Feb. 14, 1950 R. J. L. DUTTERER 2,497,158

SPARK PLUG

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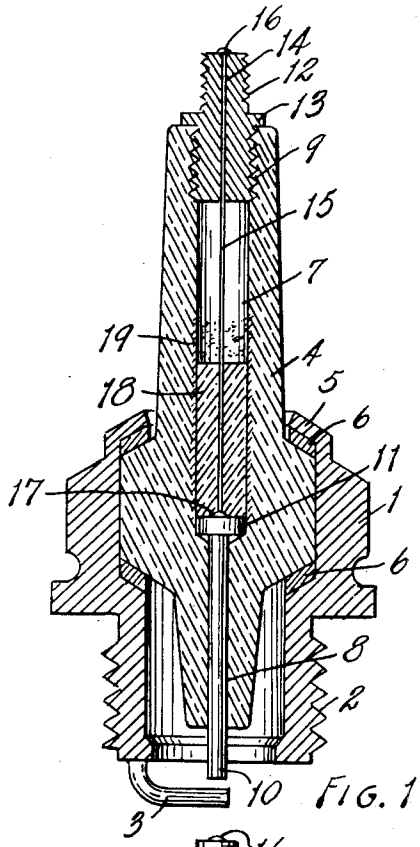


FIG. 1

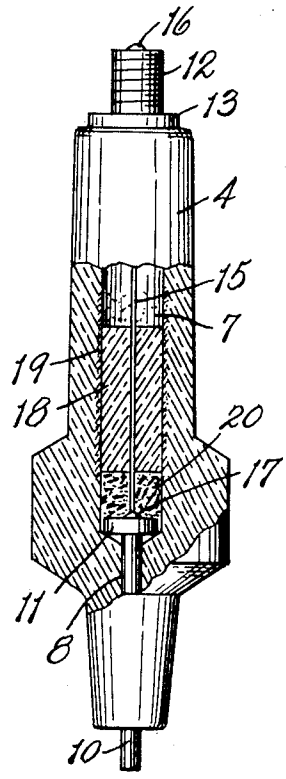


FIG. 2

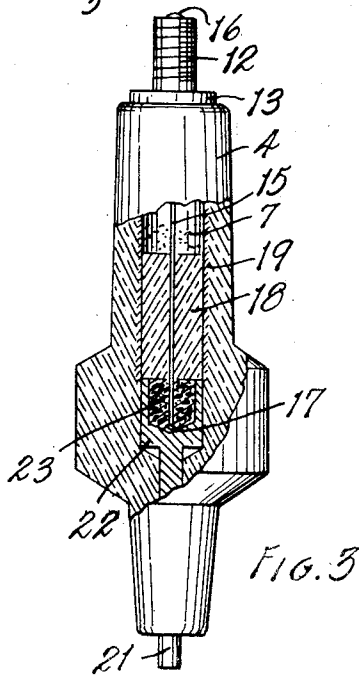


FIG. 3

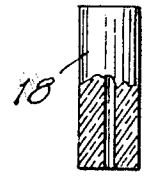


FIG. 4

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SPARK PLUG

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3 Claims. (Cl. 123—169)

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This invention relates to improvements in spark plugs.

The principal objects of this invention are:

First, to provide a tight seal around the center electrode of a spark plug which is not affected by the engine gases and temperature changes involved in the operation of an internal combustion engine.

Second, to provide a spark plug with a sectional center electrode which may be effectively sealed to the walls of the insulator and which will not transmit mechanical stresses to the insulator due to temperature variations in the insulator.

Other objects relating to details and economies of the invention will appear from the description to follow. The invention is defined and pointed out in the claims.

The drawings of which there is one sheet illustrate a preferred form of the invention and two spark plugs embodying modified forms of the invention.

Fig. 1 is a vertical cross-sectional view through a spark plug embodying the invention.

Fig. 2 is an elevational view partially in cross-section of an insulator having a modified form of the invention embodied therein.

Fig. 3 is an elevational view partially in cross-section, having a second modified form of the invention embodied therein.

Fig. 4 is an elevational view partially in cross-section of the sealing member used in Figs. 1, 2, and 3.

The reference character 1 indicates the sleeve member of a spark plug that is provided with a threaded portion 2 for installation in an engine and a side electrode 3. The ceramic insulator 4 is secured within the sleeve 1 by crimping over the rim 5 to clamp the sealing rings 6 tightly around the shoulders formed on the outer surface of the insulator in the well known manner.

The insulator defines a central bore 7 which is provided with a lower portion 8 of reduced cross section and an upper portion 9 which is internally threaded.

The lower portion of the bore is arranged to receive the lower electrode 10 which projects below the lower end of the insulator and which is provided with a collar 11 arranged to engage the shoulder at the upper end of the reduced portion of the bore. An upper terminal 12 is arranged to have a screw connection with the threaded portion 9 of the bore and is provided with a head 13 engageable with the top of the insulator to limit the distance to which the terminal may be screwed into the bore. The upper terminal 12 defines a fine central aperture 14 arranged to pass the center electrode 15 which is made of fine wire. The upper end of the center electrode is electrically connected to the upper terminal 12 as at 16 by crimping, peening, or welding the

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end of the electrode to the terminal. The lower end of the center electrode is similarly connected to the head 11 on the lower electrode as at 17.

Positioned around the center electrode and against the upper end of the lower electrode is a capillary tube 18 which is formed of glass, preferably of a boro-silicate composition. The tube 18 defines a center capillary passage which is just large enough to pass the center electrode 15. The tube 18 forms a gas tight seal in the center bore of the insulator, and in order to facilitate sealing of the tube to the walls of the bore, the walls are glazed as at 19.

The materials forming the tube 18 and center electrode 15 are chosen to have approximately the same coefficient of expansion to prevent unequal expansion from breaking the seal between the center electrode and the glass tube. It will be noted that the center electrode extends for a portion of its length through the bore without lateral support so that any variation in length of the center electrode relative to the length of the bore may be absorbed or compensated for by bending of the electrode in its unsupported portion. The center electrode being made of fine wire to pass through the capillary tube, this bending of the electrode will not apply any appreciable stress to the insulator.

In assembling the electrodes in the insulator the center electrode is first electrically secured to the lower electrode by one of the previously explained methods, and the two are passed downwardly in the bore of the insulator until the head 11 engages the shoulder at the top of the reduced portion of the bore. The capillary tube is then threaded over the center electrode and pushed downwardly against the head 11. The assembly is then heated until the glass tube 18 reaches a softening or plastic stage at which time a hollow tool is passed into the bore and around the center electrode 15 to firmly press and deform the tube into all openings and spaces within the bottom of the bore and firmly into sealing engagement with the glazed walls of the bore and the center electrode. The upper terminal 12 is then fitted over the upper end of the center electrode and screwed into the threaded portion 9 of the bore and the connection 16 between the top of the terminal and the center electrode is completed. The insulator assembly is then ready to be joined with the sleeve 1 in any of the well known manners.

In the modified form of plug shown in Fig. 2, a packing 20 formed of ceramic cement intermixed with finely divided powdered metal such as nickel or molybdenum or powdered metal alone is interposed around the lower end of the center electrode 15 and between the lower end of the capillary glass tube 18 and the collar on the lower electrode 10. In assembling the spark

plug, the deforming of the capillary tube 18 will also compact the metal or the packing mixture against the upper end of the lower electrode to increase the heat conductivity to the insulator around the lower electrode. In other respects, the insulator assembly shown in Fig.2 is the same as the preferred form of assembly shown in Fig. 1.

In the modified form of insulator assembly shown in Fig. 3 the lower electrode 21 is provided with a cup-shaped portion 22 at its upper end which fits snugly within the bore 7 of the insulator. The mixture of cement and powdered metal is positioned in the cup-shaped portion 22 and around the lower end of the center electrode 15 as is indicated at 23. The capillary glass tube 18 is pressed firmly against the cement and metal mixture and the upper end of the cup-shaped portion 22 in the operation of compressing and deforming the tube. If desired, the cement and metal mixture may extend above the cup 22. In other respects the insulator assembly is the same as the preferred form shown in Fig. 1.

As explained before, the insulator assembly will not be subjected to mechanical strains due to the expansion of the electrodes because of the small diameter and unsupported length of the center electrode 15. At the same time a continuous metallic connection is maintained between the upper terminal and the lower electrode 8, and the center bore of the spark plug is effectively sealed by compacting the capillary tube while in a soft state tightly into sealing contact with the center electrode and the glazed walls of the central bore.

The invention has been illustrated and described in embodiments which have been found to be highly satisfactory. No attempt has been made to show other possible adaptations, as it is believed that this disclosure will enable those skilled in the art to embody the invention as may be desired.

Having thus described my invention, what I claim as new and desire to secure by Letters Patent is:

1. A spark plug comprising an insulator member defining a smooth walled central bore with a lower portion of reduced cross-section and an internally threaded portion at the top thereof, a lower electrode provided with an enlargement engaging the bottom of the upper portion of said bore and extending beyond the bottom of said insulator, a center electrode formed of fine wire electrically and mechanically connected to the top of said enlargement and extending upwardly beyond the top of said insulator, a terminal tip passed over the upper end of said wire and having threaded connection with the threaded portion of said bore, said terminal tip having an enlargement engaging the top of said insulator whereby the lower end of said tip does not extend beyond the threaded portion of said bore, the upper end of said wire being mechanically and electrically connected to the top of said terminal, and a preformed capillary tube of boro-silicate glass positioned around the lower end of said center electrode and snugly fitting the walls of said bore, the walls of said bore being glazed where they contact said tube and being fused to said tube, said tube terminating substantially below said tip.

2. The method of manufacturing spark plugs including an insulator defining a smooth walled central bore with a reduced portion at the lower end thereof and an internally threaded portion at the top thereof, and a lower electrode having a shoulder at the upper end thereof which comprises the steps of, electrically and mechanically connecting a fine wire to the top of said lower electrode, introducing said lower electrode into said bore until said shoulder engages the top of said reduced portion, introducing a preformed tube of boro-silicate glass having a capillary opening therethrough into said bore with said wire threaded through said opening, said tube closely fitting the central portion of said bore, heating the insulator thus far assembled to soften said glass and compressing said tube against said shoulder and the walls of said bore, the walls of said bore being glazed adjacent to said tube, passing a terminal member having a capillary opening therein over the upper end of said wire and threading said terminal into the threaded upper end of said bore, said terminal having a flange engageable with the end of said insulator to locate said terminal axially with respect to said bore and electrically connecting the upper end of said wire to the top of said terminal, said tube being substantially shorter than the central portion of said bore whereby a substantial portion of said wire below said terminal is laterally unsupported.

3. The method of manufacturing spark plugs including an insulator defining a smooth walled central bore with a reduced portion at the lower end thereof and an internally threaded portion at the top thereof, and a lower electrode having a shoulder at the upper end thereof which comprises the steps of, electrically and mechanically connecting a fine wire to the top of said lower electrode, introducing said lower electrode into said bore until said shoulder engages the top of said reduced portion, introducing a preformed tube of glass having a capillary opening therethrough into said bore with said wire threaded through said opening, said tube closely fitting the central portion of said bore, heating the insulator thus far assembled to soften said glass and compressing said tube against said shoulder and the walls of said bore, passing a terminal member having a capillary opening therein over the upper end of said wire and threading said terminal into the upper end of said bore, and electrically connecting the upper end of said wire to the top of said terminal, said tube being substantially shorter than the central portion of said bore whereby a substantial portion of said wire below said terminal is laterally unsupported.

REX J. L. DUTTERER.

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