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FLAME CONTROL DEVICE FOR COMBUSTION CHAMBERS

Filed March 19, 1957

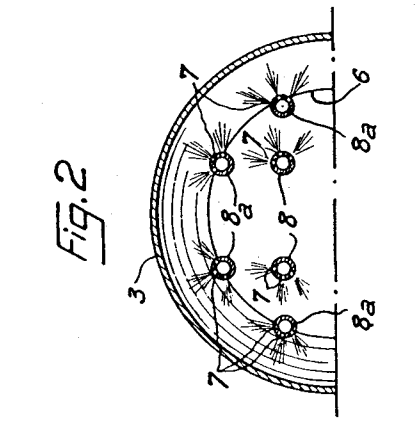


Fig. 2

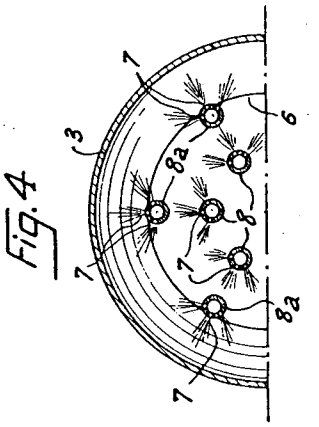


Fig. 4

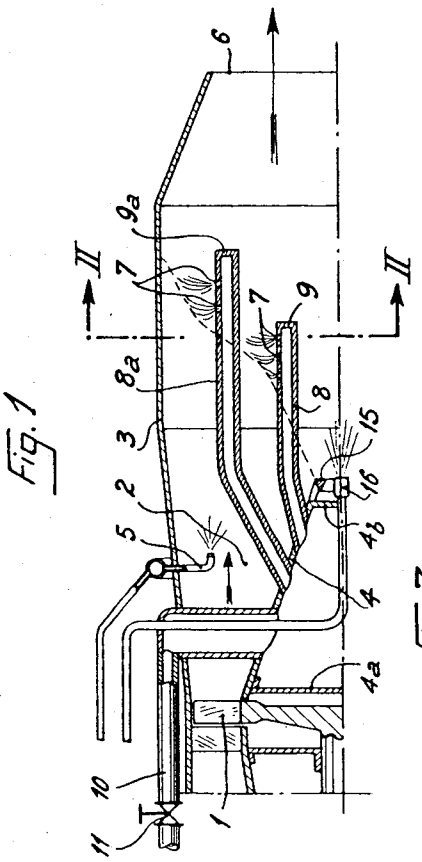


Fig. 1

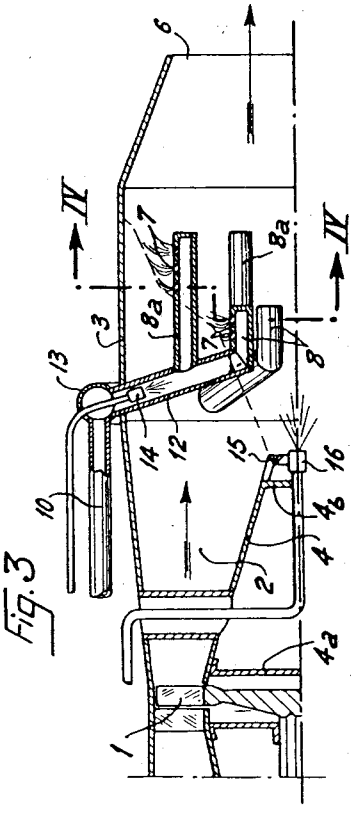


Fig. 3

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FLAME CONTROL DEVICE FOR COMBUSTION CHAMBERS

Jean Henri Bertin, Neuilly-sur-Seine, and Benjamin Jean Marcel Salmon, Suresnes, France, assignors to Societe Bertin et Cie, Paris, France, a corporation of France

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In order to improve the propagation of a flame in a flow of gas, it has already been proposed to inject into the said flow, transverse jets of an auxiliary fluid, air for example, which are preferably directed towards the exterior of the flame-front and in the vicinity of this latter.

Up to the present time, and except in the case in which the orifices or nozzles which form the auxiliary jets were pierced in the walls of the combustion chambers or the exhaust nozzles themselves, the supports of these orifices were formed either by rings arranged transversely with respect to the flow, or by radial arms. These two forms of support have a number of drawbacks. They do not lend themselves well to variations in length due to expansion, they form substantial obstacles in the general flow and give rise to troublesome variations in the useful cross-section; and finally they are not well adapted to give the best distribution and the best orientation of the auxiliary jets, since the rings make it necessary to locate the nozzles in well-defined planes, while the radial arms do not enable radial jets to be produced.

In accordance with the present invention, the orifices or nozzles are pierced on arms or tubes which extend in a direction substantially parallel to that of the flow of the gases in the combustion chamber.

In the center of this flow, these arms do not occupy a useful section very much greater than that which is necessary for the flow of the auxiliary fluid and thus give rise to losses which may be considered as aerodynamically negligible, while the auxiliary fluid, passing along a direct path to reach the nozzles, suffers only the minimum loss of pressure.

The orifices or nozzles pierced in these longitudinal tubes may be located in any suitable plane and may be given any useful orientation, in which the speed of the jets has a component at right angles to the speed of the main flow.

These arms or tubes are preferably fixed at only one of their extremities on a wall of the combustion chamber, and are free at their opposite extremities. For this reason, the tubes are able to expand freely. Without however departing from the scope of the invention, instead of leaving one extremity of the said tubes free, this extremity may be held in position by a support which allows thermal deformations to take place, such as a small rod or a wire.

Preferably also, the points at which these tubes are fixed are chosen on the upstream side of the flame-front, which enables this fixation to be effected by means of members which are readily removable, and, in consequence, the tubes can be changed independently of each other, either for tests or for repair.

The description which follows below with reference to the accompanying 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 are brought out, either in the drawings or in the text, being understood to form a part of the said invention.

Fig. 1 is a longitudinal half-section of an after-burning discharge-nozzle for a turbo-jet unit provided with a first form of embodiment of a device in accordance with the invention.

Fig. 2 is a transverse cross-section taken along the line II—II of Fig. 1.

Figs. 3 and 4 are similar views of an alternative form of embodiment.

In the drawings, there has been shown by way of example an arrangement of a post-combustion chamber that is frequently met with in turbo-jet units, but the invention is of course not limited to this kind of arrangement. The gases which have worked in the turbine **1** pass through an annular space **2** included between the wall of the ejection passage **3** and that of an internal cone **4**. They receive supplementary fuel from the injector **5**, the combustion of the fuel being effected in the passage **3** before the gases pass out of the discharge nozzle through the orifice **6** to form the propulsive jet. In order to improve the propagation of the flame in the discharge-nozzle **3**, small jets of air are discharged into this nozzle through orifices **7**, these jets having sufficient momentum to penetrate into the main jet, the air supplying these jets being supplied to this end with advantage from the compressor of the turbo-reaction unit. The orifices or nozzles **7** are preferably disposed close to the surface which defines the flame so that the jets pass through this surface and assist, as will be well understood, in the transverse propagation of the flame.

In the form of embodiment shown in Figs. 1 and 2, the nozzles **7** are pierced in tubes **8**, **8***a*, fixed at one extremity to the conical wall **4**, the opposite extremities **9**, **9***a* of these tubes being free. The fixing of the tubes **8**, **8***a* on the cone **4** may be carried out by flanges or by screwing in order that these tubes may be readily removable. The conical wall **4**, associated with two transverse partitions **4***a*, **4***b*, forms a closed chamber which serves as a supply reservoir for the tubes **8**, **8***a* with compressed air, and is coupled for that purpose to the delivery of the compressor of the reactor by a piping system **10**, provided with a valve **11** which is opened during the periods of operation of the post-combustion.

With the exception of the oblique, bent or curved portion which is necessary to fix the tube **8**, **8***a* on the cone **4**, these tubes extend in a direction substantially parallel to that of the main flow in the discharge-nozzle **3**, so that the nozzles **7** which they carry may be readily orientated to form jets having a transverse component of speed and may be placed at the useful points in the vicinity of the flame-front.

The examples shown in the drawing relate to a case in which the initiation and the stabilization of the flame are effected in the axis of the discharge-nozzle, immediately on the downstream side of the cone **4**, by virtue of a small annular screen **15** located at that point and having an auxiliary injector **16** discharging in the axis so as to produce a pilot flame. The flame in the main flow thus starts from the screen **15** and is propagated towards the downstream side along a divergent surface having an approximate contour as drawn in dotted lines. For this reason, there have been shown on the drawing two sets of tubes **8**, **8***a*, situated at different distances from the axis, the tubes **8***a* which are farthest away from the axis being longer than the tubes **8** which are closer to the said axis, in order that the jets discharged from the nozzles **7** of the tubes **8***a* may pass through the flame front, which has already been widened by the jets discharged from the tubes **8**. The nozzles of the tubes **8** and **8***a* are thus in different transverse planes.

The form of embodiment shown in Figs. 3 and 4 differs from the previous form only in that the tubes **8**, **8***a* are fixed to the wall of the discharge-nozzle **3**, this fixation

being effected in the example shown by a portion **12** common to a tube **8** and to a tube **8***a*. The common portions **12** are coupled to a circular external collector **13** which communicates through the pipe **10** with the delivery of the compressor.

In the example of Figs. 3 and 4, it has also been assumed that the air of the auxiliary jets received fuel by means of the injectors **14**, this fuel forming all or part of the fuel which is intended to be burnt in post-combustion.

It will of course be understood that modifications may be made to the forms of embodiment which have 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.

What is claimed is:

1. In a jet propulsion unit having a combustion chamber traversed by a high-velocity stream of a combustion supporting gaseous medium and a flame-holder in said combustion chamber to promote and stabilize a flame extending downstream of said flame-holder, a device for transversely spreading out said flame from said flame holder comprising a plurality of tubular members projecting into said combustion chamber and having portions extending downstream of said flame-holder in a direction substantially parallel to the direction of flow of said stream and to the axis of said flame holder and distributed around the axis of said combustion chamber and

around the axis of said flame holder at a distance from said chamber axis greater than that of said flame-holder, said portions being ported to provide orifices opening into said combustion chamber and facing in a direction substantially inclined with respect to said direction of flow, and means for supplying gas under pressure to said tubular members whereby gaseous jets issue from said orifices of said tubular members into said flame from said flame holder to create therein local turbulence favorable to transverse flame propagation.

2. A device as defined in claim 1, wherein the ported portions of some of the tubular members extend downstream further than the ported portions of the other of said tubular members, said ported portions extending further downstream being spaced from the chamber axis a greater distance than the ported portions of said other tubular members.

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