Dec. 2, 1941. H. E. LE VEQUE 2,264,765

MUFFLER

Filed March 15, 1940

Fig. 1

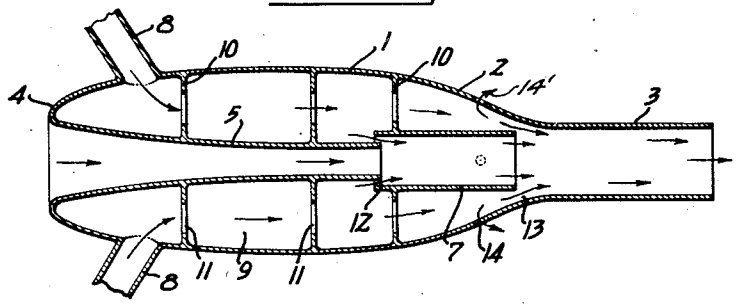


Fig. 2

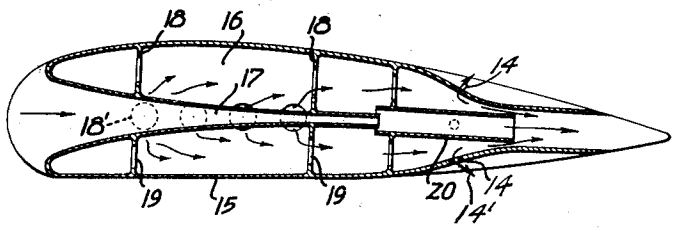


Fig. 3

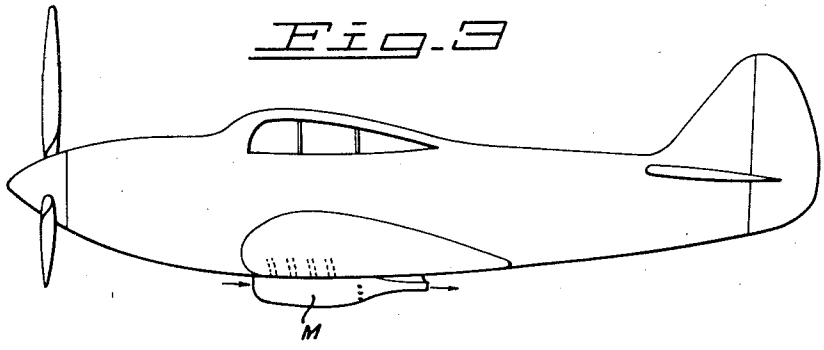
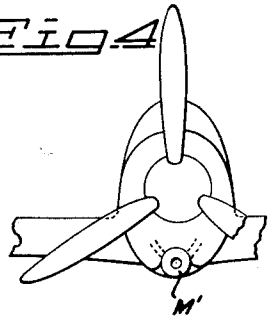


Fig. 4



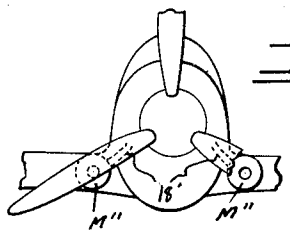


Fig. 5

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MUFFLER

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9 Claims. (Cl. 181—51)

This invention relates to mufflers and has for its objects an improved muffler adapted to not only muffle the noise of engine exhaust, but to promote cooling and to materially increase the efficiency of the engine. Another object is an improved muffler in airplanes or aircraft, wherein the muffler is adapted to accomplish the above described objects and others mentioned in the specification that is annexed hereto.

In the drawing,

Fig. 1 is a sectional view taken longitudinally through a muffler of my invention.

Fig. 2 is a section taken longitudinally of the muffler as formed in the wing of an airplane.

Fig. 3 is an elevational view of an airplane showing my improved muffler in position on the fuselage.

Fig. 4 is a fragmentary front end view of an airplane with my improved muffler countersunk in the fuselage of the airplane.

Fig. 5 is a fragmentary front end view of an airplane in which a pair of my mufflers is indicated in the wings of an airplane.

In detail, the muffler illustrated in Fig. 1 comprises an outer tubular, horizontally elongated shell 1 with the sides convergingly curved at 2 at one end to connect with one end of a tubular extension 3 that extends rearwardly with respect to the normal position of the muffler when a forwardly moving vehicle carrying the internal combustion engine with the exhaust of which the muffler is connected.

The walls of the shell 1 at the forward end thereof preferably curve radially inwardly, as at 4 to connect with the forward edges of an inner tube 5. From the forward end of said inner tube, the walls of the latter extend convergingly rearwardly, terminating at its rear end within the forward end of a tubular section 7, the rear end of which section terminates at about the juncture of extension 3 with the walls 2.

Tubes 5, 7 are open ended and coaxial with the longitudinal axis of shell 1 with the rear end of tube 5 spaced from the sides of the forward end of section 7, while the rear end of section 7 is spaced from the inner sides of the extension 3 and walls 2 adjacent the extension.

The juncture between the forward edges of the inner tube 5 with the forward edge of shell 1, is curved so that the outer shell 1 and inner tube 5 will present a stream-lined forward end facing the direction of movement of the vehicle carrying the same.

One or more exhaust pipes 8 for exhaust gases from the internal combustion engine, (not shown) connect with the sides of shell 1 and communicate with the chamber 9 formed between the shell 1 and tube 5. Baffles 10 may extend across the chamber 9 and connect between the shell 1 and tube 5 to support the latter with its central longitudinal axis substantially coaxial with the corresponding axis of the shell. These baffles are apertured, as at 11 for passage of exhaust gas therepast, and the baffles also function to break up the exhaust gases for muffling the noise thereof that would otherwise be objectionable in most instances.

It will be observed that the arrangement of the tube 5 with respect to tubular section 7, and the arrangement of the latter section with respect to the extension 3, provides a pair of annular apertures 12, 13, the former adapted to admit gas from chamber 9 into section 7 and the latter being adapted to admit gas from chamber 9 into extension 3. The rear end of the extension 3 is open, therefore, upon the actuation of the engine and exhaustion of its gas into chamber 9, the passage of such gas through both apertures 12, 13 will induce a flow of air through tube 5 for mixing with the exhaust gases in both section 7 and extension 3, resulting in cooling of the gases of combustion and contraction thereof for reducing back pressure of the exhaust gas from the engine.

In actual operation, when the vehicle carrying the muffler is moving forwardly, the forward enlarged open end of the muffler will receive a relatively large amount of air which will be carried rearwardly through tube 5 and into section 7 and extension 3, at a relatively high velocity, thus creating a relatively high suction at apertures 12, 13 for drawing the exhaust gases in chamber 5 out of the muffler through extension 3, where the gases will be greatly cooled. The cooling action of the cool air on the walls of tube 5 as well as that resulting from mixing of the air with the gases in section 7 and extension 3, together with the rapid ejection of gas from chamber 9 into the tube 7 and extension 3, result in substantial elimination of all back pressure on the engine, thereby greatly increasing the efficiency of the engine. The provision of the baffles 11, or other suitable means for breaking up the exhaust gases before ejection from the muffler, is necessary to muffle the noise of the exhaust.

I have also found it desirable to provide one or more apertures 14 around the converging walls 2 at the point where a rarified atmospheric pres-

sure tends to occur during movement of the muffler, with the vehicle, in a forward direction; which causes a flow of gases indicated by the arrows 14'. The provision of these openings at this point further contributes to the cooling of the gas and the efficiency of the engine.

In Fig. 2 my improved muffler is shown as constructed in the wing of an airplane, in which case the upper and lower wall of the outer shell 15 may be coincident with the upper and lower side of the wing, forming part of the wing surface, or, of course, the muffler may be fitted in the wing and secured thereto.

The chamber 16 between the outer shell 15 and inner tubular passageway 17 for air receives the exhaust gas from any desired number of exhaust pipes 18, and, as illustrated in Figs. 2, 5 the mufflers may be arranged in pairs adjacent the roots of the wings at either side of the fuselage for receiving gas from the banks of cylinders at opposite sides of the engine, whether the engine be of the radial air-cooled type, or of the water-cooled type. It is, of course, obvious that the muffler, or mufflers, may be at any desired point or points along the wing, as where the engines are on or along the lengths of the wings spaced from the fuselage. In Fig. 5 the mufflers M'' are close to the fuselage.

In the type of muffler illustrated in Fig. 2, the air inlet to inner tube 17 is at the leading edge of the wing and the air and gas outlet is at the trailing edge or if short of the latter at least it faces rearwardly. Baffles 18, with apertures 19 therein are provided, the same as in Fig. 1, and the tube section 20 into which the inner tube 17 extends at the rear end of the latter, corresponds to the structure of the muffler already described. In fact, the structure of the muffler itself, insofar as the elements thereof are concerned, is all included in the muffler shown in Fig. 1.

Where the muffler of Fig. 1 is used in connection with engines either mounted in the wings, or at a point in each wing spaced from the fuselage, I have found it desirable in some instances to horizontally flatten the muffler tubes somewhat, to substantially oval shape in cross-section, rather than being cylindrical. The result is substantially the same as where the outer shell and tubes therein are cylindrical. The reason for this is to keep the muffler within the vertical thickness of the wing where such thickness is reduced, and at the same time providing sufficient area for effective gas and air flow through the muffler.

Fig. 3 illustrates the muffler of Fig. 1 in one position below the fuselage of an airplane, the muffler being designated M in this view. The position of said muffler may be changed to be closer to the nose or closer to the tail, depending upon the position of the motor with respect to the nose and tail of the airplane. The exhausts (indicated in dotted line) may, as already stated, be in banks or may lead to a manifold before leading to the muffler, in which latter case, it might be that only one exhaust pipe will communicate directly with the gas chamber of the muffler.

Fig. 4 shows the muffler M' countersunk in the lower side of the fuselage of an airplane. This structure slightly reduces any tendency to produce a drag by reason of the muffler being incorporated within the confines of the fuselage sides and is, in some cases more desirable than having the muffler positioned as in Fig. 3. Where the mufflers are in the wings, and the outer shell is part of the wing or even in close proximity thereto, the said mufflers will also function to a degree for de-icing the wings under conditions where ice would tend to form on the wings.

This invention is not restricted to aircraft, but may be used on any vehicle.

Having described my invention, I claim:

1. An engine exhaust muffler comprising an elongated tubular shell having a discharge opening at one end, the sides of said shell converging in direction from the opposite end toward said one end to form a point of appreciably restricted diameter in the length of the shell, an inner tube spaced within said shell, having an inlet at one end and an outlet at the other end, said tube being outwardly flared at its inlet end and connecting with the said opposite end of the shell at the larger diameter end of the flare, the outlet end of said tube terminating adjacent said point of restricted diameter and spaced from the walls of the shell at said point, thereby forming an aperture around the outlet of the tube communicating between the space between the shell and tube and said discharge opening, a conduit communicating between said space and the engine for admitting the engine exhaust gas to said space for discharge through said aperture and out of said discharge opening, said muffler being adapted for mounting horizontally on a vehicle with the said inlet facing the normal forward direction of movement of the vehicle whereby atmospheric air will be caused to flow through the inner tube and past said aperture for mixing with the said air and for discharge through said discharge opening.

2. An engine exhaust muffler comprising an elongated tubular shell having a discharge opening at one end, the sides of said shell converging in direction from the opposite end toward said one end to form a point of appreciably restricted diameter in the length of the shell, an inner tube spaced within said shell having an inlet at one end and an outlet at the other end, said tube being outwardly flared at its inlet end and connecting with the said opposite end of the shell at the larger diameter end of the flare, the outlet end of said tube terminating adjacent said point of restricted diameter and spaced from the walls of the shell at said point thereby forming an aperture around the outlet end of the tube communicating between the space between the shell and tube and said discharge opening, a conduit communicating between said space and the engine for admitting the engine exhaust gas to said space for discharge through said aperture and out of discharge opening a baffle within said chamber between said conduit and aperture for deflecting the passage of gas to said aperture to muffle the noise of the exhaust, said muffler being adapted for mounting horizontally on a vehicle with the said inlet facing the normal forward direction of movement of the vehicle, whereby atmospheric air will be caused to flow through the inner tube and past said aperture for mixing with the said air for discharge through said discharge opening.

3. An engine exhaust muffler comprising an elongated tubular shell surrounding an open ended elongated inner tube disposed therein substantially coaxial therewith and spaced from said inner tube, one of the corresponding ends of the shell and tube being connected together thereby forming a chamber between the walls of said shell and said tube closed at one end, the sides of said shell spaced from said closed end extending convergently to a point adjacent but spaced

from the end of said tube opposite the closed end of the chamber, an outlet at restricted end of said convergent sides disposed substantially concentric with the open end of said tube adjacent thereto, an open-ended tubular section disposed in coaxial alignment with said tube and outlet, one end of said section extending into said outlet and spaced at its sides from the sides of the outlet and the open end of said tube adjacent said section extending into the opposite open end of said section and spaced at its sides therefrom, means for connecting said chamber with an engine exhaust for passage of the exhaust gas into said chamber, said muffler being adapted to mounting horizontally on a vehicle with the closed end of said chamber facing the normal forward direction of movement of said vehicle, whereby atmospheric air will be caused to flow through the forward open end of the inner tube and out of the discharge opening thereby inducing a flow of exhaust gas from said chamber to the discharge opening through the spaces between said tube and section and between the section and discharge opening.

4. An engine exhaust muffler comprising an elongated tubular shell surrounding an open-ended inner tube disposed therein substantially coaxial therewith and spaced from said inner tube, one of the corresponding ends of said tube and shell being connected together thereby forming a chamber between the walls of said shell and tube closed at one end, the sides of said shell spaced from said closed end extending convergently to a point adjacent but spaced from the end of said tube opposite the closed end of the chamber, an outlet at the restricted end of said convergent sides disposed substantially concentric with the open end of said tube adjacent thereto, thereby forming an annular aperture around said latter end of the tube for passage of gas from said chamber to said outlet, means for admitting exhaust gas under compression from an engine to said chamber for discharge through said aperture to said outlet, and openings formed in the sides of said shell adjacent the restricted end of the convergent sides thereof for porting said chamber at said openings to atmospheric air, said muffler being adapted for positioning on a vehicle with the closed end of the chamber facing the normal forward direction of movement of the vehicle, whereby the atmospheric air will be caused to flow through said tube for inducing flow of gas from said chamber to said discharge outlet and for cooling the exhaust gases.

5. In an airplane wing, an engine exhaust muffler compriisng a horizontally elongated, tubular, open-ended shell disposed within said wing and extending transversely of the length of the latter with its upper and lower sides longitudinally thereof, substantially corresponding in contour to the contour of the upper and lower sides of said wing transversely of the length of the latter at the point in said wing in which said shell is disposed; one open end of said shell being substantially even with the leading edge of said wing and opening outwardly of the latter, and its opposite open end being adjacent the trailing edge of said wing and opening outwardly and rearwardly of the wing relative to said forward edge; a horizontally elongated open-ended tube spaced within said shell and extending longitudinally of the latter with edges at one of its open ends connected with the edges of said shell at said one end of the latter; the opposite end of said tube terminating within said shell adjacent the said opposite end of the latter and spaced from the sides of said shell, said tube being of progressively decreasing diameter rearwardly from its end that is at the leading edge of said wing, and a conduit for conducting exhaust gas from an airplane engine opening into said outer shell through one of the sides thereof at a point in said shell disposed between the said one end of said shell and the end of said tube that terminates within said shell.

6. In a construction as defined in claim 5, said upper and lower sides of said shell being substantially coplanar with the upper and lower sides of said wing, respectively.

7. In a construction as defined in claim 5, the diameter of said shell and said tube at their connected end edges along the leading edge of said wing being substantially equal to the vertical thickness of said wing adjacent said leading edge.

8. In a construction as defined in claim 5, the said tube comprising a pair of tubular, axially aligned sections of which said open end of said tube as a part of one section of said pair, and which one section extends forwardly from said opposite end toward the leading edge of said wing, and the other section of said pair being spaced within said one section at one end thereof and extending therefrom forwardly toward said forward edge of the said wing, providing an annular aperture between said sections, the opposite sides of which are defined by the adjacent ends thereof, and the said adjacent ends being at a point in said shell rearwardly of the point where said conduit opens into said shell relative to the leading edge of the wing.

9. In an airplane having a pair of wings extending laterally outwardly of a central fuselage, and an engine in the latter, an exhaust muffler in each of said wings adjacent the said fuselage; each of said mufflers comprising an elongated, open-ended, tubular shell extending substantially parallel with the longitudinal axis of said fuselage, one of the open ends of each muffler opening forwardly and outwardly of the leading edges of said wings and their opposite open ends opening rearwardly relative to said forward edges, said shells being substantially within the confines of the planes of the upper and lower sides of said wings and exhaust conduits extending from said engine opening into each of said shells through one of their sides; and the upper and lower sides of each of said shells conforming in longitudinal contour to the contour of the upper and lower sides of the wings in direction transversely of the lengths of said wings whereby the open end of each shell adjacent the trailing edge of each wing is of lesser diameter than the forward open end of each shell, and an open-ended tube extending into each shell longitudinally of the latter and spaced from the sides of said shell, for conducting air through said shell for discharge rearwardly of each wing, one end of the tube in each shell being secured to the shell therearound at the forward open end of said shell, and the opposite end of such tube terminating within said shell and spaced from the sides of the latter thereby providing an aperture around said latter opposite end for discharge of gas from the exhaust conduits thrcugh the opposite open ends of said shells.

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