March 7, 1944. J. A. FISHER 2,343,371

SUCTION MUFFLER FOR AIRPLANES, AUTOMOBILES, AND THE LIKE

Filed Sept. 9, 1941

Fig. 1.

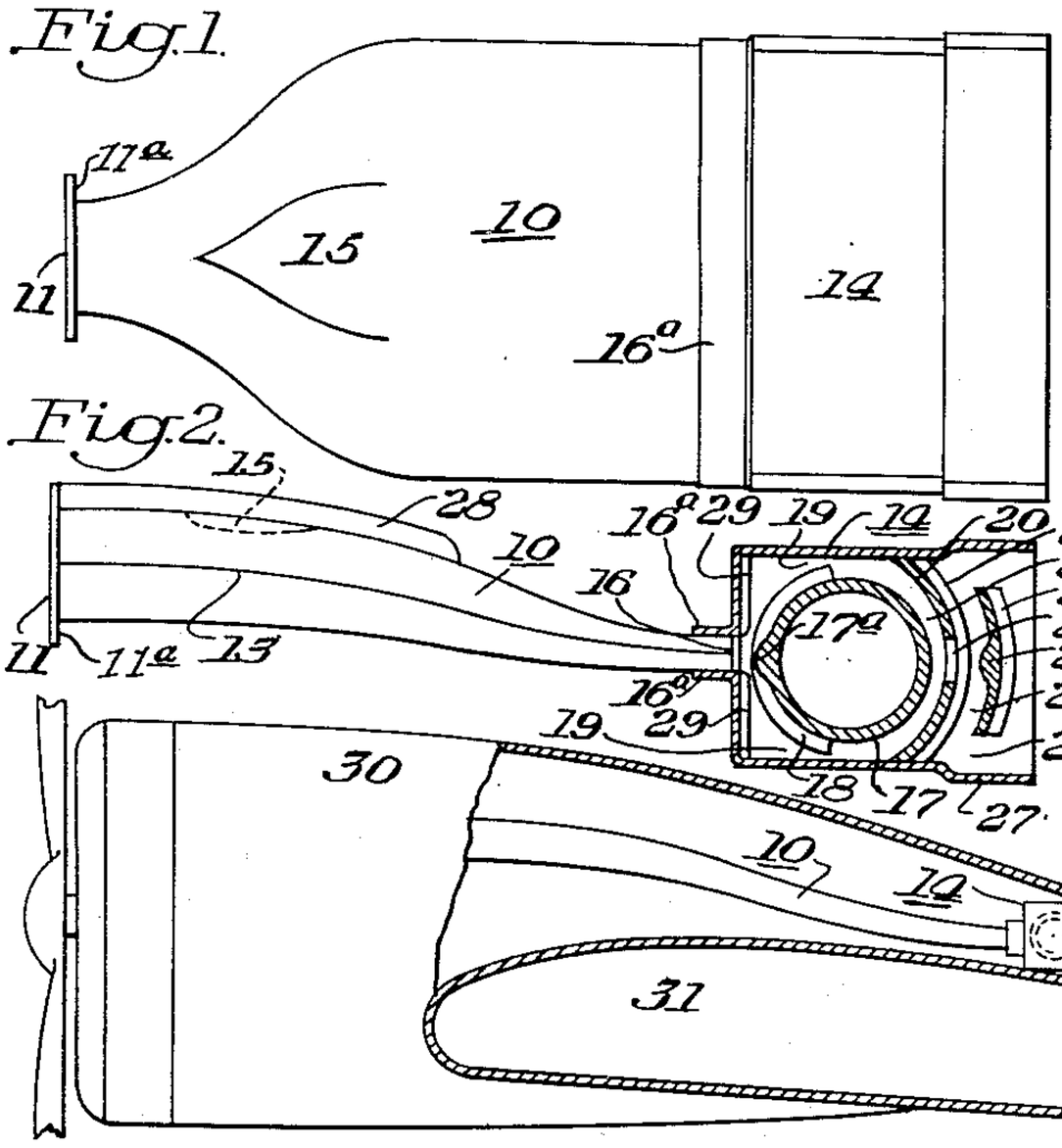


Fig. 2.

Fig. 3.

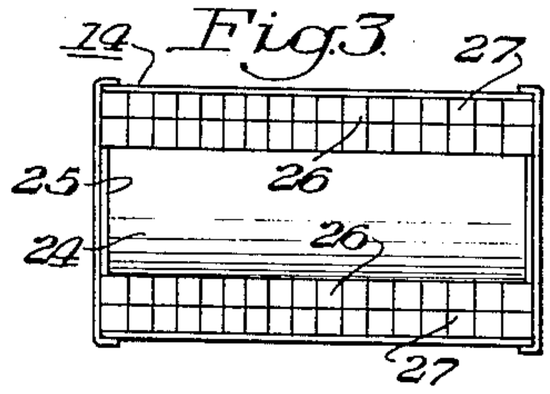


Fig. 8.

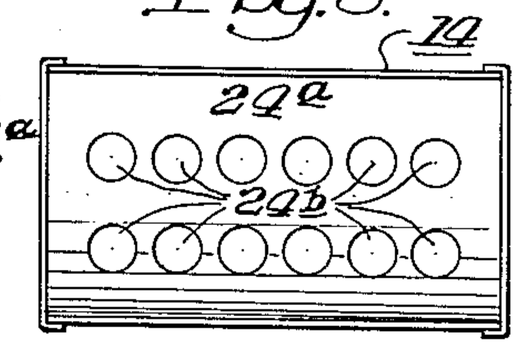


Fig. 4.

Fig. 5.

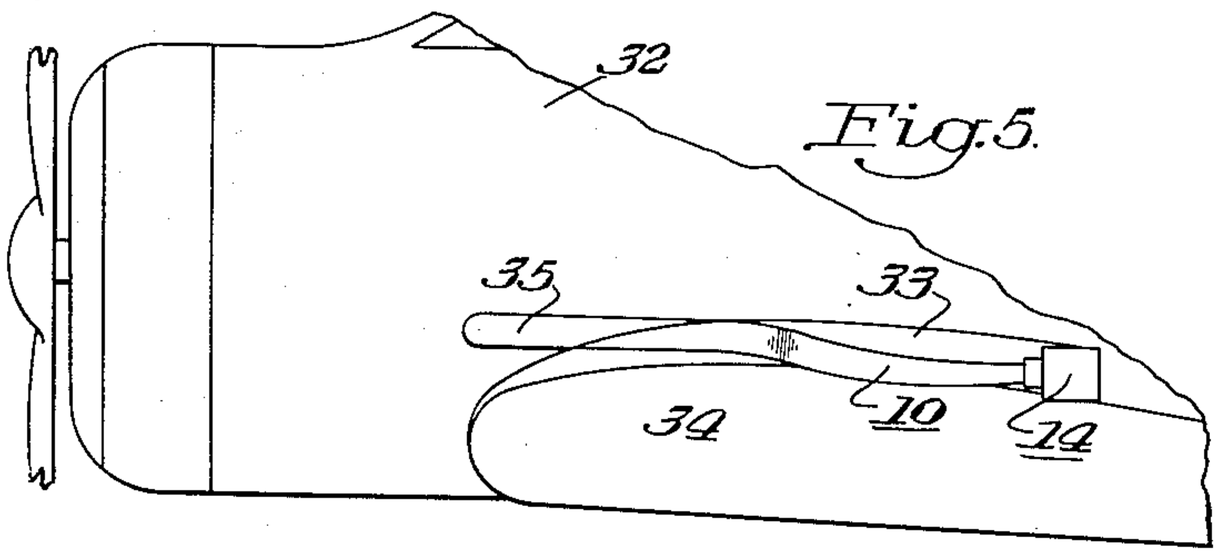


Fig. 6.

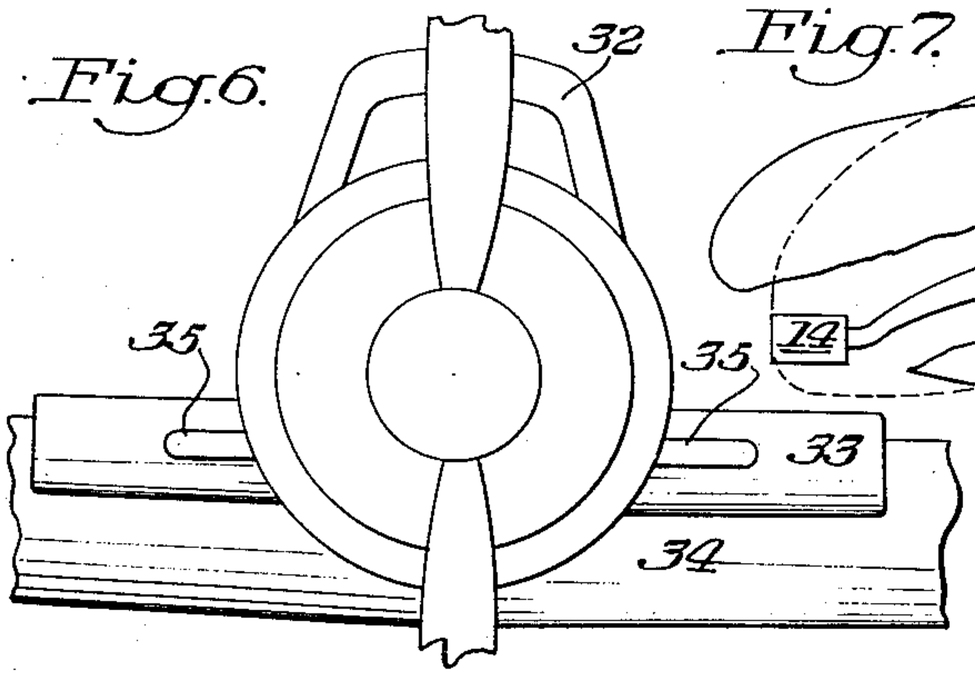
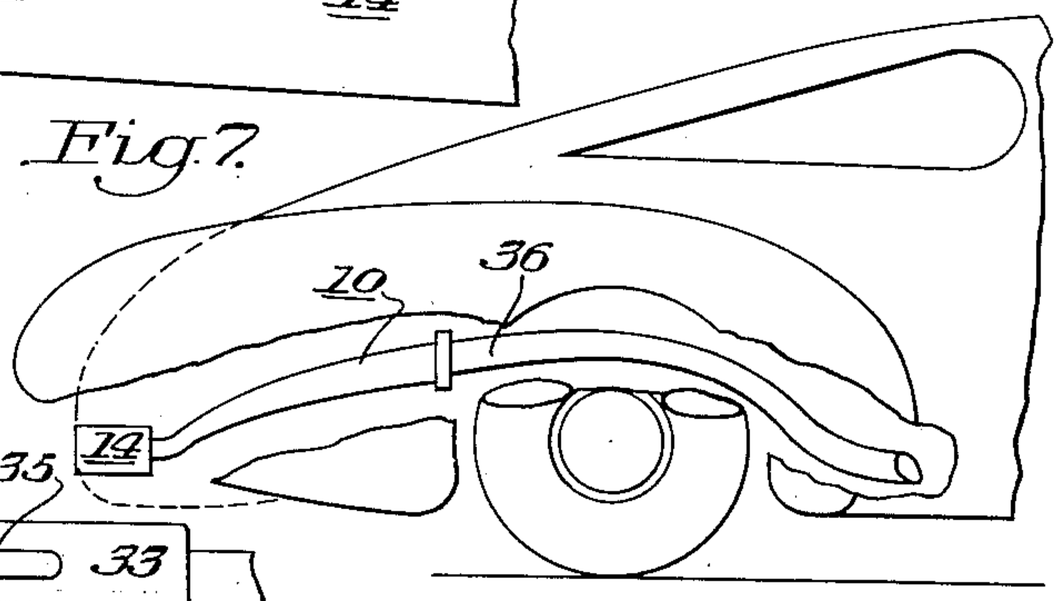


Fig. 7.



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SUCTION MUFFLER FOR AIRPLANES, AUTOMOBILES, AND THE LIKE

John A. Fisher, Steinhatchee, Fla.

Application September 9, 1941, Serial No. 410,138

10 Claims. (Cl. 181—57)

My invention comprises certain new and useful improvements in mufflers for internal combustion engines, especially those of airplanes and automobiles, and its principal purpose is the elimination or minimizing of all detrimental back pressure in the exhaust gases and the reduction of the sounds of the motor explosions to an unobjectionable minimum before and during the discharge or evacuation of the exhaust gases from the motor.

In the internal combustion engine art it has long been recognized that in the case of the types of mufflers now in use a great power loss is caused by the back pressure of the exhaust gases, including atmospheric and other restrictive pressures, and also that means are desirable to reduce the sound of the motor explosions.

These considerations are of very great importance in the case of airplanes as the reduction of atmospheric back pressure against the exhaust gases of the motor results in an increase of the available power and consequently in the speed of travel, and the reduction in the sound renders it more difficult to detect at a distance the approach of an airplane in times of war or to determine by the sound of its motor the nationality of the approaching plane.

At present it is the accepted practice in the case of airplanes to discharge the exhaust gases along with the explosive sounds directly into the compact air of the slip stream, where such noises blend and partially synchronize with the slashing or ping-like noises of the whirling propeller, which latter noises, without this blending and synchronization, would not be audible beyond a relatively short distance; and thus the approach of an airplane is audibly heralded long before the approaching airplane becomes visible to observers.

With these advantageous ends in view I have invented a new and improved muffler structure which provides an induced suction effect whereby the exhaust gases emerge into a belt or zone of rarified air, thus eliminating back pressure, and also subduing the noises of explosion inasmuch as noises cannot be produced or transmitted in a vacuum, and in a highly rarified atmosphere or partial vacuum they are effectually dampened and their transmittal reduced to a minimum.

Again, due to the internal structure and contour of my improved muffler, the noises are so baffled and absorbed as to be materially reduced even at low speeds of travel of the airplane.

However, the greater the speed of travel of the airplane, the atmospheric air at the tail or discharge end of the muffler is rarified and its pressure reduced to a greater degree, and thus the efficiency of my improved muffler both in reducing back pressures of any kind whatsoever and noise increases in a commensurate degree with the speed of travel.

In the accompanying drawing, wherein I have illustrated a practical embodiment of the principles of my invention,

Fig. 1 is a top plan view of the suction muffler;

Fig. 2 is a side elevation of the same, partially in section;

Fig. 3 is an end view lokoing from the right in Figs. 1 and 2;

Fig. 4 is a side view, partially in section, showing an application of the principles of my invention to the nacelle or cover of the motor mounted on the wing of an airplane;

Fig. 5 is a side elevation illustrating the principles of my invention applied to an airplane, the motor of which is mounted on the fuselage;

Fig. 6 is a broken front elevation of the structure illustrated in Fig. 5;

Fig. 7 is a broken side elevation showing the principles of my invention applied to an automobile;

Fig. 8 is a view similar to Fig. 3 but illustrating a modification.

Referring first to Figs. 1 to 4, inclusive, 10 indicates the body of the muffler which is of flattened form, having a materially greater internal width than vertical height. 11 indicates the mouth of the body 10 which is centrally located in the front wall of the body and is of annular form and of proper dimensions to be attachable directly to the exhaust manifold, or the pipe leading from the latter. The contour of the front wall of the body is curvilinear to produce a neck and provide a horizontally expanding path of travel for the exhaust gases. The mouth 11 may be provided with a perimetral flange 11*a*, as shown in the drawing for the ready attachment of the muffler to the exhaust exit of the motor. The body may, for the sake of convenience and economy of construction be formed of two sections, upper and lower, which are joined along the lines indicated at 13 in Fig. 1, in any convenient and well known manner.

The chamber formed interiorly of the body 10 is of such shape or relative dimensions as to direct the exhaust gases in the form of a wide but relatively shallow stream as they flow toward and into the tail box 14 hereinafter more fully described.

To facilitate such direction and formation of the stream of exhaust gases I provide in the top wall of the body 10 a dent or depression 15 located somewhat to the rear but adjacent to the mouth of the body and of rearwardly diverging side walls which may advantageously more or less parallel the diverging inner surfaces of the front wall of the body. This provision materially aids in laterally spreading and widening the stream of gases entering through this mouth 11.

The top and bottom walls of the body gradually converge, as shown in Fig. 2, to further shallow the stream of gases.

It will be seen that the structure of the body as illustrated in Figs. 1 and 2 is such that it has no interior angles or surfaces which might reflect the sound waves directly toward the rear of the body. The side walls of the body are preferably parallel or may even converge slightly toward the rear end of the body.

An important concept of my invention is that the chamber provided by the body be such so that the gases introduced thereinto by the succession of explosion puffs or blasts, incident to the operation of the motor, have sufficient volumetric space to spread and expand laterally and to obviate choking or back pressure. The gradual convergence of the top and bottom walls of the flat body 10 serves to deflect, confine and absorb most of the firing noises and produce a thin or shallow but widely spread stream of gases which thus formed can carry but little sound.

The vertical bend or curve aids in the convenient positioning of the tail end of the muffler and also aids in the spreading of the exhaust stream as it travels rearwardly, thus restricting sound.

The outlet of the body 10 is thus a widely extended but vertically restricted slotted opening.

The tail box 14 is of the full width of the body but interiorly of materially greater vertical height to augment suction effect. In its front wall it is provided with a horizontal slotted opening 16 extended for the width of the tail box and of equal horizontal length with the exit opening of the body which it matches. For convenience of attachment, the edges of the opening 16 may be provided with an outwardly extending spaced flange 16*a* which may fit over the end of the body 10 and be secured thereto as by welding or bolts.

The top, bottom and sides of the tail box 14 are closed, but the rear end of the tail box is open, except as hereinafter explained.

17 represents a baffle which is mounted horizontally in the tail box 14 and held in place as by the end flanges 18 which fit against the interior surfaces of the tail box and are welded or otherwise secured thereto. The baffle 17 is provided with an arcuate surface facing the direction from which the stream of gases flows, and said baffle is preferably of cylindrical cross sectional shape.

The baffle 17 is placed adjacent but to the rear of the entrance opening 16 of the tail box and the baffle is of such diameter as to provide passages 19 above and below the baffle extending to the full width of the tail box and of sufficient vertical dimension to provide for the free passage of the stream of gases, which is divided into two diverging branches by the baffle. A horizontal rib 17*a* at the front of the baffle 17 is preferably provided to facilitate the division of the gas into two diverging streams.

The baffle 20 is arcuate in its vertical cross-sectional characteristic, having its concave surface faced toward the baffle 17.

The baffle 20 extends to the full width of the tail box 14 and is secured at its ends thereto as by flanges 21. The baffle 20 is stepped back from the baffle 17 sufficiently to form between the two baffles the arcuate passage 22 of sufficient capacity to receive the gases passing from the passages 19.

The baffle 20 spans the full height of the tail box 14 and is provided at its center with a horizontally elongated port 23 extending from side to side of the tail box, and through which the traveling gases pass rearwardly. The port 23 is of sufficient capacity to prevent restriction of the travel of the gases.

Next in the rear of the baffle 20 is the horizontal arcuate baffle 24 having its concavity toward the baffle 20 and spaced therefrom to provide the passage 25. Like the baffles 17 and 20, the baffle 24 extends from side to side of the tail box 14 and is secured in position as by the end flanges 25*a*. The vertical extent of the baffle 24 is such as to form between its horizontal edges and the top and bottom walls of the tail box the ports 26 for the escape rearwardly of the gases passing through the port 23 and passage 25. The top and bottom walls of the tail box preferably diverge somewhat adjacent its rear end, as indicated at 27 in Fig. 2, to provide ample capacity for the ports 26 to permit the free flow of the gases without restriction.

The ports 26 may be provided with screening, as shown at 27, to further reduce sound.

Again the rear baffle 24*a* may span the full height of the tail box, as illustrated in Fig. 8, and be provided with a plurality of perforations and ports, such as indicated at 24*b*, spaced over its area for the escape of the gases.

Insulation may be applied exteriorly of the body 10 as indicated at 28, and also may be applied to the walls of the tail box as indicated at 29.

In Fig. 4 I indicate a convenient manner in which the muffler may be installed in the nacelle or covering 30 of a motor which is installed on the wing 31 of an airplane. In this instance the rear end of the nacelle is sheared off and the tail box mounted flush therewith. Thus the tail box is adjacent the upper surface of the wing where the drag or suction effect is very great.

In Figs. 5 and 6 I show the application of the principles of my invention to a motor mounted in the fuselage 32 of an airplane, the muffler being mounted in the airfoil 33 built close to the wing 34. The exhaust of the motor is led to the body 10 by means of the connecting pipe 35.

In Fig. 7 I show the muffler applied to the back or rear end of an automombile where the suction effect is great and commensurate with speed, the pipe 36 leading from the exhaust manifold of the engine to the body 10 and the tail box 14 assembly which is mounted under the rear of the automobile body.

A marked advantage may be attained in the use of the body 10 without the provision of the tail box and its baffles, or in the use of the body and tail box with the baffles omitted from the latter, but the greatest efficiency is in the use of the body, tail box and at least the first of the succession of baffles.

In the foregoing I have presented the preferred embodiment of my invention but it should be obvious or understood that a very important part of my invention, namely, the tail box arrangement for suction effect upon the exhaust,

can be applied with some degree of advantage to other or common types of mufflers.

I claim:

1. An improved baffle structure for the exhaust gases of internal combustion engines, comprising walls defining a compartment having a long slotted opening in its front wall for the admission of the gases in the form of a wide shallow stream, baffle means within the compartment to divide such stream into two diverging shallow sub-divisions flowing rearwardly, a second baffle means in the rear of the first baffle means to direct said sub-divisions toward each other, and an outlet for the escape of gases from the second baffle means.

2. An improved baffle structure for the exhaust gases of internal combustion engines, comprising walls defining a compartment having a long slotted opening in its front wall for the admission of the gases in the form of a wide shallow stream, baffle means within the compartment to divide such stream into two diverging shallow sub-divisions flowing rearwardly, a second baffle means in the rear of the first baffle means to direct said sub-divisions toward each other, and a long slotted opening in the second baffle means for the escape of the gases past the latter.

3. An improved baffle structure for the exhaust gases of internal combustion engines, comprising walls defining a compartment having a long slotted opening in its front wall for the admission of the gases in the form of a wide shallow stream, baffle means within the compartment to divide such stream into two diverging shallow sub-divisions flowing rearwardly, a second baffle means in the rear of the first baffle means to direct said sub-divisions toward each other, a long slotted opening in the second baffle means for the escape of the gases past the latter, and a third baffle means to again divide the gases into two wide shallow streams as they emerge from the compartment.

4. An improved muffler structure for the waste gases of an internal combustion chamber comprising walls defining a pair of chambers, one of said chambers having an inlet opening at one end to be connected to the exhaust of the engine and a widely extended outlet opening at the opposite end for the escape of the gases and the walls of the chamber relatively disposed to form the gases traveling from the inlet opening to the outlet opening in a thin widely extended stream, the second chamber having an inlet opening connected to the outlet opening of the first chamber and an outlet opening at the opposite end, and baffle means in the second chamber interposed in the path of the stream of entering gases and dividing the same into two diverging thin streams which pass rearwardly toward the outlet opening of the second chamber.

5. An improved muffler structure for the waste gases of an internal combustion chamber comprising walls defining a pair of chambers, one of said chambers having an inlet opening at one end to be connected to the exhaust of the engine and a widely extended outlet opening at the opposite end for the escape of the gases and the walls of the chamber relatively disposed to form the gases traveling from the inlet opening to the outlet opening in a thin widely extended stream, the second chamber having an inlet opening connected to the outlet opening of the first chamber and an outlet opening at the opposite end, baffle means in the second chamber interposed in the path of the stream of entering gases and dividing the same into two diverging thin streams, and second baffle means at the rear of the first baffle means intercepting said two streams and uniting them into one widely extending and thin stream as they pass toward the outlet of the second chamber.

6. An improved muffler structure for the waste gases of an internal combustion chamber comprising walls defining a pair of chambers, one of said chambers having an inlet opening at one end to be connected to the exhaust of the engine and a widely extended outlet opening at the opposite end for the escape of the gases and the walls of the chamber relatively disposed to form the gases traveling from the inlet opening to the outlet opening in a thin widely extended stream, the second chamber having an inlet opening connected to the outlet opening of the first chamber and an outlet opening at the opposite end, baffle means in the second chamber interposed in the path of the stream of entering gases and dividing the same into two diverging thin streams which pass rearwardly toward the outlet opening of the second chamber, and means for again dividing the stream of gases as they escape from the second chamber.

7. An improved muffler structure, for the waste gases of an internal combustion engine employed to drive an airplane or other vehicle, comprising walls defining a pair of chambers, one of said chambers serving to absorb the firing noises and having an inlet opening at one end to be connected to the exhaust of the engine and a widely extended slot-like outlet opening at the other end for the escape of the gases, and the walls of the chamber being relatively disposed to spread the gases traveling from the inlet opening to the outlet opening in a thin widely extended stream, the second chamber having an inlet opening corresponding in dimensions to the outlet opening of the first chamber and communicating therewith for the unobstructed emission of the stream of gases from the first chamber into the second chamber, and the second chamber having an outlet opening into atmosphere in the area of low pressure resulting from the travel of the airplane to facilitate the suction withdrawal of the stream of gases from the first chamber.

8. The structure of claim 7, wherein the cross-sectional area of the second chamber adjacent its inlet opening is greater than the cross-sectional area of the first chamber adjacent its outlet opening.

9. An improved muffler structure for silencing the stream of exhaust gases of an internal combustion engine, comprising walls defining a chamber having a centrally disposed inlet in its front arranged to be connected to the exhaust of the engine, the side walls of the chamber diverging from said inlet opening and the top and bottom walls of the chamber converging from the front of the chamber toward the rear end of the chamber, and an extended slot-like outlet opening at the rear end of the chamber extending from one side wall to the other to spread the gases as they pass through the chamber into a thin widely extending stream.

10. The structure of claim 9 wherein the interior of the chamber adjacent its inlet opening is provided with a laterally extending baffle to facilitate the spreading of the gases toward the side walls of the chamber.

JOHN A. FISHER.