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ELECTRIC CONNECTOR

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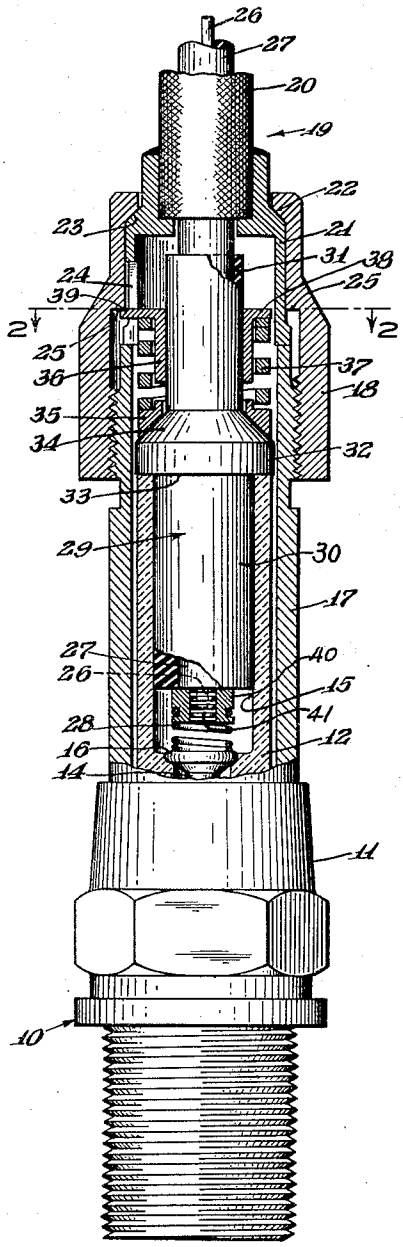


FIG. 1.

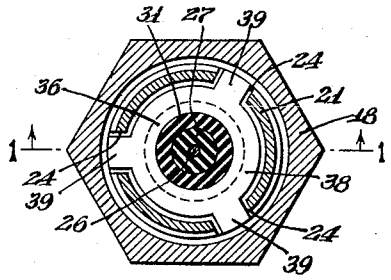


FIG. 2.

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ELECTRIC CONNECTOR

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22 Claims. (Cl. 174—77)

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 a novel radio-shielded electrical terminal connection wherein continuous insulation of the conductors is attained in a novel manner.

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

Still another object is to provide an electrical connector 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.

In the drawings wherein like reference characters refer to like parts throughout the several views,

Fig. 1 is a side elevation, with parts broken away and partly in section of a shielded spark plug and terminal connection therefor, the section being taken substantially on line 1—1 of Fig. 2; and

Fig. 2 is a transverse section taken substantially on line 2—2 of Fig. 1.

A single embodiment of the present invention is illustrated in the drawings, by way of example, 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 is adaptable in many other environments in the electrical art.

In the form shown, the spark plug **10** is of the type comprising a shell **11** adapted to be threaded into the cylinder of an engine. Mounted in shell **11** in any suitable known manner is a tubular insulator **12** which supports a center electrode **14** and insulates it from the shell. By way of example, insulator **12** may be of the type and mounted in the same manner as the corresponding insulator disclosed in Brinson et al. co-pending application Serial No. 793,782, filed December 26, 1947, now Pat. 2,651,298 for "Ignition Apparatus and Method of Making Same." The upper or outer end of insulator **12** has an enlarged bore forming a recess **15** at the inner end of which is the terminal **16** of the center electrode. The parts **14**, **16** herein called a center electrode and terminal may be an insulated conductor of any other type of electrical device.

Projecting upwardly from shell **11** and surrounding the outer end of insulator **12** is a metallic barrel or tube **17** which serves as a radio-shielding element and is normally at ground potential. The upper or outer end of barrel **17** preferably extends beyond the end of the insulator and is externally threaded for cooperation with a tubular, internally-threaded nut **18** whereby the barrel is

operatively connected with a metallic conduit **19** to effect a continuous metallic enclosure for an electrical conductor. As shown the conduit **19** comprises a flexible tube or conduit **20** having a rigid fitting or ferrule **21** soldered or otherwise suitably secured to the end thereof. Nut **18** has an internal flange or shoulder **22** which engages an external shoulder **23** on the ferrule, whereby the latter and barrel **17** are held in firm end-to-end engagement when the nut is screwed home on the barrel. This construction insures complete radio shielding and good electrical contact between the associated elements.

For a purpose to hereinafter appear, the outer or lower end of ferrule **21** is axially slotted, three slots **24** being shown. When the parts are in assembled relation, said slots terminate above an internal annular shoulder **25** in nut **18**.

Extending from conduit **19** into recess **15** is an electrical conductor **26** surrounded by the usual insulation **27**. The lower or free end of said conductor is provided in any suitable known manner with a compressible resilient terminal **28** which engages spark plug terminal **16** to effect an electrical connection between conductor **26** and center electrode **14**. As shown, by way of example, said terminal is of a known construction and comprises the spring **28** supported by an internally threaded cylindrical nut **40** which threadedly engages an externally threaded tip piece **41** secured in any suitable manner, such as by soldering, to the end of conductor **26**. Tip piece **41** is recessed for receiving the conductor, and nut **40** has an annular groove into which an end turn of spring **28** fits. The outer diameter of nut **40** is preferably somewhat larger than the diameter of cable insulation **27** so it may function to prevent removal of insulating sleeve **29** from the cable **26**, **27**. However, the sleeve **29** may be molded onto the cable and thus adhered thereto to prevent relative slippage and effect a good seal between the sleeve and the cable.

In order to minimize the danger of flashovers or sparking between terminal **28** and barrel **17**, there is provided an insulating sleeve **29** which preferably has a close fit around the insulated conductor **26**, **27** and is preferably made, at least in part, of a flexible material, such as synthetic rubber. As illustrated, said sleeve consists of three integral flexible portions, an enlarged cylindrical portion **30** which preferably has a close fit in recess **15** of insulator **12**, a reduced upper portion **31**, and a flange portion **32** having a lower plane face **33** engaging the upper end of insulator **12** and an upper beveled face **34**.

In order to provide a firm engagement and tight seal at the engaging surfaces of flange **32** and insulator **12**, novel means are comprehended by this invention for applying a yielding pressure to the upper face of the flange during the act of connecting the two units without the necessity of conductor **26**, **27** having to move relative to its conduit. Said means, in the form shown, comprises an internally beveled washer **35** seated on flange surface **34**, a tubular member **36** slidably mounted on sleeve portion **31**, and a coil spring **37** interposed between said washer and an external flange **38** on member **36**. The latter has radially extending fingers or arms **39** thereon which project through slots **24** into the path of shoulder **25** in nut **18**.

One method of assembling the terminal and conduit assembly, which is detachable as a unit from spark plug **10**, consists in extending conductor **26**, **27** with its tip piece **41** into conduit **20**, **21**, assembling parts **29**, **35**, **37** and **36** as shown, and sliding the same onto the projecting end of the cable and thereafter threading nut **40** with spring **28** onto the tip piece into engagement with the end of insulation **27** and insulating sleeve **29**. The assembled terminal-conduit unit may then be associated

with barrel 15, 17 in the manner illustrated in the drawing and secured in place by nut 18.

When the parts are in the assembled relation shown, springs 28 and 37 are both under predeterminable axial compression. As nut 18 is screwed off of barrel 17 to effect a disconnection, the compression of spring 37 is released as the shoulder 25 moves upwardly and permits the spring to move member 36 upwardly along sleeve portion 31 until arms 39 engage the inner or upper ends of slots 24. Upon continued withdrawal of nut 18 the parts of the detachable terminal-conduit unit as described above remain in fully assembled position so that when the nut is screwed onto barrel 17, the spring 37 will be compressed without necessitating any 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. For example, the same type connection may be used at the ignition harness manifold end of a spark plug lead as well as in many other environments. The shoulder 34 need not be beveled and the fingers 39 may be fewer or greater in number, if desired. In some installations it may be desirable to fill the space in conduit 20 around cable 27 with a solid insulation or to otherwise fix the cable in relation to the conduit. The upper and lower portions 31 and 30 of sleeve 29 may be dispensed with in some embodiments and contact between the sleeve and insulator need not necessarily be at the end of the latter. Various other changes may also be made in the design and arrangement of parts illustrated as well as in the materials suggested without departing from the spirit and scope of the invention as the same will now be understood by those skilled in the art.

What is claimed is:

1. In electrical apparatus of the class described, two abutting conduits, the first of which has an axially slotted end portion, means for operatively connecting said conduits, an insulator fixed in the second conduit and having a terminal therein, a conductor extending from said first conduit into electrical engagement with said terminal, an insulating sleeve surrounding said conductor and engageable with said insulator, and means operable by said conduit connecting means for pressing said sleeve against the insulator including a member having tabs projecting outwardly through the axial slots in said first conduit for engagement by said conduit connecting means and a compressible spring interposed between said member and sleeve.

2. In electrical apparatus of the class described, a tubular metallic barrel, an insulator having a recess therein fixed in said barrel, an insulating sleeve having a portion extending into said recess and an annular surface engaging an annular surface of said insulator, said annular surfaces being transverse relative to the longitudinal axis of said sleeve, a nut having threaded engagement with said barrel, an element engageable by said nut, and a spring interposed between said sleeve and said element, whereby the spring is axially compressed to press said annular surfaces together when the nut is screwed onto said barrel.

3. In electrical apparatus of the class described, two abutting conduits, means for operatively connecting said conduits together in aligned relation, two abutting insulators in said conduits, one of which is fixed relative to one conduit, and means operable by said conduit connecting means for urging the other insulator into abutting engagement with the fixed insulator including compressible resilient means operatively interposed, independently of said conduits, between said other insulator and said conduit connecting means, the latter being operable to compress said resilient means while the conduits are in end-to-end engagement.

4. In electrical apparatus of the class described, two aligned conduits in end-to-end abutment, means for operatively connecting said conduits, a first insulator fixed in one of said conduits, a second insulator extending from the other conduit and engageable with said first insulator, and means including biased resilient means interposed between said second insulator and said conduit connecting means to press transverse annular surfaces of said insulators into firm engagement with each other, said annular surfaces being transverse with respect to the longitudinal axes of said conduits and said connecting means being operable to compress said resilient means when said conduits are in end-to-end abutment.

5. Electrical apparatus as defined in claim 4 wherein the second insulator has a tubular portion closely fitting into a recess in said first insulator.

6. Electrical apparatus as defined in claim 4 wherein the means for pressing the insulators together includes a member having radial arms extending through axial slots in one of said conduits for engagement by said conduit connecting means.

7. In apparatus of the class described, a metallic tube, a metallic conduit having longitudinal slots in the end portion thereof, a tubular nut operatively engaging said tube and conduit for releasably securing the same together in end-to-end contact, an insulating tube mounted in said metallic tube, an insulating sleeve, and means for yieldably pressing said sleeve against an annular surface of said insulating tube including a sleeve having arms projecting radially through said slots for operative engagement by said nut and a spring interposed between said sleeves.

8. Apparatus as defined in claim 7 wherein the insulating sleeve comprises a portion which has a close sliding fit in said insulating tube.

9. Apparatus as defined in claim 7 wherein said sleeve with projecting arms has a sliding fit on a portion of said insulating sleeve.

10. Apparatus as defined in claim 7 comprising a beveled washer interposed between the spring and a beveled surface of said insulating sleeve.

11. In apparatus of the class described, a radio shielding assembly comprising two metallic conduits releasably held in end-to-end engagement by a metallic nut operatively engaging said conduits, an insulating tube fixed in one of said conduits, an electrical conductor extending from the other of said conduits into said insulating tube, an insulating sleeve closely surrounding said conductor, and means for yieldably pressing said sleeve against said insulating tube comprising a member movable axially relative to said sleeve and said conduits by said nut when said conduits are in end-to-end contact and resilient means interposed between said member and sleeve.

12. In apparatus of the class described, a tubular metallic barrel externally threaded at one end, an electrical insulator mounted in said barrel having a recess therein, 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 same, the extending portion of the ferrule having a plurality of axially extending slots therein and end-to-end engagement with said barrel, 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 electrical conductor extending from said conduit into said recess, a resilient terminal on said conductor engaging the terminal in said recess, an insulating sleeve closely surrounding the projecting end of said conductor, said sleeve having a portion closely fitting into said recess and a flange intermediate its ends having a surface engaging the end of said insulator and an oppositely disposed surface, a washer engaging said oppositely disposed surface of the flange, a member surrounding said insulating sleeve and slidable thereon, said member having fingers extending radially through said slots in the ferrule and into the path of an internal shoulder on said nut, and a coil spring interposed between

said fingers and washer, said spring being maintained under axial compression when the apparatus is assembled to press said flange into sealing engagement with the end of said insulator.

13. An electrical lead adapted for use in combination with a recessed member having an insulator fixed therein, said lead comprising a conduit with longitudinal slots in an end portion thereof, a tubular element operatively engageable with said member and conduit for releasably connecting the same together in end-to-end relation, an insulating sleeve, and means for yieldably pressing said sleeve against an annular surface of said insulator including a sleeve in said conduit having arms projecting radially through said slots for operative engagement by said element, and a spring interposed between said sleeves.

14. An electrical lead adapted for use in combination with a recessed member, an insulator in said recess and a terminal in said insulator, said lead comprising a conduit having longitudinal slots in an end portion thereof, means for operatively connecting said member and conduit, a conductor extending from said conduit for electrical engagement with said terminal, an insulating sleeve surrounding the projecting end portion of said conductor for engagement with said insulator, and means operable by said connecting means for pressing said sleeve against the insulator including an element in said conduit having tabs projecting outwardly through said slots for engagement by said connecting means and a compressible spring interposed between said element and sleeve.

15. In electrical apparatus of the class described, two aligned conduits, means for operatively connecting said conduits, a first insulator fixed in one of said conduits, a second insulator engageable with said first insulator, and means including biased resilient means interposed between said second insulator and said conduit connecting means to press transverse annular surfaces of said insulators into firm engagement with each other, said second-named means also including a member having radial arms extending through axial slots in one of said conduits for engagement by said conduit connecting means.

16. A cable and conduit assembly comprising, a ferrule secured to the end of the conduit, longitudinal slots in the wall of the ferrule, a collar member within the ferrule disposed about the cable and axially slidable upon the cable, outwardly disposed lugs on the collar, said lugs being located within and projecting through and beyond the ferrule slots, a sealing gasket slipped upon the cable between the collar and said cable, a flanged element on the coupling end of said gasket extending in front of the collar, a coil spring around the cable between the collar member and the gasket flange, a nut rotatably carried upon the outside of the ferrule adapted to engage a threaded coupling point said coupling point having a flanged element receiving shoulder therein, a skirt on the conduit side of the nut, said skirt being provided with an inwardly disposed boss thereon, and nut and collar linking means carried beneath the nut comprising the boss of the skirt and the collar lugs whereby the uniting of the nut with the coupling point will cause the nut to urge the collar against the coil spring and compress the flange of the sealing gasket to form a liquidproof seal within the coupling.

17. A cable and conduit coupling assembly comprising, a ferrule secured to the end of the conduit, longitudinal slots in the wall of the ferrule, a collar member within the ferrule disposed about the cable and axially slidable upon the cable, outwardly disposed lugs on the collar, said lugs being located within and projecting through and beyond the ferrule slots, a sealing gasket slipped upon the cable between the collar and said cable, a flanged element on the coupling end of said gasket extending in front of the collar, a coil spring around the cable between the collar member and the gasket flange, a ring carried upon the gasket and bearing against the conduit side of the gasket flange, a nut rotatably carried upon the outside of the ferrule adapted to engage a threaded coupling point said coupling point having a flanged element receiving shoulder therein, a skirt on the conduit side of the nut, said skirt being provided with an inwardly disposed boss thereon, and nut and collar linking means carried beneath the nut comprising the boss of the skirt and the collar lugs whereby the uniting of the nut with the coupling point will cause the nut to urge the collar against the coil spring and ring so as to compress the flange of the sealing gasket to form a liquid-proof seal within the coupling.

18. Electrical apparatus as defined in claim 2 wherein said insulating sleeve has an external annular flange, one surface of which constitutes said annular surface of the sleeve.

19. Electrical apparatus as defined in claim 18 wherein said annular surface of said insulator is the end surface thereof.

20. In electrical apparatus of the class described, a tubular metallic barrel, an insulator having a recess therein fixed in said barrel, an insulating sleeve having a portion extending into said recess and an annular surface engaging an annular surface of said insulator, said annular surfaces being transverse relative to the longitudinal axis of said sleeve, a nut having threaded engagement with said barrel, tubular means surrounding a portion of said sleeve outside of said recess including spring carrier means and an end portion of a metallic conduit, said tubular means comprising an element engageable by said nut, and a spring on said carrier means interposed between said sleeve and said element, whereby the spring is axially compressed to press said annular surfaces together when the nut is screwed onto said barrel.

21. Electrical apparatus as defined in claim 20 wherein said spring carrier means is telescopic within said conduit.

22. Electrical apparatus as defined in claim 20 wherein said spring carrier means comprises two tubular members projecting into opposed ends of said spring and having external flanges between which said spring is retained.

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