

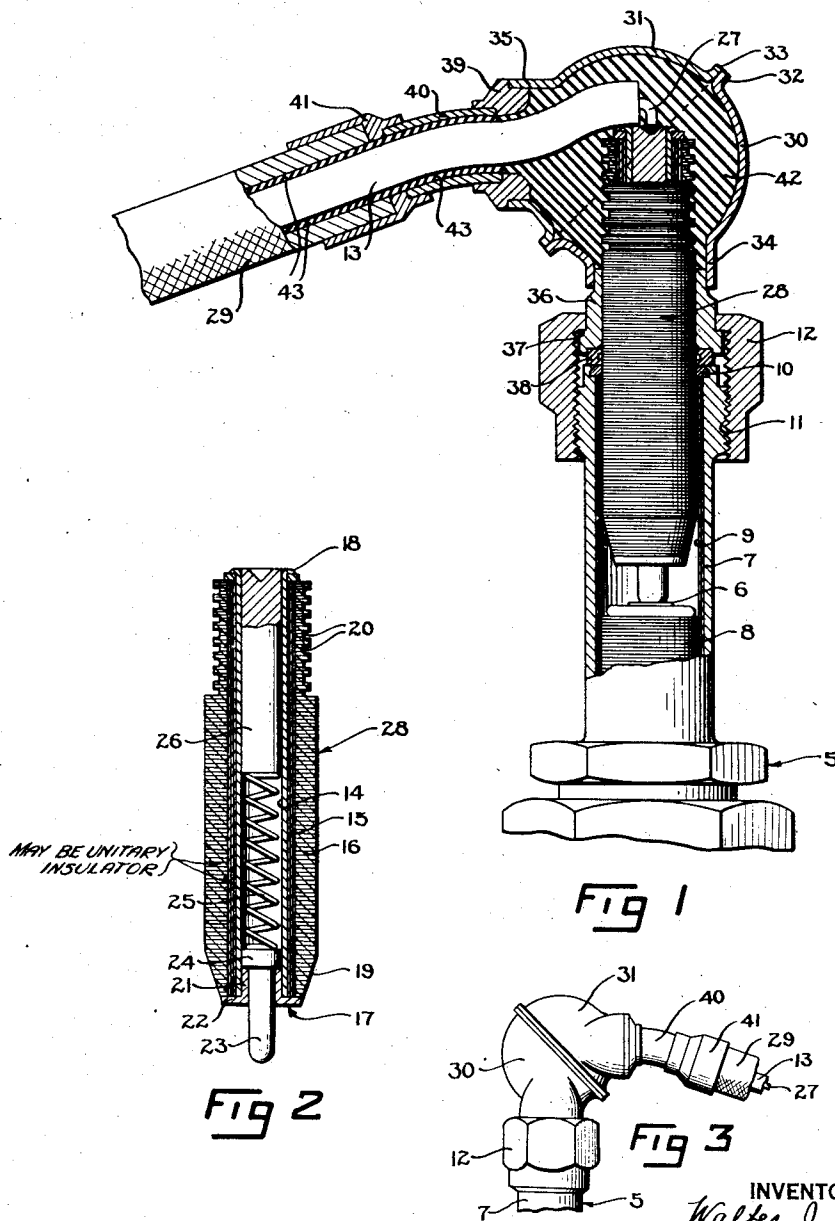
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ELECTRICAL CONNECTING AND RADIO-SHIELDING MEANS

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ELECTRICAL CONNECTING AND RADIO-SHIELDING MEANS

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This invention relates to ignition apparatus, and more particularly to means adapted for use in radio-shielded ignition systems of internal combustion engines in combination with shielded spark plugs.

By far the weakest and shortest lived portion of a modern radio-shielded ignition system is that portion whereby the so-called shielding harness and the high tension conductor housed thereby are connected to the spark plug. A great amount of time, energy and money have been spent in efforts to obviate the combined effects of high temperatures and moisture and the resulting flashovers or arcing in this part of a shielded ignition system. Due to the fact that the high tension conductor must in most instances be bent through a substantial angle at a point near the spark plug, a great amount of difficulty has also been experienced in preventing chafing of the cable insulation and eventual breakdown of the latter. The connecting means at this point in a shielded system have in the past been relatively fragile and, hence, subject to frequent damage at the hands of more or less careless mechanics.

It is accordingly an object of the present invention to improve the radio-shielding and electrical connecting means in the vicinity of the spark plugs of a shielded internal combustion engine ignition system.

Another object of the invention is to provide novel means for connecting the center electrode of a spark plug to an incoming high tension supply cable.

Still another object is to provide connecting means of the above character which are of sturdy construction and, hence, not subject to damage through careless handling and which are adapted to withstand high temperatures as well as wide and rapid changes of temperature.

A further object is to provide a novel radio-shielding elbow for an electrical conductor which is so constructed so that the parts thereof may be readily assembled to provide any of a wide range of angular distances between the axes of the inlet and outlet for the high tension conductor passing therethrough.

A still further object is to provide a novel radio-shielded means for connecting a high tension cable to a spark plug whereby the possibility and probability of a flashover are minimized.

Another object is to provide novel shielding and connecting means of the above character wherein the entrance and damaging effects of moisture are substantially eliminated.

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 drawing. It is to be expressly understood, however, that the drawing is for the purpose of illustration only and are not intended to define the limits of the invention, reference for this latter purpose being had primarily to the appended claims.

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

Fig. 1 is a side elevation view, partly in section and with parts broken away, showing one form of structure embodying the present invention;

Fig. 2 is a detail sectional view, with parts broken away, showing the novel insulated electrical connector of the device of Fig. 1; and,

Fig. 3 is a detail outside view of the novel shielding elbow of Fig. 1.

The single embodiment of the invention shown in the drawing, by way of example, is illustrated in combination with a well-known type of radio-shielded spark plug 5, only the upper portion of which is shown. The upper portion of the center electrode 6 of the spark plug is surrounded by a metallic shielding barrel 7 and may be insulated therefrom by any suitable insulating means, such as a stack of mica washers 8 and an insulating sleeve or liner 9 which may also be of mica. The upper edge of said sleeve is preferably protected by a metallic ring 10 suitably secured in the upper end of barrel 7. The outer surface of said barrel is threaded at 11 for cooperation with an internally threaded nut 12 whereby the novel shielding means to be hereinafter described are secured to the barrel.

Novel means are provided by the present invention for electrically connecting an insulated high tension supply cable 13 to center electrode 6, said means being constructed with a view to reducing to a minimum the possible flashover or arcing paths between the high tension portion of the circuit and the grounded parts of the radio-shielding structure. Said novel means are also provided with a view to insuring long and efficient service under all operating conditions and to eliminating accidental damage by careless mechanics. In the form shown, said connecting means comprises a metallic tube 14 (Fig. 2) surrounded by suitable electrical insulation, such as sheet mica sleeve 15 and mica washers 16. Insulation 15, 16 may be confined or held in compressed condition by a flanged ferrule 17

at the lower end of tube 14 and the outwardly spun upper end 18 of said tube.

The insulating qualities of mica stack 16 may be improved by coating the mica washers before compressing the same with a suitable insulating material adapted to fill any spaces that might otherwise occur between the washers or between sleeve 15 and the washers, thereby making the insulation, in effect, a solid unitary mass. One material which has been found suitable for this purpose is polymerized cashew nut shell oil. The washers may be dipped in this cashew resin in liquid form having a viscosity comparable to that of 250 S. A. E. oil. This filler material eliminates any air pockets in the insulation, the same being adapted to set without appreciable shrinkage by chemical reaction, which may be accelerated by baking, to form a high heat resistant solid having excellent insulating qualities. Insulating means for the plug connector are thus provided which will withstand rough usage as well as the high temperatures to which it is subjected during operation of an engine. Moisture or ionized air paths for possible flashovers are also reduced to a minimum.

The outer diameter of insulator 16 is slightly less than the inner diameter of ring 10 through which it extends, and the lower end of said insulation may be tapered at 19 to facilitate insertion thereof into spark plug barrel 7. The annular space between washers 16 and liner 9 may be filled with a suitable insulating compound having the consistency of grease, such as "Tite Seal"—a mixture of castor oil and mica powder, to prevent any accumulation of condensed moisture which might facilitate or promote arcing. The upper portion of mica stack 16 may have a plurality of grooves 20 machined or otherwise formed therein for the purpose of increasing the flashover path from tube 14 in the final assembly and for anchoring the plug connector in a manner to hereinafter appear. If desired, tube 14 may be slightly expanded from within against the surrounding insulation 15, 16. It will also be understood that porcelain or other suitable ceramic insulation may be used in lieu of the mica insulation illustrated. For example, a single, one-piece sleeve of any suitable insulating material may replace sleeve 15 and washers 16.

Ferrule 17 is mounted in the lower end of tube 14, the same being provided with a tubular portion 21 having a tight press-fit in said tube and an annular external flange 22 adapted to confine insulating means 15, 16 as above described. If desired, ferrule 17 may be soldered or brazed to tube 14 or the two parts may be formed as one. Slidably extending through ferrule 17 for contacting center electrode 6 is a contact plunger 23, the outward movement of which is limited by an enlarged head portion 24 thereon which engages tubular portion 21 of said ferrule. Plunger 23 is normally yieldably held in its outermost position by a spring 25 interposed between the plunger and a metallic plug or insert 26 which may have a drive fit in tube 14. The end of conductor portion 27 (Fig. 1) of insulated cable 13 may be secured to the outer end of insert 26 in any suitable manner, such as by soldering, thereby rendering the metallic conducting parts of connector plug 28 a continuation of high tension conductor 27. Cable 13 is connected in the usual manner with a source of high tension electrical current (not shown) and is shielded, in part, by a flexible metallic conduit 29 which may form a part of a complete shielding harness of any

well-known construction, such as that illustrated in Spengler et al. application, Serial No. 271,220.

Novel means are also provided for electrically insulating and radio-shielding the high tension conducting means between conduit 29 and spark plug barrel 7. As illustrated, said novel means comprises a pair of cooperating cup-shaped metallic members 30 and 31 having matching external flanges 32 and 33, respectively, said flanges being soldered or otherwise suitably secured together. Members 30 and 31 are preferably hemispherical in shape and are provided with circular openings surrounded by cylindrical portions or outlets 34 and 35, respectively, the axes of said portions making acute angles with and intersecting in or adjacent the plane containing the engaging surfaces of flanges 32 and 33, said acute angles being chosen, by way of example only, as 45° in the illustrated embodiment. The point of intersection of said axes is preferably near the center of the spherical casing formed by members 30 and 31. It will be seen that the angular relation between the axes of the tubular outlets 34 and 35 may be varied between wide limits merely by changing the relative positions of parts 30 and 31, i. e., by rotating one relative to the other about an axis perpendicular to the plane of flanges 32 and 33.

Outlet 34 of member 30 is preferably fitted with a tubular ferrule 36 which may be soldered in position for slidably receiving insulated connector 28. Said ferrule is provided with an external flange 37 engageable by an internal flange on nut 12, whereby the elbow assembly may be secured to spark plug barrel 7. If desired, a suitable gasket 38 may be interposed between ferrule 36 and the upper end of the spark plug barrel to insure against entrance of moisture into said barrel. Cylindrical portion 35 of casing member 31, which serves as an inlet for cable 13, also has a ferrule 39 secured therein for attachment to the shielding conduit surrounding cable 13. If the angle between the axis of the spark plug and the desired direction of cable 13 is less than 90°, outlets 34 and 35 may be shifted or it may be desirable to secure a short length of curved pipe 40 to ferrule 39 and attach conduit 29 to the other end thereof through the medium of a suitable ferrule 41. The connection between all of the metal parts may be effected by soldering, brazing or the like.

When the above described parts, excepting the spark plug, have been assembled, as illustrated in the drawing, the interior of casing 30, 31 may be filled with a liquid or plastic which will harden, preferably by chemical reaction, without appreciable shrinkage and which will serve as a high heat resisting electrical insulator 42. One substance which has been found suitable for this purpose is material which may be obtained by treating cashew nut shell oil in accordance with the teaching of Harvey et al. Patent No. 2,067,919 to remove the natural metals therefrom and then treating the resulting product in the manner disclosed in the Harvey Patent No. 2,218,531, and more particularly as set out in the paragraph beginning with line 75 on page 2 of the latter patent. The compound thus obtained is of tar consistency and known to the trade as "Cardolite" #700. Immediately prior to injecting said compound into casing 30, 31 by any suitable means, such as a syringe, or by a vacuum process, it is mixed first with a small amount of diethyl sulphate to produce further polymerization and then with a somewhat greater amount of furfural.

After the casing is filled with this mixture or compound 42, the entire assembly may be baked to accelerate the chemical setting of the compound. The latter in setting forms a hard substance which is tough and able to withstand high temperatures and additionally constitutes a good electrical insulator. Insulation 42 also serves by reason of its entering into grooves 20 to anchor and hold connector plug 28 rigidly in position as an integral part of the novel shielded plug connector comprehended by the invention. If desired, the inner walls of parts 30, 31 may be sprayed or painted with an electrical insulating material before said parts are secured at flanges 32, 33.

The unit formed in the manner above described may be and preferably is incorporated in a filled harness of the character described in the aforementioned Spengler et al. application. When the harness is filled with an insulating compound 43 in the manner disclosed in said application, any spaces which might be created in casing 31, 32 by shrinkage of filling material 42 during the setting of the latter may be filled by said compound.

There is thus provided a novel shielded connecting unit for suitably connecting a high tension electrical conductor to the center electrode of a shielded spark plug of the type now in common use, said unit being so constructed as to withstand considerable abuse during removal from and insertion into a spark plug. The novel unit provided is of such a nature that moisture cannot accumulate therein in such a manner as to promote flashovers or arcs and may be constructed of materials which are not appreciably affected by the high temperatures to which the unit is subjected in normal operation. The inclusion of the novel unit comprehended by this invention in a filled shielding harness makes the complete harness a relatively permanent structure, which will not be subject to the detrimental effects of moisture created by condensation or otherwise, chafing of the high tension cable insulation caused by vibration and deterioration of cable insulation resulting from high temperatures—a structure which normally gives reliable and efficient service over long periods of use under most severe operating conditions without the necessity for frequent overhauling and repair. The structure provided also makes it possible to obtain different angles between the connected conductors by merely securing members 30 and 31 together in different positions relative to one another.

Although only a single embodiment of the invention has been illustrated and described in detail, it will be understood that the same is not limited thereto but that various changes may 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 will now be understood by those skilled in the art. For a definition of the limits of the invention, reference is had primarily to the appended claims.

What is claimed is:

1. In combination with a radio-shielded spark plug having a center electrode and a shielding barrel surrounding the upper end of said electrode, a hollow metallic casing, means for removably securing said casing to said barrel, electrical conducting means extending from said casing into said barrel, high heat resistant electrical insulation closely surrounding said conducting means throughout substantially the entire length thereof and slidably extending through an opening in said casing, an insulated cable connected

to said conducting means inside said casing and extending out through an opening in said casing, and other rigid high-heat-resisting insulation filling the remaining space in said casing.

2. In combination with a radio-shielded spark plug having a center electrode and a shielding barrel surrounding the upper end of said electrode, a hollow metallic casing, means for removably securing said casing to said barrel, an insulated conductor extending into said casing through an opening therein, a rigid conductor electrically connected to said cable within said casing and extending from the latter into said barrel, rigid heat-resisting insulating means closely surrounding said rigid conductor throughout substantially the entire length of the latter, and solid insulating means filling the remaining space in said casing and interlocking with the insulating means around said rigid conductor within the casing.

3. In combination with a radio-shielded spark plug having a center electrode and a shielding barrel surrounding the upper end of said electrode, a shielded conductor for conducting high tension current to said electrode comprising a hollow metallic casing, an electrical conductor extending into said casing, insulated conducting means connecting said conductor to said center electrode including a rigid conductor, rigid heat resisting insulating means closely surrounding said rigid conductor in said casing and barrel and a spring pressed pin associated with said rigid conductor for yieldably engaging said electrode, and solid insulating means filling the remaining space in said casing and anchoring the end of said insulated conducting means in the casing.

4. In combination with a radio-shielded spark plug having a center electrode and a shielding barrel surrounding the upper end of said electrode, a shielded conductor for conducting high tension current to said electrode comprising a hollow metallic casing, means for connecting said casing to said barrel, electrical conducting means extending through said casing into said barrel, rigid insulating means closely surrounding said conducting means from a central point in said casing to a point adjacent the end thereof within said barrel, and other solid insulating means filling the remainder of the space in said casing.

5. In combination with a radio-shielded spark plug having a center electrode and a shielding barrel surrounding the upper end of said electrode, a shielded insulated conductor for conducting high tension current to said electrode comprising a hollow metallic casing, means for connecting said casing to said barrel, electrical conducting means extending through said casing into said barrel, unitary insulating means closely surrounding said conducting means from a central point in said casing to a point adjacent the end thereof within said barrel, and solid insulating means filling the remainder of the space in said casing and having interlocking relation with said ceramic insulating means.

6. In apparatus of the class described, two metallic cup-shaped members having registering circular openings, means for securing said members together with said openings in registry to form a casing, each of said members having an opening smaller than said first-named openings for receiving electrical conductors, the axis of each of said smaller openings making an angle less than a right angle with the plane of said first-named openings, an electrical conductor extending through each of said smaller openings and

being electrically connected together inside the casing, at least one of said conductors being rigid and having a recess in one end thereof, a yielding contact plunger slidably mounted in said recess and projecting therefrom, rigid insulating means closely surrounding said rigid conductor and substantially filling the opening through which said rigid conductor extends, means for positioning said insulating means on said rigid conductor, and a solid insulating compound completely filling said casing around said conductors and interlocking with said insulating means.

7. In apparatus for shielding electrical conductors, two metallic cup-shaped members having registering circular openings and means for securing said members together with said openings in registry to form a casing, each of said members having an opening smaller than said first-named openings for the passage of electrical conductors, the axis of at least one of said smaller openings making an angle less than a right angle with the plane of said first-named openings.

8. In apparatus for shielding electrical conductors, a pair of substantially hemispherically-shaped hollow metallic members having engaging circular flanges around the portions thereof having the greatest diameter to thereby form a sphere-like casing, each of said members having an opening therein for the passage of an insulated conductor, the axis of at least one of said openings making an acute angle with the plane of the engaging surfaces of said flanges.

9. In apparatus of the class described, a sphere-like metallic casing comprising two halves adapted to be secured together in substantially any angular position relative to each other, and means for securing said halves together to form said casing, each of said halves having an opening therein, said openings being so positioned that the angle which the axes thereof make with each other is dependent upon the relative positions in which said halves are secured together.

10. In apparatus of the class described, a hollow metallic casing comprising two cup-shaped portions adapted to be secured together in substantially any angular position relative to each other, means for securing said portions together to form said casing, each of said portions having an opening therein, said openings being so positioned that the angle which the axes thereof make with each other is dependent upon the relative positions in which said portions are secured together, a rigid insulated plug connector extending into the central portion of said casing through one of said openings, a conductor extending through the other of said openings and secured to said plug connector within said casing, and a solid insulating material filling said casing around said connector and cable.

11. A plug type electrical connector comprising an elongated electrical conductor having a recess in one end thereof, a contact plunger slidable in said recess and projecting therefrom, stop means for limiting the movement of said plunger out of said recess, resilient means in said recess for normally holding said plunger against said stop means, electrical insulating means closely surrounding said conductor in gas-tight association therewith throughout substantially the entire length thereof, and means for positioning said insulating means on said conductor.

12. In apparatus of the class described, a plug type connector for electrically connecting a high tension supply cable to the center electrode of a shielded spark plug comprising a metallic tube,

an insulating sleeve surrounding said tube, stacked insulating washers surrounding said sleeve, electrical conducting means for closing one end of said tube, a metallic plunger slidable in said tube and projecting from the other end thereof, means for limiting the movement of said plunger out of said tube, and resilient means interposed between said plunger and said closing means for yieldably holding said plunger in projecting position.

13. In apparatus of the class described, a plug type connector for electrically connecting a high tension supply cable to the center electrode of a shielded spark plug comprising an electrical conductor having a recess in one end thereof, means for connecting said cable to the other end thereof, a yieldable contact plunger slidably mounted in said recess and having a portion thereof projecting from said recess, insulating means closely surrounding said conductor in substantially gas-tight relation therewith throughout substantially the entire length thereof, and means on said conductor for fixing said insulating means in position.

14. In apparatus of the class described, a hollow metallic casing having a pair of openings therein, angularly disposed electrical conductors extending into said casing through said openings, means connecting said conductors at a central point in said casing, one of said conductors being rigid and having rigid insulating means closely surrounding the same within and without said casing, and a solid one-piece insulator different from said insulating means filling the remaining space in said casing.

15. A plug type electrical connector for electrically connecting a high tension supply cable to the center electrode of a shielded spark plug comprising an electrical conductor having a recess in one end thereof, a contact plunger slidable in said recess and projecting therefrom, stop means for limiting the movement of said plunger out of said recess, resilient means for normally holding said plunger toward said stop means, and electrical insulating means closely surrounding said conductor in gas-tight association therewith.

16. In apparatus of the class described, a pair of shielding conduits, an insulated electrical conductor in each of said conduits, means for electrically connecting said conductors comprising tubular insulating means extending from one of said conduits into the other of said conduits, conducting means in the bore of said insulating means for sealing the latter against the passage of gases therethrough, said conducting means having a recess in one end thereof, means connecting the conductor in said one conduit to said conducting means, a contact plunger slidable in said recess and projecting therefrom, stop means for limiting the movement of said plunger out of said recess and resilient means in said recess for normally holding said plunger against said stop means, means in said one conduit for securing one end of said tubular insulating means in said one conduit, and means for detachably securing said conduits together with said contact plunger in yieldable contact with the conductor in said other conduit.

17. In apparatus of the class described, a metallic shielding conduit, an insulated cable in said conduit, tubular insulating means extending from one end of said conduit, means in said conduit cooperating with the inner end of said tubular insulating means for retaining the latter in said conduit, conducting means in the bore of said in-

insulating means for sealing the latter against the passage of gases therethrough, said conducting means being electrically connected with said cable and having a recess in one end thereof, a contact plunger slidably mounted in said recess and projecting therefrom, means for limiting the movement of said plunger out of said recess, and resilient means in said recess for normally holding said plunger against said movement-limiting means.

18. A plug type electrical connector for electrically connecting a high tension supply cable

to a center electrode of a shielded spark plug comprising electrical conducting means including an electrical conductor having a recess in one end thereof, a contact plunger slidable in said recess and projecting therefrom, stop means for limiting the movement of said plunger out of said recess, resilient means for normally holding said plunger toward said stop means, and electrical insulating means closely surrounding said conducting means in substantially gas-tight association therewith.

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