Jan. 3, 1967 L. J. BAUGER ETAL 3,295,318

BURNER DEVICES AND COMBUSTION CHAMBERS THEREFOR

Filed June 7, 1965 3 Sheets-Sheet 1

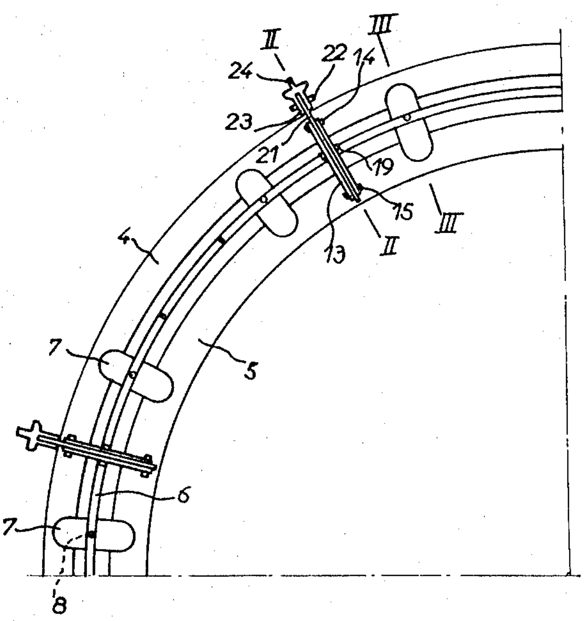

Fig.: 1

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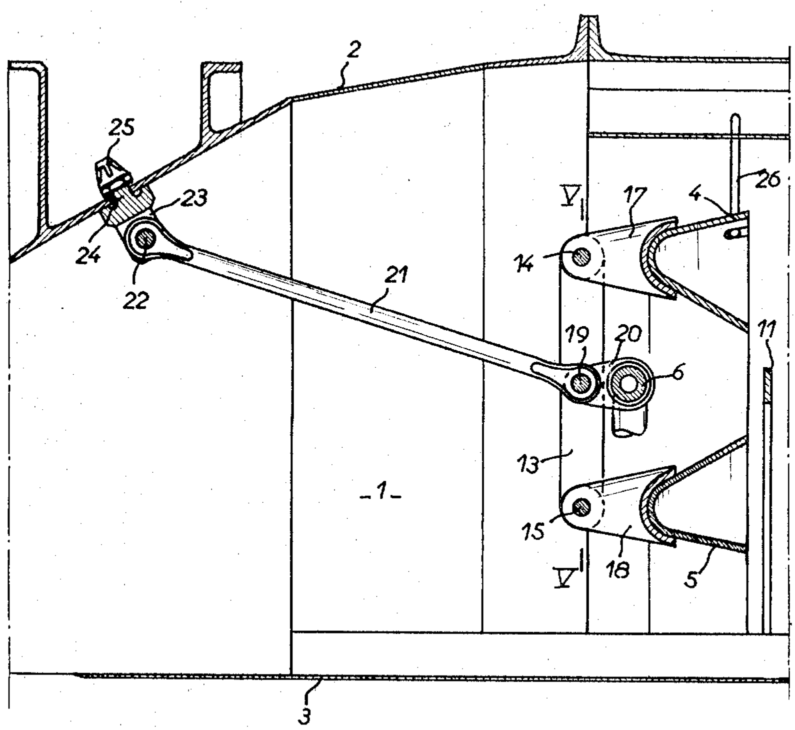

Fig.: 2

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Fig.:5

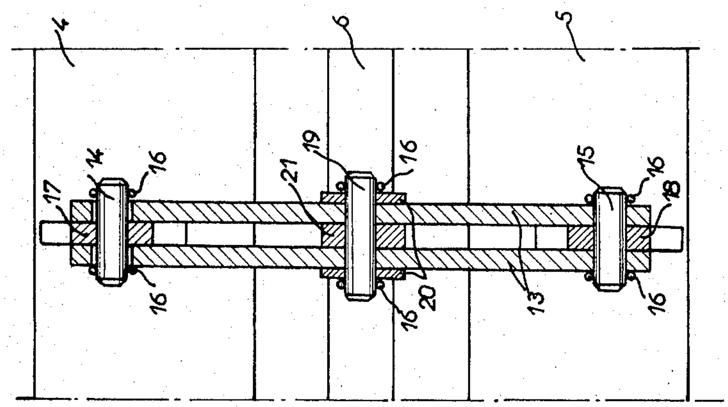


Fig.:4

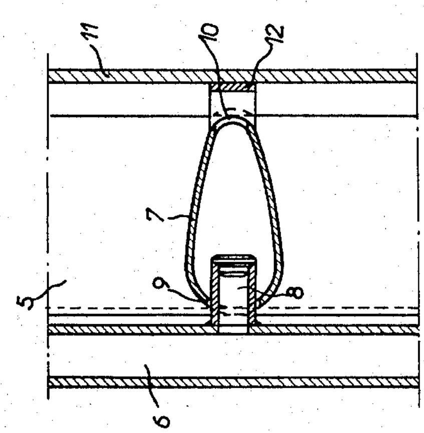
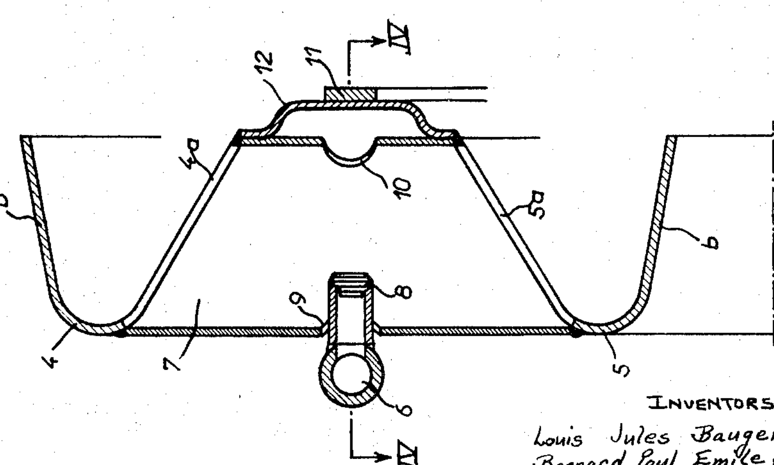


Fig.:3



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BURNER DEVICES AND COMBUSTION CHAMBERS THEREFOR

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4 Claims. (Cl. 60—39.72)

The combustion chambers of aeronautical turbo-engines are subject to high thermal loads and, so as not to require too large over-all dimensions, it is necessary to make the fullest possible use of the cross-section of the combustion chamber for the installation of flameholders, while avoiding excessive loss of static pressure.

However, the use of a plurality of flameholders and fuel supply manifolds or racks makes other combustion problems particularly acute, these problems including the need for ensuring uniform distribution of temperature at the outlet from the combustion chamber, correct atomization of the fuel and easy propagation of the flame on ignition.

It is an object of the present invention to provide a burner device which will offer a satisfactory solution to such problems. The device provided by the invention of the type comprising two or more concentric rings of V-shaped radial cross-section which are open in the downstream direction and perform the function of flame stabilizers, the means for mounting these rings in a combustion chamber being devised so as not to disturb appreciably, the flow in the combustion chamber.

According to the present invention, the rings are linked by a rigid interconnection system constituted by a series of profiled hollow radial arms or struts which are distributed transversely in the combustion chamber and each of which opens at its opposite ends into the internal space of the respective rings, the assembly comprising the rings and the hollow radial arms or struts forming a rigid unitary assembly.

According to a preferred embodiment of the invention, one or more fuel injectors are housed inside each hollow profiled strut, air inlet orifices being formed in the leading or upstream edges of the respective struts in the proximity of the said injectors. Thus, air and fuel can enter the flame-holder rings by way of the hollow struts, together with, in the case where one or more of the struts contains a sparking plug or other ignition device, an ignition flame. Openings may also be formed in the trailing edges of the hollow profiled struts for the discharge of carburetted mixture directly into the combustion chamber. In this case a screen, in the form of an annular plate for example, is advantageously disposed opposite the said outlet openings, in the path of the air-fuel mixture which is generated thereby.

The following description with reference to the accompanying drawings, of one form of burner device according to the invention, which is given by way of nonlimitative example only, will make it clearly understood how the invention can be carried into effect. In the drawings:

FIGURE 1 is a fragmentary diagrammatical view of the burner device;

FIGURE 2 is a fragmentary sectional view through the upstream portion of a combustion chamber in which the burner device being shown in radial section on the line II—II of FIGURE 1;

FIGURE 3 is a radial section on the line III—III of FIGURE 1;

FIGURES 4 and 5 are fragmentary sections on the line IV—IV of FIGURE 3 and the line V—V of FIGURE 2, respectively.

Referring to the drawings, the burner device is mounted in the combustion chamber **1** of a jet propulsion unit, the combustion chamber being defined by two annular sleeves **2**, **3**. The burner device is constituted primarily by two concentric and coplanar rings **4**, **5** of generally V-shaped cross-section, arranged with their open sides in the downstream direction, and by a fuel manifold **6** extending around the circumference of a circle whose radius is intermediate between the radii of the rings **4** and **5** and concentric with the latter.

The two burner rings **4** and **5** are connected by a number of tubular radial interconnecting arms or struts **7** distributed around the combustion chamber **1** and profiled so as to reduce the drag which they present to the flow of air passing through the chamber (the aerodynamic profile of the struts **7** can be clearly seen in FIGURE 4. The struts **7** are tubular or hollow and are secured in radial positions by welding them to the opposed faces of the V-shaped rings **4** and **5**. The walls of the faces are apertured at *4a* and *5a* at the places where they are intersected by the tubular struts **7**, so that the latter communicate with the interior of the rings at each end.

The manifold **6** which is disposed upstream of the struts **7** carries injection nozzles or heads **8** which are welded thereto and which extend into the interior of the struts **7** through orifices **9** formed for this purpose (see FIGURES 3 and 4). The diameter of the said orifices **9** is sufficient to permit a flow of air around the injectors **8** so as to obtain a suitable mixture of air and fuel. Further orifices **10** are formed in the struts **7**, at the downstream sides thereof, so as to allow the carburetted mixture to pass out. A narrow annular plate **11** is arranged coaxially between and somewhat downstream of the burner rings **4** and **5**, at equal radial distances from them; the plate **11** is held by spacers **12** fixed to the downstream sides of the respective struts **7**.

This arrangement enables the fuel to be injected under high pressure, by reason of the smaller number of injection holes which are provided. The fuel is atomized when the jet of fuel issuing from each injector **8** comes into contact with the downstream part of the associated hollow strut **7** and further, when the fuel passes out through the hole **10** and strikes against the annular plate **11** which acts as a screen. It is sprayed finely into the surrounding air and the mixture is distributed in the two wakes formed by the burner rings **4** and **5**, where it can burn. In order to prevent the mixture being carried away between the two wakes without burning therein, the sides of the two rings which face one another are preferably inclined to a greater extent with respect to the general axis of the chamber than the sides which are remote from one another (as can be seen in the drawings), so as to bring the wakes closer to the median space.

As a variant, instead of each injector **8** producing one or more jets directed towards the annular plate **11** in the same general direction as the direction of the flow of air, it can emit jets which are oblique with respect to the air flow, being directed towards the openings *4a*, *5a* by way of which the corresponding strut **7** communicates with the internal space of the rings **4** and **5**. Atomization of the fuel will then take place on the outer lips of the rings **4** and **5** instead of occurring on the annular place **11** as before. Moreover, the two methods of injection may be employed simultaneously.

It will be quite obvious that air can be supplied to the interior of the struts **7** at a pressure higher than the normal pressure of entry into the combustion chamber, simply by connecting the orifices 9 to a source of air which is subject to overpressure. Similarly, a supply of hot air can be provided by taking the air from, for example, the turbine of the jet engine.

The arrangement for suspending the two rings 4 and 5 and the fuel manifold 6 from the outer sleeve 2 of the combustion chamber will now be described, with particular reference to FIGURES 2 and 5.

The arrangement comprises a set of linking bars 13 which are pivotally connected at their ends, by means of axes 14 and 15 and securing pins 16, to T-section supports 17 and 18 which are welded to the rings 4 and 5 the leading edge shape of which they take. Each linking bar 13 is also articulated at its centre by means of an axis 19, likewise provided with securing pins 16, to a support 20 fast with the fuel manifold 6. To this same axis 19 there is coupled one end of a connecting rod 21 which is pivotally connected at its other end to the outer sleeve 2, at 22, the pivot pin 22 being mounted in a fork 23 which has a threaded boss 24 integral therewith, the threaded part of which extends through a hole formed in the sleeve 2 and receiving a self-locking nut 25. Of course, the suspension arrangement comprises a number of articulated connecting rods 21 distributed around the cross-section of the combustion chamber so as to support the burner device as a whole at the correct position.

It will be observed, however, that it is the struts 7 welded to the rings 4 and 5 which determine the positions of the latter relatively to one another and not the linkage bars 13 and 21, which support the burner device as a whole. The mounting of the burner device in the combustion chamber 1 therefore cannot introduce any additional stress due to expansion movements of the rings 4 and 5 relatively to one another.

The device which has just been described has many advantages, among which the following may be mentioned.

(1) More uniform radial distribution of temperature. The minimum temperature occurring between the two maximum temperature positions corresponding to the two rings 4 and 5 is increased due to the presence of the struts 7 and the plate 11. The result is greater efficiency, improved stability of combustion and, in the case where there is a turbine at the outlet of the chamber, better behaviour of the blades of the turbine for a given temperature.

(2) Elimination of coking of the fuel before injection. This is achieved because the manifold 6 is well upstream of the flame-front of the burner rings 4 and 5 and because the injection nozzles 8 are protected from radiation by the struts 7.

(3) Improvement of the propagation of ignition. This is achieved because the struts 7, which propagate the flame from one burner to the other, shelter the flame from the air flowing through the combustion chamber. Only a single sparking plug, such as indicated at 26 in FIGURE 2, is required to cause ignition at both the rings 4 and 5.

It will be obvious that many modifications may be made in the particular embodiment which has just been described, in particular by substituting equivalent technical means, without thereby departing from the scope of the invention as defined by the appended claims.

What we claim is:

1. An improvement in combustion equipments for combustion chambers designed to be traversed by a high-velocity air flow and of the kind comprising at least two annular flame-holder rings of V-shaped radial cross-section defining an inner space closed upstream at the apex of said V cross-section and open downstream, said rings being of different radii and arranged concentrically of each other, and a plurality of generally radial hollow struts extending between said concentric rings and communicating with said inner space thereof, said concentric rings and said radial struts forming a rigid unitary assembly, wherein said improvement comprises an annular fuel manifold having a radius intermediate the radii of said rings and arranged coaxially with respect thereto and upstream of said assembly, an inlet passage formed in the leading edge of said hollow struts at substantially the same radial distance as the radius of said fuel manifold, said inlet passage facing upstream toward said fuel manifold, and a fuel jet nozzle projecting from said manifold and through said inlet passage into the respective hollow radial strut, a substantial clearance being left between the periphery of said inlet passage and said fuel jet nozzle to allow inflow of air into said strut around said nozzle.

2. A combustion equipment as claimed in claim 1, comprising further an ignition means housed in at least one of said hollow struts, for igniting the mixture formed therein of fuel discharged by said fuel jet nozzle and of air admitted through said inlet passage.

3. A combustion equipment as claimed in claim 1, comprising further an outlet passage formed in the trailing edge of said hollow struts and facing downstream, and deflecting means positioned downstream of said struts and opposite the outlet passage thereof, to deflect fluid issuing from said outlet passage radially outward and inward toward the inner space of the flame-holder rings.

4. A combustion equipment as claimed in claim 3, wherein said deflecting means comprises an annular plate having substantially the same radius as the radial distance of said outlet passage.

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