March 27, 1956 J. J. PHILLIPS 2,740,098

SHIELDED WATERPROOF ELECTRICAL CONNECTORS

Filed May 7, 1952

FIG. 1.

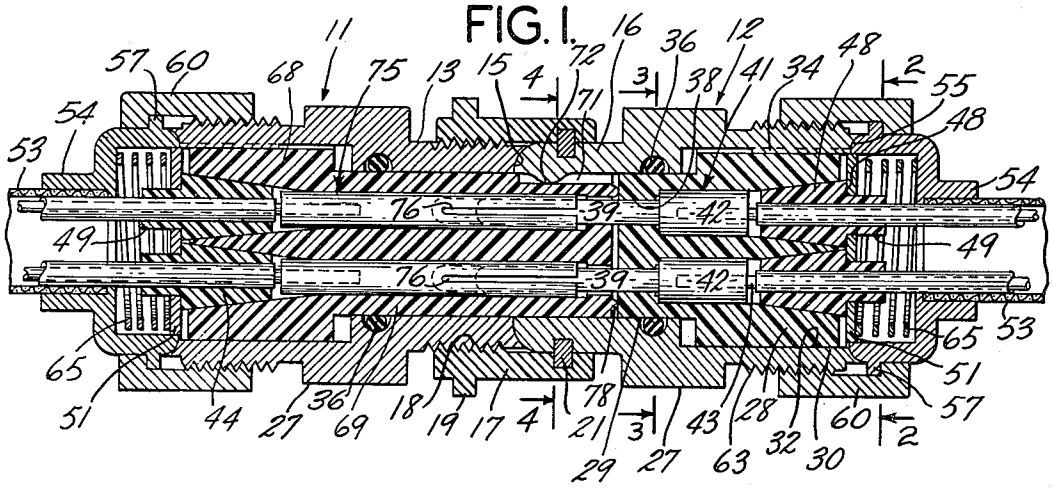


FIG. 2.

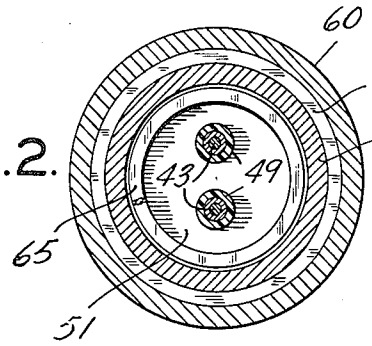
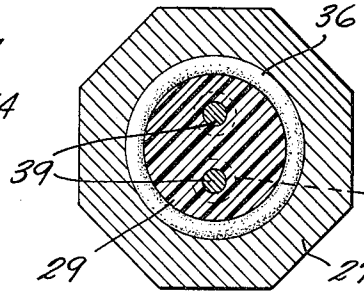


FIG. 3.



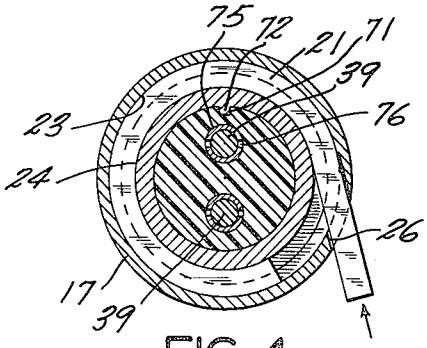


FIG. 4.

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SHIELDED WATERPROOF ELECTRICAL CONNECTORS

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7 Claims. (Cl. 339—94)

This invention relates to multiple pin and socket electrical connectors, and more particularly to a fluid-tight construction in which the conductors are sealed by compressed non-metallic elements, but the assembly is covered by detachable metal parts that maintain adequate radio shielding.

It is an object of this invention to provide an electrical connector in which the same fastening means clamps non-metallic sealing elements together under a controlled pressure at the same time that it clamps metal faces of an outside casing together firmly enough for good radio shielding. In the preferred construction, the non-metallic sealing elements come into contact ahead of the metal parts and have spring means that yield to permit continued movement of the metal faces toward one another while maintaining the pressure of the sealing elements.

Another object is to provide an electrical connector with a plurality of conductors and separate seals around each of the conductors held under pressure by the fastening elements that hold the radio shielding of the assembly.

Other objects, features and advantages of the invention will appear or be pointed out as the description proceeds.

In the drawing, forming a part hereof, in which like reference characters indicate corresponding parts in all the views,

Figure 1 is a sectional view of an electrical connector embodying this invention,

Figures 2 and 3 are sectional views taken on the lines 2—2 and 3—3 respectively, of Figure 1, and

Figure 4 is a sectional view at the plane 4—4 of Figure 1, with the pin wire in the process of being inserted during initial assembly of the connector.

The connector comprises two cooperating sections, including a socket section **11** and a pin section **12**. The socket section has a metal shell **13** with a concave, annular end face **15** which abuts against a complementary convex end face of a metal shell **16** of the pin section **12**.

There is a nut **17** with threads **18** that screw over corresponding threads on the outside of the metal shell **13**. This nut has a polygonal flange **19** for receiving a wrench. The nut **17** is rotatably connected to the metal shell **16** by a ring **21** which fits into annular channels in the confronting faces of the nut **17** and the metal shell **16**.

The nature of the ring **21** will be better understood by reference to Figure 4. The channel in the nut **17** is indicated by the reference character **23**. The complementary channel in the metal shell **16** is indicated by the reference character **24**. There is a sloping opening **26** through the top of the channel **23** for the insertion of the ring **21**. This ring, which is originally a straight wire, is pushed lengthwise through the opening **26**, and the wire takes the circular shape of the chamber which is formed by the confronting channels **23** and **24**. The wire is of a predetermined length to fill the circumferential extent of the channels, and it fits loosely enough to leave the nut **17** free to rotate with respect to the shell **16**,

although confining the nut against axial movement on the shell.

Referring again to Figure 1, it will be apparent that screwing the nut **17** on the threads **18** draws the face **15** of the shell **13** into firm contact with the complementary face of the metal shell **16** so that the shells **13** and **16** provide effective radio shielding around the parts enclosed within them. Each of the shells **13** and **16** has a polygonal flange **27** for receiving a wrench.

The shell **16** encloses a core **28** which has a cylindrical section **29** of reduced diameter, slidably fitting in a bore of the shell **16**. The core **28** also has a larger diameter section **30** which slidably fits within a cylindrical counterbore **32** of the shell **16**. In order to prevent the core **28** from turning in the shell **16**, and to always ensure that it will be inserted into the shell at the same phase angle, there is a longitudinal fin **34** on the inside of the counterbore **32**. This longitudinal fin fits into a keyway in the core **28** and serves the function of a key.

An O-ring **36** is confined in a recess in the inside wall of the shell **16**, and this O-ring acts as a seal between the metal shell **16** and the core **28** so that fluid, such as gas or liquid, cannot pass between the shell and core and thereby enter the interior of the connector where the conductor elements are located.

The core **28** has as many parallel bores **38** as there are circuits to be included in the connector. Each of the bores **38** receives a pin **39** of an electrical element **41**. At one end of the pin **39**, the electric element **41** has a head portion **42** of larger diameter than the pin **39**. The head portion fits slidably in a counterbore **40** at one end of the bore **38**, and abuts against the shoulder at the end of the counterbore. There is a recess in the outer end of the head portion **42** for receiving an electrical conductor comprising a wire **43**. The wire is soldered or otherwise secured to the head portion **42**.

There is insulation around the wire **43** and this insulation extends to approximately the end face of the head portion **42**. In order to seal the wire securely, a tapered sleeve **44** surrounds the wire, and this tapered sleeve **44** fits into a correspondingly tapered end of the counterbore **40**.

The tapered sleeve **44** has a shoulder **48** and a reduced diameter stem **49** beyond the shoulder. There are similar tapered sleeves surrounding the wires leading to all of the pins **39** of the connector. In the construction illustrated, there are two such pins, but the number of pins depends upon the number of circuits which the connector is designed to provide. One of the advantages of the invention is that it is particularly well suited for connectors having large numbers of wires and it provides a separate effective seal for each of the wires.

This seal is provided by having a clamping plate **51** with openings through which the stems **49** of the sleeves **44** extend. The clamping plate bears against the shoulder **48** at the base of each of the stems **49** and forces the tapered sleeves **44** inward against the tapered faces of the counterbores **40**. The core **28** and each of the tapered sleeves **44** is preferably made of plastic dielectric material which is slightly compressible, such as rubber, certain resins, and many of the synthetic plastic materials. The length of the tapered sleeves **44**, to their shoulders **48**, is slightly longer than the corresponding taper of the counterbores **40** so that when the tapered sleeves **44** are uncompressed, their shoulders **48** are slightly beyond the end face of the core **28**.

When the clamping plate **51** is pushed inward, it distorts the tapered sleeves **44** sufficiently to clamp them into firm contact with both the counterbore **40** and the outside surface of the insulation on the wire **43**; and with the clamping plate **51** still spaced by some clearance from the end face of the core **28**.

The cable which contains the wires 43 is surrounded by shielding 53 having an end fitting 54. This end fitting 54 has a convex, annular end face which abuts against a complementary concave, annular face 55 at the outer end of the metal shell 16. There is a flange 57 extending from the fitting 54. A clamping nut 60 has an inwardly extending flange which engages behind the flange 57 of the shielding fitting 54. Threads of the clamping nut 60 screw over corresponding threads 63 on the outer end portion of the metal shell 16. When the clamping nut 60 is tightened, it pulls the shielding fitting 54 into firm contact with the end face 55 of the metal shell 16 and provides a tight and highly satisfactory connection in the radio shielding.

The clamping plate 51 is pushed against the shoulders 48 of the tapered sleeves by a helical spring 65. One end of this spring 65 is in contact with the clamping plate 55, and the other end bears against a shoulder in the fitting 54. The spring 65 transmits a strong pressure from the fitting 54 to the clamping plate 51, and permits the same clamping nut 60 to provide the pressure of the fitting 54 against the shell face 55, and of the clamping plate 51 against the shoulders 48 of the tapered sleeves 44. This construction is simple and does not require accurate manufacturing tolerances in order to obtain a predetermined clamping pressure from the clamping plate 51 when the fitting 54 is clamped tightly against the end face 55 of the shell 16.

The construction of the socket section 11 of the connector is generally similar to that of the pin section already described. The socket section has a core 68 corresponding to the core 28 of the pin section but with a reduced-diameter, cylindrical section 69 which is longer than the corresponding section 29 of the pin section. The reason for this difference in construction is to permit the core 68 to surround the sockets into which the pins 39 extend when the connector is assembled. The core 28 extends beyond the end of its surrounding metal shell 13 and into the end of the metal shell 16 of the pin section. In order to ensure that the same pins will always engage in the same sockets, there is a keyway 71 in the extending end of the core 68, and an inwardly projecting ridge 72 of the inside wall of the metal shell 16 serves as a key in the keyway 71.

Electrical elements 75, of the socket section of the connector, correspond to the electric elements 41 of the pin section except that the ends of the electrical elements 75 are formed hollow with resilient walls so as to form sockets 76 into which the pins 39 are inserted to provide electric contact for each of the circuits through the connector.

The inner end face of the core 68, which confronts the inner end face of the core 28, has sealing means comprising an annular bead 78. The core 68, and preferably both of the cores 68 and 28, are made of plastic dielectric material which is slightly compressible so that when the confronting end faces of the cores are pressed firmly together, the annular bead 78 is distorted slightly, as necessary, to provide an effective seal against fluid, such as gas or water. Thus any fluid which passes between the face 15 and the complementary face of the outer shells, or which passes the O-rings 36, is prevented from reaching the electric conductors by the seal which is provided by the annular head 78 bearing against the face of the other core.

Both of the cores 28 and 68 preferably have a limited axial movement in the metal shells 13 and 16 which contain them, and each of the cores 28 and 68 is moved axially toward the other core by the pressure of the springs 65 to maintain a predetermined pressure of the annular bead 78 against the face of the other core.

This annular bead 78 can be located on the core 28, instead of the connection illustrated, and beads of different cross section can be used instead of the substantially semi-circular one illustrated. It is not essential that the sealing means 78 be of one piece construction with one of the cores, but having it so is advantageous in that it eliminates the possibility of the connector being assembled without the sealing means between the cores. The connector can be made with only one of the cores axially movable and this is sufficient for maintaining the seal between them.

The preferred construction of the invention has been illustrated and described, but changes and modifications can be made without departing from the invention as defined in the claims.

What is claimed is:

1. A pin and socket electrical connector comprising two sections, each of which has a metal shell and a core within the metal shell, the metal shells having complementary end faces that clamp together to provide efficient radio shielding around the cores, threads on one of the shells, a flange projecting from the other shell, a clamping nut that bears against the flange and screws over the threads to hold the complementary end faces of the shells tightly clamped against one another for good electrical contact, shielding fittings at opposite ends of the metal shells for connecting the shielding of conductor cables to the metal shells, the core withon one of the metal shells being slidable with respect to the shell toward and from the core in the other shell, sealing means between the cores, and a spring between the slidable core and the end fitting of the shell in which the core slides, said spring being compressed when the fitting is attached to the shell so as to maintain a resulting pressure on the slidable core and on the sealing means between the cores substantially independent of the pressure between the end faces of the shells.

2. An electrical connector including a core that holds a plurality of electrical elements to which separate wires are connected a different, sealing sleeve of resilient material surrounding each of the wires at the region where the wire enters the core on its way to its connection with one of the electrical elements, a fitting at one end of the connector for joining a shielding of the conductor cable with the metal shell, and common pressure transmitting means between the shielding fitting and all of the sealing sleeves exerting pressure simultaneously against all the sealing sleeves to maintain them tightly sealed around their respective conductors.

3. An electrical connector of the pin-and-socket type, comprising a pin section and a socket section, each of said sections including a metal sleeve and a core within the metal sleeve, at least one of the cores being slidable axially in its metal sleeve, sealing means between confronting faces of the cores, electrical elements comprising pins extending from the face of one core and sockets recessed below the end face of the other core, counterbores through which wires extend to the electrical elements, a different sealing sleeve surrounding each of the wires in the connector bores, a clamping plate that bears against faces of the respective wire sealing sleeves and that exerts pressure through the sleeves to the core and against the sealing means between the cores, a fitting for connecting radio shielding of an electric cable with the shell of the connector, spring means compressed between the fitting and the clamping plate so as to maintain a predetermined simultaneous pressure against all of the sealing sleeves and against the seal between the cores within the connector.

4. The electrical connector described in claim 3 and in which the cores in both sections of the electrical connector are axially slidable and there are spring means on both ends of the connector urging the sealing sleeves into firm contact with the wires which they surround and also urging the cores toward one another.

5. An electrical connector comprising a pin section and a socket section, each section having a metal shell that confronts a complimentary end face of the other shell,

means connecting the metal shells together with their confronting faces pressed together in firm contact with one another to provide radio shielding for the circuits of conductors within the shells, cores of electrical insulating material within the shells, the core located within the metal shell of at least one of the sections being slidable axially with respect to the metal shell toward a confronting face of the core of the other section, sealing means between the slidable core and said confronting face of the other section, the sealing means having a contact face of reduced area to increase the pressure thereon, and a compressed element within one of the shells urging the slidable core toward said other section and against the sealing means with a pressure substantially independent of the pressure between the end faces of the shells.

6. An electrical connector comprising a pin section and a socket section, each section having a metal shell with an end face that confronts a complementary end face of the other shell, means connecting the metal shells to one another with their confronting faces pressed together in firm contact with one another to provide radio shielding for the circuits of conductors within the shells, cores of electric insulating material within the shells including a core within the pin section having an end face from which pins project and a core within the socket section having recesses within which sockets are located and having an end face through which the sockets open, at least one of the cores being slidable axially in the metal shell toward and from a confronting face of the core in the other shell, sealing means between the slidable core and the confronting face of the other core, the sealing means having a contact face of reduced area radially outward from the areas of the end faces from which the pins project and through which the sockets open, and a spring located within one of the shells and compressed between that shell and the slidable core for urging the slidable core toward the confronting face of the other core with a pressure determined by the spring regardless of the pressure between the metal shells.

7. The connector described in claim 6, characterized by a construction in which at least one of the cores is made of resilient material and the sealing means is an annular rib on the end face of one of the cores.

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