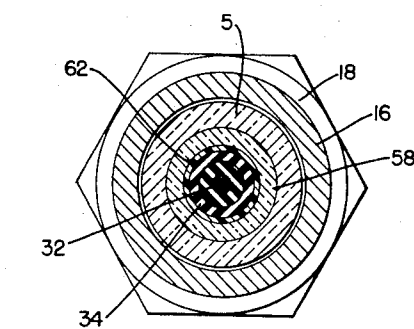
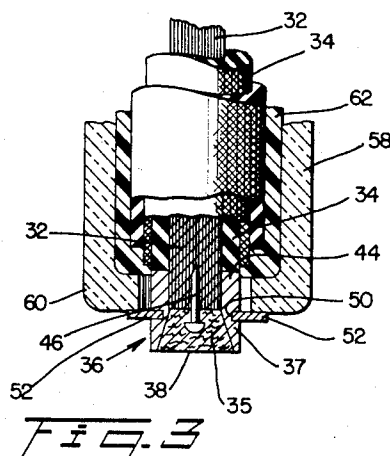
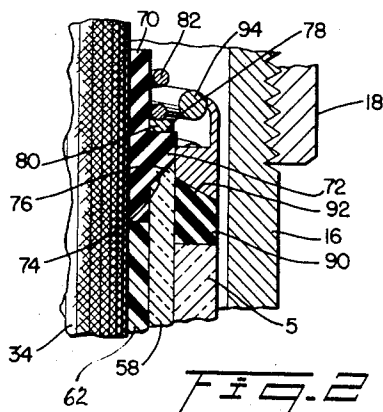
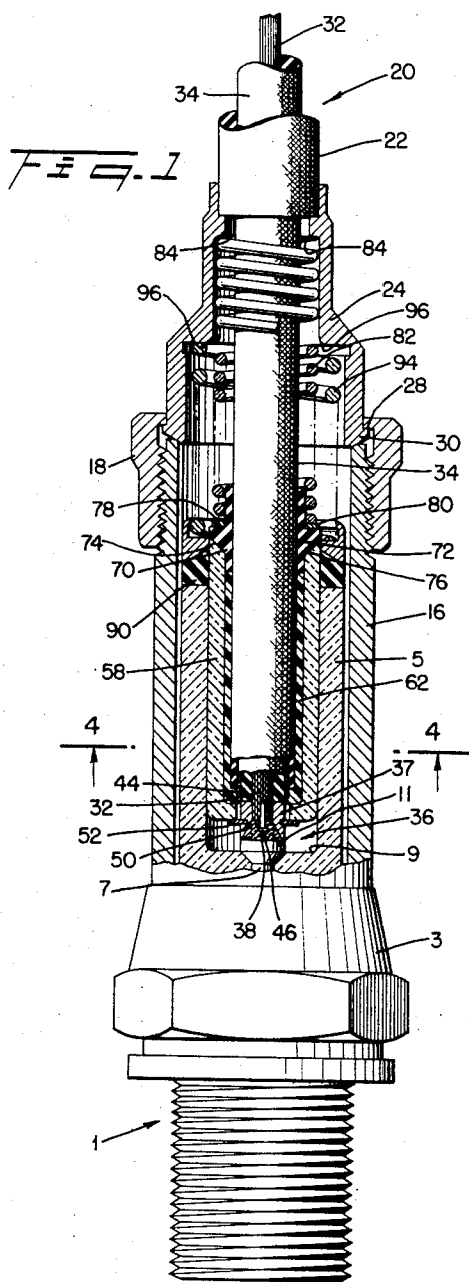


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ELECTRICAL APPARATUS

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1

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ELECTRICAL APPARATUS

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5 Claims. (Cl. 339-26)

This invention relates to electrical apparatus and more particularly to apparatus for connecting the terminal ends of two electrical conductors.

One of the objects of the present invention is to provide novel apparatus for effecting a radio-shielded connection of electrical conductors.

Another object of the invention is to provide an electrical terminal connection wherein continuous insulation of the conductors is attained in a novel manner.

A further object of the invention is to provide novel apparatus means for effectively preventing flashovers between high potential conductors and parts which are at a lower or ground potential.

A still further object of the invention is to provide novel sealing means to prevent moisture from entering the radio-shielded terminal connection.

Still another object is to provide an electrical connection wherein a firm connection of the insulation surrounding the conductors is effected automatically and simultaneously with the connection of the radio-shielding means around the conductors.

The above and further objects and novel features of the invention will more fully appear from the following detailed description when the same is read in connection with the accompanying drawings.

It is to be expressly understood, however, that the drawings are for the purpose of illustration only and are not intended as a definition of the limits of the invention.

Referring now to the drawings wherein like reference characters refer to like parts throughout the several views:

Fig. 1 shows a side elevation, with parts broken away and partly in section of a shielded spark plug and terminal connection therefor;

Fig. 2 is an expanded view of a portion of Fig. 1 in the zone of the seal between the outer end of the main spark plug insulator and the central member of the terminal connection;

Fig. 3 is an expanded view of a portion of Fig. 1 about the terminal area; and

Fig. 4 is a section of Fig. 1 through the line 4-4.

Although a single embodiment of the present invention is illustrated in the drawings in the form of a connector for connecting a radio-shielded conductor of high potential electrical energy to the input terminal of a radio-shielded spark plug in the ignition system of an internal combustion engine, it will be understood, however, that the invention has novel utility in many other electrical types of systems.

Fig. 1 shows a particular embodiment of the invention wherein spark plug 1 is of the type comprising a metal shell 3 adapted to be threaded into the cylinder of an engine. Mounted in shell 3 in any suitable known manner is a tubular insulator 5 which supports a center electrode 7 and insulates it from the shell. The upper or

2

outer end of insulator 5 has an enlarged bore forming a recess 9 at the inner end of which is the terminal 11 of the center electrode. The parts 7, 11 herein called a center electrode and terminal may be an insulated conductor of any other type of electrical device.

Projecting upwardly from said shell 3 is a metallic barrel or tube 16 which serves as a radio-shielding element and is preferably at some datum potential, normally ground. The upper extremity of the barrel 16 is externally threaded for cooperation with a tubular, internally threaded nut 18, thereby operatively connecting the barrel and conduit 20 to effect a continuous metallic enclosure for an electrical conductor. As illustrated, the conduit 20 comprises a flexible tube or conduit 22 having a rigid fitting or ferrule 24 soldered or otherwise suitably secured to the end thereof. Nut 18 has an internal flange or shoulder 28 at its upper periphery which engages an external shoulder 30 at the lower periphery of ferrule 24, so that the latter and barrel 16 are held in firm end-to-end engagement when the nut is screwed home on the barrel. This type of construction assures external continuity between the flexible conduit and the spark plug shell thus resulting in improved radio-shielding.

Extending from conduit 22 downward into shell 16 is an electric conductor 32, having the usual electrical insulation 34, and terminating at its free end in a terminal 36 whose contact surface 38 is flat, non-compressible and void of any abutting compressible elements.

Fig. 3 shows an expanded view of the electrical conductor termination 36 and the structural elements which comprise the said termination. The lower end of said conductor is stripped of a portion of its insulation 34, baring a portion of the conductor 32 sufficient to slidably engage the inner portion of a cylindrical metal bushing 37, preferably of brass and the like. The metal bushing 37 has its upper end portion 44 abutting the conductor insulation 34 and its lower end portion extending beyond the free end of the said conductor thereby forming a frusto-conical recess 35 between the said bushing and conductor at their lower extremities. A conductive pin, nail and the like 46 is driven in at the central portion of said conductor at its lower extremity to become an integral part of said conductor, the head of said pin extending beyond the end of said conductor, but completely shielded by the recess formed between said bushing 37 and conductor 32. The spread out lower end of conductor 32 in recess 35, nail 46 and bushing 37 are integrally secured by filling the recess 35 with solder and the like, the base portion of said recess thereby forming the contact terminal 36 of the upper conductor.

The metal bushing 37 intermediate its lower end portion has a recessed annular groove 50 in which is fitted a spring metal washer 52 whose outer periphery extends sufficiently outward to structurally support a tubular insulator 58 at its lower extremity 60. The tubular insulator 58 is preferably made from rigid ceramic material and the like and encloses said electrical conductor 32 in sleeve-like fashion in an axial direction, extending up to the threaded portion of barrel 16.

Intermediate the tubular insulator 58 and said electrical conductor insulation 34 is a flexible insulated sleeve member 62, preferably made from "Silastic" tubing and the like, which normally has an inner diameter smaller than the outer diameter of conductor insulation 34 necessitating pressure means forcibly applying said sleeve to said insulator in sleeve-like fashion to effect a seal tight force fit. The sleeve 62 extends from a point at its upper extremity slightly below the upper extremity of said tubular insulator 58 and terminates at its lower extremity

3

at a point at which the lower end of the electrical conductor is stripped of its insulation to form the lower terminal 36. The presence of this type of sleeve minimizes the danger of flashovers or sparking between the inner conductor and the barrel 16.

Further novel sealing means are provided for preventing moisture and the like from penetrating or leaking through the connector assembly thereby avoiding any low resistance leakage paths between the high voltage cable portions and the connector shell or ground, the said low resistance leakage paths being highly conducive to flash-over, arcing and the like.

One such means is providing a cylindrical rubber-like member 70 disposed around and tightly engaging the conductor insulation 34 at the upper extremity of said flexible sleeve 62 and substantially abutting the end portion thereof. The cylindrical rubber-like member 70 has intermediate its end portions an extended shoulder or flange 72 whose lower surface 74 is beveled or inclined to slidably engage the upper beveled or inclined surface 76 of said tubular insulator 58, the said beveled surfaces being complementary to each other. The upper portion or surface 78 of said extended flange 72 is flat and has seated thereon an annular metal washer 80.

In order to provide a firm engagement and tight seal at the engaging surfaces of flange 72 and tubular insulator 58 novel simplified means are comprehended by this invention for applying a sufficiently large yielding pressure to the upper face of the flange 72 during the act of connecting the barrel and cable portions. Said means in the form shown comprises a coil spring 82 interposed between said washer 80 and internal flange 84 of ferrule 24 at its upper extremity.

An additional novel and improved seal is provided by the use of an annular rubber-like member 90 which surrounds the upper end portion of tubular insulator 58 and is also seated upon the upper end portion of the tubular insulator 5 thereby effecting a spark-proof seal between conductor and ground when the conduits are operatively connected in end-to-end engagement.

The annular sealing member 90 has an inclined upper surface 92, said surface being adapted to engage under pressure resilient coil spring means 94, the said coil spring means being interposed between said inclined surface 92 and an internal shoulder 96 intermediate the end portions of said ferrule 24.

When the parts are in the assembled relation shown, the springs 82, 94 are both under predetermined axial compression providing sealing as contemplated by this invention. When the compressing forces are released by the unscrewing of the ferrule 24, the upper cable assembly is completely removable as a single integral unit, so that when the nut 18 is screwed into barrel 16, the coil spring means 82, 94 will be compressed with a minimum of relative movement of the input conductor and its shielding conduit.

Although only a single embodiment of the invention is illustrated in the accompanying drawings it is to be expressly understood that the invention is not limited thereto. Various other changes may also be made in the design and arrangements of parts illustrated as well as in the materials suggested without departing from the spirit and scope of the invention as will now be understood by those skilled in the art.

What is claimed is:

1. In apparatus of the class described a tubular metallic barrel externally threaded at one end thereof, an electrical insulator having a recess therein mounted in said barrel, a terminal at the inner end of said recess, a flexible shielding conduit, a ferrule secured to the end of said conduit and extending beyond the conduit, the extending portion of said ferrule having an external shoulder, a nut threaded onto said barrel and having an internal shoulder engaging an external shoulder on said ferrule to hold the ferrule and barrel in end-to-end contact, an insulated elec-

4

trical conductor extending from said conduit into said recess, a conductor termination including a rigid terminal at the end thereof engaging the terminal in said recess, an insulating sleeve closely surrounding the projecting end of said conductor, an annular insulator supportable by said conductor termination and surrounding said sleeve, a first sealing member extending upward beyond said sleeve and surrounding said conductor, said sealing member having an external shoulder engageable with said annular insulator at its upper end portion, a second sealing member surrounding said annular insulator at its upper periphery and mounted on said barrel insulator at its upper end portion, an inner coil spring interposed between an internal upper shoulder of said ferrule and the shoulder of said first sealing member, and an outer coil spring interposed between an internal shoulder intermediate the end portion of said ferrule and the said second sealing member, said inner and outer springs being maintained under axial compression when the apparatus is assembled to press the said first sealing member into sealing engagement with the upper end of said sleeve and annular insulator and the second sealing member into sealing engagement with the upper extremity of said insulator and annular insulator.

2. Apparatus as defined in claim 1 wherein said conductor termination comprises an annular metal washer integral therewith and whose outer periphery extends outwardly sufficient to structurally support said annular insulator.

3. In apparatus of the class described, a radio-shielding conduit assembly comprising a tubular metallic conduit shell, the conduit shell comprising two metallic conduit sections releasably held in end-to-end engagement, a first, outer insulating tube affixed in a first section of said shell, a first contact extending transversely of the first tube, and fixedly mounted on the first tube, a second, elongated, rigid inner insulating tube slidably mounted within the first insulating tube in the shell, an electrical conductor extending into the shell and the second tube, a second contact connected to the conductor, rigidly affixed to the inner end of the second tube, and engaging the first contact, a first annular compressible sealing means interposed between the conductor and the outer end of the second, inner tube, a coil compression spring extending axially of the tubes and having the inner end thereof engaging the annular sealing means and the outer end thereof compressibly acting upon the second section of the shell, whereby the contacts are constantly maintained in forcible engagement with each other, a second annular compressible sealing member interposed between the outer end of the first, outer tube and the conduit shell, and a second, larger diametered, coil compression spring acting between the second section of the conduit shell and the second annular sealing means.

4. Apparatus as defined in claim 3, wherein the second annular sealing means overlies and sealingly engages the outer end of the first, outer tube.

5. In apparatus of the class described a tubular metallic barrel, an electrical insulator having a recess therein mounted in said barrel, a terminal at the inner end of said recess, a flexible conduit, a ferrule secured to the end of said conduit and extending beyond the conduit, means to hold the ferrule and barrel in end-to-end contact, an insulated electrical termination including a rigid terminal at the end thereof engaging the terminal in said recess, an insulating sleeve closely surrounding the end of said conductor projecting into said recess, an annular insulator supported by said conductor termination and surrounding said sleeve, a first sealing member extending upward beyond said sleeve and surrounding said conductor, said sealing member having an external shoulder engageable with said annular insulator at its upper end portion, a second sealing member surrounding said annular insulator at its upper periphery and mounted on said barrel insulator at its upper end portion, an inner coil spring inter-

posed between an internal upper shoulder of said ferrule and the shoulder of said first sealing member, and an outer coil spring interposed between an internal shoulder intermediate the end portion of said ferrule and the said second sealing member, said inner and outer springs being maintained under axial compression when the apparatus is assembled to press the said first sealing member into sealing engagement with the upper end of said sleeve and annular insulator and the second sealing member into sealing engagement with the upper extremity of said insulator and annular insulator.

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