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REPLY TO
ATTN OF: GP

October 12, 1970

TO: USI/Scientific & Technical Information Division
Attention: Miss Winnie M. Morgan

FROM: GP/Office of Assistant General
Counsel for Patent Matters

SUBJECT: Announcement of NASA-Owned
U.S. Patents in STAR

In accordance with the procedures contained in the Code GP to Code USI memorandum on this subject, dated June 8, 1970, the attached NASA-owned U.S. patent is being forwarded for abstracting and announcement in NASA STAR.

The following information is provided:

U.S. Patent No. : 3,229,139

Corporate Source : Lewis Research Center

Supplementary
Corporate Source : _____

NASA Patent Case No.: XLE-00660

GParker
Gayle Parker

Enclosure:
Copy of Patent

FACILITY FORM 602

N70-39925

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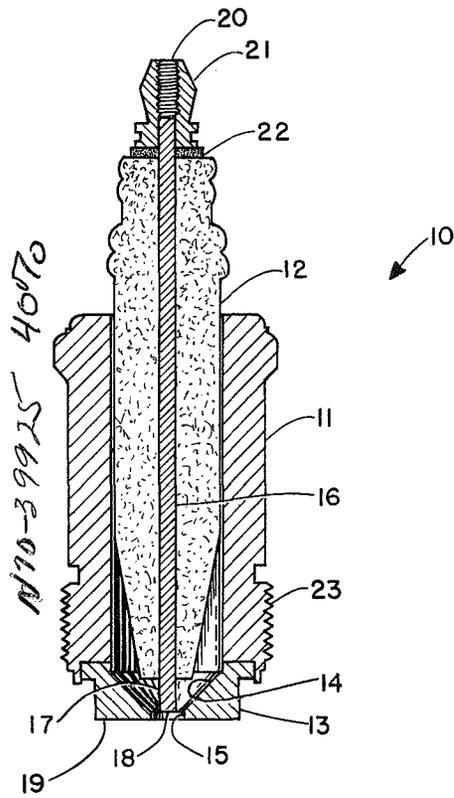
Jan. 11, 1966

J. E. WATSON

3,229,139

HIGH TEMPERATURE SPARK PLUG

Filed Oct. 18, 1962



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3,229,139

HIGH TEMPERATURE SPARK PLUG

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Filed Oct. 18, 1962, Ser. No. 231,604

1 Claim. (Cl. 313-11.5)

(Granted under Title 35, U.S. Code (1952), sec. 266)

The invention described herein may be manufactured and used by or for the Government of the United States of America for governmental purposes without the payment of any royalties thereon or therefor.

This invention relates to an improved ignitor plug and, more particularly, to an ignitor plug that is capable of operating in an extremely hot environment.

Present day devices, such as liquid fueled rockets, operate at very high temperatures, such as 4500° F. or even higher, and utilize ignitor plugs for ignition. For reliability in rocket firing these ignitor plugs should have a reasonable life expectancy even when exposed to such high temperatures.

It has been found that the conventional spark plugs that are customarily used to ignite the rocket propellants have an expected life that is measured in seconds at these high temperatures. This necessitates frequent replacement and may even result in ignition failure.

In order to solve the ignition problems inherent with the conventional spark plugs, the present invention utilizes an ignitor plug having an electrically conductive annular electrode of a temperature resistant material, and this electrode encloses the base of the plug casing to shield the center electrode. The annular electrode forms a chamber adjacent the innermost end of the center electrode, and an aperture in the annular electrode that is aligned with the center electrode provides gaseous communication between the plug exterior and the center electrode.

It is, therefore, an object of the present invention to provide an improved ignitor plug for high temperature operation that has a life expectancy that is measured in hours or days rather than seconds.

Another object of the invention is to provide an improved ignitor plug structure having no metallic parts exposed to direct flame impingement.

Other objects and advantages of the invention will be apparent from the drawing and specification which follows.

The drawing is a vertical section through an ignitor plug constructed in accordance with the present invention.

An ignitor plug 10 shown in the drawing has a tubular metal shell or casing 11 that is electrically conducting. An elongated ceramic insulator 12 is positioned within the longitudinal bore of the casing 11.

An annular electrode 13 is positioned at the base end of the casing 11 and a conical surface 14 thereof faces toward the insulator 12. An aperture 15 at the center of the annular electrode 13 is generally coaxial with the bore of the casing and an elongated center electrode 16 extends through the insulator 12 along the axis thereof in coaxial relationship with the aperture 15.

The inner end of the center electrode 16 extends beyond the insulator 12 to provide an exposed portion 17 adjacent the annular electrode 13, and this portion has a bottom surface 18 immediately adjacent the aperture 15. The bottom surface 18 of the center electrode 16 is recessed from the exterior surface 19 of the electrode 13 that is exposed to the extremely hot temperatures of the combustion flame. The upper end of the center electrode 16 opposite the exposed portion 17 is threaded at 20 to receive a terminal nut 21. A washer 22 is interposed be-

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tween the nut 21 and insulator 12 in a conventional manner.

Threads 23 formed on the exterior surface of the casing 12 at the base thereof adjacent the annular electrode 13 enable the ignitor plug 10 to be mounted in an aperture in an electrically conducting wall of a combustion chamber. When the ignitor plug 10 is so installed it is in physical and electrical contact with the combustion chamber wall, and the annular electrode 13 is the only part extending from the inner surface of this wall into the combustion chamber where the surface 19 is exposed to flame impingement from the burning gases.

According to the present invention the annular electrode 13 is made of graphite in the form of a disc that is rigidly mounted at the base of the plug 10 by crimping the bottom surface of the casing 11 adjacent the threads 23. The annular electrode 13 is able to withstand a temperature in excess of 7000° F. and serves to shield the exposed portion 17 of the center electrode 16 together with the ceramic insulator 12 from the high temperatures of the burning gases while enabling the ignitor plug 10 to produce the required spark for igniting the propellant in the combustion chamber. This spark arcs across the gap between the cylindrical exposed portion 17 adjacent the bottom surface 18 and the annular shoulder formed by the intersection of the conical surface 14 and the cylindrical aperture 15.

As is shown in the drawing, the bottom surface 18 of the center electrode 16 is generally coplanar with this annular shoulder, and for optimum spark propagation a clearance of about 0.025 inch to about 0.050 inch between the exposed portion 17 and the surface of the aperture 15 is required although a satisfactory spark will be produced when this gap is in the range of between about 0.01 inch and about 0.15 inch. The exposed portion 17 of the electrode 16 is in gaseous communication with the outer surface of the ignitor plug 10 through the cylindrical aperture 15, and this enables the spark to ignite the propellant in the combustion chamber.

Although the preferred embodiment of the invention has been disclosed and described, it will be apparent that various structural modifications and changes may be made to the ignitor plug 10 without departing from the spirit of the invention or from the scope of the subjoined claim. For example, the inwardly directed surface 14 of the annular electrode 13 may be planer instead of conical as shown in the drawing. Likewise, the exterior surface 19 may be tapered to provide a thinner cross-section which would store less heat.

Additionally, the exterior surface 19 may be coated with a ceramic oxide, such as zirconium oxide. With such a coating the annular electrode 13 can be either graphite or a refractory metal such as tungsten.

While the center electrode 16 is preferably steel, a high temperature refractory metal, such as molybdenum or tungsten may be used. In some applications this electrode may also be made from graphite.

What is claimed is:

An ignitor for use in a high temperature environment in excess of 4500° F. in the combustion chamber of a liquid fueled rocket comprising

a tubular metal shell having means for mounting the same in the wall of the rocket combustion chamber, an insulator at least partially disposed within said shell, a graphite annular electrode disposed at one end of said tubular shell and extending therebeyond into the rocket combustion chamber, said annular electrode being provided with a recessed portion on the inner side thereof facing said tubular shell and having a cylindrical aperture in axial alignment with said insulator for placing the recessed portion in com-

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munication with the outer surface of said annular electrode in the rocket combustion chamber, said cylindrical aperture being provided with an annular shoulder adjacent said recessed portion, and
 a graphite rod having a diameter smaller than that of
 said cylindrical aperture forming a center electrode
 extending coaxially through said insulator and beyond
 the end thereof to provide an exposed portion ad-
 jacent said recessed portion, the end of said exposed
 portion remote from said insulator being coplanar
 with said shoulder on said annular electrode and
 spaced therefrom for providing a spark gap, said
 annular electrode serving to shield said exposed por-
 tion of said center electrode from high temperature
 burning gases in the rocket combustion chamber.

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References Cited by the Examiner

UNITED STATES PATENTS

1,568,621	1/1926	Rabazzana.	
1,987,612	1/1935	Fernandez	313—139 X
2,088,945	8/1937	Xardell	313—138 X
2,391,458	12/1945	Hensel	313—311 X
2,406,172	8/1946	Smithells.	
2,871,389	1/1959	Skunda	313—141 X
3,061,756	10/1962	Henderson	313—311

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