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SILENCERS FOR THE EXHAUST GASES OF VEHICLE INTERNAL COMBUSTION ENGINES

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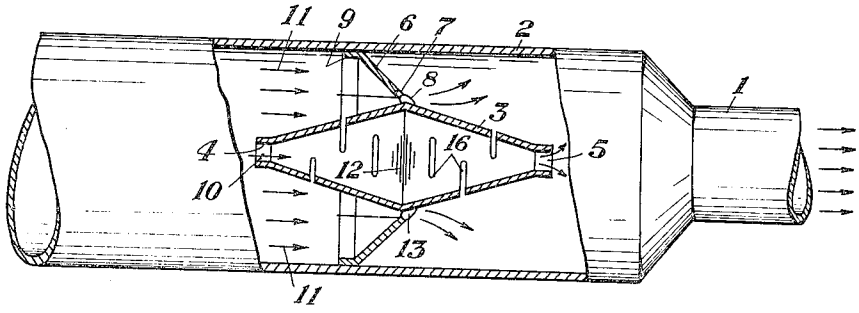

INVENTOR

GIUSEPPE CALABRESI

by Walter S. Preston

ATTORNEY

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SILENCERS FOR THE EXHAUST GASES OF VEHICLE INTERNAL COMBUSTION ENGINES

Giuseppe Calabresi, 19 Via Dei Dalmati, Rome, Italy

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My present invention relates to improvements in silencers for the exhaust gases of internal combustion engines usually employed in vehicles of all kinds, such as motor-cars, motorcycles, trucks, airplanes, motorboats, ships, and so on.

It is a well known fact that when the exhaust gases leave the cylinder of any internal combustion engine the pressure is still high e.g. as high as 3–4 atmospheres or even higher. When coming into contact with the air, these gases expand rapidly and produce a series of loud detonations.

It is an object of my invention to avoid such drawbacks by the provision of an improved silencer in the path of the exhaust gases of an internal combustion engine.

The silencer according to my present invention is based on the finding that a stream of exhaust gas can be divided by a single, improved baffling unit into two flows of different density, of a phase opposition such that the expansion of the one corresponds to the compression of the other one, and as a consequence of this produces the desirable effect that the sound waves produced by the engine travel in two mediums with a phase displacement in respect to each other as to speed, pulsations and density. In addition, and in order to transform this phase displacement into interference, this baffling unit is provided with suitable openings, through which both flows communicate.

I have additionally found that this phase displacement and thereby a perfect silencing action can be achieved by locating in a muffler casing two such units suitably arranged in respect to each other. An inherent advantage of the silencer as per the present invention is that it causes practically no back pressure and thus eliminates losses in engine performance.

This will become clear and substantiated in the following description of my invention, illustrated by the accompanying drawing, which represents a view, partly in longitudinal section, of the silencer, with one dividing and baffling unit being visible.

Referring now to the drawing, reference number **1** indicates an exhaust pipe provided in a series arrangement with an exhaust box **2** of any suitable cross-sectional shape. The exhaust pipe is connected, at one of its ends, to one or several pipes extending from one or several outlets of the cylinder or cylinders of an internal combustion engine not shown. At the opposite end of the exhaust pipe, the exhaust gases are discharged into the atmosphere, after the detonations or noise of the exhaust have been muffled by one or several silencers according to the invention.

In the following specification a single silencer will be described, arranged within the exhaust box of the exhaust pipe; however, it is to be understood that more than one silencer may be installed within the same exhaust box and/or along the exhaust pipe **1** of a smaller diameter. Good results may also be achieved by applying one or more silencers according to my invention, within an exhaust pipe not provided with an exhaust box.

According to the illustrated embodiment the silencer comprises a hollow body **3** having a longitudinal or axial cross-section of approximately rhomboidal shape so that body **3** is formed by two opposite hollow cones connected

to one another at their bases. At the opposite vertices of said hollow body two openings **4** and **5** of equal diameter are provided. Furthermore, the body **3** may be provided with slots or other openings **16** through which its interior can communicate with the outer space between the body and the inner cylindrical surface of the exhaust box **2**. The hollow body **3** is preferably (but not necessarily) secured coaxially with and interiorly of the exhaust box **2** by means of a transverse supporting wall **6** which, in the embodiment shown, has a frusto-conical shape with the edge **7** of lesser diameter facing the outlet end of the exhaust pipe **1**. The edge **7** is spaced from the peripheral surface of maximum diameter of the hollow body **3** and may be fastened to said peripheral surface of the hollow body **3** e.g. by means of spots of welding material **8**. The edge **9** of greater diameter of the supporting wall **6** contacts the inner surface of the exhaust box **2** and is fixed thereto by any suitable means, e.g. by a continuous welding.

The exhaust gases, leaving the outlets of an internal combustion engine, gather in the form of a single gaseous current within the exhaust pipe **1** and the exhaust box **2**, until they reach the open front end **4** of the hollow body **3**. At this point, the single gaseous current divides into an inner current (indicated by arrow **10**) entering the hollow body **3** and an outer current (indicated by arrow **11**) flowing between the hollow body and the cylindrical wall of the exhaust box. The gases forming the inner current **10** will expand when they reach the zone of maximum diameter **12** of the inner cavity of the hollow body **3**, whereas the gases forming the outer current **11** will be compressed when they have to pass through the annular slot **13** formed by the edge **7** of lesser diameter of the frusto-conical surface **6** and the surface of maximum diameter of the hollow body **3**. Thus, an expansion of the inner current **10** and a compression of the outer current **11** occur simultaneously at an identical zone or cross-section of the exhaust box **2**.

These opposing and simultaneous actions on the two gaseous currents cause such phase displacements of the sound waves carried by those currents that a noise muffling zone or even a zone of silence will be created at such cross-section of the exhaust box.

The inner current **10** is then under compression at the outlet **5** of the hollow body **3**, while the outer current **11** is under maximum expansion at the cross-section of the exhaust box **2** in the transverse plane of the outlet **5**. Hence, another simultaneous and opposing action on the gaseous currents **10**, **11**, i.e. a further deadening of the sound waves, occurs owing to the last mentioned cross-section.

Another important fact is that, the currents of exhaust gases are not subjected to any noticeable resistance by the hollow body **3** and the supporting wall **6**, so that the power loss of the engine is non-existent or nearly so. This result is confirmed in practice by the fact that the exhaust gases coming from the free end of the exhaust pipe, have still a very high temperature, contrary to what happens when conventional silencers are used. I have found that the provision of the slots **16** in the hollow body **3** brings about an improved result and this is probably due to the fact that the slots **16** allow a reciprocal mixing of the gases of the two currents **10** and **11** while flowing. Thereby they prevent the sound waves which had been phase-displaced at the annular slot **13** from being restored to an in-phase relationship at the outlet **5** of the hollow body **3**.

While I have described a preferred form of silencer, it is to be understood that numerous alterations, modifications and changes in the details may be made in the silencer according to my present invention, without de-

parting from the spirit and scope of the invention as defined in the claims which are made a part hereof.

What I claim is:

1. A silencer mounted in a conduit adapted to carry exhaust gases from an internal combustion engine and comprising a hollow, elongated body open at its opposite ends to provide at said ends an inlet and outlet, respectively, for said exhaust gases, said body flaring from said respective ends to a location intermediate its ends so as to define within the body an inner gas expansion chamber progressively enlarged in a direction from the inlet to said location, and an inner gas compression chamber progressively decreased in a direction from said location to the outlet, said inlet, chambers and outlet affording an unobstructed passage for a portion of the exhaust gases entering the body through the inlet; and a baffle mounted between the conduit and the body, said baffle surrounding said body between the inlet and said location, said baffle tapering from the conduit toward said location, the conduit, flaring body and tapering baffle defining an outer compression chamber extending about and located in side-by-side relation to the inner expansion chamber, the conduit, the body and the baffle defining, downstream from the baffle, an outer expansion chamber extending about the inner compression chamber in side-by-side relation therewith, said outer expansion and compression chambers communicating through constricted exhaust gas passage means between the baffle and the body at said intermediate location of the body whereby to first produce an expansion of gases flowing within the body simultaneously with compression of gases flowing past the body exteriorly thereof, followed by a compression of the gases flowing within the body simultaneously with expansion of the gases flowing exteriorly of the body.

2. A silencer as in claim 1 wherein the larger end of the baffle is disposed downstream from the inlet of the body.

3. A silencer as in claim 1 wherein the body is formed with a plurality of apertures spaced longitudinally thereof and communicating between the inner expansion chamber and outer compression chamber.

4. A silencer as in claim 3 wherein the body has additional openings spaced longitudinally thereof and communicating between the inner compression chamber and the outer expansion chamber.

5. A silencer as in claim 4 wherein the several openings are formed as slots angularly spaced about and extending circumferentially of the body.

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