Dec. 21, 1954 T. FRATILA 2,697,817

ELECTRICAL CONNECTOR

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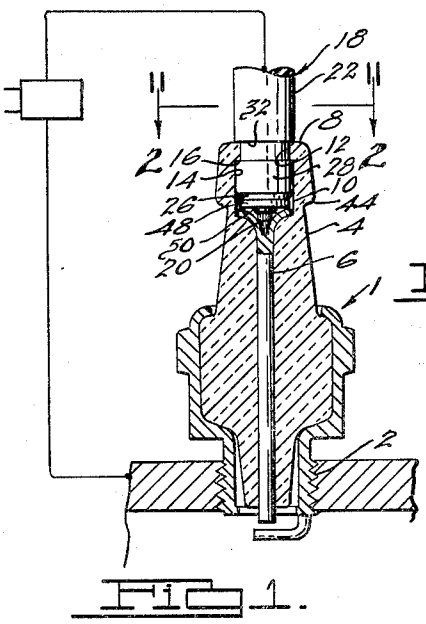


Fig. 1.

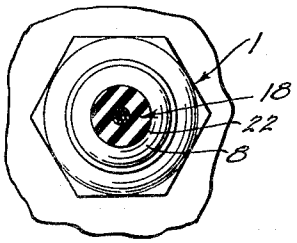


Fig. 2.

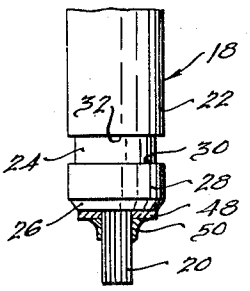


Fig. 3.

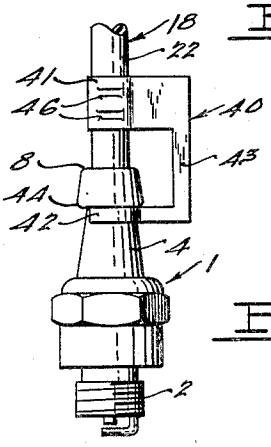


Fig. 4.

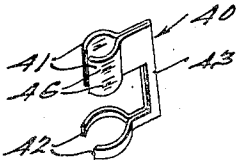


Fig. 5.

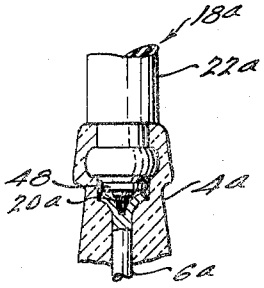


Fig. 8.

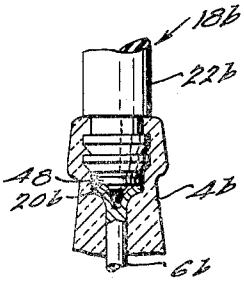


Fig. 7.

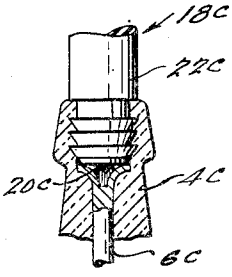


Fig. 8.

INVENTOR.
Thomas Fratila.
BY
Harness, Dickey & Pierce
ATTORNEYS.

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ELECTRICAL CONNECTOR

Thomas Fratila, Detroit, Mich.

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11 Claims. (Cl. 339—26)

This invention relates generally to apparatus for connecting an electrical wire to an electrical unit and is particularly adapted among other uses for connecting an ignition wire to a spark plug.

An object of this invention is to provide a new means for connecting a high voltage conducting wire to an electrical apparatus.

Another object of this invention is to provide such a means which is extremely economical of manufacture and which will provide a satisfactory connection.

Another object of this invention is to provide such a means which utilizes a minimum number of parts.

Another object of this invention is to provide such a means which will prevent the entrance of moisture.

Another object is to provide such a means in which the connection will not separate in use.

Other objects will be apparent from the specification, the appended claims and the drawings in which drawings:

Figure 1 is a diagrammatic view partly in section illustrating the invention;

Fig. 2 is a view taken substantially along the line 2—2 of Fig. 1;

Fig. 3 is a view illustrating a wire embodying the invention;

Fig. 4 is a view in elevation of a modified form of the invention shown in Fig. 1.

Fig. 5 is a view in perspective of the clip of Fig. 4; and

Figs. 6, 7 and 8 are partial views partly in section illustrating modified forms of the invention.

This invention contemplates generally the connecting of a high tension conductor to a piece of electrical apparatus by the utilization of a particular configuration of the insulation on the conductor which provides recessed shoulders which cooperate with complemental shoulders on the apparatus to maintain the connection. In certain other forms in which the conductor and apparatus are subjected to extreme vibration a clip may be added.

Referring to the drawings by characters of reference, the numeral 1 indicates generally a spark plug having the usual screw threads 2 for connection with the cylinder wall of an internal combustion engine and provided with a porcelain body portion 4 which carries and houses one electrode 6 of the plug. The upper end surface 8 of the porcelain body portion is provided with a recess 10 which opens outwardly through the wall 8 and into which the electrode 6 extends. The recess 10 is formed of concentrically arranged cylindrical portions 12 and 14. The recess portion 12 is of lesser diameter than that of the portion 14 providing at their intersection a shoulder 16 which faces the lower or inner wall of the recess 10 and the upper end portion of the electrode 6. Electrical energy is furnished to the plug 1 through a conductor 18 having a wire core 20 which for the purposes of flexibility may be woven from a plurality of fine wires and may extend slightly beyond the lower end of the insulation 22. The wire core 20 is surrounded by insulation 22 which may be and preferably is of a high grade of rubber which is resilient. The normal diameter of the insulation 22 is substantially that of the diameter of the recess portion 14. The insulation 22 adjacent the end which is to be inserted to the spark plug 1 is provided with a peripherally extending reduced diameter portion 24 which is substantially the same diameter as the recess portion 12 of the recess 10 and of a width substantially equal to or just slightly less than the longitudinal length of the recess portion 12. In order to facilitate the insertion of the conductor 18 into the recess 10, the end portion of the insulation 22 may be tapered or beveled as at 26. The intersection of the normal diameter portion 28 of the insulation 22 which is intermediate the recess 24 and the tapered portion 26 forms a shoulder 30 which, when the conductor 18 is inserted into the recess 10, cooperates with the shoulder 16 to hold the conductor 18 securely to the plug 1. By providing the length of the recess 24 substantially equal to or slightly less than the width of the recess portion 12, the engagement of the shoulders 16 and 30 hold a shoulder 32, formed oppositely to the shoulder 30, against the end wall 8 of the plug 1. The snug fit between the recess portions 24 and 12 and the shoulder 32 with the end wall 8 acts to prevent moisture from passing into the recess 10 and any tendency of the plug to short circuit is thereby prevented. It will be seen from the foregoing that this construction provides an extremely simple and economical arrangement for connecting ignition wires to spark plugs or similar connections of wires to electrical apparatus and which requires a minimum of parts.

Under some conditions of engine operation, as for example, in aircraft engines, it may be desirable to additionally secure the conductor 18 to the spark plug 1 by another supporting means. Under such conditions of operation and if desired, I propose to provide a clip 40 having resilient portions 41 which resiliently encompass the insulation 22 and a connecting portion 43 which extends downwardly and is provided at its lower end with a resilient bifurcated end portion 42 for resilient engagement with the outer surface of the porcelain body portion 4. In this instance the porcelain body portion 4 is provided with an outwardly extending circumferential shoulder 44 against which the bifurcated portions 42 engage to prevent outward movement of the conductor 18 from the spark plug 1.

The clip 40 may be provided with one or more grooves 46 which may be prerolled thereon and which will compress the insulation 22 for securely holding the clip 40 against movement along the conductor 18. The clip 40 may be fabricated from a piece of sheet metal or spring steel by notching away sections to provide a member having spaced pairs of oppositely extending upper and lower arms and a central connecting section after which the notched sheet metal may be rebent upon itself and the end portions of the pairs of arms formed to provide the end portions 42 for resiliently encompassing the body portion 4, the portions 41 for securement to the insulator 22 and the portion 43 which joins the portions 41 and 42.

In operation the conductor 18, with or without the clip 40, is forced into the recess 10, by compressing the portion 28, until the shoulder 30 passes beyond the shoulder 16 after which the resilient nature of the insulation causes the portion 28 to expand to normal size whereby the shoulder 30 will be positioned in juxtaposition with the shoulder 16 to hold the conductor 18 within the recess 10 of the spark plug 1. Due to the resilient nature of the insulation 22 and to the relative dimensions thereof and of the recesses 12, 14 and 24, once the conductor is inserted in the recess 10 a substantially fluid-tight fit is provided so that the vacuum created within the recess 10 intermediate the insulation 22 and lower end wall of the recess 10 due to outward movement of the conductor 18 tends to aid the shoulders 16 and 30 in their holding of the conductor 18 to the spark plug 1. Since many conductors of the type used for ignition circuits are made from braided or woven strands and the joint between the strands and the insulation is not air tight, there is provided a washer or annular member 48 which is shown as being of a diameter substantially equal to the diameter of the bevel at the end of the insulation 22 and which seats tightly against the end surface of the insulation 22. The washer 48 is held in this position and is sealed to the core 20 as by solder 50 which will fill the spaces between the core strands to prevent air from passing between the core 20 and insulation 22 to relieve any vacuum in the lower end portion of the recess 10.

In Figures 6, 7 and 8 there is shown further modified forms of the invention in which different arrangements of recesses have been provided in the spark plug body portions, 4*a*, 4*b* and 4*c* and on the insulations 22*a*, 22*b* and 22*c* of the conductors 18*a*, 18*b* and 18*c*. It will be noted, however, that as in the construction shown in Fig. 1 all of the formed shoulders on the conductors 18*a*, 18*b* and 18*c* are within the normal diameter of the insulations 22*a*, 22*b* and 22*c* whereby such shoulders can be formed directly in the insulation without the addition of material or additional elements. Further forms of shoulders will be suggested by the shown forms.

In accordance with the patent statutes there has been shown a preferred embodiment of the invention as used in connection with spark plugs but it will be evident that this same type connection may be used with other types of electrical apparatus as for example with ignition coils and distributors.

What is claimed and is desired to be secured by United States Letters Patent is as follows:

1. An electrical connection for releasably connecting an electrical apparatus to an electrical source comprising, a male portion and a female portion, said female portion including a body member of electrically insulating material, having a recess formed with a mouth opening outwardly through a wall thereof, said wall being impervious to water and extending uninterruptedly around said recess and mouth, an electrical conducting member within said recess spaced from said mouth and engageable by said male portion to complete an electric circuit, a shoulder portion formed upon said body within and extending uninterruptedly around said recess intermediate said conducting member and said mouth, said male portion including a length of conductor cable comprising an electrical conducting element surrounded by a covering of resilient homogeneous and substantially impervious electrically insulating material, an end portion of said covering at an end portion of said cable having an external dimension greater than, but compressible to correspond to, the internal dimension of said shoulder, whereby said covering end portion is positionable in said recess in engagement with said shoulder to seal said recess at a point spaced from said conducting member and to hold said conducting element of the cable in engagement with said conducting member.

2. An electrical connection for releasably connecting an electrical apparatus to an electrical source comprising, a male and a female portion, said female portion including a body member of electrically insulating material, said member having a recess formed with a mouth opening outwardly through a wall thereof, said wall being impervious to water and extending uninterruptedly around said recess and mouth, an electrical conducting member within said recess spaced from said mouth opening and engageable by said male portion to complete an electric circuit, a shoulder portion formed upon said body within and extending uninterruptedly around said recess intermediate said conducting member and said mouth, said male portion including a length of conductor cable comprising an electrical conducting element surrounded by a covering of resilient homogeneous and substantially impervious electrically insulating material, an end portion of said covering at an end portion of said cable having an external dimension greater than, but compressible to correspond to, the internal dimension of the opening surrounded by said shoulder, an end portion of said conducting element extending outwardly beyond said covering at said cable end portion, means holding said male conducting element extending end portion against movement inwardly into said covering, said cable end portion being positioned in said recess in engagement with said shoulder and said conducting member to hold said conducting element of the cable in engagement with said conducting member within the recess, and to seal said recess at the shoulder.

3. An electrical connection of the character described comprising, a female connector element, said female element being provided with a recess opening outwardly through one wall thereof, said recess having a mouth, a shoulder, and a portion of larger diameter than the shoulder spaced on the other side of said shoulder from said mouth, a male connector element comprising an end portion of a conductor cable, said cable comprising a current conducting part encased in a compressible insulating sheath, said sheath being of greater diameter than,

but compressible to correspond to, the diameter of said shoulder, and having a reduced diameter portion spaced inwardly from the end surface of said sheath, said reduced diameter portion when relaxed also being of greater diameter than said shoulder and cooperable therewith to provide an abutment on said cable to hold said male and female elements in assembled relation.

4. The combination of claim 3 in which said conducting part of said cable extends outwardly of said end surface of said sheath, and structure secured to said conducting part and seating against said sheath end surface to prevent movement of said outwardly extending cable part into said sheath.

5. In combination with means as defined in claim 3, a circumferentially tapered portion on said cable sheath adjacent said end surface of said sheath to facilitate entry of said male element into said female element.

6. An electrical connection of the character described comprising, a male element and a female element, said female element having a wall substantially impervious to water and being provided with a recess having a mouth opening outwardly through said wall, said recess having a plurality of internal peripheral shoulders, said male element comprising an end portion of a conductor cable, said cable comprising a conducting part encased in a compressible insulating sheath, said sheath when relaxed having an outer diameter greater than the diameter across said shoulders, an end portion of said sheath provided with spaced circumferential recesses spaced conformably to and interengageable with said recess shoulders to hold said sheath end portion in said recess and to provide a water seal between said sheath and the wall of the female element.

7. A female element for connection with a male element of an electrical connection comprising, a body member of electrical insulating material having a wall which is substantially impervious to water, said body member being provided with a recess having a mouth opening outwardly through said wall, a portion of said recess nearer the mouth being of lesser cross section than a second portion of said recess farther from the mouth, a shoulder joining said portions of different cross section to provide an abutment generally facing the bottom of said recess, and an electrical terminal in said recess and spaced from said shoulder.

8. A combination as defined in claim 7 in which said terminal includes a concave wire-receiving portion appurtenant to the bottom of said recess and facing said mouth.

9. In a spark plug, a body of electrically insulating material having an external wall which is substantially impervious to water and having a recess including a mouth portion opening outwardly through said wall, a conductor member within said body having a terminal portion within said recess and spaced from said mouth, a portion of said recess spaced from the terminal and nearer said mouth being of lesser cross-sectional area than a portion of said recess farther from the mouth and closer to said terminal, and a shoulder facing away from said mouth and joining said portions of different cross section.

10. A male element for connection with a female element of an electrical connection comprising, an electrical conducting cable having an end portion adapted to be received within such a female element, said cable comprising current conducting material and a sleeve of compressible insulating material surrounding said conducting material and having an end wall spaced inwardly from the end of the conducting material whereby at least some of said conducting material extends beyond said end wall, said sleeve further having a peripherally extending groove located adjacent to but spaced inwardly along said sleeve from said sleeve end wall, the depth of said groove being a minor fraction of the thickness of said insulating sleeve whereby the portion of said sleeve between said sleeve end wall and said groove is securely attached to the portion of said sleeve on the other side of said groove, and means secured to the conducting material and overlapping the end wall and blocking the sleeve from stretching longitudinally over the conducting material.

11. Means as defined in claim 10, wherein said last-named means comprises an apertured washer-like abutment member secured to said conducting material outside the sleeve and overlapping the end wall to hold said

conducting material against inward movement through said sleeve end wall into said sleeve.

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