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WALL ELEMENT FOR COMBUSTION CHAMBERS

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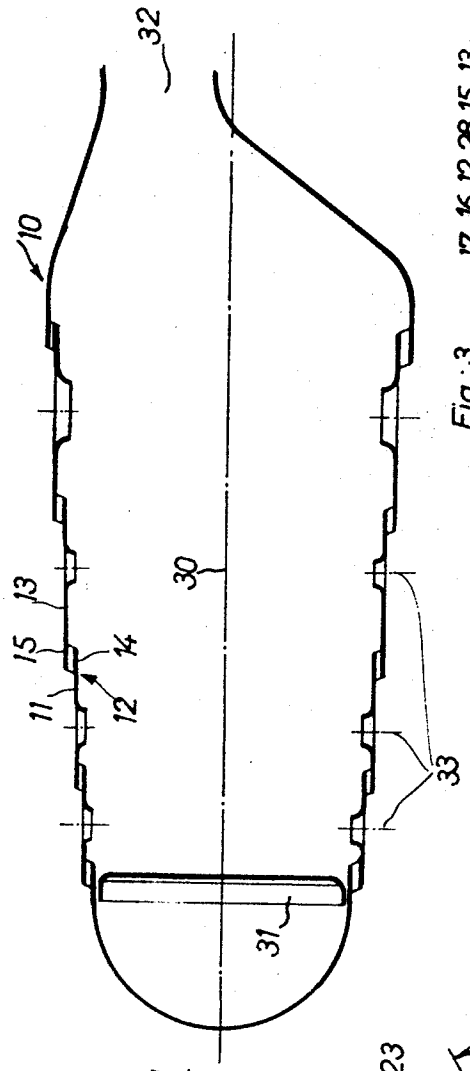


Fig: 1

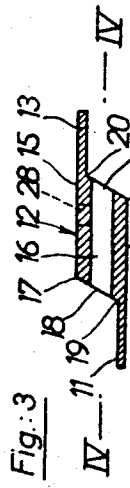


Fig: 3

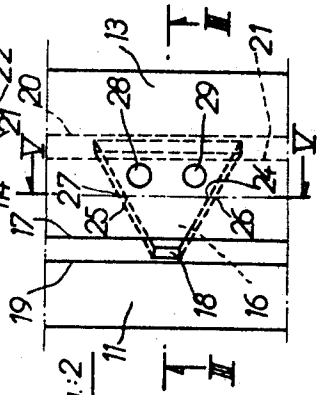


Fig: 2

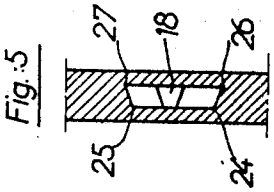


Fig: 5

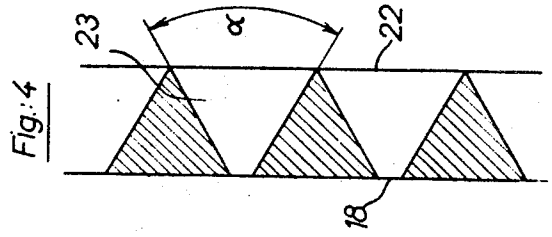


Fig: 4

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WALL ELEMENT FOR COMBUSTION CHAMBERS

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U.S. Cl. 60—39.65 7 Claims

ABSTRACT OF THE DISCLOSURE

A wall element for a combustion chamber which comprises, successively considered in the downstream direction, a relatively thin upstream portion, a thickened portion whose internal surface is substantially an extension of the upstream portion, and a relatively thin downstream portion which is substantially an extension of the external surface of the thickened portion, the thickened portion containing axial passages directed downstream. In accordance with the invention, the section of each axial passage in the thickened portion, as defined by a plane parallel to the three said portions of the wall element, increases in the downstream direction, and is triangular for example. As a consequence, the speed of the cooling air reduces as it progresses downstream and its means speed inside the passage is thus higher than at the exit from the passage, a factor which improves cooling.

This invention relates to a wall element for a combustion chamber, the term "combustion chamber" relating here in a general way to any chamber in which combustion takes place. For example, the chamber may be a main combustion chamber or a secondary combustion chamber, such as a reheat passage, in a heat engine, in particular in a turbojet engine or a conventional jet engine, or again a flame tube and in particular one of the flame tubes which make up the part of a jet engine traditionally referred to as the "combustion chamber."

Where combustion chambers are concerned, it is well known to avoid direct contact between the hot combustion gases and the chamber wall by interposing a film of cooling fluid between the two. This process is known as film cooling. In order that the inevitable mixing between the hot gases and this cooling fluid shall take place as slowly as possible, and that the film shall therefore remain efficient for the longest possible time, there must be a certain ratio between the speed of the film fluid and that of the hot gases. This speed ratio is obtained by giving the externally introduced fluid, which produces the cooling film, a pressure which is sufficiently higher than that of the hot gases.

It is well known to introduce the cooling fluid into the hot gases through openings formed in a part of the chamber wall which is substantially similar in thickness to the rest of the wall. However, this results in the production of radical local heat stresses.

A combustion chamber wall element is also known which successively comprises, working in the downstream direction, a relatively thin upstream portion, a thickened portion whose internal surface is substantially an extension of the upstream portion and a relatively thin downstream portion which is substantially an extension of the external surface of the thickened portion, the said thickened portion containing axial passages which are directed downstream. This wall element is a mechanical component which has the advantage of incorporating a relatively large mass of metal, thus facilitating heat dissipation

so that the local heat stresses are reduced. The upstream portion can be relatively short and be welded upstream to another portion, of the same thickness, of the combustion chamber wall. Similarly, the downstream portion can be relatively short and can be welded at its downstream end to another portion of the combustion chamber wall. However, in such known mechanical components used hitherto, the axial passages in the thickened portion are cylindrical and consequently the fluid flowing therein has a constant speed throughout.

In accordance with the invention, it is possible to give the cooling fluid passing through the axial passages a higher means speed than that which it has at exit from the passages. To this end, each axial passage is so designed that its section, considered in a plane parallel to the three portions of the combustion chamber wall, increases in the downstream direction. Accordingly, the speed of the cooling air reduces in the downstream direction and its means speed inside the passage is thus higher than at the exit, with consequent improvement in cooling.

Clearly, a combustion chamber wall generally includes several successive parallel elements of the kind with which the invention is concerned.

The ensuing description relating to the accompanying drawing will indicate by way of example how the invention may be carried into practice. This example relates to a flame tube in the "combustion chamber" of a turbojet engine.

In the drawing:

FIGURE 1 illustrates a longitudinal section of the axis of a flame tube comprising tube elements in accordance with the invention;

FIGURE 2, on a larger scale, is a partly external developed view of the wall of a tube element;

FIGURE 3 is a section of the line III—III of FIGURE 2;

FIGURE 4 is a developed section on the line IV—IV of FIGURE 3; and

FIGURE 5 is a transverse section on the line V—V of FIGURE 2.

In the drawing, the reference **30** designates the axis of the tube, and this also follows the general direction of flow of the gases within the tube (left to right in FIGURE 1), from the base **31** of the tube up to the plane **32** at which entry into a turbine ring takes place. The references **33** designate sets of orifices in the tube. A cooling arrangement in accordance with the invention is arranged between each two successive sets of orifices **33**. Thus, the references **11**, **12** and **13** designate three successive portions of the element forming the relevant part of the wall of the tube. In that part of the tube under consideration, **11** is a relatively thin upstream portion, for example of sheet metal, **12** is a thickened portion, the internal surface **14** of which is substantially an extension of the upstream portion **11**, and **13** is a relatively thin downstream portion, for example of sheet metal, which substantially forms an extension of the external surface **15** of the thickened portion **12**.

The external edge **17** of the upstream frontal face of the thickened portion **12** is downstream of the internal edge **19**, that is to say the said frontal surface is inclined in relation to the axis **30** of the tube. Similarly, the external edge **20** of the downstream frontal surface of the thickened portion **12** is downstream of the internal edge **21**, and the two frontal surfaces, upstream and downstream, are substantially parallel to one another.

The thickened portion **12** accommodates axial passages **16** which open into the two frontal surfaces aforementioned. The cross-section of each axial passage **16**, considered on a median plane parallel to the three portions forming the wall of the tube element, is that of a triangle

23 and its section on a plane V—V normal to the axis 30 of the tube is a trapezium 24, 25, 26, 27, although this might equally well be some other geometric shape, for example a rectangle, an oval or a semi-oval.

FIGURE 4 shows that the downstream exit sections 22 of the passages 16 are contiguous in the development of the above-mentioned median plane of the three portions. Reference 18 denotes the upstream inlet sections of the axial passages 16.

α is the apertural angle of each axial passage 16. This angle is preferably relatively large and, consequently, it is possible that the air flow in the axial passage 16 may exhibit boundary layer breakaway effects which can give rise to instability phenomena and consequently a defective film. These phenomena are avoided, or at least controlled, and at the same time the total air flow in the film is also controlled, by piercing in the thickened portion 12 two radial passages 28 and 29 which allow the axial passage 16 to communicate with the exterior of the wall and which are disposed symmetrically in relation of the plane III—III (FIGURE 2) which constitutes the axial plane of symmetry of the axial passage 16 and is normal to the three portions 11, 12 and 13 of the wall element.

What is claimed is:

1. In a combustion chamber traversed by a flow of hot fluid and the wall of which is protected by a film of cooling fluid, a wall element which comprises, successively considered in the downsrteam direction, a relatively thin upstream portion, a thickened portion the internal surface of which is substantially an extension of the upstream portion, and a relatively thin downstream portion which is substantially an extension of the external surface of the thickened portion, said thickened portion containing passages directed downstream for the introduction of the cooling fluid, and each said passage having a cross-section, on a plane parallel to the three portions of said wall element, which increases in the downstream direction.

2. A combustion chamber wall element as claimed in claim 1, wherein the thickened portion contains, for each axial passage, at least one radial passage which places the axial passage in communication with the exterior of the chamber wall.

3. A combustion chamber wall element as claimed in claim 2, wherein the thickened portion contains two radial passages for each axial passage.

4. A combustion chamber wall element as claimed in claim 3, wherein each axial passage has an axial plane of symmetry perpendicular to the three portions of the wall element and the two radial passages are disposed symmetrically in relation to the said plane.

5. A combustion chamber wall element as claimed in claim 1, wherein the said cross-section is triangular.

6. A combustion chamber wall element as claimed in claim 1, wherein the downstream exit sections of the axial passages are continguous.

7. In the flame tube of a turbojet engine, a wall element which comprises, successively considered in the downstream direction, a relatively thin upstream portion, a thickened portion the internal surface of which is substantially an extension of the upstream portion, and a relatively thin downstream portion which is substantially an extension of the external surface of the thickened portion, the upstream face of the thickened portion being exposed to the outside of the tube and the downstream face to the inside thereof, and passages in said thickened portion communicating between said faces for the introduction of cooling fluid, each of said passage increasing in width in the downsrteam direction, at least in the plane normal to an axial plane through said passage.

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U.S. Cl. X.R.

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