

Feb. 6, 1945.

E. O. SETTERBLADE.

2,368,889

SHIELDED SPARK PLUG

Filed Oct. 10, 1941

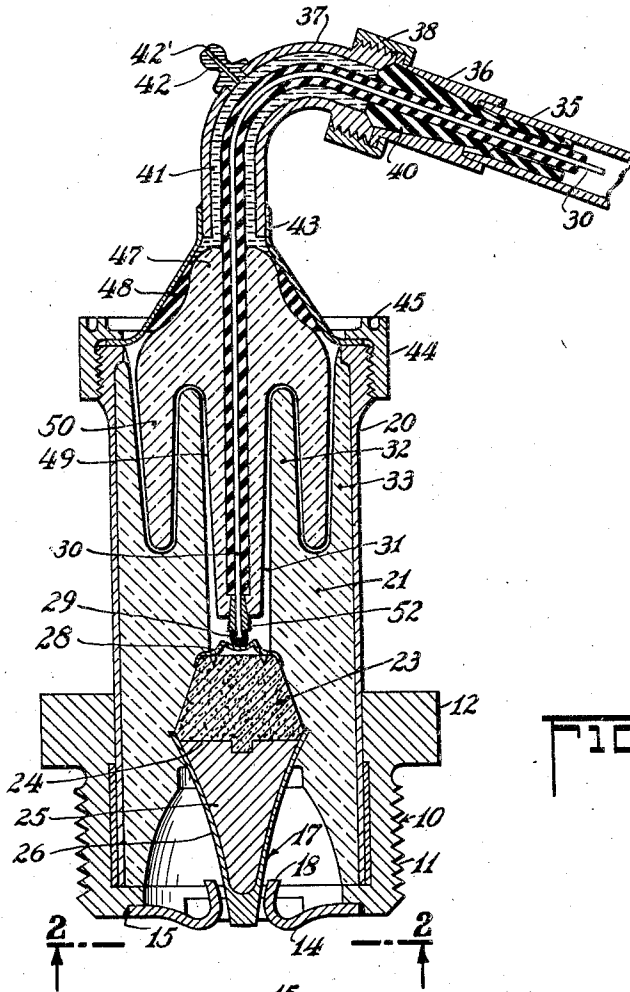
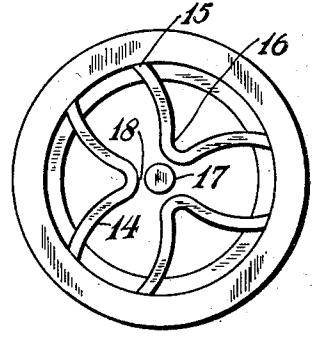


FIG. 1

FIG. 2



INVENTOR
EARL O. SETTERBLADE.

BY *W. E. Shack*
ATTORNEY

UNITED STATES PATENT OFFICE

2,368,889

SHIELDED SPARK PLUG

Earl O. Setterblade, Glen Rock, N. J., assignor to
Wright Aeronautical Corporation, a corporation
of New York

Application October 10, 1941, Serial No. 414,445

9 Claims. (Cl. 123—169)

This invention relates to spark plugs for internal combustion engines and in particular relates to improvements in electrically shielded spark plugs suitable for use in aircraft engines.

One of the problems in connection with aircraft engine spark plugs is the provision of a sufficiently long flashover gap within the spark plug and between the center electrode connection and a grounded element to prevent breakdown at high altitude. It is an object of the present invention to provide a spark plug which will meet such operating conditions and further, to provide a labyrinth flashover path which is not likely to break down under any operating condition. A further object of the invention is to provide a resistor, integral with the spark plug, to damp surges of energy across the plug gap released from the condenser formed by the radio shielding which embraces the spark plug and the ignition system. Another object of the invention is to provide a spark plug connector assembly which may readily be filled with a semi-liquid insulating compound after the assembly has been completed, to assure proper mechanical protection and insulation of the spark plug assembly. Still another object of the invention is to provide an electrode arrangement whereby the sparking points will not tend to separate at high temperature operating conditions. A further object is to provide a spark plug electrode arrangement so arranged as to stay hot enough during engine idling operation to give good engine idling characteristics and yet to run sufficiently cool under normal power output to prevent excessive erosion of the sparking points. The details of the invention are outlined in the annexed description which may be read in connection with the drawing, in which:

Fig. 1 is a longitudinal section through a spark plug according to the invention; and

Fig. 2 is a view on the line 2—2 of Fig. 1.

The spark plug proper comprises a shell 10 of steel or other hard material having screw threads 11 engaging the usual screw threads in a spark plug opening in an engine, the shell 10 having a flange 12 for application of a wrench. A plurality of outer electrodes 14 are suitably secured to the bottom of the shell 10 and each comprises a strip or wire whose ends meet the shell 10 as at 15 and whose central portion forms a loop at 16 in clearance relation to the center electrode 17. Alternately, the several fixed electrodes may be formed as a unit stamping secured at its periphery to the shell 10. The loops 16 are bent upwardly as shown at 18 in Fig. 1,

a portion of each loop being in nearly parallel relationship with the side faces of the conical center electrode 17. The normal disposition for outer electrodes is to have electrode ends bent downwardly rather than upwardly as shown, and when heated, the conventional downwardly facing electrodes have a tendency to increase the spark gap. With the present arrangement the spark gap will remain substantially constant or may close up slightly when the plug is running at normal operating temperature.

A shielding sleeve 20 is secured within the shell 10 as by brazing, pressing, or the like and within this sleeve a refractory ceramic insulator 21 is molded. When the insulator 21 is molded, the center electrode 17 is imbedded therein and also, a carbon resistor 23 is imbedded therein, the electrode 17 being in intimate contact with the resistor 23 at 24. The electrode 17 is of downwardly pointed conical form and comprises a copper core 25 embraced by a shell 26 of platinum alloy or other suitable metal adapted to resist high temperature and erosion. The resistor 23 is also of conical form to provide a gas seal against any possible leakage between the ceramic and the electrode 17. The top part of the resistor 23 is capped with a resilient metallic washer 28 suitably formed to receive a wire terminal 29 of a high tension conductor 30.

Above the resistor 23, the insulator 21 is formed with a central well 31 defined in part by a cylindrical skirt 32 formed integral with the insulator 21. Also integral with the insulator 21 is an outer cylindrical skirt 33 in contact with the sleeve 20, the two skirts 32 and 33 defining therebetween an annular well.

The high tension conductor 30 is embraced by metallic shielding 35 secured to a union fitting 40 36 which contacts a metallic elbow 37 to which it is secured by a union nut 38. The fitting 36 contains a rubber gasket 40 which seals the conductor 30 to the fitting against leakage and as the conductor 30 passes through the elbow 37, there is a space between these two parts which is filled by a semiliquid insulating compound shown at 41, through a fitting 42 attached to the elbow, said fitting having a small opening 42' through which the compound may be introduced by a pressure gun of suitable type. The bottom of the elbow 37 is bonded to a conical shell 43 whose lower edge rests upon the top of the sleeve 20, the shell and sleeve being secured to one another by a union nut 44 engaging threads on the sleeve, said nut being provided

with holes 45 for application of a spanner wrench thereto.

Within the shell 43 and the upper part of the sleeve 20 is an insulating cap 47 sealed to the shell by a rubber gasket 48. Through said cap the conductor 30 passes, the cap comprising a central stem 49 extending down into the well 31, and also comprising an annular substantially cylindrical skirt 50 which passes into the annular space between the skirts 32 and 33 of the insulator 21. The cap insulator and the insulator 21 together define a circuitous flashover path of substantially S form whose length, obviously, is much greater than would obtain if the labyrinth established by the interfitting insulator skirts were absent. It will be further noted that the limbs of the flashover path are parallel to one another which disposition seems to afford further restriction to flashover. That is, the effective length of the flashover gap shown is greater than its actual length, from the standpoint of breakdown potential, so that a higher breakdown potential is necessary for the gap shown than would be predicted from the actual gap length.

The lower end of the conductor 30 is secured in the cap extension 49 by a metallic wedge 52, which wedge may be soldered or otherwise fastened to the protruding end of the conductor to form the contactor 29 which engages the metal washer 28. The latter, incidentally, should be of slightly resilient construction to assure positive contact with the contactor 29.

In assembling the conductor and elbow unit, the insulation of the conductor 30 is first coated with sealing compound and it is inserted into the bore of the insulating cap 47. The wedge 52 is applied and the elbow 37 and its fittings are made secure, then sealing compound is injected through the fitting 42, completing the wire terminal which may be applied subsequently to the spark plug base unit.

It is believed that a plug constructed in accordance with the teachings above will have much greater life than conventional spark plugs and if, as anticipated, the plug is capable of operating properly for a period of 600 hours or more, it will be unnecessary to remove the spark plugs from an engine between major overhauls. If this hope is realized, engine construction may be simplified to the extent that the usual hardened spark plug bushings which are shrunk into cylinder heads, may be eliminated. The infrequent withdrawal of the spark plugs will allow of spark plug assembly directly into the aluminum cylinder head without need for said cylinder head bushings and thereby affording improved heat transfer from the plug to the cylinder.

While I have described my invention in detail in its present preferred embodiment, it will be obvious to those skilled in the art, after understanding my invention, that various changes and modifications may be made therein without departing from the spirit or scope thereof. I aim in the appended claims to cover all such modifications and changes.

I claim as my invention:

1. A shielded spark plug comprising a shell, a ceramic insulator secured thereto having a central passage, a center electrode secured within said central passage having a conductor passing therethrough, the upper part of said ceramic insulator having a plurality of substantially cylindrical annular undulations therein between the conductor and shell; a top member comprising a

ceramic insulator having annular undulations complementary in form to those of the other insulator, means to secure said insulators in juxtaposed relation whereby the clearance between their undulations defines a flashover path from the center electrode to said shell of substantially greater length than the straightline distance therebetween, and a conductor within said top member, contacting with said electrode at the inner end thereof and extending from the outer end of the top member to a source of electrical energy.

2. In a shielded spark plug comprising a shell, a ceramic insulator secured therein and having a central passage, an electrode secured in one end of said passage and a resistor, in contact with the electrode, secured in the other end of said passage, and contactor means secured to said shell and engaging said resistor, said insulator having an integral annular skirt projecting from the resistor end thereof, and said contactor means comprising a plurality of integral concentric annular refractory skirts between two of which said insulator skirt is assembled, whereby an elongated flashover path is defined between said shell and resistor, part of said flashover path comprising spaced parallel portions.

3. In a spark plug, a refractory cylinder comprising a core, a shielding sleeve embracing same, an attachment shell secured to said sleeve toward the lower end of said cylinder, the lower end of said cylinder being recessed and having a central electrode imbedded therein, a carbonaceous resistor engaging said electrode and imbedded in said cylinder above the electrode, said cylinder having formed therein a central well and a concentric annular well around the central well; a contactor assembly comprising a centrally bored insulator having a conductor passing there- through for engagement with said resistor, a portion of said insulator lying within each well of said refractory cylinder to define a circuitous flashover path from said conductor to said shielding, and a shielding cap embracing said conductor and a portion of said insulator, secured to said shielding sleeve.

4. In a shielded spark plug for an engine, a base portion secured to the engine having a shell, a refractory insulator and a pair of electrodes, one electrode secured to the shell and the other imbedded in the insulator, said insulator comprising at its end opposite to the electrodes a plurality of integral annular substantially cylindrical concentric skirts defining open ended annular spaces therebetween; and a cap portion having a metallic casing secured to said shell, an insulating member having a plurality of integral annular substantially cylindrical concentric skirts lying within said annular spaces of said refractory insulator, and a conductor passing through said cap portion and having electrical contact with said imbedded electrode.

5. In a shielded spark plug for an engine, a base portion secured to the engine having a shell, a refractory insulator and a pair of electrodes, one electrode secured to the shell and the other imbedded in the insulator, said insulator comprising at its end opposite to the electrodes a plurality of integral annular substantially cylindrical concentric skirts defining open ended annular spaces therebetween; and a cap portion having a metallic casing secured to said shell, an insulating member having a plurality of integral annular substantially cylindrical concentric skirts lying within said annular spaces of

said refractory insulator, and a conductor passing through said cap portion and having electrical contact with said imbedded electrode, said imbedded electrode comprising a metallic sparking point and a carbonaceous resistor the latter being wholly confined within the refractory insulator except where it is contacted by said sparking point and conductor.

6. In a shielded spark plug having a composite cap of insulating material embraced by a metallic conduit in spaced relation thereto, an element secured to said conduit having a restricted hole therethrough through which a viscous insulating compound may be introduced into the space between said conduit and insulating material to seal said space.

7. In a shielded spark plug having a composite cap of insulating material embraced by a metallic conduit in spaced relation thereto, an element secured to said conduit having a restricted hole therethrough through which a viscous insulating compound may be introduced into the space between said conduit and insulating material to seal said space, and gasket means at each end of said space to prevent leakage of said compound therefrom.

8. In a shielded spark plug having a pair of

electrodes, a base portion comprising an insulator member having a passage therethrough, a metallic shell disposed about said insulator member and connected to one of said electrodes, electric conductor means within said passage and including the other of said electrodes, said insulator member having a plurality of substantially cylindrical annular ribs projecting therefrom, a cap portion comprising an insulator member having a plurality of substantially cylindrical annular ribs adapted to be received between the annular ribs projecting from said base portion, a metallic shell disposed about said cap portion connected to said first mentioned shell, and conductor means within said cap portion having electric contact with said first mentioned conductor means.

9. In a shielded spark plug, a spark plug cap member having an insulator portion and a metallic shell, said shell having a metallic conduit portion extending therefrom, a conductor member extending through said conduit and insulator portions, and a viscous sealing compound disposed between said conductor member and conduit and between said shell and insulator portion.

EARL O. SETTERBLADE.