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M. RAVEL

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COMBUSTION CHAMBERS OF REACTION PROPULSION UNITS

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Fig. 1.

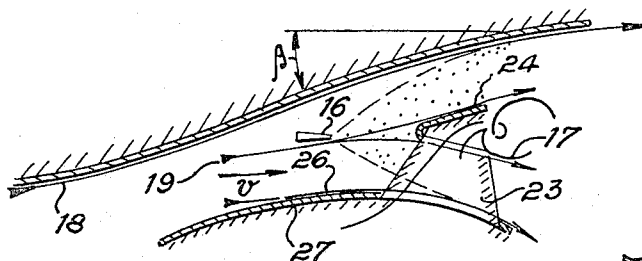
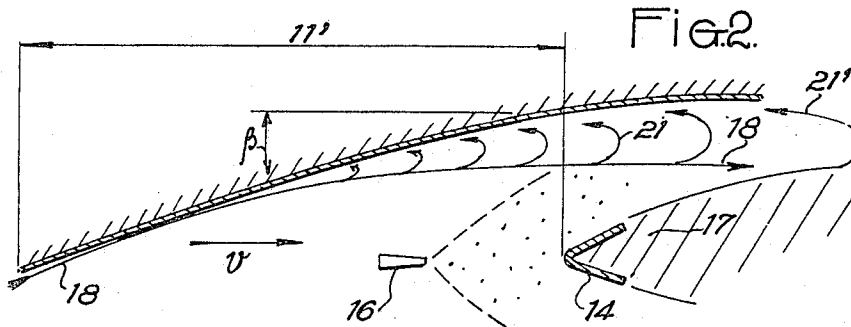
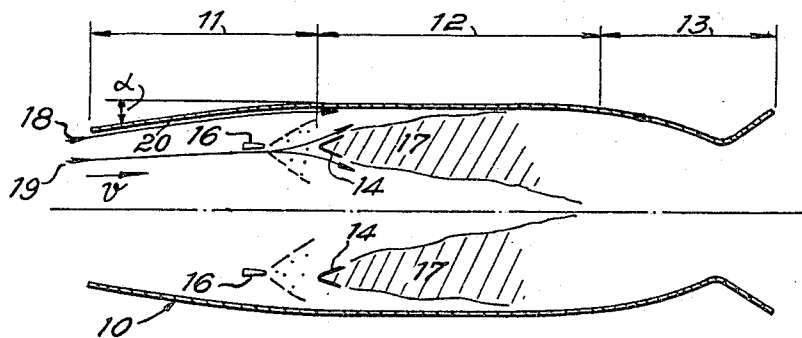


Fig. 3.

Inventor
Maurice Ravel
By
Karl W. Flocks
Attorney

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M. RAVEL

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FIG. 4.

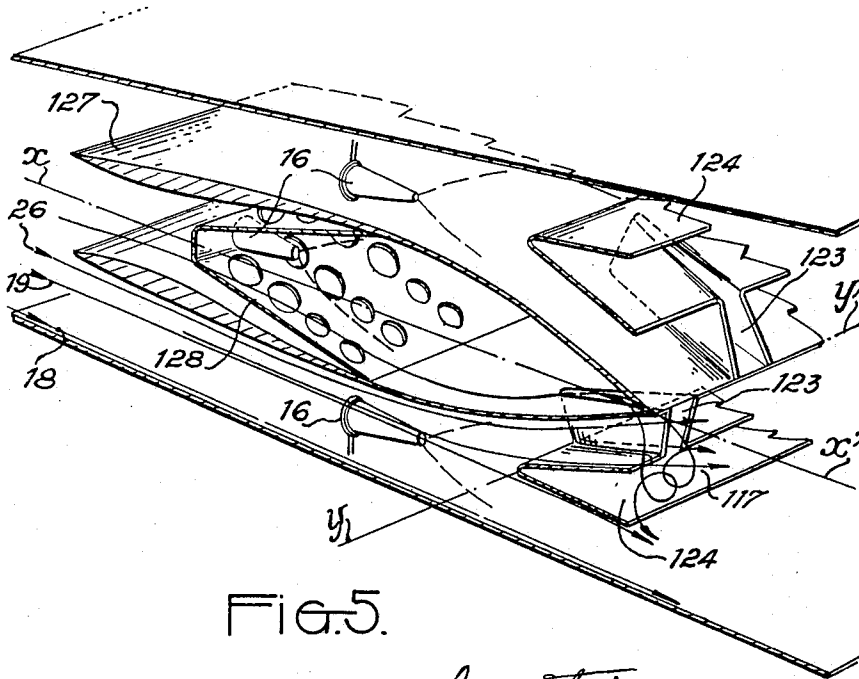
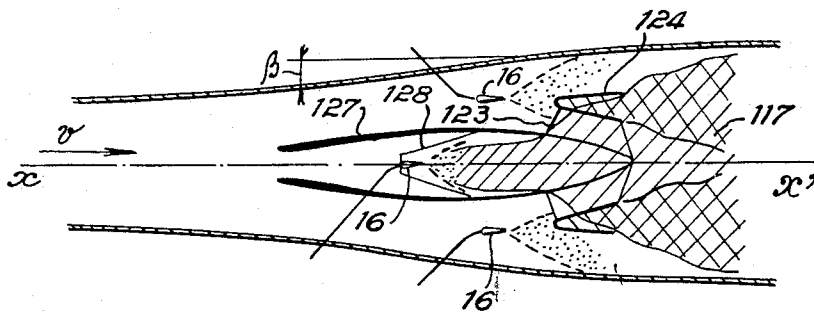


FIG. 5.

Inventor
Maurice Ravel

By Wm. W. Flocks

Attorney

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COMBUSTION CHAMBERS OF REACTION
PROPULSION UNITS

Maurice Ravel, Morsang-sur-Orge, France, assignor to
Nord-Aviation Societe Nationale de Constructions
Aeronautiques, Paris, France, a joint-stock company of
France

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2 Claims. (Cl. 60—39.74)

The present invention relates to an improvement in combustion chambers of reaction propulsion units, the present improvement being intended to reduce their length and their weight.

It is known that the length of a propulsion reactor is the sum of the lengths of three essential elements which are: apart from the discharge-nozzle, the diffuser at the front and the combustion chamber. The function of the diffuser is to slow-down the air and to bring it to a sufficiently-low speed for the combustion to be possible. This slowing-down is effected in a divergent, the maximum angle of which is that which corresponds to the appearance of detachment of the flow from the wall. The function of the combustion chamber is to achieve the most complete combustion possible of the previously carburized mixture; this combustion determines, under given conditions of flight of the propulsion reactor, the length of the chamber from the downstream side of the flame stabilisers; and this length cannot be reduced without increasing the quantity of unburnt gases in the consumption of the reactor.

The improvement forming the object of the invention proposes to shorten these two elements by arranging the flame-stabilisers as far upstream as possible before the end of the diffuser and consecutively to determine judiciously the profiles of these stabilisers so as to obtain in the combustion chamber thus formed, variations of section of the different streams of air compatible with a flow without detachment from the walls.

The difficulties of an adaptation of this kind become apparent with the outline of the profile of the combustion members arranged in the interior of a chamber, the walls of which are for this reason highly divergent. This profile must in fact be such that no detachment can take place, either on the combustion members or on the walls of the chamber, since it is well known that any such detachment results in losses of power and results in backward surges of burnt gases which are dangerous for the walls.

The present invention has essentially for its object a combustion chamber comprising, in addition to the usual injectors and igniters, combustion members constituted by a pilot flame stabiliser communicating with appropriate burners. This chamber is arranged in such manner that its walls are highly divergent, that the pilot flame stabiliser has a profile such that the variation of section of passage between the said stabiliser and the walls of the chamber is disposed so as to permit a normal flow and a suitable slowing-down of the flow of air passing through the said chamber, that the said stabiliser extracts a part of the flow of air on the upstream side, gives it a normal flow and produces, after suitable carburization by means of a usual burner, a pilot flame which is sent through communication conduits at the rear of other burners located in the channels formed by the free space between the stabiliser and the walls of the chamber, that the said burners produce, by means of the said pilot flame, the combustion of the flow of air passing into the channels, the said flow having been previously carburized by means of the usual injectors, and slowed down by the arrange-

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ment of the free section between the stabiliser and the walls of the chamber.

The description which follows below will make the invention more clearly understood while at the same time bringing out other characteristic features and advantages.

The description is particularly directed to one form of preferred embodiment, reference being made to the accompanying drawings, in which:

FIG. 1 is a diagram showing a longitudinal cross-section of a conventional propulsion reactor.

FIG. 2 is an explanatory diagram to a larger scale, showing clearly the detachment from the walls of a stream of air passing into a diffuser whose walls are too divergent.

FIG. 3 is a diagram showing how, by virtue of the application of the improvement according to the invention, the same air-stream is given a normal flow and how the combustion is produced.

FIG. 4 is a diagram showing in a longitudinal section the arrangement of a chamber in accordance with one preferred form of embodiment of the invention.

FIG. 5 is a detail view in perspective showing to a larger scale the pilot flame stabiliser arranged in the chamber and the arrangement of the section of passage of the burnt gases and of the flow of air in the lateral channels.

It will be necessary to refer to FIGS. 1, 2 and 3 in order to realize the nature of the problem to be solved and to define the scope of application of the invention.

A conventional propulsion reactor 10 (FIG. 1) comprises, from the upstream to the downstream side, a divergent of length 11, a combustion chamber of length 12 and a discharge nozzle of length 13. In the chamber 12 are arranged burners 14 and in front of these burners, injectors 16 produce the vaporization of the fuel. The wake 17 of the burners 14 maintains the combustion. The flow of air enters the divergent length 11 which ensures the slowing down necessary for its combustion. In a machine of this kind, the streams of air 18, 19 will flow correctly against the wall 20 of the diffuser and against the burners as long as the local angle α of the divergent section 11 is small.

If, with the object of reducing the length 11 of the divergent to a length 11' and the value of the angle α is increased and brought up to the value β of FIG. 2, it is found that the streams 18 become detached from the wall and the reverse currents 21 are then produced. In addition, a back-flow combustion 21' can be produced by backward deflection of the wake 17 of the burner along the walls of the diffuser and this combustion may burn the walls.

The improvement according to the invention enables these drawbacks to be overcome by arranging, as shown in FIG. 3, the pilot flame stabilizing device in such manner that the disposition of the variation of the various transverse sections of passage of the flow of air around the said flame stabilisers is always compatible with a normal flow of the air streams. Inside the stabilizer, there is placed any type of combustion device so as to permit, by virtue of evacuation conduits 23 arranged in such manner that the hot gases coming from the said combustion are evacuated to the rear of the secondary burners 24, the suitable combustion of the flux of air passing through the channels.

It is easy to see from FIG. 3 that the air streams 18, 19 and 26 with a speed v have a normal flow by virtue of the profile of the stabilizer 27, although the local angle of divergence β is very large. Similarly, from this figure it can be seen that the wake 17 of the burner maintains the combustion of the stream of air previously carburized by the injectors 16.

FIGS. 4 and 5 give an example of the practical application of the device described above. In these figures, which show a symmetrical unit having an axis X-X', the pilot flame-stabilizer 127 is arranged and has a profile such as to take a first portion of the flow of air having a speed v , to slow down this part of the flow in order to bring it into the required conditions for combustion, to produce this combustion by any appropriate device (in the example shown, there has been chosen a device comprising a gutter stabilizer with orifices 128), to evacuate the combustion gases by conduits 123 terminating at the rear of the burners 124, to produce, by virtue of the wake 117 of these burners, the combustion of the mixture of the remaining flow of air, this second portion of the flow of air having been slowed-down, after carburation, by the arrangement of the section of passage together with the profiling of the stabilizer 127, which is in turn defined by the divergence of the angle β .

It follows from the foregoing description that the invention relates to an improvement made in combustion chambers of propulsion reactors, the said improvement being characterized by the points decapitulated below, taken separately or in combinations.

There is arranged in the interior of a chamber with highly divergent walls a pilot flame stabilizing device which permits, by virtue of its arrangement: the extraction of a part of the flow of air passing through the chamber; the combustion of this part of the flow; the evacuation of the burnt gases through conduits arranged between the said stabilizer and suitable burners; and the combustion of the remaining part of the flow of air by virtue of an arrangement of the variation of section of passage comprised between the stabilizer and the combustion chamber, such that the said portion of the flow of air passes into the zone of the burners under conditions of combustion.

The internal and external profiles of the stabilizer, the conduits and the burners are arranged in such manner that the flow of air is normal over the whole of its travel and that no parasitic turbulence appears at any point whatever.

The burners are arranged in such manner that the combustion takes place under the normal conditions for this type of propulsion unit.

It will of course be understood that the invention has only been described and shown purely by way of explanation and not in any restrictive sense, and that it may receive any modifications in conformity with its spirit without thereby departing from the scope of the said invention.

Thus, in particular, the axes X-X' and Y-Y' may be rectilinear or otherwise, the conduits 123 may be of any number and arranged facing each other or in staggered relation, and finally, the principle shown diagrammatically in FIG. 3 can be applied to any number of stabilizers, burners, conduits, provided that the necessary conditions are respected.

Similarly, with the sole object of simplification, there

have been expressly left out of the foregoing description descriptions of specific well known auxiliary devices such as injectors, igniters, etc., necessary to the correct operation of a propulsion reactor but not necessary to a complete description of the invention.

It will be obvious to those skilled in the art that various changes may be made without departing from the spirit of the invention and therefore the invention is not limited to what is shown in the drawings and described in the specification but only as indicated in the appended claims.

I claim:

1. In a propulsion reactor,
 - a combustion chamber having a pair of highly divergent walls with curved planar interior portions between which a flow of air passes,
 - a pilot flame stabilizing device within said combustion chamber having a pair of curved planar surface portions opening toward the flow of air passing through said combustion chamber,
 - at least one burner within said stabilizing device,
 - at least one additional burner located between said stabilizing device and at least one interior wall of said combustion chamber,
 - conduit means projecting through said planar surface of said stabilizing device and communicating with said additional burner, and
 - fuel injector means for feeding carburized fuel to said burners.
2. In a propulsion reactor,
 - a combustion chamber having a pair of highly divergent curved planar interior walls between which a flow of air passes,
 - a pilot flame stabilizing device within said combustion chamber having a pair of curved planar surfaces opening toward the flow of air passing through said combustion chamber,
 - at least one burner within said stabilizing device,
 - at least one additional burner located between said stabilizing device and each interior wall of said combustion chamber,
 - conduit means projecting through each of the planar surfaces of said stabilizing device and terminating adjacent and downstream of said additional burners, and
 - fuel injector means for feeding carburized fuel to said burners.

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55 CARLTON R. CROYLE, *Primary Examiner*.

RALPH D. BLAKESLEE, *Examiner*.