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[54] **IMPROVEMENTS IN OR RELATING TO**
COMBUSTION CHAMBERS
1 Claim, 2 Drawing Figs.

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431/242, 352

ABSTRACT: An annular combustion chamber comprising a plurality of ducts adapted to inject axially in an upstream direction a gasiform mixture containing vaporized fuel, each duct being associated with a pair of radial nozzles adapted to inject into said chamber two air jets directed toward one another, the geometrically defined area in which the jets are to meet being located at the outlet end of said duct.

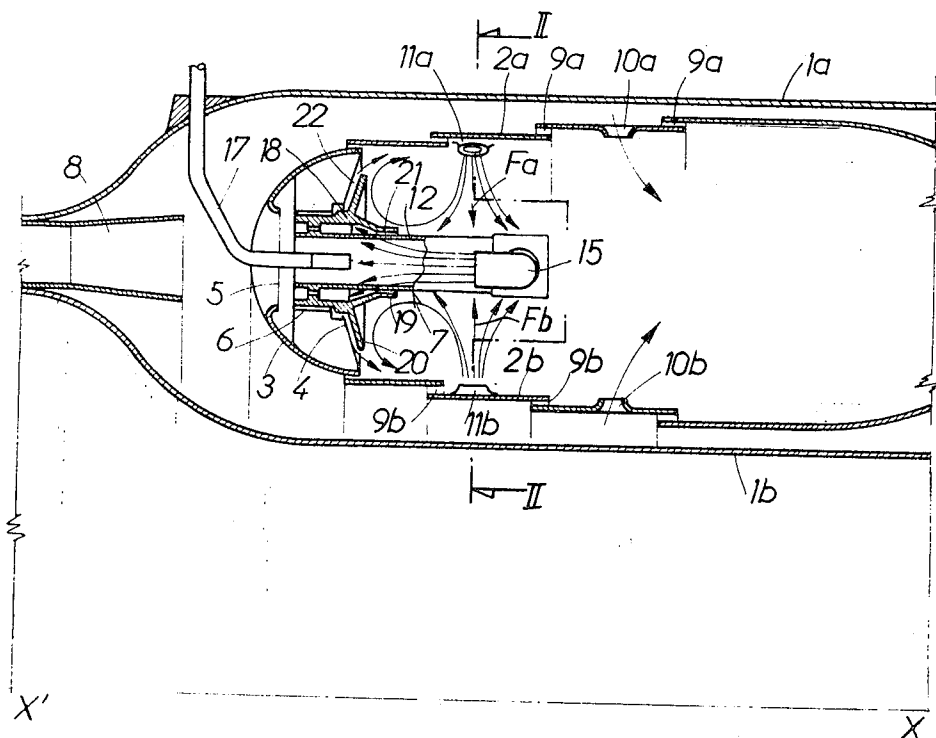


FIG. 1

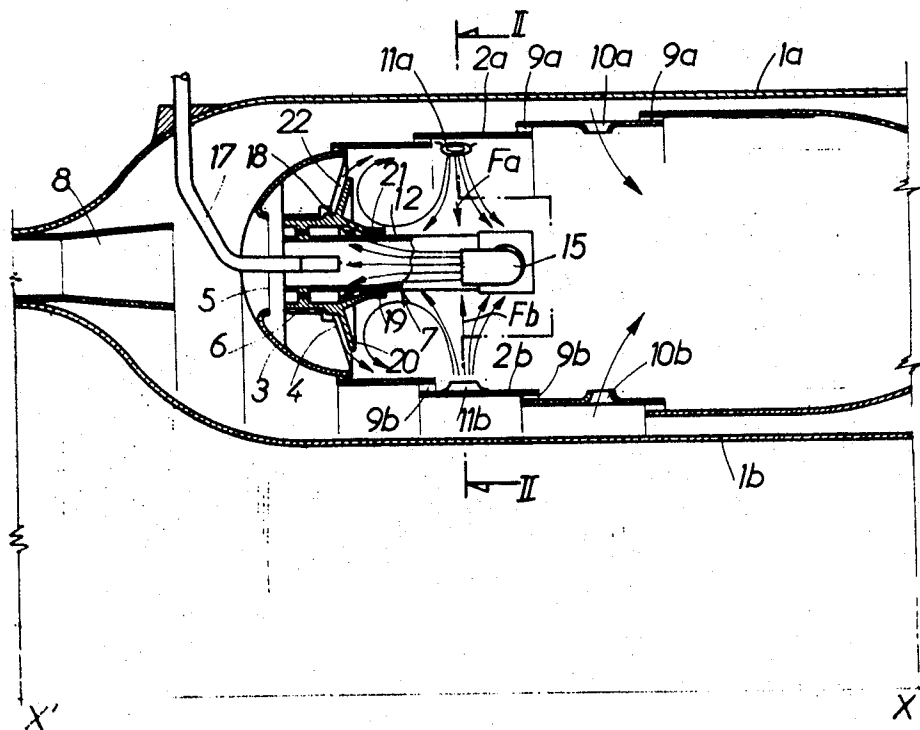
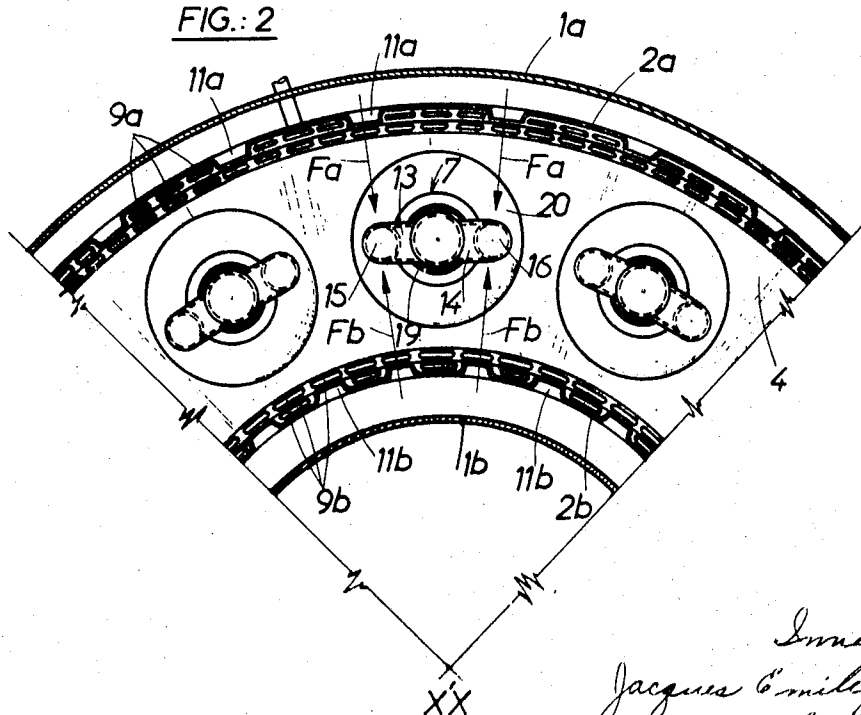


FIG. 2



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IMPROVEMENTS IN OR RELATING TO COMBUSTION CHAMBERS

Our invention has for its object an annular combustion chamber intended chiefly for gas turbine engines and has more particularly for its object an improvement facilitating the initiation and stabilization of the flame in the upstream region of such a combustion chamber.

It is known for stabilizing a flame in the upstream region of a combustion chamber, to produce in said region such large and stable reversed streams, that the average duration of the stay in said upstream region of burning particles is increased. A known method for this purpose consists in resorting to impacts between fluid jets and more particularly air jets, a fraction of the throughput of which is recirculated towards the upstream region of the combustion chamber and produces in said region an eddying flow facilitating the initiation and maintenance of the combustion, whereas the remainder of said jets flows directly towards the outlet end of the combustion chamber. Such a method implies a difficulty inasmuch as the impact point between oppositely directed jets is not stable and consequently the intensity of the eddying phenomena observed in the upstream region of the combustion chamber may be subjected to large fluctuations which cannot be foreseen and which may jeopardize the stability of the combustion.

It has already been proposed to stabilize the impact between two jets of fluid moving in opposite directions with a view to increasing the eddying phenomena in the upstream region of a combustion chamber by resorting to a baffle located in the geometrically defined area in which the jets are to meet. It has been found as a matter of fact that the use of such a baffle preventing the direct impact between the two jets and forming an element subdividing symmetrically the recirculated stream may cooperate in the production of a very marked stabilizing effect for said stream together with an increase of its flow rate.

Such advantages are obtained however at the expense of a number of drawbacks among which may be mentioned in particular, in addition to a more intricate structure of the chamber, the difficulty of protecting against heat such a baffle subjected to a very high temperature while additional losses of head are incurred.

Said drawbacks are cut out in the case of a combustion chamber arranged as will be explained hereinafter.

According to our invention, there is provided an annular combustion chamber comprising a plurality of ducts adapted to inject axially in an upstream direction a gasiform mixture containing vaporized fuel, each duct being associated with a pair of radial nozzles adapted to inject into said chamber two air jets directed towards one another, the geometrically defined area in which the jets are to meet being located at the outlet end of said duct.

It is thus apparent that is is no longer necessary to resort to one or more independent baffles. The design of the combustion chamber is consequently simplified. Any further loss of head is cut out, while the cooling of the walls of the baffle is ensured by the vaporization of the fuel and the movement in an upstream direction of the reversed stream is initiated by the jet of vaporized fuel. There is thus obtained the unexpected result (namely, the stabilization of the point of impact between oppositely directed jets of fluids) for which the vaporizing means had never been designed hitherto, and which in fact in all known former applications had never been achieved.

The following description referring to the accompanying drawings given by way of example and by no means in a limiting sense will allow our invention to be readily understood. In said drawings:

FIG. 1 is an axial sectional view of an annular combustion chamber adapted to operate with fuel vaporizing means and incorporating stabilizing means designed in accordance with our invention.

FIG. 2 is a sectional view through line II-II of FIG. 1.

The combustion chamber provided with fuel vaporizing means, which has been illustrated, includes as well known in the art an outer casing 1a and an inner casing 1b which are

substantially coaxial and define between them an annular space inside which two substantially coaxial walls 2a and 2b define the actual combustion chamber. The latter is closed at its upstream end by an annular cap or dome 3 inside which is fitted an annular structure 4. Said dome 3 and annular structure 4 are provided with two series of openings 5 and 6 distributed uniformly round the axis XX' of the combustion chamber, the cooperating openings in the two series being in axial alignment with each other. Fuel vaporizing means designated by the general reference number 7 are fitted with a clearance coaxially inside each opening 6. The upstream region of the combustion chamber is connected through at least one duct 8 with a supply of a combustion-supporting fluid such as compressed air. Said air flows through the annular passages extending between the casing 1a, 1b and walls 2a, 2b and enters the combustion space through the openings 5 to form primary air, and through ports 9a and 9b to form cooling air. It also enters through nozzle-like ports 10a and 10b as diluting air and through nozzle-like ports 11a and 11b as secondary combustion supporting air. The ports 9a, 9b are advantageously directed substantially parallel to the axis of the combustion chamber whereas the ports 10a, 10b are preferably directed in a substantially radial direction across the walls 2a, 2b.

The ports 11a, 11b extend also in a substantially radial direction across the walls 2a-2b in transverse registry with the preliminary vaporizing means 7 and cooperate in the stabilization of the flame in the upstream region of the combustion chamber as disclosed hereinafter with further detail.

Each of the preliminary vaporizing means 7 includes in a conventional manner a tubular duct 12, the upstream end of which is housed coaxially inside the openings 5 and 6. Said duct branches at its downstream end so as to form two transverse tubular ducts 13 and 14 which are bent back through 90° in an upstream direction as illustrated at 15 and 16. A duct 17 feeding liquid fuel opens into the upstream region of each duct 12.

The cross section of opening 6 has a larger size than the duct 12 and it allows positioning round the latter a member 18 which may be rigid with said duct. Said member 18 is provided with two extensions 19 and 20 defining with the duct 12 and the structure 4 two passageways 21, 22 through which a small fraction of the flow of primary air may enter directly the combustion space.

During operation, the larger fraction of the primary flow of air enters together with the liquid fuel the fuel vaporizing means, the walls of which are subjected along their outer surfaces to the action of the flame. Consequently the fuel is vaporized in said means and the mixture of air and vaporized fuel escapes substantially axially from the ducts 13, 14 in a direction opposed to the general direction of flow of the combustion gases, that is towards the cap or dome 3. The small amount of air injected through the passageway 21 round the duct 12 serves mainly for ensuring a certain thermal insulation of the upstream portion of the fuel vaporizing means 7.

The ports 11a, 11b provide for the production of two groups of substantially radial jets, the directions of which face each other. In known arrangements, the corresponding jets illustrated by the arrows Fa and Fb would impinge against each other and a fraction of the fluid forming said jets is then returned in an upstream direction so as to produce within a region adjacent the cap or dome 3 an eddying area adapted to facilitate the initiation and maintenance of the combustion, whereas the other fraction of said fluid flows directly towards the downstream end of the combustion space.

The impact between said oppositely directed jets is however not stable and, in order to remove said lack of stability which has consequential effects on the intensity of the turbulent phenomena occurring in the region of the chamber adjacent the cap 3, it has already been proposed as mentioned hereinabove to insert along the geometrical locus of impact between the jets a baffle preventing any direct impact between jets and forming a symmetrically arranged member within the

reversed fluid flow. The introduction of such a baffle constituted for instance by one or more plates however makes the structure of the chamber more intricate and leads to additional losses of head and furthermore it is necessary to solve a problem of protection against heat by reason of the very high temperatures prevailing in the region of the chamber enclosing the baffle.

According to our invention, the baffle is constituted by the outlet end of the fuel vaporizing means, which outlet end is suitably located with reference to the injection ports 11a, 11b. As illustrated in the drawings the oppositely directed jets Fa, Fb extend in the transverse plane defined by the outlet openings of the rearwardly directed ducts 15 and 16, such an arrangement providing the advantage of initiating and maintaining the reversed flow of fluid. It also facilitates the production of eddies.

Obviously the use as a baffles, of elements forming part of the fuel vaporizing means, that is of elements already present but which had not been made use of hitherto, for that purpose is advantageous for many reasons. It does not lead to any additional loss of head within the chamber and cuts out the problem of the cooling of the baffles, which problem is solved by the vaporization of the fuel within the ducts of the fuel vaporizing means, and these advantages are obtained at the expense of a very small modification in the structure of the chamber, consisting in the mutual matching between the location of the ports 11a, 11b ensuring the injection of and the fuel vaporizing means.

Our invention provides furthermore the advantage of homogenizing more speedily the combustion region as the mixture of primary air and vaporized fuel is injected at the point of origin of the eddies.

I claim:

1. An annular combustion chamber fed with liquid fuel and

compressed air comprising:

two coaxial annular casings enclosing between them an annular space;

two coaxial annular walls coaxial with said casings, housed within said annular space and the interval between which defines an annular combustion space through which the combustion gases are adapted to flow, said walls defining between them and the corresponding casings annular passages;

means adapted to supply said annular passages with compressed air;

a dome closing the combustion space at one end thereof;

a plurality of means adapted to inject into the region of the combustion space lying in the vicinity of the dome vaporized fuel, each of said means having an outlet opening facing the dome and through which last-mentioned vaporized fuel is exhausted towards the dome in a direction substantially parallel to the axis of the annular walls, said outlet openings being distributed along an annular line extending at substantially equal distances from the said annular walls; and

a plurality of nozzlelike ports extending across said annular walls and connecting each of the annular passages with the annular combustion space, a nozzlelike port across one annular wall registering substantially radially with a corresponding nozzlelike port across the other annular wall and with a corresponding outlet opening through which vaporized fuel is exhausted said dome having openings adjacent said plurality of means for injecting vaporized fuel, deflector means surrounding each of said means for injecting vaporized fuel adjacent said dome and adapted to deflect air passing through said openings in said dome toward said annular walls.