April 30, 1946. E. A. ROBERTSON 2,399,390

RADIO-SHIELDED CONNECTION ESPECIALLY FOR SPARK PLUGS

Filed April 13, 1942

Fig. 1.

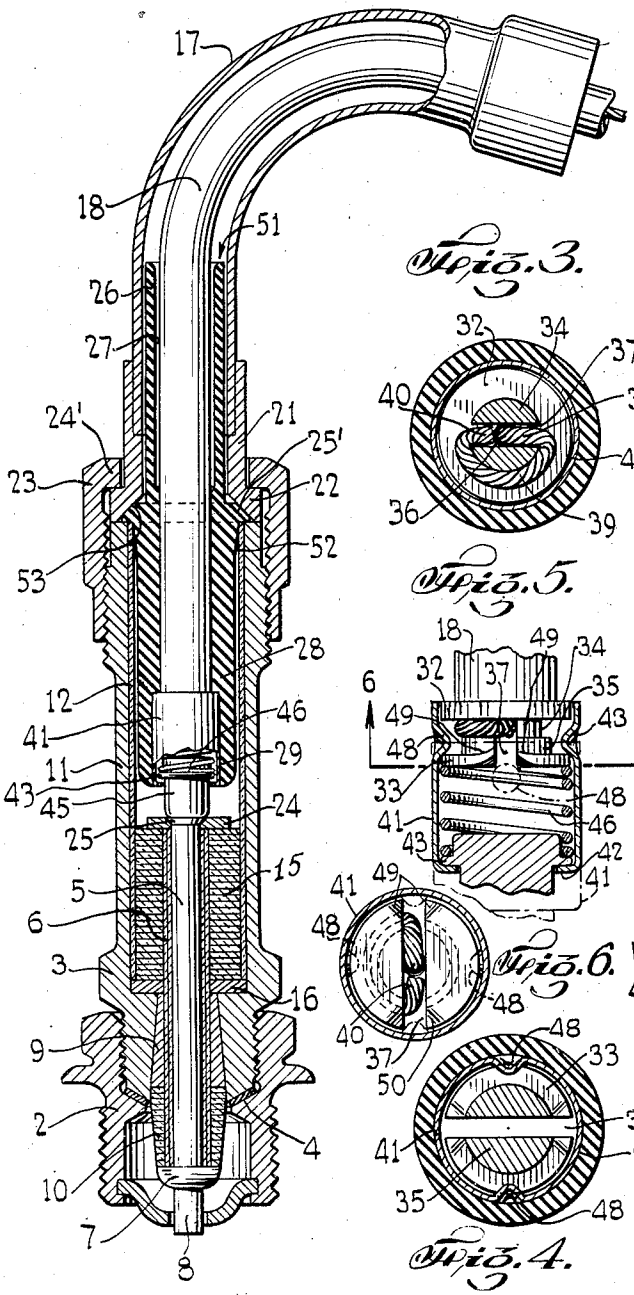


Fig. 2.

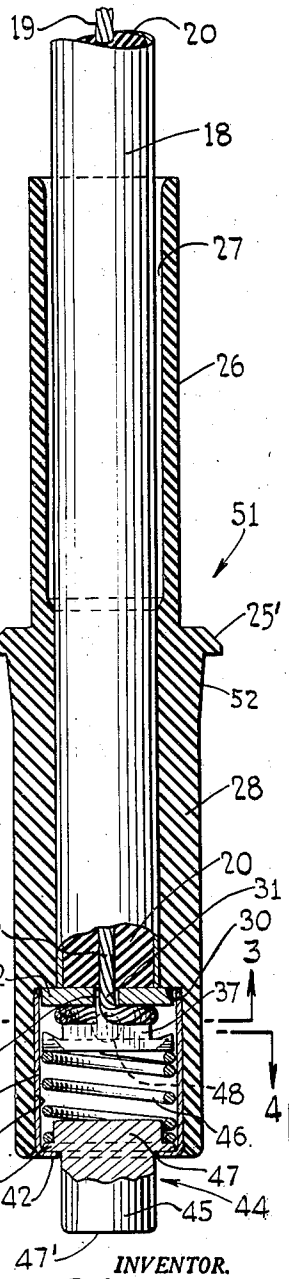


Fig. 3.

Fig. 5.

Fig. 6.

Fig. 4.

INVENTOR.
E. A. Robertson
BY
Thomas Howe
ATTORNEY

Patented Apr. 30, 1946 2,399,390

UNITED STATES PATENT OFFICE

2,399,390

RADIO-SHIELDED CONNECTION, ESPECIALLY FOR SPARK PLUGS

Edwin A. Robertson, Sandusky, Ohio, assignor to Titeflex, Inc., a corporation of New Jersey

Application April 13, 1942, Serial No. 438,796

8 Claims. (Cl. 174—35)

This invention relates to electrical connections, particularly radio-shielded connections and especially radio-shielded connections for the spark plugs of internal combustion engines.

It is the main object of the present invention to provide a radio-shielded electrical connection adapted to efficiently establish electrical connection with the spark plug and shall, when provided with a radio-shield in conjunction with the spark plug, provide a durable construction and one not liable to improper operation.

In some forms of radio-shielded connections for spark plugs, contact with the plug is effected by a coiled spring which is located in the chamber within the insulating lining of the radio-shield, the spring being exposed within such chamber. Under such circumstances the insulating lining of the radio-shield which is usually of mica, tends to become damaged by the contact with the sharp terminal end of the spring, and also there is a severe corona discharge around the spring which produces a contamination of the atmosphere inside the chamber referred to which results in decrease in the effective life of the device. It is a further object of the invention to avoid the disadvantages just referred to.

It is a further object of the invention to provide a radio-shielded electrical connection which is capable of advantageous use in other connections as well as in relation to spark plugs.

A further object of the invention is to provide improved contacting devices for conductors which shall not only be useful in connection with radio-shielded connections, especially in relation to spark plugs, but shall also be useful with conductors in other relations and which are or are not radio-shielded.

A further object of the invention is to provide an improved conducting terminal member for a conductor not only in relation to spark plugs and radio-shielded connections, but shall be useful in relation to conductors generally.

A further object of the invention is to provide a spring-pressed connector having a flat contact surface for connecting a conductor, especially with the central electrode of a spark plug within the insulating lining of a radio-shielding casing as before referred to, whereby the area of contact of the connector with the electrode shall be increased and rendered more certain and any sharp points liable to cause damage to the insulating lining shall be avoided.

A further object of the invention is to provide a connector in a chamber within a radio-shielding casing having an insulating lining whereby contaminating effect of corona discharge in said chamber shall be reduced to a minimum.

A further object of the invention is to provide a conductor terminal member of electrical conducting material which shall be securely and efficiently connected with the conductor, both electrically and mechanically, without the use of solder, solder being customarily employed to connect such terminal members with conductors in the radio-shielded connections with spark plugs. This connection, however, of terminal members with conductors, as now proposed, is not limited to connections in relation to spark plugs or radio-shielded connections, but may be employed in connection with electrical conductors generally.

Other and ancillary objects of the invention will appear hereinafter.

In the accompanying drawing which illustrates the invention—

Fig. 1 is a side elevation, partly in section and on a scale enlarged from the normal, of a spark plug, an ignition cable for supplying high tension current thereto and means, with appurtenant devices, for connecting the ignition conductor with the central electrode of a spark plug, the whole being radio-shielded, the ignition cable and its radio-shielding conduit being partly broken away, the structure shown in this figure embodying the present invention;

Fig. 2 is an axial section, on an enlarged scale, of that portion of the device of Fig. 1 consisting of the insulating sleeve which extends into the radio-shielding conduit for the ignition cable and into the radio-shielding barrel secured to the spark plug, together with the end of the ignition-cable surrounded thereby and means associated therewith for connecting with the central electrode of the spark plug;

Fig. 3 is a section on the line 3—3 of Fig. 2;

Fig. 4 is a section on the line 4—4 of Fig. 2;

Fig. 5 is a view, partly broken away and partly in section, of the lower end of the apparatus as shown in Fig. 2, with the insulating sleeve omitted, but turned through 90° from the view of Fig. 2; and

Fig. 6 is a section on the line 6—6 of Fig. 5.

Referring to the drawing, the spark plug comprises a metal shell 2 which is adapted to be screwed into the engine block. Within the shell 2 is screwed the metal nut or bushing 3 against the gasket or washer 4. A central electrode 5 is surrounded by mica insulation 6 and has a head 7 and a sparking point 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 or barrel 11 secured to the metal nut 3, preferably being integral therewith as shown, extends upwardly therefrom. The shell 2 being screwed into the engine block, is thereby grounded so that the cylinder 11, the nut 3 and the shell 2 are grounded.

The space in the lower part of the cylindrical casing 11, 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, and at the upper end of the stack the metal plate or washer 24 is held tightly against the mica washers by the upset end 25 of the electrode 5, the end 25 being countersunk in the plate 24 so that its upper surface is flush with the upper flat surface of the plate 24. The metal, tubular elbow 17, of circular cross section, is adapted at its outer end to be secured in any suitable or well known electrical conducting manner to the radio-shielding conduit for the electric cable 18 comprising a metal, electrical conductor 19 with suitable insulation 20 thereon. This cable may be a well-known or suitable construction of insulated wire and extends toward the magneto or other source of ignition current, and the radio shielding is continued from the elbow 17 so as to suitably radio-shield the conductor as is well understood. The other end of the elbow 17 has secured to it a circular ferrule 21 secured to the elbow by soldering or any suitable means, and having a flange 22. Surrounding the ferrule is a nut 23 having an inturned flange 24' which engages with the flange 22 to draw the latter toward the end of the metal cylinder 11 as the nut 23 is screwed up on the cylinder 11.

To adapt the cable 18 for co-operation with the spark plug and shielding structure as referred to, a sleeve 51 of comparatively soft, resilient rubber, or rubber-like material, is placed about the cable. This rubber sleeve has the integrally formed intermediate flange 25', there being upon one side of the flange the relatively thin-walled cylinder 26 having a bore providing a clearance 27 about the cable. Upon the other side of the flange is the thicker walled cylindrical portion 28 which tightly grips the cable so as to form a fluid- and gas-tight junction therebetween. In the end of the thick-walled portion 28 of the rubber sleeve is formed a circular recess 29 forming the shoulder 30. The end portion 31 of the conductor 19 of the cable is bared and the end of the insulation is substantially flush with the shoulder 30.

Firmly secured to the bared end 31 of the cable conductor is a spool-shaped metal piece having the upper end head 32 and the lower end head 33 with the connecting neck portion comprising the cylindrical part 34 of less diameter and the cylindrical part 35 of greater diameter. The upper end head 32 has a central circular hole 36 which opens at its lower end into the transverse slot 37 which extends entirely across the spool-shaped piece and from the lower surface of the head 33 to the lower surface of the head 32. The bared end of the conductor of the cable 18 passes through the hole 36, the head 32 being snugly fitted against the end of the insulation 20 of the conductor 18 and against the shoulder 30 of the rubber sleeve. The bared conductor is bent about the edge of the hole 36 and passes diametrically outward through the slot in the neck portion 34 to the circumference of the portion 34, the portion 38 of the conductor lying in the slot. The conductor is then again bent at less than a right angle and passes by a semi-circle 39 about the circumference of the portion 34 to the other end of the slot 37 where the conductor is bent, sharply and its end 40 inserted in the opposite end of the slot from which it has previously emerged as just described. This furnishes a secure mechanical connection and also a good electrical connection without the use of solder.

Inserted within the recess 29 of the rubber bushing or sleeve 51 is a metal cylinder 41 open at both ends, its inner end bearing against the shoulder 30 on the rubber sleeve, and its other end being substantially flush with, or slightly within, the outer end of the recess 29. The outer end of the cylinder 41 has an inturned flange 42 which engages beneath a flange 43 on a plunger 44 to limit the outward movement of the plunger. The plunger has a cylindrical portion 45 extending from the cylinder 41 and is pressed outwardly by a coiled metal spring 46 bearing at one end against the head 33 and at the other end against the flange 43 on the plunger, the latter end being centered by the circular boss 47 on the plunger which is embraced by the spring end. The outer contacting end 47' of the plunger is a plane surface.

The cylinder 41 is secured in the recess 29 in the end of the insulating sleeve by having inwardly punched projections 48, 180° apart, overlapping the head.

The cylinder casing 41 is assembled with the head 33 by bringing the projections 48 in line with the ends of the slot 37 as indicated by the dotted lines in Fig. 5. The casing 41 is then moved inwardly toward the ignition conductor 18, the projections moving through the ends of the slot 37 to a point above the upper surface of the head 33 and are then turned so that they will not be over the slot 37 but will overlap the edges of the head 33 (see full lines Figs. 4 and 6). The projections will then obviously engage the head 33 to prevent outward movement of the cylinder 41. The corners on the head 33 are bent upwardly to form upwardly inclined ears 49 at one end of the slot 37 and similar ears 50 at the other end of the slot, these ears providing tapered entrances to the slot for projection 48, as appears clearly from Fig. 5, thereby facilitating the finding of the slot by the projections in assembling the cylinder with the head 33, and also provides obstructions retarding and preventing accidental moving of the projections over the slot 37 to permit disengagement of the cylinder from the head, after the projections have been entered through the slots and turned into locking position above the head 33, as described. The outer surface of the sleeve 51, just below the flange 25, has the tapered portion 52.

In assembling the device of Fig. 2, the cable 18 is threaded through the sleeve 51 with its end projecting from the recess 29 and the conductor bared of insulation. The spool-shaped metal piece comprising the end heads 32 and 33 is then secured to the cable by inserting the bared conductor through the hole 36 and with the head 32 abutting against the end of the cable insulation 20. The end of the cable is then secured about the neck portion 34 of smaller diameter, as previously described.

Preparatory to assembling the cylinder 41 with the spool comprising the end heads 32 and 33, the cylinder has placed within it the plunger 44, its flange resting upon the flange 42 of the cylinder

and its cylindrical portion 45 protruding from the cylinder, while the spring 46 is placed within the cylinder with its lower end encircling the boss 47 and resting upon the flange 43 on the plunger.

The cylinder 41 then has its end opposite the plunger slipped about the spool-like member comprising the end heads 32 and 33, care being taken that the oppositely located projections 48 are in line with the ends of the slot 37 so that they will pass therethrough as the cylinder 41 is slipped about the spool-like member. The projections having passed through the slot to a position above the end head 33, the cylinder is turned whereby the projections are interlocked with the end head 33 to prevent movement of the cylinder outwardly with relation to the end head as before described.

The pressure of the spring 46 outwardly against the inturned flange on the cylinder will tend to draw the projections 48 downwardly against the top face of the head 33 so that a spring-lock will be provided at this stage of the assembly by opposing the spring-pressure to the passage of the projections over the ears 50.

The rubber sleeve 51 and the cable 18 with its connected parts are then relatively slid longitudinally so that the spool-like structure with the cylinder 41 and other parts therewith will be drawn into the recess 29 in the sleeve 51 until the end head 32 comes against the shoulder 30 on the sleeve 51. The lower end of the casing or cylinder 41 will then be substantially flush or slightly within the extreme end of the rubber sleeve, while the cylindrical portion 45 will project outwardly therefrom under the pressure being pressed outwardly by the spring 46. The assembly will then be as shown in Fig. 2.

When the parts have been assembled with the sleeve 51 the projections 48 cannot rise to pass the ears 49 and 50 because the cylinder 41 will come against the shoulder 30 on the sleeve 51, against which the head 32 of the terminal member also abuts, so that the projections cannot pass over the ears and thus accidentally disengage the cylinder from the terminal member.

The rubber sleeve 51, assembled with the parts as just described, will have its cylindrical portion 26 extending within the elbow 18 as shown in Fig. 1, the nut 23 being detached from the cylinder 11 and rotatably retained upon the ferrule 21, the cable elbow and its connected structures are assembled with the spark plug and its connected structures by inserting the lower cylindrical portion 28 into the chamber within the cylinder 11 and its insulating lining until the lower face of the flange 25 comes against the upper end of the cylinder 11. The cylindrical sleeve part 28 substantially fills the chamber referred to and its tapered portion 52 is wedged within the top end of the chamber so as to form a tight fit therein similar to a cork in a bottle. The nut 23 having been engaged with the threads on the cylinder 11, will now be screwed home drawing down the beveled face 53 of the ferrule against the upper face of the flange 25 and when screwed home will compress such rubber flange between the ferrule and the end of the cylinder 11 so as to form a fluid-tight gasket preventing fluid leakage at the joint between the ferrule and the chamber and also from the chamber within the cylinder 11 to the clearances within the elbow 17. The nut 23 is preferably screwed down until the metal ferrule 21 makes contact with the end of the metal cylinder 11 so that the electrical contact will be insured, but even if contact between the ferrule and cylinder is not effected in this manner electrical connection between the ferrule and the cylinder 11 is realized through the nut 23. With the parts thus assembled the plunger 44 bears upon the upper end of the electrode 5 or upon the metal plate 24 or both, the flange 43 being lifted off of the flange 42 so that the plunger is forced against the electrode end, or such end and the plate 24, by the spring 46. In this manner good and certain electrical contact is secured between the plunger and the electrode and the contact is enhanced for the reason that the area of contact is increased due to the flat end of the cylindrical portion 45 of the plunger.

It will be noted that in the construction illustrated the insulating sleeve covers the contacting devices down to a short distance from the central spark plug electrode so that the flash-over distance between the spark plug connections to ground is at a maximum, in a device of given dimensions; also the contact spring and its adjacent parts are almost completely enclosed by the insulating sleeve and the contacting plunger has a flat contact surface of relatively large area so that damage to the insulating lining of the radio-shielding barrel, is prevented, the corona discharge is reduced and a certain and relatively large contact is effected.

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

What is claimed is:

1. The combination with an electrical conductor, of a terminal member electrically and mechanically secured thereto, of a reciprocating contact plunger, a spring interposed between said member and said plunger and a casing engaging said plunger to limit its outward movement, said casing having inward projections by which it is secured to said terminal member, said terminal member having a ledge and slots through which said projections may be entered and then turned to engage said ledge to prevent separation of said casing from said member.

2. The combination with an electrical conductor, of a terminal member electrically and mechanically secured thereto, of a reciprocating contact plunger, a spring interposed between said member and said plunger and a casing engaging said plunger to limit its outward movement, said casing having inward projections by which it is secured to said terminal member, said terminal member having a ledge and slots through which said projections may be entered and then turned to engage said ledge to prevent separation of said casing from said member, said terminal member having ears to obstruct passage of said projections into said slots.

3. The combination with a radio-shielding conduit, of a radio-shielding barrel having an insulating lining, an electrical conductor in said conduit and extending into said barrel, means for securing said conduit and barrel together, an insulating sleeve extending into said conduit and into said barrel, said sleeve having a flange clamped between said conduit and barrel, said insulating sleeve having a bore for said electric conductor and a recess adjacent one end of the sleeve and in communication with said bore, said electric conductor passing through the first mentioned bore and electrical conducting means comprising a spring-pressed contact plunger mounted in said recess and electrically connected

with said conductor said sleeve bearing against said lining in fluid-tight relation.

4. The combination with a radio-shielding conduit, of a radio-shielding barrel having an insulating lining, an electrical cable in said conduit and extending into said barrel, means for securing said conduit and barrel together, an insulating sleeve extending into said conduit and into said barrel, said sleeve having a flange clamped between said conduit and barrel, said insulating sleeve having a bore for said electric cable and a recess adjacent one end of the sleeve and in communication with said bore, said electric cable passing through the first mentioned bore and electrical conducting means comprising a spring-pressed contact plunger mounted in said recess and electrically connected with said cable, said sleeve forming a fluid-tight connection with said cable.

5. The combination with a radio-shielding conduit, of a radio-shielding barrel having an insulating lining, an electrical cable in said conduit and extending into said barrel, means for securing said conduit and barrel together, an insulating resilient sleeve extending into said conduit and into said barrel, said sleeve having a flange clamped between said conduit and barrel, said insulating resilient sleeve having a bore for said electric cable and a recess adjacent one end of the sleeve and in communication with said bore, said electric cable passing through the first mentioned bore, and electrical conducting means comprising a spring-pressed contact plunger mounted in said recess and electrically connected with said cable, said sleeve being resiliently pressed against said cable to form a fluid-tight connection therewith.

6. The combination with a spark plug having a center electrode, of a radio-shielding barrel surrounding the upper end of said electrode, a radio-shielding conduit, means for securing said conduit and barrel together, an electrical conductor in said conduit and extending into said barrel, an insulating sleeve extending into said conduit and into said barrel but terminating above said electrode, said sleeve having a flange clamped between said conduit and barrel, said insulating sleeve having a bore for said electric conductor and a recess adjacent one end of the sleeve and in communication with said bore, said electric conductor passing through the said bore and electrical conducting means comprising a spring-pressed contact plunger adapted to contact with said electrode, mounted in said recess and electrically connected with said conductor.

7. The combination with a spark plug having a center electrode, of a radio-shielding barrel surrounding the upper end of said electrode, a radio-shielding conduit, means for securing said conduit and barrel together, an electrical conductor in said conduit and extending into said barrel, an insulating sleeve extending into said conduit and into said barrel but terminating above said electrode, said sleeve having a flange clamped between said conduit and said barrel, said sleeve having a bore of relatively small diameter and a larger bore communicating therewith and being adjacent the end of said sleeve, contacting means for said conductor in said larger bore, said contacting means comprising a casing, a reciprocating contact plunger adapted to contact with said electrode and a spring pressing said plunger outwardly from said larger bore, said casing being secured within said bore and engaging with said plunger to limit its outward movement under the spring pressure.

8. The combination with a radio-shielding conduit, of a radio-shielding barrel having an insulating lining, means for securing said conduit and barrel together, an insulating sleeve extending into said conduit and into said barrel, said sleeve having a flange clamped between said conduit and barrel, said insulating sleeve having a bore therein and a recess adjacent one end of the sleeve and in communication with said bore, and electrical conducting means in said conduit and sleeve, said conducting means including a cable extending from said conduit into said barrel through said bore and a spring-pressed contact plunger mounted in said recess and electrically connected with said cable, said sleeve forming a fluid-tight connection with said conducting means.

EDWIN A. ROBERTSON.