Feb. 16, 1954 C. W. KLOSTERMANN 2,669,702

SEALED CONNECTOR

Filed May 12, 1950 2 Sheets-Sheet 1

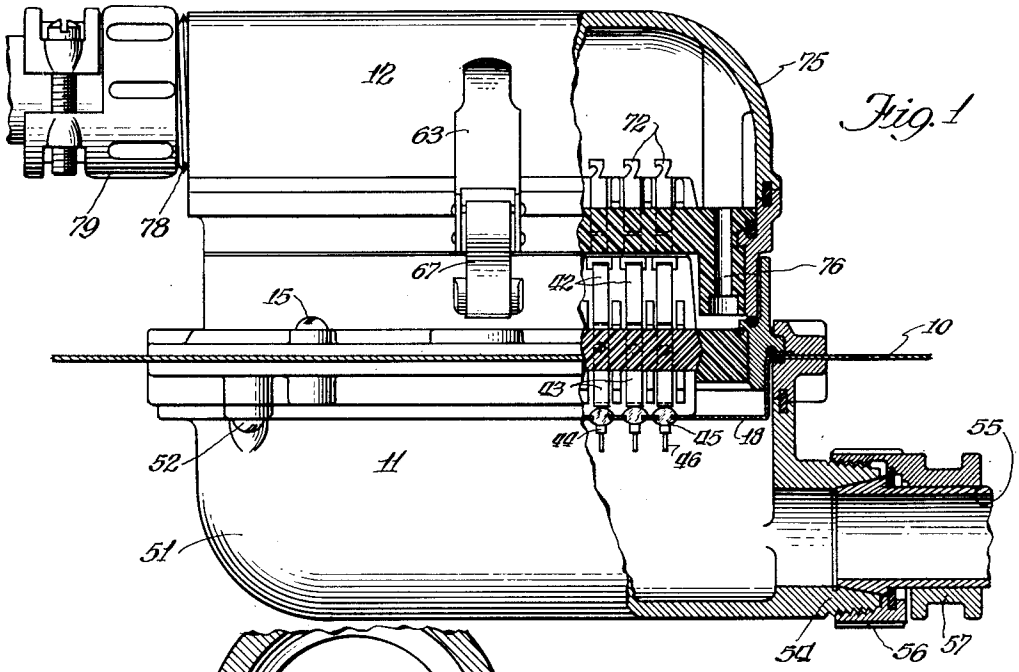

Fig. 1

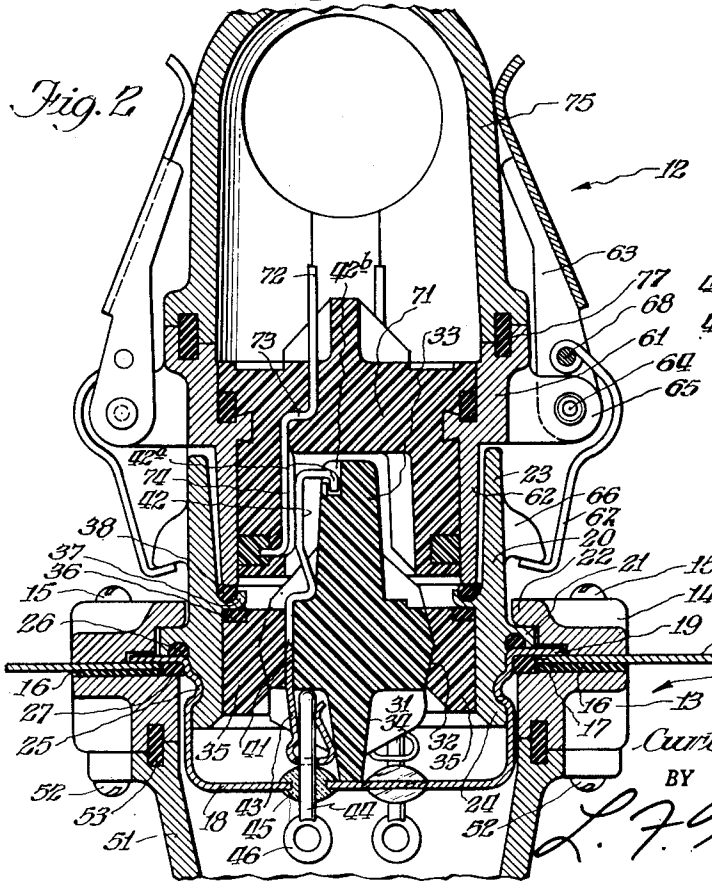

Fig. 2

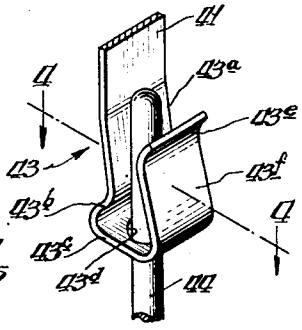

Fig. 3

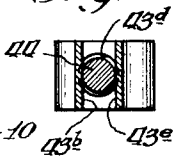

Fig. 4

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Feb. 16, 1954 C. W. KLOSTERMANN 2,669,702

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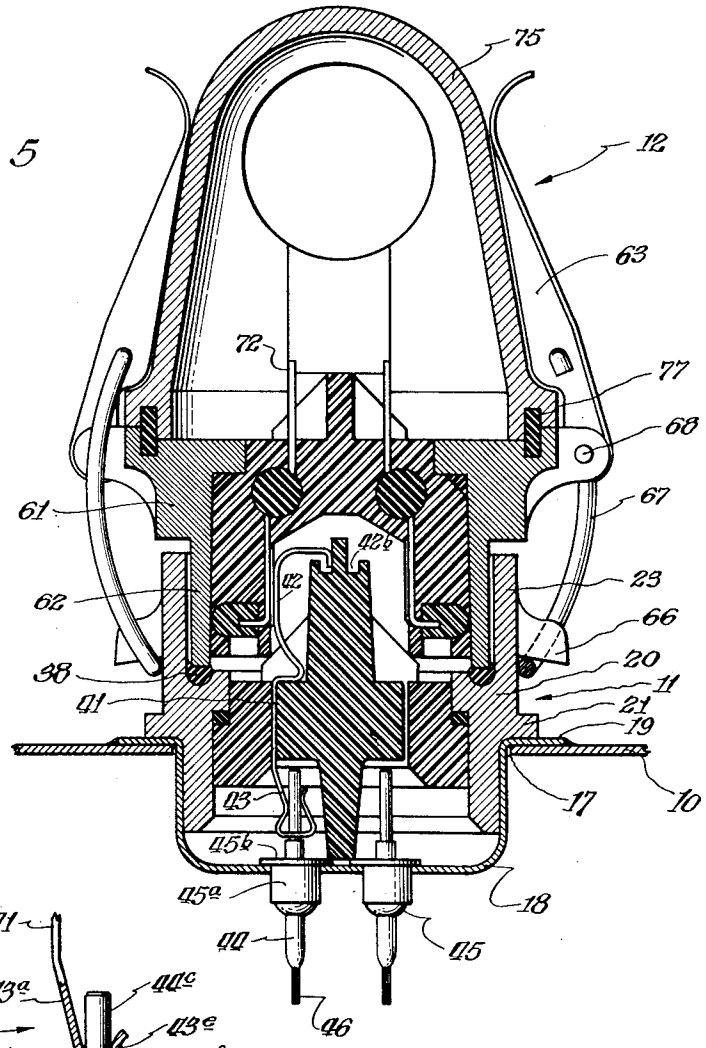
Filed May 12, 1950 2 Sheets-Sheet 2

Fig. 5



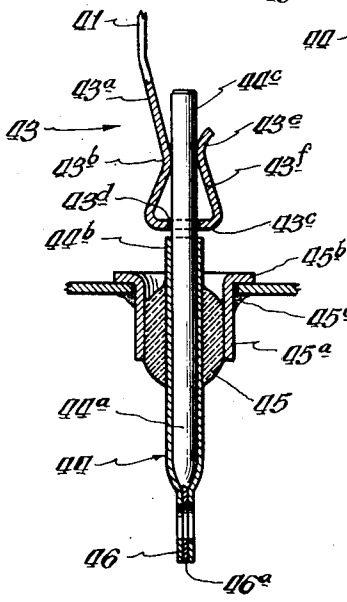


Fig. 6

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SEALED CONNECTOR

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5 Claims. (Cl. 339—196)

1

This invention relates to electrical connectors, and has particular reference to sealed multi-conductor connectors, both of the hermetically sealed and pressure sealed types.

It is the general aim of the invention to provide a multiple connector having a large number of relatively closely spaced contacts, wherein the individual conductors are sealed in the wall in such a manner that they are efficient from an electrical standpoint, yet are protected against physical damage either due to rough use of the equipment or arising by reason of strains imposed in initially assembling component parts of the connector. The invention is illustrated in a preferred embodiment of the inventive concept, in which the connector is designed to establish disengageable electrical unions between two multi-conductor cables carried within conduits positioned on the opposite sides of a sealed wall.

In the present state of the art, the provision of pressure sealed and hermetically sealed housings for electronic equipment has become accepted as a conventional expedient in apparatus designed for use under conditions of adverse humidity and variable atmospheric pressure, but the development of connectors suitable for use with such equipment has posed many heretofore unsolved problems, particularly since such a connector must reconcile conflicting considerations of mechanical strength and electrical efficiency if it is to be at all satisfactory for its intended purpose. The problem has been particularly troublesome in the development of multiple connectors for high frequency electronic apparatus, wherein a large number of electrical conductors are housed in a relatively small connector shell, since the multitude of conductors within the unit must be individually insulated and sealed by dielectric material having low loss characteristics, yet all parts must be guarded against breakage. The use of conductors extending through fused glass bead insulators provides a perfect hermetic seal, but these have heretofore presented some shortcomings from an electrical standpoint, due to the fact that, so far as known, any alloys having a thermal coefficient of expansion which permits them to be bonded to the glass have an undesirably high electrical resistance. The use of glass bead insulators has heretofore also been regarded as

2

impractical from a mechanical standpoint, since these beads are necessarily very fragile in nature. This is particularly true in connection with connectors of multiple contact design, since the manufacturing tolerances necessarily employed in these bring about additional difficulties which may reach serious proportions. This is primarily for the reason that the contacts in electrical connectors of this type should be mounted in fixed position on the dielectric inserts of the connector to avoid transmitting stresses due to coupling and uncoupling the connector to the seals. Yet if the contacts are molded in the inserts (or otherwise positively fixed in position), even the slightest dimensional variations in spacing of the contacts with respect to their seals will interfere with the free assembly of the parts, and will consequently impose strains on the pins which may fracture the seals and destroy the usefulness of the connector.

It is, therefore, the primary object of the invention to provide a sealed connector incorporating a glass bead and metal termial conductor pin extending therethrough for each contact, yet with the parts so constructed and related that the connector is of low inherent resistance and at the same time not unduly liable to mechanical failure as a result of physical impact or abuse. This is accomplished in the present invention by utilizing a novel terminal connector fused within the bead, with a dielectric insert carrying all of the contacts of the connector in fixed positions, and coupling means formed as a part of the contacts but arranged to permit considerable latitude as the dimensional relationships between the pins and contacts, so that a gang of contacts in fixed positions may be assembled on a gang of seals in fixed positions without imposing any appreciable strains on the parts, even though the spacings between the several seals and contacts have some deviations from absolute perfection.

This permits considerable relative movement between the pins and the contacts without sacrificing the efficiency of the electrical unions between these parts. This movement may be either up and down, back and forth, or sideways. That is, the coupling is so arranged as to hold itself snugly in surface engagement with the conductor pin, yet to permit relative move-

ment between the pin and the coupling support, so that strains imparted by such movement or by improper spacing of the several contacts and conductor pins will not exert appreciable strains on the fused seals by which these pins are carried.

A present preferred embodiment of the invention is illustrated in the drawings of this specification, wherein:

Figure 1 is a side elevational view, partly in section, showing the present preferred embodiment of a pressure sealed connector constructed in accordance with these teachings;

Figure 2 is a transverse sectional view thereof;

Figure 3 is an enlarged, fragmental, perspective view of the coupling portion of one of the connector contacts shown in engagement with one of the terminal conductor pins;

Figure 4 is a detail sectional view taken substantially on the plane of the line 4—4 of Figure 3;

Figure 5 is a cross sectional view of a hermetically sealed connector according to the present teachings; and

Figure 6 is a detail sectional view of a sealed glass bead insulator and terminal, which is employed in the present teachings.

The connector illustrated in Figures 1 and 2 is designed to establish electrical connection between two multiconductor cables on opposite sides of a pressure sealed wall. This wall is represented in the drawings by the sheet metal partition 10. This connector comprises, in general, a receptacle portion 11 mounted on the partition 10, with a detachable plug portion 12 fitted in the socket. The receptacle 11 includes a pair of coacting metal rims 13 and 14 clamped to the opposite faces of the metal sheet 10 as by machine screws 15. A gasket 16 is placed on the upper surface of the rim 13 to provide an air-tight seal between the rim 13 and the lower surface of the sheet metal 10. The metal sheet 10 is cut out with an aperture 17 to accommodate the connector, and a metal sealing shell 18 is inserted in the aperture and provided with outwardly extending flanges 19, which may be welded or soldered to the metal sheet 10 so that the shell establishes a seal across the aperture 17 in the metal sheet.

The receptacle includes a hollow shell 20 adapted to receive the plug 12. The shell has a marginal flange 21 clamped under flange 22 of the rim 14 of the unit, and has an upwardly extending socket 23 to receive the plug. The lower end 24 is fitted into the sheet metal sealing member 18. As illustrated, these parts are held together by crimping the metal of the shell 18 into recesses in the shell 23 as indicated at 25. An upper gasket 26 and a lower gasket 27 are provided to insure a watertight seal between these parts.

The shell 23 of the receptacle has a dielectric contact carrying insert comprising a central molded part 31 having V-tapered walls 32 at its opposite sides and provided with a longitudinally extending upper partition 33 and a longitudinally extending lower partition 34. The V-walls 32 of this piece of the insert coact with correspondingly shaped V-walls on the side pieces 35, so that the entire insert functions as a solid unit and is held in position by the metal sealing shell 18 which bears against the lower wall 34 and holds the insert in position with the gasket 36 bearing against the marginal inside flange 37, on which the sealing gasket 38 is carried. The insert includes a multiplicity of individual contact members, each of which consists of a double ended spring having a central portion 41 clamped fixedly on the insert and provided with an upper portion 42 and a lower portion 43. The upper portion is free to flex within limits to engage a coacting contact, but has a reversely bent end 42*a* seating in a pocket 42*b* in the insert to limit its flexing movement.

The lower portion 43 comprises what may be termed a coupler, by which the contacts are joined to terminal conductors fused in the hermetically sealed wall of the connector. These terminal conductors each comprise a metal terminal pin 44 of the form shown in detail in Figure 6. These pins 44 extend through and are supported in a glass bead seal 45, which may be fused directly into the openings of the shell as shown, or bonded to small metal sleeves that are soldered in these apertures, as hereinafter described. The pins 44 are each provided with a terminal loop 46 on which the individual conductors of a cable may be soldered.

The contacts are formed from a relatively thin, flat strip of spring metal, and the mounting portions 41 thereof are fixed immovably in the dielectric insert. The coupling portion of each contact comprises a downwardly extending reverse bend (Figure 3), to frictionally engage one of the terminal pins 44. The coupling portion consists of a leg 43*a* which normally lies at a slight angle to the pin it engages. This leg, at its lower end, is doubled back at 43*b* to provide a convex line contact surface extending entirely across the width of the strip and adapted to bear on the pin 44 adjacent its lower end. The coupling portion continues from the portion 43*b* in a reverse bend 43*c* extending transversely across the terminal pin and provided with an aperture 43*d*, so that the pin extends upwardly through the strip. The aperture 43*d* is of considerably greater diameter than the diameter of the pins, so that the coupling need not contact the pins at this point. A contact is established on the opposite side of the pin, however, by a bent lip 43*e* provided at the upper end of the arm 43*f* of the strip.

By examination of Figures 3 and 4, it will be seen that by this arrangement a firm electrical union is maintained between the contact 41 and the pin 44, since the inherent resilience in the reverse bend 43*c* of the strip will hold the contacting surfaces 43*b* and 43*e* in firm engagement on the pin at all times. The relatively long, thin and fairly flexible leg portion 43*a* allows a high degree of flexibility in a lateral direction, however, since the angle at which this portion of the coupler stands might vary widely without imposing any serious stresses on the pin 44 or on the glass seal 45 associated with it.

The coupling between the pin and contact also permits considerable longitudinal shifting of the parts without imposing appreciable strains, by reason of the fact that the aperture 43*d* is sufficiently large that it does not contact the pin, with the result that the pin and contact may shift laterally merely by relative sliding between the convex surfaces 43*b*, 43*e* on the coupling, and the opposite cylindrical surfaces on the pin. It is also obvious that vertical movement between these parts is unrestricted except for the light frictional engagement therebetween, and it follows that the specific coupling here shown and described provides universal movement of the parts, yet at all times maintains an intimate electrical bond therebetween.

The terminal loops 46 of all the conductors

are enclosed by a bottom cover 51 clamped to the lower rim portion 13 by machine screws 52, and a sealing gasket 53 is provided between these parts to maintain a watertight joint. The lower cover has a threaded neck 54 to which a conduit 55 may be clamped as by the coupling nut 56 and adjustable clamp 57, so that the individual conductors from the terminal pins 44 may be taken from the connector in the form of a unitary cable.

The plug 12 of the connector comprises a main shell 61 having a flange 62 adapted to fit within the flange of the receptacle shell 23 and to bear against the sealing gasket 38, so that a watertight joint is assured between the plug and its receptacle. The entire plug is held in assembled relation with the receptacle by a pair of toggle latches, each of which comprises a manually operable lever 63 pivoted on a pin 64 carried in one of the ears 65 of the plug shell and linked to anchor projections 66 on the receptacle by the pair of spring straps 67 carried on pins 68.

The plug includes a molded insert 71 in which a multiplicity of metal contacts are carried. Each of these contacts includes an offset portion 73 fixed in the insert, and a terminal 72 to which individual conductors of the cable may be soldered. Each contact also includes a contacting face 74, against which the upper portion 42 of the corresponding receptacle contacts may bear. The entire group of contacts is enclosed by a top cover 75 secured to the shell 61 and to the insert 71 by a plurality of upwardly extending machine screws 76 (Figure 1). A resilient gasket 77 is provided between the shell 61 and the top cover 75 to seal the joint against moisture. The cover 75 is provided with a neck portion 78 and a coupling nut 79 to provide clamping means for a cable consisting of the individual conductors extending from the terminals 72.

The connector illustrated in Figure 5 is of the same general type as the one heretofore described, and the corresponding parts thereof are accordingly identified by similar reference numerals. This connector differs from the disclosure of Figures 1 and 2 primarily in that it is arranged to utilize a hermetic seal rather than a pressure seal, and to this end the flange 18 of the cup 18 is soldered or brazed directly to the partition 10 without the use of any through bolts such as the machine screws 15 of the previously described unit.

The disclosure of Figure 5 also differs from the foregoing disclosure in that the glass bead seals are not fused directly into the wall of the member 18, but are fused into small cylindrical cups or bushings 45*a* (Figure 6) which have flanges 45*b* which may be soldered to the metal of the cup 18 as at 45*c*. This figure also illustrates the structure of the terminal pins 44, which, according to the present teaching, have a novel feature which permits satisfactory bonding between the metal and the glass seal, yet at the same time provides a low resistance connection through the hermetically sealed wall. In the known prior art, it has been regarded as inevitable that a terminal conductor extending through and bonded to a fused glass insulator must necessarily be of rather high resistance metal. This is because only certain alloys having low coefficients of thermal expansion can be successfully bonded to the glass. These alloys are all high resistance metals.

The present teaching provides, however, a seal which is of low resistance, yet at the same time affords a satisfactory bond between the metal and glass surfaces. To accomplish this the terminal pins 44 are made with a central rod or pin 44*a* of copper, silver or similar low resistance metal surrounded by an external sleeve 44*b* of an alloy having the requisite characteristics for bonding to the glass bead. Kovar is a suitable metal for this purpose. The rod and sleeve are fused together adjacent their lower ends and are both flattened so that the terminal ring 46 includes a thin central layer 46*a* of the highly conductive metal. Thus, when external wiring is soldered to the terminal ring, the connection extends directly from the external wire through the portions 46*a* and 44*a* of the rod to the upper end 44*c* of the rod, which extends beyond the end 44*b* of the tube and directly engages the surfaces 43*b* and 43*e* of the coupling connector 43. With this arrangement, the hermetic seal is perfectly maintained by the bond between the glass and alloy surfaces, yet a low resistance electrical path is established through the seal.

From the foregoing specification, it will be apparent that the teachings of this invention provide for a novel and highly efficient connector wherein a multitude of individual conductors may be carried through a hermetically sealed wall in an area occupying a minimum of space, but having an improved contact mounting such that dimensional variations existing between the coacting parts of the hermetic seal and the socket contacts are successfully compensated for, so that the likelihood of damage to these parts is minimized. The hermetic seal is established by low resistance connectors, yet the pins are fused in glass beads in the sealing wall, to afford an electrical contact that is not only thoroughly insulated, but is of low loss design, well suited to use with high frequency electronic apparatus. The coupling by which electrical union is established with these parts is so designed as to be of a single integral piece, but yet to permit considerable movement in any direction without imposing undue strains on the seal. By this expedient, the heretofore conflicting considerations of electrical efficiency and mechanical strength in a connector of this type are reconciled, and a more efficient, more compact and yet more rugged connector is provided.

Having thus described my invention, what I claim as new and desire to secure by United States Letters Patent is:

1. A sealed connector comprising, in combination, a relatively rigid metallic shell having a marginal mounting flange extending thereabout, with a connector socket open on one side of the flange, and opposed walls forming an inner end of said shell on the other side of the flange; a metallic sealing cap fixedly mounted with respect to the shell and including a bottom partition extending across and closing the inner end of said shell, with side walls on said cap in telescoping relation with the walls of the inner end of the shell whereby the sealing cap and the shell are held together and with an outwardly extending marginal soldering flange thereon; said metallic sealing cap having a multiplicity of apertures in the bottom thereof with a single metallic terminal pin extending through each of said apertures; the terminal pins having straight inner end portions standing in parallel relationship to each other, with the pins supported in said apertures by glass beads fused to the pins and fixedly

mounted within said apertures; a dielectric insert extending between the opposed walls of said metallic shell, with a multiplicity of separate contact members comprising narrow flat metallic strips carried by and extending through said insert; each of said contact members comprising a laterally yieldable outer portion housed within the socket portion of the shell, an intermediate portion within the dielectric member and fixedly held therein, and a yieldable coupler portion disposed between the dielectric member and the sealing cap, said coupler portion of each of said contacts including a free standing spring leg extending from the dielectric member to the pin, with a reverse bend at the extreme end of said leg and an oversize aperture in the reverse bend loosely encircling the terminal pin, and with a pair of oppositely disposed convex contact surfaces parallel with each other and extending laterally across the leg in a direction perpendicular to the terminal pin and engaging the terminal pin on opposite sides thereof.

2. A sealed connector comprising, in combination, a relatively rigid metallic shell having a marginal mounting flange extending thereabout, with a connector socket open on one side of the flange, and opposed walls forming an inner end of said shell on the other side of the flange; a metallic sealing cap fixedly mounted with respect to the shell and including a bottom partition extending across and closing the inner end of said shell, with side walls on said cap in telescoping relation with the walls of the inner end of the shell whereby the sealing cap and the shell are held together and with an outwardly extending marginal soldering flange thereon; said metallic sealing cap having a multiplicity of apertures in the bottom thereof with a single metallic terminal pin extending through each of said apertures; the terminal pins having straight inner end portions standing in parallel relationship to each other, with the pins supported in said apertures by glass beads fused to the pins and fixedly mounted within said apertures; a dielectric insert extending between the opposed walls of said metallic shell, with a multiplicity of separate contact members comprising narrow flat metallic strips carried by and extending through said insert; each of said contact members comprising a laterally yieldable outer portion housed within the socket portion of the shell, an intermediate portion within the dielectric member and fixedly held therein, and a yieldable coupler portion disposed between the dielectric member and the sealing cap, said coupler portion of each of said contacts including a free standing spring leg extending from the dielectric member diagonally to the pin, with a contact surface extending laterally across the leg adjacent the end thereof and engaging the terminal pin.

3. A sealed connector comprising, in combination, a relatively rigid metallic shell having a connector socket open on one side and opposed walls forming an inner end of said shell; a metallic sealing cap fixedly mounted with respect to the shell and including a bottom partition extending across and closing the inner end of said shell, with a marginal soldering surface thereon; said metallic sealing cap having a multiplicity of apertures in the bottom thereof with a single metallic terminal pin extending through each of said apertures; the terminal pins having straight inner end portions standing in parallel relationship to each other, with the pins supported in said apertures by glass beads fused to the pins and fixedly mounted within said apertures; a dielectric insert extending between the opposed walls of said metallic shell, with a multiplicity of separate contact members carried by and extending through said insert; each of said contact members comprising an outer portion housed within the socket portion of the shell, an intermediate portion within the dielectric member and fixedly held therein, and a yieldable coupler portion comprising a narrow flat metallic strip disposed between the dielectric member and the sealing cap, said coupler portion of each of said contacts including a free standing spring leg extending from the dielectric member to the pin, with a reverse bend adjacent the end of said leg and with a pair of parallel oppositely disposed contact surfaces extending laterally across the leg in a direction perpendicular to the terminal pin and engaging the terminal pin on opposite sides thereof.

4. A sealed connector comprising, in combination, a relatively rigid metallic shell having a connector socket open on one side and opposed walls forming an inner end of said shell; a metallic sealing cap fixedly mounted with respect to the shell and including a bottom partition extending across and closing the inner end of said shell, with a marginal soldering surface thereon; said metallic sealing cap having a multiplicity of apertures in the bottom thereof with a single metallic terminal pin extending through each of said apertures; the terminal pins having straight inner end portions standing in parallel relationship to each other, with the pins supported in said apertures by glass beads fused to the pins and fixedly mounted within said apertures; a dielectric insert extending between the opposed walls of said metallic shell, with a multiplicity of separate contact members carried by and extending though said insert; each of said contact members comprising an outer portion housed within the socket portion of the shell, an intermediate portion within the dielectric member and fixedly held therein, and a yieldable coupler portion comprising a narrow flat metallic strip disposed between the dielectric member and the sealing cap, said coupler portion of each of said contacts including a free standing spring leg extending from the dielectric member to the pin, with a reverse bend at the extreme end of said leg and an oversize aperture in the reverse bend loosely encircling the terminal pin, and with a pair of oppositely disposed convex contact surfaces parallel with each other and extending laterally across the leg in a direction perpendicular to the terminal pin and engaging the terminal pin on opposite sides thereof.

5. A sealed connector comprising, in combination, a relatively rigid metallic shell having a connector socket open on one side and opposed walls forming an inner end of said shell; a metallic sealing cap fixedly mounted with respect to the shell and including a bottom partition extending across and closing the inner end of said shell, with a marginal soldering surface thereon; said metallic sealing cap having a multiplicity of apertures in the bottom thereof with a single metallic terminal pin extending through each of said apertures; the terminal pins having straight inner end portions standing in parallel relationship to each other, with the pins supported in said apertures by glass beads fused to the pins and fixedly mounted within said apertures; a dielectric insert extending between

the opposed walls of said metallic shell, with a multiplicity of separate contact members carried by and extending through said insert; each of said contact members comprising an outer portion housed within the socket portion of the shell, an intermediate portion within the dielectric member and fixedly held therein, and a yieldable coupler portion comprising a narrow flat metallic strip disposed between the dielectric member and the sealing cap, said coupler portion of each of said contacts including a free standing spring leg extending from the dielectric member diagonally to the pin, with a contact surface extending laterally across the leg adjacent the end thereof and engaging the terminal pin.

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