Oct. 24, 1950 R. K. CHRISTIE 2,526,933

AVIATION SPARK PLUG

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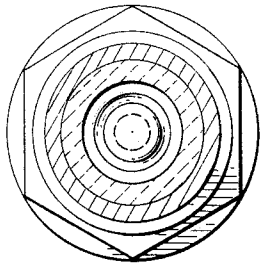


FIG-2-

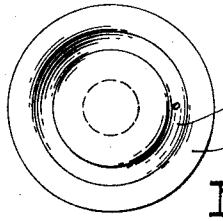


FIG-4-

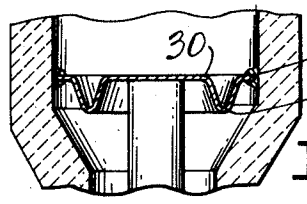


FIG-3-

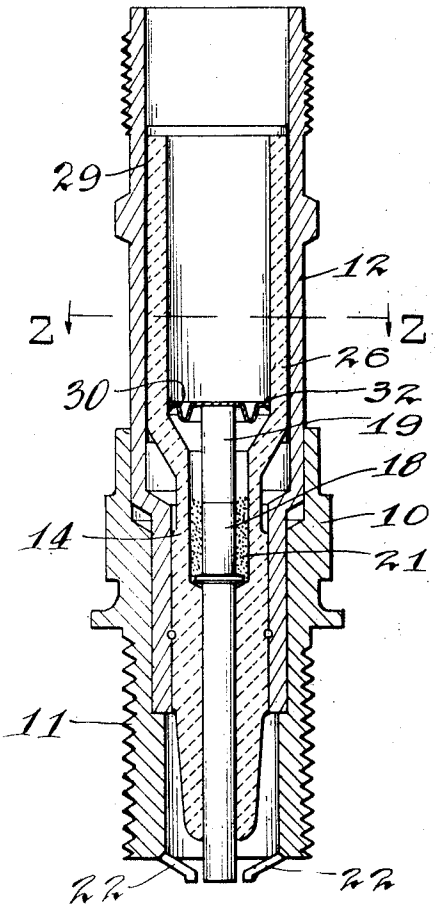


FIG-1-

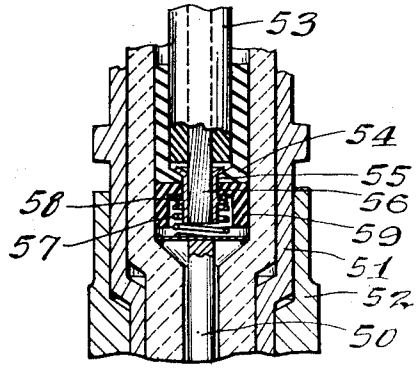


FIG-5-

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AVIATION SPARK PLUG

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5 Claims. (Cl. 123—169)

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This invention relates to a spark plug of the type used in aircraft engines and is particularly directed to means to reduce or eliminate the formation of corona and accidental electrical discharge within the spark plug body.

In the operation of aircraft engines at high altitude, difficulty has been encountered due to disruptive electrical discharge within the barrel portion of radio shielded spark plugs with which the engines are commonly equipped. Such discharge, of course, prevents normal engine ignition and results in loss of power. Various expedients have been tried in an effort to eliminate this difficulty. In certain instances attempts have been made to eliminate the easily ionizable rarified air from the spark plug barrel, and in other instances it has been attempted to maintain normal atmospheric pressure in the barrel as well as in the entire ignition harness. While a degree of success has been attained by these expedients, their adoption is costly and is attended by certain disadvantages.

It is the primary object of the present invention to eliminate the formation of corona in a radio shielded aircraft spark plug by so adjusting the potential gradients existing therein that disruptive discharge does not occur.

Other objects and advantages of the invention will become apparent from the following specification, reference being had to the accompanying drawings in which:

Figure 1 is a central vertical section of a spark plug embodying the present invention; Fig. 2 is a section on line 2—2 of Fig. 1; Fig. 3 is a fragmentary sectional view, somewhat enlarged, of a portion of the spark plug shown in Fig. 1; Fig. 4 is a plan view of an electrode bridging disc, and Fig. 5 is a fragmentary sectional view of a modified form of the invention applied to a conventional radio shielded spark plug.

Referring to the drawings, one form of a spark plug constructed in accordance with the invention is shown in Fig. 1, and includes a shell 10 having a threaded part 11 for engagement with an engine cylinder head. A shield barrel 12 extends upwardly from the shell 10 and is mechanically and electrically united with the shell so that it is at ground potential. Fixed in the shell 10 is a core 14 which is held in place in any suitable manner, preferably by a malleable locking sleeve which is compressed and deformed so that a part of the metal of which the locking ring is composed flows into a groove in the core. The construction of the shield barrel and the manner of locking the assembled parts in place form no part of the present invention.

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The upper end of the shield barrel receives a conventional ignition harness (not shown) with a connector cable protruding into the upper end of the barrel to make electrical contact with a center electrode 18. (See Fig. 5.) The center electrode assembly may be of any suitable construction and may include a small series resistor 19 disposed between the cable tip and the electrode proper. The electrode may be held in the core and sealed against gas leakage by a body of compacted powder 21. At its firing end the center electrode cooperates with suitable ground electrodes 22 carried by the shell 10.

Since the connector cable is at high potential it is necessary to provide an insulating lining for the shield barrel. In the present instance a single ceramic member 26 is used, that serves not only to support and insulate the center electrode, but also to line the shield barrel. In the unitary piece there are, of course, no joints to be sealed, there is no problem of dissimilar thermal expansion and no problem of non-uniform potential gradients through closely adjacent insulating parts.

In the known shielded spark plugs the exterior of the shield barrel liner is at ground potential and there is little or no increase in potential as the axis of the spark plug is approached. Thus the interior of the liner is very close to ground potential while the metallic connector parts adjacent the upper end of the center electrode are at the highest potential in the entire system. The surrounding air thus becomes the determining factor as to electrical breakdown. At high altitudes this air is rarified and is easily ionizable. Further there are always surfaces having low radii of curvature, if not sharp points, adjacent which corona formation can begin readily. Once begun the corona spreads until it reaches the insulating sleeve at which time the inner part of the sleeve has assumed maximum potential and the outside has remained at ground potential. The thickness of the sleeve is always enough so that no breakdown occurs through a uniform section, but the corona spreads throughout the barrel so that flashover occurs usually around the end of the sleeve, either at the top or the bottom.

In the present invention the exterior of the single insulating member 26 is at ground potential, and uniformity in this direction may be further assured by coating the exterior of the piece with metal 29 either in the form of foil or by sputtering or otherwise.

In the form of the invention shown in Figs. 1 to 4, a metallic bridging disc 30 is provided which overlies the center electrode and extends radially

towards the ceramic piece **26**. The disc **30** is formed with an expansion ridge **31** and is normally of such diameter as to lie closely against the interior wall of the ceramic core and shield liner **26**. The two parts are joined together by a mass which adheres to both, indicated at **32**, which preferably comprises a body of glass formed by melting a mass of glass in place so that it unites both with the metallic disc and with the normal glaze of the insulator.

The disc at its lower side is fixed either to the center electrode or to the series resistor **19** if one is used. In either event the disc assumes the high potential of the cable tip when the spark plug is in use. Thus the inside surface of the ceramic core and liner portion **26** is likewise at high potential so that the entire potential drop occurs across the ceramic liner with no intervening air gaps. Under these circumstances, and because of the relatively smooth surface of the metal disc, the formation of corona is very unlikely. As the spark plug heats in use, radial expansion of disc **30** is taken in the ridge **31** which can, at the same time, allow for axial expansion of the center electrode parts without disturbing the seal **32**.

In the modified form of the invention shown in Fig. 5, the center electrode of a conventional radio shielded spark plug is indicated at **50**, the liner for the shield barrel at **51** and the barrel itself at **52**. A connector cable **53** extends into the barrel and carries a tip **54** of insulating material and a metal grommet **55** to which the conductor **56** is soldered. A connector spring **57** contacts the center electrode **50** and is also in electrical contact with a shoulder **58** on the grommet **55**. Also fixed in place by shoulder **58** is a mass of resilient conducting material **59** formed preferably as a cup having a normal diameter greater than the bore into which it is inserted.

The conducting material **59** is preferably a plastic material known commercially as "conducting rubber" and, while retaining the resilient properties of rubber, has an electrical resistance of the order of 15–50 ohms per inch. The outer face of the cup of conducting rubber is thus at a potential very close to that of the conductor **56** and is in close compressive contact with the inner surface of liner **51** so that this surface is also at or near electrode potential. Since there is little or no dielectric stress in the air around the upper end of the center electrode **50**, corona formation is effectively inhibited.

It will thus be seen that the present invention provides a spark plug structure in which electrical failure caused by ionization of air within the barrel or by failure at a joint between adjacent elements is practically eliminated. While two preferred embodiments of the invention have been shown and described, it should be expressly understood that numerous modifications and changes may be made without departing from the invention as defined in the appended claims.

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

1. In a spark plug of the class described, a grounded metallic shell, a functionally integral barrel member extending from said shell, a ceramic liner for said barrel member having its exterior at the same potential as said barrel, a center electrode assembly mounted in said shell but insulated therefrom and terminating within said ceramic liner, and an expansible metallic conducting member electrically connected to the top of said center electrode assembly and to the interior of said ceramic liner whereby the interior of said liner, at the juncture, is at electrode potential.

2. In a spark plug of the class described, a grounded metallic shell, a functionally integral barrel member extending from said shell, a ceramic liner for said barrel member having its exterior at the same potential as said barrel, a center electrode assembly mounted in said shell but insulated therefrom and terminating within said ceramic liner, and an expansible metal disc having its center portion electrically connected to said center electrode assembly and a peripheral seal connecting said disc to the interior of said ceramic liner whereby the interior of said liner, at the seal line, is at electrode potential.

3. A device in accordance with claim 2 in which said peripheral seal for said metal disc comprises a fused mass which is united to the interior of said ceramic liner.

4. In a spark plug of the class described, a grounded metallic shell, a functionally integral barrel member extending from said shell, a unitary ceramic member fixed in said shell and locked against movement relative thereto, a portion of said ceramic member extending into said barrel as a liner, said last portion being in the form of a tube the exterior of which is at the same potential as said barrel member, a center electrode assembly mounted in said ceramic member and terminating below the upper end thereof, and expansible means to establish an area on the interior of said ceramic member which is at substantially the same potential as said center electrode.

5. A spark plug in accordance with claim 4 in which said last means comprises a mass of conductive rubber.

ROBERT K. CHRISTIE.

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