears in FIG. 4. Stated somewhat differently, the shifting of the camming sleeve 100 causes the portion thereof circumjacent the openings 102 to bear or cam against the balls 80, thereby forcing the balls 80 radially outwardly by virtue of the spherical segments normally received in the circumferential groove 82 being acted upon by the adjacent cylindrical portion of the camming sleeve 100 as clearly illustrated in FIG. 4.

Owing to the continued engagement of the lugs 68 in the ramp grooves 70 (maintained so by the action of the washer 106), the coupling ring 72 remains with the component 12. A reverse rotation or twist imparted to the coupling ring 72 will separate it for later use or it can be left in place as hereinafter explained.

Assuming now that the components 10 and 12 are to be remated, then the component 10 is thrust axially into the coupling ring 72 and sufficient longitudinal movement will cause the shoulder 112 to engage the inwardly directed flange 110 so that the camming sleeve 100 is moved upwardly from the position in which it is depicted in FIG. 4 to that in which it is shown in FIG. 3. The upward movement overcomes the spring action supplied by the wave washer 106 and the sloping surface 78 causes the balls 80 to move inwardly when the various openings 106 move into radial registry therewith. Further upward movement shifts the balls 80 fully into their confined condition, this being the condition appearing in FIG. 3 (and also FIG. 2). Such action can be achieved irrespective of whether the coupling ring 72 remains on the component 12 or not. However, a mechanical advantage is derived by reason of the helical grooves 70 if the coupling ring is first removed from the component 12, pressed on the component 10 and then twisted onto the component 12 as initially described.

Although it should be readily apparent that my electrical connector will find considerable utility in various situations, one specific situation exists where a pilot must make an immediate disconnection of the components 10 and 12. All he has to do is to pull downwardly on the component 10 to effect the release. This can be done very quickly. On the other hand, if a pilot is to eject himself from the cockpit of a plane, the component 10 can be the upper one and is then simply pulled along with the pilot during the ejecting procedure in the same manner that the launching of a missile would produce or accomplish the release.

The degree of force required to effect the release can be governed by the strength of the coil spring 92. If desired, the spring retainer 94 can be in the form of an externally threaded nut so as to be engaged within the coupling ring 72, when internally threaded, to vary the degree of spring action and thereby determine the force required to accomplish the separation.

I claim:

1. A releasable connector comprising first and second connector components having interengaging contacts when mated, said first connector having a peripheral groove, a plurality of ball members having inner segments thereof received in said groove, means engageable with said second connector component for normally engaging outer segments of said ball members to cause the inner segments of said ball members to remain in said groove and thereby retain said first and second connector components in a mated relation, said means including a coupling ring formed with a first bore portion having an internal diameter of a size to confine segments of said ball members in said groove and an enlarged second bore portion of sufficient internal diameter to accommodate said ball members when displaced from said groove, a carrier sleeve for normally assisting said coupling ring in retaining said ball members in said first bore portion, and spring means biasing said carrier sleeve member in the direction of said first bore portion, said spring means yielding to permit movement of said ball members into said second bore portion.

2. A releasable connector in accordance with claim 1 including a third bore portion intermediate said first and second bore portions, said third bore portion providing a sloping surface for urging said ball members inwardly toward said groove when said carrier sleeve member is moved in the direction of said first bore portion.

3. A releasable connector in accordance with claim 2 in which said carrier sleeve member is provided with angularly disposed openings for receiving each ball member.

4. A releasable connector in accordance with claim 3 including a camming sleeve member innerjacent said carrier sleeve, said camming sleeve member having a plurality of circular openings of smaller diameter than the ball members but sufficiently large to permit the inner segments of said ball members to extend into said groove, and additional spring means normally biasing said camming sleeve member in the direction of said second bore portion so as to cause displacement of said ball members from said groove when said carrier sleeve member moves toward said second bore portion.

5. A releasable connector in accordance with claim 4 in which said additional spring means constitutes a wave washer, said camming sleeve member having an outwardly directed portion so as to be engaged by said wave washer and said camming sleeve member having an inwardly directed portion, said first connector component having a shoulder engageable by said last-mentioned portion of said camming sleeve member.

6. A releasable connector comprising first and second connector components, having interengaging contacts when mated, said first connector component having a circumferential groove, a plurality of balls having segments thereof received in said groove, a coupling ring, interfitting lug and helical groove means associated with said second connector and said coupling ring so as to cause longitudinal advancement of said coupling ring when rotated in one direction, said

coupling ring having a first diameter portion to retain the inner segments of said balls in said circumferential groove and a second diameter portion of a size sufficient to permit said balls to move out of said circumferential groove, a carrier sleeve having a radially directed opening for each ball, spring means urging said carrier sleeve into said first diameter portion, a camming sleeve having a plurality of openings therein for accommodating larger portions of said balls to permit said segments to be received in said circumferential groove and to force said balls outwardly when said camming sleeve is shifted axially, said camming sleeve having an outwardly directed flange, and a wave washer disposed so as to bear against the outwardly directed flange on said camming sleeve, whereby when said first component is pulled axially with respect to said second component, said spring means compresses to permit said carrier sleeve to move longitudinally to a position such that the balls are free to leave said circumferential groove, the spring action provided by said wave washer forcing said camming sleeve member in a direction to force said balls outwardly from said circumferential groove.

7. A releasable connector in accordance with claim 6 in which said first component has a shoulder and said camming sleeve has an inwardly directed flange engageable with said shoulder, the latching position of said balls when in said circumferential groove maintaining said camming sleeve in a position to cause its outwardly directed flange to press against said wave washer to flatten same, whereby when said first component is pulled away from said second component said wave washer acts to shift said camming sleeve to force said balls outwardly and thus release said first component from said second component and whereby said shoulder acts against said inwardly directed portion of said camming sleeve to return said balls to said circumferential groove and to again flatten said wave washer when said first component is relatched with said coupling ring.

8. A releasable connector in accordance with claim 7 in which said second connector component has a barrel, said lug means being integral with said barrel and said groove means being formed in said coupling ring, said wave washer reacting against one end of said barrel to maintain said coupling ring in engagement with said second component after said first component has been pulled therefrom.

9. A releasable connector comprising first and second connector components having interengaging contacts when mated, said first connector component having a groove extending therearound, a coupling ring, interfitting lug and helical groove means associated with said second connector and said coupling ring so as to cause longitudinal advancement of said coupling ring when rotated in one direction, said coupling ring having a first diameter bore portion and a second diameter bore portion of a larger size than said first bore portion, a ball carrier sleeve having at least one radially directed opening, at least one ball member received in said radially directed opening and having a segment thereof received in said groove, a camming sleeve having an opening therein for accommodating a larger portion of said ball member to permit said segment thereof to be received in said groove and to force said ball member outwardly when said camming sleeve is shifted axially with respect to said groove, yieldable means actuated by said coupling ring for urging said carrier sleeve in the direction of said first bore portion when said coupling ring is rotated in a direction to cause said interfitting lug and helical groove means to produce mating of the contacts on said first connector components with the contacts on said second connector component to yieldably maintain said ball member in said first bore portion, whereby said yieldable means yields sufficiently when said first connector component is pulled axially with respect to said second connector component to permit said ball member to move from said first bore portion into said second bore portion, thereby allowing said ball member to move outwardly from said groove and thereby permit separation of said interengaging contacts from their mated condition.

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10. A releasable connector in accordance with claim 9 in which said yieldable means includes a coil spring having one end engaging said ball carrier sleeve and means bearing against the other end thereof movable in unison with the advancement of said coupling ring.

11. A releasable connector in accordance with claim 10 including spring means acting on said camming sleeve to force said ball member outwardly when said ball member has been shifted axially into said second bore portion.

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12. A releasable connector in accordance with claim 11 in which said last-mentioned spring means bears against a portion of said second connector component, said last-mentioned spring means being compressed as said coupling ring advances said first connector component in the direction of said second connector component to effect mating of said interengaging contacts.

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