Dec. 23, 1958 N. P. COUPE 2,865,441

IGNITERS FOR GAS TURBINE ENGINES, COMBUSTION HEATERS, THERMAL DE-ICING PLANTS AND THE LIKE

Filed Feb. 15, 1955 2 Sheets-Sheet 1

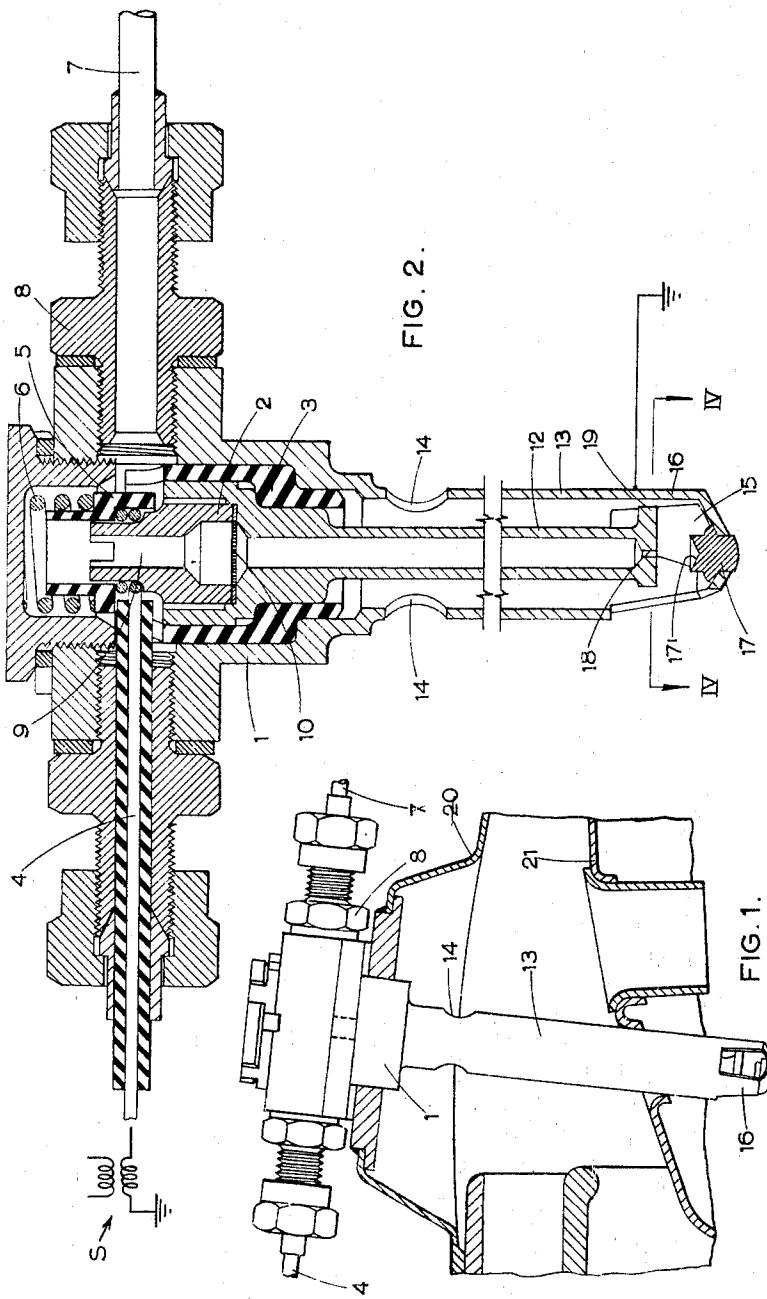

FIG. 2.

FIG. 1.

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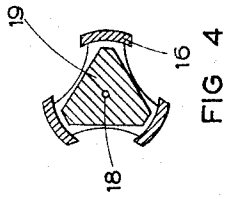

FIG 4

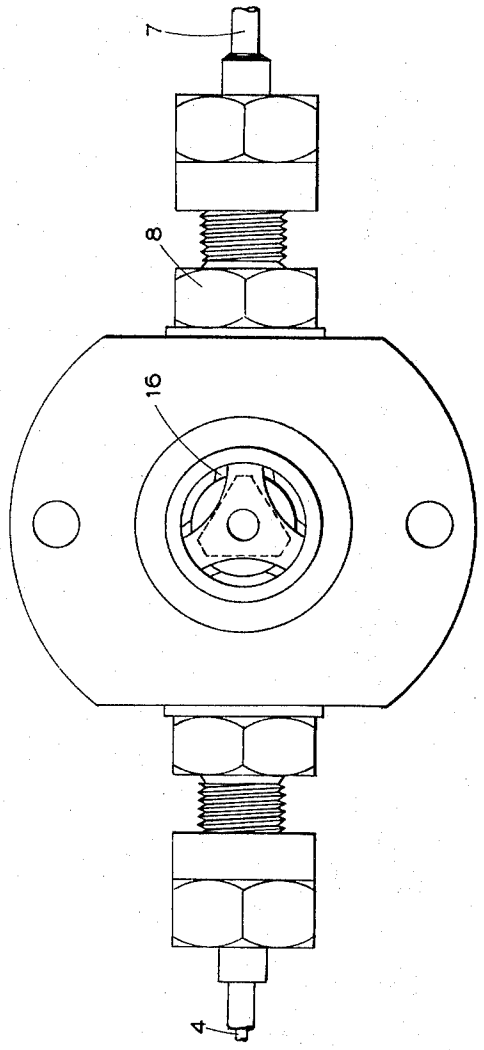

FIG. 3.

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IGNITERS FOR GAS TURBINE ENGINES, COMBUSTION HEATERS, THERMAL DE-ICING PLANTS AND THE LIKE

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Claims priority, application Great Britain March 2, 1954

2 Claims. (Cl. 158—28)

This invention relates to igniters for gas turbine engines and combustion heaters such as those used in thermal de-icing plant and is concerned with that type of igniter, commonly called a torch igniter, through which a stream of liquid pilot fuel flows to sustain a flame for igniting the main combustion fuel in the combustion chamber of the engine or heater.

The devices at present in use rely on a spark from a sparking plug to ignite an atomised flow of liquid pilot fuel and whilst these devices operate successfully at initial starting when the speed of the combustion air is at only a fraction of its normal speed during operation of the engine or heater, they are not entirely satisfactory when it is necessary to re-light the main combustion fuel during operation of the engine or heater at which time the combustion air flow more closely approaches operational speed with the result that the igniter fails to light or is blown out before the main fuel is ignited.

Now the object of the present invention is to provide an improved construction of torch igniter, which will generate a stable penetrating flame, suitable also for re-ignition purposes, in which the greater the flow of the combustion air the stronger will be the flame.

To this end, according to the present invention, the liquid pilot fuel flows through a tube and issues as a jet to strike a part carried by an outer tube through which combustion air flows so that the pilot fuel fans out therefrom in an atomised state to pass through apertures in such outer tube and be ignited by sparks generated between such pilot fuel conveying tube and the portions of the outer tube intermediate the apertures therein.

The liquid pilot fuel may be led to the fuel pipe in any convenient manner and a booster coil or other appropriate source of electrical energy is likewise connected in any convenient manner to such tube which may be of relatively simple construction as it is only necessary that it terminate in an orifice through which the pilot fuel may jet and also be formed to extend into proximity to the portions of the combustion air conveying tube intermediate the apertures therein.

The part on which the jet of pilot fuel impinges is formed as a recessed cone so that such fuel is deflected back by its tapered surface and is projected as a divergent spray in an atomised state, some of which passes out through the orifices whilst the remainder is projected between the extended portions of the fuel tube and the adjacent portions of the combustion air tube to be ignited by the sparks which jump between those parts when the source of electrical energy is connected to the pilot fuel tube.

With a torch igniter designed according to the present invention the combustion air which will flow through the outer combustion air tube during the operation of the engine heater or the like will cool that portion of the device.

Now in order that the invention may be clearly understood and readily carried into effect an embodiment thereof is by way of example hereinafter more fully described with reference to the accompanying drawings which are given for purposes of illustration only and not of limitation.

In these drawings:

Figure 1 is an elevation of the torch igniter shown in position in a section of a gas turbine engine,

Figure 2 is a sectional elevation of the torch igniter shown on an enlarged scale,

Figure 3 is an under plan view looking on the underside of Figure 2, and

Figure 4 is a cross section taken on the line IV—IV of Figure 2.

Referring now to the said drawings, and in particular to Figure 2 thereof, the torch igniter in the form illustrated has a head portion comprising an outer part **1** and an inner or core part **2** which is electrically insulated from the outer part **1** by electrical insulating material **3** comprising for example, a mass of nylon or other convenient material. Electric current from a booster coil or other source of electrical energy is carried by the cable **4** to the core **2**, the electrical connection to which is completed by the part **5** which is acted upon by the spring **6**. Liquid pilot fuel conveyed by the conduit **7** is taken through the union **8** to flow in around the upper part of the core **2**, the part **5**, spring **6** and end of the cable **4**. The fuel then passes down an axial bore **9** in the core **2**, through a filter **10**, and into the tube **12** which is in electrical contact with the core **2**.

An outer tube **13** conveniently integral with the outer part **1** extends concentrically around the tube **12** and this tube **13** has an orifice or orifices **14** adjacent the head for entry of combustion air which flows down between the tubes **12** and **13**. At the opposite end of the tube **13** apertures **15** are provided and the portions **16** of the tube **13** between such apertures **15** are shaped or otherwise adapted to carry a part **17** which is formed with a recessed conical surface **17'**. The end of the tube **12** is constricted to form an orifice **18** through which fuel flowing through the tube **12** may jet to impinge on the recessed conical surface **17'** to be deflected and fan out therefrom in an atomised state. The tube **12** has its end shaped to provide portions **19** extending into proximity to the portions **16** of the tube **13**. Thus the greater part of the atomised fuel is projected through the apertures **15** whilst the remainder is projected into the gaps between the parts **16** and **19** to be ignited by the sparks which will bridge such gaps when the electric current is switched on.

In use the torch igniter has its head disposed exteriorly of the outer casing or combustion air annulus **20** around the combustion chamber wall **21** with the tube **13** extending through the combustion chamber wall **21** into the flame tube or main combustion zone substantially as shown in Figure 1. Due to this disposition of the torch igniter the combustion air in the casing or annulus **20** flows in through the orifice or orifices **15** through the tube **13** and into the combustion chamber.

Now when it is desired to ignite or re-ignite the main combustion fuel, the supply of pilot fuel is switched on so that such pilot fuel flows through the conduit **7**, the head of the device, and through the tube **12** to spray out in atomised form as above described. The booster coil or the like is connected so the current flows through the cable **4** to the core **2** so that now sparks jump between the parts **19** of the tube **12** and the parts **16** of the tube **13** to ignite the pilot fuel entering the gaps therebetween and in turn ignite the main spray of atomised pilot fuel.

The combustion air entering the orifice or orifices **14** and flowing through the tube **13** supports combustion and gives rise to a stable flame of strong penetrating power. When the main fuel has been successfully ignited the pilot fuel is switched off as is also the booster coil.

The air flowing through the tube **13** during operation of the turbine engine or combustion heater cools the device down to a permissible temperature.

It will be appreciated that the new design of fuel atomising means and the means for igniting the same may be combined with other forms of head for leading fuel to the tube **12** and for supplying electric current to that tube.

I claim:

1. A torch igniter for gas turbine engines and combustion heaters such as those used in thermal de-icing plants, comprising a straight inner fuel conveying tube provided at its outer end with a jetting orifice, an outer tube surrounding and spaced from said inner tube and insulated therefrom, said outer tube having at least one air inlet aperture adjacent its inner end, a plurality of circumferentially spaced extension portions at the outer end of said outer tube forming discharge apertures, a deflector and atomizer element carried by said extensions of said outer tube in spaced relation to said jetting orifice and having an indented conical surface in its upper face concentric with said jetting orifice, a plurality of radial projections each extending from the outer end of said inner tube to points inwardly of said extension portions of said outer tube between said discharge apertures, said discharge apertures extending between transverse planes spaced inwardly and outwardly of said projections, and means for establishing an electrical potential between said tubes whereby sparks are created between said projections and the adjacent portions of said outer tube whereby to ignite said fuel.

2. In combination, a torch igniter according to claim 1 and an internal combustion device, said combustion device having an inlet for combustion air and a combustion chamber which are separated by a partition, said igniter extending through said partition with said air inlet aperture disposed at the combustion air inlet side of said partition and with said discharge apertures disposed at the combustion chamber side of said partition.

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