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D. INGALLS

2,278,448

RADIO SHIELDING CONDUIT CONNECTION

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FIG. 1

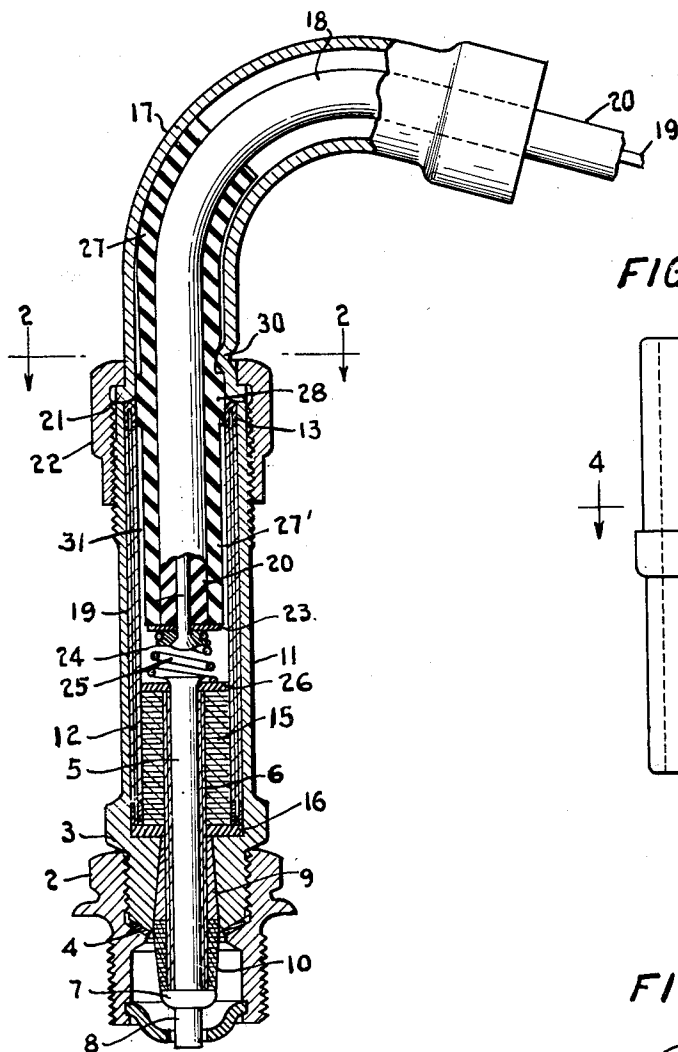


FIG. 3

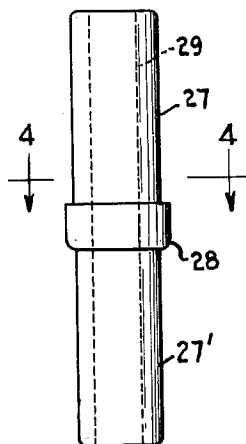


FIG. 4

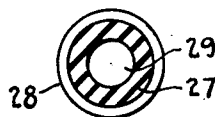
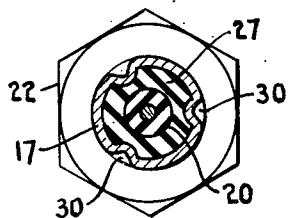


FIG. 2



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RADIO SHIELDING CONDUIT CONNECTION

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15 Claims. (Cl. 123—169)

The present invention relates to the provision of connections, having the desired characteristics, between shielding conduits for electrical conductors.

Although the invention may have other applications, it is especially adapted for the connection of ignition conductors for internal combustion engines, and the conduits for such conductors, with the casings and electrodes of spark plugs.

The invention is especially efficacious in connection with connections to spark plugs wherein the shielded conduit connected to the shielding casing of a spark plug is in the form of an elbow.

The main object of the invention is to provide a connection as referred to having a bushing whereby a solid and secure connection may be made, good electrical connection between the joined conduits may be secured, the joined conduits are sealed at their joint against ingress of moisture from the exterior and the shielding casing for the spark plug is sealed from the conduit connected thereto, while the ignition conductor in one of the joined conduits, especially that of curved or elbow formation, is properly spaced, secured and insulated.

Other and ancillary objects of the invention will appear hereinafter.

In the accompanying drawing which illustrates the invention—

Fig. 1 is a vertical central section of a spark plug, radio shielding casing therefor and radio shielding elbow connected to said casing, embodying the invention;

Fig. 2 is a section on the line 2—2 of Fig. 1;

Fig. 3 is a side view of the improved bushing employed in the assembly of Fig. 1; and

Fig. 4 is a section on the line 4—4 of Fig. 3.

Referring to the drawing, the spark plug comprises a shell 2 which is adapted to be screwed into the engine block. Within the shell 2 is screwed the nut or bushing 3 against the gasket or washer 4. A central electrode 5 is surrounded by rolled mica insulation 6 and has a head 7 and an electrode 8 of conventional form. This central spindle or electrode is gripped into the nut 3 so as to produce a gas-tight joint by forcing a compressible metal ring 9 forward in a tapered opening of the nut. Mica disk insulation 10 surrounding the central electrode and the insulation 6 is confined between the ring 9 and the head 7. A metal cylinder 11 extends upwardly from and is integral with the nut 3, it being understood, of course, that the shell 2 is also of metal.

This cylinder 11 has a lining 12 of rolled mica

which is inserted from the upper end of the cylinder. The upper end of the insulating sleeve 12 is bound by a metal ferrule 13 of U-section embracing the layers and pinched thereon. The casing comprising the cylinder 11 and lining 12 act as a radio shield for the spark plug.

The space in the lower part of the casing between the mica sleeves 6 and 12 is occupied by a stack 15 of mica washers bearing at its lower end upon the metal washer 16 resting upon the nut 3. The metal tubular elbow 17 of circular cross section is adapted at its outer end to be secured in any suitable or well known manner to the shielding ignition conduit for the cable 18, comprising the conductor 19 and the insulation 20 carried thereby, extending toward the magneto or other source of ignition current, while the other end of the elbow 17 has a flange 21 engaged by the nut 22 screw-threaded upon the metal cylinder 11 and adapted to draw the elbow and the cylinder toward each other. The ignition cable 18 extends through the elbow into the casing comprising the metal cylinder 11 and mica sleeve 12, the inner end of the conductor 19 passing through a hole in the center of a metal washer 23 which bears against the end of the insulation 20. The end of the conductor 19 also passes through a peripherally grooved washer 24, the conductor 19 being fanned out at its end and soldered so as to securely hold the washer 24 against the washer 23 and the latter washer against the end of the insulation 20.

Sprung into the groove of the washer 24 is the upper convolution of a spiral spring 25, the lower end of which bears upon a metal washer 26 secured to the end of the central spark plug electrode 5 so that connection is established from the ignition conductor 19 to the central electrode. The spring 25, however, is not secured to the washer 26 but may be removed therefrom by un-screwing the nut 22 and drawing the ignition cable upwardly when the spring 25 will be lifted off the washer 26. Good contact of the metal spring 25 with the washer 26, however, is secured by the spring pressure of the spring 25 when the parts are in assembled condition.

The soft rubber bushing, the same being resilient, water-tight and flexible, as shown in Fig. 3 (before assembly in the spark plug connection) is integrally formed and comprises the cylindrical portions 27 and 27' on opposite sides of the laterally projecting flange or enlarged portion 28 midway between its ends, this bushing having a uniform bore 29 passing entirely through it. The dimensions of the cylinder may of course be made

such as to cooperate with their related parts in the assembled structure. In the present instance, however, the cylinder 27' is of slightly smaller outside diameter than the cylinder 27, to accommodate conditions within the spark plug casing. In the assembled structure, the bushing of Fig. 3 is telescoped over the ignition cable 18, its inner end bearing against the washer 23 and, the bore 28 being slightly smaller than the cable 18, the bushing, by reason of its resiliency, tightly grips the cable. Ordinarily in assembling the parts, the rubber bushing of Fig. 3 is telescoped on the end of the cable 20, resiliently gripping the same and the washers 23 and 24 and the spring 25 are assembled on the end of the cable as described. The cylindrical portion 27 is then inserted within the elbow 17 and also the enlarged portion 28 is partially inserted therein, the extent of its entry therein being limited by the inwardly extending projections 30 formed by punching the wall of the elbow 17 from the outside inwardly. This leaves a portion of the enlargement 28 extending beyond the end of the elbow and, the diameter of the flange or enlargement being greater than the internal diameter of the elbow, the portion of the flange entering the end of the elbow is compressed in a manner similar to that of a cork forced within the neck of a bottle whereby the flange 28 is resiliently pressed firmly and securely against the inner wall of the elbow 17 and forms a fluid-tight connection therewith.

The elbow, with its parts thus assembled, is then assembled with the spark plug casing comprising the metal cylinder 11 and its insulating lining 12, by inserting the cylinder 27' into such casing, bringing the end of the elbow and the end of the casing into proper registry and screwing the nut 22 upon the cylinder 11 of the casing. The ends of the elbow and the casing will be drawn towards each other as the nut is screwed up and such action will force the lower portion of the flange or enlarged portion 28 within the casing, the flange portion 28 being compressed tightly and resiliently against the circular wall of the casing so as to form a fluid-tight joint similar to a cork placed in the neck of a bottle. The nut 23 is preferably screwed home so that the metal end of the elbow contacts the metal end of the casing thereby forming a good electrical connection between such radio shielding parts. If, however, the nut is not screwed entirely home, electrical connection will be made between the elbow and casing through the nut and the flange 28 may be sufficiently entered within the spark plug casing to furnish a fluid-tight joint even when the nut 23 is not screwed completely home. After assembly as described, the parts will be in the position as shown in the assembled view of Fig. 1. In such assembly the cylinder 27' is separated from the lining 12 of the casing by a space 31.

Above the flange 28 the cylindrical portion 27 of the soft rubber bushing extends into and its flexibility permits it to be curved according to the curvature of the elbow. This portion 27 of the bushing therefore properly spaces the ignition cable from the walls of the elbow at all points so that such cable cannot be misplaced so as to approach too closely or come in contact with the walls of the elbow whereby a flash-over might be caused, but the ignition cable is at all points held at a maximum distance from the elbow walls, and the cable is securely insulated and guarded against flash-over in the elbow.

The ignition cable being resiliently gripped by the rubber bushing so as to form a water-tight connection and the flange or enlarged part 28 forming fluid-tight connections at the end of the elbow and at the end of the spark plug casing, the joint between the elbow and the casing is securely sealed against the admission of moisture from the exterior and also the spark plug casing is sealed off from the elbow. The construction thus fulfills a most desirable function, namely that the interior of the cable conduit should not only be sealed against admission of moisture from the exterior, but the interior of the elbow and its connected shielded conduit should be shut off from the spark plug chamber so that no accumulation of moisture may be transmitted therefrom to the spark plug.

The cylinder portion 27 of the bushing which extends below the washer portion 28 operates to hold the end of the ignition cable in proper position and stiffen it as well as increases the diameter of the insulation of the cable conductor so that flash-over from corona effect or otherwise, is prevented.

The bushing consisting of the cylinders 27 and 27' and the flange or enlargement 28 may be made of material having suitable characteristics other than soft rubber, as for instance the synthetic rubber of which an example is that known under the trade name of "Neoprene."

With the parts assembled as described, the spring 25 will press upon the washer 26 and establish good connection with the central electrode 5.

While the invention has been illustrated in what is considered its best application it may have other embodiments without departing from its spirit and is not therefore limited to the structure shown in the drawing.

What I claim is:

1. The combination with a spark plug, of a radio shielding casing therefor, a metal radio shielding conduit for a conductor cable to said spark plug, a conductor cable extending through said conduit and into said casing, an integral, tubular, resilient, flexible, fluid-impervious, insulating bushing through which said cable passes, said bushing having an outwardly extending enlargement intermediate its ends and cylindrical portions of less diameter on each side of said enlargement, said enlargement resiliently pressing against said casing and said conduit, one of said cylindrical portions of the said bushing extending into said conduit upon one side of said enlargement and the other of said cylindrical bushing portions extending into said casing upon the other side of said enlargement, means for securing said conduit and casing together with said bushing enlargement resiliently bearing upon said conduit and casing and means at the end of said cable for connecting it with an electrode of the spark plug.

2. The combination with a spark plug, of a radio shielding casing therefor, a curved metal radio shielding conduit for a conductor cable to said spark plug, a conductor cable extending through said conduit and into said casing, an integral, tubular, resilient, flexible, fluid-impervious, insulating bushing through which said cable passes, said bushing having an outwardly extending enlargement intermediate its ends and cylindrical portions of less diameter on each side of said enlargement, said enlargement resiliently pressing against said casing and said conduit, one of said cylindrical portions of the said bush-

ing extending into said conduit upon one side of said enlargement and the other of said cylindrical bushing portions extending into said casing upon the other side of said enlargement, means for securing said conduit and casing together with said bushing enlargement resiliently bearing upon said conduit and casing and means at the end of said cable for connecting it with an electrode of the spark plug.

3. The combination with a spark plug, of a radio shielding casing therefor, a metal radio shielding conduit for a conductor cable to said spark plug, a conductor cable extending through said conduit and into said casing, an integral, tubular, resilient, flexible, fluid-impervious, insulating bushing through which said cable passes, said bushing having an outwardly extending enlargement intermediate its ends and cylindrical portions of less diameter on each side of said enlargement, said enlargement resiliently pressing against said casing and said conduit, one of said cylindrical portions of the said bushing extending into said conduit upon one side of said enlargement and the other of said cylindrical bushing portions extending into said casing upon the other side of said enlargement, means for securing said conduit and casing together with said bushing enlargement resiliently bearing upon said conduit and casing and means at the end of said cable for connecting it with an electrode of the spark plug, the said bushing enlargement entering partially into said conduit and partially into said casing.

4. The combination with a spark plug, of a radio shielding casing therefor, a metal radio shielding conduit for a conductor cable to said spark plug, a conductor cable extending through said conduit and into said casing, an integral, tubular, resilient, flexible, fluid-impervious, insulating bushing through which said cable passes, said bushing having an outwardly extending enlargement intermediate its ends and cylindrical portions of less diameter on each side of said enlargement, said enlargement resiliently pressing against said casing and said conduit, one of said cylindrical portions of the said bushing extending into said conduit upon one side of said enlargement and the other of said cylindrical bushing portions extending into said casing upon the other side of said enlargement, means for securing said conduit and casing together with said bushing enlargement resiliently bearing upon said conduit and casing and means at the end of said cable for connecting it with an electrode of the spark plug, the said cylindrical bushing portion entering said casing being of smaller diameter than the cylindrical bushing portion extending into said conduit.

5. The combination with a spark plug, of a radio shielding casing therefor, a metal radio shielding conduit for a conductor cable to said spark plug, a conductor cable extending through said conduit and into said casing, an integral, tubular, resilient, flexible, fluid-impervious, insulating bushing through which said cable passes, said bushing having an outwardly extending enlargement intermediate its ends and cylindrical portions of less diameter on each side of said enlargement, said enlargement resiliently pressing against said casing and said conduit, one of said cylindrical portions of the said bushing extending into said conduit upon one side of said enlargement and the other of said cylindrical bushing portions extending into said casing upon the other side of said enlargement, means for

securing said conduit and casing together with said bushing enlargement resiliently bearing upon said conduit and casing and means at the end of said cable for connecting it with an electrode of the spark plug, said tubular bushing resiliently pressing on said cable.

6. The combination with a spark plug, of a radio shielding casing therefor, a metal radio shielding conduit for a conductor cable to said spark plug, a conductor cable extending through said conduit and into said casing, an integral, tubular, resilient, flexible, fluid-impervious, insulating bushing through which said cable passes, said bushing having an outwardly extending enlargement intermediate its ends and cylindrical portions of less diameter on each side of said enlargement, said enlargement resiliently pressing against said casing and said conduit, one of said cylindrical portions of the said bushing extending into said conduit upon one side of said enlargement and the other of said cylindrical bushing portions extending into said casing upon the other side of said enlargement, means for securing said conduit and casing together with said bushing enlargement resiliently bearing upon said conduit and casing and means at the end of said cable for connecting it with an electrode of the spark plug, said bushing enlargement entering into said conduit.

7. The combination with a spark plug, of a radio shielding casing therefor, a metal radio shielding conduit for a conductor cable to said spark plug, a conductor cable extending through said conduit and into said casing, an integral, tubular, resilient, flexible, fluid-impervious, insulating bushing through which said cable passes, said bushing having an outwardly extending enlargement intermediate its ends and cylindrical portions of less diameter on each side of said enlargement, said enlargement resiliently pressing against said casing and said conduit, one of said cylindrical portions of the said bushing extending into said conduit upon one side of said enlargement and the other of said cylindrical bushing portions extending into said casing upon the other side of said enlargement, means for securing said conduit and casing together with said bushing enlargement resiliently bearing upon said conduit and casing and means at the end of said cable for connecting it with an electrode of the spark plug, said bushing enlargement entering into said casing.

8. The combination with a plurality of radio shielding conduits, of a conductor cable therein, an integral, tubular, resilient, flexible, fluid-impervious, insulating bushing about said cable, said bushing having an outwardly extending enlargement intermediate its ends and cylindrical portions of less diameter on each side of said enlargement, said enlargement resiliently pressing against both of said conduits, one of said cylindrical bushing portions extending into one of said conduits and the other of said cylindrical bushing portions extending into the other of said conduits and means for holding said conduits together with said bushing enlargement resiliently bearing upon both of said conduits.

9. The combination with a plurality of radio shielding conduits, of a conductor cable therein, an integral, tubular, resilient, flexible, fluid-impervious, insulating bushing about said cable, said bushing having an outwardly extending enlargement intermediate its ends and cylindrical portions of less diameter on each side of said enlargement, said enlargement resiliently pressing

against both of said conduits, one of said cylindrical bushing portions extending into one of said conduits and the other of said cylindrical bushing portions extending into the other of said conduits and means for holding said conduits together with said bushing enlargement resiliently bearing upon both of said conduits, one of said conduits being curved.

10. The combination with a plurality of radio shielding conduits, of a conductor cable therein, an integral, tubular, resilient, flexible, fluid-impervious, insulating bushing about said cable, said bushing having an outwardly extending enlargement intermediate its ends and cylindrical portions of less diameter on each side of said enlargement, said enlargement resiliently pressing against both of said conduits, one of said cylindrical bushing portions extending into one of said conduits and the other of said cylindrical bushing portions extending into the other of said conduits and means for holding said conduits together with said bushing enlargement resiliently bearing upon both of said conduits, the said bushing enlargement entering partially into one of said conduits.

11. The combination with a plurality of radio shielding conduits, of a conductor cable therein, an integral, tubular, resilient, flexible, fluid-impervious, insulating bushing about said cable, said bushing having an outwardly extending enlargement intermediate its ends and cylindrical portions of less diameter on each side of said enlargement, said enlargement resiliently pressing against both of said conduits, one of said cylindrical bushing portions extending into one of said conduits and the other of said cylindrical bushing portions extending into the other of said conduits and means for holding said conduits together with said bushing enlargement resiliently bearing upon both of said conduits, the said bushing enlargement entering partially into each of said conduits.

12. The combination with a plurality of radio shielding conduits, of a conductor cable therein, an integral, tubular, resilient, flexible, fluid-impervious, insulating bushing about said cable, said bushing having an outwardly extending enlargement intermediate its ends and cylindrical portions of less diameter on each side of said enlargement, said enlargement resiliently pressing against both of said conduits, one of said cylindrical bushing portions extending into one of said conduits and the other of said cylindrical bushing portions extending into the other of said conduits and means for holding said conduits together with said bushing enlarge-

ment resiliently bearing upon both of said conduits, said tubular bushing resiliently pressing on said cable.

13. The combination with a curved, tubular, metal radio shielding conduit, of a conductor cable extending therethrough and an integral, tubular, resilient, flexible, fluid-impervious, insulating bushing about said cable, said bushing comprising an outwardly extending enlargement intermediate its ends and cylindrical portions of less diameter on each side of said enlargement, one of said cylindrical portions and at least a portion of said enlargement extending within said conduit and the other of said cylindrical bushing portions extending outside said conduit, and means adjacent the end of the last mentioned cylindrical bushing portion connected with the conductor of said cable and adapted to establish connection thereof with a spark plug.

14. A bushing for a radio shielding conduit connection, said bushing being integral, tubular, resilient, flexible, fluid-impervious and insulating, the said bushing having an interior bore adapted to resiliently bear upon a conductor cable passing through the connected conduits and said bushing comprising an outwardly extending enlargement intermediate its ends adapted to bear resiliently against both the connected conduits to seal them from the exterior and from each other and cylindrical portions of less diameter, one on each side of said enlargement, one of said cylindrical portions being adapted to extend into one of the connected conduits and the other of said cylindrical portions being adapted to extend into the other of the connected conduits.

15. A bushing for a radio shielding conduit connection, said bushing being integral, tubular, resilient, flexible, fluid-impervious and insulating, the said bushing having an interior bore adapted to resiliently bear upon a conductor cable passing through the connected conduits and said bushing comprising an outwardly extending enlargement intermediate its ends adapted to bear resiliently against both the connected conduits to seal them from the exterior and from each other and cylindrical portions of less diameter, one on each side of said enlargement, one of said cylindrical portions being adapted to extend into one of the connected conduits and the other of said cylindrical portions being adapted to extend into the other of the connected conduits, one of said cylindrical portions being of less outside diameter than the other of said cylindrical portions.

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