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GLOW PLUG IGNITER

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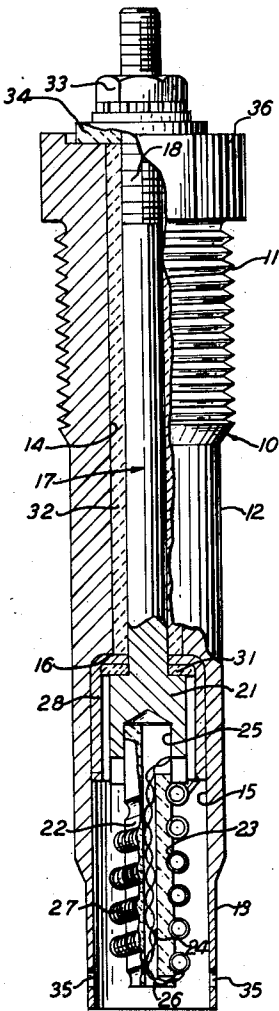


FIG. 1

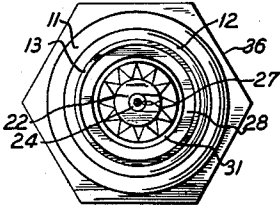


FIG. 2

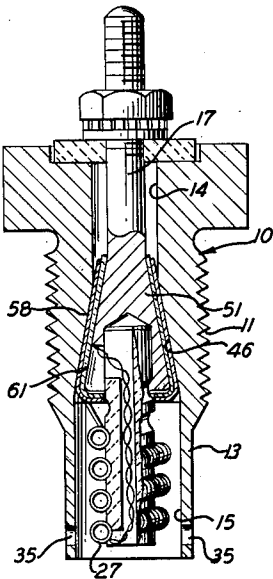


FIG. 3

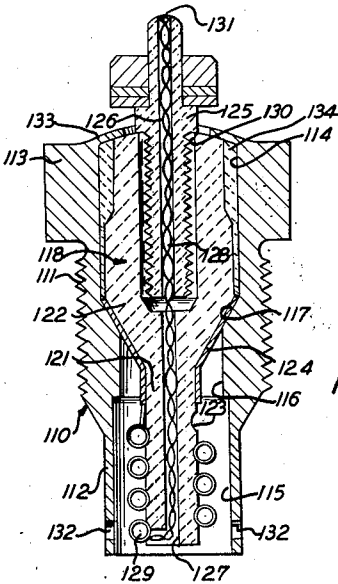


FIG. 4

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3,017,541 GLOW PLUG IGNITER

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This invention relates to a glow plug igniter and more particularly to a glow plug igniter which is especially adapted for use in the combustion chambers of gas turbine engines.

Although not so limited, the glow plug igniter of this invention is suitable for use in the heating means of the Elastic Fluid Power Plant disclosed in copending application Serial Number 650,446, filed April 3, 1957, in the names of Willis M. Clark, Jr., and Benjamin T. Howes, and assigned to the assignee of the present invention. Glow plugs used in this type of power plant must ignite a mixture of fuel and air which flows past the glow plug at quite high rates from the impetus of the compressor turbine. This high rate of flow past the igniter has always been a problem as this raw mixture of fuel and air tends to cool the igniter below ignition temperatures.

Under normal starting conditions, the resistance wire of a glow plug igniter must reach very high temperatures, on the order of 1500 to 3000 degrees F., for a period of ten seconds or more in order to ignite the fuel-air mixture. After combustion has been initiated and the glow plug has been de-energized, the end of the glow plug element will be exposed to high temperatures, for example, from 1400 to 1800 degrees F., for long periods of time while the engine is operating.

The present invention provides a glow plug igniter which is admirably suited for use in a gas turbine engine working under the above operating conditions. Briefly, the invention comprises a glow plug igniter with a body which is adapted to be affixed to the combustion chamber of a gas turbine engine. An electrical conductor, electrically insulated from the body of the glow plug, is mounted within the body along with a refractory support which is adapted to support a resistance wire. The body of the glow plug serves as one electrical terminal for the resistance wire while the electrical conductor serves as the other terminal. Preferably, the refractory support has a helical groove positioned in its outer periphery and the resistance wire, which is preferably helically coiled, is wrapped around this support member in the helical grooves, thus providing a large surface area of resistance wire for use in igniting the combustible mixture. The resistance wire is connected at one end to the body and the other end to the electrical conductor, both of these connections preferably being made a considerable distance from the end of the glow plug which is adapted to protrude into the combustion chamber. This feature provides for electrical connections in a region which is relatively cool during engine operation.

The end of the glow plug body preferably extends beyond the end of the refractory support and protrudes farther into the combustion chamber than does the resistance wire. The body has a series of apertures positioned therein in the vicinity of the resistance wire and preferably near the end of the refractory support. Such a structure prevents the resistance wire from being unduly chilled by the flow of raw fuel and air past the glow plug prior to ignition, while the apertures located adjacent the resistance wire causes turbulence of this fuel and air mixture adjacent the heated resistance wire which aids materially in the initiation of combustion.

An object of the present invention is the provision of a glow plug igniter for use in the combustion chamber of a gas turbine engine.

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A further object of the invention is the provision of a glow plug igniter for use in the combustion chamber of a gas turbine engine in which a large surface of heated resistance wire is exposed to a combustible mixture.

Another object is to provide a glow plug igniter for use in a gas turbine engine in which the resistance wire is protected against undue chilling from the flow of an unignited combustible fuel mixture past said glow plug prior to ignition.

A further object is the provision of a glow plug igniter for use in a gas turbine engine in which a structure to produce turbulence of unignited fuel-air mixture about the resistance wire is provided.

Still another object of the invention is the provision of a glow plug igniter for use in a gas turbine engine in which the electrical connections are made remote from the end of the glow plug which extends into the combustion chamber of the engine.

Other objects and attendant advantages of the present invention will become more apparent as the specification is considered in connection with the drawings in which:

FIGURE 1 shows a partial longitudinal sectional view of one embodiment of the invention;

FIGURE 2 is an end view of the embodiment shown in FIGURE 1;

FIGURE 3 shows a partial longitudinal sectional view of another embodiment of the invention;

FIGURE 4 is a partial longitudinal sectional view of another embodiment of the invention.

Referring now to the drawings there is shown in FIGURES 1 and 2, one embodiment of the present invention in which the numeral 10 designates the glow plug body as a whole. The glow plug may have a threaded portion 11 which is adapted to be fitted into the combustion chamber of a gas turbine engine, a portion 12 having a smaller diameter than the threaded portion 11, and a portion 13 of still smaller diameter which forms a sleeve about the igniter unit. As shown, the glow plug body has two internal bores 14 and 15 with the upper bore 14 having a smaller diameter than the bore 15, thereby forming a shoulder 16.

An inner assembly comprising an electrical conductor generally designated by the numeral 17 and a refractory support 22 is fitted into the body 10. The electrical conductor 17 is provided with a threaded end portion 18 and an enlarged end portion 21.

The refractory support 22 is preferably made of alumina, Al_2O_3 , and has a helical groove 23 formed in its outer surface, and a central bore 24 positioned therein. The refractory support is suitably positioned in a bore 25 in the enlarged end portion 21 of the electrical conductor 17. A resistance wire having a double twisted lead 26 is secured to the enlarged portion 21 of the electrical conductor 17 and said double twisted lead extends through the bore 24 to the end of the refractory support 22 at which point one of the leads terminates. The remaining lead is then formed into a helically coiled portion 27 which is positioned in the helical groove 23 of the refractory support 22. The end of the resistance wire is then suitably connected to a metallic sleeve 28 which fits in the bore 15 of the body 10 and against the shoulder 16. The sleeve 28 is electrically insulated from the electrical conductor 17 by means of a refractory insulating washer 31, preferably mica, positioned between said sleeve and the enlarged end portion 21 of the electrical conductor 17.

A suitable insulating sleeve 32 made, for example, of refractory ceramic, may be positioned in the bore 14 between the electrical conductor 17 and the body 10. The whole inner assembly comprising the electrical conductor 17, the refractory support 22 and the resistance wire is suitably secured in the body 10 by means of a nut 33

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which is threaded down on the threaded portion 18 of the electrical conductor 17. An insulating washer 34, preferably made of mica, is positioned between the body 10 and the nut 33 to maintain the electrical conductor 17 and the body 10 electrically isolated, so that the electrical conductor 17 can serve as one terminal of the glow plug and the body 10 can serve as the other terminal. The upper portion of the body member 10 may be provided with a hexagonal shaped portion 36 which may be used in tightening the glow plug igniter in a combustion chamber of a gas turbine engine.

It will be noted that the end of the body portion 13 extends beyond the end of the refractory support 22 and also beyond the helically coiled resistance wire 27. A plurality of apertures 35 may be positioned around the periphery of the portion 13 of the glow plug body. The body portion 13 shields the resistance wire from the cooling effect of the unignited fuel-air mixture prior to ignition while the apertures provide a means for producing desired turbulence about the resistance wire which aids materially in the ignition of the combustible mixture.

Provision of the helically coiled wire wound in the helically coiled grooves on the refractory support, provides a maximum of resistance wire exposure to the unignited fuel-air mixture, while connecting the resistance wire to the electrical conductor and the glow plug body remote from the end of the glow plug which protrudes into the combustion chamber keeps this connection, which may be of the soldered type, from exposure to elevated temperatures.

Provision of the shoulder 16 in the body member 10 and the enlarged end portion 21 of the electrical conductor 17 together with the sleeve 23 and insulating washer 31, provides a gas tight seal between the body member and the inner assembly of the glow plug igniter. As the gas pressure in the combustion chamber rises, the enlarged end portion 21 of the electrical conductor 17 will be forced against the insulating washer 31, sleeve 23 and the shoulder 16 thereby forming a gas tight seal and preventing separation of the inner assembly from the glow plug body.

FIG. 3 depicts a glow plug igniter similar to the one disclosed in FIGURES 1 and 2, except that the intermediate portion of the body between the two internal bores 14 and 15 forms a tapered portion 46. The enlarged end portion 51 of the conductor 17 is also tapered to complement the shape of portion 46. Similarly, sleeve 58 and insulating member 61 are so shaped to fit the contours of the enlarged end portion 51 and the tapered portion 46. This glow plug igniter provides all of the advantages of the igniter disclosed in FIGURES 1 and 2, and in addition, provides a greater surface area between tapered portion 46 of the body 10 and the tapered enlarged end portion 51 of the electrical conductor 17, thereby providing a larger sealing area for the prevention of gas leaks between the inner assembly and the body of the glow plug.

In the embodiment illustrated by FIG. 4, there is shown a glow plug igniter body generally designated by the numeral 110, having a threaded portion 111, a portion of reduced diameter 112, and a hexagonal shaped portion 113 which is adapted to receive a tool for securing the igniter body within the combustion chamber of a gas turbine engine. The body has a first internal bore 114, a second internal bore 115, and a third internal bore 116 of smaller diameter than either the bore 114 or 115. Preferably, the transition between the bore 114 and 116 is made by means of a tapered portion 117. A refractory support 118 having a portion of reduced diameter 121 and a tapered portion 122 is positioned within the bores in the body 110 with the tapered portion 122 being complementary in shape to the tapered portion 117. The portion of reduced diameter is similar to the refractory support 22 shown in FIGURES 1 and 3, and has a helical groove 123 positioned around the periphery thereof.

A sleeve 124 made of an electrical conductive material

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is positioned around the tapered portion 122 of the refractory support 118 and may extend down to encompass part of the portion of reduced diameter 121. This sleeve makes electrical contact with the tapered portion 117 of the body 110 and a resistance wire 129 is electrically connected thereto. As with the embodiments of FIGURES 1 and 2 and FIG. 3, this resistance wire is preferably helically coiled and positioned within the groove 123 in the refractory support.

The refractory support has an internal bore 130 which is adapted to receive an electrical conductor 125. The electrical conductor has an internal bore 126 which is aligned with a second internal bore 127 in the refractory support member. A twisted lead 128, which is an extension of the helically coiled resistance wire 129, extends through the bore 127 in the refractory support member and through the bore 126 in the electrical conductor where it is electrically connected to the conductor 125 at 131 by brazing or spot welding. As in the other embodiments of the invention a second twisted lead may be employed with lead 128 and may extend from the connection 131 to the end of the refractory support where it terminates.

The lower portion 112 of the body member 110 extends beyond the end of the refractory support member 118 and beyond the helically coiled resistance wire 129 to prevent undue cooling of the resistance wire by the flow of the unignited combustible mixture, and is provided with a plurality of apertures 132 which cause desired turbulence as previously discussed. Positioned at the top of the body is a flange 133 which extends to engage the refractory support 118 and to prevent the pressure in the combustion chamber from separating the refractory support 118 from the body 110. An insulating material 134, such as magnesium oxide, may be positioned between the refractory support 118 and the body 110.

All of the embodiments of the invention provide the advantages discussed particularly in connection with the embodiment disclosed in FIGS. 1 and 2. In addition, means are provided in all three embodiments to prevent the gas pressure developed in the combustion chamber from separating the inner assembly from the body of the glow plug igniter.

It will be understood that the invention is not to be limited to the exact construction shown and described, and that various changes and modifications may be made without departing from the spirit and scope of the invention, as defined in the appended claims.

What is claimed is:

1. A glow plug for use in the combustion chamber of a gas turbine engine comprising, a body for mounting the glow plug igniter within said combustion chamber, said body having a first internal bore extending from one end of said body to a point intermediate the ends thereof and a second internal bore extending from the other end of said body to said point intermediate the ends thereof thereby forming a shoulder in said body, an electrical conductor having an enlarged end portion, said electrical conductor being positioned within said first internal bore with the enlarged end portion being positioned within said second internal bore, insulating material positioned between one end of said enlarged end portion and said shoulder, a refractory support having a helical groove positioned in the periphery thereof being supported by the other end of the enlarged end portion of said electrical conductor, and a helically coiled resistance wire positioned in the helical groove of said refractory support and being electrically connected at one end to said body and at the other end to said electrical conductor, said body extending axially beyond said refractory support and said helically wound resistance wire at the end of said body which is adapted to be positioned within said combustion chamber, said body being imperforate from one end thereof to a position immediately adjacent the end thereof which extends beyond said refractory sup-

port and said helically wound resistance wire into said combustion chamber, said body having a plurality of apertures positioned around the periphery thereof immediately adjacent said end adapted to be inserted in the combustion chamber and immediately adjacent the end of said refractory support and said electrical resistance wire, the enlarged end portion of said electrical conductor engaging the shoulder in said body formed between said first internal bore and said second internal bore through said insulating material thereby preventing the fluid pressure which is developed within said combustion chamber from separating said refractory support and said helically coiled resistance wire from said body.

2. A glow plug igniter for use in the combustion chamber of a gas turbine engine comprising, a body portion for mounting the glow plug igniter within said combustion chamber, said body having a first internal bore extending from one end of said body to a point intermediate the ends thereof and a second internal bore of larger diameter than said first internal bore extending from the other end of said body and terminating short of said first internal bore, a tapered portion joining said first and said second internal bores, an electrical conductor having an enlarged tapered end portion, the enlarged tapered end portion being positioned within the tapered portion of said body, electrical insulating material being positioned between said tapered portions with the remainder of the electrical conductor being positioned within said first internal bore and being electrically insulated from said body, a refractory support having a helical groove positioned in the periphery thereof being supported by the enlarged end portion of said electrical conductor, a helically wound resistance wire positioned in the helical groove in said refractory support and electrically connected at one end to said electrical conductor and at the other end to said body, said body extending axially beyond said refractory support and said helically wound resistance wire at the end of said body which is adapted to be positioned within said combustion chamber, said body being imperforate from one end thereof to a position immediately adjacent the end thereof which extends beyond said refractory support and said helically wound resistance wire into said combustion chamber, said body having a plurality of apertures positioned around the periphery thereof immediately adjacent to said end adapted to be inserted in the combustion chamber and immediately adjacent the end of said refractory support and said electrical resistance wire, the tapered enlarged end portion of said electrical conductor engaging the tapered portion of said body through said electrical insulating material thereby preventing the fluid

pressure which is developed within said combustion chamber from separating said refractory support and said helically coiled resistance wire from said body.

3. A glow plug igniter for use in the combustion chamber of a gas turbine engine comprising, a body portion for mounting the glow plug igniter within said combustion chamber, said body having an internal bore, a refractory support having an enlarged end portion and a reduced end portion positioned within said bore, said enlarged end portion having an internal bore, said reduced end portion also having an internal bore, an electrical conductor positioned within the internal bore of the enlarged end portion of said refractory support, the smaller end portion of said refractory support having a helically groove positioned therein, a helically coiled resistance wire positioned in said helical groove and being electrically connected at one end to said body, a twisted extension of the other end of said resistance wire extending through the internal bore in the reduced end of said refractory support and being electrically connected to said electrical conductor, said body extending axially beyond the end of the reduced end of said refractory support and said helically coiled resistance wire, at the end of said body which is adapted to be positioned within said combustion chamber, said body being imperforate from one end thereof to a position immediately adjacent the end thereof which extends beyond said refractory support and said helically wound resistance wire into said combustion chamber, said body having a plurality of apertures positioned therein immediately adjacent the smaller end of said refractory support and said helically coiled resistance wire, said body having a flange extending therefrom over said internal bore and engaging the enlarged end portion of said refractory support for preventing the fluid pressure which is developed within said combustion chamber from separating said refractory support and said helically coiled resistance wire from said body.

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