

[54] CONNECTOR LOCKING MECHANISM

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[58] Field of Search 339/16, 75, 91, 45, 143, 339/177, 217, 258 A; 24/211; 85/81; 285/319, 308

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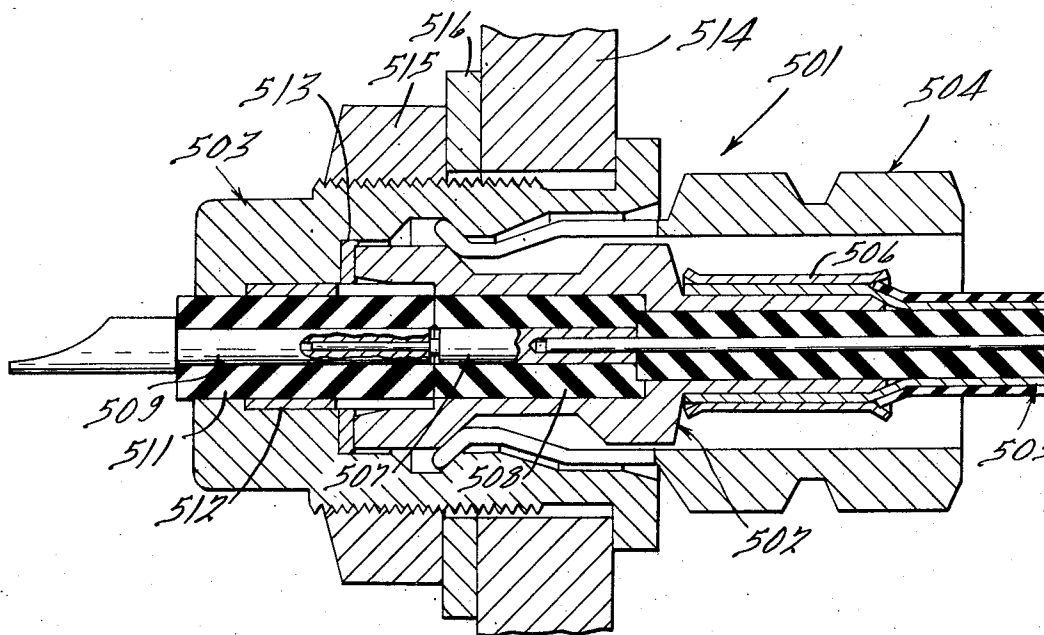
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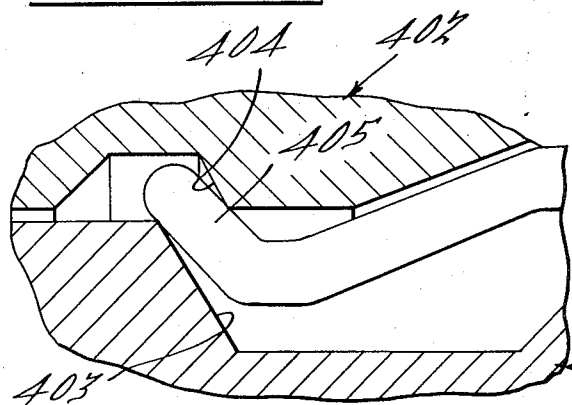
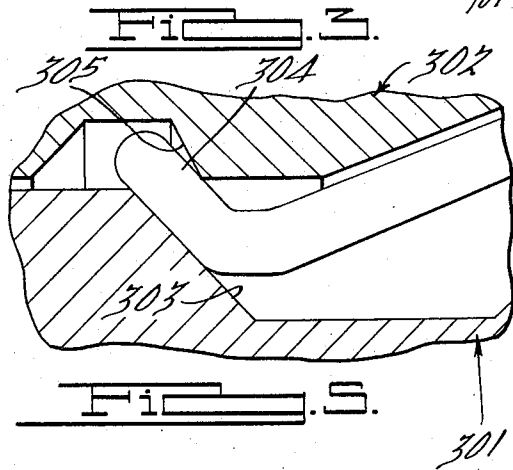
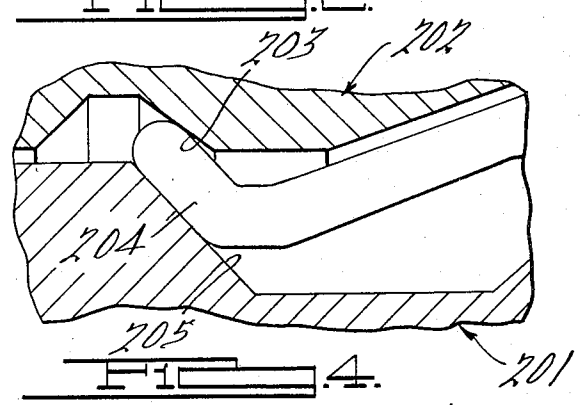
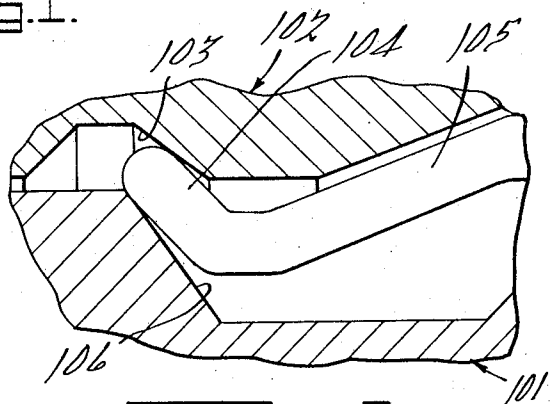
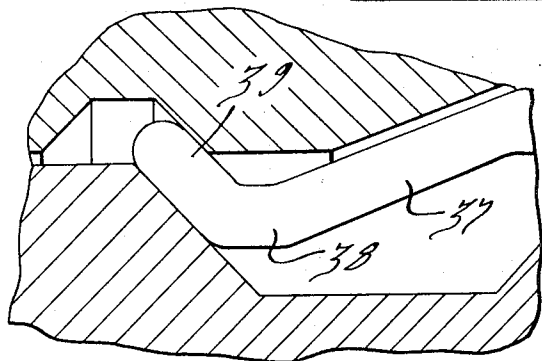
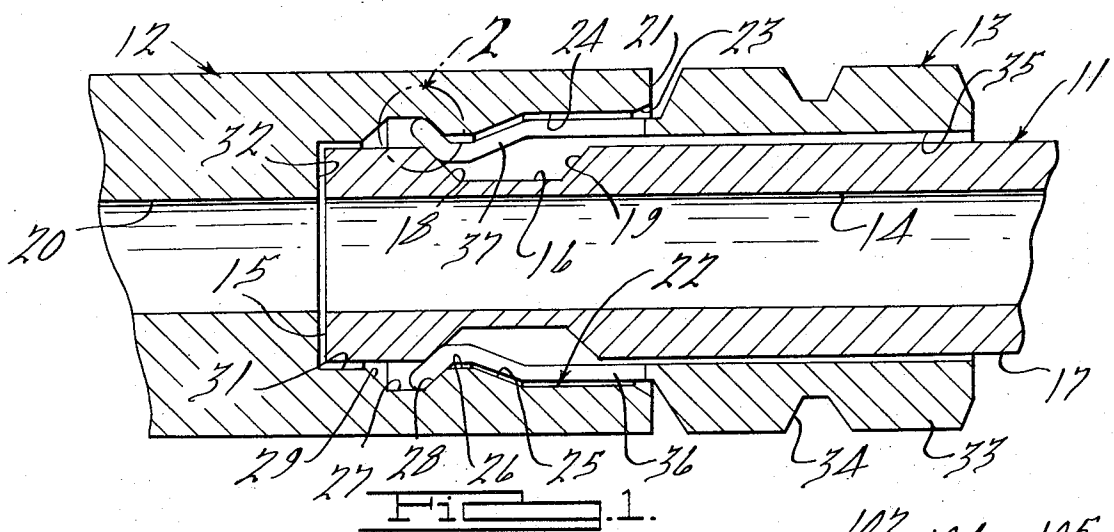
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[57] **ABSTRACT**

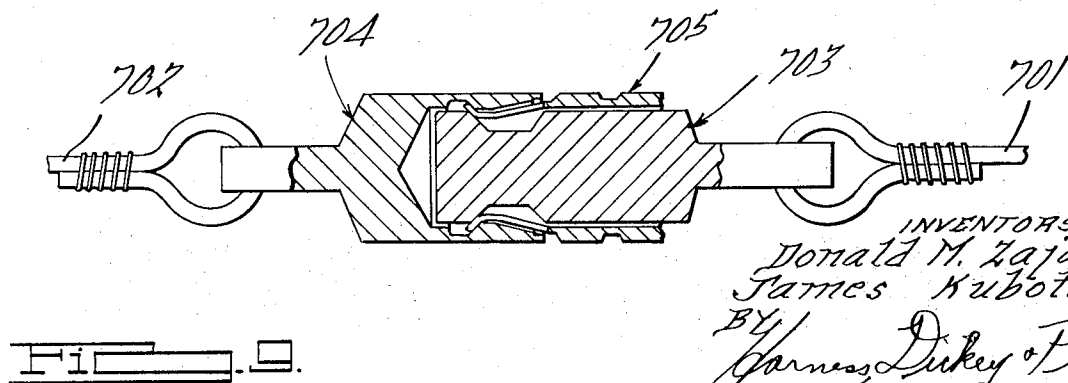
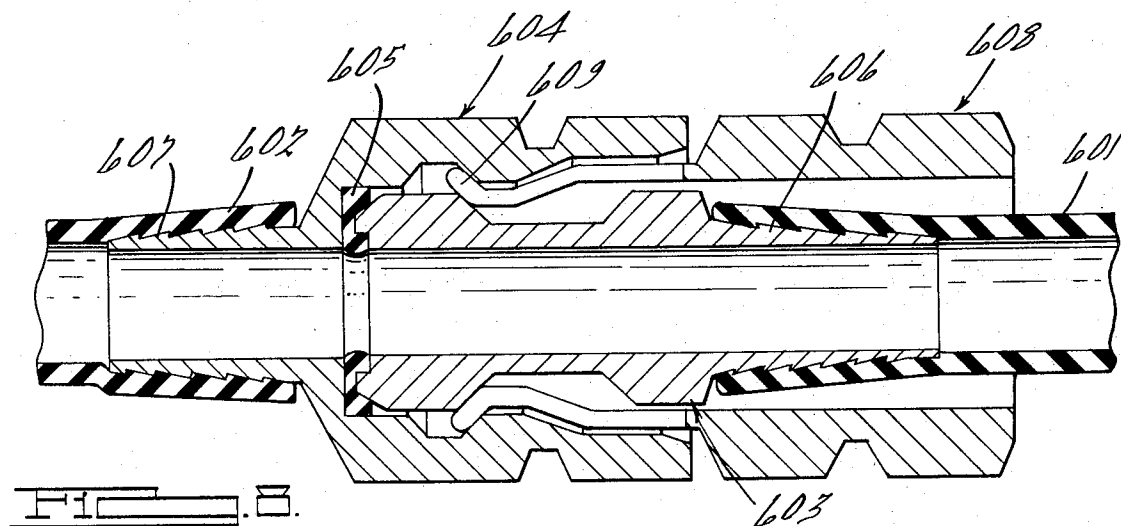
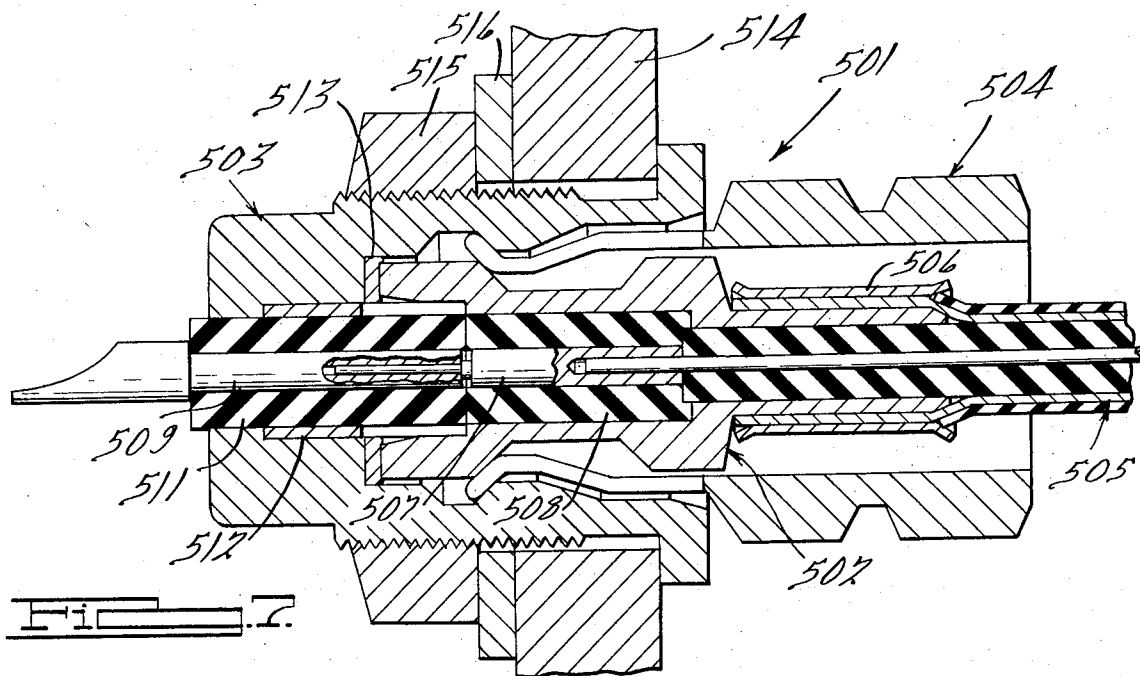
A quick-disconnect device for electrical, mechanical or hydraulic couplings. Plug and receptacle members have longitudinally offset annular grooves with facing locking ends. A coupling sleeve on one member has spring fingers with inclined ends insertable between the facing locking ends to resist axial separating forces of the plug and receptacle members. Uncoupling is effected by sliding the sleeve to extract the fingers. Modifications of the invention control connector disengagement with varying predetermined axial separating forces on the plug and receptacle members.

16 Claims, 9 Drawing Figures





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CONNECTOR LOCKING MECHANISM

This is a continuation of application Ser. No. 166,363 filed July 16, 1971, now abandoned.

BACKGROUND OF THE INVENTION

1. Field of the Invention

The invention relates to couplers of the quick-disconnect type, and although the invention is particularly useful for electrical conduits, it is also applicable to hydraulic or mechanical connections. The invention has particular use in discouraging the pulling of an electrical wire or cable in order to disconnect the coupling, such pulling being likely to damage the terminal.

2. Description of the Prior Art

Applicant is aware of no prior connectors of this type having a similar construction. Various connectors are available having bayonet slots, sliding springs or pressed plungers, but they are generally of a much more complex and expensive construction. In addition to the art of record in the parent application, the constructions of the following United States patents are also known: Brown et al No. 3,136,366, Fischer No. 3,160,457, and Stevens No. 3,639,890.

BRIEF SUMMARY OF THE INVENTION

The connector of the present invention is much simpler and less expensive than previously known connectors of this type, and it is extremely positive and reliable in its action.

It is a special feature of the invention that the two parts of the coupling can be joined or separated by a simple straight in or straight out, push-pull kind of motion. No twisting or turning is necessary as in a bayonet or threaded connection, for example. Furthermore, the present invention has the advantage that the two parts of the connector can be joined and locked together by simply pushing one part onto the other. This is a one hand operation. Separate manipulation of two or more parts with both hands to effect coupling is not necessary as in the case of many prior art connectors.

More particularly, the instant connector comprises interfitting plug and receptacle members provided with confronting annular surfaces, formed with offset annular grooves which have facing locking ends, preferably in the form of frustoconical surfaces. A coupling sleeve is slidably mounted on one of the members and has axially extending spring fingers with inclined ends.

To couple, the plug member and the coupling sleeve are simply pushed into the receptacle member with one hand while the receptacle member is held with the other hand. This simple operation automatically locks the two members securely together. The inclined ends of the locking fingers snap into the groove of the receptacle as the latter is pushed home and they wedge firmly between the locking ends of the grooves to positively resist any separating force exerted directly on the plug and receptacle members by reason of the fact that the separating force merely causes compression of the spring ends between the locking ends of the grooves. Uncoupling is effected merely by slidably retracting the coupling sleeve so as to withdraw the spring ends from between the locking ends of the grooves.

Variations of the invention are provided to permit disengagement despite large or moderate axial separating forces on the carriers, that is, the conduits or cables secured to the plug and receptacle members. Other

modifications are provided which prevent disengagement of the coupling with light, moderate or heavy pulling forces on the carriers. In all embodiments, coupling and uncoupling of the connector will take place only by applying the proper axial forces to the coupling sleeve. Disengagement can never take place when the separating forces are applied to the carriers only.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a cross-sectional view in elevation of the connector.

FIG. 2 is an enlarged cross-sectional view in elevation of the area marked 2 in FIG. 1, showing the manner in which the ends of the spring fingers lock the plug and receptacle members in their coupled position.

FIG. 3 is a view similar to FIG. 2 but showing a second embodiment of the invention in which the connector can be uncoupled despite a relatively large axial separating force applied to the carriers.

FIG. 4 is a view similar to FIGS. 2 and 3 showing a "semi-open" locking angle which permits connector disengagement despite a moderate axial separating force applied to the carriers.

FIG. 5 is a similar view showing still another embodiment of the invention in which a "semi-closed" locking angle prevents connector disengagement with moderate to heavy axial separating forces on the carriers.

FIG. 6 illustrates another variation of the invention in which fully closed locking angles prevent connector disengagement with light axial separating forces on the carriers.

FIG. 7 is a cross-sectional view in elevation illustrating a typical electrical connector application using the connector locking mechanism of this invention.

FIG. 8 is a cross-sectional view in elevation showing the application of the invention to a hydraulic coupling, and

FIG. 9 is a cross-sectional view in elevation showing how the invention can be applied to a mechanical coupling.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring first to the embodiment of FIGS. 1 and 2, the connector comprises three basic parts, a plug member generally indicated at 11, a receptacle member generally indicated at 12, and a coupling sleeve generally indicated at 13. All three of these elements 11, 12 and 13, and therefor the connector itself, are of circular cross-sectional shape but they may be of rectangular or other suitable shape. The plug and receptacle members are normally secured to the ends of conduits, cables, wires, hoses, or other elongated elements for electrical, mechanical or hydraulic uses. These elements, not illustrated in FIGS. 1 to 6 but shown in FIGS. 7 through 9, are generically referred to herein as "carriers."

As suggested, the plug member 11 here shown is of elongated generally cylindrical shape and has an inner bore 14 extending therethrough. The end 15 of plug member 11 here shown is flat, and an annular groove 16 is formed on the external annular surface 17 of the plug. Groove 16 has a pair of frustoconical surfaces 18 and 19 at its opposite ends.

The receptacle member 12 is of larger diameter than the plug member 11 and it has a bore 20 extending therethrough which is aligned with the bore 14 when

the connector is coupled. The outer end 21 of the receptacle member 12 is flat, and an annular surface generally indicated at 22 extends inwardly therefrom and confronts the surface 17 of the plug. The surface 22 is formed with a flared entrance 23 which leads to a cylindrical bore 24, and the latter in turn is followed by a frustoconical ramp 25. This ramp 25 in turn is followed by a relatively short cylindrical surface 26 which leads to an annular groove 27 having frustoconical end surfaces 28 and 29. A short cylindrical bore 31 extends inwardly from the groove 27 and ends in a flat surface 32. The entire distance from the surfaces 21 to 32 is such that the plug member 11 may enter the receptacle member 12 sufficiently to achieve the locking condition described below. In this position, groove 16, which may be termed the "inner" groove, and groove 27 (the "outer" groove) are axially offset. It should be noted that the diameter of surfaces 26 and 31 is only slightly greater than the external diameter of plug member 11, and that when the plug member is fully entered into the receptacle member frustoconical surfaces 18 and 28, which are of substantially the same angle, are in facing spaced relation.

Coupling sleeve 13 is slidably mounted on surface 17 of plug member 11 and comprises a main finger gripping portion 33 having one or more gripping grooves 34, and a central bore 35 which rides on the plug member. A plurality of circumferentially spaced spring fingers 36 extend axially from one end of sleeve 13. Each of these fingers has a main axially extending portion followed by an inwardly tapered portion 37, a short axially extending portion 38 and then flared ends 39. The distance of fingers 36 from the sleeve centerline is such that in their normal unstressed position they will assume the approximate configuration shown in FIGS. 1 and 2. In this position, portions 38 of the fingers will be disposed in groove 16 of the plug, retaining sleeve 13 thereon. The spring fingers are capable of being flexed inwardly when ends 39 engage ramp 25 as the connector is being coupled, and then springing outwardly between locking surfaces 18 and 28.

In operation, assuming an initial condition in which the plug and receptacle members are uncoupled and coupling sleeve 13 is in same position on the plug member within the limits of its travel permitted by the groove 16, the sleeve is held in one hand and the receptacle member is held in the other hand and the two are simply pushed together. This motion, of course, also causes the plug member 11 to be inserted into the receptacle member 12 until the surface 15 of the plug member engages or substantially engages the surface 32 of the receptacle member. When the members 11 and 12 first come together in the coupling motion, the finger ends 39 engage the ramp 25, causing the fingers to flex inwardly, and as the coupling motion proceeds, the spring finger ends are guided by surface 26 until they spring outwardly between the locking end of the grooves 16 and 27 for mutual engagement by the surfaces 18 and 28. The connector will then be in its locked condition.

It will be noted from FIG. 2 that any axial forces on the connector members tending to separate them will be resisted by a compressive force created in ends 39 of spring fingers 36. Thus, one cannot uncouple the connector by an axial separating force supplied to the carriers alone.

To uncouple the connector, a rightward force will be exerted by the operator's fingers on coupling sleeve 13, sliding finger ends 39 out of the space between surfaces 18 and 28. The fingers will be bent inwardly, entering groove 16 with the finger ends passing ramp 25. The connector will then be unlocked and may be uncoupled.

FIG. 3 shows a modification of the invention which is basically similar to that previously described but in which the connector can be uncoupled despite fairly large axial separating forces applied to plug member 101 and receptacle member 102. In this case, frustoconical surface 103 on receptacle member 102 has a shallower angle than that of end 104 of spring member 105. Frustoconical surface 106 of plug member 101 has a steeper angle than that of spring end 104. The result is that the frustoconical surfaces of the plug and receptacle members will not fully engage the spring finger ends as in the case of the first embodiment. Therefore, withdrawal frictional resistance of the spring fingers will be minimized, permitting uncoupling of the connector despite fairly large axial separating forces applied to the plug and receptacle members.

FIG. 4 illustrates a third embodiment of the invention in which uncoupling is permitted despite moderate axial separating forces applied to the plug and receptacle members. The plug member is indicated at 201 and the receptacle member at 202, and frustoconical surface 203 of the receptacle member has an open locking angle with respect to spring finger end 204, as in the previous embodiment. However, frustoconical surface 205 of member 201 is angled similarly to spring finger end 204. With only one surface rather than two in an "open" condition with respect to the spring finger ends, uncoupling can be effected even though a moderate axial separating force is being applied to the plug and receptacle members.

FIG. 5 illustrates a fourth embodiment of the invention in which uncoupling of the connector will be prevented if moderate to heavy axial separating forces are applied to the plug and receptacle members. The plug member is indicated at 301 in FIG. 5 and the receptacle member at 302. In this case, frustoconical surface 303 of plug member 301 has the same angle as spring end 304. However, surface 305 of member 302 has a steeper angle than the spring end. This will create a relatively large frictional force which keeps the spring fingers locked in place when moderate to heavy separating forces are applied to the plug and receptacle members. With only light or with no separating forces, uncoupling can be accomplished by shifting coupling sleeve 13 to the right as described above.

FIG. 6 is a fifth embodiment of the invention in which even light axial separating forces on the plug and receptacle members will prevent uncoupling of the connector. The plug member is here indicated at 401 and the receptacle member at 402. Both frustoconical surfaces 403 and 404 of the plug and receptacle members respectively have steeper angles than spring ends 405. The result will be that very large frictional forces will be created even with light axial separating forces on the two members, thus not permitting withdrawal of the spring fingers by a rightward force applied to the coupling sleeve.

It will be noted that the degrees of the angular differences between the frustoconical surfaces and the spring member ends may be varied in all of these embodi-

ments, thus achieving any desired combination of closed or open angles and therefore controlling to a great extent the conditions under which the connector can be uncoupled.

FIG. 7 illustrates a typical electrical connector application using this invention. The connector is generally indicated at 501 and comprises a plug member generally indicated at 502, a receptacle member generally indicated at 503 and a coupler sleeve generally indicated at 504. The carrier in this case is the coaxial cable 505 which is attached to plug member 502 with sleeve 506. The plug half of the electrical connectors also comprises male pin 507 and insulator 508 disposed within member 502.

The receptacle half of the connector includes female contact 509 and insulator 511 disposed within receptacle member 503. The outer conductor electrical contact is assured by outer contact ring 512, which is very important for radio frequency transmission requirements. In this connection, however, it will be readily appreciated that, while the male pin 507 is here shown associated with the plug member 502 and the female contact is shown associated with the receptacle member 503, this arrangement can be and sometimes is reversed. Weather sealing can be obtained by compression of a gasket 513. This gasket may be of conductive material to minimize radio frequency radiation or leakage. Receptacle member 503 is attached to a conventional panel 514 by a jam nut 515 and washer 516. The receptacle could have another configuration such as a coaxial cable type with similar cable attachments as shown for the plug.

In operation of the embodiment of FIG. 7, it will be noted that coupling of the connector may be effected as previously described. Uncoupling of the connector cannot be effected by an axial pull exerted on cable 505, but only by sliding coupling sleeve 504 to the right to withdraw the spring finger ends from between the facing frustoconical surfaces of the plug and receptacle members.

FIG. 8 shows the connector of this invention applied to a typical garden hose having sections 601 and 602. Section 601 is mounted on the plug member which is generally indicated at 603 while section 602 is attached to receptacle member 604. A pressure sealing gasket 605 is disposed between the members. Standard hose attachments 606 and 607 may be used to attach the hose to the members in a manner which prevents leakage.

The operation of the embodiment of FIG. 8 is similar to the previous embodiments. Coupling of the connector will be effected by inserting plug member 603 in receptacle member 604 and then sliding coupling sleeve 608 to the left until spring finger ends 609 enter between the facing frustoconical surfaces on the plug and receptacle members. Uncoupling will be accomplished by pulling coupling sleeve 608 to the right.

It should be mentioned that the embodiments of FIGS. 3 or 4 could be particularly useful in hydraulic applications of the invention, if an axial separating force is applied to the plug and receptacle members due to the weight of the carrier or the equipment with which the connector is used.

FIG. 9 illustrates an application of the invention to mechanical purposes, namely to connect a pair of cables 701 and 702. These cables are secured to plug members 703 and receptacle member 704 respectively.

The remaining parts of this embodiment, including coupling sleeve 705, are similar to the previous embodiments, and the operation will be the same.

What is claimed is:

1. A connector comprising detachably interfitting plug and receptacle members having radially spaced confronting annular surfaces provided with inner and outer facing locking shoulders, an annular coupling sleeve slidable on said plug member, means attaching an elongated element to said plug member, said sleeve having axially extending, radially flexible spring fingers disposed between said annular surfaces when the members interfit and formed with flared ends insertable between said facing locking shoulders, whereby to resist axial separating forces applied to said members and to lock said members securely together, said finger ends being deflectable radially by one of said locking shoulders upon axial sliding movement of said sleeve relative to the plug member, thus uncoupling said members so they may be separated, the sleeve being completely withdrawable from said plug member at least in an uncoupling direction past said attaching means after the members have been separated, and facing abutment means on said plug and receptacle members separate from said annular surfaces and said sleeve and directly engageable when the plug member is inserted in the receptacle member to limit their relative movement in an engaging direction independently of said sleeve.

2. The combination according to claim 1, intermediate portions of said spring fingers being bent inwardly and disposed in an annular groove of the plug member to retain the coupling sleeve thereon.

3. The combination according to claim 1, said locking shoulders forming the ends of grooves, the locking ends of said grooves being formed by surfaces at least one of which is angularly related to said spring finger ends.

4. The combination according to claim 3, the angle of said receptacle member surface being less than the angle of said spring finger ends and the angle of said plug member surface being greater than the angle of said spring finger ends, whereby withdrawal frictional resistance of said spring ends will be minimized, permitting uncoupling of the connector despite relatively large axial separating forces applied to said plug and receptacle members.

5. The combination according to claim 3, the angle of one of said groove end surfaces being substantially the same as said spring finger ends, the angle of the other surface being less than said spring finger ends, whereby uncoupling of said connector will be permitted despite moderate axial separating forces being applied to said plug and receptacle members.

6. The combination according to claim 3, the angle of one of said groove end surfaces being substantially the same as said spring finger ends, the angle of the other surface being greater than said spring finger ends, whereby uncoupling of said connection will be prevented when moderate to heavy axial separating forces are applied to said plug and receptacle members.

7. The combination according to claim 3, the angles of said groove end surfaces being greater than said spring finger ends, whereby uncoupling of said connection will be prevented when relatively light axial separating forces are applied to said plug and receptacle members.

8. The combination according to claim 1, said elongated member comprising an electrical conduit having a pin, the receptacle being secured to a female contact.

9. The combination according to claim 8, said electrical conduit comprising a coaxial cable, said receptacle member being panel mount.

10. The combination according to claim 1, said elongated member comprising a hose, said receptacle member also being attached to a hose, said facing shoulders comprising a gasket disposed between the outer end of said plug member and a shoulder within said receptacle member, the members both having passages connected to said hoses.

11. The combination according to claim 1, said elongated member comprising a cable, said receptacle members also being attached to a cable.

12. The combination according to claim 1, said annular coupling sleeve being annularly closed.

13. The combination according to claim 1, the intermediate portions of said fingers being offset radially inwardly from their end portions and disposed in a plug member groove to yieldably retain the sleeve thereon but being substantially shorter than the axial extent of said groove, whereby both locking and unlocking of said members may be accomplished by movement of said coupling sleeve alone.

14. The combination according to claim 13, said fingers and plug member groove having additional surfaces coacting in response to withdrawal of said sleeve

after separation of the members to flex said fingers outwardly and permit continued withdrawal of the sleeve in an uncoupling direction, all other parts of said plug member being in non-obstructing relation with said sleeve whereby the sleeve is withdrawable from the plug member in either direction when the plug and receptacle members are separated.

15. A coaxial plug connector for use in conjunction with a receptacle member having an inwardly facing annular surface with an annular locking shoulder, said connector comprising an annular plug member having an outwardly facing groove, means securing an elongated element to said plug member, a coupling sleeve having an annularly closed portion slidably mounted on said plug member, the sleeve having a plurality of axially extending resilient fingers, said fingers having intermediate portions disposed in said groove to releasably retain the sleeve on said plug member, and flared end portions, the internal diameter of said annularly closed portion of the sleeve being greater than the external diameter of any portion of said plug member or element securing means, whereby said sleeve is removable from and replaceable on the plug member from the front or back thereof but only by axial sliding movement relative thereto.

16. The combination according to claim 15, said fingers having first portions of relatively large diameter and inwardly sloping portions extending therefrom to said intermediate portions.

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