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COMBUSTION DEVICES ESPECIALLY SUITABLE FOR GAS TURBINE

ENGINES AND PROPULSION UNITS FOR AIRCRAFT

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2 Sheets-Sheet 1

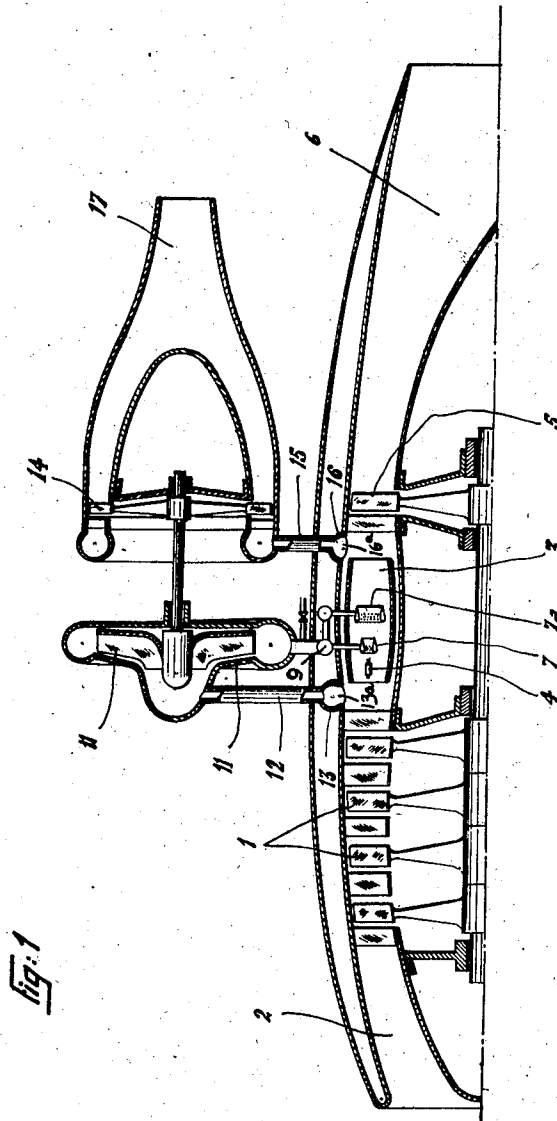


Fig. 1

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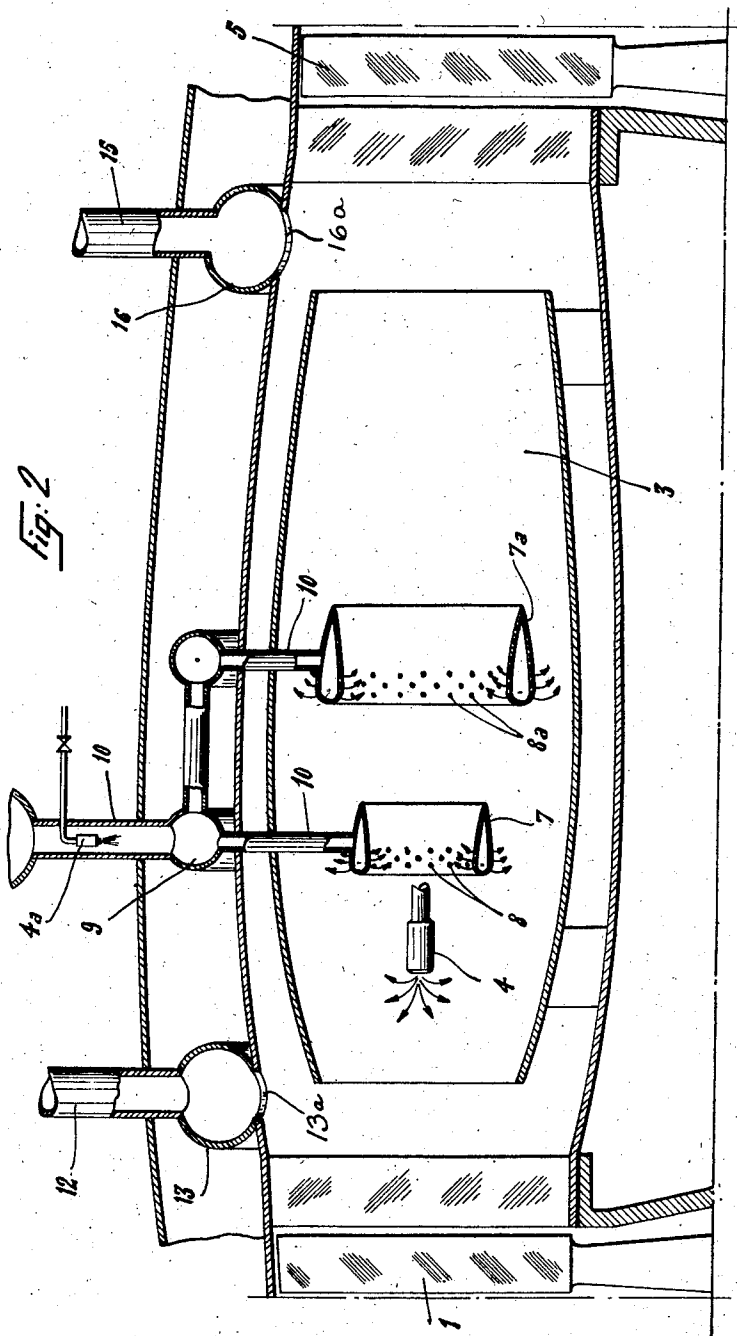
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COMBUSTION DEVICES ESPECIALLY SUITABLE FOR GAS TURBINE ENGINES AND PROPULSION UNITS FOR AIRCRAFT

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Application July 12, 1954, Serial No. 442,764

Claims priority, application France July 15, 1953

3 Claims. (Cl. 60—39.15)

In the U. S. patent application Ser. No. 379,663, filed September 11, 1953, there is described means of generating fluid screens in the heart of a flow of gas in which it is desired to produce a combustion, the said screens enabling a turbulent zone to be set up in the flow, with consequent reduction in speed, in which the flame can be stabilized, these screens thus replacing in an advantageous manner the normal types of stabilizing screens constituted by solid walls.

On the other hand, in the U. S. patent application Ser. No. 427,114, filed May 3, 1954, there is described the application to the development of a flame which has already been stabilized in any particular manner, of means adapted to produce transversely with respect to the front zone of the flame, small auxiliary gaseous jets which create in the flow of fluid a partial turbulence which facilitates the transverse propagation of the flame.

It has been stated in the application Ser. No. 379,663 referred to above, that in the case of a gas turbine engine, such as for example, a reaction propulsion unit, the fluid screen or screens may be supplied from a source of air derived from the compressor of the engine.

This arrangement is convenient in practice when it is a question of stabilizing a combustion within an atmosphere in which the static pressure is lower than the total pressure at the delivery side of the compressor, as is the case in particular with an intermediate combustion chamber placed after the first stage of the turbine, or of an after-burning chamber.

The present invention is directed to the application of fluid screens or jets to combustion chambers which operate under the pressure obtaining at the delivery side of the compressor, such as is the case of the chambers which precede the turbine. In accordance with the invention, the supply arrangement for these screens or jets comprises compression means adapted to deliver the gas necessary for the formation of the screens or of the jets under a pressure greater than that supplied by the air compressor of the engine.

The preferred form of embodiment of the invention is that in which the air which supplies the screens, derived from the compressor of the engine, is delivered by a small supplementary compressor of the centrifugal type towards the nozzle or nozzles which form the screens or the jets.

The description which follows below with regard to the attached drawings (which are given by way of example only and not in any sense by way of limitation) will make it quite clear how the invention may be carried into effect, the special features which may be brought out, either from the drawings or from the text, being understood to form a part of the said invention.

Fig. 1 is a view in partial cross-section of a reaction propulsion unit provided with a form of embodiment of the invention.

Fig. 2 shows to a larger scale a combustion chamber with its device for forming a fluid screen.

In the drawings, there is to be seen at 1 the air compressor of the engine, supposed to be of the multi-stage

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axial-flow type in the present example. This compressor takes in atmospheric air through the annular passage 2 and delivers it into the combustion chambers 3, which have the shape of small barrels and are provided with fuel injectors 4. The gas generated in these chambers is applied to the turbine 5 which drives the compressor 1. The gas discharged from the turbine escapes through the nozzle 6 which may or may not be preceded by an after-burning chamber.

In order to stabilize the flame in the chambers 3, in spite of the speed of the flow of air passing through these chambers, flame-stabilizers of the fluid screen type have been provided in them.

In the example shown, these stabilizers consist of a hollow ring 7 on the downstream side of each of the injectors 4, the latter being arranged to discharge the fuel in the direction opposite to that of the air-flow, the hollow ring having a streamlined cross-section pierced with holes 8 or with one or a plurality of slots through which escapes the air which is led into the interior of the ring 7 under a total pressure higher than the static pressure of the gas passing through the combustion chamber. The orifices 8 of the ring 7 are preferably oriented in such manner that the jet of gas which escapes from them has sufficient penetration into the fluid in movement to set up on the downstream side of the injector, fluid screens which create a turbulence zone in which the flame can be stabilized. The said orifices 8 may be slightly inclined towards the upstream side of the flow for that purpose.

The rings 7 are combined with other rings 7a, the diameter of which is a little greater and which are also provided with orifices 8a through which also pass jets of air directed transversely with respect to the flow in the combustion chamber, and which have the effect of accelerating the transverse propagation of the flame, that is to say of increasing the liveliness of the combustion.

In the example shown, the hollow rings 7 and 7a are supplied with air under pressure provided by the annular collector 9 and the pipes 10 of the delivery of a small centrifugal compressor 11. The intake of this supplementary compressor 11 communicates through the pipe 12 with an annular collector 13 which is arranged around the outlet of the main compressor 1 and communicates with this outlet by a slot 13a or a series of holes. By virtue of the compressor 11, the air supplied to the hollow bodies 7 and 7a is thus raised to a total pressure which is higher than the static pressure obtaining in the chambers 3. The ratio of compression of the compressor 11 is chosen in dependence on the size which it is desired to give to the fluid screens.

It is an advantage to provide, in the air supply conduits of the rings 7 and 7a, one or a number of injectors 4a which enable the air to be carburetted by injecting into it a part of the fuel which is to be burnt in the chambers 3.

In this way, the combustion is given an improved uniformity inside these chambers.

In the example considered, the compressor 11 is driven by a small gas turbine 14 to which is supplied a portion of the hot gases generated in the chambers 3. The admission side of this auxiliary turbine communicates by means of a pipe 15 with an annular collector 16 arranged around the admission of the main turbine 5 and communicating with this admission by a series of holes or by a slot 16a which may or may not be continuous. The gases escaping from the turbine 14 may supply a small exhaust nozzle 17 which adds its effect to that of the main discharge nozzle 6.

It will of course be understood that modifications may be made to the form of embodiment which has just been described, in particular by the substitution of equivalent technical means, without thereby departing from the spirit or from the scope of the present invention. The

centrifugal compressor shown in the drawings may be replaced by a compressor of any other type, axial, volumetric, etc.

What I claim is:

1. In a jet propulsion engine having a tubular and substantially unobstructed combustion chamber and an air compressor connected to discharge thereinto an axial flow of air at flame-extinguishing velocity, a flame-holding device comprising an auxiliary compressor which discharges fluid at a pressure substantially in excess of the discharge pressure of said air compressor, and jet forming means connected with the discharge of said auxiliary compressor and opening into said combustion chamber at a substantial inclination with respect to the direction of said axial flow therethrough to form across a portion of said flow transverse fluid jets creating therebehind a wake zone wherein a flame can be held.

2. A device as claimed in claim 1 further comprising piping means for tapping a fraction of the air discharged by the compressor of the engine and leading this air to the suction end of the auxiliary compressor.

3. A device as claimed in claim 2 further comprising a gas turbine drivingly connected with the auxiliary compressor, piping means for tapping a fraction of the motive gas generated in the combustion chamber and leading this gas to the intake end of said turbine, and a rearwardly facing jet propulsion nozzle connected with the discharge end of said turbine.

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