Feb. 20, 1951 C. CIPRIANI 2,542,903

SPARK PLUG AND METHOD OF MAKING SAME

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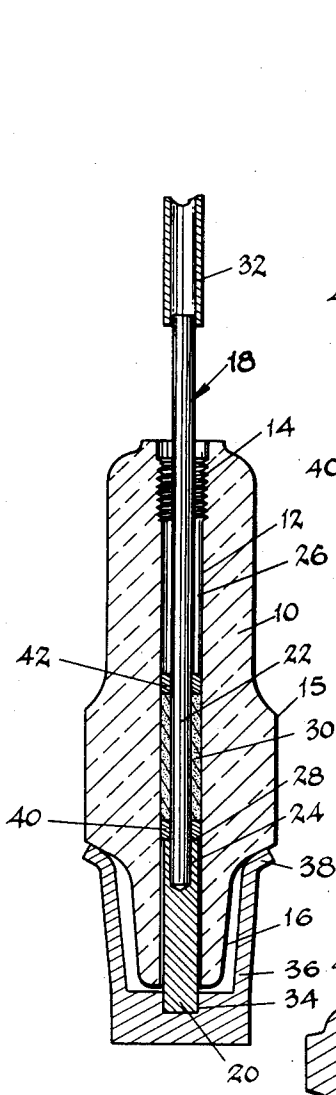


Fig. 1

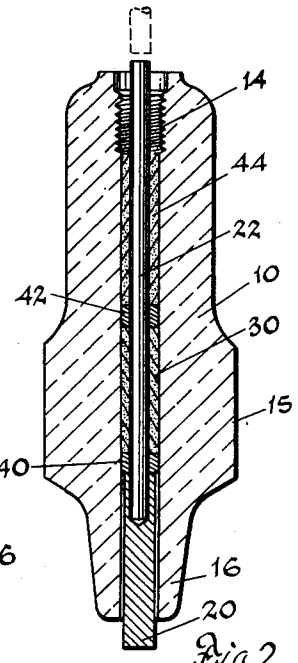


Fig. 2

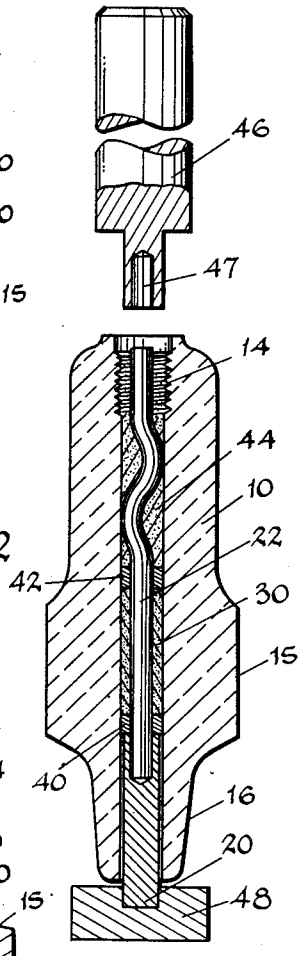


Fig. 3

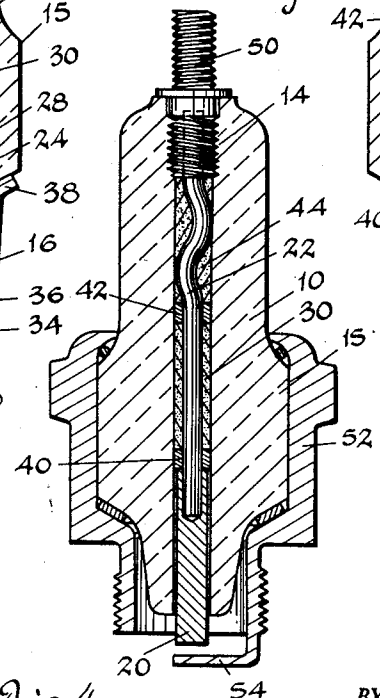


Fig. 4

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SPARK PLUG AND METHOD OF MAKING SAME

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6 Claims. (Cl. 123—169)

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This invention relates to spark plugs, more particularly to the method of sealing the center electrode in the bore of a spark plug insulator.

When using a spark plug insulator having a smooth central bore of uniform diameter, which is very desirable from the manufacturer's point of view, a problem has arisen which involves the mechanical positioning of the center electrode in the bore, particularly when using a powder-pack seal to prevent the center electrode from becoming dislodged from the bore and dropping into the cylinder of an internal combustion engine in which the spark plug is being used. It is generally preferable to provide a suitable positive mechanical means for preventing the displacement of the center electrode in the event the seal disintegrates.

It is, therefore, the principal object of this invention to provide a holding and sealing means for a center electrode of a spark plug which will positively hold the electrode in position in the insulator even though the sealing element disintegrates.

It is a further object of this invention to provide a method of positioning a center electrode in the bore of an insulator having uniform diameter wherein a seal is obtained by the use of compacted powder, such as talc, and a positive mechanical holding means is provided to prevent dislodgement of the center electrode in the event the sealing element becomes mechanically disrupted.

Other objects and advantages of this invention relating to the arrangement, operation and function of the related elements of the structure, to various details of construction, to combinations of parts and to economies of manufacture, will be apparent to those skilled in the art upon consideration of the following description and appended claims, reference being had to the accompanying drawings forming a part of this specification wherein like reference characters designate corresponding parts in the several views.

In the drawings:

Fig. 1 is an elevational view, in section, showing an initial step in the formation of a spark plug insulator assembly incorporating the invention;

Fig. 2 is an elevational view, in section, showing a second step;

Fig. 3 is an elevational view, in section, showing a third step, and

Fig. 4 is an elevational view, in section, showing an insulator incorporating the invention positioned in the shell to form a complete spark plug.

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Referring to the drawings, particularly to Fig. 1, a ceramic insulator 10 is shown preferably constituted of a ceramic material having desirable characteristics which makes it suitable for use in a spark plug, for example, alumina, which is provided with a central bore 12 extending longitudinally thereof having a substantially uniform cross-sectional area throughout its length except for a small upper section which is provided with threads 14 for the purpose of positioning the terminal, as will be described hereinafter. The external conformation of the insulator may take any desirable form, such as, for example, shown in Fig. 1 where an enlargement 15 is shown to provide upper and lower shoulders and a tip portion 16 which is adapted to extend into the firing chamber of an internal combustion engine in which the spark plug is to be used.

Positioned in the bore 12 of the insulator is a center electrode assembly 18 consisting of a firing tip 20, preferably made of spark resistant metal such as nickel, having a diameter slightly smaller than the diameter of the smooth bore 12 of the insulator in which it is positioned to allow expansion for temperature rise, and a terminal portion 22 which is attached to the upper end of the firing tip portion 20 by extending into a bore 24 thereof, being brazed or otherwise permanently attached thereto. The diameter of the terminal portion 22 is substantially smaller than the diameter of the smooth bore of the insulator so as to provide an annular space 26 therebetween. The tip portion of the electrode, being approximately the diameter of the bore, provides a floor 28 for the annular space 26 and forms a platform against which a powder-pack sealing body 30 is compacted, as will be described hereinafter. The firing tip 20 of the center electrode is adapted to extend a predetermined distance from the tip portion 16 of the insulator, while the terminal portion 22 is sufficiently long to extend a substantial distance above the top end of the insulator in order to cooperate with a tube-like compacting ram 32 which is of a dimension to allow reciprocation in the annular space 26, being guided therein by the terminal portion 22. The material of terminal portion 22 is preferably selected for its coefficient of expansion (and cheapness), so that minimum stress is placed on the component parts of the assembly, particularly the powder-pack seal and the insulator when there is a substantial rise in temperature.

The first step in positioning the center elec-

trode 18 in the bore of the insulator 10 is to place the center electrode in the bore with the firing tip 20 thereof projecting a slight distance from the firing tip 16 of the insulator, so that it will extend into a recess 34 in an anvil 36 which also has an upstanding flange portion 38 which cooperates with the lower shoulder of the enlargement 15 in a manner to hold the center electrode in a predetermined spaced relation with the lower shoulder of the insulator, so that the firing tip 20 of the electrode projects a predetermined distance from the bore. With the parts in this position, an asbestos washer 40 is placed upon the terminal portion 22 of the electrode and forced into position against the floor 28 of the annular space 26 by the ram 32. The asbestos washer 40 forms a partial seal for the electrode which allows the compaction of loose, granulated material, such as talc, thereabove in a manner to form a holding and sealing body 30 for the electrode in the bore of the insulator. This is preferably accomplished in steps each forming a small increment until the desired volume of compacted talc is positioned in the annular space 26 of the bore. The powder is compacted to a predetermined degree to form a good seal between the electrode and bore and thereafter a second asbestos washer 42 is pressed into position above the body of compacted granular material 30 to prevent absorption of moisture from a body of cement 44 (Fig. 2) which is then positioned in the bore above the asbestos washer 42. It is highly desirable to prevent the compacted body 30 from absorbing moisture from this body of cement 44 inasmuch as any moisture taken into the compacted body tends to make it porous and less resistant to leakage. The cement body 44, positioned in the bore of the insulator 10, may be of a sodium silicate type which requires the evaporation of the moisture therefrom before hardening, or it may be one of the chemically-setting cements such as are well known in the art.

Either before or after the cement body 44 has been placed in position, the upper end of terminal portion 22 of the center electrode 18 extending out of the insulator is cut off a short distance above the upper terminus of the spark plug insulator. While the cement body 44 is still in unset condition and plastic, a solid ram member 46 is applied to the end of the electrode by fitting the upper end of the terminal portion 22 into a socket 47 of the ram in order to distort the terminal portion in the body of the still plastic cement, as is clearly shown in Fig. 3. For this purpose, the firing tip 20 of the electrode is fitted into the socket of a second anvil 48 to carry the load necessary to distort the terminal portion 22 applied by the ram 45, so that the compacted granular material 30 forming the seal will not be disrupted during this step.

A terminal member 50 is then positioned on the insulator by the threads 14 of the insulator while the cement is still in the plastic state and unset, so that the cement may cooperate in the threads to hold the terminal permanently in position. The insulator is then mounted and sealed in a spark plug shell 52 having a ground electrode 54 to cooperate with the extending firing tip 20 of the center electrode to form a completed spark plug which need not be described in further detail.

This provides a construction which will hold the center electrode assembly in position in the insulator of the spark plug in the event the sealing body 30 of compacted powder should disintegrate for any reason. The distorted section of the terminal portion 22 of the center electrode will be gripped by the hardened and set cement body 44 to provide a reliable mechanical holding means to prevent dislodgment of the center electrode from the insulator for any unforeseeable reason.

It is to be understood that the above detailed description of the present invention is intended to disclose an embodiment thereof to those skilled in the art, but that the invention is not to be construed as limited in its application to the details of construction and arrangement of parts illustrated in the accompanying drawings, since the invention is capable of being practiced and carried out in various ways without departing from the spirit of the invention. The language used in the specification relating to the operation and function of the elements of the invention is employed for purposes of description and not of limitation, and it is not intended to limit the scope of the following claims beyond the requirements of the prior art.

What is claimed:

1. In a spark plug, a ceramic insulator having a longitudinal bore of uniform diameter for a center electrode, a center electrode positioned in the bore, comprising a firing-tip portion of material resistant to spark erosion of a dimension to substantially fill the bore and a terminal portion attached to the tip portion at the upper end thereof being of a dimension substantially smaller than the bore of the insulator to provide an annular space therebetween, a body of compacted material forming a holding and sealing means for the electrode positioned in the annular space in the bore above the firing tip portion of the electrode, a body of cement positioned in the annular space above the body of compacted material and a longitudinally distorted section of the terminal portion of the electrode with laterally displaced portons positioned in the body of cement to form a reliable mechanical holding means for the center electrode.

2. In a spark plug, a ceramic insulator having a longitudinal bore of uniform diameter for a center electrode, a center electrode positioned in the bore, comprising a firing-tip portion of material resistant to spark erosion of a dimension to substantially fill the bore and a terminal portion attached to the tip portion at the upper end thereof being of a dimension substantially smaller than the bore of the insulator to provide an annular space therebetween, a washer of asbestos positioned about the terminal portion above the tip portion, a body of compacted granular material forming a holding and sealing body for the center electrode positioned in the annular space in the bore above the asbestos washer, a second asbestos washer positioned above the body of compacted material, a body of cement positioned in the annular space above the second asbestos washer and a longitudinally distorted section of the terminal portion of the electrode with laterally bent parts of original cross-section positioned in the body of the cement to form a reliable holding means for the center electrode.

3. In a spark plug, a ceramic insulator having a uniform longitudinal bore including a threaded section, a center electrode positioned in the bore, comprising a firing-tip portion of material resistant to spark erosion of a dimension to substantially fill the bore and a terminal

portion attached to the tip portion at the upper end thereof being of a dimension substantially smaller than the bore of the insulator to provide an annular space therebetween, a washer of asbestos positioned about the terminal portion above the tip portion, a body of compacted granular material forming a holding and sealing body for the center electrode positioned in the annular space in the bore above the asbestos washer, a second asbestos washer positioned above the body of compacted material, a body of cement positioned in the annular space above the second asbestos washer, a longitudinaly distorted section of the terminal portion of the electrode with laterally bent parts of original cross-section positioned in the body of the cement to form a reliable holding means for the center electrode, and a terminal attached to the insulator and cooperating with the terminal portion of the center electrode fitting into the threaded portion of the bore of the insulator.

4. In a spark plug, a ceramic insulator having a uniform longitudinal bore including a threaded section, a center electrode positioned in the bore, comprising a firing-tip portion of material resistant to spark erosion of a dimension to substantially fill the bore and a terminal portion attached to the tip portion at the upper end thereof being of a dimension substantially smaller than the bore of the insulator to provide an annular space therebetween, a washer of asbestos positioned about the terminal portion above the tip portion, a body of compacted granular material forming a holding and sealing body for the center electrode positioned in the annular space in the bore above the asbestos washer, a second asbestos washer positioned above the body of compacted material, a body of cement positioned in the annular space above the second asbestos washer, a longitudinally distorted section of the terminal portion of the electrode with laterally bent parts of substantially unchanged cross-section positioned in the body of the cement to form a reliable holding means for the center electrode, and a terminal attached to the insulator and cooperating with the terminal portion of the center electrode fitting into the threaded portion of the bore of the insulator and permanently cemented therein by the body of cement cooperating with the electrode.

5. The method of positioning a headed center electrode in a smooth cylindrical bore of the

ceramic insulator of a spark plug, comprising holding the center electrode in predetermined position in the bore by the head thereof from the firing-tip end, compacting a body of compactable material above the head to form a holding and sealing body, positioning a body of cement above the body of compacted material, longitudinally distorting the portion of the center electrode by laterally bending portions thereof in the body of the cement while the cement is still unset, and positioning a terminal in the bore of the insulator to cooperate with the body of cement whereby said terminal portion and said center electrode are permanently held in position in the insulator by the set and hardened cement.

6. The method of positioning a headed center electrode in a smooth cylindrical bore of the ceramic insulator of a spark plug, comprising holding the center electrode in predetermined position in the bore by the head thereof from the firing-tip end, positioning an asbestos washer above the headed portion of the center electrode, compacting a body of compactable material above the head to form a holding and sealing body, positioning a second asbestos washer above the body of compactable material, positioning a body of cement above the body of compacted material and thereafter longitudinally distorting the portion of the center electrode by laterally bending portions thereof without substantially changing its cross-section in the body of the cement while the cement is still unset whereby a reliable mechanical holding means is formed for the center electrode after the cement has set and hardened.

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