March 18, 1969 G. F. RADEMACHER 3,434,012

GLOW IGNITER

Filed June 1, 1967

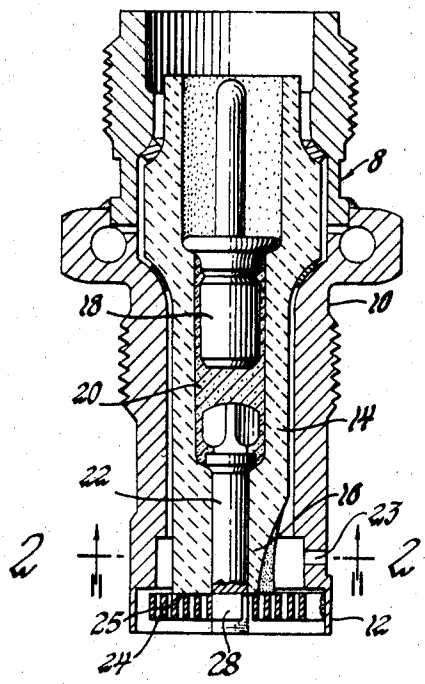


Fig. 1

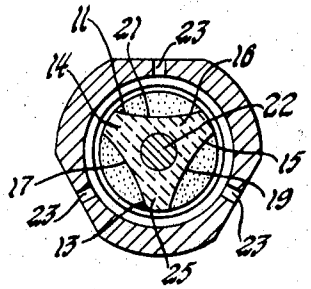


Fig. 2

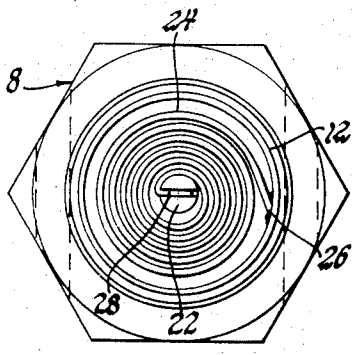


Fig. 3

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GLOW IGNITER

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ABSTRACT OF THE DISCLOSURE

A glow igniter for use in a combustion chamber of a gas turbine engine having a flat coil of spirally wound ribbon resistant wire supported on a fluted ceramic insulator within the lower end of the igniter shell. The surface of the fluted insulator end provides solid support for the resistance wire coil without removing an excessive quantity of heat which adversely affects the operation of the coil.

This invention relates to a glow igniter, and more particularly to an improved glow igniter having a fluted insulator.

Glow igniters having a flat coil of spirally wound ribbon resistance wire are presently being used for ignition purposes in gas turbine engines. A flat coil of ribbon resistance wire has the advantage of providing a large metal surface area for a given cross sectional area which results in a high degree of heat dissipation at a low current consumption rate with the additional advantage of a reduced current requirement for the glow element. One of the disadvantages of using ribbon resistance wire in the coil is that this wire is relatively fragile. Since the ribbon resistance wire in the coil tends to be fragile, it is necessary to firmly support the coil and yet not permit the support means to excessively conduct heat away from the coil to thereby reduce its effectiveness. Various ceramic structures are being used to support the coil. One such ceramic structure is an independent element in the form of a cross having a hole in the center thereof to permit the passage of the center electrode. Another form of support is the use of ceramic rods positioned in a plane so as to support the flattened coil. Both of the ceramic structures mentioned above are loosely fitted into the glow igniter shell which is adapted with a shoulder or other means to prevent the ceramic support pieces from moving in the direction away from the coil. Since the ceramic supports are loosely supported in the shell structure, they are not rigid and are subject to vibrate against the coil during the periods of engine operation. Under certain operating conditions the vibration of the ceramic supports against the coil cause the ribbon wire to fail due to abrasion. These separate ceramic supports also increase the cost of manufacturing the glow igniter.

The use of the end of the firing tip portion of the ceramic insulator as a support means to provide the necessary rigidity is not satisfactory. The firing tip end of the standard insulator provides adequate rigid support for that portion of the coil near the center electrode but it does not provide adequate support for that portion of the coil which is near the annular ground electrode. Increasing the diameter of the end of the insulator to provide adequate support for the entire coil is not satisfactory because the increased insulator mass removes heat away from the coil thereby causing the coil to be inoperative.

It is an object of this invention to provide an improved glow igniter having rigid support means for the flat coil of ribbon resistance wire. It is another object

of this invention to provide a glow igniter having rigid coil support means adapted to provide a minimum heat loss from the coil. It is still another object of this invention to provide support means for the coil which is integral with the insulator whereby the support means is rigid and not subject to relative movement due to vibrations encountered in service. It is yet another object of this invention to provide an inexpensive means to support the coil of resistance wire.

These and other objects are accomplished by a glow igniter comprising a substantially flat coil of spirally wound ribbon resistance wire supported by a ceramic insulator having a fluted configuration on the firing tip end portion. The insulator firing tip end portion has preferably three parallel axially extending grooves equally spaced about the insulator end to form three axially extending ribs. The end surface of the firing tip formed by the grooves and the ribs lies in a plane parallel to the flat coil and extends from the insulator centerbore to the outer edge of the insulator ribs. The end surface occupies an area of 5 to 30% of the area of a circle in the same plane which touches the outer radial edges of the ribs. This end surface provides solid support for the coil with a minimum heat loss. The construction cost of a glow igniter having fluted support means integral with the insulator is lower than glow igniters having separate support means.

Other objects and advantages of this invention will be apparent from the following detailed description, reference being made to the accompanying drawings wherein a preferred embodiment of this invention is shown.

In the drawings:

FIGURE 1 is a side view in elevation of a glow igniter in accordance with this invention;

FIGURE 2 is an end view taken along lines **2—2**; and

FIGURE 3 is an end view of the glow igniter.

Referring now to FIGURE 1 of the drawing, the glow igniter **8** comprises a conventional outer tubular metal shell **10** having the lower end portion thereof constituting an annular ground electrode **12**. The ground electrode **12** may be of any suitable high temperature erosion-resistant metal or metal alloy. A nickel-stainless steel alloy containing approximately 78% nickel and 15% chromium is used in the preferred embodiment.

Positioned within the shell **10** is a tubular insulator **14** having a fluted firing tip portion **16** positioned within the ground electrode **12**. The firing tip portion **16** consists of three axially extending ribs **11**, **13** and **15**, separated by three axially extending grooves **17**, **19** and **21**, as shown in FIGURE 2. The end surface **25** of the firing tip portion formed by the ends of ribs **11**, **13** and **15** lie in a plane perpendicular to the centerbore and provides solid support for the coil **24**, as shown in FIGURE 3. When the coil diameter is 0.4 inch, the preferred insulator firing tip portion construction has three axially extending ribs. Each rib forms an angle of about 120° with each of the other two ribs in the preferred embodiment. These ribs extend from the insulator centerbore, where they are relatively thick depending on the diameter of the center electrode, outwardly toward the outer edge of the coil where they are relatively thin, that is about 0.020 inch wide. An insulator rib thickness of 0.020 inch wide represents the minimum thickness that can be obtained with the low cost manufacturing techniques at the present state of the art. The end surface of an insulator having three ribs provides adequate support with a minimum heat loss. Insulator constructions having less than three ribs do not provide sufficient support for the coil. When the coil is small, that is, in the order of 0.4 inch, insulator constructions having more than three ribs tend to remove too much heat from the coil. In igniters having a

substantially larger coil, the preferred structure can contain more than three ribs depending upon the diameter of the coil as will be hereinafter fully described.

The area of the supporting end surface **25** is from 5 to 30% of the area of a circle which touches the outer edges of ribs **11**, **13** and **15** and which is perpendicular to the centerbore. Areas of this magnitude provide solid support for the coil without removing a quantity of heat therefrom which causes the coil to be inoperative.

End surface areas greater than 30% remove heat in a quantity which causes the coil to be inoperative due to a high heat loss. Areas less than 5% do not provide sufficient solid support for the coil. The preferred area depends upon the size of the coil. The smaller the coil, the larger the support area percentage that is required and the area approaches 30%. For example, in the preferred embodiment having a coil diameter of 0.4 inch, the end surface area of the three ribs is about 18 to 22% of the area of the circle previously described. For igniters employing larger coil diameters the end surface area percentage can be as low as 5% when there are three ribs since in these cases, the area of the circle is increased in proportion to the square of the radius. In these larger igniter coil constructions, the end surface area can be increased to provide even more support by having more than three ribs.

The insulator is preferably of a ceramic material composed of at least 85% alumina and is of the type fully described in U.S. Patent No. 2,760,875, issued to Karl Schwartzwalder and Helen Blair Barlett. The fluted insulator is formed by the conventional molding techniques described in the patent mentioned above and has excellent mechanical strength and heat shock resistance.

Positioned within the insulator is the conventional electrical conductive path formed by the terminal screw **18**, the conductive metal-glass seal **20** and the center electrode **22**. Holes **23** shown in FIGURES 1 and 2 in the ground electrode **12** provide air so that the fuel vapor may ignite on contact with the coil **24**.

The coil **24** is supported on the fluted insulator end surface **25**. As shown in FIGURE 3, the coil **24** has one end thereof connected to the center electrode **22** at **28** and one end connected to the ground electrode **12** at **26**. Any conventional resistance wire may be used. Resistance wire in the form of a ribbon is preferred because of its greater surface area for a given cross sectional area. In the preferred embodiment, Kanthal D ribbon resistance wire, a high chromium alloy, is used.

The novel fluted insulator construction results in improved performance by providing rigid support without excessive heat loss. This construction also provides a simple, low cost means integral with the insulator for supporting the resistance coil of a glow igniter.

While the invention has been described in terms of a preferred embodiment, it is to be understood that the scope of the invention is not limited thereby except as defined in the following claims.

I claim:

1. A glow igniter for use in a combustion chamber of a gas turbine engine comprising a tubular metal shell having a lower end constituting an annular ground electrode, a unitary tubular ceramic insulator positioned within said metal shell and having a centerbore therethrough forming an axis, said insulator having a lower cylindrical portion with a radius, said cylindrical portion terminating in a firing tip portion, said firing tip portion having a plurality of spaced axially extending grooves and a plurality of axially extending ribs separating said grooves from one another, said grooves and said ribs terminating axially in a firing tip having a radial surface in a plane which is perpendicular to said centerbore, said surface having an area of 5 to 30% of the area of a circle in said plane having said radius, a center electrode positioned in said insulator, a substantially flat coil of spirally wound resistance wire having a first end connected to said center electrode and a second end connected to said ground electrode, said coil positioned on said surface of said firing tip wherein said surface provides solid support integral with said insulator for said coil without removing an excessive quantity of heat which adversely effects the operation of said coil.

2. A glow igniter as described in claim **1** wherein said firing tip portion has three axially extending ribs.

3. A glow igniter as described in claim **1** wherein said ribs are equally spaced from each other about said firing tip end portion.

4. A glow igniter as described in claim **1** wherein said resistance wire in said coil is in the form of a ribbon.

5. A glow igniter as described in claim **1** wherein said surface has an area of about 18 to 22% of the area of said circle.

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