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IGNITER PLUG

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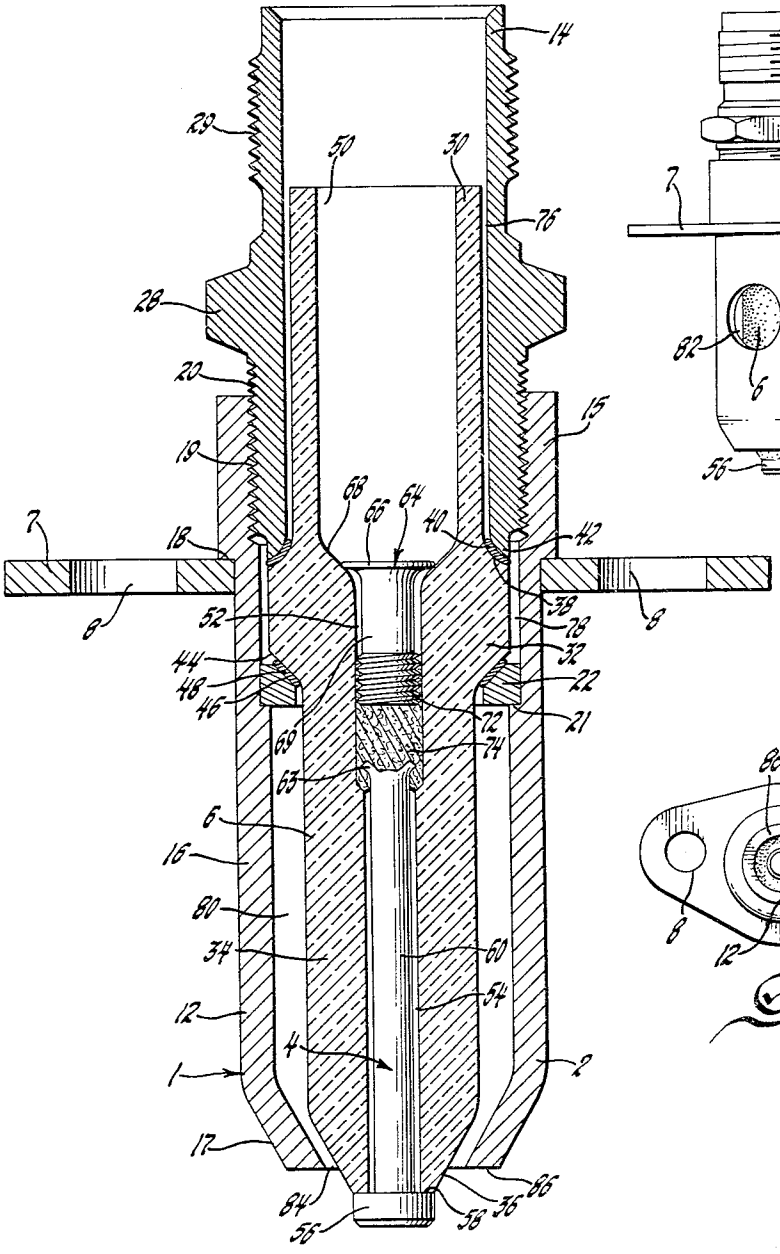


Fig. 1

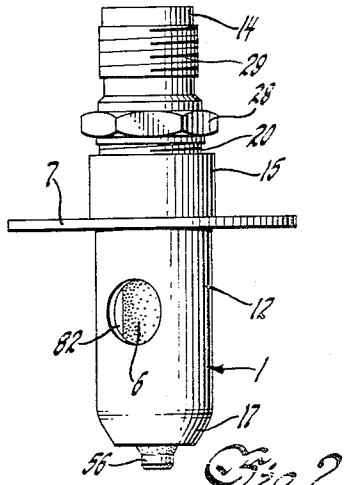


Fig. 2

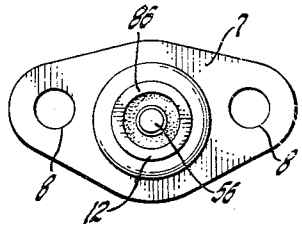


Fig. 3

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IGNITER PLUG

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The present invention relates to igniters for hydrocarbon engines and more particularly to igniters of the so-called surface gap type which are employed to ignite the fuel mixtures burned in internal combustion gas turbines.

Due to the high temperatures caused by the combustion of hydrocarbon fuels, the spark or igniter plugs for kindling these fuels, particularly those used in gas turbines, obviously operate under severe conditions. The carbonaceous material which is formed as a result of the combustion of such fuels continually forms on the electrodes of igniter plugs during operation of the turbine. Such formations, if unchecked, accumulate to such a degree as to greatly reduce the efficiency of the igniter plug and not infrequently completely prevent the operation thereof. The high temperatures under which igniter plugs operate also accelerate erosion of the electrodes thereof.

It is an object of the present invention to provide an igniter plug which minimizes or entirely eliminates the undesirable characteristics of most of the prior plugs, thereby assuring effective and reliable operation for long periods of time.

It is also an object of this invention to provide an igniter plug having a gap of the so-called creepage type whereby the cooling air circulating therethrough together with the natural detergent action of the spark function to maintain a clean unobstructed path for the spark under all conditions of operation.

A further object is to provide an igniter plug having a central ceramic core which is so constructed that in case of fracture thereof due to changes in temperature conditions or for any other reason, the fragments are prevented from dropping out of the casing of the igniter plug, thereby preventing damage to the moving parts of the associated engine.

A still further object is to provide an igniter plug having a ventilated spark gap whereby the temperatures of the electrodes are maintained within a safe range, thus preventing rapid erosion of the exposed parts.

A still further object is to provide in an igniter plug an electrode having a large exposed surface area for electrical discharge, thereby insuring longevity of service.

A still further object is to provide an igniter plug whose combined center insulating core and electrode can be readily replaced in case either becomes damaged.

Other and further objects will become apparent as the description of the invention progresses.

Of the drawings:

Fig. 1 is a cross-sectional view of an igniter plug embodying the features of the present invention.

Fig. 2 is a reduced side elevational view of the igniter plug showing the structure of the exterior thereof, and

Fig. 3 is an end view of the plug looking upwardly from the bottom thereof.

Referring to the drawing, the numeral 1 designates generally the igniter plug embodying the present invention which in the present instance consists of three basic parts, an outer casing or shell 2 forming the grounded electrode of the igniter plug, an inner or live electrode 4 and an insulating or ceramic core structure 6 disposed between

shell 2 and electrode 4. A mounting plate 7 is secured to the shell 2 and may in turn be secured to the combustion chamber wall of the engine (not shown) by bolts or by any other suitable securing means, a pair of openings 8 being provided in said plate for that purpose.

The outer casing or shell 2 is composed of two separable parts, a lower shroud 12 and an upper sleeve 14. The lower shroud 12 comprises an upper enlarged portion 15 and a reduced lower portion 16 which terminates at its lower end in a downwardly tapering frusto-conical end portion 17. An annular shoulder 18 is provided between portions 15 and 16 of shell 2 and forms a seat for mounting plate 7 which is press fitted and brazed on said lower portion. The interior of shroud 12 is internally threaded near the upper end thereof, as shown at 19, for receiving the lower externally threaded portion 20 of the upper sleeve 14. The interior of lower shroud 12 is provided with an annular shoulder 21 for supporting an annular ring 22. The upper sleeve 14 of shell 2 is tubular in form and comprises in addition to the lower externally threaded portion 20 an intermediate hexagonal portion 28 and an upper externally threaded portion 29. The hexagonal portion provides facets which may be engaged by a wrench to facilitate assembly of the parts.

The core structure 6 is also of tubular form and may be constructed of ceramic or of any other suitable insulating material. Core structure 6 comprises an upper barrel 30, a larger diameter intermediate portion 32, and a reduced lower shank 34 which terminates at its lower end in a frusto-conical portion 36. An inclined annular shoulder 38 is provided between the barrel 30 and intermediate portion 32 which forms a seat for a gasket 40. Thus, when the upper sleeve 14 and lower shroud 12 are assembled the lower end 42 of the former is brought tightly into engagement with gasket 40. An effective seal is thus provided. An inclined annular shoulder 44 is provided between intermediate portion 32 and lower barrel 34 which is disposed in substantially parallel relation with the inclined annular surface 46 of ring 22. A gasket 48 is provided between surface 46 and shoulder 44 which forms an effective seal between the parts when shroud 14 is drawn tightly against shoulder 38 during assembly of shell 2. The internal diameter of the bore of core structure 6 varies, the upper portion 50 being relatively larger terminates in an intermediate narrower portion 52, which portion in turn terminates in a further reduced portion 54.

The electrode 4 comprises a cylindrical head or base portion 56 which engages the lower end 58 of the frusto-conical portion 36 of core structure 6. The outer surface of head 56 coincides with the lower edge of frusto-conical portion 36, as shown in Fig. 1. The shank 60 of electrode 4 extends upwardly into the reduced portion 52 of the bore of core 6 and the upper end thereof is peened over as shown at 63 so as to extend laterally beyond the upper end of said reduced bore portion. The cap or contact element 64 extends downwardly into the intermediate bore portion 52 and the head 66 thereof rests upon the downwardly inclining shoulder 68 disposed at the lower end of bore portion 50. The lower portion of the shank 69 of cap 64 is provided with a series of spiral projections as shown at 72. An electrically conductive cement 74 is provided in bore portion 52 which surrounds the upper end of the shank 60 of electrode 4 and extends between the spiral projections 72, the latter being provided to effect a bond between the cement and the cap. The peened over portion 63 of shank 60 also effects a bond between the cement 74 and said shank to secure the electrode in proper position. Other forms of roughened surfaces may be employed instead of the spiral projections 72, if it is so desired.

To assemble the igniter plug 1 the shank 60 of the electrode is first inserted through the reduced bore portion 54 of core 6 in such a manner that it is centered therewithin. The end of the shank 60 is then peened over or otherwise upset to insure a better grip by the bonding material and also to prevent it from dropping from the core in case of separation from the said bonding material. A charge of cement or bonding material 74 is then placed in the intermediate portion 52 of the bore. The cap or contact element 64 is then inserted downwardly into the intermediate portion 52 of the bore until the head 66 thereof rests upon the tapered shoulder 68 of the lower end of the upper bore portion 50. The tapered shoulder facilitates centering the cap in bore portion 52. When the parts have been so assembled the cement or bonding material is treated so as to effect bonding of the parts. The method for accomplishing this depends upon the type of material used. Several different types of materials have been used for this purpose. It has been found, however, that a material consisting of a powdered mixture of finely ground glass and copper has proven to be satisfactory. When such bonding material is used the charge thereof is placed in bore portion 52 either as a powder or as a pellet. The entire core structure 6 is then heated until the glass powder becomes plastic at which point pressure is applied both on the head of the cap or contact element 64 and on the lower end of electrode 4 until they assume the position shown in Fig. 1. The core structure 6 is then allowed to cool at which time the cement or bonding material not only holds the electrode securely in position but the material itself also forms a good conductor between the cap and electrode proper.

After the core 6 has cooled, it is assembled in the shell 2, as previously described. The inclined shoulder 44 on intermediate portion 32 and the inclined surface 46 on ring 22 enable the core structure 6 to be properly centered within shell 2.

As shown in Fig. 1, the outer metallic shell 2 is spaced from the core structure 6 except at the relatively narrow annular bearing portions where contact is made with gaskets 40 and 48. It is seen that an extended annular space 76 is provided between the inner surface of the upper sleeve 14 and the upper portion 30 of core structure 6. A second annular space 78 is provided between the inner surface of lower shroud 12 and the intermediate portion 32 of core 6, while a third annular space 80 is provided between the inner surface of lower shroud 12 and the lower portions 34 and 36 of core 6. An opening 82 is provided in the lower shroud 12 of shell 2 to provide for circulation of gases through annular space 80.

A conductor, not shown, leading from any suitable source of electric potential is secured to cap 64, the enlarged interiors of the sleeve 14 and the upper end of core structure 6 being provided to facilitate attachment of the conductor to said cap.

As shown in Fig. 1, the frusto-conical portion 36 of core structure 6 extends downwardly a short distance below the lower end 17 of shroud 12 and the outer surface of the former is spaced from and lies in substantially parallel relation with the inner surface of the latter.

In operation a high voltage electric potential is delivered to cap member 64 by a conductor, not shown, which flows through cement 74 and thence through shank 60 to the electrode head 4. Electrode 4 discharges its electric charge thus produced across the air gap 84 between said electrode and the lower end 86 of shroud 12 which constitutes the grounded electrode of the igniter plug 1. The sparks follow paths upwardly along the surface of the frusto-conical portion 36 of core 6 and when coming abreast with the lower end 86 of grounded electrode 12 they jump across the air gap to the latter.

The opening 82 in shroud 12 causes a constant stream of air to be circulated through passage 80 and across the air gap 84, which operates to protect the parts against excessive heat. This circulating air also operates to maintain the surfaces of the electrodes and adjacent parts clean and free from the accumulation of carbonaceous deposits. Should carbon particles adhere to any of the electrode surfaces it would produce a low resistance path for the spark to follow and consequently the spark would be concentrated at such points which coupled with the circulating air will produce localized areas of high temperature. Such carbon particles therefore would quickly burn leaving the surfaces clean. It is also seen that a relatively large area of the lower shroud is exposed to circulating air. The heat absorbed by the shroud accordingly is rapidly dissipated by the circulating air, thereby minimizing the rate of erosion thereof. This also applies to electrode 4 over which streams of air also pass. Since the area of electrode 4 is relatively great, the effect of erosion is minimized thereby assuring longevity of service.

It is also seen that should the live or center electrode 4 require repair or replacement the core structure 6 may readily be removed and a new one inserted in its place.

Although only one embodiment of the invention has been described and illustrated, it is apparent that various changes and modifications may be made without departing from said invention. It therefore is to be understood that the invention is not to be limited to the single embodiment disclosed herein, but only by the claims which follow.

What is claimed is:

1. An igniter plug comprising in combination, a central electrode including an extended base portion providing a relatively large surface for the discharge of electrical sparks and a shank, an elongated tubular electrical insulating member for receiving said shank, said member having an exterior frusto-conical portion converging toward said base portion, electrical conducting means for securing said shank to the interior of said member, an electrical conducting shell disposed in substantially concentric spaced relation with said member and forming an annular ground electrode for said plug, the inside diameter of said annular ground electrode being intermediate the extreme diameters of said frusto-conical portion, means providing a gas tight seal between a center portion of said shell and said member, the exterior of said member between said center portion and said frusto-conical portion being spaced from the interior of said shell to form a cylindrical space therebetween, said base portion and a part of the frusto-conical portion of said member extending beyond the end of said shell, whereby upon energization of said central electrode, the sparks resulting therefrom are caused to travel along the outer surface of the said adjacent end of said member and thence across the space between said member and shell.

2. An igniter plug comprising in combination, a central electrode comprising an enlarged base portion to provide a relatively large surface for the discharge of electrical sparks and a shank portion, an elongated tubular electrical insulating member for supporting said shank in such a manner that said base portion lies in abutting relation with a tapered end thereof, said end being tapered to substantially the same diameter as said base portion means for securing said shank to the interior of said member, an electrical conducting shell disposed in substantially concentric spaced relation with said member and forming the ground electrode of said plug, one end of said shell being tapered to form a restricted nozzle between said shell and said tapered insulating member, means providing a gas tight seal between said shell and said member, the tapered end of said insulating member and said base portion extending beyond the tapered end of said shell, whereby the sparks resulting from energization of said electrode are caused to travel along the exterior surface of said member and thence across the space between said member and said shell, and said shell having an aperture therein whereby in operation a fluid coolant circulates through the said space between said shell and said insulating member so as to pass through said

nozzle to thereby clean and cool the said parts and said base portion and prevent carbonaceous formations from accumulating thereon.

3. An igniter plug comprising in combination, a central electrode including an enlarged end portion to present a relatively large surface for the discharge of electrical sparks and a reduced shank portion, an elongated electrical insulating sleeve for receiving said shank, a tapered end portion on said sleeve engaging the said enlarged end of said electrode, an electrical conducting shell forming the ground electrode of said igniter plug mounted on said sleeve in substantially concentric spaced relation therewith one end of said shell being tapered in such a manner that the said enlarged end portion of said electrode and a portion of the said tapered end portion of said sleeve extend beyond said tapered end of said shell, so as to form a nozzle between the tapered ends of said shell and said sleeve whereby the sparks resulting from a potential difference between said electrodes will travel over said tapered end portion of said sleeve and thence across the space between said tapered end portion and said shell, and said shell having an opening therein communicating with the space between said shell and said insulating member whereby air and gases may flow through said nozzle to thereby clean and cooling the tapered end of said sleeve and said electrodes.

4. In a device of the class described, a central electrode, comprising an enlarged end portion to provide a relatively large surface for the discharge of electrical sparks and a reduced shank portion, a tubular electrical insulating core, a substantially frusto-conical end portion on said core engaging said enlarged end portion, means for securing said shank to the interior of the core, a metallic shell forming a ground electrode for said plug, means for retaining said shell in substantially coaxial spaced relation with said core over a major portion of the length thereof, said last mentioned means comprising an annular inclined shoulder disposed interiorly of said shell, an inclined annular shoulder on said core engaging said first mentioned shoulder and adjustable means for holding said shoulders in intimate contact, a frusto-conical portion on said shell disposed in spaced substantially concentric relation with said first mentioned frusto-conical portion forming an annular orifice for air and gases, said shell having an opening therein through which air and gases may pass, said air and gases flowing through the space between said core and shell and discharging over said enlarged portion of said electrode through said orifice.

5. In an igniter plug for internal combustion engines, the combination of an electrically non-conductive tubular core, including, an elongated cylindrical barrel portion and a frusto-conical portion at one end thereof, a central electrode comprising an enlarged end portion engaging the end of said frusto-conical portion and a reduced shank portion, means for securing said shank portion interiorly of said core in substantially coaxial relation therewith, an electrically conductive shell forming the ground electrode of said plug, means for securing said shell to said core in such a manner as to provide an annular space therebetween over a major portion of the length thereof, a frusto-conical portion at one end of said shell disposed in spaced substantially concentric relation with said first mentioned frusto-conical portion forming an annular nozzle therebetween, a portion of said first mentioned frusto-conical portion and said enlarged end portion of said central electrode extending beyond the end of said last mentioned frusto-conical portion, and said shell having an opening therein through which air and gases may flow, said air and gases then flowing through the said annular space between shell and core and thence through said nozzle thereby discharging over the outer end of said first mentioned frusto-conical portion and said enlarged end portion of said central electrode.

6. In an igniter plug, the combination of an electrical insulating tubular core, a tapered portion provided at one end of said core, a central electrode engaging the end of said tapered portion, said portion being tapered to substantially the same size as said electrode, a shell surrounding said core and disposed in spaced relationship therewith, means providing a seal intermediate the ends of said shell and core, the space between said shell and said core extending from said seal to said tapered portion, one end of said shell forming an annular ground electrode, the size of said electrode being smaller than said core thereby preventing said core passing therethrough, and said shell having an opening extending therethrough to intersect said space so air and gas may pass to the interior thereof to effect cooling and cleaning of said electrodes and said tapered portions, the tapered portion of said core and said central electrode extending through said ground electrode of said shell, whereby the sparks from said central electrode are caused to creep therefrom over the end of said core and thence across said air space to said shell.

7. The invention set forth in claim 6, where said ground electrode and said tapered portion form a restricted orifice which is positioned to communicate with and form an outlet for the space between said shell and said core whereby the air and gases flowing in the space between said shell and core are directed over said extended end of said core and central electrode.

8. An igniter plug, comprising, a central electrode, a tubular electrical insulating core supporting said electrode and an electrically conductive shell mounted in spaced relation with said core over a portion of the length thereof, a frusto-conical portion at one end of said core, a frusto-conical portion at one end of said shell disposed in spaced relation with said first mentioned frusto-conical portion to form a restricted annular orifice, said first mentioned frusto-conical portion extending beyond the end of said last mentioned frusto-conical portion, said central electrode comprising an extended base portion and a shank, means for securing the free end of said shank to the interior of said core in such a manner as to cause said base portion to engage the end of said frusto-conical portion on said core, whereby said base portion cooperates with said last mentioned frusto-conical portion to prevent fragments of said core from passing between said base portion and said shell, and means for forcing air and gases through the space between said core and said shell whereby said fluid will be discharged through said orifice against said electrodes and across the frusto-conical portion of said core.

9. In an igniter plug the combination of an outer shell having an open end forming an annular electrode, an inner member having an elongated shank with an enlarged end forming a center electrode, said inner member being disposed concentrically inside of said shell and having said enlarged end projecting through said open end, said center electrode being in spaced relation to said annular electrode, an insulating core having a hub secured to said inner member and a portion of the interior of said shell by a gas tight seal, said core having a barrel portion of substantially uniform thickness surrounding said shank and being disposed between said hub and said open end, an end on said barrel projecting through said open end and tapering to substantially the same diameter as said enlarged portion, the inside diameter of said annular electrode being intermediate the outside diameters of said barrel portion and said center electrode.

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