

- [54] **GAS TURBINE ENGINE COMBUSTION APPARATUS**
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[73] Assignee: **The Secretary of State for Defence in Her Britannic Majesty's Government of the United Kingdom of Great Britain and Northern Ireland, London, England**

[22] Filed: **Jan. 31, 1972**

[21] Appl. No.: **221,952**

[30] **Foreign Application Priority Data**

Feb. 2, 1971 Great Britain 3,657/71

[52] U.S. Cl. **239/132.5, 239/424.5, 239/433, 239/533, 60/39.74 R**

[51] Int. Cl. **F02g 1/00, B05b 7/04**

[58] Field of Search **239/132.5, 127.3, 239/403, 406, 433, 425.5, 419.5, 421, 422, 424.5, 424, 291, 533; 60/39.74 R**

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Primary Examiner—Robert S. Ward, Jr.

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[57] **ABSTRACT**

A fuel burner assembly for a gas turbine engine has a number of main fuel ducts each one of which opens cut into an annular duct which surrounds the main fuel nozzle. Air is arranged to flow through the annular duct and completely atomise the main fuel flow and this is particularly the case at low fuel flows when it is sometimes difficult to ensure that complete atomisation takes place.

7 Claims, 4 Drawing Figures

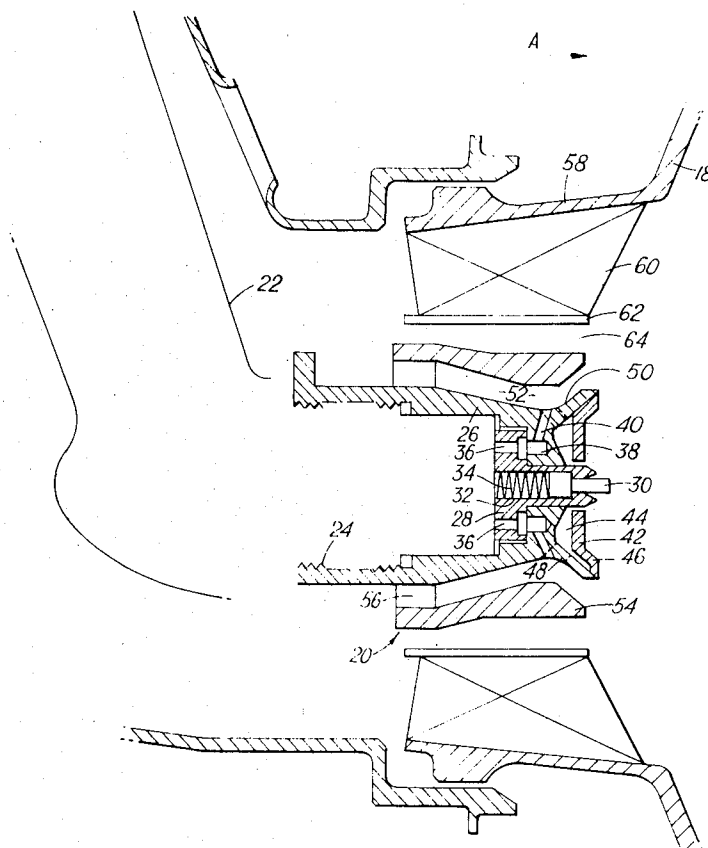


Fig. 1.

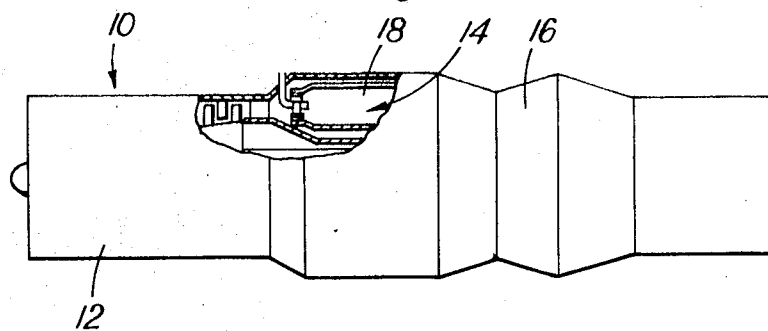


Fig. 3.

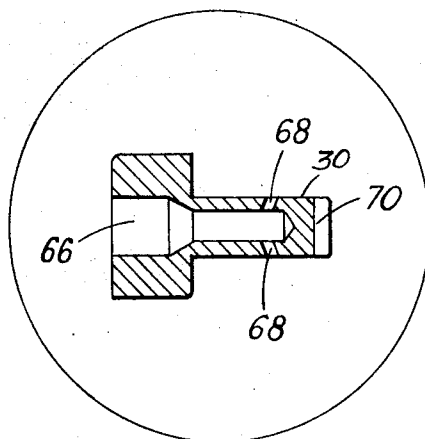


Fig. 4.

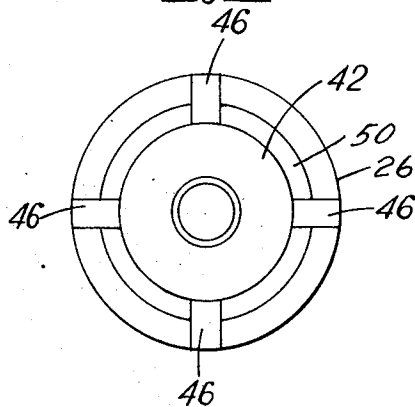
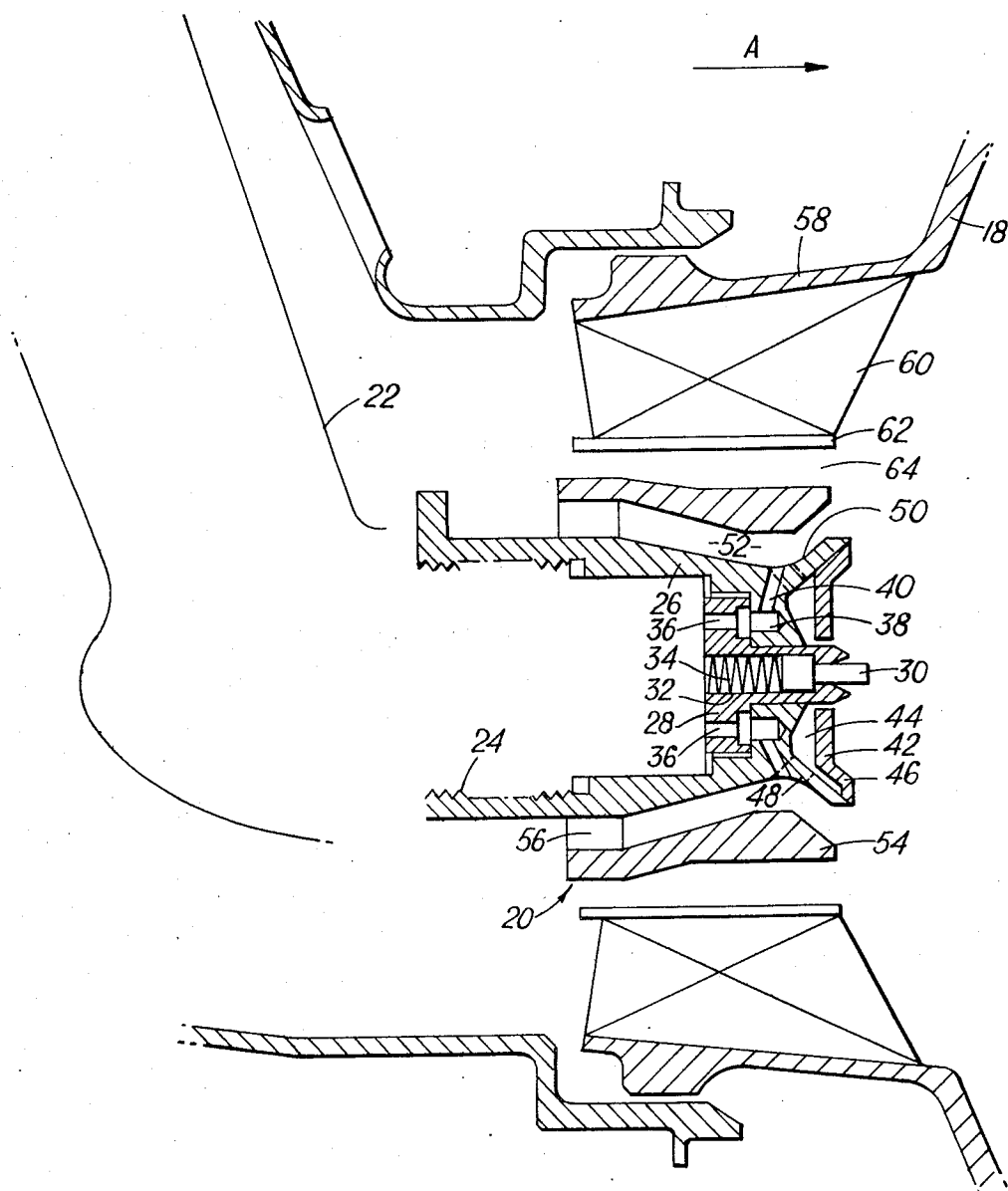


Fig. 2.



GAS TURBINE ENGINE COMBUSTION APPARATUS

This invention relates to combustion apparatus for gas turbine engines and is concerned with burner assemblies for such engines.

At low fuel flows it is sometimes difficult to ensure that all the main fuel is atomised and the present invention seeks to provide a burner assembly in which substantially complete atomisation takes place at low fuel flow.

According to the present invention there is provided a fuel burner assembly for a gas turbine engine, the burner assembly including a main fuel nozzle having a plurality of fuel supply ducts, each of said ducts being arranged to receive a supply of fuel and an annular air supply duct surrounding the main fuel nozzle, the said annular air duct arranged to receive a supply of air and the fuel supply ducts being in communication with the air supply duct.

Each of the fuel supply ducts may comprise two portions, one portion extending in the axial direction and the other portion extending radially and in a downstream direction and opening out into the air supply duct.

The air supply duct may be formed by the outer surface of the main fuel nozzle and the inner surface of a ring member which is attached to the main fuel nozzle by a number of radially extending projections.

The burner assembly may include a primary fuel nozzle and a primary fuel injector the primary fuel nozzle being retained in position by the attachment of the main fuel nozzle to a fuel feed arm, the primary fuel injector being retained in position by a spring biasing the injector against a shoulder formed on the primary fuel nozzle.

A heat shield may be attached to the downstream face of the main fuel nozzle and a number of apertures may be provided in the main fuel nozzle to connect the air supply duct with the recess which is formed between the main fuel nozzle and the heat shield. By this means, a supply of air can flow into the recess and out around the heat shield to prevent the deposition of carbon.

The invention will now be more particularly described with reference to the accompanying drawings in which,

FIG. 1 shows a diagrammatic layout of a gas turbine engine having one or more fuel burners according to the present invention,

FIG. 2 shows a part sectional elevation to an enlarged scale of one of the burners and part of one of the combustion chambers shown in FIG. 1.

FIG. 3 shows in greater detail the shown primary fuel injector shown in FIG. 2 and

FIG. 4, shows a part end elevation of FIG. 2.

In FIG. 1, a gas turbine engine 10 has compressor means 12, combustion means 14 and turbine means 16. The combustion means 14 comprises a ring of equi-spaced combustion chambers 18 each being provided with a burner assembly 20 which is shown in detail in FIG. 2.

In FIG. 2 the burner assembly 20 is attached to a fuel feed arm 22 which is provided with ducts (not shown) for the flow of the primary fuel and the main fuel, the burner assembly 20 being screwed into the end of the feed arm at 24.

The burner assembly 20 comprises a main fuel nozzle 26 which is screwed onto the fuel feed arm and locates and retains a primary fuel nozzle 28. A primary fuel injector 30 is located in a central bore 32 of the primary fuel nozzle 28 and is biased in the downstream direction (indicated by arrow A) by a coil spring 34. The primary fuel duct in the feed arm 22 is in communication with the bore 32 and a number of circumferentially equi-spaced ducts 36 in the primary fuel nozzle 28 are in communication with the main fuel duct in the feed arm 22. Each duct 36 is axially aligned with a blind hole 38 and each hole 38 is in communication with an inclined duct 40. The ducts 40 are inclined in a downstream direction at an angle of 65° to the longitudinal axis of the burner assembly.

A heat shield 42 is positioned in a recess 44 formed in the main fuel nozzle 26 and is held in position by four welded tags 46. The heat shield has a central bore formed with a projection (not shown) which engages with an axial slot (not shown) in the primary fuel nozzle 28 to prevent rotation of the nozzle 28.

A number of circumferentially arranged equi-spaced ducts 48 are formed in annular flange 50 of the nozzle 26 and communicate between the recess 44 and an annular duct 52 with which the ducts 40 also communicate. The ducts 48 are inclined in an upstream direction at an angle of 45° to the longitudinal axis of the burner assembly and serve for the passage of high pressure air from the duct 52 into the recess 44.

The duct 52 is formed between the main fuel nozzle 26 and a ring shaped member 54 which is secured to the nozzle 26 on a number of equi-spaced radially extending arms 56. The outer and inner surfaces of the nozzle 26 and ring 54 respectively are so shaped that the duct 52 is inclined inwardly to the burner assembly axis and then outwardly at the required cone angle.

The combustion chamber 18 has a forwardly extending neck 58 on which are supported a number of swirler vanes 60 the inner ends of which are secured to a ring 62. A duct 64 for the flow of high pressure air is formed between the outer surface of the ring 54 and the inner surface of the ring 62.

As shown in detail in FIG. 3, the primary fuel injector 30 has central bore 66 which connects with two radially extending ducts 68. The ducts 68 are inclined in the downstream direction at an angle of typically approximately 80° to the burner axis and fuel passing out of these ducts is arranged to impinge against a frusto-conical deflecting face formed on the primary fuel nozzle 28. A screw-driver slot 70 is machined in the end face of the injector 30 so that the angular position of the ducts 68 can be varied.

In operation, the primary fuel injector functions as described in the copending U.S. application Ser. No. 221,953 filed Jan. 31, 1972 by Denis Richard Carlisle and assigned to the same assignee, the said application being now abandoned. The main fuel is pumped through the ducts 40 into the annular duct 52 and the high pressure air flowing through this duct atomises the fuel and forces the fuel out of the downstream end of the duct and high pressure air flowing through the duct 64 also atomises the fuel after fuel has passed out of the duct 52. At low main flows it is sometimes difficult to ensure that the fuel is completely atomised and the disposition and arrangement of the fuel ducts 40 and air duct 52 ensure that substantially all the main fuel is atomised particularly at low fuel flows.

High pressure air also flows through the ducts 48 into the recess 44 and out of the recess both through the annular slot between the heat shield 42 and the primary nozzle 28 and the annular slot between the heat shield 42 and the flange 50 to prevent the deposition of carbon on the heat shield 42.

I claim:

1. A fuel burner assembly for a gas turbine engine, the burner assembly comprising a main fuel nozzle having a plurality of fuel supply ducts extending there-through, each of said fuel supply ducts being arranged to receive a supply of fuel, and an annular air supply duct surrounding the main fuel nozzle and having an upstream end for receiving a supply of air and a downstream end, said annular air supply duct being unobstructed and capable of only axial flow of air there-through, and each of said fuel supply ducts extending through said main fuel nozzle being in communication with said annular air supply duct at a point upstream of the downstream end of said annular air duct whereby atomization of fuel takes place in said annular air duct even at low fuel flow.

2. A fuel burner assembly as claimed in claim 1 in which each of said fuel ducts in said main fuel nozzle comprises two portions, one portion extending in the axial direction and the other portion extending radially and in a downstream direction and opening out into the air supply duct.

3. A fuel burner assembly as claimed in claim 1 in which the annular air supply duct is formed between the outer surface of the main fuel nozzle and the inner surface of a ring member which is attached to the main

fuel nozzle by means of a plurality of radially extending members.

4. A fuel burner assembly as claimed in claim 1 having a primary fuel nozzle and a primary fuel injector, the primary fuel nozzle being retained in position by the attachment of the main fuel nozzle to a fuel feed arm and the primary fuel injector being retained in position by a spring biasing the primary fuel injector against an abutment face of the primary fuel nozzle.

5. A fuel burner assembly as claimed in claim 1 including a heat shield attached to the downstream face of said main fuel nozzle and forming with said main fuel nozzle a recess.

6. A fuel burner assembly as claimed in claim 5 in which a number of ducts connect the annular air supply duct with the recess formed between the main fuel nozzle and the heat shield.

7. A fuel burner assembly for a gas turbine engine, the burner assembly comprising a main fuel nozzle having a plurality of fuel ducts, each of said ducts being arranged to receive a supply of fuel, an annular air supply duct surrounding said main fuel nozzle, said annular air supply duct being arranged to receive a supply of air and the fuel supply ducts being in communication with the air supply duct, a primary fuel nozzle and a primary fuel injector, said primary fuel nozzle being retained in position by attachment of the main fuel nozzle to a fuel feed arm and the primary fuel injector being retained in position by a spring biasing the primary fuel injector against an abutment face of the primary fuel nozzle.

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UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,764,071 Dated October 9, 1973

Inventor(s) Denis Richard Carlisle

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Please correct front page format as follows:

In [75] Inventor: "Richard Carlisle, Risley, England"
should read [75] Inventor: --Denis Richard Carlisle,
Risley, England,--

Signed and sealed this 1st day of January 1974.

(SEAL)

Attest:

EDWARD M. FLETCHER, JR.
Attesting Officer

RENE D. TEGTMEYER
Acting Commissioner of Patents