Nov. 14, 1939. J. MALCZEWSKI 2,179,894

MEANS FOR CHECKING FLAME PROJECTION FROM INCANDESCENT GAS DISCHARGE CONDUITS

Filed May 20, 1936 2 Sheets-Sheet 1

Fig. 1.

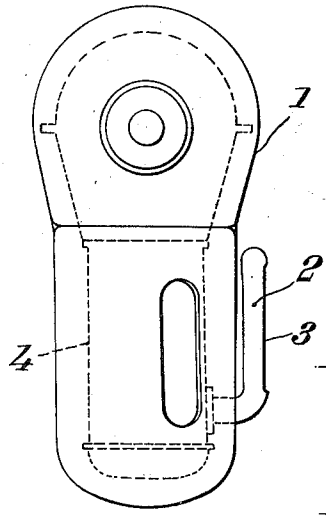


Fig. 2.

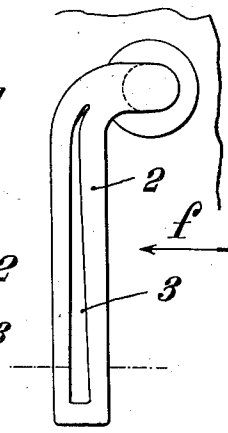


Fig. 4

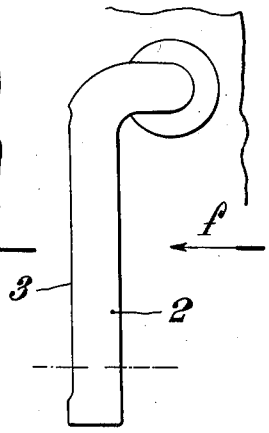


Fig. 3

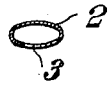


Fig. 5

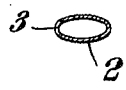
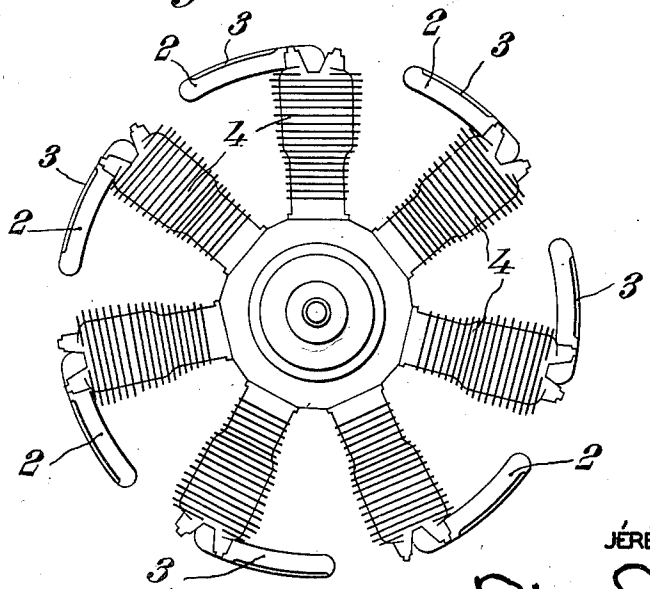


Fig. 6.



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Filed May 20, 1936 2 Sheets-Sheet 2

Fig. 7.

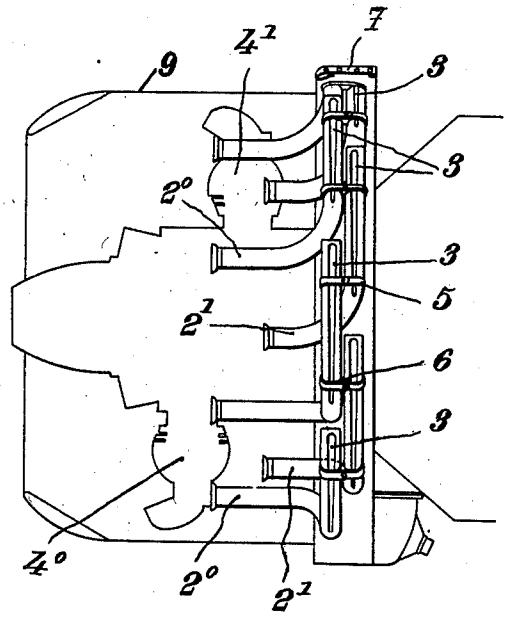
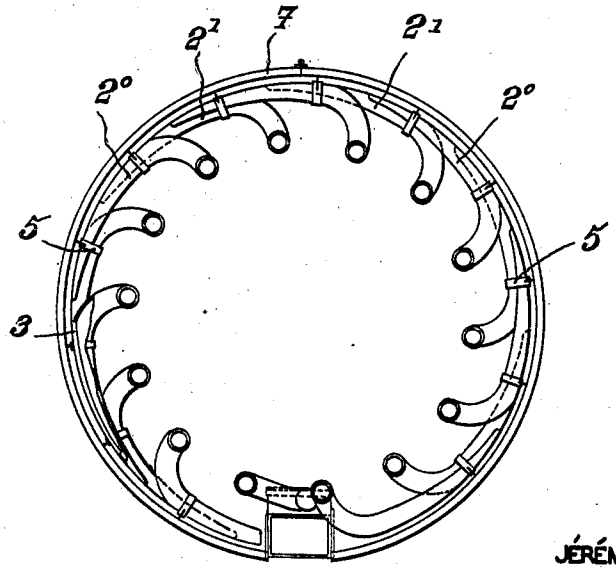


Fig. 8.



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MEANS FOR CHECKING FLAME PROJECTION FROM INCANDESCENT GAS DISCHARGE CONDUITS

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15 Claims. (Cl. 60—29)

This invention relates to discharge conduits for incandescent gases or gaseous mixtures, and more particularly, to such conduits having relative motion with respect to the surrounding air, as, for example, exhaust conduits of aircraft or other automotive engines.

The main purpose of my invention is to improve the construction of such incandescent gas discharge conduits, in order to eliminate, as far as possible, the tendency to project flames therefrom.

The principal object of my invention is to provide an incandescent gas discharge conduit having relative motion with respect to the surrounding air, in which the portion of said discharge conduit comprising the gas outlet means is swept by the moving air stream, and said gas outlet means discharge said gas or gases in a direction substantially perpendicular to said air stream.

Another object of my invention is to provide an incandescent gas discharge conduit of the above type, in which said gas outlet means discharge said gas or gases progressively and at a substantially uniform velocity, at all points of said orifice, for the sake of avoiding the concentration of the flame at any point, and the possibility that said flame might resist at such point the extinguishing action of the air stream.

A further object of my invention is to provide an incandescent gas discharge conduit of the above type, in which said gas outlet means consist in an orifice having considerably greater length measured in the direction of motion of the outflowing gas, than width, measured perpendicularly to said gas flow, and in which said width, preferably, although not necessarily, increases progressively in the direction of said gas flow, in order to compensate the drop in gas pressure along said orifice, and thus to maintain a substantially uniform discharge rate along said orifice.

A still further object of my invention is to provide an incandescent gas discharge conduit as above associated with deflecting baffle means purporting to cause the air stream to sweep directly across the incandescent gas discharge orifice, preferably, although not necessarily, in a manner to accelerate the air flow abreast of said discharge orifice, for example by producing a venturi effect at said orifice.

A still further object of my invention is to provide, in an internal combustion engine having relative motion with respect to the surrounding air, exhaust means comprising the improvements herein before described.

A still further object of my invention is to provide, in an internal combustion engine as above described, for example of the radial aircraft type, exhaust means as above defined which overlap circumferentially, thus forming a plurality of exhaust orifices lying axially substantially in a common cylindrical surface, and associated with deflecting baffle means, for example a ring type cowl, which purports to cause the air stream to sweep directly across said exhaust orifices, preferably, but not exclusively, in a manner to accelerate the air flow abreast of said orifices, for example by producing a venturi effect at said point.

Other objects and advantages will appear to a person skilled in the art, from the following description, with reference to the accompanying drawings, which description and drawings are, of course, given mainly for the purpose of illustration, and should not be construed as limiting the scope of my invention.

In these drawings:

Fig. 1 shows, diagrammatically, an end view of a vertical aircraft engine, provided with exhaust means embodying my invention, together with the engine cowling.

Figs. 2 and 3 show, respectively in elevation and in plane cross-section, exhaust means according to my invention.

Figs. 4 and 5 show, also in elevation and in plane cross-section, another form of exhaust means according to the invention.

Fig. 6 shows, in elevation, a radial aircraft engine equipped with exhaust means according to the invention.

Figs. 7 and 8 show, the first in side elevation and the second in front elevation, an embodiment of the invention, as applied to the exhaust of a double-row radial aircraft engine, the cylinders of which have been omitted in Fig. 8, for the sake of simplicity.

In Figs. 1, 2 and 3, I have shown the application of my invention to a vertical aircraft engine with cylinders in line. 1 is the cowl hood enveloping the engine 4, 2 is the exhaust pipe which passes preferably through said cowl and is best disposed perpendicularly to the direction of flow of the air stream. In said exhaust pipe, and preferably along the generatrix of tangency of said pipe with a plane parallel to said air stream, I provide an elongated slot-like orifice 3, which may advantageously be made of relatively narrow width at the end nearest the engine, where the exhaust gas pressure is highest, and of progressively increasing width, in the direction of

the exhaust gas flow, so as to provide a wider path for the escape of said exhaust gas as the latter's pressure drops. The arrow *f* indicates the direction of flow of the air stream, which sweeps across the orifice 3, and so tends to extinguish the flames.

The exhaust pipe 2 may advantageously be made of elliptical cross-section, with the longest axis parallel to the air flow, for the purpose of reducing the drag; or any other streamlined cross-section may be used for this purpose. Optionally, the orifice may be provided, as shown in Figs. 4 and 5, on the trailing edge of the ellipse.

Fig. 6 illustrates diagrammatically a radial aircraft engine provided with exhaust pipes embodying my invention. To this end, I set said exhaust pipes 2 substantially at right angles to the direction of flow of the air stream and substantially along a circumference tangent to the heads of the engine cylinders 4, and I provide each exhaust pipe 2 with an exhaust orifice 3 preferably located along the outermost generatrix of said exhaust pipes, thus discharging the exhaust gases in a direction substantially perpendicular to that of the air stream, so that the flames issuing from said exhaust pipe may be almost instantaneously extinguished by the air stream.

Figs. 7 and 8 illustrate the application of my invention to an aircraft engine of the double row radial type. The object sought in this design is to arrange the exhaust piping so as to offer, on one hand, the minimum frontal resistance, and, on the other hand, considerable available length for the exhaust orifices.

Fig. 7 shows, in side elevation, only one cylinder of each row; while Fig. 8 shows, in front elevation, only the layout of the exhaust piping, the cylinders having been omitted for the sake of simplicity and clearness.

In this embodiment, I arrange the exhaust pipes 2^0 and 2^1 from cylinders 4^0 and 4^1, respectively, of the front and rear rows of cylinders, so that said exhaust pipes overlap and lie in circles of substantially equal diameter, lying substantially in a common cylindrical surface; and I secure said pipes in place by means of clamps 5 and spacing blocks 6.

I also prefer to locate the exhaust orifices 3 on the outer face of said exhaust pipes, in the same manner as shown in Fig. 6.

The advantage of this arrangement is that it offers the minimum frontal resistance, for the row of exhaust pipes 2^0 covers that of the pipes 2^1; furthermore, all the exhaust orifices 3 lie in a cylindrical surface, and it is therefore easy to arrange a cylindrical baffle ring 7 to direct the air stream directly across the mouth of said orifices. Said baffle ring 7 may readily be associated with an outer cowl 9, and can also easily be designed to accelerate the air abreast of the orifices, and to increase thereby its effectiveness in extinguishing the exhaust flames, by designing it to form an annular passage of reduced cross-section around said orifices. As shown in Fig. 7, the outlet portions of the pipes 2^0 and 2^1 are substantially aligned with the cowl 9, and the orifices 3 project slightly beyond the outer surface of cowl 9. Thus the ring formed by the exhaust pipe is to some extent a continuation of the cowl and therefore minimizes the amount of drag while maintaining the advantages of cooling and flame quenching.

By the means exposed above, I obtain an arrangement of exhaust piping for engines having relative motion with respect to the air which has a low drag resistance, and is furthermore remarkably efficient in avoiding the projection of flames from said pipes.

I wish it to be understood, however, that I do not desire to be limited to the exact constructions described and illustrated, for obvious modifications thereto will occur to a person skilled in the art. Also my invention is, of course, applicable to other types of engines, as, for example, to the V, H and I types.

What I claim is:

1. In a radial aircraft internal combustion engine, exhaust conduits comprising, in combination, terminal sections lying substantially in a cylindrical surface concentric with the engine shaft, and exposed to the moving air stream, each of said terminal sections being substantially longer than the arc of said cylindrical surface separating two adjacent cylinders, and overlapping the terminal section of the exhaust conduit of the adjacent cylinder, said terminal sections having discharge orifices lying in surfaces substantially perpendicularly to the radii of said cylindrical surface.

2. In a radial aircraft internal combustion engine, exhaust conduits comprising, in combination, terminal sections lying substantially in a cylindrical surface concentric with the engine shaft and exposed to the moving air stream, said sections having lateral elongated discharge orifices in the sides thereof, said orifices being substantially centered on the outermost generatrices of said terminal sections, and a baffle ring associated with said exhaust conduits and forming an annular air passage of relatively small radial width across the mouths of said elongated discharge orifices.

3. In a double row-radial aircraft internal combustion engine, exhaust conduits comprising, in combination, terminal sections lying substantially in a cylindrical surface concentric with the engine shaft and exposed to the moving air stream, each of said terminal sections being substantially longer than the arc of said cylindrical surface separating two radially adjacent cylinders, and the terminal section of the exhaust conduit from a cylinder in one row overlapping the terminal section of the exhaust conduit from the adjacent cylinder in the other row of cylinders, said terminal sections having elongated discharge orifices in the sides thereof, said orifices being, and substantially centered on the outermost generatrices of said terminal sections, and a baffle ring associated with said exhaust conduits and forming an annular air passage of relatively small radial width across the mouths of said discharge orifices.

4. In a radial aircraft internal combustion engine, exhaust conduits comprising, in combination, terminal sections lying substantially in a cylindrical surface concentric with the engine shaft and exposed to the moving air stream, said sections having lateral elongated discharge orifices in the sides thereof, said orifices being substantially centered on the outermost generatrices of said terminal sections, and a baffle ring associated with said exhaust conduits and forming an annular air passage across the mouths of said discharge orifices, said annular passage being of smaller radial width breast of said elongated discharge orifices than at the front entrance to said ring cowl, thus forming an annular venturi having its low pression section substantially abreast of said discharge orifices.

5. A combustion engine comprising a stationary cylinder having a gas discharge opening, and an exhaust conduit secured at one end to the walls of said opening and exposed to a stream of air, said conduit having outlet means substantially flush with the surface of said conduit extending from a point closely adjacent said opening in said cylinder to a point spaced a substantial distance therefrom, the axis of said outlet means being directed transversely to the direction of flow of said air stream.

6. A combustion engine comprising at least one stationary cylinder having a gas discharge opening, and an exhaust conduit secured at one end to the walls of said opening and exposed to a stream of air, said conduit having outlet means substantially flush with the lateral wall thereof extending from a point closely adjacent said opening in said cylinder and parallel to the axis of said conduit, said axis extending substantially vertically to the direction of flow of said air stream.

7. An internal combustion motor for a vehicle, especially for an aircraft, said motor having radially extending cylinders, an exhaust system joined to said cylinders comprising conduits fixed with respect to said vehicle and exposed to the action of relative wind, said conduits extending from said cylinders and terminating in the form of a substantially continuous ring about the axis of said motor, and outlet means in said ring causing exhaust gases to escape laterally from said conduits and longitudinally with said wind.

8. A motor according to claim 7, a cowl surrounding said motor, said outlet means being substantially adjacent the outside surface of said cowling.

9. A motor according to claim 7, an annular cowl surrounding said motor, and said outlet means extending adjacent the outside surface of said cowl and exhausting said gases outwardly of said cowl.

10. A radial internal combustion motor mounted within a cowling and having an exhaust system with at least one exhaust pipe of longitudinal form and flattened section extending substantially parallel to said cowling and transversely to the direction of the relative wind, said pipe having at least a flattened face arranged substantially parallel to the relative wind and provided with orifice exhaust means.

11. A motor according to claim 7, an annular cowl surrounding said motor, said outlet means extending adjacent the outside surface of said cowl and exhausting said gases outwardly of said cowl, and baffle ring means parallel to and spaced from said cowl and conduits for accelerating said wind abreast of said outlet means.

12. A stationary internal combustion engine adapted to be mounted on a vehicle and having an exhaust system comprising at least one conduit means fixed with respect to said engine and extending from an exhaust port thereof in the path of the relative wind to a point immediately adjacent said port and at such a distance from said port to cause the exhausting of incandescent gases, and outlet means flush with a wall of said conduit means disposed in a plane substantially parallel to the direction of said relative wind and providing an exit of said gases from said conduit means directly into said relative wind as incandescent gases substantially normal to the direction of travel of said gases in said conduit and thereby extinguishing said gases in the relative wind.

13. An exhaust system for a stationary internal combustion engine comprising conduit means for leading incandescent exhaust gases from said engine in a direction transversely of the direction of the relative wind, and outlet means for exhausting said gases immediately adjacent said engine along the length of said conduit means substantially normal to the direction of travel of said gases in said conduit means directly as incandescent gases into said relative wind at substantially right angles to said direction of said wind whereby said incandescent gases are extinguished by said relative wind.

14. An engine exhaust system for an engine having at least one fixed cylinder comprising conduit means for leading incandescent exhaust gases from said engine in a direction transversely of the direction of the relative wind, and elongated outlet means having its longitudinal axis perpendicular to the direction of the relative wind for exhausting said gases immediately adjacent said engine directly as incandescent gases into said relative wind at substantially right angles to said direction of said wind whereby said incandescent gases are extinguished by said relative wind.

15. An engine exhaust system as in claim 14, a cowling for said engine, and said conduit means comprising an exhaust pipe of longitudinal form and flattened section extending substantially parallel to said cowling and transversely to the direction of the relative wind, and said elongated outlet means extending through a flattened face of said pipe.

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