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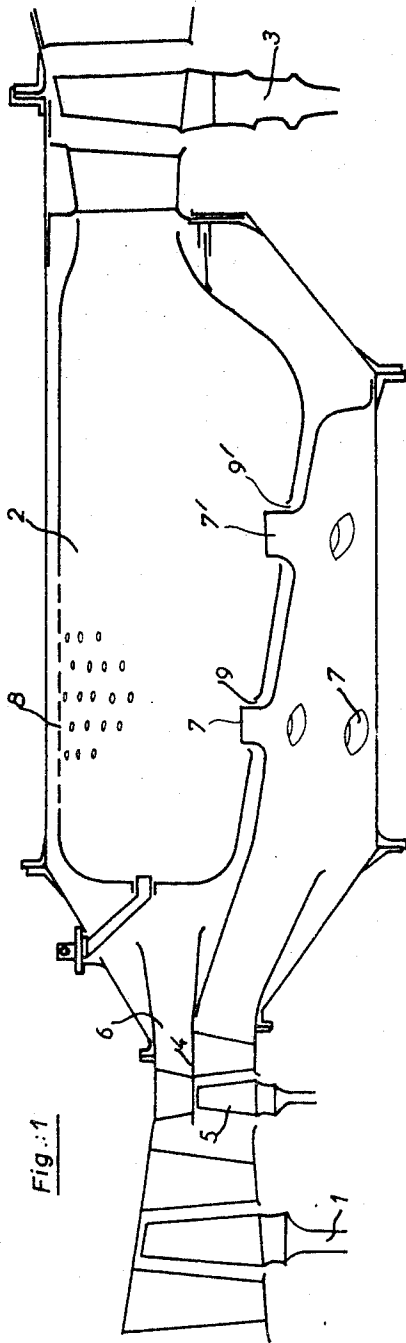
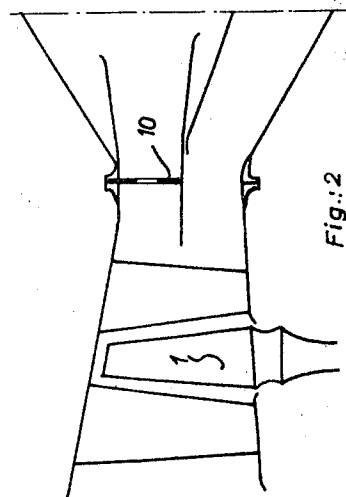
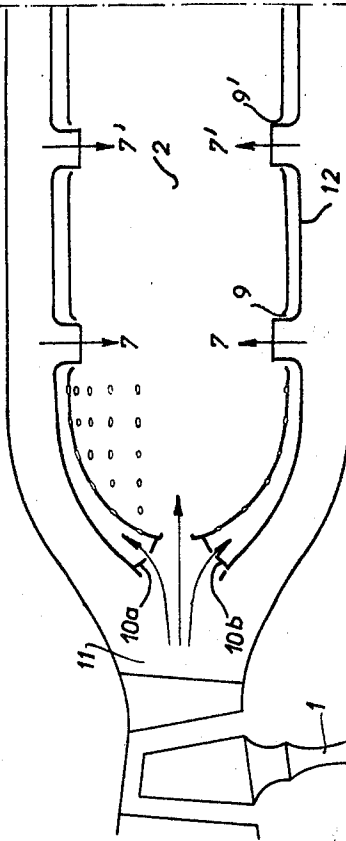
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3,440,818

COMBUSTION CHAMBER COOLING AIR CONTROL IN TURBOJET ENGINES

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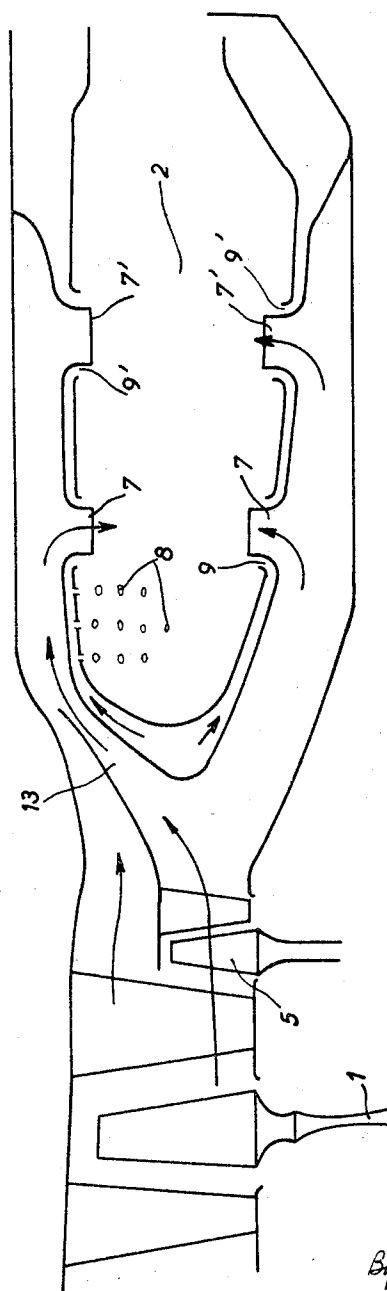


Fig. 4

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COMBUSTION AND COOLING AIR CONTROL IN TURBOJET ENGINES

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4 Claims

ABSTRACT OF THE DISCLOSURE

Combustion chamber for turbojet engine comprising a flame-tube, means for injecting fuel into said flame-tube, means for supplying said flame-tube with combustion air and dilution air, and means for supplying said flame-tube with cooling air at a pressure which is lower than that of combustion and dilution air.

In order to create in the interior of the combustion chamber of a turbojet engine the turbulence necessary for its proper functioning, a flow of air is introduced across the flame-tube, through holes of adequate size, in the form of several jets making an appreciable angle with the general direction of principal flow within the chamber. This results in a loss of pressure in the combustion chamber, this loss of pressure being directly related to the dynamic pressure of the jets.

If the positioning of the holes is correct, there results a short zone of combustion completely filling the cross-section of the flame-tube which latter consequently develops a considerable heat flow. For this reason it is necessary to introduce a certain proportion of the flow or air in the form of cooling films; this proportion can vary from 15% to 50% according to the type of turbojet. These films of air constitute a protective layer separating the walls of the flame-tube from the hot gases.

Several methods exist for introducing the cooling air into the flame-tube.

The first of these methods consists of forming a film of air in a slot in such a way that, at its exit, the flow is parallel to and in the same direction as the principal flow, and is sufficiently uniform. The speed of the air at the exit of the slot should be either less than or equal to the average speed of the principal flow. To do this, given the difference in pressure between the interior and the exterior of the flame-tube, it is necessary to create a loss of pressure in the cooling air, which otherwise would have too great a speed (from two to four times according to circumstances).

A second method consists in creating, instead of a continuous film, a close succession of jets formed by means of a mechanical component pierced by juxtaposed holes whose axes are parallel with the direction of the principal flow. In this case a loss of pressure is produced first by friction in the interior of the holes and then by a sudden widening at the outlets thereof, since the dynamic pressure at the outlets is again very high.

Finally, another method is the "sweating" of the cooling air as it passes through the walls of the flame-tube. The loss of pressure is brought about by friction in the wall and by sudden widening at the exit, and it may be necessary to create a pressure loss upstream of the wall so as not to have too great a penetration of the cooling air into the flame-tube.

In consequence, whichever is the cooling technique used it is necessary, in order to achieve adequate efficiency in

the conventional construction of the combustion chamber, to create a pressure loss in the cooling flow.

According to the invention, in order to avoid this pressure loss, the air flow at the exit of the compressor is divided into two streams, one of these streams being compressed in a stage of supplementary compression and penetrating into the flame-tube to form combustion air and dilution air, and the second stream penetrating into the flame-tube to form the cooling air. The combustion air and dilution air is then compressed to a high degree whilst the cooling air is compressed to a lesser degree, instead of compressing all the air to the same degree in the usual way.

In order to avoid the complication of a supplementary stage to compress one stream of air only, it is possible to expand the cooling air flow, for example across a metering plate. This system, theoretically not so good as the preceding one, nevertheless offers advantages which are not inconsiderable. It permits, in particular, the use of relatively simple air inlets. Thus, if it is desired to have the combustion air and dilution air inlets at different sides of the chamber it is necessary to provide cross ducting for separating the two flows when a supplementary stage of compression is employed. This complication can be avoided by using an expansion diaphragm on each side.

The description which will follow with reference to the accompanying drawing, given by way of non-limitative example only, will explain fully how the invention can be carried into effect.

In the drawings:

FIGURE 1 represents a schematic section of a device according to the invention, which contains a supplementary compression stage for the combustion air;

FIGURE 2 shows another embodiment in which the cooling air is expanded through a diaphragm;

FIGURE 3 shows a variation of the embodiment of FIGURE 2;

FIGURE 4 presents a variation of the embodiment of FIGURE 1 wherein the supply of combustion air and dilution air takes place on two sides of the chamber.

Referring to FIGURE 1, the device includes a compressor, of which only the last stage of compression 1 has been represented, a flame-tube 2 and a turbine 3. At the exit of the last stage of the compressor, the flow of air is divided into first and second air passages by a partition 4. One part of the flow of air leaving the compressor in the first passage is compressed again by a supplementary stage 5 provided in the compressor. This air penetrates into the flame-tube 2 by means of holes 7 and 7'.

The other part of the flow of air, which passes through the second air passage or duct 6, is not compressed and penetrates into the flame-tube 2 by holes such as those indicated at 8. It also penetrates into the flame-tube 2 by means of apertures 9 and 9' encircling the holes 7 and 7'. The holes 8, 9 and 9' are of such sizes that the speed of the flow of air through them is low.

The holes 8 are those which feed the thermal protection films of the flame-tube 2. They can be designed in accordance with conventional techniques, that is to say in the form of slots or again in the form of a series of holes close together. This last technique results in small jets of air through the holes, the penetration being weak because the pressure difference across the flame-tube 2 can be diminished to the desired level and because the axial component of the jets can be regulated by the speed of the flow in the ring-shaped space encircling the flame-tube. It is also possible to benefit from the effectiveness of the technique of "sweating" through a porous wall, without running into difficulties such as blocking and high manufacturing costs.

The flow of air penetrating at a slow speed through the holes 9 and 9' is not in itself capable of ensuring combustion and dilution. These functions are fulfilled respectively by the jets penetrating at high speed through the holes 7 and 7' and which entrain the jets 9 and 9'.

According to FIGURE 2 the air leaving the last stage 1 of the compressor is divided into two streams, one of which serves to feed the flame-tube with the combustion air and dilution air, the other stream of air through the second air passage being expanded across a metering plate 10 and serving to feed the thermal protection films. The flame-tube, which has not been represented in this figure, is similar to that of the device of FIGURE 1.

With reference to FIGURE 3, the air is emergent from the compressor through a duct 11. It feeds the flame-tube 2 with combustion air and dilution air through the holes 7 and 7'. The air serving to furnish the thermal protection films is expanded across two metering plates 10a and 10b and penetrates into the flame-tube 2, passing through the second air passage or space 12 situated between the two pockets and the holes 8 or 9 and 9'. It would also be possible to feed the flame-tube in a perfectly symmetrical manner.

In FIGURE 4, the combustion and dilution air, compressed by the supplementary stage 1, enters into the chamber by the holes 7 and 7' placed on two sides of the chamber. To this end, ducts 13 cross the flow of cooling-air entering by the holes 8 and 9 and feed in, from the opposite side to the supplementary compressor stage, a suitable flow of combustion and dilution air.

It will be appreciated that various modifications of the above-described embodiments are possible within the scope of the invention, as defined by the appended claims.

We claim:

1. A combustion chamber for turbojet engines comprising a flame tube, means for injecting fuel into said flame tube, a compressor near one end of said flame tube

for providing a flow of air thereto, first air passage means and second air passage means at the exit end of said compressor for dividing the air flow into two streams, the air stream through said first air passage means penetrating into said flame tube to form combustion air and dilution air, the air stream through said second air passage means penetrating into said flame tube to form cooling air, and means at said exit end of said compressor in one of said air passage means for creating a pressure in said second air passage means lower than that in said first passage means, whereby operating efficiency of the combustion chamber is increased.

2. The combustion chamber according to claim 1 wherein said means for creating said lower pressure comprises a supplementary stage compressor in said first air passage means for further compressing the combustion air and dilution air.

3. The combustion chamber according to claim 1 wherein said means for creating said lower pressure comprises a metering plate in said second air passage means.

4. The combustion chamber according to claim 1 wherein nozzles are provided on said flame tube through which the combustion air and dilution air are introduced into said flame tube.

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