Sept. 8, 1953

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2,651,178

COMBINATION INJECTOR AND STABILIZER
FOR GAS TURBINE AFTERBURNERS

Filed Jan. 18, 1951

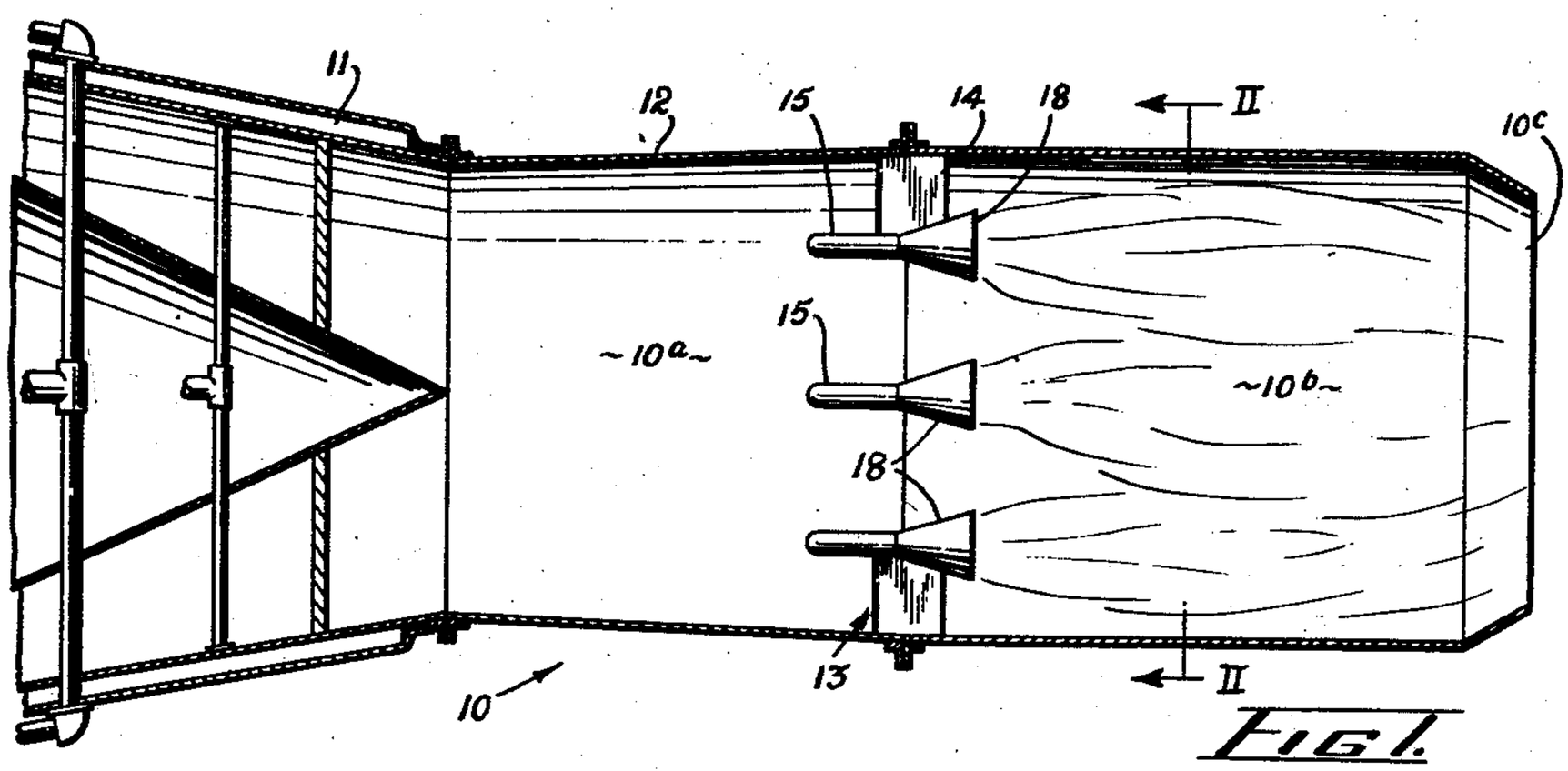

FIG. 1.

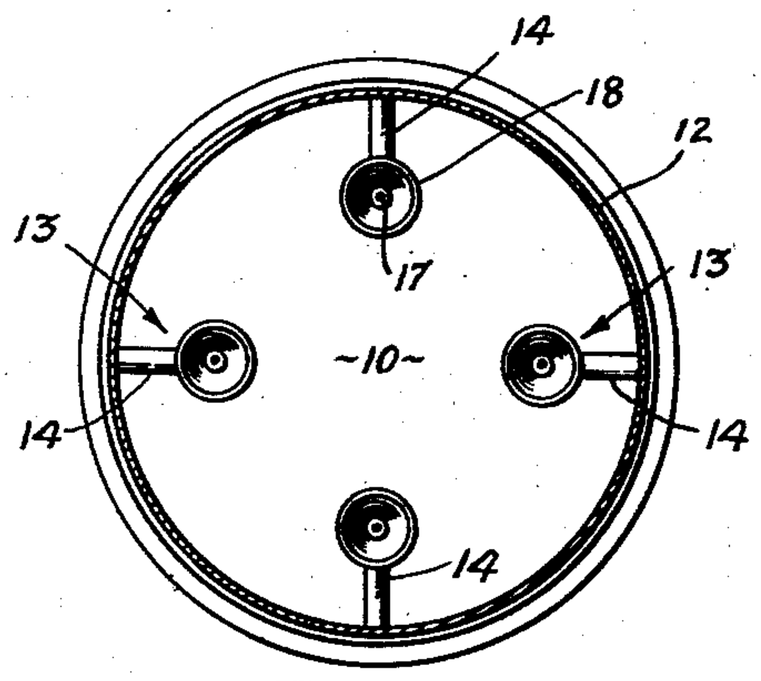

FIG 2.

FIG 3.

FIG 4.

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Patented Sept. 8, 1953 2,651,178

UNITED STATES PATENT OFFICE

2,651,178

COMBINATION INJECTOR AND STABILIZER FOR GAS TURBINE AFTERBURNERS

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Application January 18, 1951, Serial No. 206,648

3 Claims. (Cl. 60—39.72)

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This invention relates to afterburners used in gas turbine engines, and more particularly to combination fuel injecting and stabilizing means for such afterburners.

In the afterburning process, a secondary charge of fuel is injected into the exhaust air which has already been passed through the primary combustion system of the engine and the mixture is then burned to provide additional propulsive thrust. This secondary combustion usually takes place downstream of the turbine in the jet pipe, and such being the case, it is customary to provide a series of rearwardly facing stabilizing cones which protect the flame of combustion from "blowing out." The igniters are customarily mounted on these cones but the fuel jets are separately mounted upstream of the cones, and are arranged to inject the fuel in such a way that it mixes non-uniformly with the air in order to maintain smooth combustion.

It will be recognized that due to the independent mounting of their fuel jets and stabilizing cones, afterburners of this type will be unnecessarily heavy and cumbersome, and furthermore, that the insulation of the installation will be unduly complex.

It is the object of this invention to provide in a light, compact unit the means whereby afterburning may be initiated and sustained.

The invention will be more readily understood from consideration of the following description and its accompanying drawing which forms a part of the description and in which like reference characters denote like parts throughout the same:

Figure 1 is a cross sectional view of the tail cone and jet pipe of a gas turbine engine embodying an afterburner constructed in accordance with the invention,

Figure 2 is a view taken on section II—II in Figure 1,

Figure 3 is an enlarged sectional view of the combined injector-stabilizer unit, and

Figure 4 is a view taken on section IV—IV of Figure 3.

The embodiment of the invention illustrated in Figure 1 is shown installed in a conventional afterburner 10, which replaces the normal jet pipe installation; the afterburner extends rearwardly from the tail pipe 11 to which it is attached coaxially. The afterburner has an outer wall 12 providing in the afterburner 10 a diffuser 10^a whose cross section increases uniformly along its length, an afterburner combustion chamber 10^b and a variable nozzle 10^c.

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A circular assembly of injector stabilizer cone units 13 is mounted concentrically within the combustion chamber 10^b of the afterburner on radial support fairings 14 extending inwardly from the wall 12 (see Figure 2). Each unit (see Figure 3) comprises a hollow injector tube 15 having open ends to provide at its forward end a main fuel jet 16 and at its rear end an auxiliary or pilot jet 17 of smaller diameter. A rearwardly facing stabilizing cone 18 is provided by a conical baffle attached to the injector tube upstream of the pilot jet, so as to surround the end of the tube and the jet. An igniter 19 projects into the cone 18 (see Figure 4) and its lead wires 20 are ducted through the fairing 14 to the exterior of the afterburner and thence to a source of electrical power (not shown); a fuel supply line 21, connecting to an external source of fuel, is similarly ducted through the fairing 14 and enters the injector tube 15. The unit 13 is so disposed within the afterburner that the axes of the injector and the cone are substantially parallel to the longitudinal axis of the afterburner assembly 10.

It will be understood that the terms "forward" and "rearward" as well as "upstream" and "downstream," as used in this description, refer to the disposition of the engine to which the afterburner is attached and to the normal direction of gas flow through the engine.

In accordance with usual practice, air is drawn into the engine and compressed, fuel added to it and the mixture burned, the products of combustion being utilized in providing energy for the initial compression of the air and in providing a rearwardly directed propulsive jet. These combustion products are exhausted through the tail pipe 11 into the afterburner unit 10 where they first pass through the diffuser 10^a which reduces their velocity and thereby lowers the thermodynamic pressure loss due to heat release, and then they pass into the combustion chamber 10^b.

Fuel is supplied under pressure to each of the injector-stabilizer assemblies 13 in the combustion chamber through the lines 21; it flows into the injector tube 15 and is then discharged into the gas stream. The fuel is discharged from the main jet 16 upstream or forwardly in a narrow-angled conical spray which produces the required non-uniform mixture of fuel and gas, and from the pilot jet 17 downstream or rearwardly inside the stabilizing cone 18. The igniter 19 lights the fuel from the pilot jet which in turn ignites the mixture of fuel from the main jet and exhaust gas. To insure continuous combustion, the flame

from the pilot jet is sheltered within the protected region of recirculation or stabilization afforded by the cone 18. The resulting combustion and expansion through the variable nozzle 10c provides the desired additional thrust to assist in propulsion.

Those skilled in the art will readily appreciate that an injector-stabilizer of the type described may be incorporated in the combustion systems of ram-jets with equal advantage and therefore it will be understood that the form of the invention herewith shown and described is to be taken as a preferred embodiment of the same and that various changes in the shape, size and arrangement of the parts may be resorted to without departing from the spirit of the invention or the scope of the subjoined claims.

What I claim as my invention is:

1. An afterburner for a gas turbine engine, comprising a combustion chamber defined by an outer wall providing a duct through which a stream of gas is caused to flow, a hollow injector tube in the duct for injecting fuel into the combustion chamber, the injector tube being disposed with its longitudinal axis parallel to the stream of gas and having open ends providing a fuel jet at each end, the jet at the downstream end of the tube being an auxiliary jet discharging in a downstream direction and the jet at the other end of the tube being a main jet discharging in an upstream direction, a baffle connected to and surrounding the injector tube at a location upstream of the auxiliary jet and extending away from the injector tube into the stream of gas to protect the auxiliary jet from the gas stream, igniting means for the auxiliary jet, and means for supplying fuel from a remote source to the injector tube.

2. An afterburner for a gas turbine engine, comprising a combustion chamber defined by an outer wall providing a duct through which a stream of gas is caused to flow, a hollow injector tube in the duct for injecting fuel into the combustion chamber, the injector tube being spaced from the wall by a hollow fairing extending inwardly from the wall and being disposed with its longitudinal axis parallel to the stream of gas and having open ends providing a fuel jet at each end, the jet at the downstream end of the tube being

an auxiliary jet discharging in a downstream direction and the jet at the other end of the tube being a main jet discharging in an upstream direction, a baffle connected to and surrounding the injector tube at a location upstream of the auxiliary jet and extending away from the injector tube into the stream of gas to protect the auxiliary jet from the gas stream, igniting means for the auxiliary jet, and means for supplying fuel from a remote source to the injector tube.

3. An afterburner for a gas turbine engine, comprising a combustion chamber defined by an outer wall providing a duct through which a stream of gas is caused to flow, a hollow injector tube in the duct for injecting fuel into the combustion chamber, the injector tube being disposed with its longitudinal axis parallel to the stream of gas and having open ends providing a fuel jet at each end, the jet at the downstream end of the tube being an auxiliary jet discharging in a downstream direction and the jet at the other end of the tube being a main jet discharging in an upstream direction, a conical baffle connected to and surrounding the injector tube at a location upstream of and near the auxiliary jet, the auxiliary jet being disposed within the conical space defined by the baffle, igniting means for the auxiliary jet, and means for supplying fuel from a remote source to the injector tube.

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