

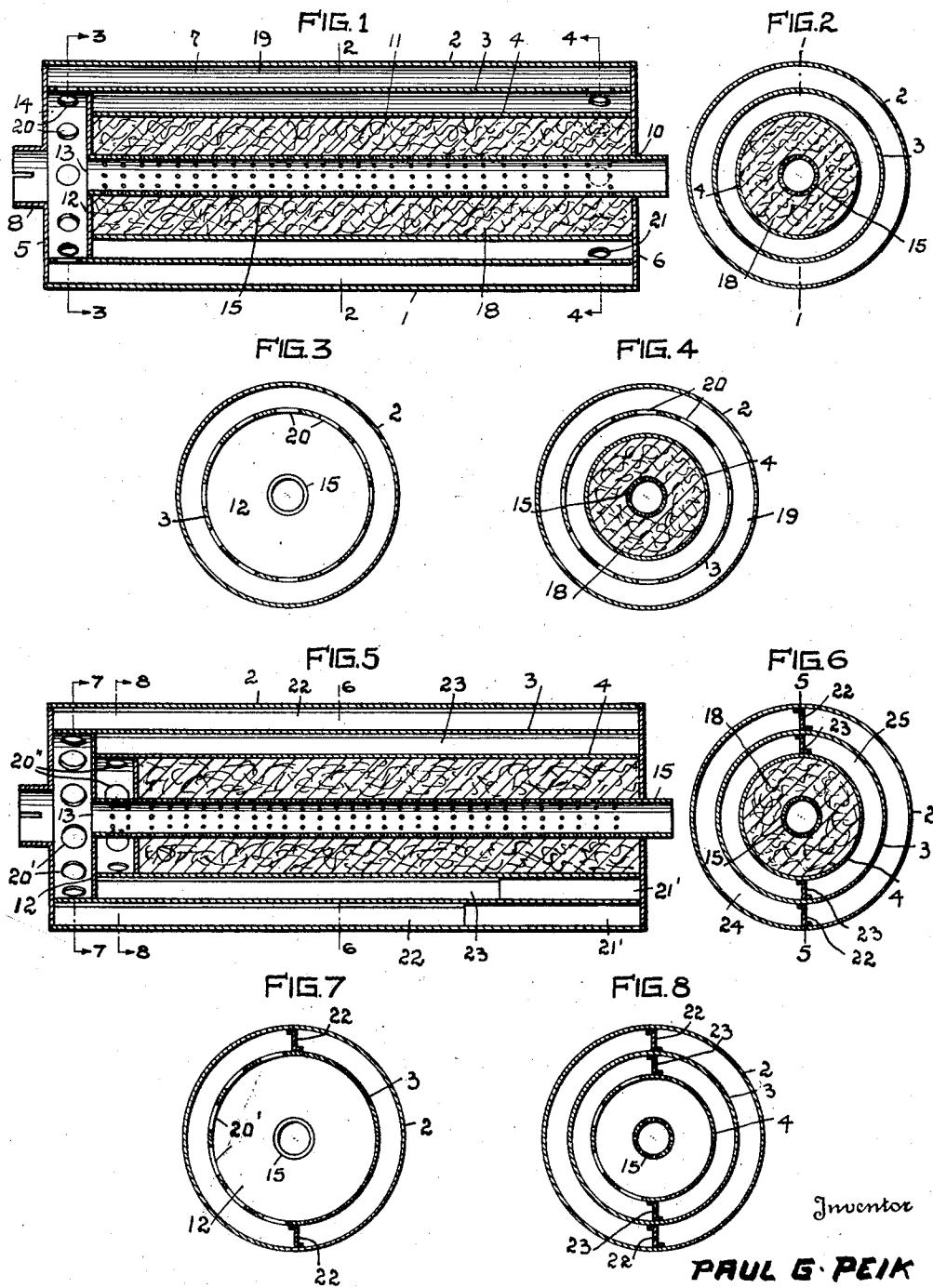
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MUFFLER

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MUFFLER

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1 Claim. (Cl. 181—41)

This invention relates to mufflers for silencing the exhaust noises of engines, particularly of internal combustion engines.

The general object of the invention is to provide a combined acoustic and resonator muffler, of exceptionally low production cost having a degree of compactness heretofore unattained in mufflers of comparable efficiency.

Another object of the invention is to provide a durable efficient combined acoustic and resonator muffler of low construction cost which embodies a series of resonator chambers of substantial length when compared with the length of the muffler.

Still another object of the invention is to provide a combined acoustic and resonator muffler of the type referred to above with a series of resonator chambers tuned within narrow ranges with respect to each other to broaden the range of frequencies in which the muffler will silence low sound frequencies.

Fundamentally all sound deadening is due to resonance action. The highest efficiency of sound deadening,—that is, elimination of any sound wave in one cycle,—is attained only by providing a separate chamber tuned exactly to the length of that wave. This method is not feasible in a muffler, due to the multiplicity of sound waves in the exhaust stream, and the constant variation of their frequency due to the acceleration and de-celeration of the engine. While each individual air space in sound absorbing material employed in mufflers of the so-called acoustic type, is far too small to have an efficient sound deadening action in one cycle, acoustic mufflers are nevertheless very efficient in deadening high frequencies of sound due to the multiplicity of air spaces and the high rate of oscillation of the high frequencies. Thus, the so-called acoustic mufflers are extremely efficient in eliminating the high frequencies, but (for reasons which are explained later) are so inefficient in their action on the low frequencies that such mufflers must be made in a considerable length to obtain the necessary elimination of the low sound frequencies, so long in fact that it is common practice to make them in two units so that they can be mounted between the re-inforcing members of the modern automobile chassis.

The following brief reference to acoustic mufflers and resonator mufflers will serve to show how the above objects are attained and to bring out the main features of the invention.

Resonator mufflers in turn are extremely efficient in deadening low frequencies in an exhaust

gas stream. Their efficiency is limited due to the multiplicity of sound waves in the exhaust stream of an internal combustion engine and the variation of the sound waves due to acceleration and deceleration of the engine. Their length, which is governed by the wave length of the low frequencies in an exhaust gas stream, is considerable and therefore the manufacturing costs of reasonably efficient resonator mufflers are high and their use is limited to automobiles with relatively large frame structures.

The objects and advantages of the invention will become more apparent from the following description, when taken in conjunction with the accompanying drawing, wherein:

Figure 1 is a longitudinal sectional view of an exhaust muffler according to the invention, the section being taken on line 1—1 of Figure 2;

Figure 2 is a transverse sectional view taken on line 2—2 of Figure 1;

Figures 3 and 4 are transverse sectional views taken on lines 3—3 and 4—4 respectively of Figure 1;

Figures 5 through 8 show a slightly modified form of the muffler provided with separating fins to increase the number of resonator chambers employed, thus, Figure 5 is a longitudinal sectional view through the modified muffler taken on line 5—5 of Figure 6;

Figure 6 is a transverse sectional view taken on line 6—6 of Figure 5;

Figures 7 and 8 are transverse sectional views taken on lines 7—7 and 8—8 respectively of Figure 5.

Referring more particularly to the structure disclosed in Figures 1 through 4 of the drawing, the muffler 1 comprises a series of telescoped cylinders 2, 3 and 4 arranged in spaced relationship with respect to each other. The outer cylinder 2 and the adjoining cylinder 3 are connected at opposite ends in any suitable manner, as by welding to the front and rear end walls 5 and 6 respectively, thus forming resonator chamber 7 of ring shaped cross-section between these two cylinders. End wall 5 is formed with an inlet extension 8 having an outlet opening 9, and end wall 6 is centrally perforated to form an opening 10. The third cylinder 4 is somewhat shorter and at its rear end welded to rear end wall 6. The front end of cylinder 4 is welded to an inner wall 12 which in turn is secured to the inner wall of cylinder 3. Front end wall 5 is spaced a slight distance from inner wall 12 due to the difference in length between cylinders 3 and 4, thus forming a chamber 14 at the front end of the muffler.

Cylinder 4 encloses a round sleeve or pipe 15 in axial alignment with the respective inlet and outlet openings 9 and 10, and extending from inlet opening 13 in inner wall 12 of shell 4 to and through opening 10 in rear end wall 6, thus forming a ring shaped chamber 11 within cylinder 4. Pipe 15, which is made of perforated sheet metal, communicates through its perforations with the interior of cylinder 4 surrounding said pipe. The ring shaped chamber 11 in cylinder 4 is packed with any sound absorbing fire proof material 18 such as expanded micaceous material, slag wool, steel wool etc. and communicates with the space inside of pipe 15, as previously described, which space constitutes an unobstructed main passage for the exhaust gas.

The silencing efficiency of the structure just described is more effective on the high sound frequencies than on the lower ones, the latter being more readily muffled or silenced by resonating action. Good muffling on both high and low frequencies has heretofore only been obtained by employing relatively long mufflers, which as pointed out above cannot be used on reinforced short frame structures of automobiles. In order to obtain a resonator effect in combination with the acoustic action of the muffler so far described without greatly increasing the length of the muffler, the space between shells 2, 3 and 4 is utilized as a resonator chamber 19. Chamber 19 which may be tuned to silence the loudest period of the low sound frequencies of the exhaust gas stream, is approximately twice the length of the outer cylinder 2 and consequently is about double the length of the muffler as a whole, one half of the length of chamber 19 constituting the outer ring shaped space between cylinders 2 and 3, and the other half constituting the inner ring-shaped space between cylinders 3 and 4 which in effect serves as a second resonator chamber.

A series of openings or slots 20 in the wall of cylinder 3 close to one end thereof provide direct communication between the two halves of chamber 19, and a series of openings 21 in the wall of said cylinder close to the opposite end thereof provide direct communication between chamber 14 and one end only of resonator chamber 19. Therefore as the chambers are connected in series the same will be caused to function as a compound resonator.

For internal combustion engines having an un-

usually complex combination of distinct loud periods of low frequencies the number of resonator chambers of the muffler is preferably increased. Such a structure is disclosed in Figures 5 to 8 of the drawing, wherein I show a muffler closely resembling the structure shown in Figures 1-4, with the exception that the space between shells 2 and 3 and shells 3 and 4 is subdivided by fins 22 and 23 respectively, whereby two elongated reversed or U-shaped resonator chambers 24 and 25 of substantial length are formed, which therefore function as a simple resonator. The length of chambers 24 and 25 may be individually adapted to silence the loudest periods of the two lowest sound frequencies of the exhaust gas stream by arranging the communicating openings or slots 20', 20'' in cylinders 3 and 4 more or less apart from the end of said cylinders, but slots 20' should be so positioned that the chambers 24 and 25 will be substantially longer than the length of the outer cylinder 2 and consequently longer than the length of the muffler as a whole. The communicating passages 21' between the halves of chambers 24 and 25 are arranged similarly to openings 21 in the muffler previously described.

It will be understood that mufflers according to the invention can readily be built with any number of simple resonator chambers of the required tuning either by providing further subdivisions by means of additional fins, or by increasing the number of shells or cylinders, and that these mufflers possess very high muffling efficiency despite the fact that the length of the muffler is comparatively short.

Having thus described my invention, what I claim is:

A muffler for silencing the exhaust noise of internal combustion engines, comprising an unobstructed main passage having a plurality of perforations therein, an expansion chamber having sound absorbing material packed therein and encircling said passage and communicating therewith through said perforations, and two substantially U-shaped resonator chambers, each being of substantially greater length than said muffler and each being in communication with the main passage, said resonator chambers being spaced from the main passage by different radial distances.

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