PATENT SPECIFICATION (11) 1 559 779

1 559 779

(21) Application No. 46152/75 (22) Filed 7 Nov. 1975
(23) Complete Specification filed 28 Oct. 1976
(44) Complete Specification published 23 Jan. 1980
(51) INT CL³ F23D 11/38
(52) Index at acceptance F4T BX GT

(72) Inventors GORDON EDWARD ANDREWS and GEORGE EDWARD BUNN

(19)



(54) COMBUSTION ASSEMBLY

(71) We, LUCAS INDUSTRIES LIMITED, a British Company of Great King Street, Birmingham, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to a combustion assembly, and more particularly, though not exclusively, to a combustion assembly for a gas turbine engine.

According to the present invention, there is provided a combustion assembly comprising a baffle plate having a plurality of apertures therethrough which are distributed substantially evenly over at least a portion of the baffle plate; air supply means arranged in use to supply air to an upstream side of the baffle plate for passage through said apertures; and a plurality of fuel spraying devices mounted on said at least a portion of the baffle plate, each fuel spraying device including a body having air and fuel passages therein and at least one outlet communicating with said passages so that a mixture of air from the air passage and fuel from the fuel passage is ejected therefrom in use, the outlets of the fuel spraying devices being disposed on a downstream side of the baffle plate and being arranged to eject the fuel/air mixture in a pattern which is in correspondence to the disposition of the aperture so that substantially uniform mixing of the fuel/air mixture from the fuel spraying devices and the air passing through said aperture is ensured.

Preferably, each fuel spraying device has a plurality of outlets which extend substantially radially of the respective body and which are arranged to eject said fuel and air mixture from the fuel spraying device in a substantially radial direction in use.

Conveniently, a fuel outlet orifice of the fuel passage of each fuel device is aligned with the or each said outlet in the body of the fuel spraying device.

The or each outlet in the body of each fuel spraying device may extend towards one of said air admission apertures, and may be arranged to eject said fuel and air mixture therefrom into the path of air passing through that aperture in use. However, it is also within the scope of the invention for the or each outlet to extend towards a portion of the baffle plate which separates adjacent air admission apertures.

Advantageously, the body of each fuel spraying device comprises two parts, of which a first, nozzle part contains said at least one outlet and has an abutment which engages the baffle plate on the downstream side thereof and a spigot which extends through an opening in the baffle plate, and a second, collar part is engaged with said spigot, the baffle plate being clamped between the collar part and the abutment on said nozzle part.

The combustion assembly preferably also comprises a flame tube having an inlet opening in which said baffle plate and said fuel spraying devices are disposed, said fuel spraying devices being distributed over substantially the whole area of said inlet opening.

An embodiment of the present invention will now be described, by way of example, with reference to the accompanying drawings in which:—

Fig. 1 is a schematic sectional view of a combustion assembly according to the present invention, applicable to a gas turbine engine;

Fig. 2 is a section on the line B—B in Fig. 3 of a fuel spraying device forming part of the assembly of Fig. 1;

Fig. 3 is a section on the line A—A in Fig. 2; and

Fig. 4 is an enlarged fragmentary view of a baffle plate forming part of the assembly of Fig. 1.

Referring first to Fig. 1, the gas turbine combustion assembly comprises a tubular flame tube 10 having an axial inlet opening 11. Disposed in opening 11 is a unitary baffle plate 12 having a plurality of identical fuel

spraying devices 13 mounted thereon and supported thereby. Part of the baffle plate 12 is shown is detail in Fig. 4. The fuel spraying devices 13 are distributed on an hexagonal grid over substantially the whole area of the inlet opening 11. A plurality of air admission apertures 14 extend through the baffle plate 12, and are disposed between the fuel spraying devices 13. In use, air is supplied to an upstream side of the baffle plate 12 and flows through the aperture 14.

One of the fuel spraying devices 13 is shown in detail in Figs. 2 and 3. This device 13 includes a body 16 constructed in two parts — a nozzle part 17 and a collar part 18. The nozzle part 17 comprises a head portion 19 and an integral hollow spigot 20 which is screw-threaded on its external surface. Six radially extending outlet passages 21 are provided in the head portion 19, and are equi-angularly spaced about the axis of the body 16. The outlet passage 21 communicates with an annular air passage 22 which extends axially through a spigot 20. The air passage 22 co-axially surrounds a fuel passage 23 defined by a tubular wall 24, which wall 24 is integral with an end wall 25 of nozzle part 17 and which extends axially beyond the end of spigot 20. The fuel passage 23 communicates with the outlet passages 21, and fuel outlet orifices 26 of the fuel passage 23 are aligned with the outlet passages 21. In use, fuel from the fuel passage 23 and air from the air passage 22 mixed within the device 13, and the resultant mixture is ejected from the outlet passages 21, in a substantially radial direction. The fuel passage 23 is connected to a fuel supply pipe 27 see Fig. 1 at end thereof remote from end wall 25.

The collar part 18 of body 16 has an axial bore 29 extending therethrough, which bore 29 comprises a cylindrical portion 30 and an inwardly tapered portion 31 communicating therewith. The cylindrical portion 30 is screw-threaded, and engages the screw-threading on spigot 20 of nozzle part 17. The inwardly tapered portion 31 surrounds the fuel passage 23, and communicates directly with air passage 22 in nozzle part 17.

Each fuel spraying device 13 is mounted on baffle 12 in the following manner. The junction between head portion 19 and spigot 20 of nozzle part 17 forms an annular abutment, which engages the downstream side of baffle plate 12 with respect to the intended direction of air flow through the engine and the spigot 20 extends through an opening 33 (Fig. 4) in the baffle plate 12. The collar part 18 is screwed onto spigot 20 on the upstream side of the baffle plate 12, and the baffle plate 12 is thereby clamped between collar part 18 and the said abutment on nozzle part 19.

In this particular embodiment, each fuel spraying device 13 is orientated such that each of the outlet passages 21 extends towards one of the apertures 14 surrounding the device 13. In this way, the fuel and air mixture is ejected from device 13 into the path of air passing through the apertures 14. However, in an alternative embodiment (not shown), the outlet passages 21 extend towards portions of the baffle plate 12 which separate adjacent apertures 14.

From the above, it will be apparent that fuel for the gas turbine engine is premixed with air within the fuel spraying devices 13, is ejected from the latter, and is then further mixed with the air flowing through the apertures 14 in the baffle plate 12. In view of the fact that the fuel outlet orifices 26 are aligned with the outlet passages 21 in each device 13, and also in view of the fact that the outlet passages 21 are arranged to eject the fuel and air mixture on the downstream side of baffle plate 12, impingement of the fuel on metal surfaces is substantially avoided. The fuel is atomised for the most part by air passing through the fuel spraying devices 13; the air passing through the apertures 14 in the baffle plate 12 can be used, however, to atomise large fuel droplets.

In addition, the disposition of the apertures 14 in baffle plate 12 ensures that substantially uniform mixing occurs between the fuel and air mixture ejected from the fuel spraying devices 13 and the air flowing through the apertures 14. In this way, fuel-rich pockets in the flame tube 10 are substantially avoided. This enables the amounts of pollutants, particularly the oxides of nitrogen, in the engine exhaust to be reduced by using a reduced temperature of combustion. It also serves to reduce the amount of cooling air required for the combustion assembly.

The applicants have found that mixing of the air and fuel improves as the percentage pressure loss across the baffle is increased. Moreover, the rate of mixing can be varied by varying the distance between each fuel spraying device and its surrounding apertures in the baffle plate.

WHAT WE CLAIM IS:—

1. A combustion assembly comprising a baffle plate having a plurality of apertures therethrough which are distributed substantially evenly over at least a portion of the baffle plate; air supply means arranged in use to supply air to an upstream side of the baffle plate for passage through said apertures; and a plurality of fuel spraying devices mounted on said at least a portion of the baffle plate, each fuel spraying device including a body having air

and fuel passages therein and at least one outlet communicating with said passages so that a mixture of air from the air passage and fuel from the fuel passage is ejected therefrom in use, the outlets of the fuel spraying devices being disposed on a downstream side of the baffle plate and being arranged to eject the fuel/air mixture in a pattern which is in correspondence to the disposition of the apertures so that substantially uniform mixing of the fuel/air mixture from the fuel spraying devices and the air passing through said apertures is ensured.

2. A combustion assembly as claimed in claim 1, wherein each fuel spraying device has a plurality of outlets which extend substantially radially of the respective body and which are arranged to eject said fuel and air mixture from the fuel spraying device in a substantially radial direction in use.

3. A combustion assembly as claimed in Claim 1 or 2, wherein a fuel outlet orifice of the fuel passage of each fuel spraying device is aligned with the or each said outlet in the body of the fuel spraying device.

4. A combustion assembly as claimed in Claim 1, 2 or 3, wherein the or each outlet in the body of each fuel spraying device extends toward one of said air admission apertures, and is arranged to eject said fuel and air mixture therefrom into the path of air passing through that aperture in use.

5. A combustion assembly as claimed in Claim 1, 2 or 3, wherein the or each outlet extends towards a portion of the baffle plate which separates adjacent air admission apertures.

6. A combustion assembly as claimed in any preceding claim wherein the body of each fuel spraying device comprises two parts, of which a first, nozzle part contains said at least one outlet and has an abutment which engages the baffle plate on the downstream side thereof and a spigot which extends through an opening in the baffle plate, and a second, collar part is engaged with said spigot, the baffle plate being clamped between the collar part and the abutment on said nozzle part.

7. A combustion assembly as claimed in any preceding claim further comprising a flame tube having an inlet opening in which said baffle plate and said fuel spraying devices are disposed, said fuel spraying devices being distributed over substantially the whole area of said inlet opening.

8. A combustion assembly substantially as hereinbefore described with reference to the accompanying drawings.

MARKS & CLERK,
Alpha Tower,
ATV Centre,
Birmingham B1 1TT.
Agents for the Applicants.

Printed for Her Majesty's Stationery Office by the Courier Press, Leamington Spa, 1980.
Published by the Patent Office, 25 Southampton Buildings, London, WC2A 1AY, from which copies may be obtained.

1559779 COMPLETE SPECIFICATION
2 SHEETS *This drawing is a reproduction of the Original on a reduced scale*
Sheet 1

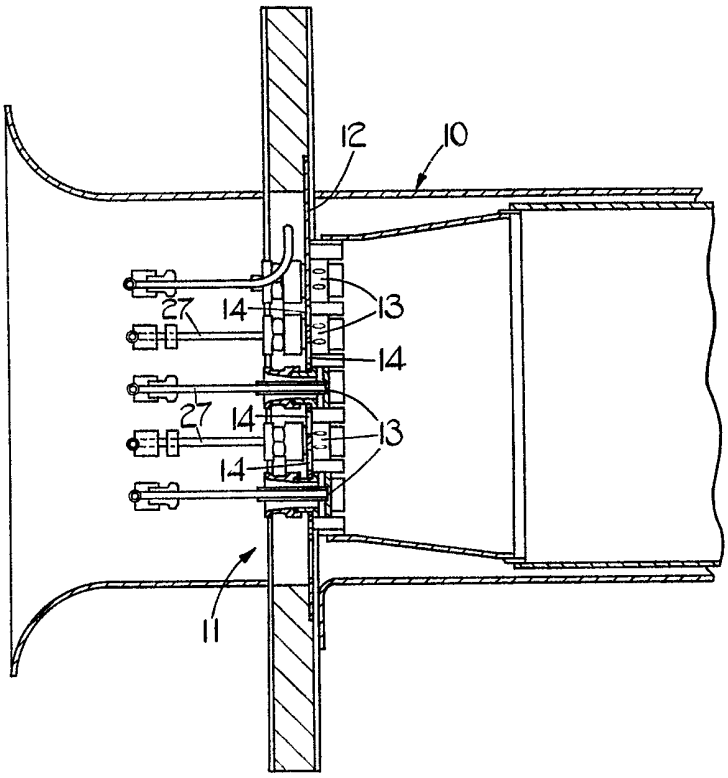
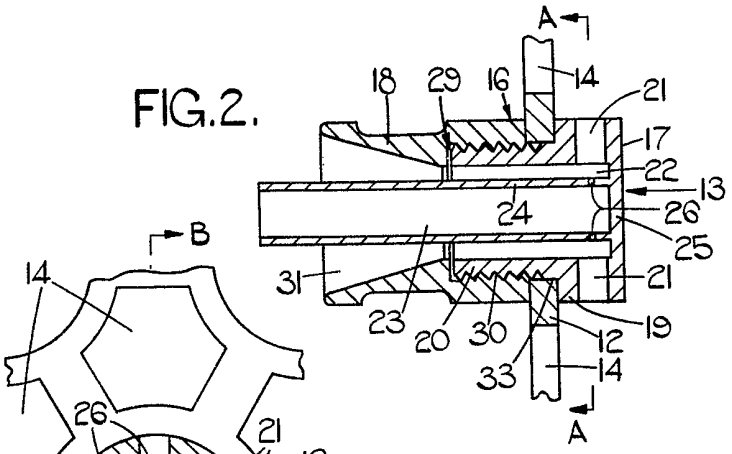


FIG.1.

FIG.2.



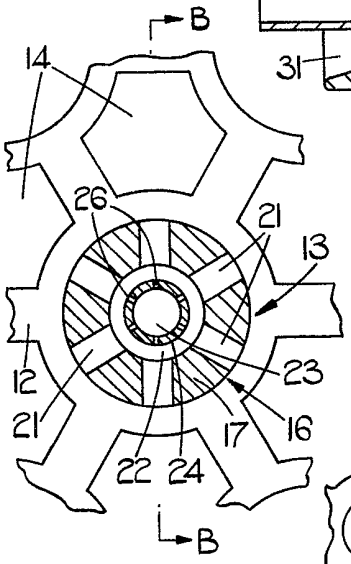


FIG.3.

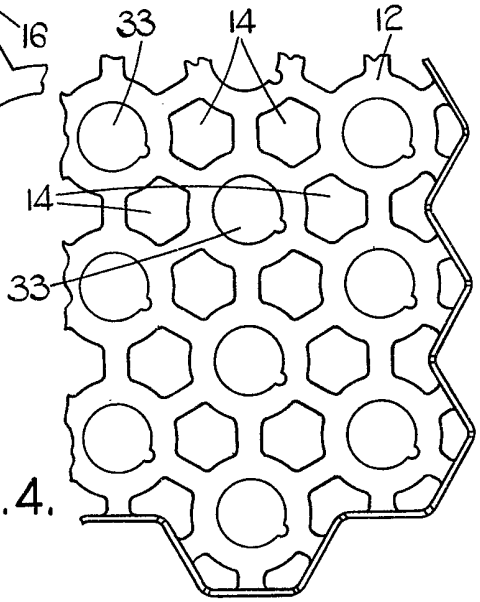


FIG.4.