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SPARK PLUG AND METHOD OF MAKING

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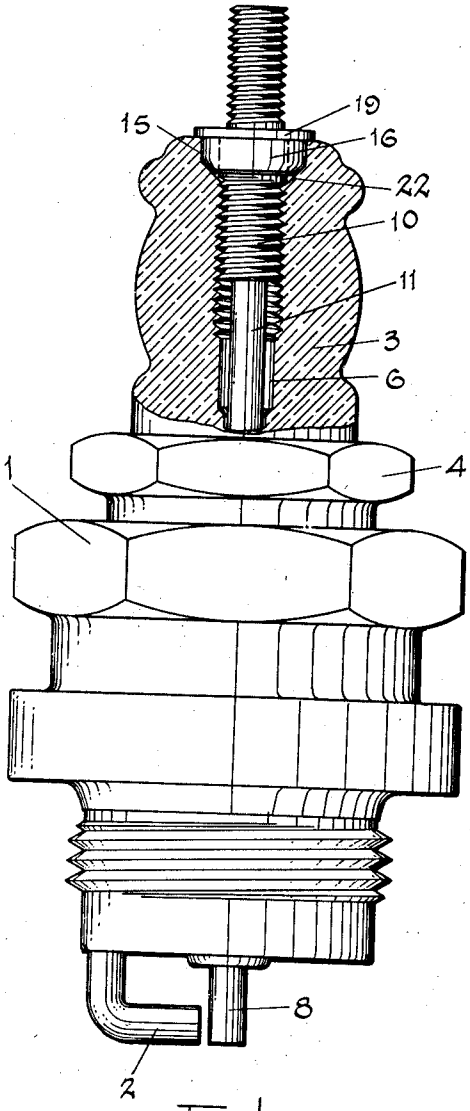


Fig 1

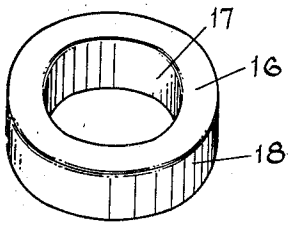


Fig 2

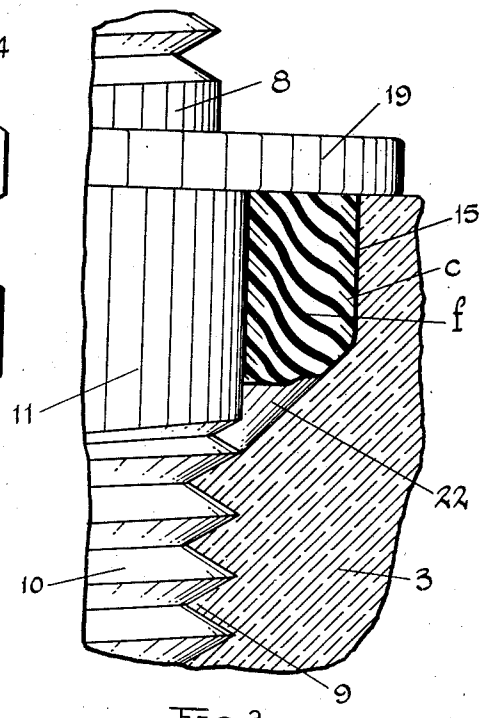


Fig 3

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SPARK PLUG AND METHOD OF MAKING

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8 Claims. (Cl. 123—169)

My invention relates, generally, to a spark plug for an internal combustion engine. The invention, further, relates to a spark plug of the variety having a board insulator body, usually formed of a suitable ceramic material, and a metallic central electrode extending, substantially, centrally of and through the bore of the insulator body aforesaid. It is well known to the art that a spark plug not only serves the function of producing and delivering an igniting spark to the combustible fuel, with which the engine cylinder chamber is charged, generating gases thereby whose pressures are forcefully exerted against the engine piston and transmitted therefrom as useful power, but, also, the function of plugging the opening in the cylinder wall formed, of necessity, to permit the insertion of the spark-delivering parts of the spark plug into the cylinder chamber, and of sealing the cylinder chamber against the escape of the power-producing gases, especially, during and immediately subsequent to the generation thereof. The failure of a given spark plug to efficiently perform the latter function materially detracts from the advantages that may be gained by its efficient sparking action.

It is with this latter function of a spark plug that my invention is concerned. The leakage of gas from the cylinder, in spark plugs currently used, is believed to occur, principally, along the surfaces of the metallic electrode and through the annular spaces between said electrode and the surfaces of the insulator bore. To combat said leakage, it has, largely, been the practice, during production and assembly of spark plugs, to pack said annular spaces with a quantity of a pulverent ceramic material, such as kaolin, soapstone, or the like. This procedure requires suitable fixtures for holding the electrode and insulator body in a desired relation, and tools and machinery for effecting a packing in a rather restricted space. In some instances, the packed aggregate may be bonded together by a sodium silicate, or other cement, or caused to cohere by enmeshment in aluminus silicate, known to the trade as sillimanite. The cemented aggregate must, thereafter, be properly cured to remove the cement slaking liquid from the aggregate, the accomplishment of which, to a commercial certainty, is rendered difficult by the entrappment of liquid in the voids of the aggregate. Whether the aggregate is bonded by cement, properly cured, or coheres by enmeshment, there is little adhesion of the substantially integrated aggregate to the surfaces of the metallic electrode, for the reason that the aggregate and electrode are formed of adhesively repellant materials and have adjoining surfaces of but slight conformance, thus, permitting a leakage of gas between the surface of the electrode and the aggregate filler. From the standpoint of commercial production and use, the sealing success experienced in the use of the aggregate filler is only of such exact constancy as to be comparatively commercially economical and practical. My invention, particularly, relates to the provision of a positive means for filling and sealing the annular space between the facing surfaces of the electrode and insulator bore of an assembled electrode and insulator and for actively seizing upon and adhering to the said electrode and bore surfaces to prevent leakage of gas from within the firing chamber of an engine cylinder.

The invention has for its object to provide a method of and means for sealing a spark plug electrode to its insulator, said means having a gas impervious density, a manually manipulatable bulk, and an identity separate and individual from either the electrode or the insulator. By the provision of such method and means, the use and handling of pulverent aggregates in commercial assembly of spark plugs is dispensed with, as well as the need for careful packing, cementing, and curing of said aggregates. An embodiment of the said means of my invention may be preformed, delivered to a spark plug assembly bench, easily seized and, by the method of my invention, installed by an assembler of but average skill to produce an effective seal in the spark plug.

Another object of the invention is to provide means for sealing a spark plug electrode to its insulator and having surface portions capable of great adherence with another surface, such as those of the electrode or insulator bore, upon the application, in accordance with my method, of but slight forces to said means in directions effecting a mutual surface contact. By the provision of such means and the utilization of my method, a seal is assured along the surfaces of the center electrode, along which gas leakages occur in many of the structures presently used. A further object is to provide a sealing means of the character described, having distortible surface portions capable of adjusting and accommodating themselves to the exigencies of form of the surface that is contacted by said means in response to the exercises provided by my method. By the provision of said means and utilization of my method, the surfaces of the electrode and the insulator bore need only be machined to a desired approximate form or size without the need for producing nearly exact smoothness or critical dimensions as is preliminarily required in installations of some of the sealing means of the prior art.

A still further object of the invention is to provide means for sealing a spark plug electrode to its insulator and having a pliable body portion,

which, upon application of distorting forces, as provided by the method of my invention, resiliently yields to urge its surface portions into more intimate contact with and adhesion to other surfaces, such as those of the electrode and insulator bore, and, by bodily trusion, occupies spaces having an outline, other than that of the normal outline, of said means. A further object is to provide means and a method for applying distorting forces to said sealing means as the spark plug electrode and insulator are assembled in production.

The invention consists in other features and advantages which will appear from the following description and upon examination of the drawing. Structures containing the means and useful in performing the method of the invention may partake of different forms and still embody the invention. To illustrate a practical application of the invention, I have selected a spark plug as an example of the various structures and details thereof that contain the invention and shall describe the selected structure and method by which it is made hereinafter, it being understood that variations may be made without departing from the spirit of the invention. The particular structure selected is shown in the accompanying drawing and it, together with the method of making the same, is described hereinafter.

Fig. 1 of the accompanying drawing illustrates a side elevation of a spark plug embodying my invention, a portion of the insulator thereof being shown broken away to better illustrate the assembled relation of the parts. Fig. 2 illustrates a perspective view of the element selected for purposes of illustrating an embodiment of the sealing means of my invention. Fig. 3 illustrates an enlarged section showing the assembled insulator, the sealing element, shown in Fig. 2, and the electrode.

In the accompanying drawing, my invention is illustrated in assembled relation with a spark plug, having the usual annular shell 1 supporting an electrode 2 and having, within its confines, an insulator body 3 formed of a suitable ceramic material. The insulator 3 may be locked in its position, within the shell 1, by a suitable bushing 4.

The insulator body 3 is formed to have a central passageway or bore 6, through which a metallic center electrode 8 extends, to locate one end thereof in some proximity to a portion of the electrode 2 and the other end in a position to be connected with a suitable electrical conductor. If desired, a portion of the passageway 6 may be threaded, as at 9, to engage with threads 10 formed on the shank 11 of the electrode 8.

Preferably, the bore through the insulator 3, forming the passageway 6, has an increased, transverse dimension in one portion thereof to form a chamber 15, through which the shank 11 of the electrode 8 extends, when in assembled relation with said insulator. The chamber 15 provides a receptacle for receiving an element 16, embodying the sealing means of my invention. The particular element chosen for purposes of illustrating the invention, is formed of synthetic rubber, but experience has shown any of a great number of materials, such as Bakelite, copper, or asbestos, or a combination thereof, having the desired elasticity and thermal resistance, may be used with good results. The element 16 chosen is, preferably, of an integral annular shape, the diameter of the inner surface 17 being less or substantially equal to the diameter of the portion of the shank 11, which extends through the chamber 15, and the diameter of the outer surface 18 being not substantially greater or equal to the transverse dimension or diameter of the chamber 15. The element 16, illustrated, has a dimension, along its central longitudinal axis, somewhat greater than the dimension of the chamber 15 along its central longitudinal axis. Thus, the element 16 is adapted to receive the shank 11 of the electrode 8 within its inner surface 17 and to freely interfit and nest in the chamber 15, except for that portion thereof which, by reason of the greater lineal dimension of the element 16 as compared to the lineal dimension of the chamber 15, extends beyond one end of the chamber 15.

In the construction shown in the drawing, the chamber 15 is formed proximate to one end of the bore 6 and its end is adapted to be closed by a cap, which may be provided in a collar 19. The collar 19 may be caused to close said chamber and be retained thereby, by some suitable means of applying a force thereto, which causes the portion of the element 16, which extends beyond one end of the chamber 15, for the aforesaid reason, to be forced into the chamber 15. If desired, said collar 19 may be affixed to the shank 11 of the electrode 8 and, as the electrode is threadedly engaged by the threaded portions 9 of the bore 6 to locate the electrode 8 in assembled relation to the insulator, the collar 19, in its movement to seat against the insulator, will engage and force the extending portion of the element 16 into the chamber 15.

As the said extending portion of the element 16 is forced into the chamber 15, the portions thereof adjacent the inner surface 17 of said element 16 are compressed by reason of the frictional adherence of the surface 17 to the shank 11 of the electrode 8, the compression being effected in directions extending substantially parallel to the surfaces of said shank. The compression, thus effected, seeks release in radial directions, as well as longitudinal directions, tending to force the surface 17 into more intimate contact and greater frictional adherence with the surface of the shank 11. The portions adjacent to the outer surfaces 18 of the element are, likewise, compressed and, in the same manner, engage and associate in intimate contact with the wall of the chamber 15. The body portion of the element between said surfaces 17 and 18 is, correspondingly and momentarily, compressed, in response to which it moves to modify the normal shape of the element 16 and "flows" toward the electrode shank and the bore 6, by reason of its yieldingly pliable relation to the surfaces 17 and 18 and because its movement, in said directions, is not opposed, except by the aforesaid relation to said surfaces 17 and 18. The compression of the surface portions and the position to which the body portion of the element 16 flows, after seating the collar 19 relative to the chamber 15 is illustrated somewhat descriptively in Fig. 3 of the drawing, the short lines *c* between adjacent section indication lines illustrating compression of the surface portions 17 and 18 and curved section indication lines *f* illustrating extent of trusion of the body portion from its normal position.

The chamber 15, with its walls extending coaxial to the shank 11 and the collar 19, form means for applying a distorting force to said element 16 to cause various portions, particularly the surface portions, into more intimate and, thus, more efficient sealing relation to the

surfaces of the electrode shank 11 and the insulator bore 6. Preferably, the chamber 15 is provided with wall portions adjoining its said shank coaxial walls, which tend to guide, toward the electrode shank 11, such portion of the element 16 as "flows" in the compression thereof. Accordingly, said chamber is provided with a wall portion 22, which is inclined to the axis of said shank, and, preferably, converges from the coaxial walls of the chamber 15 toward the walls of the bore 6. Thus, the wall portion 22 acts camwise to the trusion of the element 16, relative to the chamber 15 and electrode shank 11. The convergent wall portion 22 tends to urge portions of the element 16 toward the shank 11 and into extended surface contact therewith. In a sense, therefore, the aforesaid chamber coaxial walls not only act as an active part of the element compressing means, but, also, provide a means for serving the element to the caming action of the wall portion 22.

Those skilled in the art will appreciate that other arrangements and forms of the parts than those particularly shown and described herein may be utilized, without departing from the spirit of my invention, as set forth in the claims hereto appended.

I claim:

1. A spark plug having a central electrode and an electrode insulator; the insulator having an internal passageway and a chamber, near one end of said passageway and communicating therewith, for receiving said electrode within said insulator; said chamber having walls converging toward the walls of said passageway; a preformed compressible and expandable space-filling medium of a bulk, when normally expanded, greater than the capacity of said chamber to receive said medium therein when said electrode extends therethrough; and means for urging said medium into said chamber and cooperative with said converging walls to compress and direct the trusion of portions of said medium between the walls of said passageway and the surfaces of said electrode to prevent movement of gases through said passageway and chamber.

2. A spark plug having a central electrode and an electrode insulator; the insulator having an internal passageway for receiving the electrode within said insulator body; the passageway having certain wall portions converging inwardly; a space-filling medium having an elastic fatigue considerably less than that of the insulator disposed interjacent said electrode and the walls of said passageway; and means for urging said space-filling medium toward said converging wall portion and between the surfaces of said electrode and the walls of said remaining passageway portions to prevent movements of gas through said passageway.

3. A spark plug having a central electrode and an electrode insulator; the insulator having an internal passageway for receiving the electrode within said insulator body; a space-filling medium of an elastic fatigue less than that of the insulator disposed in circumjacence to said electrode and within the passageway portion; and means for urging said space-filling medium both axially along and radially relative to said passageway and against the electrode surfaces and the walls of the passageway to prevent movement of gas through the passageway.

4. A spark plug having a central electrode and an electrode insulator; the insulator having an internally bored passageway for receiving the electrode within the insulator; a preformed and pliable space-filling medium having a manually seizable bulk and disposed between the surfaces of said electrode and the walls of said passageway; and means, including the electrode and walls of said passageways, for applying counteractive pressures to said space-filling medium to produce a gas impervious compaction and distortion of the space-filling medium into intimate approximation with surfaces of the electrode and walls of the insulator body.

5. A spark plug having a central electrode and an electrode insulator; the insulator having an internal passageway and a chamber, near one end of said passageway and communicating therewith, for receiving said electrode within said insulator; said chamber having walls converging toward the walls of said passageway; a preformed and compressible annular element having an inner surface portion adapted to engage the electrode, an outer surface portion adapted to engage the walls of the passageway, and a body portion; and means for urging said element into the chamber to compress the inner and outer surface portions and produce trusion of the body portion in directions toward the electrode, as determined by said converging walls, to prevent movement of gases through said passageway and chamber.

6. A spark plug having a central electrode and an electrode insulator; the insulator having a substantially central passageway extending therethrough to receive the electrode therein; and an element under stress of a degree greater than normal and less than the elastic limit thereof disposed between the electrode and passageway surfaces in dynamic bearing relation therewith to prevent the movement of gas along said engaged surfaces.

7. In a method of making a spark plug having a cored electrode insulator and of sealing the insulator against gas movements through said coring, which consists in positioning an electrode within and extending substantially centrally of and through said insulator and a pliable, space-filling element, preformed to substantially fit, in substantial circumjacence to said electrode and in substantial interjacence to said electrode and insulator; applying strain on said element of a degree less than one beyond the elastic limit of said element to effect deformation thereof as determined by the contour and relation of the proximate electrode and insulator surfaces; and thereafter maintaining a strain on said element less than one beyond the elastic limit of said element.

8. In a method of making a spark plug having a cored electrode insulator and a central electrode within and extending substantially centrally of and through said insulator and of preventing the movement of gas between said insulator and electrode, which consists in locating a space-filling medium in a portion of the space interjacent the electrode and insulator; applying a strain on said medium of a degree less than one beyond the elastic limit of said medium; and thereafter maintaining a strain on said medium of a degree less than one beyond the elastic limit of said medium.

REX J. L. DUTTERER.