NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
WASHINGTON, D.C. 20546

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

Gayle Parker

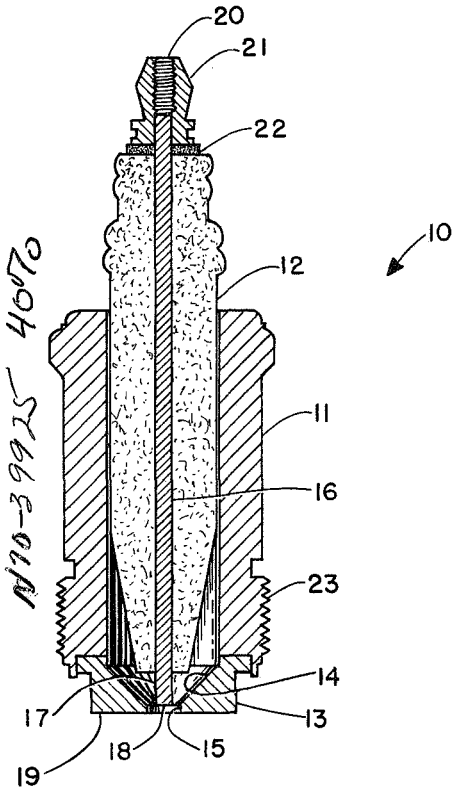
Enclosure:
Copy of Patent

N70-39925

Jan. 11, 1966 J. E. WATSON 3,229,139

HIGH TEMPERATURE SPARK PLUG

Filed Oct. 18, 1962



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United States Patent Office

3,229,139

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3,229,139

HIGH TEMPERATURE SPARK PLUG

John E. Watson, Cleveland Heights, Ohio, assignor to the United States of America as represented by the Administrator of the National Aeronautics and Space Administration

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, therefor, 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 between 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-

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 adjacent 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 portion of said center electrode from high temperature burning gases in the rocket combustion chamber.

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