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2,616,408

SPARK PLUG

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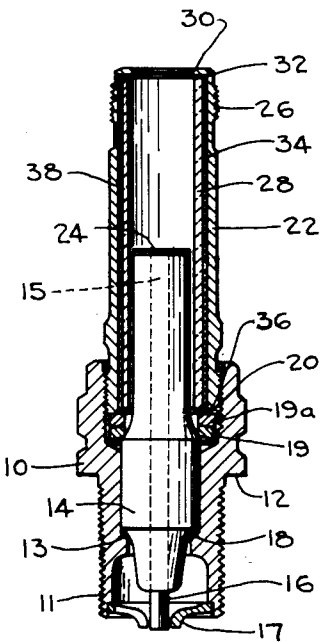


FIG-1

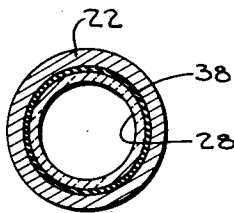


FIG-3

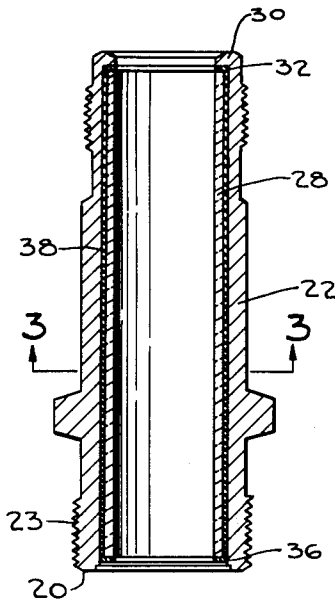


FIG-2

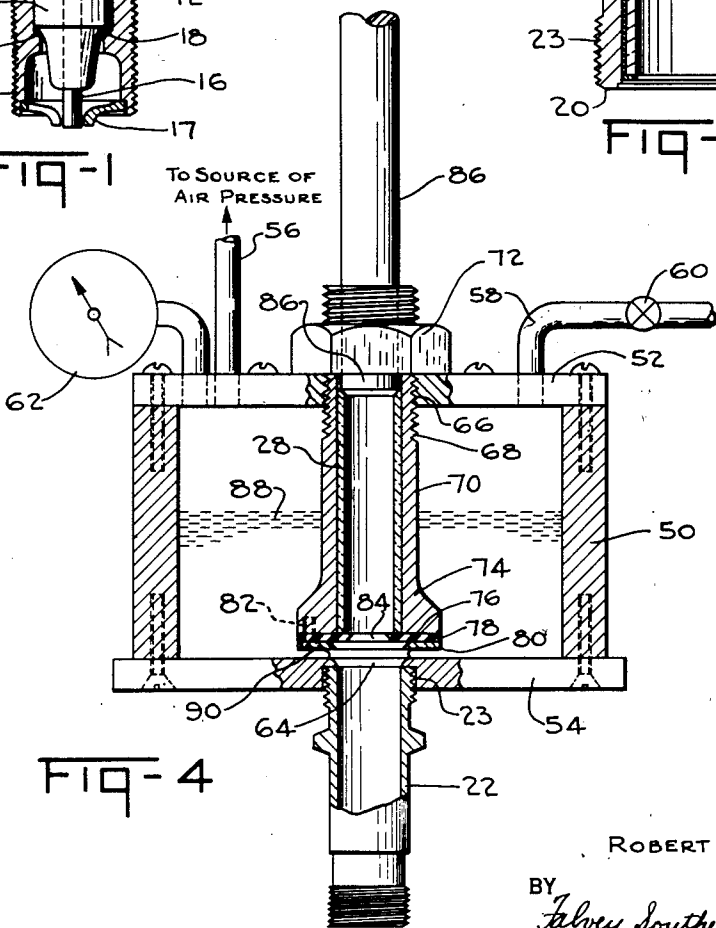


FIG-4

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SPARK PLUG

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1 Claim. (Cl. 123—169)

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This invention relates to spark plugs and to the method of making same, more particularly to the method of holding ceramic insulating tubes in a spark plug of the aviation type used in connection with a shielded ignition system.

In spark plugs used in connection with shielded ignition systems, such as used in aviation work, a ceramic tube is utilized in an upper barrel-like extension of the spark plug in which, at an intermediate joint, connection is made with an end of an insulated ignition cable and the terminal end of the center electrode, whereby the ignition potential may be led to the spark gap of the plug without substantial losses, such as from flash-over and the like. In the past, these tubes have been held in position by the use of spring-like centering washers which have been undesirable, due to the fact that adverse tolerance in the cooperating parts place heavy stresses in the ceramic tubes which often resulted in breakage in the relatively frangible tubes. This breakage would some times occur at the time of manufacture and cause a large number of rejects of finished plugs, or, again, it would occur at a later time when the plug was in use in a spark plug engine. In the latter event, the breakage of the ceramic tube would cause flash-overs to destroy the usefulness of the plug.

The present invention contemplates a novel construction which will obviate this difficulty by introducing a method of holding the ceramic tube in position in the spark plug without any substantial strains being present therein and thereby avoid these destructive breakages and accompanying flash-overs. The invention further contemplates a method whereby this result can be efficiently attained in a spark plug being suitable for use in mass production.

It is, therefore, a principal object of this invention to position a frangible ceramic insulating tube in the barrel of a spark plug of the shielded type so as to be free from stress and strain and yet resiliently held in position.

It is a further object of this invention to provide a method of positioning a ceramic tube concentrically within a metallic tube by a layer of stable, resilient organo-silicon oxide polymers between, whereby the ceramic tube is substantially free of stress and strain.

It is a further object of this invention to provide a device for conveniently positioning a layer of rubber-like silicone between concentric metal and ceramic tubes.

Other objects and advantages of this invention relating to the arrangement, operation and func-

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tion 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 claim, reference being had to the accompanying drawings forming a part of this specification wherein like reference characters designate corresponding parts in the several views.

Referring to the drawings:

Fig. 1 is an elevational view, partly in section, of a spark plug incorporating the invention;

Fig. 2 is an enlarged elevational view, in section, of the shielding tube of the spark plug;

Fig. 3 is a plan view, in section, taken along the line 3—3 of Fig. 2;

Fig. 4 is an elevational view, in section, of a device for carrying out the invention.

Referring to the drawings, particularly to Fig. 1, a spark plug is shown having a body member 10, with a threaded portion 11 to fit into an engine, and an external shoulder 12 adapted to cooperate with a sealing gasket (not shown). An internal shoulder 13 is shown, against which is seated an enlarged portion of an insulator 14 carrying a center electrode 15 provided with a firing tip 16 cooperating with a ground electrode 17 fitted into the body member 10. A gasket 18 is provided for sealing the insulator 14 in the shell 10 as shown.

To maintain a sealing pressure on the gasket 18, a spring member 19 is provided in the nature of a ring which bears on the upper shoulder of the enlarged portion of the insulator 14. Tension is maintained on the spring member 19, by a washer 19a thrust downwardly by the bottom end 20 of a shielding tube 22 threaded into the upper end of the body member 10 by a threaded section 23. The terminal end 24 of the center electrode 15 projects into the shielding tube 22 and terminates adjacent a central position thereof where contact is made with a conductor (not shown) adapted to project into the shielding tube from the opposite end and held in position by an attaching means (not shown) cooperating in threaded relation with threads 26 on the outside of the shielding tube 22.

To insulate the connection between terminal end 24 of the center electrode and the conductor from the metallic shielding tube 22, a ceramic tube 28 is provided which is fitted into the interior of the shielding tube from the bottom end thereof and abuts against an inwardly extending flange 30 with a gasket 32, made preferably of asbestos therebetween at the upper end of the shielding

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tube. The dimension of the cooperating tubes are such that an annular space 34 is provided between them as shown. At the lower end of the ceramic tube 28 a second gasket 36 is provided to rest upon the washer 19a. The method of positioning this ceramic tube within the metallic shielding tube is the locus of the invention to be described in detail hereinafter.

It is clear from the already described structure that the ceramic tube 28 must be placed in position in the metallic shielding tube 22 before the shielding tube is threaded into operative relation with the shell 10. Preferably the assembly is made as a separate sub-assembly for the spark plug as is clearly shown in Fig. 2. In order to hold the ceramic tube 28 resiliently in the metallic shielding tube 22, the space 34 therebetween is filled with a rubber-like body 38 of organo-silicon oxide polymers, known in the trade as silicones. These polymers are very stable to moisture and temperatures found in the spark plug when in use and form an excellent resilient body to protect the relatively frangible ceramic tube from breakage. This is accomplished by creating a cushioning effect for blows inflicted by rough usage and also allows positioning of the ceramic tube without stress and strain in the tube itself. It is highly desirable to position the body of these polymers as compactly as possible and without vesiculation, for which purpose a novel machine is provided, as shown in Fig. 4 and described in detail hereinafter. The aforementioned machine is also described and claimed in application, Serial No. 719,304 filed December 30, 1946.

The organo-silicon oxide polymers most satisfactory for the aforementioned purpose are relatively heavy viscous fluids at room temperature, and can be obtained commercially under the trade-name of Silastic SC-69-3 (K392) made by Dow Corning Corporation of Midland, Michigan. These polymers are in the form of a soft, dense, white paste which will spread easily and will adhere tenaciously to a clean, smooth surface. It is particularly advantageous to use a ceramic surface such as found on a ceramic article as it comes from the vitrifying furnace. Clean surfaces on the articles to which these polymers are to adhere are essential.

Referring now to Fig. 4, a device is shown which is designed to facilitate the positioning of a body of the aforementioned polymers between the ceramic tube 28 and the metallic shielding tube 22. For this purpose, a container 50 is provided, preferably made of brass having a cubicle form with a cover 52 and a bottom 54 in parallel arrangement. The container is made air-tight for purposes to be described hereinafter, being in communication with a source of air pressure through conduit 56 positioned in the cover 52. A bleeder conduit 58 is provided, controlled by a valve 60, also in communication with the container 50 through the cover 52. The valve 60 allows an operator to control the air pressure in the chamber as measured by a gauge 62.

The floor 54 of the container 50 is provided with a centrally-located aperture 64, which is counter-bored and threaded to allow a metal shielding tube 22 to be fitted therein by the threads positioned on its lower end as shown in Fig. 2. The tube is inverted for this, so that the flanged end thereof depends from the floor, substantially as shown with the aperture 64 coinciding with the internal diameter of the tube.

The cover 52 is provided with an aligning

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threaded aperture 66, into which is fitted the threaded end 68 of a cylinder 70, which depends from the cover and terminates a short distance above the floor 54 as shown. The cylinder 70 is locked in adjusted position in the cover 52 by lock nut 72, and is provided at its lower terminus by an enlargement 74 to form a lower face 76, to which is attached a rubber packing 78 by means of a ring plate 80 held to the face by screws 82 which pierce the face. The rubber packing 78 is provided with a central aperture 84 in alignment with the bore of the cylinder 70 and the aperture in the ring plate 80, which is chamfered to provide a sharp wiping edge adjacent its upper surface somewhat smaller in diameter than the diameter of the bore of the cylinder 70. The aperture in the ring plate 80 is rounded downwardly to give a smooth surface to allow flexing of the gasket member downwardly when in use as described hereinafter.

The bore of the cylinder 70 is of a diameter to allow the ceramic tube 28 to fit loosely therein to allow ready longitudinal movement through the bore to hold the tube 28 in alignment with the spaced longitudinal juxtaposition to the tube 22. When positioned in the bore, the tube 28 rests upon the upper surface of the gasket 78, while its upper end is adapted to cooperate with a plunger 86 adapted to be moved manually in the bore of the cylinder to thrust the ceramic tube 28 downwardly into partial engagement or telescoping relation with the metallic shielding tube 22, thereby deflecting the gasket 78 downwardly to form a seal with the exterior of the tube 28. The operator begins a cycle of operation in this manner with the parts in position in the device as shown in Fig. 4.

A body 88 of the organo-silicon oxide polymers is positioned in the container 50 as shown with an air space above. Inasmuch as the polymer is a soft, dense, white paste of relatively high viscosity, it does not flow readily without the application of substantial air pressure on its upper surface. It, therefore, does not flow of its own volition through a narrow gap or circumambient orifice 90 formed between the ring plate 80 and the bottom 54 of the container but must be extruded or forced to do so by the air pressure aforesaid.

To position a ceramic tube within a metallic shielding tube, an operator proceeds as follows: With the parts of the device in the position shown in Fig. 4, the plunger 86 is thrust downwardly to move the ceramic tube through the aperture in the gasket 78 which distends the flexible material thereof downwardly to form a seal with the outside of the tube and seals the gap or orifice 90 until the tube enters a slight distance the metallic shielding tube 22 threaded into the bottom. At this point, the valve 60 in the bleeder conduit 58 is closed to build up an air pressure over the body 88 of the polymers in the container until a pressure of 70 pounds per square inch is attained. Then simultaneously, the plunger 86 is slowly moved downwardly to advance and telescope the ceramic tube 28 into the metallic tube 22, and the air pressure in the container opens the seal formed in the gap or orifice 90 to a sufficient extent to deposit a thin layer of the polymers on the outer surface of the ceramic tube, which carries the polymers into the metallic tube to fill completely the space 38 therebetween. This continues until the ceramic tube is completely telescoped with the metallic tube and is seated against the gasket 32 adjacent the flange

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30 of the metallic tube 22. The air pressure is then released, the plunger retracted, and the completed tube assembly removed from the aperture 64. The second gasket 36 is then positioned in the assembly as shown and the whole is heat-treated at a temperature of 600° F. for one hour, which brings the polymers to a soft rubbery condition. The heat treatment cures the polymers and causes adherence to a maximum degree to both members with which it is in contact.

To begin a new cycle of operation, a second metallic tube is positioned in the aperture 64, and a second ceramic tube is dropped into the bore of the cylinder 70 and the plunger replaced to the starting position as shown in Fig. 4.

The soft, rubbery condition of the layer of polymers, after heat-treatment between the ceramic tube 28 and the metallic tube 22, protects the ceramic tube from lateral stresses and holds the tube resiliently in position. There is substantially no stress or strain in the ceramic tube, either during assembly or after complete assembly and in use as a spark plug. This substantially obviates breakage arising from this source.

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 claim beyond the requirements of the prior art.

What is claimed and it is desired to secure by United States Letters Patent:

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In a spark plug of the shielded type, a lower metallic shell member with a threaded portion for fitting the spark plug into a suitable opening in a combustion chamber, a main insulator seated concentrically in the lower shell member having a center electrode sealed therein, said main insulator having an upper terminus above the shell member and provided with external sealing means cooperating with the shell member, an upper metallic shielding tube fitted at its lower end into the lower shell member, a ceramic tube housed concentrically in the shielding tube over the main insulator which terminates substantially at the center of said ceramic tube, said shielding tube having an inwardly projecting flange at its upper end to overlie the ceramic tube to hold it in position therein, said ceramic tube cooperating with the main insulator at its other end, and an elastic body of organo-silicon polymers positioned between the metallic shielding tube and the ceramic tube to resiliently hold it in position therein.

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