Jan. 3, 1961 J. A. IRWIN 2,967,224

HOT WIRE IGNITER

Filed Oct. 8, 1956 3 Sheets-Sheet 1

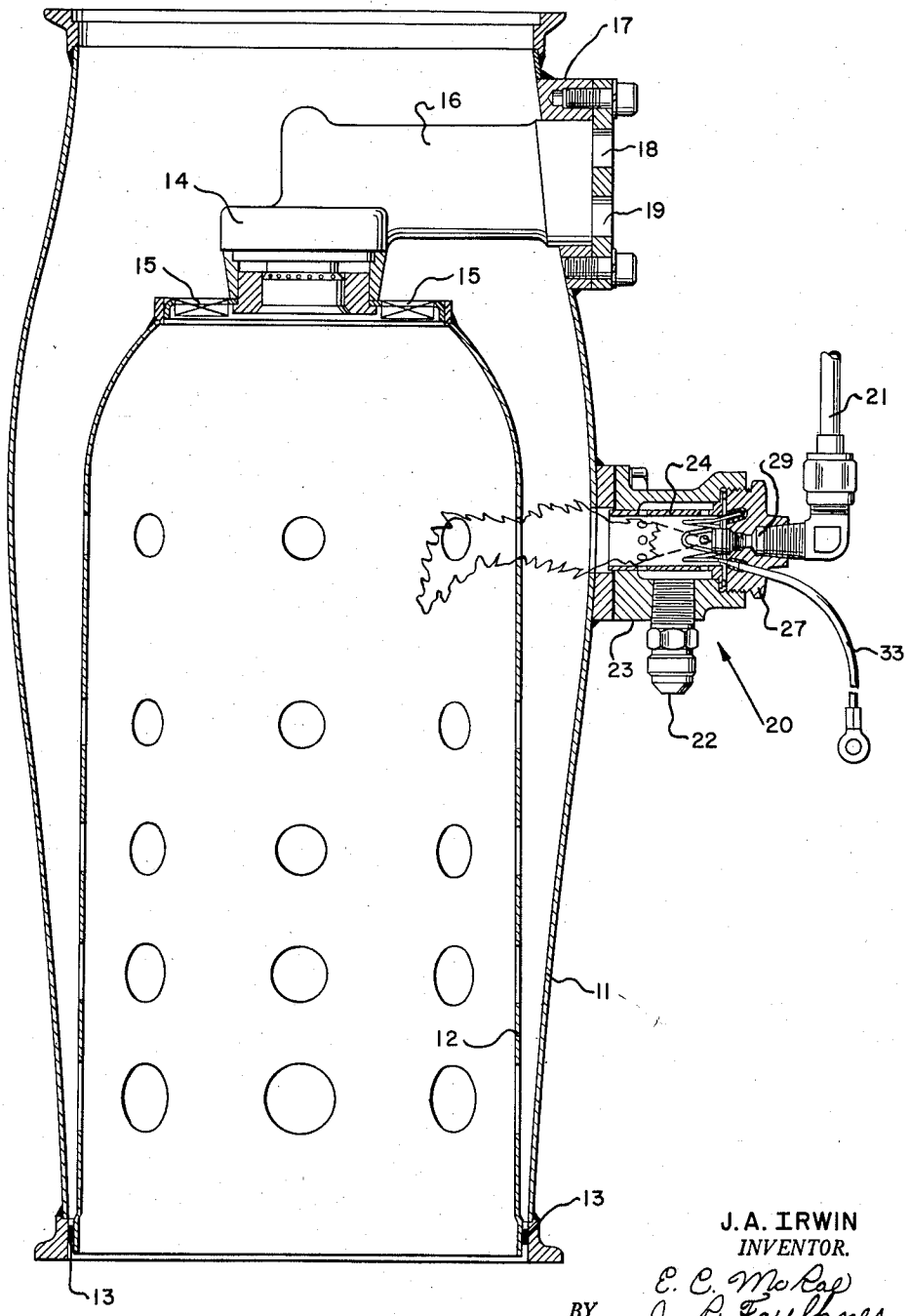


FIG. 1

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HOT WIRE IGNITER

Filed Oct. 8, 1956 3 Sheets-Sheet 2

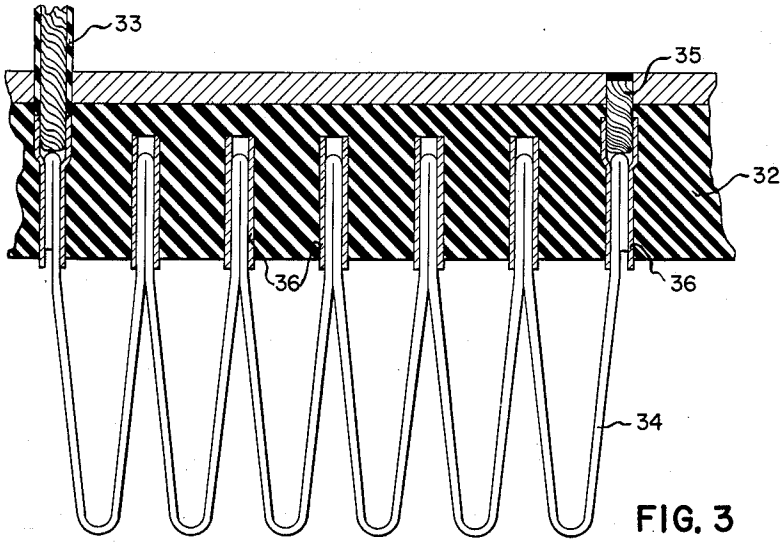


FIG. 3

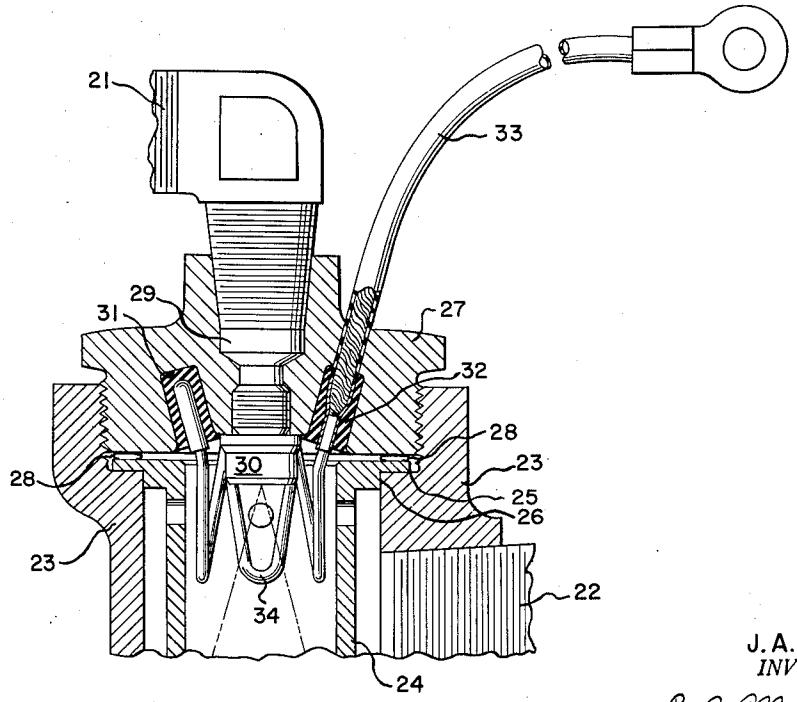


FIG. 2

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HOT WIRE IGNITER

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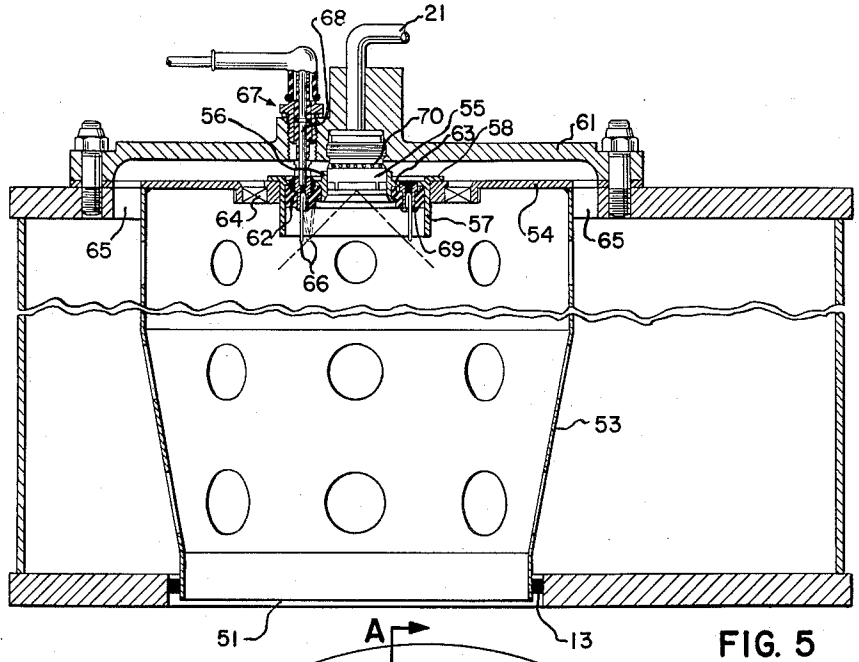


FIG. 5

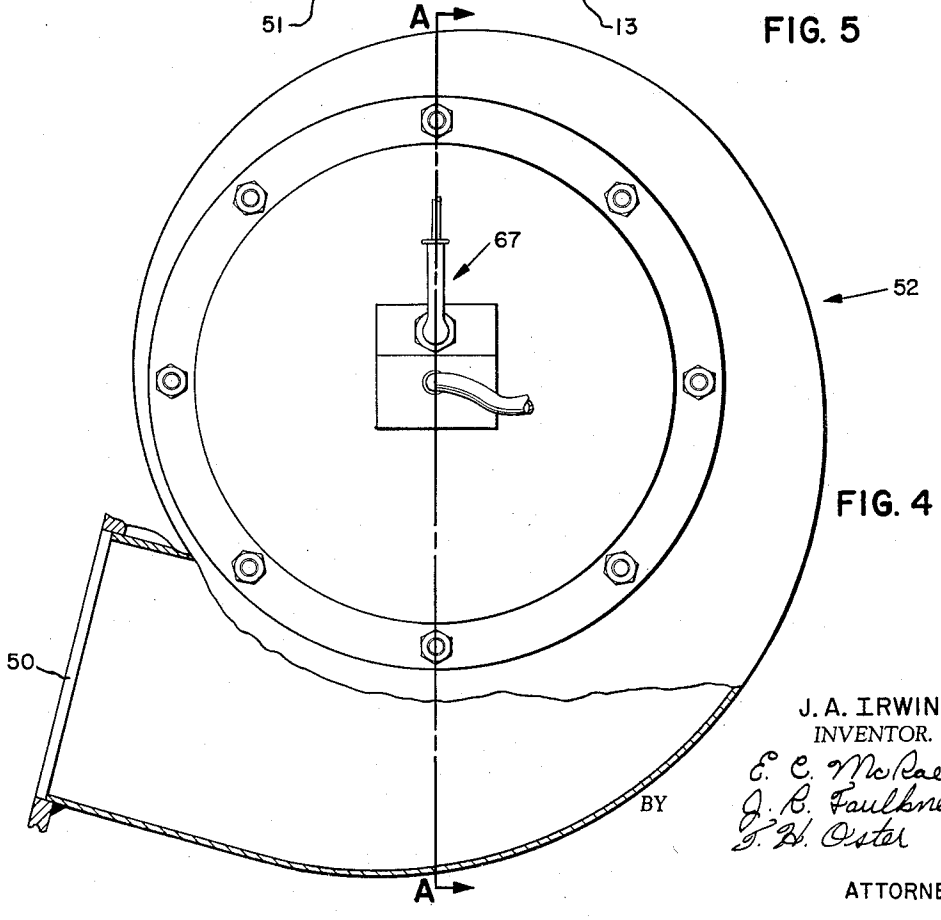


FIG. 4

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HOT WIRE IGNITER

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10 Claims. (Cl. 219—32)

This invention relates to an improved igniter for use in the combustion section of a gas turbine or the like although it is by no means so limited.

It is common practice in the gas turbine art to employ a small igniter to initiate combustion of the air fuel mixture. A hot wire or glow plug igniter is generally preferred over a spark plug igniter to eliminate the expense of the ignition coil and shielded lead necessary in the latter type.

Unfortunately, conventional glow plugs are fragile because the hot ignition wire is an unsupported spiral coil which must be rather short and thin so that it will support its own weight. The geometry of the glow plugs now in use is such that the heat from the hot wire is not directed to the fringe of the fuel spray where the proper air fuel mixture first occurs. Furthermore, the geometry of the conventional coil requires that it be placed directly in the path of the atomized fuel spray, consequently, the quenching action of the fuel impinging on the coil delays its heating to a temperature sufficient to ignite the fuel which results in slow and erratic starting.

Accordingly, it is an object of this invention to provide an igniter in which the hot wire is located at the periphery of the fuel spray where the proper fuel air ratio first occurs and where the igniter is not quenched.

Another object is to provide a glow plug which is compact and rugged and in which the ignition wire is supported along its length.

Still another object is to provide a glow plug in which the hot wire is so positioned that it is not cooled by the quenching action of the fuel spray impinging upon it.

These and many other objects will become apparent upon inspecting the specification and drawings which show for illustrative purposes two embodiments of my invention as they might appear in typical gas turbine combustion assembly.

Figure 1 is a somewhat schematic representation of my igniter in a typical gas turbine assembly,

Figure 2 is a longitudinal section showing of my igniter in greater detail,

Figure 3 is a developed view of my ignition wire,

Figure 4 is a top view of a second embodiment of my invention, wherein my igniter is used in another manner, and

Figure 5 is a section taken along line A—A' of Figure 4.

Referring more particularly to Figure 1, it is apparent that the combustion assembly comprises a tubular outer casing **11**, the forward end of which receives air from the compressor (not shown) and the rear or discharge end communicates with the turbine (also not shown). A shorter flame tube **12** is mounted coaxially within the outer casing while a series of projections **13** maintain proper alignment of the flame tube within the casing. In the foreward end of flame tube **12** is mounted a main fuel nozzle **14** aligned with the longitudinal axis of the flame tube. Around the outer periphery of this nozzle is a primary air swirler **15** which tends to impart a

peripheral component to that portion of the air flowing directly into the flame tube **12** thereby insuring good mixing and combustion in the flame tube. The remainder of the air flows in the annular space between the flame tube **12** and casing **11**. Some of this air enters the combustion chamber within the perforated flame tube **12** through the first row of openings in the wall of this tube and may serve to augment the supply of air for combustion of the fuel. But by far the greater portion of the air flowing in the annulus enters through the other perforations and acts as "secondary air," i.e., it dilutes the hot products of combustion and serves to cool them to the temperature required at the power turbine. A hollow nozzle strut **16** extends radially outward from nozzle **15** to the outer casing **11** and is securely mounted at **17**. Strut **16** performs two functions, not only does it support the nozzle and the foreward end of flame tube **12** but it also provides a flow path for fuel inlet and return lines **18** and **19** respectively. A torch igniter **20** is mounted in the wall of the outer casing intermediate between the main nozzle strut and the discharge of the combustor while the fuel inlet **21** of the igniter is tapped off the main fuel line and the air inlet **22** is connected to a compressor bleed. It is to be understood that the details of the combustor assembly do not, per se, form part of this invention and for that reason are shown rather schematically and are not explained in greater detail.

Referring now to Figures 2 and 3 which show one embodiment of the igniter in greater detail; it is composed of a cylindrical body portion **23**, having air inlet port **22** in its wall. A combustion liner **24** depends within body **23** from a shoulder **25** and is held in spaced concentric relation to **23** by a stepped pilot diameter **26**. A conducting cap **27** is threaded into the upper end of body **23** and by means of a gasket **28** seals the peripheral lip of a combustion liner **24**. A fitting **29** positions the fuel nozzle **30** within an appropriate bore in cap **27** and at the same time provides a connection between the fuel supply and the nozzle. Circular groove **31** is machined or otherwise formed in the cap and is filled with an insulating material as seen at **32**. An insulated cable **33** leading from a power source (not shown) passes through cap **27** and extends into the insulating material where it connects to one terminal of the igniter wire **34** (which may be chromel "A" for example). This wire extends downwardly from the cover into the interior of combustion liner **24** and loops upwardly back into the insulating material **32** in the cap at a distance from the first portion of the wire embedded in the insulation. The wire forms a series of these supported loops in almost a complete circle concentric with the center of the fuel nozzle. The terminal portion of the wire is connected to a conductor **35** (best seen in Figure 3) which is embedded in the metal cap or ignition wire support **27** which provides a ground connection for the wire. In the drawings I have shown the cap as being metallic and having an insulation insert therein. It is to be understood, however, that I do not wish to be limited to that specific embodiment; if desired, the whole cap may be fabricated of non-conducting material and the hot wire grounded to some other part of the turbine machinery.

Each portion of wire **34** which is embedded in the insulating material is surrounded by a small sleeve **36** of conducting material (such as beryllium copper) which acts as an electrical conductor to prevent local overheating of the wire within the insulating material which might lead to spalling and chipping of the insulation and ultimate loosening of the wire.

Operation

Air from inlet **22** enters the combustor liner through the perforations so that it uniformly mixes with the outer

periphery of the atomized cone of fuel from nozzle 30 and is ignited by the electrically heated wire 34 which encircles the fuel spray and therefore directs its heat at the outer periphery of the spray where the proper combustible air-fuel mixture is first formed. The liner 24 is used to meter the incoming air; the relative amounts of air and fuel can be altered by varying the hole size, the amount of air or the amount of fuel admitted to the igniter. Since the ignition wire surrounds the periphery of the spray, it is not cooled by the spray impinging upon it so that a torch is formed in a matter of a few seconds. This torch enters the main flame tube 12 through one or more of the holes in this tube and ignites the fuel from the main nozzle 14. Immediately upon ignition of the main fuel spray the combustion within flame tube 12 becomes self-sustaining and the turbine continues in operation without the aid of the igniter.

Figures 4 and 5 show another embodiment of the invention in which the glow plug ignites the main fuel stream directly, thereby eliminating the torch. As shown in these figures, a scroll type combustor 52 assembly having an air intake at 50 and a gas discharge at 51 is employed in this embodiment. The geometry of the scroll case 52 is designed to maintain constant pressure at all points on the periphery of the flame tube and houses an inner perforated flame tube 53 which is secured to the annular plate 54 in any suitable manner. A dished igniter cover 61 which is bolted at the end of the casing remote from the discharge 51 through the periphery of the annular plate 54 serves also as an igniter retaining means. A fuel nozzle 55 is mounted in this cover and extends through an appropriate hole in plate 54. The nozzle 55 serves to align the inner sleeve 56 of the igniter assembly which surrounds it while an elongated concentric outer cylinder 57 fits within the central hole in plate 54 and together with sleeve 56 forms the body of the igniter. A lip 58 on cylinder 57 is seated against the upper face of this plate 54. An annular insulating ring 62 is pressed into the space between cylinders 56 and 57 and the lower edge of cylinder 56 is crimped or flanged to hold the insert in place against a metallic ring 63 of the igniter formed integral with the cylinders. A plurality of air swirlers surround the igniter as shown at 64 while ports 65 are formed in plate 54 encircling flame tube 53. The igniter wire 66 depends from the insulation ring 62 in a series of loops encircling the fuel nozzle in a manner similar to that shown in Figures 2 and 3. A standard automotive snap-on terminal shown generally at 67 provides the electrical connection for the wire through contact rod 68 and the first of the conducting sleeves 69. As is apparent in the drawing, the first sleeve 69 is insulated from ring 63 while the final sleeve is soldered or brazed to this ring to provide a ground connection.

In this embodiment the air from the compressor which may be preheated in a heat exchanger enters at 50, the major portion of this air spirals around in the annular space between the flame tube and scroll case and enters the flame tube where it dilutes the hot combustion products and exits at 51. The "primary" or combustion air passes through ports 65 into the space above plate 54 where it divides into two streams: the smaller portion enters ports 70 in the fuel nozzle and flows internally of the nozzle to wipe or clean the nozzle face. The major portion of this air flows through swirlers 64 and forms a combustible air-fuel mixture at the fringes of the fuel spray where it is ignited by the heat from the ignition wire. Cylinder 57 serves to protect the ignition wire from the direct flow of the air passing through the swirlers which would tend to cool the wire.

While the invention has been shown in but a few preferred embodiments, it will be obvious to those skilled in the art that it is not so limited but is susceptible of various changes and modifications without departing from the spirit thereof.

I claim:

1. A hot wire igniter comprising, a resistance wire formed into a plurality of W-shaped projections, a conducting sleeve segment terminating the top of each projection, said segments carried in spaced relationship in a dielectric.

2. An ignition wire arrangement comprising a resistance wire formed into a plurality of repeated angular bends with top portions formed into acute angles, said top portions carried in spaced relationship in a dielectric, and means short-circuiting said top portions in said dielectric.

3. The arrangement of claim 2 wherein said means include metal sleeves pressed over said portions in said dielectric.

4. An igniter comprising, an ignition wire supporting means, an electrically heated ignition wire dependent from said supporting means in a plurality of loops embedded in said supporting means at spaced intervals, means supplying electricity to said ignition wire, and means for shorting out those portions of the ignition wire which are embedded in the supporting means.

5. An igniter comprising, an ignition wire support including a portion of insulating material, an electrically heated ignition wire dependent from said support in a plurality of loops, said loops embedded in the insulating material of said support at spaced intervals, and means for shorting out those portions of the ignition wire which are embedded in said insulating material.

6. An igniter comprising an open ended body cylinder, a cap secured to said body cylinder, a resistance wire grounded at one end and dependent from said cap conductor means connected to the end of said resistance wire remote from said grounded end for supplying current to electrically heat said resistance wire, said cap including a portion of insulating material, said wire embedded in said insulating material at spaced intervals, and means for shorting out of the circuit those portions of the resistance wire which are embedded in said insulating material.

7. A hot wire igniter comprising loops of resistance wire formed in a plurality of generally W-shaped projections, an annulus of dielectric, the top portions of said projections being embedded at spaced intervals in said annulus of dielectric, and means short circuiting said top portions.

8. A hot wire igniter comprising a resistance wire formed in a plurality of generally W-shaped projections, an annulus of dielectric, a portion of said projections embedded at spaced intervals in said annulus of dielectric, and metal sleeves surrounding adjacent projections in electrical contact therewith for short circuiting the portions of said projections embedded in said annulus of dielectric.

9. A hot wire igniter comprising a resistance wire formed in a plurality of loops, a body of insulating material, each of said loops having terminal portions embedded in said body of insulating material, and means for short circuiting the terminal portions of adjacent loops.

10. A hot wire igniter comprising a resistance wire formed in a plurality of loops, a body of insulating material, each of said loops having terminal portions embedded in said body of insulating material, and a metal sleeve surrounding and in electrical contact with terminal portions of adjacent loops for short circuiting the terminal portions of adjacent loops.

References Cited in the file of this patent

UNITED STATES PATENTS

976,221	Scrimgeour	Nov. 22, 1910
1,670,819	Morris et al.	May 22, 1928
1,721,910	Kemble	July 23, 1929
1,755,846	Steed	Apr. 22, 1930

(Other references on following page)

5

UNITED STATES PATENTS

2,530,827	Lakota et al.	Nov. 21, 1951
2,648,951	McDougal	Aug. 18, 1953
2,701,445	Andrews et al.	Feb. 8, 1955
2,708,252	Cohn	May 10, 1955
2,731,079	Smits	Jan. 17, 1956
2,760,340	Seglem	Aug. 28, 1956
2,761,947	Rice et al.	Sept. 4, 1956
2,795,220	Atwood et al.	June 11, 1957

6

FOREIGN PATENTS

359,104	Great Britain	Oct. 22, 1931
616,481	Great Britain	Jan. 21, 1949
621,789	Great Britain	Apr. 20, 1949