United States Patent

Upstone et al.

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[45] **July 18, 1972**

[54] ELECTRICAL CONNECTOR INTERFACIAL SEALS

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[52] **U.S. Cl.** ..... **339/94 R**

[51] **Int. Cl.** **H01r 13/52**

[58] **Field of Search** 339/42, 59–61, 339/94

[56] **References Cited**

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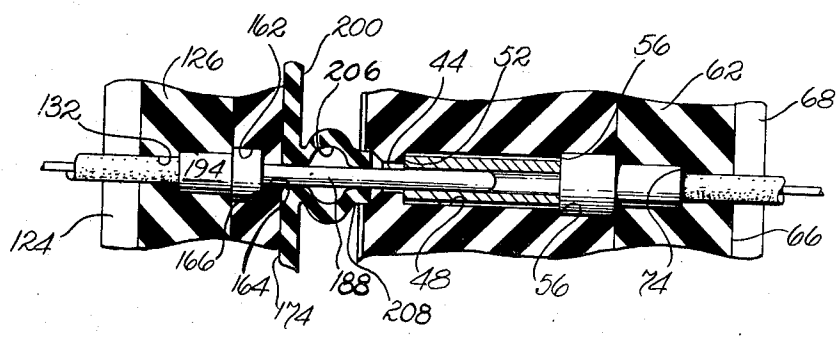
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[57] **ABSTRACT**

An interfacial seal for an electrical connector for use between electrical connector interfaces. The environmental seal is formed of a resilient material and mounted on one of the connectors. A rear portion of the seal is fixed to the connector member. Upon mating, the front portion of the seal forms a sealing surface between the connector members and an intermediate portion of the seal collapses outwardly. The intermediate and forward portion of the seal may be initially tubular in shape and surround the contacts of one of the connector members. Moreover, a groove may be formed on the inner surface of the tubular members which provides a relief.

6 Claims, 5 Drawing Figures



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2 Sheets-Sheet 1

FIG. 1.

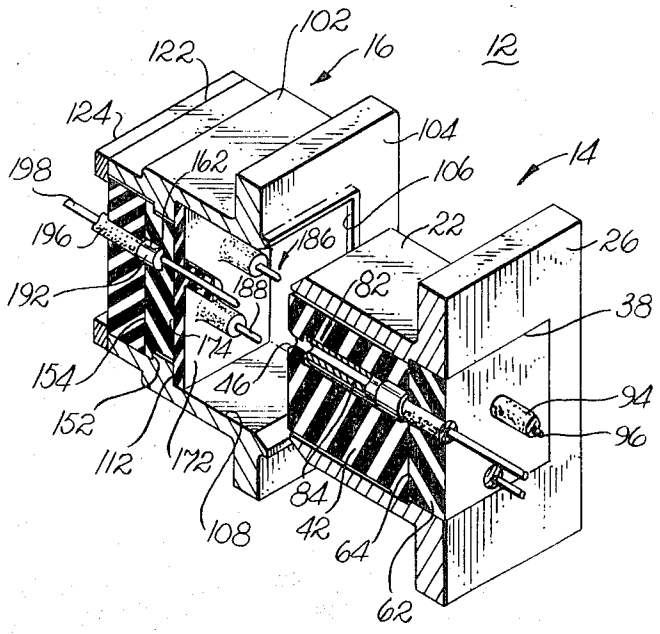


FIG. 4.

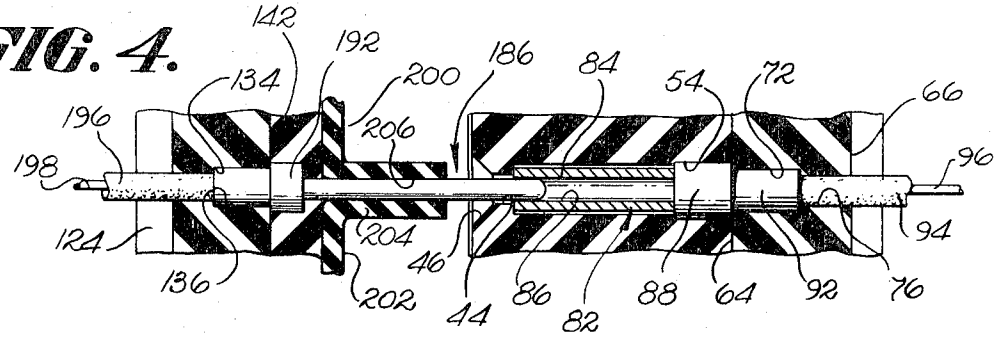
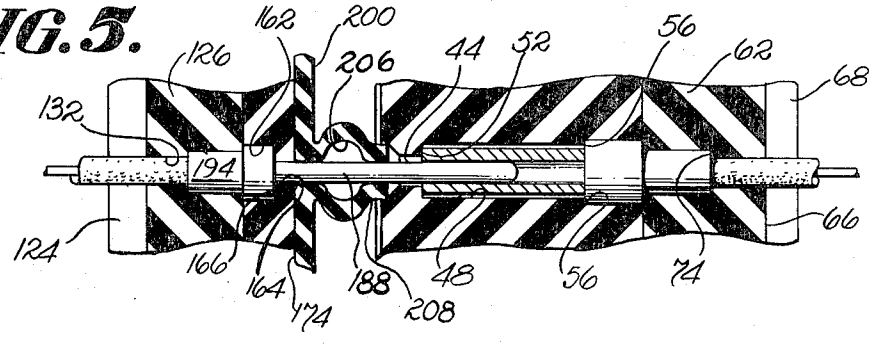


FIG. 5.



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FIG. 2.

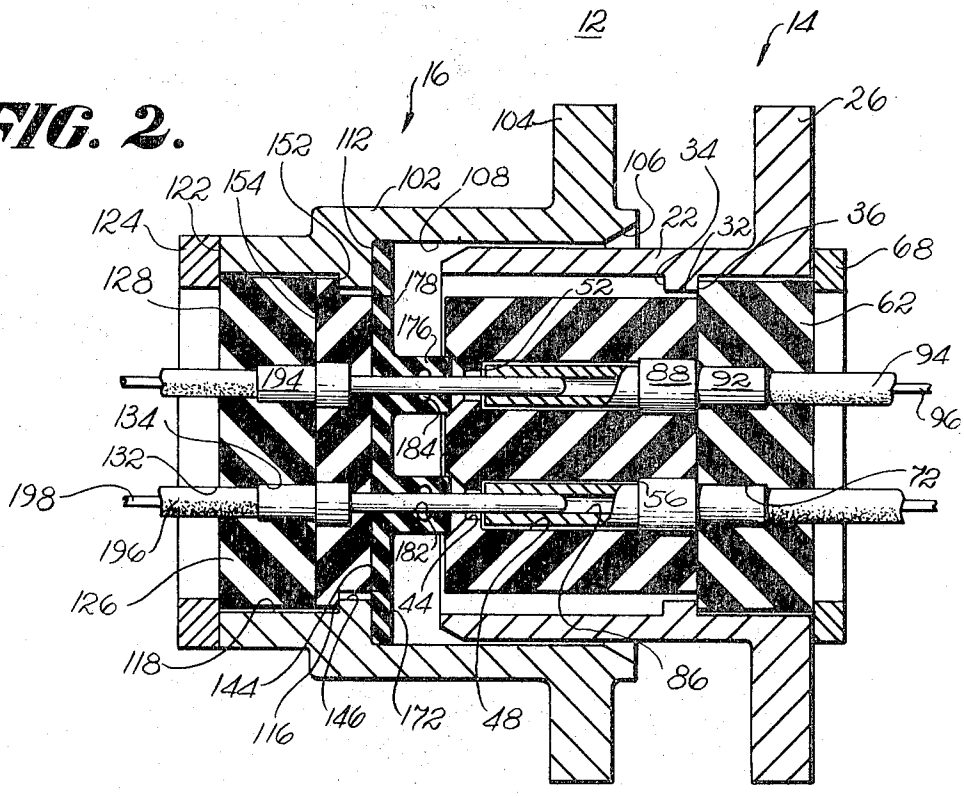
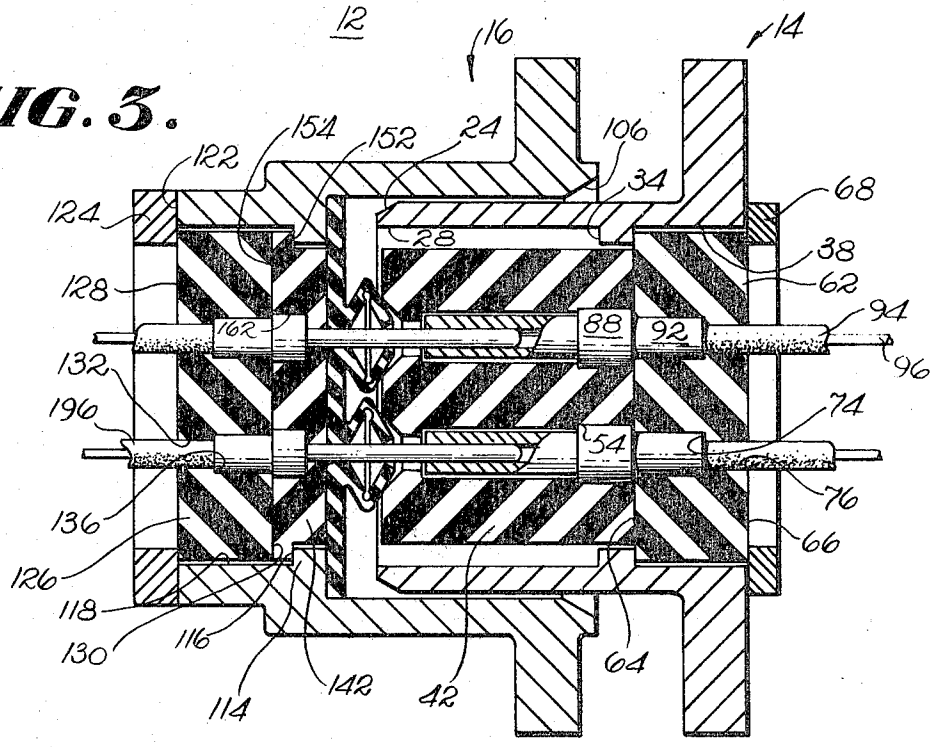


FIG. 3.



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ELECTRICAL CONNECTOR INTERFACIAL SEALS

The invention relates in general to electrical connector interfacial seals and, more particularly, to an environmental seal for use between electrical connector interfaces.

BACKGROUND OF THE INVENTION

Interfacial sealing components, particularly those used between the mating faces of electrical connectors are used to isolate individual circuits from the detrimental effects of otherwise degrading environments.

Typically harmful environmental conditions include moisture, salt spray, sand, dust, fluids as well as fumes. To overcome these and other environmental factors from being transmitted from one area of equipment to another area through connectors, electrical interfacial seals have been used to provide the necessary isolation desired. Conventional interfacial seals function primarily by means of compressive forces which are formed when two connector halves are mated. Typically conventional environmental seals include flat gaskets while other types utilize projecting surfaces to effect localized compressive loading when the two connector halves are mated. The later mentioned projecting surface seal is generally considered the most reliable type of seal and may be considered to operate in the same fashion as does a "cork in a bottle."

However, the most significant deficiency in the aforementioned seals is the inability of these seals to maintain sealing over a wide range of engagement lengths, that is, the distance between engaging faces. While conventional cable to box, cable to wall, or cable to cable connectors are generally held in close mating relationship through the function of their built-in coupling components, rack and panel type connectors must function over a much wider span of interfacial spacings. This wide spacing range is due to the fact that one-half of the connector is mounted in an equipment rack whereas the mating connector is mounted on the equipment box. Because of the structural characteristics of such installations a wide variation in connector mounting surfaces results with considerably larger variations between connector faces than occurs with other connector installations.

In order to overcome the attendant disadvantages of prior art environmental seals wherein the connector halves are subjected to a broad spectrum of spacings, the present invention provides a highly efficient reliable environmental seal. The seal provides maximum environmental protection which is effective throughout a broad spectrum of spacings between the connector halves. Moreover, the force per unit length of deflection of the seal can be controlled to values significantly less than conventional seals. The seal can be used where each connector contains a plurality of pin and socket contacts. Moreover, the seal is readily removable and replacable should damage thereto occur.

SUMMARY OF THE INVENTION

The invention comprises an electrical connector assembly having an environmental seal between a pair of mating interfaces of a first connector member and a second connector member. Each of the connector members having axially extending forward portions which are adapted to mate with one another and form a mated connector assembly. The environmental seal is formed of a resilient material and is mounted on one of the connectors. The seal has a rear portion generally fixed on the connector member, an intermediate portion extending forwardly from the rear portion mounted adjacent the forward portion of the one connector members, and a front edge surface which abuts an opening in the other of the connector members upon mating and forms a sealing surface therebetween. The opening in the other connector member is fixed relative to the rest of the other connector member, with the intermediate portion collapsing outwardly upon mating of the connector members.

The advantages of the invention, both as to its construction and mode of operation, will be readily appreciated as the same becomes better understood by reference to the following detailed description when considered in connection with the accompanying drawings in which like referenced numerals designate like parts throughout the figures.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 illustrates a perspective view, partly in section, of a male and a female connector prior to mating utilizing the novel environmental seal in accordance with the invention;

FIG. 2 depicts male and female connectors of FIG. 1 partly in section partially mated;

FIG. 3 depicts the male and female connectors of FIG. 1 partly in section with the connectors fully mated;

FIG. 4 illustrates an alternative embodiment of the seal shown in FIG. 1, partly in section, prior to interconnection of the connector halves; and

FIG. 5 illustrates the insulating seal of FIG. 4, partly in section, in a position wherein the connector halves are fully mated.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now to the drawings there is shown in FIG. 1 a connector assembly **12** having a plug connector **14** which is to be mated with a receptacle connector **16**. The plug connector **14** comprises an outer shell **22** which is champfered at its front outer surface **24** and contains an outwardly extending flange **26** at its rear outer surface. The inner surface of the shell **22** contains a front bore surface **28** which terminates at an inwardly extending flange **32** having a forward facing shoulder **34** and a rearward facing shoulder **36**. The shell **22** further contains a rear bore surface **38** which terminates at the rearward facing shoulder **36** of the flange **32**.

Mounted with the shell **22** is a front insulator member **42** whose outer dimensions are slightly less than the inner dimensions of the flange **32**. The insulator **42** contains a plurality of bores **44** which terminate with a forward facing flared portion **46**. The rear end of the bore **44** is adjacent an enlarged circular bore portion **48** with the junction of the bores **44** and **48** defining a rearward facing shoulder **52**. A rear bore portion **54** is slightly greater in diameter than the bore **48** with the junction of the bores **48** and **54** being defined by a rearward facing shoulder **56**.

Mounted in the bore portion **38** of the shell **22** is a rear insulator member **62**. The front face **64** of the insulator **62** abuts the rearward facing shoulder **36** of the shell and the rear face **66** of the insulator **62** is flush with the rear surface of the flange **26**. A retaining ring **68** whose outer dimensions are greater than the bore **38** and whose inner dimensions are less than the outer dimensions of the insulator **62** is utilized to maintain the insulator **62** in the bore **38**. The insulator **62** contains a plurality of forward bores **72** axially aligned with the bores in the front insulator **42**. The bores **72** terminate in a forward facing shoulder **74**. The insulator **62** further comprises rear bores **76** which terminate at the shoulder **74**. Electrical socket contacts **82** are mounted within the insulators **42** and **62** and contain a front contact portion **84** having a bore **86** therein. The front contact portion is integral with an enlarged cap portion **88** which abuts the rearward facing shoulder **56**. The rear surface of the cap **88** is mounted flush with the interfacing surfaces of the front and rear insulators **62**. A crimping cup **92** of the contact **84** is integral with the cap **88**. The crimping cup **92** is mounted in the front bore **72** of the rear insulator **62**. Extending rearwardly through the rear bores **76** are conductors **94** whose wires **96** have been crimped to the crimping cup **92**.

The receptacle connector **16** comprises an outer shell **102** having an outwardly extending flange **104** formed along the front outer surface thereof. The shell **102** has a champfered front surface **106** whose rear terminates at an enlarged forward bore portion **108**. The rear end of the forward bore por-

tion terminates in a forwardly facing shoulder **112**. An inwardly extending flange portion **114** is defined at its front surface by the forward facing shoulder **112** and in its rear surface by a rearward facing shoulder **116**. A reduced diameter rear bore **118** is formed from the rear end of the shell **102** to the rearward facing shoulder **116**. Abutting the rearward facing surface **122** of the shell is an annular retaining ring **124** whose outer surface is flush with the outer surface of the conductive shell **102** and whose inner dimensions are slightly smaller than the bore **118**.

Mounted at the rear end of the conductive shell **102** is a rear insulator **126** which is held within the shell by means of the retaining ring **124**. The rear surface **128** of the insulator **126** is flush with the rear surface **122** of the shell **102** and the front surface **130** terminates rearwardly of the rearward facing shoulder **116**. The rear insulator contains reduced diameter rearward bores **132** and enlarged diameter forward bores **134**, with a forward facing shoulder **136** defining the junction of the bores. A front insulator **142** has its front surface **144** positioned flush with the forward facing shoulder **112**. The forward outer surface **146** of the insulator **142** is slightly less than the inner dimension of the flange **114** and the rear portion thereof is slightly less than the bore **118** and contains a forward facing shoulder **152** which abuts the rearward facing shoulder **116** of the shell **102**. Further, the rear surface **154** of the front insulator **142** abuts the front surface of the rear insulator **126**. The front insulator **142** further contains a plurality of enlarged rear bores **162** and a reduced diameter forward bore **164**. The junction of the bores **162** and **164** define a rearward facing shoulder **166**.

An interfacial seal **172** which is normally made of a resilient elastomer containing silicone, or other similar resilient material, has a rear surface **174** which abuts the front surface **144** of the front insulator **142**. The seal contains a plurality of forwardly extending tubular portions **176** which extend from the front face **178** of the seal. Each of the tubular portions contain a bore **182** which extends from the front end of the tubular portion through to the rear surface **174** of the seal, the bores **182** being axially aligned with the bores of the front insulator **142** and the rear insulator **126**. Further, an annular opening **184** is formed approximately in the center of the tubular portion along the surface of the bore **182**.

Pin contacts **186**, having a front contacting surface **188** for mating with the socket contacts **84**, are mounted in the receptacle shell **102**. The pin contacts extend forwardly of the tubular seal portion **176** and the rear end of the contacts terminate at a cap member **192** which is mounted in the bore **162** of the front insulator **142**. The rear surface of the cap **192** is flush with the rear surface of the front insulator **142** and the front surface of the cap **192** abuts the rearward facing shoulder **166**. The pin contact portion **188** extends forwardly from the front end of the cap member **192** and is seated in the bore **164** of the front insulator **142** and the bore **182** of the seal **172**. A crimp cup **194** is mounted in the bore **134** of the rear insulator **126** and the front end thereof is integral with the rear surface of the cap **192**. The rear end of the cup **194** abuts the forward facing shoulder **136** formed in the insulator **126**. Conductors **196** have wires **198** therein, the wires being crimped to the crimp cup **194** with the conductors being positioned in the bore **132** of the rear insulator **126**.

As the pair of mating connectors **14** and **16** are joined together, as shown in FIG. **2**, the pin contacts **186** enter the contact portion **84** of the socket contacts. Further, the front end of tubular portion **176** abuts the flared portion **46** of the insulator **42** and continued mating of the connectors as shown in FIG. **3** allows the desired seal to form between the mating connectors. Moreover, the annular opening **184** of the bore **182** provides an internal relief for the seal and allows the seal to deflect outwardly along a plane of the opening with lower sealing forces.

Referring now to FIGS. **4** and **5** there is shown an alternative embodiment of the interfacial seal but with the internal relief opening omitted. The seal **200** is formed of a forward facing surface **202** and tubular portion **204** extending therefrom. A bore **206** is formed in the tubular portion. The front end **208** of the tubular portion enters the flared portion **46** of insulator **42** upon mating causing the tubular portion to collapse outwardly radially along the axis of the connectors.

As can readily been seen, sealing is achieved in both embodiments at the junction of the front opening of the insulator **42** and the tubular front end of the sealing member. Thus, the seals are made effective over a broad spectrum of spacings between the connectors. As the mating distance decreases the seal expands into the open area between members, but due to the recovery characteristics of the material, the seal will continue to function as mating distances increase again. Thus, any inherent tendencies for mated distances to change under vibration, loading, temperature, expansion, contraction, or change in alignment conditions will be compensated for by the resilient recovery characteristics.

Further, it should be understood that individual tube seals could be used rather than the arrangement wherein the tubular members are all joined together by a common portion.

What is claimed is:

1. An electrical connector assembly having an environmental seal between a pair of mating interfaces of a first connector member and a second connector member, each of said connector members having axially extending forward portions which are adapted to mate with one another and form a mated connector assembly;

said environmental seal being formed of a resilient material and being mounted on one of said connectors, said seal having a rear portion generally fixed on said connector member, an intermediate portion extending forwardly from said rear portion and mounted adjacent the forward portion of said one connector members and a front edge surface which abuts an opening in the other of said connector members upon mating, and forms a sealing surface therebetween, the opening in said other connector member being fixed relative to the rest of said other connector member, said intermediate portion collapsing outwardly upon mating of said connector members.

2. An environmental seal for a pair of mating connectors, each of said connectors having a plurality of electrical contacts at least a portion of which is mounted in an insulator block; said contacts in one of said connectors being adapted to be mated with the contacts in the other connector; said seal having a rear portion which is generally fixed to a front surface of one of said insulator blocks and a plurality of intermediate portions and front portions, said intermediate and front portions being tubular in shape and having an inner surface which surrounds said contacts of one of said connectors;

the insulator block of said other connector having openings formed at the entry of a bore having its contacts mounted therein with the portion of said other insulator block containing said openings being fixed relative to said contacts; said front end portions of said seal engaging said openings upon mating of said connector shells, while said intermediate portion collapses as said connectors are drawn closer together.

3. An environmental seal in accordance with claim **2** wherein a groove is formed on the inner surface of said intermediate portion, said intermediate portion collapsing along the plane of said groove.

4. An environmental seal in accordance with claim **2** wherein said rear portion is formed of a surface which covers at least the entire front surface of said insulator block to which it is mounted.

5. An environmental seal in accordance with claim **2** wherein said intermediate portion collapses generally radially along the axis of said connectors.

6. An environmental seal in accordance with claim **2** wherein said seal will provide an effective seal over a range of distances between said connectors.

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