United States Patent [19]

Carlisle et al.

[11] **3,788,067**

[45] **Jan. 29, 1974**

[54] **FUEL BURNERS**

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[73] Assignee: **The Secretary of State for Defense, in Her Britannic Majesty's Government of the United Kingdom of Great Britain and Northern Ireland**, Whitehall, London, England

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

[21] Appl. No.: **221,954**

[30] **Foreign Application Priority Data**

Feb. 2, 1971 Great Britain 3657/71

[52] **U.S. Cl.** ..... **60/39.74 B**

[51] **Int. Cl.** **F02c 7/22**, F02g 3/00

[58] **Field of Search** ..... 60/39.74 R

[56] **References Cited**

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Primary Examiner—Clarence R. Gordon

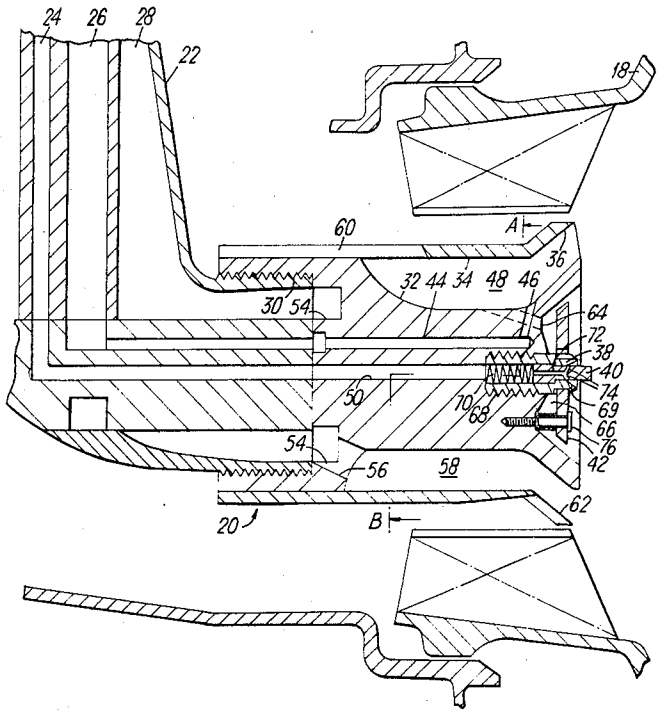
Attorney, Agent, or Firm—Cushman, Darby & Cushman

[57] **ABSTRACT**

A dual fuel burner assembly for a gas turbine engine has a fuel nozzle consisting of a central member in which ducts for the flow of liquid and gaseous fuel and a supply of air are formed and a shroud member. The outlets of the liquid fuel ducts communicate with the air supply ducts and the shroud member has a flared end formed with a number of equi-spaced slots which are aligned with the outlets of the gaseous fuel ducts. A supply of air is arranged to flow through the slots to stabilise the flow of gaseous fuel at low fuel flows.

A heat shield is attached to the downstream face of the central member and the gap between the heat shield and the central member is in communication with the air supply ducts so that air can flow around the heat shield to prevent carbon deposition.

3 Claims, 4 Drawing Figures



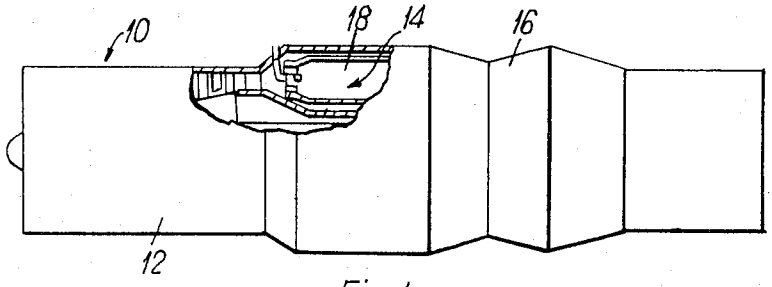


Fig. 1.

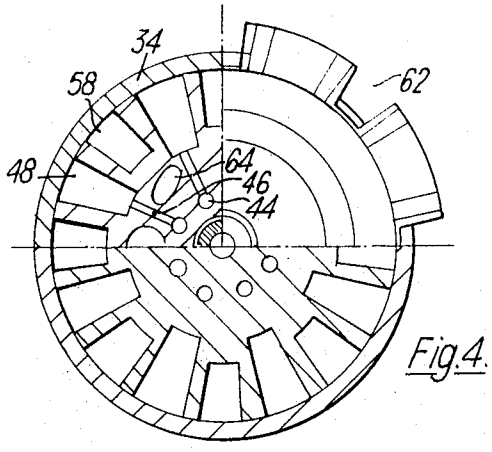


Fig. 4.

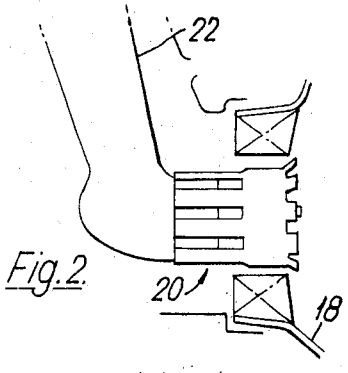


Fig. 2.

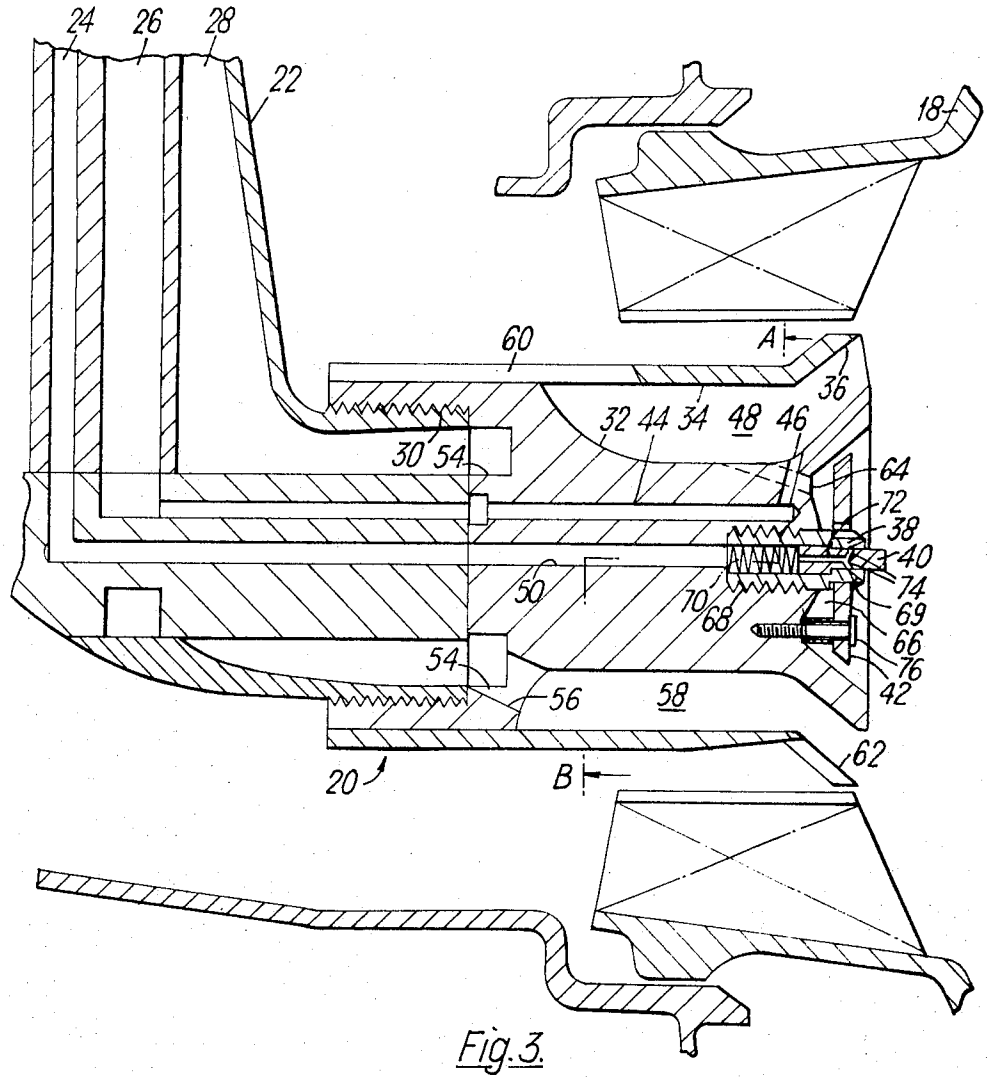

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Fig. 3.

FUEL BURNERS

This invention relates to fuel burners and is concerned with fuel burners for gas turbine engines which are capable of operating on two or more different fuels, i.e., a liquid fuel and a gaseous fuel.

According to the present invention there is provided a burner assembly for a gas turbine engine, the assembly including a fuel nozzle having a plurality of ducts arranged to receive liquid fuel and a plurality of ducts arranged to receive a gaseous fuel, a supply of air being arranged to impinge upon the gaseous fuel leaving the gaseous fuel ducts.

The fuel nozzle may comprise a central member and a shroud member, the shroud member having a number of axial slots which aligned in the outlets of the gaseous fuel ducts.

The liquid and gaseous fuel ducts may be formed in the central member and may be arranged alternately around the circumference of the central member.

The central member may have a plurality of liquid fuel supply ducts, at least one of which is arranged to be coaxial with the central member, the remaining supply ducts being in communication with the liquid fuel ducts.

The liquid supply ducts comprise two portions, one portion extending axially parallel to the axis of the central member, the other portion extending radially and in a downstream direction connecting the liquid fuel supply ducts with the liquid fuel ducts.

The downstream ends of the central member and the shroud may be flared outwardly to give the desired fuel spray angle.

Preferably the flared end of the shroud is formed with air slots which are aligned with the outlets of the gaseous fuel ducts, so that the air can impinge upon the gaseous fuel passing out of the gaseous fuel ducts.

The shroud may also have further air supply slots which are in communication with the liquid fuel ducts in the central member to ensure substantially complete atomisation of the liquid fuel at all fuel flows.

Preferably, a primary fuel nozzle and primary fuel injector are retained in the central member, the primary fuel nozzle being secured to the central member and the primary fuel injector being biased by a spring against a shoulder on the primary fuel nozzle.

The primary fuel injector may have a central bore in communication with the central liquid fuel supply duct in the central member, the bore being in communication with at least two radially extending outlet ducts, primary fuel being arranged to leave said two ducts and impinge against a frusto-conical deflecting face formed on the primary fuel nozzle.

A heat shield may be secured to the downstream end of the central member and form a recess in combination with the central member, the recess being in communication with the liquid fuel ducts so that air can flow into the recess and out around the heat shield to prevent the deposition of carbon.

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

FIG. 1 is a diagrammatic layout of a gas turbine engine having one form of burner assembly according to the present invention,

FIG. 2 shows a portion of the combustion apparatus of the engine shown in FIG. 1,

FIG. 3 is a section through the combustion apparatus shown in FIG. 2 and

FIG. 4 is a composite end view showing a quarter section *A*, a quarter end view and a half section *B*.

In the drawings, FIG. 1 shows a gas turbine engine **10** having compressor means **12**, combustion apparatus **14** and turbine means **16**, the combustion apparatus comprising a number of circumferentially arranged combustion chambers **18**, each having a burner assembly **20** mounted on a burner arm **22**.

Referring now more particularly to FIGS. **3** and **4**, the burner arm has three ducts **24**, **26** and **28** for the supply of fuel, the ducts **24** and **26** being for liquid fuel and the duct **28** for gaseous fuel. The duct **24** is for the flow of primary fuel and duct **26** is for the flow of main fuel. The burner assembly is screwed onto the arm **22** at **30** and comprises a main liquid fuel nozzle **32** having shroud **34** with a flared skirt **36**, a primary fuel nozzle **38**, a primary fuel injector **40** and a heat shield **42**.

The fuel nozzle **32** has eight circumferentially arranged equi-spaced axial ducts **44** which are connected to the main fuel duct **26**, the ducts **44** being in communication with eight corresponding fuel jets **46**. The main fuel can then pass into circumferentially spaced axial ducts **48** which are formed between the nozzle **32** and the shroud **34**. A central duct **50** for the flow of primary fuel to the injector **40** is provided in the nozzle **32** and is connected to the duct **24** in the arm **22**. Eight equi-spaced axial ducts **58** are machined in the nozzle **32** for the flow of a gaseous fuel and each of the slots **52** are connected to the duct **28** by means of a manifold **54** and drillings **56**. The further eight axial ducts **58** are located between the ducts **48**, one duct **58** being located between two adjacent ducts **48**. Eight slots **60** are machined in the shroud **34** so that high pressure air can flow into the ducts **58** and atomise the main fuel flowing out of the jets **46**. Eight slots **62** are machined in the skirt **36** for the flow of high pressure air which is used to narrow the angle of the gaseous fuel at low gaseous fuel flow values. Eight apertures **64** connect the ducts **58** with a recess **66** which is formed in the downstream end of the nozzle **32**.

The primary fuel nozzle **38** is screwed into the main fuel nozzle at **68** and retains the primary fuel injector **40** which is biased in the downstream direction by a coil spring **70**. A frusto-conical deflecting surface **69** is formed on the downstream face of the nozzle **38**. The primary fuel injector **40** has a central bore **72** which is in communication with the duct **24** and two jets **74** which are connected with the bore **72**. Fuel passing out of the jets **74** is arranged to impinge against a frusto-conical surface formed on the primary nozzle **38**. The operation of the primary fuel nozzle and injector are 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 (now abandoned).

The heat shield **42** is attached to the main fuel nozzle **32** by means of two screws **76** and the heat shield is keyed to the injector **38** by means (not shown) to prevent rotation of the injector.

In use, primary fuel passes out of the ducts **74** and impinges against the deflecting surface to form two locally enriched zones of fuel. This particularly ensures that weak extinction does not occur and that anti-smoke requirements are met. This particular portion of the burner assembly is described in detail in the aforementioned U.S. application Ser. No. 221,953.

The main fuel passes out of the jets **46** into the ducts **58** where it is atomised by the high pressure air which flows into the duct through the slots **60.** This arrangement is particularly suitable for atomising the main fuel flow when the flow value is low. The high pressure air also flows into the recess **66** and around the heat shield **42** to prevent the deposition of carbon.

When it is required to run the engine on gaseous fuel, the liquid fuel supply is shut off and gaseous fuel is allowed to flow through the ducts **48.** During normal running the high pressure air which flows through the slots **62** does not have any significant effect on the gaseous fuel flow. However, at low gaseous fuel flows the air flowing through the slots **62** is used to narrow the gas angle and thereby stabilize the flame.

We claim:

1. A fuel burner nozzle for a gas turbine engine, the nozzle including a central member having a plurality of ducts arranged to receive liquid fuel and a plurality of ducts arranged to receive a gaseous fuel, said gaseous fuel ducts and said liquid fuel ducts being alternately arranged around the periphery of said central member and all of said ducts being at substantially the same radial distance from the center of said central member, and a shroud member surrounding the central member, the shroud member having a plurality of slots aligned with the outlets of the gaseous fuel ducts, the slots extending longitudinally in a direction parallel with the centerline of the nozzle.

2. A fuel nozzle as claimed in claim **1** in which the downstream ends of the central member and the shroud member are flared outwardly to give the desired spray angle, the slots being formed in the flared end of the shroud.

3. A fuel nozzle as claimed in claim **1** in which a heat shield is attached to the downstream end of the nozzle and forms a recess in combination with the central member of the nozzle, and in which air supply ducts are formed in the central member in communication with the recess.

* * * * *

UNITED STATES PATENT OFFICE

CERTIFICATE OF CORRECTION

Patent No. 3,788,067 Dated January 29, 1974

Inventor(s) Denis Richard Carlisle and John Joseph Nichols

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

In the front page format of the above-identified Patent, please correct [30] to read as follows:

--[30] Foreign Application Priority Data

Feb. 2, 1971 Great Britain.....3655/71--

Signed and sealed this 21st day of May 1974.

(SEAL)
Attest:

EDWARD M.FLETCHER,JR.
Attesting Officer

C. MARSHALL DANN
Commissioner of Patents

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