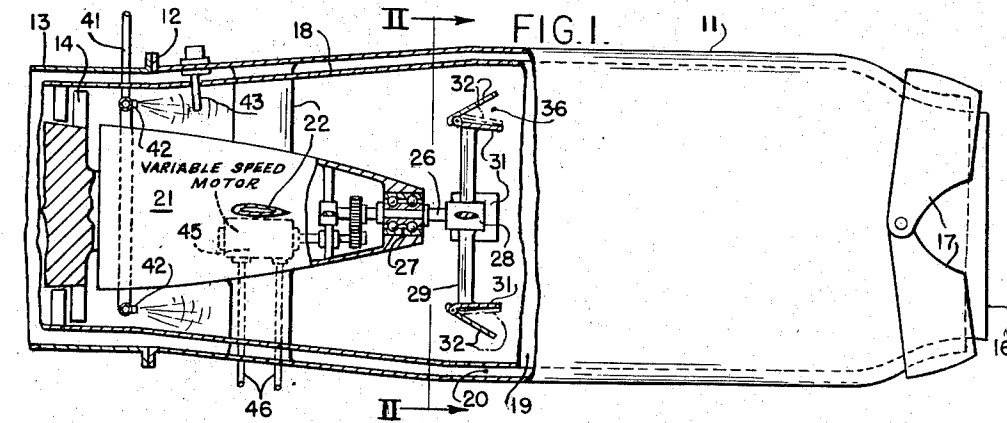
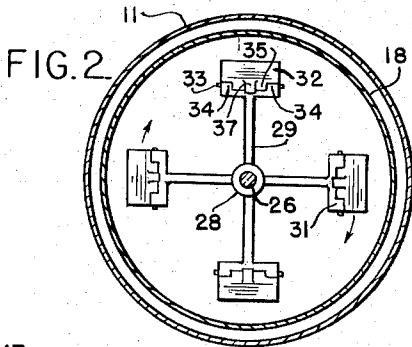
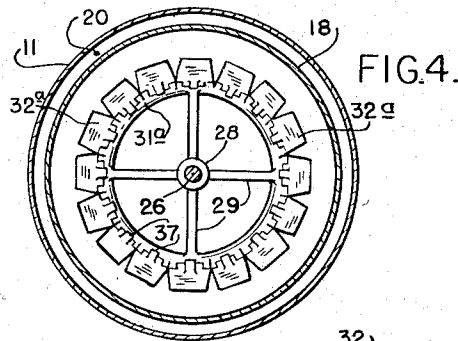
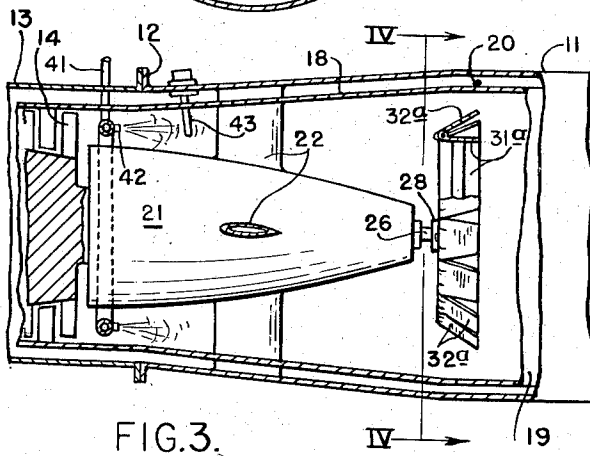
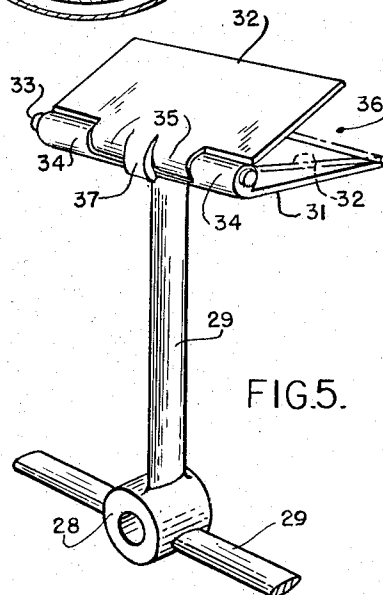


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FLAMEHOLDING APPARATUS

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2,875,580

FLAMEHOLDING APPARATUS

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This invention relates to jet engines, more particularly to combustion apparatus therefor, and has for an object to provide novel flameholding structure for such combustion apparatus.

In jet engines the highly heated and compressed gases travel through the exhaust portion of the engine at relatively high velocities, usually well in excess of fifty feet per second. Inasmuch as the rate of flame propagation in such exhaust streams is less than fifty feet per second, it is impossible to retain a flame formation in such exhaust gases unless means are utilized to provide a zone or zones of reduced velocity, in which zones flame formation may be retained.

Many jet engines are equipped with afterburners to provide for burning of additional fuel in the exhaust gases. However, this supplemental burning of fuel frequently occurs only during short intervals of operation of the engine, for example, when sudden bursts of speed are desired as during maneuvering in combat, or for purposes of obtaining additional thrust during take-off or wave-off. Most conventional flameholding devices presently utilized produce a drag or impedance to the normal flow of exhaust gases within the exhaust portion of the engine both during afterburning and during non-afterburning operation. Consequently, various attempts have been made to provide flameholders which produce less drag or impedance to gas flow when non-afterburning than when afterburning.

In accordance with the present invention a flameholder is provided which involves the use of one or more pairs of baffles hingeably joined at their upstream edges so that they may be separated at their downstream edges to provide, in effect, a V-shaped structure whose apex is directed upstream, with the result that the V-shaped space thereby provided defines a zone of stagnancy capable of effecting flame retention. The pair or pairs of baffles are mounted on a rotary support and means are provided for rotating this support and the baffles carried thereby during afterburning operation of the engine. Such rotation of the flameholding apparatus results in outward movement of the outer baffle with respect to the inner baffle to provide the V-space therebetween. During non-afterburning operation of the engine the flameholding device is not rotated and, consequently, with centrifugal forces no longer acting on the outer baffle, it is pushed inwardly against the inner baffle by the action of the exhaust gases flowing therepast, thereby reducing the effective transverse area of the flameholding structure to that of a single thin vane or baffle with consequent reduction in drag or impedance thereof.

Accordingly, it is another object of the invention to provide flameholding structure which is moved by centrifugal action to operative position during afterburning operation of the engine and is returned to inoperative position during non-afterburning operation of the engine by action of the gases flowing therepast.

The foregoing and other objects are effected by the invention as will be apparent from the following description and claims taken in connection with the accompanying drawings, forming a part of this application, in which:

Fig. 1 is a longitudinal side elevational view, with por-

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tions broken away for the sake of clearness, and illustrating the aft portion of a jet engine incorporating flameholding structure constructed in accordance with the present invention;

Fig. 2 is a transverse sectional view taken along the line II—II of Fig. 1, looking in the direction indicated by the arrows;

Fig. 3 is a fragmentary longitudinal view, partially in section, similar to Fig. 1 but showing a modified flameholding device;

Fig. 4 is a transverse sectional view taken along the line IV—IV of Fig. 3, looking in the direction indicated by the arrows; and

Fig. 5 is a perspective view of one of the flameholding elements shown in Figs. 1 and 2.

Referring now to the drawings in greater detail, and particularly to Fig. 1, there is shown the aft portion of a jet engine comprising an outer tubular casing 11 provided at its upstream edge with a flanged connection 12 with the downstream end of the main engine casing 13, the latter housing, from front to rear, a compressor (not shown), combustion apparatus (not shown), and a turbine 14.

The exhaust casing 11 may be provided with an inner tubular casing or liner 18, defining an afterburner combustion chamber 19, and spaced from the outer casing 11 to provide a passage 20 for flow of cooling air between the two casings. The downstream end of the inner casing 18 terminates in an exhaust opening 16 whose effective area may be varied by a suitable exhaust nozzle schematically illustrated at 17. Disposed in the upstream end of the exhaust casing is the usual fairing or tailcone 21 immediately downstream of the turbine 14, and supported from the outer casing 11 by the struts 22.

A shaft 26 is journaled in the downstream end of the tailcone 21, as at 27, and is coaxial with the tubular casings 11 and 18 and extends downstream beyond the tailcone 21. Secured on the extending portion of the shaft 26 is a hub member 28 carrying a plurality of radially extending arms 29 at the free ends of which are mounted inner baffles 31, preferably disposed parallel to the axis of rotation of the shaft 26.

As illustrated in Fig. 5, the inner baffle 31 is rectangular and has associated therewith an outer baffle 32 of similar shape, the two baffles being joined at their upstream edges by a pin 33 passing through eyelets 34 and 35 provided on the inner and outer baffles, respectively. With this construction, the outer baffle 32 is free to move between a first position, indicated by dotted lines in Figs. 1 and 5, where it closely abuts the inner baffle 31 and a second position where it is at a substantial angle with respect to the inner baffle, as illustrated by solid lines in Figs. 1 and 5, in which latter position there is provided between the two baffles a V-shaped space or zone 36 serving to anchor any flame formation produced in the afterburner combustion chamber.

Preferably suitable means, such as the lug 37, is provided for limiting the outward movement of the outer baffle 32 with respect to the inner baffle 31. While in the construction illustrated in Figs. 1, 2 and 5, four such pairs of inner and outer baffles are shown, it will be apparent that a greater or lesser number may be utilized as found desirable.

Afterburning fuel is admitted to the upstream end of the afterburner combustion chamber through the conduit 41 and the annular series of nozzles 42 associated therewith. Suitable means, such as the ignitor 43, is provided downstream thereof to ignite the afterburner fuel admitted through the conduit 41 and nozzles 42.

Housed within the tailcone 21 is a suitable motor 45 which may be of any desired type, for example, an elec-

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tric motor or an air motor, provided with motive power through conduits 46 disposed in one of the struts 22 which is formed hollow for the reception of these conduits. The motor is connected through suitable shafting and gearing with the shaft 26 which carries the flameholding structure, and serves to rotate the latter during afterburning operation of the engine. As previously mentioned, rotation of the flameholder results in the centrifugal forces which act upon the outer baffles 32 moving the latter outwardly to provide the flameholding zones 36 between the inner and outer baffles. When the afterburning operation is ended, the motor 45 will be shut off and with the afterburner no longer rotating, the forces of the gases flowing past the flameholder will force the outer baffles 32 inwardly against the inner baffles 31 to reduce and substantially eliminate the drag effect of the flameholding structure.

The motor 45 may be of a variable speed type, and variations in the speed thereof will result in corresponding variations in the centrifugal forces applied to the outer baffles 32. Consequently, by varying the speed of the motor 45, the effective flameholding area of the baffles may be varied as desired, as with change in altitude of the plane.

In Figs. 3 and 4, there is shown a modified form of flameholder which differs from that described above only in that the flameholding structure is substantially continuous circumferentially with the inner baffle being comprised of a single annular baffle 31a to which are pivotally secured a substantially continuous series of outer baffles 32a. It will be apparent that this form of flameholder operates in the same manner as that of the previous modification, the outer baffles being moved outwardly due to centrifugal action when the flameholding structure is rotated and being moved inwardly against the inner baffles by the exhaust gases flowing therepast when the flameholding structure is stationary during non-afterburning operation of the engine.

While the invention has been shown in several forms, it will be obvious to those skilled in the art that it is not so limited, but is susceptible of various other changes and modifications without departing from the spirit thereof.

What is claimed is:

1. Combustion apparatus comprising wall structure defining a flow path for a high velocity combustible mixture; and flameholding apparatus disposed in said flow path for creating a degree of stagnancy therein sufficient to effect flame retention; said flameholding apparatus comprising first and second members pivotally connected adjacent their upstream edges, considered in the direction of flow in the flow path, means mounting said members for rotation in a plane transverse to the direction of said flow, said first member being carried by said mounting means and said second member being disposed radially outward of said first member, whereby during rotation of said mounting means and said members, said second member may pivot outwardly about the pivotal connection with said first member and provide with said first member a sheltered zone downstream thereof.

2. For use with combustion apparatus through which a stream of combustible mixture is adapted to flow at velocities in excess of the rate of flame propagation therein; flameholding apparatus for producing in the stream of combustible mixture a degree of stagnancy sufficient to effect flame retention, said flameholding apparatus comprising supporting structure fixed with respect to the combustion apparatus, a shaft journaled in said supporting structure with its longitudinal axis parallel to the direction of flow of combustible mixture through the combustion apparatus, an arm secured to, and rotatable with, said shaft within said combustion apparatus, and a V-shaped structure carried by said arm with the point of the V disposed upstream with respect to the flow of the stream of combustible mixture, said V-shaped struc-

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ture comprising a pair of baffles constituting the legs of the V and pivotally connected at the point of the V, the radially inner one of said baffles being secured to the arm and the radially outer one of said baffles being free to pivot between a first position where it closely parallels said inner baffle and a second position where it forms a V with said inner baffle.

3. In combustion apparatus for a jet engine; tubular casing structure defining a combustion chamber adapted to receive a high velocity stream of combustible mixture, supporting structure mounted in the casing structure, a shaft rotatably mounted in the supporting structure with its axis of rotation generally parallel to the direction of flow of the stream of combustible mixture through the combustion chamber, a hub secured on said shaft and rotatable therewith, a plurality of arms extending outwardly from said hub, and flameholding structure carried by said arms and disposed in the flow path of the combustible mixture stream, said flameholding structure comprising radially inner baffle structure secured to said arms and radially outer baffle structure pivotally connected to the inner baffle structure for limited movement with respect to the latter between a non-flameholding position where the baffle structures are substantially parallel to each other and a flameholding position where the baffle structures are disposed at a substantial angle to each other with the apices of the angles disposed upstream, thereby providing V-shaped sheltered zones for flame retention during combustion of the combustible mixture in the combustion chamber.

4. In combustion apparatus for a jet engine; tubular casing structure defining a combustion chamber adapted to receive a high velocity stream of combustible mixture, supporting structure disposed in said combustion chamber, a shaft rotatably mounted in said supporting structure with its axis of rotation generally parallel to the longitudinal axis of the tubular casing structure, a hub carried by and rotatable with said shaft, a plurality of arms extending generally radially outward from said hub, first flat baffles secured to the free ends of said arms, said first baffles lying in planes generally tangential to the axis of the shaft, second flat baffles associated with the first baffles, means pivotally joining pairs of associated first and second baffles at their upstream edges to provide hinge-like structures, and means for rotating the shaft and the baffle structure carried thereby, the second baffle of each hinge-like structure being pivotable radially outward under effect of centrifugal forces during rotation of the shaft to provide V-shaped sheltered zones at the downstream side of the hinge-like structures.

5. In combustion apparatus for a jet engine; tubular casing structure defining a combustion chamber for a high velocity stream of combustible mixture, supporting structure disposed in the casing structure, a shaft rotatably mounted in said supporting structure with its axis of rotation substantially parallel to the longitudinal axis of the tubular casing structure, a hub carried by and rotatable with said shaft, a plurality of arms extending outwardly from said hub, an inner baffle member carried by said arms, outer baffle members associated with said inner baffle member, means pivotally joining said inner and outer baffle members at their upstream edges, whereby said outer baffle members may swing outwardly at their downstream edges from the inner baffle member to define between the inner baffle member and the outer baffle members V-shaped sheltered zones, and means for rotating the shaft and the baffle members, whereby centrifugal forces will effect outward movement of said outer baffle members to effect the V-shaped sheltered zones.

References Cited in the file of this patent

UNITED STATES PATENTS

2,696,709	Oulianoff	Dec. 14, 1954
2,784,551	Karby et al.	Mar. 12, 1957