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FLAMEHOLDER CONSTRUCTION

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2 Sheets-Sheet 2

FIG. 2

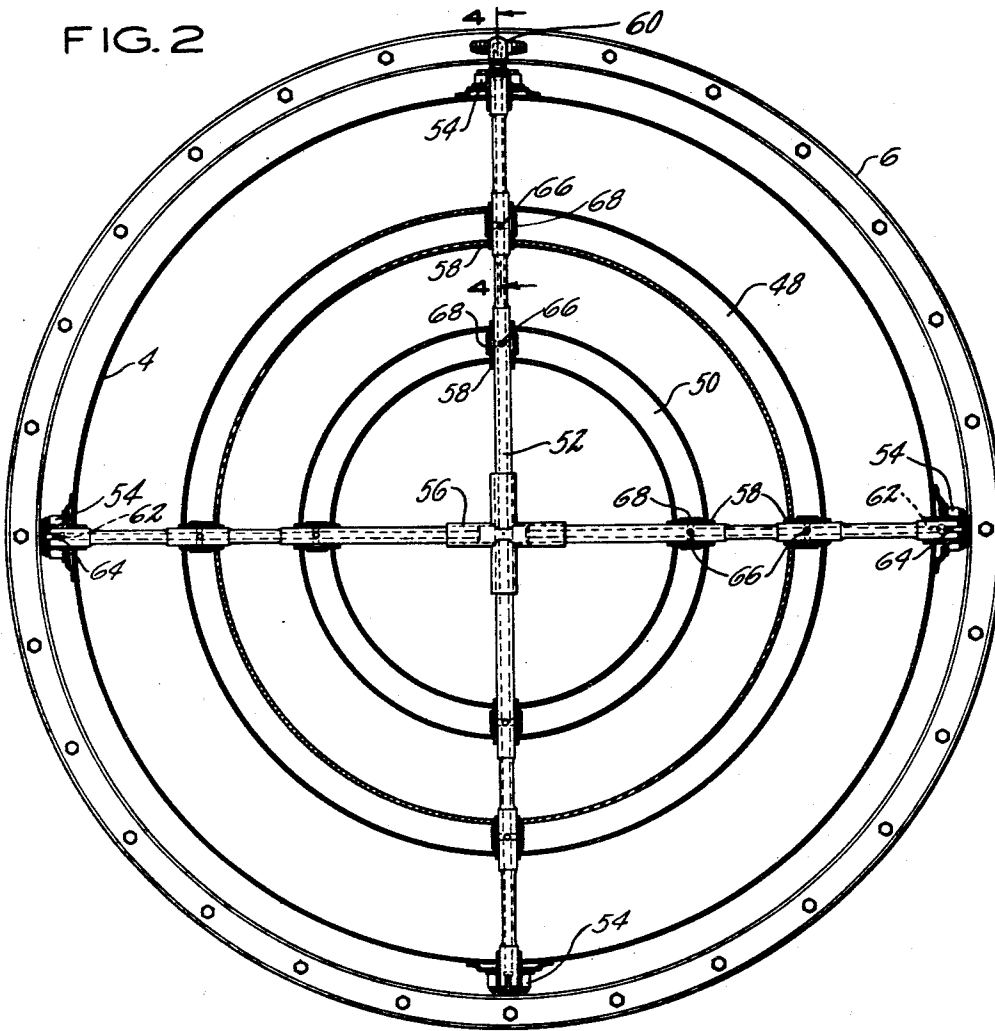
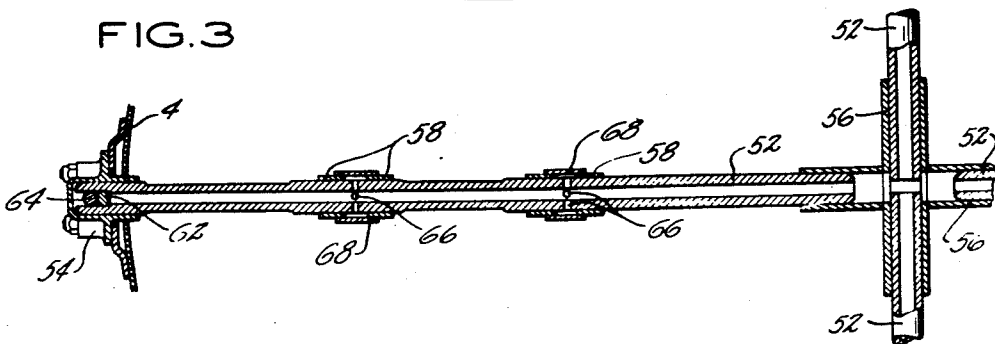


FIG. 3



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FLAMEHOLDER CONSTRUCTION

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12 Claims. (Cl. 60—35.6)

This invention relates to flameholders used, for example, in afterburners for jet engines or in other combustion chambers.

The flameholder functions to create enough turbulence in the gas flowing through the combustion chamber in which the flameholder is located to cause the combustible mixture to burn within the combustion chamber without having the flame blown downstream by the normal velocity of the gases through the chamber. Because of the temperature of the combustion taking place within the chamber the flameholder becomes extremely hot and has a relatively short life. A feature of this invention is an arrangement for supplying cooling air to the flameholder.

The flameholder elements are frequently supported on radially extending rods on which they are slidable to permit relative thermal expansion to take place. One feature of this invention is an arrangement for cooling the supporting rods of the slidable connections for the flameholders in order to prevent the parts from binding during the operation of the combustion chamber in which the flameholder is located.

When a device of this type is used in an afterburner where combustion takes place only during a part of the jet engine operation, the necessity for cooling the flameholders exists only during afterburner operation. The afterburner is generally provided with a variable area nozzle which is opened when the afterburner is ignited to provide a larger flow area at the discharge end of the combustion chamber. A feature of the invention is an arrangement by which the cooling air is circulated to the flameholder only during the period that the variable area nozzle is full-open so that the cooling fluid is used only while the afterburner is in operation.

Other objects and advantages will be apparent from the specification and claims, and from the accompanying drawings which illustrate an embodiment of the invention.

Fig. 1 is a side elevation of an afterburner with the invention applied thereto.

Fig. 2 is a sectional view substantially along the line 2—2 of Fig. 1 showing the flameholders and supports.

Fig. 3 is an enlarged fragmentary sectional view of a part of Fig. 2.

Fig. 4 is a fragmentary sectional view of a part substantially along the line 4—4 of Fig. 2 showing the cooling air supply to the flameholders.

The invention is shown in an afterburner construction for use primarily in augmenting the thrust of a gas turbine power plant, the turbine exhaust of which is directed into the entrance 2 of the afterburner. The latter is in the form of a duct which has a portion 4 beginning at the admission end of the afterburner and gradually increasing in diameter to a point 6 approximately midway between the ends of the afterburner. Downstream of the point 6 the duct has a portion 8 which gradually decreases in diameter to the variable nozzle 10. Although the latter may be of any desired configuration, the arrangement shown is the eyelid type in which opposed eyelid members 12 (only one of which is shown) are pivoted on an axis 14 so that they may be moved apart to increase the nozzle area.

The eyelids are moved into open position hydraulically as, for example, by means of a cylinder 16 having a piston 18 therein with a projecting rod 20. The rod 20 is connected through a carriage 22 on a track 24 to a rod 26 extending to the eyelid. With this arrangement the

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admission of fluid to the upstream end of the cylinder 16 causes the eyelid to close and the admission of fluid to the downstream end of the cylinder causes the eyelid to open. Although the actuation of the eyelid may be automatic the mechanism for accomplishing this purpose is represented in the present application by a valve 28 in a casing 30 having a fluid inlet port 32, outlet ports 34 and 36 connected respectively as by conduits 38 and 40 to the opposite ends of the cylinder 16. The valve casing 30 also has a discharge port 42 and the valve is so arranged that the outlet ports may be alternately connected to the inlet port 32 or to the discharge port.

Fuel is supplied to the combustion chamber by a fuel manifold 44 which surrounds the portion 4 of the duct and is connected to a number of radially extending fuel nozzles 46. It will be understood that in operation the valve (not shown) which controls the supply of fuel to the nozzles may be interconnected with the valve 28 for controlling the eyelids. Downstream of the fuel nozzles are located flameholders 48 and 50 which function to create sufficient turbulence so that the flame will not be blown downstream by the flow of gas through the combustion chamber. Each of the flameholders, as shown more clearly in Fig. 4, is substantially V-shaped in cross section with the base of the V projecting upstream and each flameholder is arranged in the form of a ring with the flameholder 50 positioned within the ring defined by the flameholder 48.

The flameholders are supported within the combustion chamber by radially extending tubes 52 supported at their outer ends in bushings 54 carried by the duct portion 4 and engaging at their inner ends in a cross-shaped member 56 in which the tubes may be slidable to accommodate differential thermal expansion. The tubes 52 pass through the flameholders and the latter have sleeves 58 which surround and are slidable on the tubes. As best shown in Fig. 4, at each intersection of the flameholder with any one of the tubes the flameholder carries a pair of relatively short sleeves 58 rather than a single long sleeve with these sleeves spaced apart as shown in Figs. 3 and 4.

The tubes 52 are hollow, as shown, and the connecting member 56 is also hollow so that the tubes are interconnected for a flow of cooling fluid through all of the tubes. One of the tubes, the uppermost one in the arrangement shown in Fig. 2, has a fitting 60 connected thereto for a supply of cooling air into the tube. The remaining tubes have their outer ends plugged as at 62 (Fig. 3) and are held in position within the supporting bushings 54 by a transverse pin 64. With this arrangement cooling fluid under pressure is supplied to all of the tubes and is allowed to escape from the tubes into the flameholders through openings 66 in the tubes. These openings are located between the opposed sleeve 58 carried by the flameholders. To assure a more uniform distribution of the cooling fluid escaping through the opening 66, the pair of sleeves 58 is surrounded by an overlying sleeve 68 in such a manner that the cooling air is caused to blow out in a direction substantially parallel to the supporting tubes and into the V-shaped configuration of the flameholder. This cooling fluid also functions to cool the tubes as will be apparent and a small portion of the cooling fluid may leak out between the tube and the surrounding sleeves 58.

In order to supply cooling fluid only while the afterburner is in operation the fitting 60 is connected by a tube 70 having a check valve 72 therein to the duct 40 leading to the downstream end of the eyelid actuating cylinder. As above stated, when the afterburner is in operation the eyelids are opened by the admission of fluid under pressure to the downstream end of the cylinder 16. Accordingly, at the same time, the fluid under pressure will pass through duct 70 of the fitting 60 into the intersecting tubes 52 and thence to the flameholders. The check valve 72 is arranged as shown in Fig. 4 to prevent the back flow of gas from the afterburner duct into the actuating mechanism when pressure is not applied to the downstream end of the actuating cylinder.

Although the device has been described in conjunction with an afterburner for use on a gas turbine power plant,

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it will be understood that the arrangement is equally applicable for other combustion chambers where by reason of the rate of flow of gas through the combustion chamber duct it becomes necessary to create more or less turbulence in order to permit combustion to take place.

It is to be understood that the invention is not limited to the specific embodiment herein illustrated and described, but may be used in other ways without departure from its spirit as defined by the following claims.

I claim:

1. A burner in the form of a duct having a variable area nozzle at its downstream end, means for varying the area of the nozzle, means for supplying fuel to the duct upstream of the nozzle, flameholders substantially in the form of open V-shaped members within the duct downstream of the fuel supplying means, tubular means for supporting said flameholders, means for supplying a cooling fluid to said tubular means and thence to the flameholders, and means responsive to actuation of said nozzle varying means for controlling said cooling fluid supplying means.

2. A burner in the form of a duct having a variable area nozzle at its downstream end, means for varying the area of the nozzle, flameholders within the duct, radially extending tubes supported by the duct at their outer ends and operating to support the flameholders in position within the duct, means for supplying cooling fluid through said tubes to the flameholders and means responsive to actuation of said nozzle varying means for controlling the admission of cooling fluid from said supplying means to said supporting tubes and thence to the flameholders.

3. A burner in the form of a duct having a variable area nozzle at its downstream end, means for varying the area of the nozzle, flameholders within the duct, radially extending tubes supported by the duct at their outer ends and operating to support the flameholders in position within the duct, and means responsive to actuation of said nozzle varying means for admitting cooling fluid to said supporting tubes and thence to the flameholders, said tubes being hollow and having passages therein adjacent to the flameholders for the escape of the cooling fluid from the tubes into the flameholders.

4. An afterburner construction in the form of a duct into which the turbine exhaust gas is directed, said duct having an upstream portion gradually increasing in diameter in the direction of gas flow through the duct, said duct having a variable area thrust nozzle at its downstream end, reversible fluid pressure actuated means for varying the area of the nozzle and means for admitting fluid under pressure to said pressure actuated means in a nozzle area increasing direction, in combination with means located in the duct adjacent to and downstream of the inlet end and in said upstream portion for supplying fuel to said duct, flameholders in the duct downstream of the fuel supplying means and also located in said upstream portion and a connection for delivering fluid under pressure from said fluid pressure actuated means to said flameholder when fluid is admitted by said fluid admitting means in a nozzle area increasing direction.

5. A combustion chamber including a duct through which gas flows and into which fuel is injected to be burned with the gas, flameholders in the form of rings located in said duct, transversely extending intersecting tubes supporting said flameholders, means for introducing cooling fluid into said tubes, and passages through said tubes and communicating with the interior of the flameholders for the escape of the cooling fluid from said tubes into the flameholders.

6. A combustion chamber including a duct through which gas flows and into which fuel is injected to be burned with the gas, flameholders in the form of rings located in said duct, transversely extending intersecting tubes supporting said flameholders, said flameholders being slidable on said tubes to provide for differential expansion, means for introducing cooling fluid to said tubes, and passages through said tubes and into said flameholders for the escape of the cooling fluid from the tubes into the flameholders.

7. A combustion chamber including a duct through

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which gas flows and into which fuel is injected to be burned with the gas, flameholders in the form of rings located in said duct, transversely extending intersecting tubes supporting said flameholders, said flameholders being slidable on said tubes to provide for differential expansion, means for introducing cooling fluid to said tubes, and passages through said tubes and into said flameholders for the escape of the cooling fluid from the tubes into the flameholders, said flameholders having sleeves thereon surrounding the supporting tubes and slidable thereon.

8. A combustion chamber including a duct through which gas flows and in which fuel is burned with the gas, flameholders located in said duct, said flameholders being substantially V-shaped in cross section with the base of the V projecting upstream, transversely extending intersecting tubes supporting said flameholders, each leg of the V of the flameholder having a sleeve thereon through which the tubes extend and are slidable, radial passages in said tubes between the adjacent ends of the tubes and within the V-shaped cross section of the flameholder for the escape of the cooling fluid from the tubes into the flameholder, and means for supplying cooling fluid under pressure to said tubes.

9. A combustion chamber including a duct through which gas flows and in which fuel is burned with the gas, flameholders located in said duct, said flameholders being substantially V-shaped in cross section with the base of the V projecting upstream, transversely extending intersecting tubes supporting said flameholders, the latter having sleeves thereon through which the tubes extend and are slidable, means for supplying cooling fluid to said tubes, radial passages in said tubes located between adjacent supporting sleeves for the escape of the cooling fluid from the tubes into the flameholder.

10. A combustion chamber including a duct through which gas flows and in which fuel is burned with the gas, flameholders located in said duct, said flameholders being substantially V-shaped in cross section with the base of the V projecting upstream, transversely extending intersecting tubes supporting said flameholders, the latter having sleeves thereon through which the tubes extend and are slidable, means for supplying cooling fluid to said tubes, radial passages in said tubes located between adjacent supporting sleeves for the escape of cooling fluid from the tubes into the flameholder, and a sleeve on the tube overlying the passages and extending between the adjacent supporting sleeves for directing the flow of cooling fluid.

11. In an afterburner, a duct through which gas from a gas turbine is directed to a thrust nozzle, flameholders positioned within said duct, radially extending tubes positioned within said duct and supporting said flameholders, the latter having sleeves therein through which the tubes extend and are slidable, means for supplying cooling fluid to certain tubes, and passages in said certain tubes adjacent to the sleeves for introducing the cooling fluid from said tubes into the flameholders.

12. In an afterburner, a duct through which gas from a gas turbine is directed to a thrust nozzle, flameholders positioned within said duct, radially extending tubes positioned within said duct and supporting said flameholders, the latter having sleeves therein through which the tubes extend, means for supplying cooling fluid to certain tubes, and means for introducing cooling fluid from said tubes into the flameholders, said last means including radially extending passages in said tubes and a sleeve surrounding the tube and overlying said passages to cause the flow of cooling fluid into the flameholders in a direction substantially parallel to the tubes.

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