

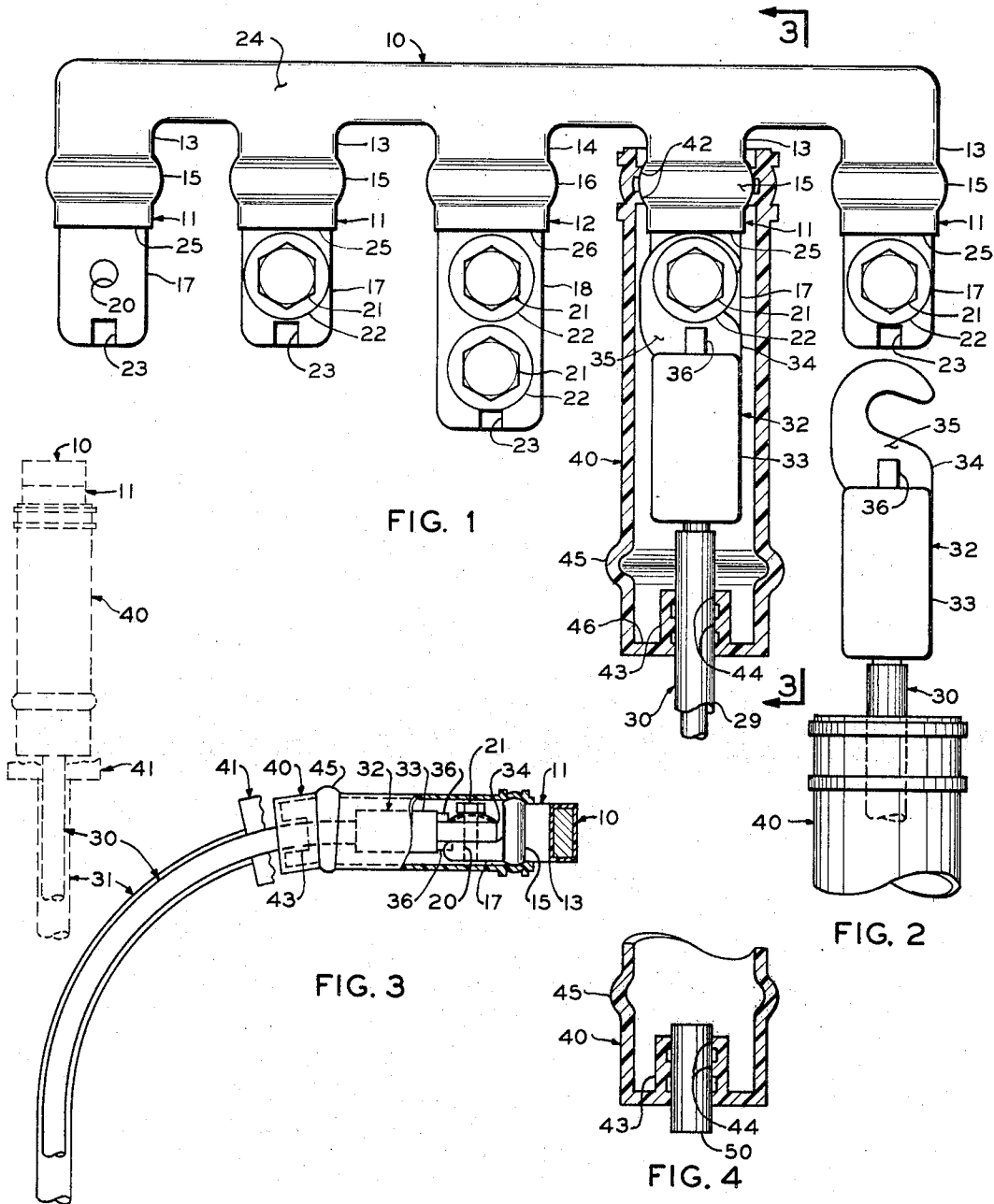
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ELECTRICAL CONNECTOR MANIFOLD

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ELECTRICAL CONNECTOR MANIFOLD

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8 Claims

ABSTRACT OF THE DISCLOSURE

The manifold includes an elongate bus bar which is provided with an in-line row of transversely projecting terminals to facilitate the bending of a set of attached conductors on a substantially common curvature. Each terminal includes a lug attachment tang for the attachment of a conductor lug, each pair of associated conductor lug and lug attachment tang being locked by a tongue and groove locking means between their faces, to prevent relative rotation of the connected lug and tang. Individual, flexible insulating sheaths provide waterproof protection for each connection, the sheaths being pressure-sealed at one end to an associated terminal, and pressure-sealed at the other end to a conductor.

BACKGROUND OF THE INVENTION

This invention relates to an electrical connector, and more particularly to a waterproof electrical connector having attached flexible conductors locked in place.

Of the problems which arise in the construction of underground conductor connections, none is more serious than providing the joint with waterproof protection. Failure to provide adequate waterproofing results in the necessity to provide connection replacements because of destruction by corrosion. Further, a potentially severe safety hazard is possible, especially in the vicinity of the connection, if the connection is submerged in ground water.

Many of the waterproof connections, which are currently used, achieved their waterproof capability at the expense of flexibility of the conductors. Since the connectors are at times placed in relatively small containers, this flexibility is of great importance since it facilitates the bending of the conductors to suit a particular container.

In the heretofore conventional connectors of this general type, the conductors are sometimes grouped together in a roughly circular pattern to permit a waterproof cover or cannister to be placed over the group of conductors. When conductors are grouped together in this way, they usually take a roughly circular formation provided with relatively more structural resistance to bending than if the cables were aligned in side-by-side relation. This result follows from the same principle which provides that a plate, which when formed into a tube, is much stronger than the same plate which remains flat. Specifically, the resistance to bending of a line of conductors in a direction transverse to the alignment is simply the sum of the resistances of the individual conductors. Thus, an in-line group of conductors can be much more easily manipulated than a similar group having a circular pattern, with an in-line group, the conductors can be made long enough to be worked on above ground, and then doubled over with ease into their outer container.

The use of individual sheaths allow each connection to be waterproof without the necessity for having an overall waterproof container. In addition, individual sheaths permit each connection to be "made" or "unmade" without disturbing the remaining connections. This fact has particularly important ramifications in corrosive atmosphere.

With an overall cover, it is more difficult to maintain the waterproofing seal because once the seal is broken, all of the connections are vulnerable.

In order to make the use of individual seals practical in the present connector, two novel structural features are used. For example, cooperating locking means are provided between the lug attachment tang of the terminal and the associated conductor lug which practically eliminate the possibility of breaking the electrical connection. In addition, the sheath is provided with a flexible portion which permits the conductor to be bent into a curved configuration without breaking the waterproof seal.

SUMMARY OF THE INVENTION

The electrical connector includes an elongate bus bar having transversely projecting terminals for the attachment of conductor lugs, and each individual connection is covered with a flexible insulating sheath providing a waterproof cover.

Each terminal includes a body portion and a depending lug attachment tang. The body portion of each terminal has a peripheral boss which cooperates with one end of the associated sheath to provide a watertight seal. The other end of the sheath cooperates with the conductor to provide a second watertight seal.

Each conductor is connected to its associated terminal by a conductor lug which is fastened to the lug attachment tang by a fastener. Cooperating tongue and groove locking means are provided to preclude rotation of the lug attachment tang and conductor lug relative to each other. The cooperating locking means are spaced from the fastener at each connection to provide a resistance couple which precludes rotation of the connection.

The terminal bosses are circular in cross section and the sheaths are annular, the external diameter of each boss being greater than the minimum internal diameter of a peripherally continuous, pressure contact portion of the sheath sealingly engaging the boss.

The bus bar terminals are disposed along the length of the bus bar in a substantially straight line to facilitate the bending of the conductors about a substantially common radius of curvature.

Each sheath includes a relatively flexible portion to take up bending in the conductor without destroying the waterproof seal between the sheath and conductor.

The bus bar and the exposed portions of the terminal exteriorly of the sheath are provided with a water-imperious, electrically non-conducting coating to complete the waterproofing of the joint.

BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 is an elevational view including a section through an assembled connection;

FIG. 2 is an exploded view of the connection, the sheath being shown in fragmentary form;

FIG. 3 is a fragmentary view illustrating the bending of the conductors from an upright position, and

FIG. 4 is a fragmentary view illustrating the use of a plug in lieu of a conductor in a sheath.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now by characters of reference to the drawing, and first to FIG. 1, it will be understood that the electrical connector includes an elongate bus bar 10. A plurality of transversely projecting terminals 11 and 12 are disposed in longitudinally spaced relation along the bus bar 10 to form a substantially straight, in-line row. The outer terminals 11 and the central terminal 12 are essentially similar, the central terminal 12 being somewhat larger to accommodate the greater size of the input conductor 31 shown in FIG. 3. For the purpose of this

description, one of the terminals 11 will be described, and related numerals, referring respectively to the center terminal 12, will be included in parentheses.

Each terminal 11 (12) includes substantially cylindrical body 13 (14) provided with a peripherally continuous boss 15 (16). The body portion 13 (14) is integrally attached at its upper end to the bus bar 10. The terminal 11 (12) also includes a lug attachment tang 17 (18) which depends from the rear side of the body portion 13 (14). The lug attachment tang 17 (18) is provided with a threaded hole 20 receiving a bolt 21, the bolt 21 holding a conical compression washer 22. An open ended groove 23, constituting a locking means, is provided at the end of each lug attachment tang 17 (18).

The bus bar 10 is coated with a water-impervious, electrically non-conductive plastic coating 24 which is terminated in the preferred embodiment at a point 25 (26) on the lug attachment tang 17 (18) below the boss 15 (16).

Conductors 30 (31) attached to the terminals 11 (12) are each provided with a lug 32. Each conductor lug 32 includes a body portion 33 and a tang 34. Each tang 34 is centrally located with respect to the body portion 33, and has opposite flat faces 35, each of which is provided with a projecting tongue 36, constituting a locking means. The tongue 36 is shaped to interfit and cooperate with the groove 23 on the face of the connector lug 17 (18). The tongue and groove locking means 36 and 23 preclude rotation of the conductor lug 32 relative to the lug attachment tang 17. The locking means provided by the cooperating tongue 36 and groove 23 are spaced from the center of rotation provided by the fastening bolt 21, and provide a resistance couple against relative rotational movement of lugs 17 and 32.

It will be understood that the bolt 21 exerts a pressure between the faces of the interconnected conductor lug 32 and lug attachment tang 17 (18) which is maintained constant by the use of the conical washer 22.

Each connected joint is provided with a sheath 40 (41) of a resilient water-impervious material. At its upper end, the sheath 40 (41) is provided with internal annular ribs 42, constituting a pressure contact portion, which have a smaller internal diameter than the external diameter of the boss 15, thereby providing a peripheral, continuous seal preventing the ingress of water into the sheath 40.

At its lower end, the sheath 40 (41) is provided with a reentrant internal tube 43. This tube 43 includes internal ribs 44, constituting a pressure contact portion, which contact a waterproof cover 29 of the conductor 30 to form an effective seal preventing the ingress of water into the sheath 40 (41) thereby protecting the electrical connection from corrosion.

The annular ribs 42 and 44 provide a cleaning or wiping action on the components to which they are attached. This is an important function since the work is normally done outdoors where mud and dirt prevail. The ribs 42 and 44 also retain the sealing compound and lubricant that is required for best operation. In addition, a pressure concentration is attained in the ribs 42 and 44 and the total force of the contracting or stretched sheath 40 (41) is directed to a smaller area. This pressure concentration of the ribs 42 and 44 creates a degree of indentation in the insulation over which the sheath 40 (41) is placed so that the sheath 40 (41) is more firmly affixed and resists movement.

The sheath 40 (41) is provided with a bellows 45, constituting a relative flexible portion, to allow bending of the conductor 30 (31) in the vicinity of the lower seal between the ribs 44 and conductor 30 (31) without destroying the seal.

As shown in FIG. 3, the flexible conductor 30 (31) may be bent in a curved configuration with part of the curved conductor portion extending in the sheath 40 (41) and the sheath 40 (41) will remain watertight. In the preferred embodiment, the relative stiffness of the reentrant tube 43, as compared with annular end wall 46, is such that

the end wall 46 constitutes a second relatively flexible portion.

Internal pressure in the sheath 40 (41), as may be occasioned by air expansion and caused by heating of the conductor, is exerted on the tube in a manner which increases the sealing capability of ribs 44.

It is thought that the functional advantage of this electrical connector have become fully apparent from the foregoing detailed description of parts, but for completeness of disclosure, the installation and usage of the connector will be briefly described.

The electrical connector described is capable of being totally submerged in water without suffering from corrosive effects caused by the water, and without passing current through the surrounding water. Moreover, this waterproof connection is maintained even though the conductors are bent in the manner shown in FIG. 3. In fact, the arrangement of terminals 11 (12) and the locking means 36 and 23 provided are specifically designed to enable this bending action under watertight conditions.

The conductor connection is made by slipping the tang 34 of the conductor lug 32 over the shank of the bolt 21. When the conductor lug 32 is aligned substantially as shown in FIG. 1, the tongue 36 automatically interfits the groove 23. Tightening the bolt 21 to the conical compression washer 22 brings the opposing faces of the conductor lug 32 and the lug attachment tang 17 into pressure contact. Rotation of the conductor lug 32 relative to the lug attachment tang 17 is effectively prevented by the couple action of the tongue and groove locking means 36 and 23, the tongue and groove locking means 36 and 23 being spaced from the center of rotation defined by bolt 21. The provision of a tongue 36 on each face 35 of the conductor lug 32 permits an operable connection to be made in the manner described regardless of the direction in which the tang 34 faces longitudinally of the bus bar 10. This alternate locking arrangement is a distinct advantage because otherwise the conductor lug 32 might require removal and replacement of the conductor 30 (31) could be severely twisted.

In order to waterproof the connection, the sheath 40 (41) is pushed upwards until the ribs 42 at the upper end of the sheath embrace and engage the boss 15 under pressure, thereby providing a waterproof seal. The lower waterproof seal is formed as soon as the reentrant tube 43 is placed over the outer waterproof cover 29 of the conductor 30 (31) so that annular ribs 44 engage the cover 29 under pressure.

Although only one of the outer terminals 11 is shown fitted with a waterproof sheath 40, it will be understood that all terminals 11 (12) may be so fitted. In the event that a terminal 11 (12) is not provided with a conductor 30 (31), that terminal may nevertheless be easily waterproofed by inserting a sheath 40 (41) over the terminal in the manner described above and by fitting a plug 50 into the tube 43 at the lower end of the sheath 40 (41). The plug 50 takes the place of a conductor 30 (31) which would otherwise be used. This feature is clearly shown in FIG. 4.

It will be clear that the center terminal 12 which is usually the input terminal is shown in the preferred embodiment as having two bolts 21. A conductor lug having a double tang (not shown) would be provided at this location.

By providing the terminals 11 (12) in an aligned disposition along the bus bar 10, and by providing the cooperating locking means 36 and 23 at each terminal connection, the conductors 30 (31) will likewise be substantially aligned in a straight row. By disposing the conductors 30 (31) in-line, rather than in a substantially circular cluster, the force required to bend the group of conductors 30 (31) from the upright position shown in broken lines in FIG. 3 to a substantially horizontal position shown in full lines will merely be the sum of the

forces required to bend each conductor 30 (31) individually.

It is a disadvantage to provide conductors arranged in a circular cluster. The resistance of a clustered group is considerably greater than the sum of the individual resistances to bending of the separate conductors. When a push is applied to the bus bar 10 of the present connector, the in-line group of conductors 30 (31), when aligned and locked as described, may be bent to a substantially common configuration. Moreover, the bus bar 10 provides a convenient handle to which the push may be applied. The relatively flexible portions 45 and 46 provided at the lower end of each sheath 40 (41) permits the watertight nature of the connection to be retained even though the curvature of the conductors 30 (31) is rather severe.

It is of course, a great convenience to be able to make and repair such connections while they are oriented in a vertical position, and then simply bend the in-line group into its downward, and final underground location.

Although the invention has been described by making detailed reference to a single preferred embodiment, such detail is to be understood in an instructive rather than in any restrictive sense, many variants being possible within the scope of the claims hereunto appended.

I claim as my invention:

1. An electrical connector comprising:

- (a) flexible electrical conductors,
- (b) an elongate bus bar including a plurality of transversely projecting terminals disposed in spaced, in-line relation along the bar,
- (c) a plurality of conductor lugs, each lug having one end attached to a conductor, and having the other end removably connected to an associated terminal,
- (d) fastening means connecting each conductor lug to its associated terminal, whereby the conductors are disposed in substantially in-line relation to facilitate bending of the conductors as a group about a substantially common radius of curvature,

(e) each terminal including:

- (1) a body portion attached at one end to the bus bar, the body portion including a peripheral boss, and
- (2) a lug attachment tang depending from the body portion for connection to the conductor lug, and

(f) a plurality of insulating sheaths of resilient, water-impervious material provided waterproof protection for the connections, each sheath including:

- (1) a first end providing a peripherally continuous pressure contact portion sealing with the associated terminal of the connection, and
- (2) a second end providing a peripherally continuous pressure contact portion sealing with the associated conductor of the connection.

2. An electrical conductor as defined in claim 1, in which:

- (g) the pressure contact portion of the sheath sealing engages the boss of the body portion, and
- (h) the external periphery of the boss is greater than the minimum internal periphery of the sealing engaging, pressure contact portion.

3. An electrical connector, comprising:

- (a) flexible electrical conductors,
- (b) an elongate bus bar including a plurality of transversely projecting terminals disposed in spaced, in-line relation along the bar,
- (c) a plurality of conductor lugs, each lug, having one end attached to a conductor, and having the other end removably connected to an associated terminal, and
- (d) fastening means connecting each conductor lug to its associated terminal, whereby the conductors are disposed in substantially in-line relation to facilitate

bending of the conductors as a group about a substantially common radius of curvature,

(e) a plurality of removable insulating sheaths of resilient, water-impervious material providing waterproof protection for the connections of the lugs to the terminals, each sheath including:

- (1) a first end providing a peripherally continuous, pressure contact portion sealing with the associated terminal of the connection, and
- (2) a second end providing a peripherally continuous pressure contact portion sealing with the associated conductor of the connection,
- (3) at least one of said peripherally continuous pressure contact portions being disposed in stretched relation about its associated connector part,

(f) each terminal including:

- (1) a body portion attached to one end of the bus bar, and
- (2) a lug attachment tang depending from the body portion for connection to the conductor lug, and

(g) cooperating tongue and groove locking means locking each conductor lug to the lug attachment tang of its associated terminal to prevent rotation of the conductor lug relative to the lug attachment tang,

(h) the conductor lug including one of said locking means, and

(i) the lug attachment tang including the other of said locking means, and

(j) the cooperating locking means are spaced from their associated fastening means, whereby to provide a resistance couple against rotation of the conductor lug relative to the lug attachment tang.

4. An electrical connector as defined in claim 3, in which:

- (k) each lug attachment tang includes a flat face,
- (l) said one of the tongue and groove locking means is located on the flat face of the lug attachment tang,
- (m) each conductor lug includes a pair of opposite flat faces, and
- (n) said other of the tongue and groove locking means is located on one of the faces of the conductor lug.

5. An electrical connector as defined in claim 4, in which:

- (o) a second, alternative tongue and groove locking means is provided on the other flat face of the conductor lug for selective locking cooperation with the said one of the locking means carried by the lug attachment tang by either of said alternative locking means.

6. An electrical connector, comprising

- (a) flexible electrical conductors,
- (b) an elongate bus bar including a plurality of transversely projecting terminals disposed in spaced, in-line relation along the bar,
- (c) a plurality of conductor lugs, each lug, having one end attached to a conductor, and having the other end removably connected to an associated terminal, and
- (d) fastening means connecting each conductor lug to its associated terminal, whereby the conductors are disposed in substantially in-line relation to facilitate bending of the conductors as a group about a substantially common radius of curvature,
- (e) a plurality of removable insulating sheaths of resilient, water-impervious material providing waterproof protection for the connections of the lugs to the terminals, each sheath including:

- (1) a first end providing a peripherally continuous pressure contact portion sealing with the associated terminal of the connection, and
- (2) a second end providing a peripherally continuous pressure contact portion sealing with the associated conductor of the connection,

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- (3) at least one of said peripherally continuous pressure contact portions being disposed in stretched relation about its associated connector part,
- (f) cooperating tongue and groove locking means locking each conductor lug to its associated terminal in substantial longitudinal alignment therewith to prevent rotation of the conductor lug relative to the terminal,
- (g) the conductor lug including one of said locking means, and
- (h) the terminal including the other of said locking means.
7. An electrical connector, comprising:
- (a) flexible electrical conductors,
- (b) an elongate bus bar including a plurality of transversely projecting terminals disposed in spaced, in-line relation along the bar,
- (c) a plurality of conductor lugs, each lug having one end attached to a conductor, and having the other end removably connected to an associated terminal,
- (d) fastening means connecting each conductor lug to its associated terminal, whereby the conductors are disposed in substantially in-line relation to facilitate bending of the conductors as a group about a substantially common radius of curvature,
- (e) cooperating tongue and groove locking means, locking each conductor lug to its associated terminal to prevent rotation of the conductor lug relative to the terminal,
- (f) the conductor lug including one of said locking means, and
- (g) the terminal including the other of said locking means,
- (h) each terminal, including:
- (1) a body portion attached at one end to the bus bar and including a peripheral boss, and
- (2) a lug attachment tang depending from the body portion for connection to the connector lug, and
- (i) a plurality of insulating sheaths of resilient, water-impervious material provide water protection for the connections, each sheath including:
- (1) a first end providing a peripherally continuous, pressure contact portion sealing with the boss of an associated terminal of the connection, and

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- (2) a second end providing a peripherally continuous, pressure contact portion sealing with the conductor of the connection.
8. An electrical connector as defined in claim 7, in which:
- (j) each sheath is provided with a relatively flexible portion at the said second end to allow bending of the conductor in the vicinity of the seal of the pressure contact portion with the conductor without destroying the seal,
- (k) each lug attachment tang includes a flat face, the said one of the locking means is located on the flat face of the lug attachment tang,
- (l) each conductor lug includes a pair of opposite flat faces,
- (m) the said other of the locking means is located on one of the faces of the conductor lug, and
- (n) a second, alternate locking means is provided on the other flat face of the conductor lug for selective cooperation with the said one of the locking means carried by the lug attachment tang,
- (o) each boss is substantially circular in cross section,
- (p) each sheath is substantially annular,
- (q) the pressure contact portion of the said first end of the sheath sealing engages the circular boss,
- (r) the external diameter of the boss is greater than the minimum internal diameter of the engaging, pressure contact portion, and
- (s) the bus bar and the body portions of the terminals are provided with a water-impervious, electrically non-conductive coating.

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