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ELECTRICAL CABLE CONNECTOR PART

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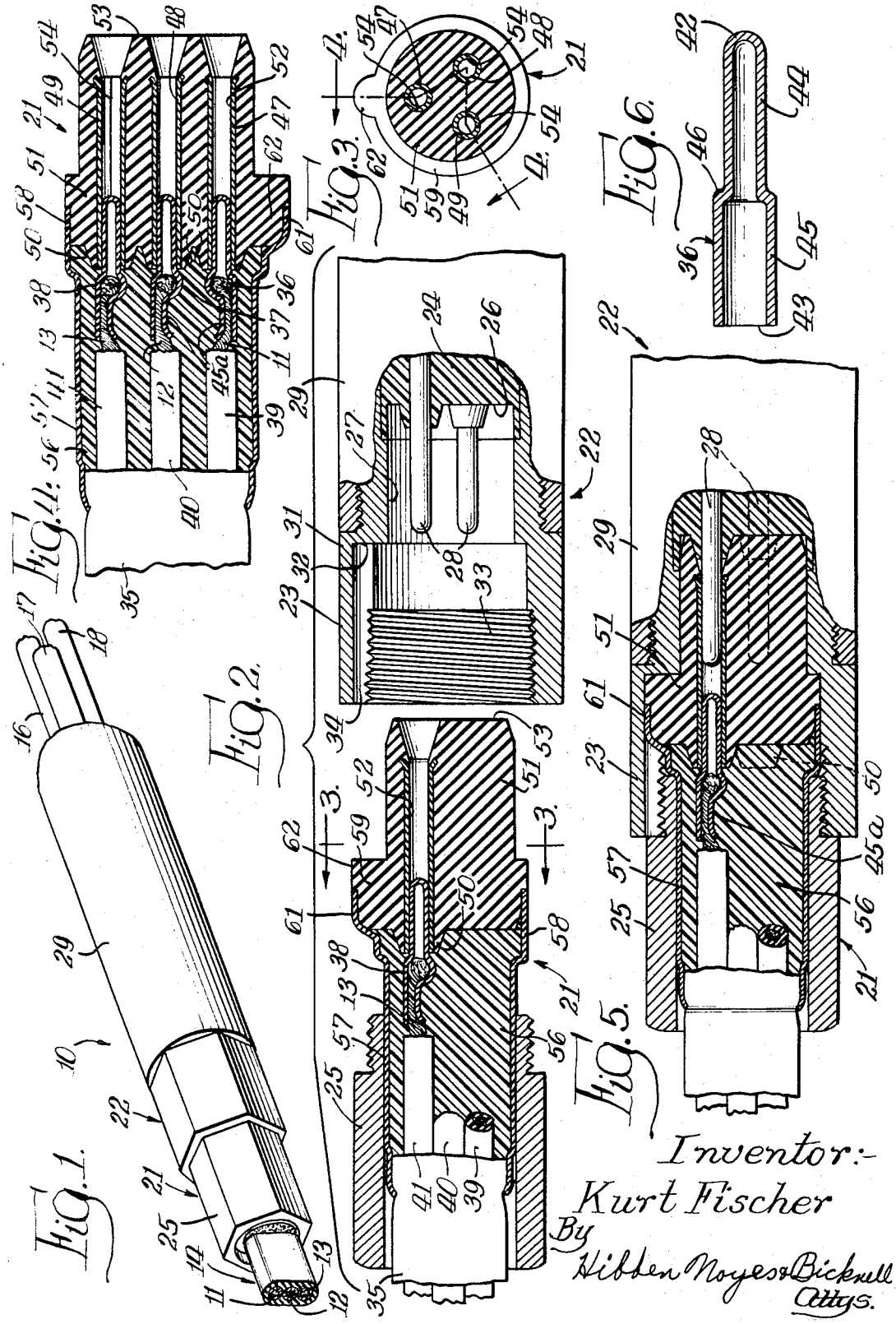

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ELECTRICAL CABLE CONNECTOR PART

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This invention relates to electrical wiring connections, and more particularly to an improved plug part of a sealed cable connector adapted to be submersed in a high pressure electrically conductive liquid.

It is an object of this invention to provide a plug part of a sealed electrical connector having socket part adapted to mate with the plug part, including a novel and inexpensive connector clamp.

Still another object is to provide a plug part of the foregoing character, including improved orienting means.

A still further object is to provide a plug part of the foregoing character, which effectively seals the plug part against entry of liquid.

Other objects and advantages of the invention will become apparent from the following description taken in conjunction with the accompanying figures of the drawing, in which:

FIG. 1 is a perspective view of an electrical cable connector embodying the features of the invention;

FIG. 2 is an enlarged longitudinal sectional view showing the parts of the cable connector when separated but in position to be assembled to each other;

FIG. 3 is a sectional view taken on the line 3—3 of FIG. 2;

FIG. 4 is a sectional view taken on the line 4—4 of FIG. 3;

FIG. 5 is a longitudinal sectional view of the connector with the parts secured to each other; and

FIG. 6 is an enlarged sectional view of a part of the connector.

In general, an electrical connector incorporating the invention is designed to be submersed in a high pressure fluid, and comprises plug and socket parts designed to be connected together. Electrical wire conductors are secured to each of the parts and, when the parts are connected together, sealed electrical connections are made between the wires of the two parts. Since it is important that each wire of one part be electrically connected to a certain wire of the other part, improved orienting means are provided to ensure proper connection of the parts.

When the connector and the wires attached thereto are submersed in a high pressure electrically conductive liquid, it is possible that the liquid may enter a break, for example, in the insulation surrounding one of the wires at a location displaced from the connector and creep between the strands making up the wire to the connector. To prevent the liquid from entering the connector and short circuiting the wires within the connector, a novel and improved water block clamp is provided at the ends of the wires secured to the plug part of the connector. In addition, the construction of the plug part is improved to provide added protection against liquid creepage around the water block clamps.

In greater detail, an electrical connector **10** incorporating the invention is designed to connect the wires **11**, **12** and **13** of a cable **14** to three wires **16**, **17** and **18**. The electrical connector **10** comprises a plug portion **21** and a socket portion **22** which are designed to be connected together by a nut **25** threaded into the socket part **22** and bearing longitudinally against the plug part **21**. When so connected, the plug and socket parts electrically connect the wires **11**, **12** and **13** to the wires **16**, **17** and **18**, respectively and to form a liquid tight seal around the wires.

The socket part **22** of the electrical connector **10** comprises a metal sleeve **23** (FIG. 2) and an insulating body **24**. The insulating body **24** extends into the interior of the sleeve **23** at one end thereof and has its end surface, indicated at **26**, spaced from the other end of the sleeve to provide a socket portion **27** within the sleeve **23**. The conductors **16**, **17** and **18** extend into and are embedded in the insulating body **24**, the ends of the wires **16**, **17** and **18** being arranged in triangular relation with each other at their inner ends, and prongs **28** are electrically connected to the ends of the wires **16**, **17** and **18**, the prongs **28** also being embedded in the insulating body **24** but projecting beyond the end thereof. The insulating body **24** and the adjacent portion of the sleeve **23** may be cased in an insulating sleeve **29**, or threads may be formed on the outer periphery of the sleeve **23** for connection of the sleeve **23** to an end bell of a motor, for example.

The prongs **28** are also arranged in triangular relation and project beyond the end surface **26** of the insulating body **24** and into the socket portion **27** of the sleeve **23**. Beyond the socket portion **27**, the sleeve **23** is provided with an enlarged portion **31** providing an inner transverse shoulder **32** at the outer end of the socket portion **27**. The interior of the enlarged portion **31** for at least a portion of its length is threaded as at **33**, and a longitudinally extending groove **34** is provided at one side of the enlarged portion **21** interiorly thereof, with the groove **34** extending from the outer end of the sleeve **23** to the transverse shoulder **32**.

The wires **11**, **12** and **13** of the cable **14** secured to the plug part **21** are covered with layers **39**, **40** and **41** (FIGS. 2 and 4) of an insulating material and with a cover **35** which is common to the three wires. The portion of the cover at the enr of cable is removed, and the insulating material **39** to **41** is removed from the end portions of the wires **11** to **13** to bare the end portions of the wires. The plug part **21** comprises three identical clamp members **36**, **37** and **38** (FIG. 4) which are respectively secured to the bared ends of the wires **11** to **13**. As shown in FIG. 6 which illustrates the clamp member **36** before connection with the wire **11**, the clamp member **36** initially is generally tubular and includes a closed end **42** and an open end **43**, the portion **45** of the clamp member **36** adjacent the open end **43** being enlarged relative to the portion **44** of the clamp **36** adjacent the closed end **42**, thus forming a shoulder **46** at the juncture of the reduced portion **44** and the enlarged portion **45**. The clamp members may be inexpensively manufactured because, with the foregoing construction, it will be seen that they may be made of sheet metal by drawing operations. While the wire **11** may be secured to the clamp member **36** by soldering, it is preferred that the wire **11** be secured to the clamp member **36** by inserting the bared end portion of the wire **11** into the open end **43** of the clamp member until the end of the wire reaches the shoulder **46**, and then crimping or otherwise reducing the diameter of part of the length of the enlarged portion **45** of the clamp member **36** to bring the enlarged portion **45** into tight mechanical and electrical engagement with the bared end portion of the wire **11**. Thus the portion **45** of each clamp member is crimped onto the bared end portion of the wire for part of the length of the portion **45** as shown at **45***a* in FIG. 5, leaving an uncrimped part to receive the end of the wire.

The plug part **21** of the connector further comprises three contact members **47**, **48** and **49**, (FIG. 4) which are generally tubular and elongated. The reduced portions **44** of the three clamp members **36**, **37** and **38** form prongs which are inserted into one end of the associated contact members **47**, **48** and **49**. The ends of the contact members **47** to **49** which receive the clamp members **36** to **38** may be flared outwardly, although this is not necessary. The prongs of the three clamp members fit into the ends of the

three contact members with a snug or press fit in order to establish firm electrical connections between the clamp members and the contact members.

The three contact members 47, 48 and 49 are arranged in a triangular relation similar to that of the prongs 28 of the socket part of the connector, and the contact members 47 and 49 are held in this relation by a bushing 51 made of a somewhat yieldable insulating material such as rubber. The bushing 51 is generally circular in cross section and is adapted to be inserted into the socket portion 27 of the sleeve 23, as shown in FIG. 5. Longitudinally extending holes 52 are formed completely through the bushing 51, and the three contact members 47 to 49 are positioned in these holes 52. The contact members 47 to 49 are slightly shorter than the length of the holes 52, and the outer ends of the contact members are spaced inwardly from the end surface 53 of the bushing 51. Since the holes 52 extend to the end surface 53 of the bushing, the prongs 28 of the socket part may be inserted through the openings of the holes 52 at the end face 53 and into the contact members 47 to 49. To ensure firm electrical connections between the prongs 28 and the contact members 47 to 49, the internal diameters of the contact members 47 to 49 are preferably made substantially equal to or slightly less than the other diameters of the prongs 28, and the wall of each contact member 47 to 49 is longitudinally slit as at 54, the slits 54 permitting the contact members 47 to 49 to flex and expand slightly as the prongs 28 are inserted therein, such expansion of the contact members 47 to 49 resulting in a firm electrical connection between the prongs 28 and the contact members 47 to 49.

The bushing 51 extends from the face 53 rearwardly, or toward the left as seen in FIG. 4, to a point adjacent the upper ends of the contact members 47 to 49, and conical portions 50 are preferably formed on the bushing 51 around the contact members 47 to 49 as shown in FIG. 4.

The plug part 21 further comprises a one piece metal sleeve 57 surrounding the end portions of the wires 11 to 13 and the clamping members 36, 37 and 38, the sleeve 57 being coaxial with the bushing 51. The inner or right hand end of the sleeve 57 has a portion 58 of increased diameter which extends around the upper end portion (as seen in FIG. 4) of the bushing 51. The portion of the bushing 51, which is adjacent the sleeve 57, is enlarged to form a shoulder 59 limiting the extent to which the enlarged portion 58 of the sleeve 57 may be pushed down over the bushing 51. To provide a rigid backing for the bushing 51 and to hold the wires and the clamp members in place, the sleeve 57 is filled with a rigid potting compound 56, which extends into the enlarged portion 58.

In one method of assembling the plug part of the connector, the contact members 47 to 49 are positioned in the holes 52 of the bushing 51 and the clamp members 36 to 38 are secured to the bared end portions of the wires 11 to 13. After the nut 25 and the sleeve 57 are slipped over the ends of the wires and on to the cable 14, the prongs of the three clamp members are inserted into the upper ends of the three contact members 47 to 49 and then the sleeve 57 is moved toward the bushing 51 and the increased diameter portion 58 of the sleeve 57 is pushed over the bushing until it meets the shoulder 59. With the foregoing parts so assembled, the assembly is positioned with the cable 14 extending upwardly from the bushing 51 and the potting compound 56 in a liquid state is poured into the upper open end of the sleeve 57. The liquid flows around the wires 11 to 13 and the upper end portions of the three clamp members 36 to 39, and it completely fills the space within the sleeve 57. After the potting compound 56 has hardened, it holds the parts of the plug part in tightly assembled relation. The potting material, in completely filling the space within the sleeve 57 fits tightly on the conical portions 50 of the bushing 51 so that the length of the creepage path between any two of the clamping members 36 to 38 or the contact members 47 to 49 is materially increased over what it would be if the conical portions were not present, thus decreasing the chance of fluid creepage.

Since it is important that each of the wires 11 to 13 be connected to a certain one of the wires 16 to 18, an orienting lug portion 61 (FIG. 4) is formed on the enlarged portion 58 of the sleeve 57. The rubber bushing 51 also has a radially extending lug 62 formed thereon a portion of which is received within the lug 61 of the sleeve 57. As the plug part is inserted into the socket part, the lugs 61 and 62 enter the groove 34, and the contact members 47 to 49 and the prongs 28 are arranged relative to the lugs 61 and 62 and the groove 34 such that the wires 11 to 13 and the wires 16 to 18 are properly interconnected.

The longitudinal dimensions of the plug part and the socket part are such that the lugs 61 and 62 must enter the groove 34 before the contact members 52 of the plug part engage the prongs 28 of the socket part. To hold the plug part 21 in the socket part 22, the nut 25 is threaded into the threads 33 of the socket part 22, the nut bearing against the shoulder formed by the enlarged portion 58 of the sleeve 57.

The foregoing construction is advantageous for numerous reasons. The clamp members 36 to 38 form excellent water barriers or blocks because of the closed ends 42 of the clamp members, and may be inexpensively manufactured because they do not require machining but may be drawn to form. Further, the tubular contact members 47 to 49 may also be inexpensively manufactured and they provide excellent electrical connections between the clamps 36 to 38 and the prongs 28. The construction is also advantageous in that the conical portions 50 on the rubber bushing 51 around the upper ends of the contact members 47 to 49 serve to increase the length of the creepage paths at the juncture between the bushing 51 and the potting compound 56. Still another advantage residing in this construction is that the orienting lug 61 is formed integrally with the sleeve 57, thereby eliminating the possibility that the lug 61 may become angularly displaced relative to the remainder of the sleeve 57 and the contact members 47 to 49. In addition, the integral construction of the sleeve 57 provides added space within the sleeve for the insulating potting compound 56 and the conductors and the sleeve 57, thereby reducing the possibility of a short circuit between the conductors or one of the conductors and the sleeve 57.

I claim:

1. A plug part for association with a socket part to form a sealed electrical connector and adapted to be secured to at least one wire, said plug part comprising at least one generally tubular clamp member which is closed at one end and open at its other end, said clamp member in said open end being adapted to receive an end of said wire in electrical engagement therewith, at least one generally tubular contact member, said closed end of said clamp member being positioned in one end of said contact member and in press fit engagement therewith, and electrical insulating means around said members and supporting said members for telescopic engagement of the other end of said contact member with a prong of the socket part of said electrical connector, said insulating means comprising a relatively yieldable portion around said contact member and a relatively rigid portion around said clamp member, said yieldable and rigid portions abutting each other and the interface between said yieldable and rigid portions being irregular around said contact member to increase the length of the creepage paths along said interface between said yieldable and rigid portions.

2. A plug part for association with a socket part to form a sealed electrical connector and adapted to be secured to at least one wire, said plug part comprising at least one generally tubular clamp member which is closed at one end and open at its other end, said clamp member in said open end being adapted to receive an end of said wire in electrical engagement therewith, at least one generally tubular contact member, said closed end of said clamp member being positioned in one end of said contact mem-

ber and in press fit engagement therewith, and electrical insulating means around said members and supporting said members for telescopic engagement of the other end of said contact member with a prong of the socket part of said electrical connector, said insulating means comprising a relatively yieldable member around said contact member and a relatively rigid member around a part of said clamp member, said yieldable and rigid members abutting each other and said yieldable member having a conical portion around said contact member and fitting tightly within the rigid member to increase the length of the creepage paths between the yieldable and rigid members from said clamp and contact members.

3. Apparatus as in claim 1, and further including a sleeve around said insulating means, said sleeve including a radially extending lug integrally formed thereon.

4. Apparatus as in claim 3, wherein said lug is hollow, and said insulating means includes an orienting lug portion which extends into said hollow lug of said sleeve.

5. A plug part for association with a socket part to form a sealed electrical connector and adapted to be secured to a plurality of wires, said plug part comprising a plurality of generally tubular contact members, one end of each of said contact members being adapted to receive a prong of said socket part, a plurality of clamp members adapted to be secured to the ends of said wires, each of said clamp members having a prong formed thereon which is inserted into the other end of the associated contact member, a relatively yieldable insulating member positioned around and supporting said contact members, a relatively rigid insulating member positioned around and supporting said clamp members, and a sleeve enclosing said rigid insulating member and partially enclosing said yieldable insulating member, said yieldable insulating member including a conical portion around each contact member and in tight engagement with said rigid insulating member.

6. A plug part for association with a socket part to form a sealed electrical connector and adapted to be secured to at least one wire, said plug part comprising a yieldable member made of an electrical insulating material, said members having a hole formed therethrough, a tubular contact member positioned in said hole, one end of said contact member being accessible for telescopic engagement with a prong of the socket part of said electrical connector, a generally tubular clamp member having one closed end and one open end, said open end being adapted to receive an end of said electrical wire and be electrically connected thereto, said closed end of said clamp member being positioned in the other end of said tubular connector member in press fit relation therewith, and relatively rigid electrical insulating means around said clamp member and said end of said wire, said electrical insulating means further being in firm engagement with said yieldable member around said hole and thereby holding said clamp and contact members in engagement and providing a firm backing for said yieldable member.

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