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AUTOMATICALLY RETRACTABLE SPARK PLUG FOR GAS TURBINES

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Fig. 1.

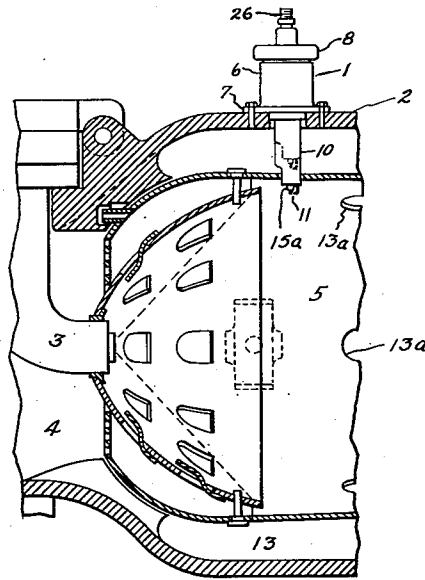
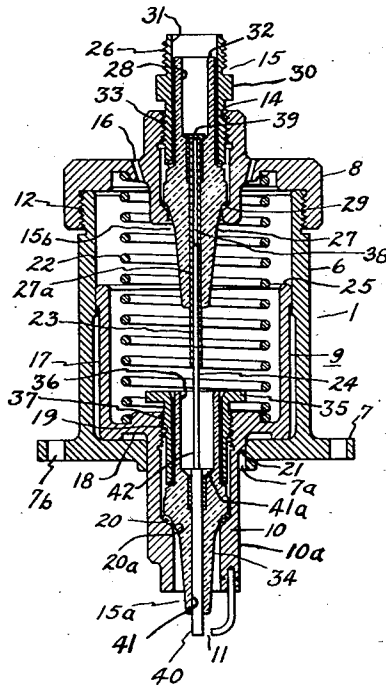


Fig. 2.



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AUTOMATICALLY RETRACTABLE SPARK
PLUG FOR GAS TURBINESDonald C. Berkey, Scotia, N. Y., assignor to Gen-
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3 Claims. (Cl. 175-115)

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This invention relates to an ignition device for a mixture of fuel and compressed air, and more particularly it relates to an automatically retractable electric igniter for a combustion chamber in a gas turbine system.

In a gas turbine power plant, air from a compressor is sent to a combustion chamber, fuel is mixed with the air, the mixture is burned, and the products of combustion drive a gas turbine. The burning of the fuel and air is a continuous combustion process, as compared with the intermittent or cyclic burning in the cylinder of an automobile engine. An ignition device is required to initiate the combustion, but once the burning has started, the igniter has no further function and if it is left in the hot gas stream, its electrodes may become carbonized, the carbonization necessitating frequent replacement of the igniter.

An object of this invention is to provide an improved igniter of the electric spark-plug variety for a gas turbine type combustion chamber.

A further object of this invention is to provide an automatically retractable ignition device for a combustion chamber whereby the igniter is removed from the stream of hot gases to prevent carbonization of the electrodes.

Broadly, this invention comprises means for initiating continuous burning within a combustion chamber of a gas turbine power plant, and a device including a piston and cylinder arrangement for automatically removing the igniter from the stream of hot gases after combustion has been initiated.

Further objects and advantages of this invention will become apparent and the invention will be better understood from the following description referring to the accompanying drawings and the features of novelty which characterize this invention will be pointed out with particularity in the claims annexed to and forming a part of this specification.

Referring to the drawing annexed to this specification, Fig. 1 is a sectional view of a combustion chamber for a gas turbine incorporating the improved ignition device; and Fig. 2 is a sectional view of the ignition device by itself.

An ignition device 1 is shown in operative association with a combustion chamber 2 in Fig. 1. Fuel entering combustion chamber 2 through a nozzle 3 is mixed with compressed air entering through a passage 4. The mixture is burned in a chamber 5; the products of combustion driving a gas turbine (not shown).

Ignition device 1 comprises a cylindrical body

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portion 6 having a flange 7, a cap 8, a cup-shaped member or piston 9 (shown in Fig. 2) having a protrusion 10 that carries an igniter 11.

Body portion 6 of the ignition device is a cylindrical tube-like member rigidly secured to the flange 7, which is shaped to conform to the outer surface of chamber 2. Flange 7 includes a plurality of openings 7b which permit the device to be removably secured to the wall of the combustion chamber 2. At the upper end of the cylindrical member of body portion 6, a threaded portion 12 is provided to accommodate cap 8, thus allowing the cap to be removably secured to body portion 6. Cap 8 has an opening 14 therein to house a first electrode assembly 15b. In the cap 8, a plurality of openings 16 are also provided as pressure release openings keeping the air or gases within the cylindrical member at a pressure equal to atmospheric.

Piston 9 comprises a skirt portion 17 and an end portion 18 which has an opening 19 that accommodates the first electrode assembly 15b. Protrusion 10 is a component part of end 18 of piston 9 and it is of a size that permits it to be inserted through an opening 7a in flange 7.

Opening 19 extends completely through protrusion 10 of piston 9 and is provided with a shoulder or reduced section 20a for limiting the insertion of a second electrode assembly 15a therethrough. A gasket 20, positioned between igniter member 15a and shoulder 20a in opening 19, prevents highly compressed gases within the combustion chamber from leaking into body portion 6 of the ignition device. Three flat surfaces 10a spaced 120° apart are cut or ground on the lateral surfaces of protrusion 10. The purpose of the flat surfaces is to increase the area of gas passage between protrusion 10 and the opening 7a in flange 7. These flat surfaces start at a "cut-off" shoulder 21, which is located on protrusion 10. Shoulders 21 are arranged to be within flange 7 when piston 9 is fully extended. This construction allows the operating pressure of the combustion chamber to act initially upon an area roughly equal to that of a transverse cross section through protrusion 10. The piston 9 is spring biased and moves only gradually upward when normal operating pressure acts on the cross section area of protrusion 10. This action retains the igniter in the gas stream for a reasonable time after combustion is initiated within the combustion chamber. After protrusion 10 has been moved up to a position where the cut-off shoulder 21

is above the top of flange 7, compressed air from the air supply chamber 13 passes through the openings formed by the flat surfaces 10a and acts upon the total projected area of the piston 18, instead of the much smaller effective area of the protrusion 10. This considerably increases the force acting in opposition to the spring 22, whereupon piston 9 is then removed from its extended position suddenly, rather than by the gradual motion initially caused by gas pressure acting on protrusion 10 alone.

Coil spring 22 is disposed within skirt 17 of piston 9, and is under compression between cap 8 of the cylinder and end 18 of the piston. The spring is under sufficient compression to hold end 18 of the piston against the flange 7, forcing protrusion 10 and electrode member 15a carried thereby into the combustion chamber. The spring force is opposed by normal operating pressure within the combustion chamber to an extent that permits electrodes 40, 11 to be removed from the hot gas stream when the combustion chamber comes up to normal operating pressure during the starting cycle.

Any of the hot gases that may leak between the skirt 17 of the piston and the wall of the body portion 6 escape through the openings 16 in cap 8 to the atmosphere.

Igniter 15 comprises the first electrode assembly 15b, the second electrode assembly 15a, connected electrically by a pair of telescoping electrodes 23, 24.

Electrode assembly 15b comprises an insulator 27 of porcelain or the like having a central opening 27a extending axially therethrough. Insulator 27 is inserted through central opening 14 provided in cap 8 and is separated from direct contact therewith by a gasket 29. A bushing 30, having an axial bore 31 large enough to accommodate an extended portion 32 of insulator 27, is inserted over extended portion 32 and a threaded portion 33 on bushing 30 engages a threaded portion of opening 14 in end cap 8 to rigidly secure insulator 27 to end cap 8. Bushing 30 is further provided at its upper end with a threaded portion 26 for engaging a conduit (not shown) adapted to conduct a high voltage ignition cable (not shown) into opening 28 in insulator 27.

The second electrode assembly 15a of igniter 15 is generally similar in construction to the first portion 15b. Portion 15a is provided with an insulator 34 which extends through protrusion 10 on piston 9. Insulator 34 is cushioned from direct contact with protrusion 10 by gasket 20. A bushing 35, having a central opening large enough to accommodate extended portion 36 of insulator 34, is inserted thereover and its threaded portion 37 is brought into engagement with the threaded portion of bore 19.

The hollow electrode 23 fits securely in a bore through insulator 27 and extends axially therefrom towards portion 15a. A central axial opening 38 extends completely through electrode 23. Electrode 23 is secured in insulator 27 by a cap 39 which is arranged to contact the high voltage cable terminal connected to threaded fitting 26.

The movable electrode 24 has an enlarged portion 40 extending through a central bore 41 in insulator 34 and is sealed in place by a sleeve 41a. A reduced electrode portion 42 extends from base portion 40 into the bore 38 in electrode 23. Reduced portion 42 is freely slidable in bore 38 of electrode 23. Any air gap which may exist between reduced portion 42 and the bore 38 is easily

jumped by the high potential current passing through the electrodes. End portion 40 of electrode 24 projects from insulator 34 to form a spark gap with a grounded electrode 11 secured to the end of protrusion 10.

The component parts of the igniter are assembled in the following manner. First, the second electrode assembly 15a is inserted into opening 19 in the protrusion 10. Piston 9 is inserted into the body portion 6 with protrusion 10 extending through the aperture 7a in flange 7. Spring 22 is loosely placed against the inner end surface of piston 9 and cap member 8 is screwed onto housing 6. The first electrode assembly 15b of the igniter is then inserted through the aperture 14 in cap member 8, electrode 23 coming into telescoping engagement with the movable electrode 24. After securing housing 6 to the combustor wall, a high tension power cable (not shown) may be removably connected to the fitting 23 at the end of igniter 15. Then when a high voltage is applied to the power cable, current travels down electrode 23, across the gap formed by the telescoping portions of the electrodes and out through electrode 24 to the spark gap defined by electrodes 40, 11.

In operation, this retractable spark plug functions in the following manner. To start a gas turbine of the type described, a starting motor (not shown) cranks an air compressor (not shown). The cranking speed is adequate to force some air through inlet 4 in combustion chamber 2, thence through outer passageway 13 and openings 13a into the actual combustion space 5. The air pressure built up by the starting motor driving the compressor is not great enough to effect movement of protrusion 10 against the bias of spring 22; but it is sufficient to initiate self-sustaining combustion. Fuel is now injected through nozzle 3 into this compressed air, and the mixture is ignited by a spark across electrodes 40, 11 of the igniter. The products of combustion from the burning so initiated drive a gas turbine (not shown) which is directly connected to the air compressor that supplies compressed air to opening 4 of the combustion chamber. The gas turbine gradually increases in speed, in turn building up the discharge pressure of the air compressor and that of the air in passageway 4 until normal operating speed of the turbine is reached.

Spring 22 within the automatically retractable spark plug is adapted to maintain the piston 17 in the position shown in Fig. 2 at all pressures below normal operating pressure of the combustion chamber. Consequently, the electrodes 40, 11 remain in the combustion space until normal pressure is reached, whereupon the pressure acting on the bottom of protrusion 10 forces piston 9 away from flange 7. The motion of protrusion 10 out of the combustion space is at a slow rate as compressor discharge pressure gradually increases until shoulder 21 on protrusion 10 passes the inner edge of opening 7a in flange 7. Then, however, the air pressure acts on the total bottom surface 18 of the piston member 9. This greatly increased force rapidly retracts the igniter points 40, 11 out of the hot combustion chamber and into the cool air stream traveling from inlet 4 through passageway 13. This retracted position is indicated by the dotted line position in Fig. 1. Edge 25 on skirt portion 18 of piston 9 strikes the inner surface of cap 8 and limits the withdrawal of protrusion 10 from the combustion chamber.

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The limiting position is so arranged, however, that the ignition points are completely withdrawn from the actual combustion space and into the cool air stream passing through passage-way 13.

Any compressed air or gases that pass extended portion 15b of the igniter or which pass skirt 17 of piston member 9 into body portion 6 exit to the atmosphere through apertures 16 in cap 8. The withdrawal of the protrusion 10 from the hot combustion chamber keeps the electrodes 40, 11 of the igniter from carbonizing, thus maintaining them in good operating condition much longer than if they were continuously exposed to the hot gas stream within the combustion space.

While for convenience in description the combustion supporting fluid is referred to as "air," it will be obvious that the igniter of this invention may be equally applicable to other thermal reaction devices, such as rocket motors, in which other fluid reactants are used.

Modifications of this invention will occur to those skilled in the art and it is desired to be understood, therefore, that this invention is not to be limited to the particular arrangement disclosed, but that the appended claims are meant to cover all modifications which do not depart from the spirit and scope of this invention.

What I claim as new and desire to secure by Letters Patent of the United States is:

1. An electric ignition device for combustion apparatus to which a pressure fluid is supplied during normal operation and discontinued when the apparatus is shut down comprising a cylindrical body member having one open end and a central opening in the other end, a piston member slidably disposed in the body and having a protruding end portion, means resiliently biasing the piston to an extended position in which the protruding piston portion projects through said central opening, an end cap closure member secured to the open end of the body and having a central opening and at least one pressure relief passage therethrough, a first insulated electrode assembly secured in the central opening of the end cap and having a first electrode projecting axially into the housing, a second insulated electrode assembly secured in a central bore through the protruding piston por-

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tion and having a second electrode with a first end portion projecting from the exterior end of the assembly and defining a spark gap with a grounded electrode carried by the piston protrusion, said second electrode having a second end portion slidably engaging the first electrode in electrical conducting relation therewith for all positions of the movable piston, the body being adapted to be secured to the combustion apparatus with the protruding piston end portion subjected to the pressure of the fluid supply whereby during normal operation said pressure will maintain the piston in retracted position.

2. An electric ignition device in accordance with claim 1 in which the protruding piston end portion has at least one circumferential portion cooperating with the body to define a passage for communicating fluid pressure to the entire end surface of the piston and a cut-off portion adapted to interrupt such communication of pressure fluid to the piston when in fully extended position, whereby the pressure fluid will initially act on the protruding piston end portion only and initial movement of the piston against the bias of the resilient means effects communication of pressure fluid through said passage to cause further rapid movement of the piston to the fully retracted position.

3. An electric ignition device in accordance with claim 1 in which the slidably engaged electrode portions are in telescopic relation.

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