

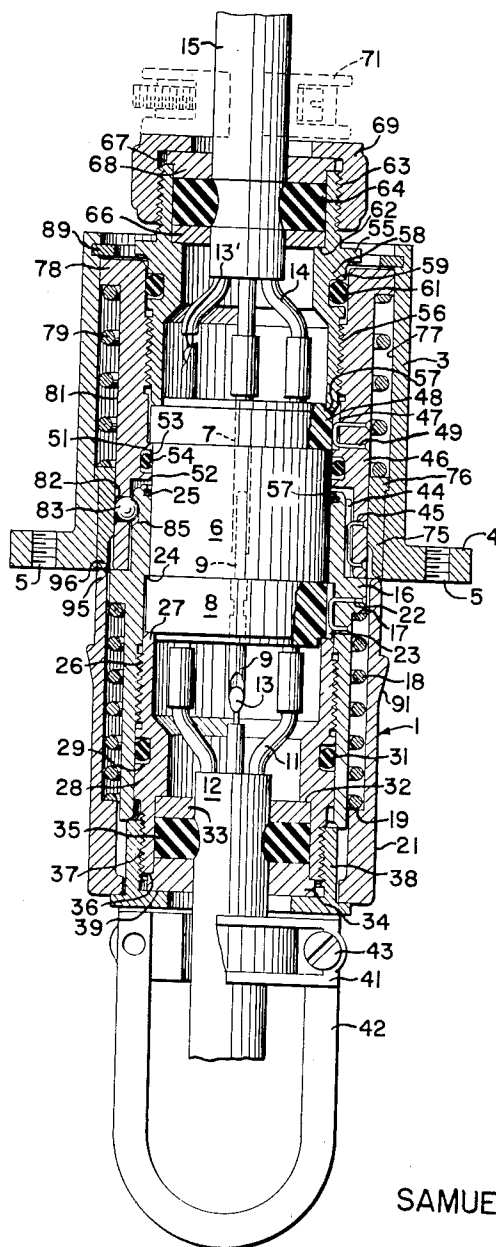
Feb. 21, 1956

S. A. HUMPHREY

2,735,993

CABLE CONNECTOR

Filed Nov. 30, 1953



INVENTOR
SAMUEL A. HUMPHREY

BY

L. D. O'Brien
R. M. Hicks
ATTORNEYS

2,735,993

CABLE CONNECTOR

Samuel A. Humphrey, Silver Spring, Md., assignor to the United States of America as represented by the Secretary of the Navy

Application November 30, 1953, Serial No. 395,326

8 Claims. (Cl. 339-91)

(Granted under Title 35, U. S. Code (1952), sec. 266)

The invention described herein may be manufactured and used by or for the Government of the United States of America for governmental purposes without the payment of any royalties thereon or therefor.

This invention relates generally to an electrical cable connector and more specifically to a waterproof, explosion proof construction for multiple wire cables which is self-locking upon interengagement of the severable elements thereof and is adapted for automatic release disengagement.

Prior arrangements for rapid securing or locking of mated elements of electrical cable connectors have incorporated various types of spring clip rings or bayonet fittings carried by one element of the connector for locking or frictional engagement with cooperative parts of the other element to provide for semi-automatic engagement and quick release. Generally, in the prior types of construction, the locking action is neither automatically engaging nor automatically releasable. They are commonly of such design as to be arranged to replace, or be interchangeable with, the threaded locking collar of commercial varieties of the connectors.

Also prior semi-automatic locking devices of this nature are not readily adapted for use in waterproof and explosion proof connector engagements.

A threaded locking collar type cable connector showing certain waterproofing structure common to the instant invention is shown in Patent No. 2,605,315 to R. L. Hargett, which issued on July 29, 1952. The instant invention provides certain improvements over the structure of this patent, both as to the waterproofing and explosion proofing arrangements and additionally provides a device characterized by automatic unlocking provisions.

In the preferred embodiment of the invention herein-after described in greater detail, the plug unit is adapted for gripping at a knurled shell portion thereof for aligned insertion into the receptacle with locking action occurring automatically as the plug is advanced to the final locked relationship between the elements. This improved construction is such that when the shell is released following plug insertion, it provides a locked joint or connection which is resistant to accidental opening due to shock or vibration. Additionally, it prevents water from entering the contacts and is explosion proof while closed and during separation. The particular locking arrangement provides for automatic separation of the plug from the receptacle by a concerted axial pull and is effective even when the plug is pulled out at an angle of 30° with the axis of the receptacle.

The automatic separation is advantageously accomplished by merely exerting a continuous generally axial pull on the plug and cable. The automatic release is effected by details hereinafter set forth with greater particularity.

The construction of the plug-half of the connector of the instant invention preferably contains the male contact tips in an insert of an insulating material and which may be of a commercially available variety. It is to be under-

stood, however, that the plug-half of the connector may carry the female jacks in an insert of a well known character. The insert is enclosed by a metallic sleeve which extends slightly beyond the ends of the contacts in a conventional manner. On the outside of the sleeve there is arranged an annular groove which is adapted to engage a plurality of small balls, carried by the panel mounted receptacle half of the connector. The balls when engaged by the grooved portion of the sleeve, provide the locking feature of the connector. A rubber washer is provided on the inside bore of the sleeve at the contact end, which functions to provide a water and gas tight seal when the plug portion of the connector is joined into electrical contact with the jacks of the female insert in the receptacle half.

The female insert is also of a commercially available type. As the connector elements are separated, the washer carried by the plug functions to slide along the outside surface of the female insert, and maintains contact until the electrical connections are broken, thereby keeping the interior of the connector water-tight during withdrawal of the plug. This arrangement also prevents the possibility of any explosion due to contact arcing when the connector parts are separated in an explosive atmosphere.

The receptacle portion of the connector is provided with a sliding sleeve which is spring loaded to serve as a sliding cylindrical bolt in a cylindrical lock. This sleeve is moved by another spring loaded sleeve on the plug-half of the connector which serves as a key to move the bolt to a position adjacent or slightly rearward of the balls when the connection of the two parts is being made. It then snaps back to its original position allowing the bolt to return, thereby locking the two halves of the connector. When the connector is pulled apart the interior portion of the receptacle half of the connector moves to release the ball engagement with the groove in the plug sleeve. The balls are then permitted to move free of the plug-half and allow the connector free movement during separation.

This invention is equally well adapted for free cable plug to free cable receptacle connection, it merely requiring that the receptacle housing be held while engaging or disengaging the connector plug.

A feature of the invention resides in the incorporation in a plug and receptacle of a cable connector, of means providing automatic locking engagement coupled with the function of automatic release.

It is one object of this invention to provide an electrical connector which can be quickly and easily joined while being resistant to accidental opening due to shock and vibration.

It is another object of this invention to provide an electrical connector which will prevent water from entering the contacts.

Another object of this invention resides in the provision of an electrical connector for multiple wire cable which is explosion-proof while closed and during separation and which permits automatic separation even when the plug is pulled out at an angle of 30° with the axis of the receptacle.

It is also an object of this invention to provide a contact construction which may be either of a locking type or automatic releasing type.

Other objects and many of the attendant advantages of this invention will be readily appreciated as the same becomes better understood by reference to the following detailed description when considered in connection with the accompanying drawing wherein:

The drawing is a cross sectional view with parts in elevation and with parts broken away of an electrical plug and socket connection according to the present invention.

Referring now to the drawing there is shown an elec-

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trical plug connector assembly generally indicated at 1 for mating engagement with a receptacle member generally indicated at 2. The receptacle comprises a housing sleeve 3 having a plurality of radially extending flange bosses 4 by which the device is adapted for panel mounting by provision of the threaded bores 5. The electrical connections of the plug and receptacle unit are made in a conventional manner in the female body element 6 with jacks 7 located therein to receive in mating engagement the plug tips or contactors 9 which are retained by the plastic body portion 8 of the plug unit. Suitable connection to the plug is made by soldering the leads 11 at the terminal ends 13 of the plugs. The plurality of leads are brought out of the plug in a unitary cable arrangement generally indicated at 12.

The electrical wiring leads for the receptacle body insert 6 are connected at the solder terminals 13' at the back ends of the jacks 7 and extend from the receptacle as leads 14 which may be a plurality of individual leads or as in the preferred embodiment shown they may be contained by a cable generally indicated at 15. The connections at the jacks are generally similar to the plug end arrangements.

The plug assembly, which engages the receptacle comprises a lock-sleeve 16 which has a forward counterbore of a suitable diameter for telescopic reception of the insulating insert 6 of the receptacle and a rear bore of slightly greater diameter for reception of the insulating insert 8 of the plug assembly. It is aligned when the plugs 9 engage jacks 7 in a manner such that a forward face of the flanged portion 17 thereof is arranged to abut mating portions of the receptacle. This flanged portion 17 of lock-sleeve 16 is adapted to restrain or back-up a spring 18 disposed against the rear face portion thereof. The opposite end of the spring 18 is restrained by the stepped bore shoulder portion 19 of the outer key-sleeve 21.

The stepped lock-sleeve 16 is provided with a guide-key arrangement 22 which mates with a groove or key-way 23 provided in the male insert body 3 to prevent rotation thereof with respect to other guide-keyed arrangements hereinafter to be described, while permitting sliding reception of the body 3 therein to the limit provided by the reduced or stepped bore shoulder at 24. The forward extension of the sleeve 16 at the reduced bore adjacent the shoulder 24 is adapted for telescopic reception of the female insert 6 when all of the plugs 9 and jacks 7 are aligned. The forward most portion of the inner bore of lock-sleeve 16 is provided with a suitable gasket at 25 to prevent entrance of moisture to the contacts after mating connection of the respective parts. The rear bore of this lock-sleeve 16 is additionally provided with an internally threaded portion at 26 for reception of the generally cylindrical screw clamp sleeve 27 which maintains the insert 8 intact against the shoulder 24. This clamp sleeve 27 is provided with an enlarged cross section at 28, the outer diameter of which is adapted for telescopic reception in the outer end bore of the lock-sleeve 16. This portion 28 is provided with an undercut portion 29 for reception of the O-ring gasket 31 which provides a seal between lock-sleeve 16 and the clamp sleeve 27. The internal bore of the clamp sleeve 27 is stepped for a greater diameter at the outer end thereof to provide a shoulder 32 for reception of a plurality of metallic gland washers 33 and 34 through which the cable 12 is arranged to pass. The washer is configured to provide an outer shoulder portion for engagement with the end face of the lock-sleeve 16 and to limit the compression of the soft rubber washer, gland packing stuff, or the like 35, about the cable 12. The deformation of the washer 35 about the cable 12 assures a waterproof sealed relationship at the interior of the clamp sleeve 27.

The outer end portion of the lock-sleeve 16 is externally threaded at 37 to receive a mating internally

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threaded gland nut and cable clamp unit 38 which engages the washer 34 on the outer face 39 of the washer to compress the rubber washer 35 against the cable. The combined cable clamp and gland nut 38 is provided with an outer end portion of a conventional cable clamp variety adapted to mate with a cable clamp plate element 41. The cable clamp portion of 38 is adapted to retain a generally horseshoe shaped pull handle 42 in clamped relation between the body thereof and the clamp plate 41 as by machine screws 43.

The forward portion of the lock-sleeve 16 which telescopically receives the insert element 6 is provided with a guide-key slot 44 at one portion of the outer periphery thereof for engagement with a guide-key element 45 carried by the sleeve 46 of the receptacle 2. This guide-key functions to provide quick and proper alignment of the male plug 1 in the receptacle 2 and engagement of plugs 9 of insert 3 with jacks 7 of insert 6.

The after portion of insert 6 is suitably guide-keyed in sleeve 46 by a key-way 48 which engages guide-key 49 affixed in the sleeve 46. The female insert 6 is restrained against forward movement in the sleeve 46 by the annular shoulder and stepped bore at 51. The reduced diameter portion 52 adjacent shoulder 51 is provided with an undercut 53 for reception of the O-ring 54 which is adapted for sealing engagement with the insert body portion. The increased diameter portion 48 of the insert 6 is provided with an annular seat at 57 for clamped retention of the insert 6 against shoulder 51 by the clamp sleeve nut 55. This nut 55 is provided with threads 56 arranged to engage a mating threaded portion of the receptacle sleeve 46. The clamp sleeve nut 55 is also provided with an increased cross section portion 58 having an undercut 59 on the outer periphery thereof for reception of the O-ring 61 which engages the rear end counterbore of the sleeve 46 exteriorly of the threaded portion at 56. The waterproof seal for clamping the cable 15 is generally similar to that shown for the cable 12 of the plug unit and comprises a stepped bore 66 on the clamp nut sleeve 55 which provides a shoulder 62 for reception of the metallic washer 66 to provide deforming of seal gasket 64 by the outer washer 68. This washer is provided with a stepped shoulder at 67 which serves as a stop. The upper face of 68 is engaged by the clamp ring 69 having threads thereon at 63 for engagement with the mating threaded portion of the clamp 58. If desired the clamp nut 69 may be provided with a cable clamp as shown by the dotted outline and which is generally similar to the clamp on gland nut 38 of the plug end.

In addition to the hereinbefore described mechanical arrangements for making electrical connections between the plug and receptacle and for providing a waterproof and explosion proof seal therebetween, the invention arrangements providing automatic locking and unlocking action between the plug and the receptacle which will now be described.

The sleeve 75 serves as a sliding bolt for the locking feature and is arranged for axial movement within the annular outer housing 3. It is provided with an annular shoulder portion 76 which is stopped by an annular mating shoulder of 3 to limit forward travel thereof. It is arranged for rearward movement in the stepped bore 77 of receptacle housing 3. Disposed between the end face of the shoulder portion 76 and the flange portion 78 of the innersleeve 46 is a spring 79 which normally urges the bolt sleeve 75 forwardly in encircling relationship with the outer cylindrical surface 81 of sleeve 46.

The sleeve bolt 75 is displaced rearwardly by the cylindrical key-sleeve element 21 of the plug portion of the connector for bolt unlocking action following partial engagement of the insert elements 6 and 8 to a position where sleeve 16 engages the locked balls 83. The sleeve 46 is provided with one or a plurality of radially disposed holes 82 adapted for reception, respectively, of one or a plurality of ball locking members 83. A forward portion

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of the sleeve 75 is contoured to permit the ball 83 to move radially outward a sufficient amount to allow the forwardly extending portion at 25 of the lock-sleeve 16 to pass into the receptacle during mating of the tip connectors 9 and the individual jacks 7. This forward extending portion at 25 of lock-sleeve 16 which moves telescopically over insert 6 is provided with a ring groove or a plurality of notches at 85 for engagement with the balls 83 when male and female contacts of the elements 6 and 8 are in full engagement. The annular shoulder or flange portion 78 of sleeve 46 is retained in the housing 3 by a suitable ring clip 89 at the upper end of the housing.

In operation, the unit 1 is aligned such that the key-way portion 44 of the plug mates with the guide-key 45 of the receptacle and thereby aligns all of the plug tip elements 9 carried by the insert 8 with the female jack connectors 7 in proper relation to insure that the corresponding connectors are always reconnected in the proper order. The formed portion 91 of the key-sleeve 21 which is preferably knurled to facilitate gripping thereof, provides means for holding the cable connector plug for insertion in the receptacle. The spring 13, which bears against one end of the key-sleeve 21, allows the plug parts to move with the key-sleeve 21 until the insert connector parts have become partially engaged. As they come together, it permits sliding advancement of the forward portion of lock-sleeve 16 and seal 25 axially along the insert 6. At the instant this forward portion engages the ball or balls which is or are normally locked inward against the sleeve 76, it is temporarily prevented further advancement in the female receptacle. The forward portion 95 of the cylindrical key sleeve 21, which is of the same diameter as the corresponding bore for the bolt sleeve 75, comes into play to engage end 96 of the bolt sleeve 75 and functions to move the bolt sleeve 75 against the spring 79 to a position which allows the ball or balls free movement. This permits further advancement of the forward portion of the lock-sleeve 16 to a point where the ball may move into the seat or groove 85. At this point the connection of the two elements is complete and the sleeve 21 is released for return by the spring 18 of the plug element. It will thus be apparent that a connection is provided which is readily engageable to connect two cable ends and which provides a waterproof connection by virtue of the several seals provided therein.

The assembly is well adapted for either semi-automatic release as by a procedure which is inverse to that of the locking engagement or automatic release of the two elements by applying an axial pull on the handle 42 or cable 12.

The release disengagement action which is the inverse of locking action may be accomplished by sliding the sleeve 21 against bolt-sleeve 75 by grasping the knurled portion 91 with one hand and advancing the sleeve against the pressure spring 79 until balls 83 are released from grooves 85 for movement into engagement with the portion 95 of bolt-sleeve 75. This releases the lock on sleeve 16 and allows withdrawal of the connectors 9 by an axial pull on handle 42 which is grasped by the forefinger of the other hand.

This procedure is required when length limitations on cable 13 do not permit any slack therein.

The preferred release is accomplished by grasping the handle 42 and pulling the plug from the receptacle. The cable must have sufficient slack to allow travel of insert 6 with sleeve 46 to a position where balls 83 are free to move outward to a position adjacent 96 of bolt-sleeve 75. In this action the shoulder portion 78 of sleeve 46 compresses spring 79 to prevent rearward movement of the bolt-sleeve 75 as the plug is withdrawn. After removal of the plug, the spring 79 returns the sleeve 78 and insert 6 to the normal position thereof.

An explosion proof arrangement is provided since the seal is made water and gas proof by action of the washer 25 against the body portion 6 as the plug is withdrawn. 75

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The length of the forward projection on the lock-sleeve 16 is preferably made greater than the length of the connector tip elements 9 whereby they are withdrawn from the mating jacks 7 of the receptacle member 3 prior to disengagement of the washer 25 with the body portion 6. It is apparent from the foregoing, that any arcing occurring between the male plug tips 9 and the female jack elements 7 is limited to the sealed enclosed area and thus prevents the ignition of any explosive gas in the environment thereof which might otherwise enter the inner portion of the inserts before complete severance of the tips and jacks. It will be apparent to one skilled in the art that the portion 3 shown as a receptacle body with flanges thereon may comprise merely a generally cylindrical sleeve whereby the combination of the plug and receptacle may be utilized for cable connections at points intermediate the panel or bulkhead mounting position.

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

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

1. In an electrical cable connecting device of the character described comprising the combination of a plug assembly and a receptacle assembly, a pair of non-conducting insert members with one each carried respectively by said plug and said receptacle, a plurality of separable mating conductors carried respectively by said pair of inserts, cylindrical housing means for said receptacle of a character providing for telescopic reception and locking of said plug therein and incorporating complementary automatic release means therefor, a lock-sleeve member insert and having a grooved portion thereon adapted for locking with mating telescopically engageable portions of said receptacle housing means, an axially slidable cylindrical releasing key sleeve carried by the plug, a slidable bolt-sleeve carried by the receptacle and adapted for engagement by said sliding key of the plug, locking means carried by the receptacle to engage said grooved portion of the plug, a sleeve member adapted for axial movement therein and having at least one locking member of said locking means carried in apertures therein, a spring disposed between the said sleeve member and the sliding bolt-sleeve to provide locking bias relative movement therebetween, and said locking action being adapted for release upon engagement of said bolt-sleeve by the key sleeve of the plug or an axial pull on said plug, said bolt sleeve being disposed for movement to provide for engagement of the locking means between the respective locked members of the plug and receptacle housing means upon insertion of the mating elements of the inserts, and adapted upon key release to provide a locked relationship between the plug and receptacle which is automatically separable upon axial withdrawal of the plug by an axial displacement of the locking means of the receptacle followed by a radial displacement thereof, and means carried by the plug for explosion proof mating engagement with the insert elements of the receptacle.

2. An automatic locking and unlocking cable connector comprising, a plug, a receptacle, separable means having mating portions carried respectively by the plug and receptacle for providing continuity of a plurality of electrical circuits therethrough, a telescopically operated locking means having a lock-sleeve member and a cylindrical key-sleeve member carried by said plug, said key-sleeve member being co-axially disposed with respect to said lock sleeve member, a second sleeve member carried by the receptacle for controlled axial movement therein, a plurality of ball latch elements carried by said second sleeve member and engageable with said sleeve member, a generally cylindrical axially slidable bolt-sleeve disposed in said receptacle for aligned engagement with said cylindrical key-sleeve, means provided on the slidable

bolt-sleeve for releasing the ball engagement between the lock-sleeve members of the plug and receptacle when an axial pull is applied to the plug, and spring means disposed between the bolt and said sleeve member for repositioning of the receptacle lock-sleeve member after release movement of the ball elements from locking engagement between the lock-sleeve and sleeve member respectively of the plug and receptacle.

3. The structure of claim 2 further comprising means carried by said plug in coaxial relationship with said circuit continuity means portion carried by the receptacle.

4. The structure of claim 3 further characterized by means resiliently carried by the receptacle for providing waterproof clamping of the cable therein and movable with respect thereto to permit automatic release of the plug from the receptacle with the application of an axial pull thereon.

5. An electric cable connector comprising axially separable telescopic plug and socket members, a first cylinder within said socket disposed for coaxial engagement with said plug member, a second cylinder carried by said receptacle and disposed for aligned engagement with said plug, a receptacle housing enclosing said first and second cylinders, spring means disposed between said first and second cylinders whereby the first cylinder is normally biased backwardly in said receptacle housing and is slidable within said housing to a position a substantial distance from the forward end of said housing, said second cylinder being differentially movable with respect to said first cylinder, a first cylindrical sleeve on said plug for telescoping engagement with said first cylinder, means carried by said first cylinder and restrained by said second cylinder for locking said first cylinder and said first cylindrical sleeve together to prevent axial movement therebetween while so locked and being permitted axial movement theretogether to the forward limit of travel of said second cylinder, a second cylindrical sleeve on said plug disposed for slidable movement over said first cylindrical sleeve and constructed to engage and displace said second cylinder of the receptacle to provide release of said locking means between said first cylinder of the receptacle and a second said first cylindrical sleeve, and spring means carried by said plug for normally biasing said second cylindrical sleeve out of engagement with said receptacle while permitting move-

ment into engagement with the second cylinder of the receptacle thereby to function as a key for release of the locking engagement of the plug and receptacle upon forward movement thereof, said last second cylindrical sleeve being constrained by said spring means of the plug to provide for axial movement of said locked first cylinder and first cylindrical sleeve with respect thereto for automatic release of the plug and socket when an axial pull is exerted upon the plug end cable.

6. In an electrical cable connector structure having axially separable plug and receptacle members with coacting terminals therein, a plug housing, a receptacle housing, locking means cooperating between the plug housing and the receptacle housing, a cylindrical sleeve on said plug, a mating sleeve on said receptacle for telescopic reception of said plug sleeve, said locking means comprising a plurality of locking elements carried by said receptacle sleeve, a recessed surface on said plug sleeve for engagement with said locking elements, an axially movable cylindrical bolt-sleeve member concentrically disposed about said receptacle sleeve and having a lock release surface at the outer end thereof, a cylindrical key sleeve carried by the plug and disposed for engagement with said bolt sleeve of the receptacle for axial displacement thereof upon plug locking engagement with the receptacle and for release therefrom.

7. The structure of claim 6 further characterized by the inclusion of means carried by said receptacle housing for providing automatically releasable mounting of the receptacle whereby the lock is unlocked upon axial withdrawal of the plug from the receptacle.

8. The structure of claim 6 further characterized by the inclusion of means carried by said plug for providing a water-proof, gas-proof engagement with the receptacle insert, separable means thereon for gas-tight sealing of a first cable within the plug housing, and separable means on said receptacle housing for gas-tight sealing of a second cable to be electrically joined with said first cable.

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