July 5, 1966 J. C. KYLE 3,259,872

SEALED MULTI-CONTACT CONNECTOR

Filed March 7, 1962 2 Sheets-Sheet 1

Fig. 1

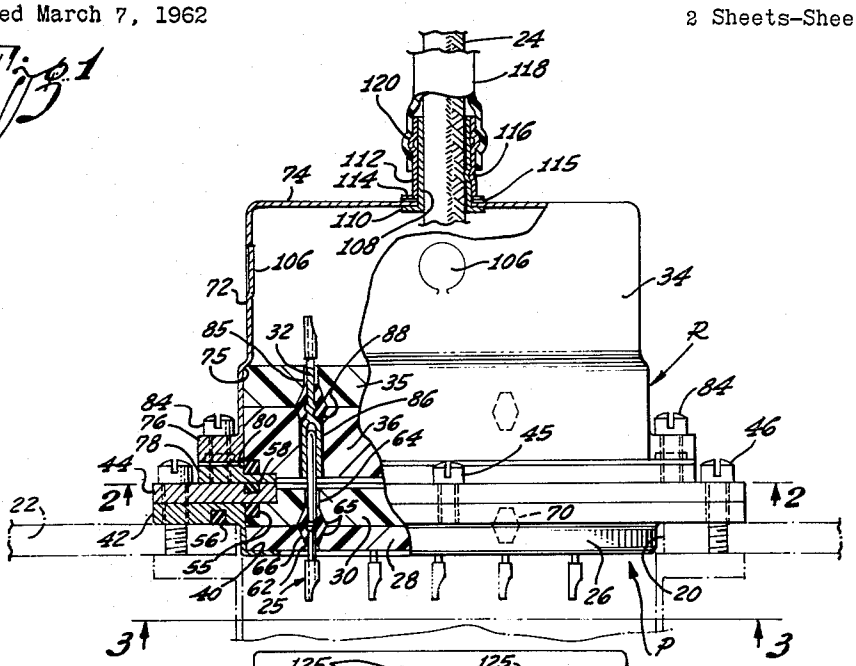


Fig. 2

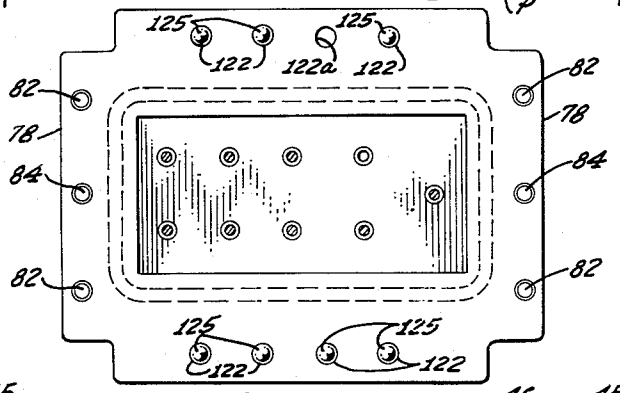
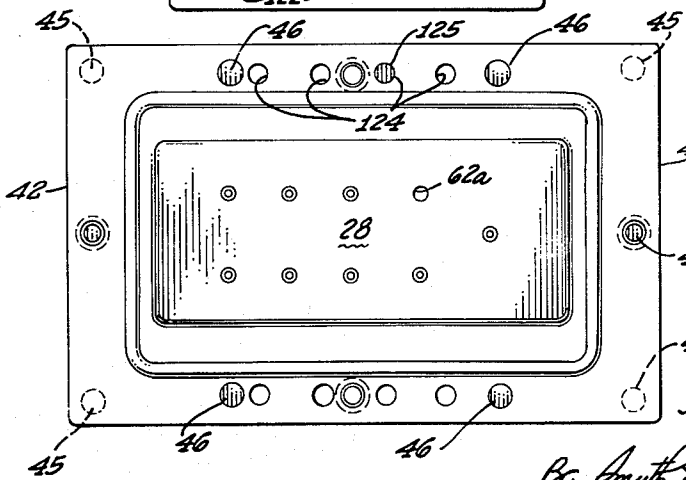


Fig. 3



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Fig. 4

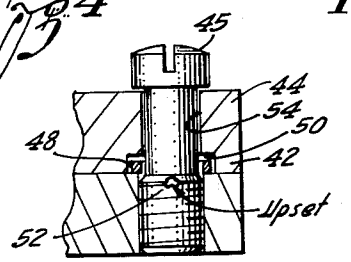


Fig. 6

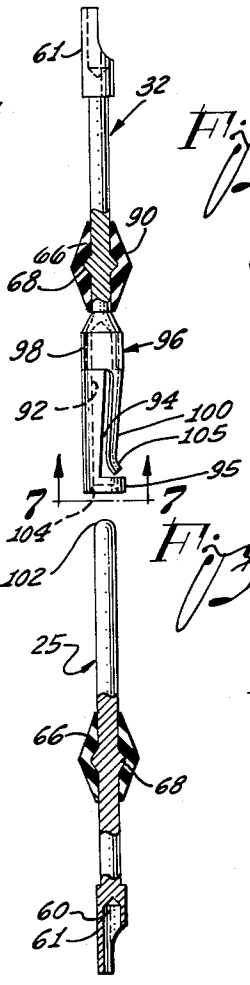


Fig. 10

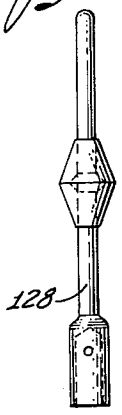


Fig. 11

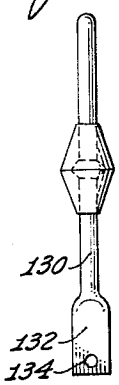


Fig. 12



Fig. 7

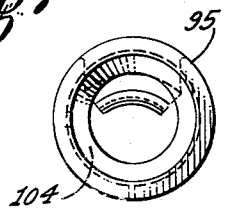


Fig. 8

Fig. 9

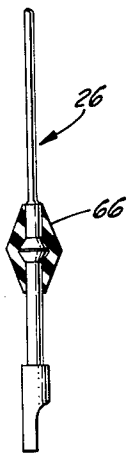
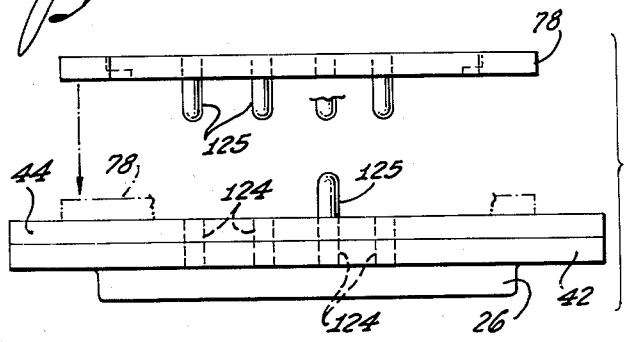


Fig. 5



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United States Patent Office 3,259,872 Patented July 5, 1966

3,259,872

SEALED MULTI-CONTACT CONNECTOR

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Filed Mar. 7, 1962, Ser. No. 178,158
15 Claims. (Cl. 339—94)

This invention relates to a multi-contact connector of the general type wherein a multi-contact plug assembly is engageable with a complementary multi-contact receptacle assembly.

While the invention is widely applicable to various specific purposes, the invention has special utility for connecting a multi-conductor cable with electrical components behind a bulkhead or a like wall structure, the receptacle assembly being mounted on the cable and the plug assembly being mounted in an opening in the bulkhead. Such an embodiment has been selected for the present disclosure and will provide adequate guidance for those skilled in the art who may have occasion to apply the same principles to other specific purposes.

In general, a plug assembly or a receptacle assembly of the type to which the invention pertains comprises a plurality of contact elements, insulating means in the form of one or more bodies of insulating material to embrace and support the contact elements and a suitable housing shell encasing the insulating means. Since the contact elements vary in type and vary in number for different installations, and since some insulations require sealed connectors, and since the multi-conductor cables are required to enter housing shells from various directions in various installations, it is common practice to fabricate a wide variety of housing shells and a wide variety of insulating bodies to make up different connectors that vary in these different respects.

An important object of the present invention is to simplify matters by providing a single model of housing shell for a plug assembly in combination with a single model of insulating means, which combination may be aptly termed "universal" since it may be assembled with various numbers of different types of contact elements for both sealed and unsealed installations and the receptacle assembly may receive a multi-conductor cable from any desired direction. A similar universal combination is provided for a receptacle assembly. Such versatile combinations reduce fabrication cost, minimize manufacturing delays, reduce the inventory burden and, in addition, make it possible to salvage used connectors since a connector made for one specific purpose may be dismantled and reassembled to serve another specific purpose.

The invention is characterized by a construction in which two plate-like insulating bodies or blocks are clamped together face to face in a surrounding housing shell with pairs of aligned bores in the two bodies, respectively. Different specific types of interchangeable contact elements may be mounted in the pairs of aligned bores of the two insulating bodies and any number of contact elements may be used up to the total number of aligned pairs of bores.

A feature of the invention is the provision of sealing means embracing the individual contact elements and sandwiched between the two insulating bodies under sealing compression. As exemplified by the presently preferred practice of the invention, such sealing means may comprise individual elastomer collars embracing the individual contact elements at intermediate points thereof. Since the elastomer collars are firmly bonded to the contact elements and since the elastomer collars are firmly trapped between the two insulating bodies, the contact elements are positively retained at their assembled positions.

A feature of the preferred practice of the invention is that the aligned pairs of bores in the two insulating bodies are slightly oversized relative to the contact elements that are mounted therein, the contact elements being resiliently supported and centered in the bores, by the elastomer collars. In effect, the contact elements are floatingly supported with a certain degree of individual freedom for lateral movement. Resiliently mounting the contact elements in this manner permits pin contacts and cooperating socket contacts to adapt themselves to each other in such manner as to permit liberal dimension tolerances and to reduce breakage of contact elements. In this regard, a feature of the invention is that both the pin contacts and the cooperating socket contacts may be floatingly mounted in their respective assemblies so that the resilient mounts in both of the assemblies may yield as required for alignment of the individual pin contacts with the corresponding socket contacts.

In the preferred practice of the invention, at least one bore of each pair of the aligned bores of the two insulating bodies is formed with an enlargement that opens onto the confronting faces of the two insulating bodies and the elastomer collars of the contact elements are shaped and dimensioned to fit into the bore enlargements under substantial compression when the two insulating bodies are clamped together. Thus the compressed elastomer collars effectively seal the aligned bores in which the contact elements are mounted. In the present embodiment of the invention, both bores of each aligned pair of bores have such enlargements.

If there are remaining aligned bores of the two insulating bodies that are not needed to house contact elements in a particular connector assembly, these empty bores may also be effectively sealed by installing elastomer bodies therein of the same profile dimensions as the elastomer collars. As will be explained, additional continuous sealing members may be used to seal the peripheral regions of the two insulation bodies as well as to seal the juncture of the plug receptacle with the rim of the bulkhead opening and to seal the juncture between the plug assembly and the mating receptacle assembly.

With reference to the direction of entry of a multi-conductor cable into a receptacle assembly, the housing shell of the assembly is provided with knockout portions in all of its sides, any one of which may be easily manually removed to provide an opening to receive the cable from the corresponding direction. An important feature of the invention is the provision not only for sealing the entry of the cable into the housing shell, but also for mechanically connecting the cable to the housing shell to keep the cable from transmitting stresses to the contact elements inside the housing shell.

As will be explained, two telescoped flanged ferrules embrace the cable at the housing shell opening with the flanges of the two ferrules clamping the rim of the opening, the outer ferrule being crimped to the inner ferrule and the inner ferrule being crimped to the cable for mechanically attaching the cable to the housing shell. Two provisions seal the entry, one provision being a sealing ring under sealing pressure by the outer ferrule flange, the other provision being a sealing sleeve embracing both the outer ferrule and an adjacent portion of the cable.

A further feature of the invention is a simple means to key or polarize the two assemblies of a multi-contact connector to insure that only the two particular assemblies can be connected together. A plurality of pins is divided between the two assemblies and a corresponding plurality of sockets is divided between the two assemblies, the combined pins and sockets of each of the two assemblies being arranged on a given pattern.

In the preferred practice of the invention, two flanges

on opposite sides of one assembly are paired with two corresponding flanges on the opposite sides of the other assembly and each of these side flanges is initially fabricated with a row of four holes, there being sixteen holes forming eight pairs of aligned holes on the two assemblies. Eight pins are fixedly mounted in eight of the sixteen holes, the selected eight holes being divided between the two assemblies. Thus each keying pin on each connector assembly registers with a corresponding hole or keying socket on the other connector assembly.

The features and advantages of the invention may be understood from the following detailed description and the accompanying drawings.

In the drawings, which are to be regarded as merely illustrative:

FIG. 1 is a view partly in side elevation and partly in section showing the plug assembly of a multi-contact connector mounted in an opening in a bulkhead and showing the complementary receptacle assembly of the connector attached to a multi-conductor cable with the two connector assemblies plugged together;

FIG. 2 is a face view of the receptacle assembly as seen along the line 2—2 of FIG. 1 with a pair of fastening screws shown in section;

FIG. 3 is a rear elevational view of the plug assembly as seen along the line 3—3 of FIG. 1 with certain fastening screws shown in section;

FIG. 4 is a greatly enlarged fragmentary sectional view of a fastening screw provided with a collar for creating separation force between two abutting pairs of a connector assembly;

FIG. 5 is a diagrammatic side elevational view of the structure of the two assemblies that provide the keying or polarizing means;

FIG. 6 is a view partly in side elevation and partly in section showing the construction of a socket contact that may be used in an assembly;

FIG. 7 is a greatly enlarged end view of the same socket contact element as viewed along the line 7—7 of FIG. 6;

FIG. 8 is a similar view of a plug contact that may be used in an assembly;

FIG. 9 is a similar view of a second plug contact of smaller diameter that may be used interchangeably with the plug contact of FIG. 8;

FIGS. 10 and 11 are similar views of other plug contacts that may be used interchangeably; and

FIG. 12 is a longitudinal sectional view of an elastomer sealing body that may be used in aligned bores where a contact element is omitted.

In the presently preferred embodiment of the invention shown in FIG. 1, the multi-contact electrical connector comprises a plug assembly, generally designated P and a receptacle assembly, generally designated R. The plug assembly P is illustrated as mounted in a circular opening **20** in a bulkhead or other wall structure **22** and the receptacle assembly R is illustrated as mounted on a multi-conductor cable **24**.

Each of the two assemblies P and R comprises a plurality of contact elements mounted in a housing shell by suitable insulation means, which insulation means is made in separable sections. Thus the plug assembly P has a plurality of pin contacts **25** mounted in a housing shell **26** by insulating means in the form of a first plate-like insulation body **28** and a second similar insulation body **30**, the two bodies being assembled face to face. In like manner the receptacle assembly R comprises a plurality of socket contacts **32** mounted in a housing shell **34** by insulation means in the form of a first plate-like insulation body **35** and a second similar insulation body **36**.

The housing shell **26** of the plug assembly P has a continuous side wall that is formed with a forwardly facing shoulder **40**, the shoulder being spaced substantially rearwardly from the opened front side of the housing shell. In the construction shown, the forwardly facing shoulder **40** is in the form of an inward flange of the housing shell. The first insulation body **28** rests against the shoulder **40** and the second insulation body **30** rests flat against the first insulation body.

Suitable means is provided for engagement with the margin of the second insulation body **30** and the housing shell **26** to retain the two insulation bodies firmly seated in the housing shell. For this purpose the housing shell **26** may be formed with a relatively thick peripheral flange **42** and a relatively thick clamp member **44** in the form of an open rectangular frame may be connected to the flange by short screws **45** with the clamp member overlying the margin of the second insulation body **30**. The marginal portion of the second insulation body **30** may be recessed as shown in FIG. 1 to receive the overlapping portion of the clamp member **44** so that the clamp member protrudes only slightly beyond the face of the second insulation body. Additional longer screws **46** extend through both the clamp member **44** and the peripheral flange **42** of the housing shell into the bulkhead **22** to anchor the plug assembly P in the circular opening **20** of the bulkhead.

Referring to FIG. 4, a feature of this embodiment of the invention is that each of the relatively short screws **45** that connect the clamp member **44** to the housing flange **42** is provided with a radial flange **48** with the clamp member **44** counter-bored as indicated at **50** to receive the flange. As shown in FIG. 4, the radial flange **48** may be in the form of a washer or collar with the screw upset as indicated at **52** to keep the collar from shifting axially towards the threaded end of the screw. Each screw **45** slidingly extends through the clamp member **44** and for this purpose each screw **45** may be formed with a smooth shank portion as shown in FIG. 4 or, instead, the bore **54** in the housing flange **42** may be oversized to avoid engagement with the thread of the screw. The advantage of this construction of the four short screws **45** is that when the screws are loosened the radial flanges **48** exert separation force between the clamp member and the housing shell.

If a sealed construction for the multi-contact connector is desired, a continuous sealing member **55** may be seated in a peripheral recess of the second insulation body **30** in sealing contact with the insulation body and both the clamp member **44** and the inner surface of the housing shell **26**. A second continuous sealing member **56** may be mounted in a continuous groove in the rear face of the housing flange **42** to provide a seal between the housing flange and the bulkhead **22**. A third continuous sealing member **58** may be seated in a continuous groove in the outer face of the clamp member **44** to form a seal between the plug assembly P and the receptacle assembly R. These three continuous sealing members **55**, **56** and **58** may be omitted if a sealed construction is not required in a particular insulation.

In FIG. 1, the pin contacts **25** are of the construction shown in FIG. 8. For connection to a corresponding wire, each pin contact **25** has an axial bore **60** at its base end with a portion of the side wall of the bore cut away as indicated to form what is commonly termed a "solder pot" **61**, to facilitate the soldering of the wire to the contact.

For mounting the plurality of pin contacts **25**, the first insulation body **28** is formed with a plurality of bores **62** and the second insulation body **30** is formed with a corresponding plurality of bores **64**, the bores of the two pluralities registering with each other to form pairs of aligned bores. It is contemplated that the bores of at least one of these two pluralities of bores **62** and **64** will be formed with enlargements that open onto the confronting faces of the two insulation bodies **28** and **30**. In the construction shown, both of the two sets of bores are formed with flared or conical enlargements **65**. Thus the insulation means that mounts the contacts in the plug assembly may be considered as having a plurality of bores corresponding to the plurality of pin contacts **25** with

these bores enlarged at intermediate points and with the insulation means made in sections that may be separated for access to the bore enlargements.

Since the solder pots **61** are enlargements on the base ends of the pin contacts **25** and since the bores **62** in the first insulation body **28** must clear the solder pots, the bores **62** are oversized relative to the portions of the pin contacts that extend through the bores. A feature of this embodiment of the invention is that the bores **64** in the second insulation body **30** are also slightly oversized with the result that there is appreciable freedom for lateral movement of the pin contacts **25** relative to the two insulation bodies in which they are mounted.

The pin contacts **25** are resiliently mounted in the pair of insulation bodies **28** and **30** by means of elastomer collars **66**, best shown in FIG. 8, that embrace intermediate portions of the pin contacts and are bonded thereto by any well known means, as by a suitable adhesive, to form resilient enlargements on the pin contacts. Preferably each pin contact **25** is formed with a circumferential bead or rib **68** which is encased by the elastomer collars **66**, the rib presenting oppositely directed shoulders to strengthen the bond between the collar and the pin contact. The elastomer collars **66** are of a configuration to seat in the flared enlargements of the aligned bores **62** and **64**. In the construction shown, the bores are conically flared and therefore each of the elastomer collars **66** has the general configuration of two cones positioned back to back, a configuration which may be aptly termed a double wedge. The elastomer collars **66** are dimensioned somewhat oversized relative to the pairs of bore enlargements **65** in which they seat with the result that the elastomer collars are substantially compressed by tightening of the four screws **45** and thus serve as seals for the pairs of aligned bores **62** and **64**, the seals functioning with wedging action.

The elastomer collars **66** center the pin contacts **25** in the aligned oversized bores in a resilient manner that permits appreciable variation in the alignment of the pin contacts. In effect the pin contacts are floatingly mounted as distinguished from fixedly or rigidly mounting.

As may be seen in FIG. 3, there is a total of nine pairs of aligned bores **62–64** in this embodiment of the invention and therefore the plug assembly may be fabricated with any selected number of pin contacts up to a total of nine. In this example there are eight pin contacts **25**, there being no contact in the bore **62***a* (FIG. 3).

If a sealed construction is desired, a suitable elastomer sealing body is mounted in each pair of aligned bores **62–64** that does not house a pin contact. Thus the bore **62***a* of the first insulation body **28** and the corresponding bore **64** of the second insulation body **30** may be sealed by an elastomer sealing member **70** of the character shown in section in FIG. 12. The elastomer sealing member **70** is of substantially the same configuration in profile and the same dimensions in profile as an elastomer collar **66** on a pin contact **25**. Consequently the tightening of the screws **45** also places the elastomer sealing member **70** under sealing compression.

It is apparent that all paths of possible leakage are sealed off to make the plug assembly fluid-tight. The elastomer collars **66** and the elastomer sealing member **70** seal all of the aligned bores through the two insulation bodies **28** and **30**; the continuous sealing member **55** blocks leakage around the periphery of the insulation bodies inside the housing shell **26**; and the continuous sealing member **56** blocks leakage around the outside of the housing shell between the housing shell and the rim of the opening in the bulkhead **22**. In addition, the continuous sealing member **58** prevents leakage at the juncture of the plug assembly P and the receptacle assembly R.

The receptacle assembly R may be of the same general construction as the plug assembly P with suitable provision for fluid-tight connection with the cable **24**. In the construction shown, the housing shell **34** is of box-like configuration with a continuous side wall **72** and a back wall **74**, the side wall being offset to form a forwardly facing shoulder **75** for abutment by the first insulation body **35**. The housing shell **34** is further formed in the previously described manner with a relatively thick peripheral flange **76** and a rectangular clamp member **78** overlaps both the flange and the margin of the second insulation body **36**. Here again a continuous sealing member **80** may make sealing contact with the perimeter of the second sealing body **36** as well as with the clamp member **78** and the inner surface of the side wall **72** of the housing shell.

Four short screws **82** (FIG. 2) extend through the housing flange **76** into the clamp member **78** to tighten the two insulation bodies **35** and **36** against each other and two longer screws **84** extend through both the housing flange **76** and the clamp member **78** into the clamp member **44** of the plug assembly P to lock the two assemblies R and P together. The short screws **82** may be of the same construction as the previously described short screws **45** to function in the same manner to create separation force between the clamp member **78** and the housing flange **76**.

The stocket contacts **32** are mounted in the two insulation bodies **35** and **36** in the same manner as heretofore described. Thus the first insulation body **35** has a plurality of slightly oversized bores **85**, the insulation body **36** has a corresponding plurality of slightly oversized bores **86** and both sets of the aligned bores have flared enlargements **88** that open onto the confronting faces of the two insulation bodies. In the previously described manner each of the socket contacts **32** has an elastomer collar **90** that is dimensioned to seat under compression in the bore enlargements.

Preferably, each of the socket contacts **32** is of the construction shown in FIG. 6. The base end of each socket contact **32** is formed with a solder pot **61** but may be adapted in other ways for connection to a wire. The shank of the socket contact is formed with a previously described circumferential rib **68** for increasing the effectiveness of the bond with the elastomer collar **90**.

The leading end of a socket contact **32** has an axial bore **92** to serve as a socket for the cooperating pin contact **25**. A substantial portion of the wall of the bore is cut away to form a longitudinal slot **94** that terminates short of the leading end of the socket contact to leave a solid ring portion **95** at the leading end of the socket contact to receive the leading end of the corresponding pin contact **25**. A spring clip, generally designated **96** has a cylindrical base portion **98** which fixedly embraces the shank of the socket contact **32** and this spring clip has a forwardly extending spring finger **100** which extends along the length of the longitudinal slot **94**.

As may be seen in FIG. 8, the corresponding pin contact **25** has a rounded nose **102** and the ring portion **95** at the leading end of the socket contact **32** is tapered or chamfered as indicated at **104** to facilitate entry of the rounded nose. The leading end of the spring finger **100** is curved outward as indicated at **105** and lies in the path of entry of the rounded nose to be cammed radially outward by entry of the pin contact **25**. Thus when the pin contact **25** is inserted into the socket contact **32**, the spring finger **100** insures a friction fit for effective electrical connection. The ring portion **95** of the socket contact serves as a guard for the leading end of the spring finger **100** to insure that the spring finger will not be encountered endwise by the pin contact.

To provide choice in the matter of the direction of entry of the multi-conductor cable **24** into the housing shell **34**, the housing shell is provided with four knockouts **106** on its four opposite sides and a fifth knockout in its back wall **74**. In FIG. 1, the knockout in the back wall **74** has been removed to provide a circular opening for admission of the cable **24**. As shown in FIG. 1 a first inner ferrule **108** embraces the cable **24** and is formed with a radial flange **110** at its inner end which abuts the inner surface of the back wall **74** of the housing shell. A second outer

ferrule **112** that is entirely outside of the housing shell **34** is telescoped over the inner ferrule **108** and is provided with a second radial flange **114** that abuts a sealing ring **115**.

The procedure of assembling the two ferrules **108** and **112** and the sealing ring **115** consists in placing the ferrules in the relative positions shown in FIG. 1 and then applying axial force to the two ferrules in opposite directions to drive the ferrule flanges **112** and **114** towards each other to place the sealing ring **115** under sealing compression. While the sealing ring **115** is held under compression in this manner, a crimping tool is applied to crimp the two ferrules as indicated at **116** in FIG. 1, the outer ferrule **112** being crimped against the inner ferrule **108** and the inner ferrule being crimped against the cable **24**.

The crimping operation has two important results in that it not only fixedly interconnects the two ferrules to maintain the sealing ring **115** permanently under compression, but also causes the inner ferrule to grip the cable **24** permanently. In this manner the cable **24** is connected to the housing shell **34** to prevent any tension load on the cable from being transmitted to the individual wires of the cable inside the housing shell **34**.

The final step in sealing the entry of the cable **24** into the housing shell **34** is the application of a plastic sleeve **118** to embrace both the outer ferrule **112** and the adjacent portion of the cable **24** as shown in FIG. 1. After the plastic sleeve **118** is mounted in this manner, the sleeve is shrunk to make a fluid-tight fit. In the construction shown, the outer ferrule **112** is swaged to form a circumferential rib **120** for increasing the effectiveness of the seal. A suitable plastic may be employed that may be shrunk by the application of heat. A sleeve of irradiated polyethylene is highly satisfactory for this purpose.

The key or polarizing arrangement will now be described, which arrangement insures that a receptacle assembly R can be connected only to the correct plug assembly P. When the two assemblies are interconnected as shown in FIG. 1, the two clamp members **44** and **78** are in face to face abutment and these two clamp members may be considered as forming two opposite side flanges on the plug assembly P and the receptacle assembly R respectively. As may be seen in FIG. 2, the clamp member **78** has two rows of keying bores **122** on each of its opposite sides, there being four bores in each row. In like manner, as indicated in FIGS. 3 and 5, the clamp member **44** of the plug connector P has a corresponding pattern of key bores **124** arranged in two rows of four each, the key bores extending through the contiguous peripheral housing flange **42**.

It is contemplated that eight key pins **125** will be divided between the key bores **122** in the receptacle assembly and the key bores **124** in the plug assembly, the various key pins being mounted for example by staking. In the illustrated embodiment of the invention, seven key pins **125** (FIG. 2) are mounted in seven of the eight key bores **122** with one key bore **122** empty and an eighth key pin **125** (FIGS. 3 and 5) is mounted in the particular key bore **124** of the plug assembly that registers with the key bore **122***a*. This arrangement of a series of eight key pins and a series of eight key sockets with each of the two series divided between the plug assembly P and the receptacle assembly R permits 256 permutations. With reference to the keying feature it is also to be noted that the pattern of the nine aligned bores for mounting the pin contacts **25** and the similar pattern of nine bores for mounting the socket contacts **32** has a keying function since only one relative orientation permits the two patterns to match.

The manner in which the invention serves its purpose may be readily understood from the foregoing description. It is apparent that each of the two described connector assemblies may be fabricated with any desired number of contact elements up to a maximum number of nine and that the invention is not limited to this particular maximum. It is also apparent that various types of contact elements may be used interchangeably. For example, relatively thin pin contacts may be substituted for any or all of the relatively heavy pin contacts **25**. FIG. 9 shows such a thin pin contact **26** which is of the same general construction as the pin contact **25** and is provided with an identical elastomer collar **66**. FIG. 10 shows a pin contact **128** that may be used of the type that may be crimped over the end of a wire. FIG. 11 shows another pin contact **130** which may be used, this pin contact having a flat end portion **132** with an aperture **134** therein to receive the end of a corresponding wire.

It is also apparent that a multi-contact connector of the character described fabricated to meet certain requirements, may be dismantled and reassembled for reuse in a new installation having different requirements. The separation force exerted by the screws **45** of the plug assembly and the screws **82** of the receptacle assembly facilitate the dismantling of an assembly for such a conversion.

My description in specific detail of the selected embodiment of the invention will suggest various changes, substitutions and other departures from my disclosure within the spirit and scope of the appended claims.

I claim:

1. In a multi-contact connector assembly for mating with a similar complementary multi-contact connector device, the combination of:

a plurality of contact elements each extending in a first direction;

individual elastomer collars having insulating properties and embracing the individual contact elements and bonded to the elements to form on the elements elastomer enlargements extending in a second direction transverse to the first direction;

a housing shell; and

insulating means mounting the plurality of contact elements and the elastomer collars in the housing shell, said insulating means having a plurality of bores housing the corresponding contact elements, said bores being oversized relative to the contact elements, said bores being formed with enlargements at intermediate points thereof to seat and retain said elastomer enlargements of the corresponding contact elements with the elastomer enlargements having dimensions greater than the enlargements in the bores and resiliently retaining and floatingly supporting the contact elements with freedom for lateral shift of the contact elements within the range permitted by the oversized bores, said insulating means being made in releasably interconnected sections in face-to-face contact for separation at the positions of the enlargements in the bores to make said enlargements of the bores accessible for the mounting of the contact elements with the elastomer enlargements therein.

2. A combination as set forth in claim **1** wherein the portion of each contact element on which an elastomer collar is mounted is formed with oppositely directed shoulders extending in the second direction from the contact elements for interlocking engagement with the elastomer collar to strengthen the bond between the contact elements and the collar.

3. In a multi-contact connector assembly for mating with a similar complementary multi-contact connector device having a plurality of contact elements, the combination of:

a housing shell having an open front side, said housing shell having a continuous side wall formed with an inner forwardly facing shoulder spaced rearward from said front side;

a first insulation block nested laterally in said housing shell against said shoulder;

a second insulation block nested laterally inside said housing shell in face-to-face contact with said first insulation block;

a plurality of spaced bores extending forwardly in said first insulation block;

a corresponding plurality of spaced bores in said second insulation block registering with the bores in the first insulation block to form aligned pairs of forwardly extending bores,

the bores of at least one of said pluralities being formed with enlargements at positions corresponding to the confronting faces of the two blocks;

contact elements mounted in at least some of said pairs of aligned bores for cooperation with the corresponding contact elements of said complementary device, the contact elements being provided with oppositely directed lateral shoulders;

elastomer collars embracing said contact elements respectively bonded to the elements and seated in the enlargements of the aligned bores and seated on the oppositely directed shoulders of the contact elements, said collars being oversized relative to the enlargements of the bores;

a clamp member engaging said second insulation block at the marginal extremities of the second insulation block; and

fastening means engaging said clamp member and said housing shell and clamping said two insulation blocks together with consequent sealing compression of said sealing collars in the enlargements in the bores.

4. A combination as set forth in claim **3**

in which the contact elements are in only some of said aligned bores; and

which includes solid sealing bodies in the remaining aligned bores nested in said enlargements thereof under sealing compression.

5. A combination as set forth in claim **3**

in which said clamp member has a continuous portion overlapping the front margin of said second insulation block; and

in which a continuous sealing element extends along said margin under sealing compression between the second insulation block and the clamp member, said sealing element abutting said continuous side wall of the housing shell.

6. A combination as set forth in claim **3** in which said enlargements of the bores are conically flared enlargements and said elastomer collars are of corresponding configuration dimensioned for compression by the bore enlargements and in which the oppositely directed lateral shoulders of the contact elements are conical enlargements.

7. In a multi-contact connector assembly for mating with a similar complementary multi-contact connector device, the combination of:

a housing shell having an open front side, said housing shell having a continuous side wall formed with an inner forwardly facing shoulder spaced rearward from said front side;

a first insulation block nested laterally in said housing shell against said shoulder;

a second insulation block nested laterally inside said housing shell in face-to-face contact with said first insulation block;

a plurality of spaced, forwardly extending bores in said first insulation block;

a corresponding plurality of spaced, forwardly extending bores in said second insulation block the bores in said second block registering with the bores in the first insulation block to form aligned pairs of bores,

all of the bores in the two blocks being formed with enlargements that open onto the confronting faces of the two blocks;

elastomer elements mounted in said enlargements of the bores, said elastomer elements being oversized relative to the enlargements of the bores to seal the bores;

contact elements mounted in at least some of said pairs of aligned bores for cooperation with corresponding contact elements of said complementary device, said contact elements being embraced by the corresponding elastomer elements and bonded thereto, said contact elements being provided with oppositely directed lateral shoulders for interlocking engagement with the elastomer element;

a clamp member engaging opposite marginal portions of said second insulation block; and

fastening means engaging said clamp member and said housing shell and clamping said two insulation blocks together with consequent compression of said elastomer elements.

8. In a multi-contact connector assembly for mating with a similar complementary multi-contact connector device, having a plurality of contact elements, the combination of:

a housing shell having an open front side, said housing shell having a continuous side wall formed with an inner forwardly facing shoulder spaced rearward from its front side;

a first insulation block nested in said housing shell against said shoulder;

a second insulation block nested inside said housing shell in face-to-face contact with said first insulation block;

a plurality of forwardly extending spaced bores in said first insulation block;

the bores in the first and second blocks being enlarged at the faces of the first and second insulation blocks;

a corresponding plurality of forwardly extending spaced bores in said second insulation block, the bores in the second block registering with the bores in the first insulation block to form aligned pairs of bores;

contact elements mounted in said pairs of aligned bores for coooperation with the corresponding contact elements of said complementary device, the contact elements having oppositely directed lateral shoulders;

elastomer sealing means embracing, and bonded to said oppositely directed lateral shoulder of said contact elements at the confronting faces of the two insulation blocks and disposed in the enlargements in the bores at the faces of the first and second insulation blocks, said elastomer elements being oversized relative to the enlargements in the bores at the faces of the first and second insulation blocks;

continuous sealing means abutting the inner surface of said continuous side wall of the housing shell and a continuous margin of at least one of said two insulation blocks; and

means engaging said second insulation block and said housing shell to hold the housing shell and the insulation block assembled together and to place all of said sealing means under sealing compression to cut off all leakage paths from the open front side of said housing shell to the rear face of the first insulation block.

9. A combination as set forth in claim **8** which includes a continuous peripheral sealing means on the front side of said assembly for sealing compression between the assembly and said complementary connector device.

10. In a multi-contact connector assembly for mating with a similar complementary multi-contact connector device, the combination of:

a housing shell having an open front side and a continous peripheral flange and a continuous side wall formed with an inner forwardly facing shoulder spaced rearward from the front side of the housing shell;

a first insulating block nested in said housing shell against said shoulder;

a second insulating block nested inside said housing

shell in face-to-face contact with said first insulation block;

a plurality of spaced bores in said first insulation block;

a corresponding plurality of spaced bores in said second insulation block registering with the bores in the first insulation block to form aligned pairs of bores;

the bores of at least one of said pluralities of bores being formed with enlargements that open onto the confronting faces of the two insulation blocks;

elastomer sealing bodies in said enlargements respectively of the bores, said elastomer sealing bodies being oversized relative to the enlargements to seal the bores;

contact elements mounted in at least some of said pairs of aligned bores for cooperation with corresponding contact elements of said complementary device, said contact elements being provided with oppositely directed lateral walls embraced by, and bonded to the corresponding elastomer sealing bodies;

a clamping frame conforming to the configuration of said flange and overlapping the peripheral margin of said second block; and

fastening means engaging said clamp member and said housing shell and clamping said two insulation blocks together with consequent sealing compression of said elastomer sealing bodies at the enlargements of the aligned bores.

11. A combination as set forth in claim **10** in which said fastening means comprises a plurality of screws extending through said flange and said clamping frame, said screws being in screw-threaded engagement with only one of said flange and said clamping frame, said screws having collars to engage the other of said flange and said clamping frame to create separation force between the flange and the clamping frame in response to unscrewing of the screw.

12. A multi-contact connector assembly for mounting in an opening in a bulkhead with a rim in a fluid-tight manner for mating with a similar multi-contact device comprising:

a housing shell having an open front side and having a continuous peripheral flange to overlie the rim of the bulkhead opening, said housing shell having a continuous side wall formed with an inner forwardly facing shoulder spaced rearward from the front side of the housing shell;

a first insulating block nested in said housing shell against said inner shoulder;

a second insulating block nested inside said housing shell in face-to-face contact with said first insulation block;

a plurality of spaced forwardly extending bores in said first insulation block;

a corresponding plurality of spaced forwardly extending bores in said second insulation block, the bores in said second insulation block registering with the bores in the first insulation block to form aligned pairs of bores;

elastomer sealing means embracing, and bonded to, said oppositely directed lateral shoulders in said contact elements at the confronting faces of the two insulation blocks;

continuous sealing means abutting the inner surface of said continuous side wall of the housing shell and abutting a continuous margin of at least one of said two insulation blocks to seal paths through the bulkhead opening along the inner surface of the housing shell;

means engaging said second insulation block and said housing shell to hold the housing shell assembled together and to place said elastomer sealing means under sealing compression to seal off paths through said bores;

a continuous sealing member on the back side of said flange at the housing shell for contact with the bulkhead around the rim of the bulkhead opening; and

means to anchor said flange of the housing shell to the bulkhead and thereby compress said continuous sealing member to seal paths through the bulkhead opening around the outer surface of the housing shell.

13. A combination as set forth in claim **12** in which said engaging means includes a continuous clamp member overlapping said flange of the housing shell and

further includes fastening means interconnecting the flange and the clamp member; and

in which said continuous sealing member makes sealing contact with said clamp member and

which includes a second continuous sealing member contacting with said clamp member and said complementary device to seal the juncture between the multi-contact assembly and the multi-contact device.

14. In combination for mounting in an opening in a wall

a first multi-contact connector assembly for mounting in the opening in the wall;

a second multi-contact connector assembly joining with said first connector assembly, each of said two assemblies having a housing shell with an open front side and with a continuous peripheral flange around the housing shell, each housing shell having a continuous side wall formed with an inner forwardly facing shoulder spaced rearward from the front side of the housing shell, the peripheral flange of the first assembly being dimensioned to overlap the rim of said wall opening, each of said assemblies having a first insulating block nested in its housing shell against said inner shoulder thereof and a second insulating block nested in its housing shell in face-to-face contact with the first insulation block, each of said blocks having a plurality of forwardly extending bores therethrough with the bores of the two blocks registered with each other to form pairs of aligned bores,

the bores of at least one of said first and second insulating blocks in each assembly having enlargements that open onto the confronting faces of the two blocks in each assembly;

contact elements mounted in the pairs of bores of the insulation blocks of the first assembly and having oppositely directed lateral shoulders disposed at the positions of the enlargements in the bores;

complementary contact elements mounted in the pairs of bores of the insulation blocks of the second assembly and having oppositely directed lateral shoulders disposed at the positions of the enlargements in the bores;

elastomer sealing collars embracing, and bonded to, the individual contact elements of each of said assemblies at the positions of the oppositely directed lateral shoulders and seating in said enlargements of the bores of the assembly and being oversize relative to the enlargements in the bores, each of said assemblies having a continuous clamping member overlapping the flange of the housing shell of the assembly, each of said assemblies having fastening means interconnecting its clamping member and the peripheral flange of its housing shell to clamp its two insulation blocks together for sealing compression of said elastomer collars, each of said assemblies having continuous sealing means around at least one of its two insulation blocks;

fastening means to hold the two assemblies together; and

continuous sealing means sealing the juncture between the two assemblies.

15. The combination as set forth in claim **14** and including continuous sealing means to seal the juncture between the peripheral flange of the first assembly and the rim of said wall opening.

(References on following page)

References Cited by the Examiner

UNITED STATES PATENTS

2,091,851	8/1937	Halvorson	339—103
2,247,452	7/1941	Seils	339—226
2,265,341	12/1941	Borchert	339—63
2,307,972	1/1943	Shrunk	339—185
2,368,503	1/1945	Unger	336—90
2,522,907	9/1950	Streb	339—185
2,619,515	11/1952	Doane	339—94

2,659,872	11/1953	Gilbert	339—176
2,669,702	2/1954	Klostermann	339—196
2,677,115	4/1954	Stevens	339—60
2,768,231	10/1956	Schwennesen et al.	174—18

FOREIGN PATENTS

587,643	5/1947	Great Britain.

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