United States Patent [19]

Kailus

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[54] **ELECTRICAL CONNECTOR**

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[52] **U.S. Cl.** .... **339/177 R,** 339/278 D

[51] **Int. Cl.** **H01r 17/06**

[58] **Field of Search** .. 339/60, 61, 89 C, 90 C, 91 P, 339/94 R, 94 C, 94 M, 126 J, 136 C, 177 R, 177 E, 278 D; 174/75 C, 88 C, 89

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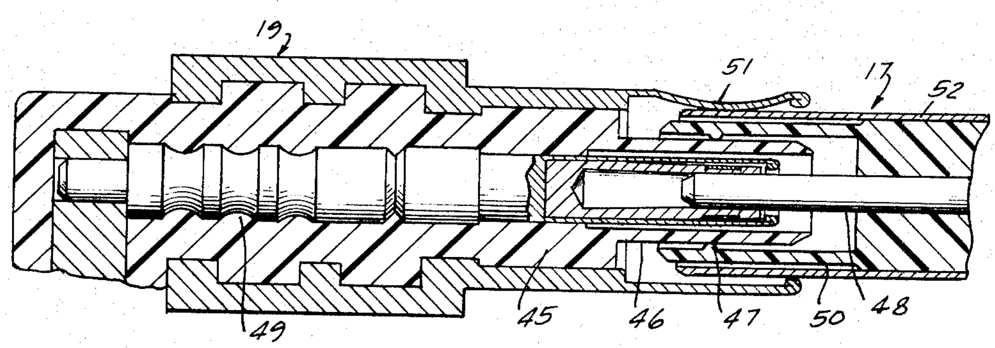
[57] **ABSTRACT**

A high-temperature electrical connector including interengageable mating sections each having a central and an outer-tubular metallic contact and an insulating sleeve disposed therebetween with the insulating sleeve of the one section having self-lubricating surfaces of a fluorocarbon engaging the sleeve or its associated outer-tubular metallic contact of the other section, the fluorocarbon having a relatively low heat deflection temperature so as to deform at high temperatures. The other insulating sleeve is composed of a material such as an aromatic polysulfone with a relatively high heat deflection temperature to provide a relatively rigid support for the fluorocarbon sleeve.

6 Claims, 6 Drawing Figures



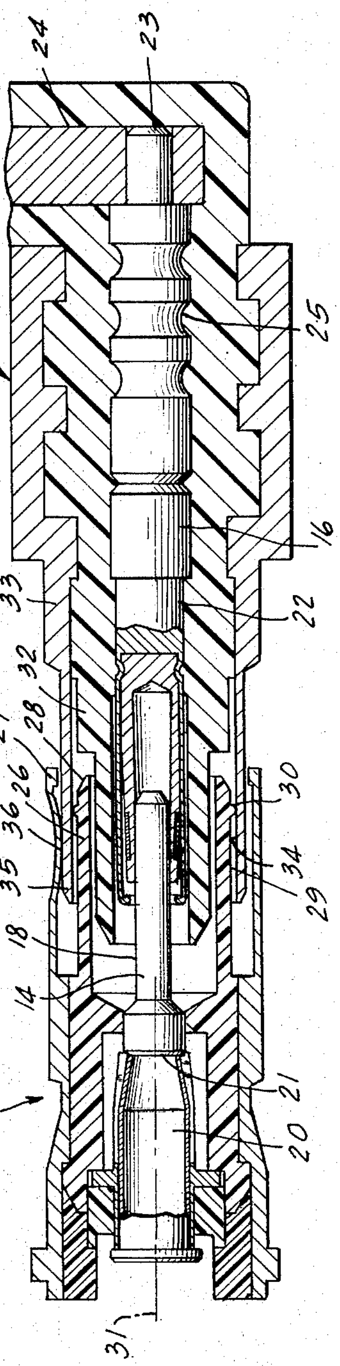


FIG-1

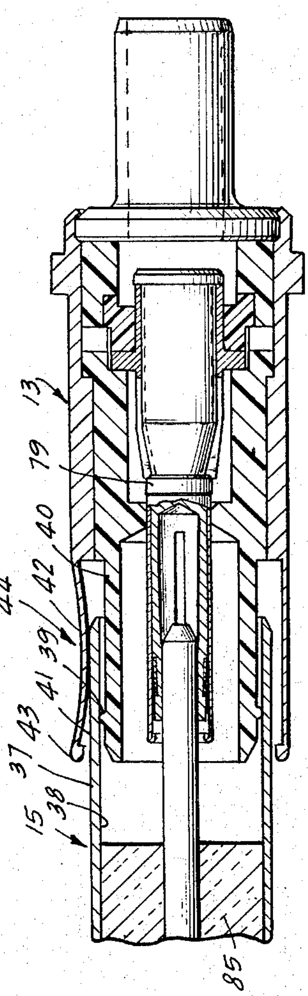


FIG-2

INVENTOR.
WILLIAM A. KAILUS

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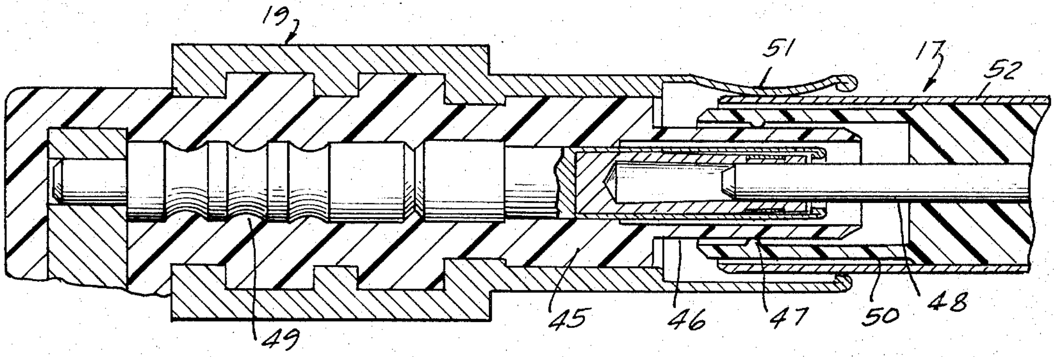
ATTORNEYS

Fig-3



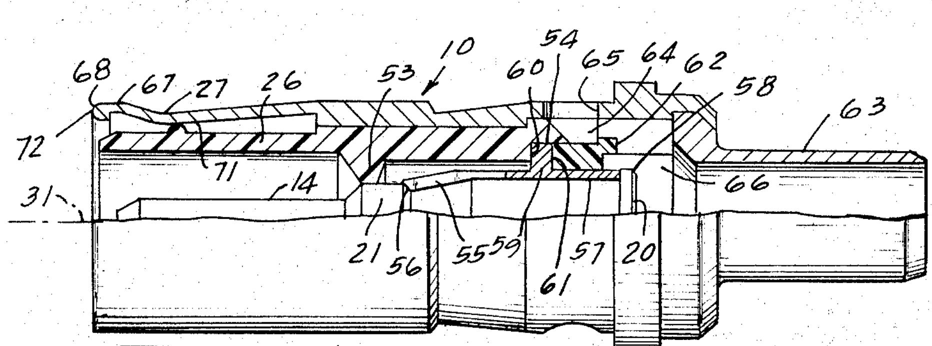


Fig-4

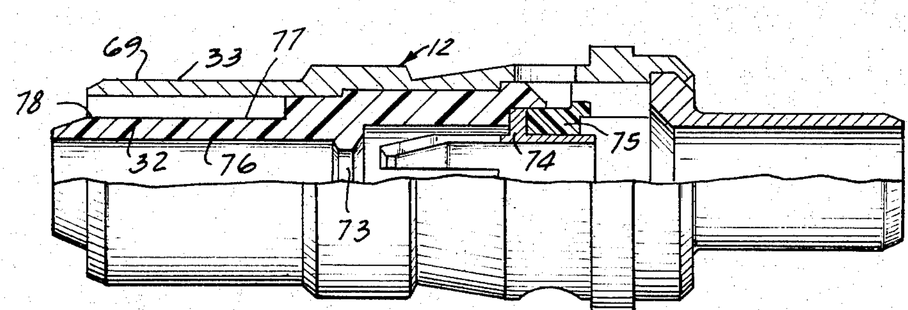


Fig-5

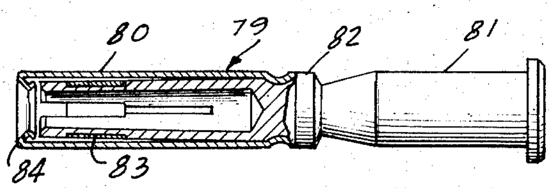


Fig-6

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ELECTRICAL CONNECTOR

BACKGROUND OF THE INVENTION

In connectors of the plug-and-receptacle type, interengageable connector sections are mated to provide electrical connection between centrally-mounted mating contacts and to interconnect protective housings surrounding these contacts. In one type of connector, the housings are composed of insulating materials with at least one housing being shaped as a sleeve to receive the other in engaging relationship.

In another type, the housings are metallic to provide electrical shielding of the central contacts and insulating members are provided to isolate the central and outer contacts. In one example of the second type of connector used at elevated temperatures (e.g. 250°–300° F.), one of the insulating members longitudinally extends as a sleeve between the central and outer contacts and abuts against the other insulating member rearwardly located in the connector section.

As the temperature requirements of these connectors have increased, it has been necessary to provide dielectric materials for the sleeves which are insulatively stable at the higher temperatures in addition to having other properties required for connector housings. Some materials, while insulatively stable at temperatures of 400°–500° F.,are so rigid that they do not easily mate; and in those instances where a seal is to be established, these materials are not sufficiently yieldable to provide sealing effect.

Another problem associated with some materials insulatively stable at temperatures of 400°–500° F. is that they tend to distort at the higher temperatures and this distortion interferes with the desired mating of the connector sections. In some instances, it is possible for the mating surfaces of the same material to lock and resist separation of the sleeves during attempts to release the connector sections. Among the materials having heat distortion properties which can result in this problem are the self-lubricating fluorocarbons and particularly polytetrafluoroethylene.

SUMMARY

This invention relates to electrical connectors with interengageable mating sections in which an insulating sleeve on one of the sections is mated within a complimentary protective housing on the other section. The sleeve is composed of a self-lubricating fluorocarbon with a relatively low heat deflection temperature and thereby heat distortable in a mating relationship with the complimentary protective housing. More particularly, the invention is directed to an electrical connector with interengageable mating sections in which the complimentary protective housing engageable with the fluorocarbon sleeve is composed of a material having a relatively high heat deflection temperature to maintain the mating relationship while permitting the sections to be released at high temperatures. Exemplary of a material with such high heat deflection temperatures is an aromatic polysulfone which is insulatively stable at temperatures of 400°–500° F. and also has a heat deflection temperature of over 500° F. at 264 psi as measured in ASTM D 648-56.

Several advantages result from the electrical connector of the invention. One is the utilization of a high temperature, self-lubricating fluorocarbon as an elongated insulating sleeve in the connector construction. In addition to its useful high-temperature properties, the fluorocarbon provides self-lubricating properties and thereby can be easily inserted within or over a complimentary protective housing without requiring the second housing to be similarly self-lubricating. It is also sufficiently yieldable to form an interference fit with the complimentary housing.

Another advantage is provided by the combination of the fluorocarbon sleeve with a complimentary protective housing composed of a material comparatively rigid at the higher temperatures. The rigid housing provides a mating surface which resists distortion and permits release of the connector sections.

Another advantage is provided by the use of a complimentary protective housing mateable in an engaging relationship with the fluorocarbon sleeve and composed of a material having a high heat deflection temperature to maintain the engaging relationship without preventing the connector sections from being released.

In those instances where a seal is desired, a further advantage is provided at the high temperatures when the fluorocarbon sleeve includes a raised collar which tightly bears against the mating surface of the rigid complimentary housing. Although the raised collar is under stress and distorted by the heat, it tends to conform to the mating surface of the rigid material and maintains some sealing effect.

DESCRIPTION OF THE DRAWING

In the drawings

FIG. 1 is a side view in cross section of the electrical connector of the invention.

FIG. 2 is a side view in cross section of a second embodiment of the connector of the invention.

FIG. 3 is a side view of a third embodiment of the connector of the invention.

FIG. 4 is a side view partially in cross section of one of the mating sections of the connector of FIG. 1.

FIG. 5 is a side view partially in cross section of the second mating section of the connector of FIG. 1.

FIG. 6 is a side view in cross section of a socket contact of FIG. 2.

GENERAL DESCRIPTION

The electrical connector of the invention is designed for high temperature use and comprises first and second interengageable mating sections, each with a protective body containing one or a plurality of contact-receiving bores and contacts mounted therein. In one mating section, the body includes one or a plurality of yieldable sleeves extending around the contacts in the bores with self-lubricating surfaces adapted to easily slide against surfaces in the other mating section while being insulatively stable at temperatures in the order of 400°–500° F. The protective body of the second mating section includes a similar number of bores and complimentary contacts mounted therein to mate with those contacts in the first section. Advantageously, the second protective body provides one or a plurality of insulating surfaces insulatively stable at the higher temperatures and relatively rigid to accept the self-lubricating surfaces of the sleeves and form insulated enclosures around the mated contacts.

Preferably, the self-lubricating surfaces are composed of a fluorocarbon such as polytetrafluoroethylene and provide self-lubrication at temperatures of 400°–500° F. Since the fluorocarbons with these characteristics tend to be heat distortable as illustrated by low heat deflection temperatures (e.g. below about 300° F. at 66 psi as measured in ASTM D 648-56), the adverse effects of heat distortion on the mating surfaces of the connector are reduced by including as the complimentary mating surface, a material which is relatively rigid at the higher temperatures. Advantageously, when the mating is accompanied by bearing stress on the adjacent surfaces, the fluorocarbon surface includes a raised portion as a bearing surface which can be heat distorted while maintaining engagement with the adjacent surface which can be formed to permit easy release of the mating sections.

Connectors according to the present invention are applicable to a wide variety of constructions but in a typical installation will comprise one or a plurality of pairs of interengageable mating sections **10** and **12** with mating contacts **14** and **16** made of leaded copper and centrally mounted in their respective sections.

As illustrated in FIG. **1**, first section **10** includes central contact **14** with forward pin **18**, rear socket **20**, and intermediate cylindrical portion **21** for mounting the contact in section **10**. Second section **12** includes central contact **16** with forward socket **22**, rear pin **23** swagged in a bussing ring **24**, and intermediate irregular surfaces **25** for mounting in section **12**. Bussing ring **24** is part of a bussing assembly described in my copending application entitled "CONNECTOR MODULE" and filed Sept. 7, 1971 as Ser. No. 178,097.

Disposed around and laterally spaced apart from contact **14** are protective sleeve **26** of plastic such as the described fluorocarbon and sleeve **27** of berryllium copper which serve respectively for insulating and electrical shielding purposes. Sleeve **26** is disposed between contact **14** and outer-tubular contact of sleeve **27** and includes mating end **28** which engages section **12** when sections **10** and **12** are mated. As illustrated, sleeve **26** includes an outer peripheral surface **29** with laterally projecting riser **30** which extends around surface **29** in a direction normal to the longitudinal axis **31** of sleeve **26** and is designed to telescopingly engage with surface **34** of section **12**. Mating end **28** except for riser **30** is sized so as to be spaced apart from sleeve **27** to permit release of the sleeves. As illustrated, sleeve **26** extends longitudinally beyond contact **14** and is laterally spaced apart from the contact.

Section **12** also includes protective sleeves **32** and **33** which provide insulative and electrical protection for central contact **16** in a similar manner to sleeves **26** and **27** in respect to contact **14**. The combination of sleeves **32** and **33** provides at least one surface illustrated in FIG. **1** as surface **34** on sleeve **33** for snug engatement and more advantageously an interference fit with riser **30** of sleeve **26**. Sleeve **33** includes mating end **35** from which surface **34** extends rearwardly as a smooth annular shape with a minimum cross section at mating end **35** in order that the heat deflection and distortion in sleeve **26** will not result in the interlocking of sleeves **26** and **33** together. Since riser **30** also serves for sealing purposes, it is preferred that surface **34** be circular with its diameter remaining essentially constant for length **36** over which riser **30** passes.

In some instances, as illustrated in FIG. **2**, connector sections **13** and **15** are provided in which section **15** includes metallic sleeve **37** with surface **38** for mating with riser **39** of sleeve **40** and no separate insulating sleeve is provided. Metallic sleeve **37** also includes outer surface **41** for mating with metallic sleeve **42** to provide electrical connection between the two outer contacts. Sleeve **42** includes mating end **43** shaped as a spring **44** which resiliently bears against metallic sleeve **41**. As illustrated, section **15** is formed with glass insulator **85** as part of a hermetic seal (not shown).

As illustrated in FIG. **3**, insulating sleeve **45** can provide surface **46** upon which riser **47** engages during the mating. In this embodiment, central contacts **48** and **49**, insulating sleeves **45** and **50**, and outer tubular contacts **51** and **52** respectively become mated. As illustrated, sleeve **50** is sized so as to telescope over surface **46** of sleeve **45** with riser **47** engaging surface **46**.

Mating sections **10** and **12** of FIG. **1** are releasable and separately illustrated in FIGS. **4** and **5** respectively. Contact **14** is centrally mounted on internal collar **53** of sleeve **26** and locked into its position along longitudinal axis **31** by retainer clip **54** of beryllium copper which includes a forwardly extending inwardly tapered end **55** which engages shoulder **56** of cylinder **21** on contact **14** and resists movement in a rearward direction. Rear sleeve **57** of clip **54** serves to prevent contact **14** from moving in a forward direction by engaging outer flange **58**. Clip **54** includes outer collar **59** snugly positioned between shoulder **60** of sleeve **26** and surface **61** of rear insulator **62** of a high-temperature plastic to retain clip **54** in section **10**.

After an external contact (not shown) is connected to socket **20** and its shielding cable is connected to rear ferrule **63**, connector section **10** is potted by pouring a potting compound into aligned apertures **64** and **65** in sleeves **26** and **27** respectively. In this operation, the rear internal end **66** becomes potted and retains rear insulator **62**, sleeve **26**, and contact **14** in position. The potting compound is prevented from entering socket end **20** by the presence of the external contact. Outer metallic sleeve **27** is formed as spring **67** on mating end **68** and when mated with sleeve **33** (FIG. **5**), bears against its surface **69** with sufficient force to prevent accidental removal of the sections **10** and **12**. Spring **67** is conveniently formed with an inwardly depressed bow **71** which extends to a forwardly positioned, inwardly bent hook **72**.

FIG. **5** is illustrateive of mating section **12** without central contact **16** and includes internal collar **73**, retainer clip **74**, and rear insulator **75** similar to those members described for section **10**. Sleeve **32** is cylindrical shaped and extends forwardly with smooth inner and outer surfaces **76** and **77** to mating end **78**.

Central socket **79** for the mating section **13** of FIG. **2** is illustrated in FIG. **6** and includes forward and rear sockets **80** and **81** separated by cylindrical mounting portion **82**. Forward socket **80** includes pressure spring **83** to bias socket **80** inwardly. A forwardly hooked hood **84** is fastened over socket **80** and limits the outward deflection of socket **80**.

The foregoing description of the present invention is only illustrative of an exemplary form which the invention may take. Still other modifications and variations will suggest themselves to persons skilled in the art. It is intended, therefore, that the foregoing detailed description be considered as exemplary only and that the scope of the invention be ascertained from the following claims.

I claim:

1. An electrical connector comprising first and second interengageable mating sections, each including at least one central metallic contact and outer protective longitudinally elongated sleeve therefor, the sleeve of the first section being composed of a self-lubricating fluorocarbon having a heat deflection temperature below about 300° F. at 66 psi and having a mating end with an inwardly projecting lateral riser sized to telescope over and engage the sleeve of the second section with said mating end except for said riser being sized so as to be spaced apart from the second sleeve to permit release of the sleeves, the second sleeve having a mating end with a periphery of an essentially constant cross-sectional dimension along the longitudinal axis for engagement with said riser and being composed of a material having a heat deflection temperature above about 400° F. at 264 psi, the riser bearing against said periphery with a laterally directed force when said sections and sleeves are mated.

2. The electrical connector of claim 1 wherein each of said sections includes a second metallic contact outwardly disposed about said sleeve as a shield for the central contact with the shield for one of the central contacts including an inward curve to form a spring means for engagement with the shield for the other of said central contacts, and the sleeve of said second section is a thermoplastic polysulfone.

3. The connector of claim 1 wherein said sleeve with said riser extends longitudinally beyond said central contact and is laterally spaced apart therefrom.

4. The electrical connector of claim 3 wherein said second sleeve is a plastic sleeve disposed around and spaced apart from said central contact and said plastic is a polysulfone.

5. The electrical connector of claim 4 wherein said riser extends radially around said mating end for sealing engagement with the mating end of the sleeve of the second section.

6. The electrical connector of claim 5 wherein said fluorocarbon is polytetrafluoroethylene.

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