March 15, 1960 C. E. NELSON 2,928,492

EXHAUST MUFFLER

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Fig. 1.

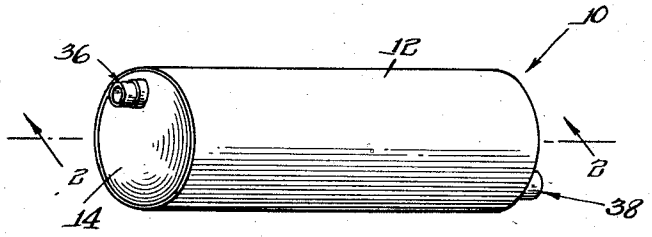


Fig. 2

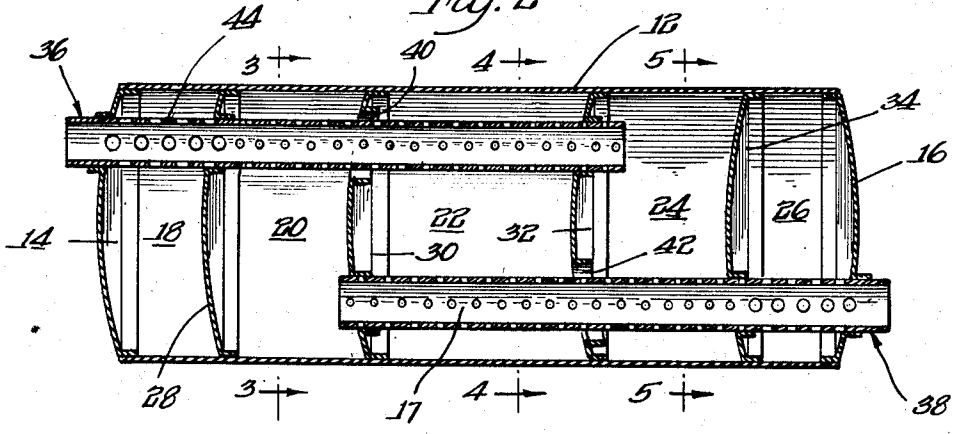


Fig. 3.

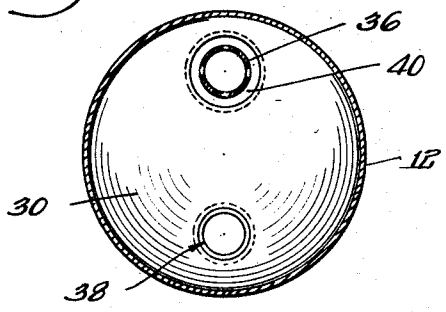


Fig. 4.

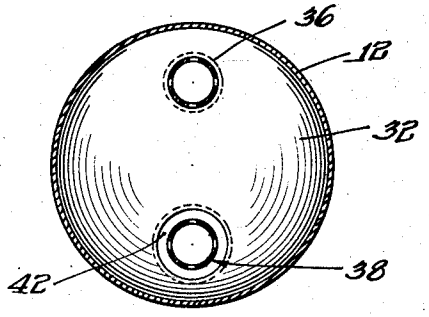
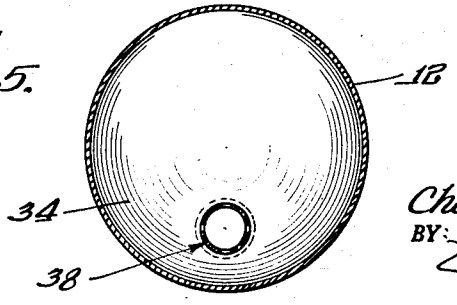


Fig. 5.



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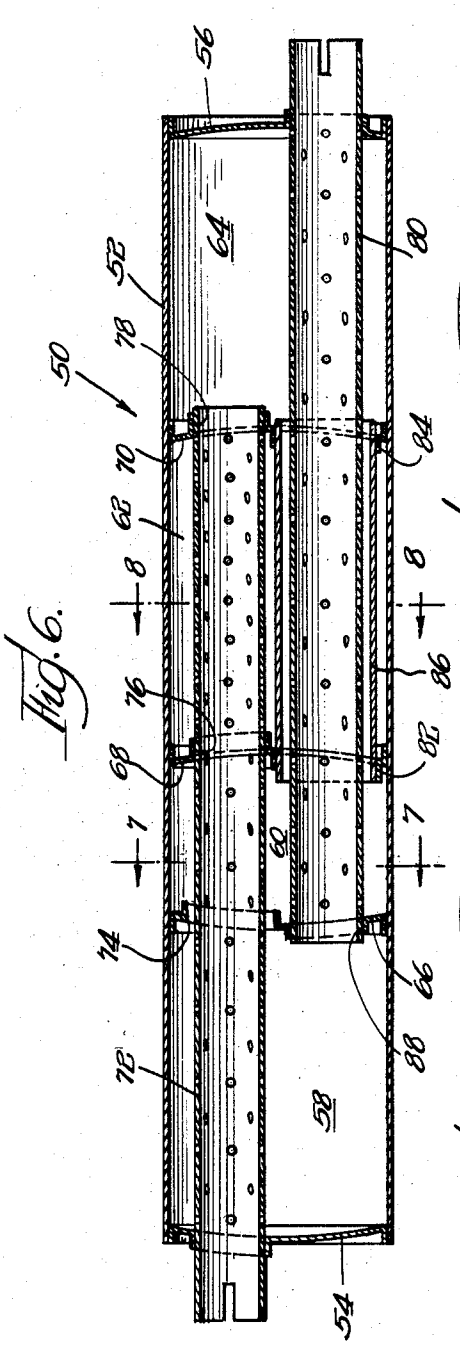


Fig. 6.

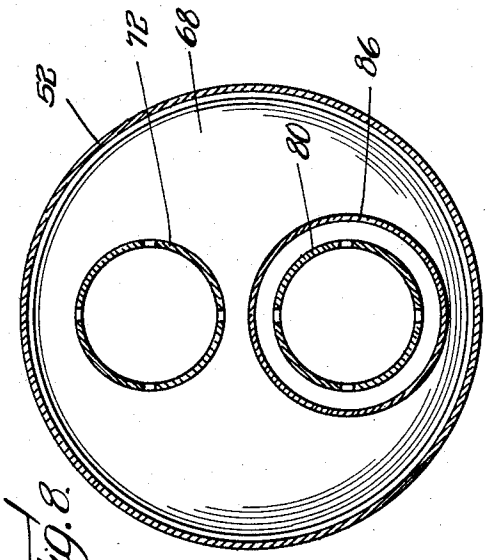


Fig. 8.

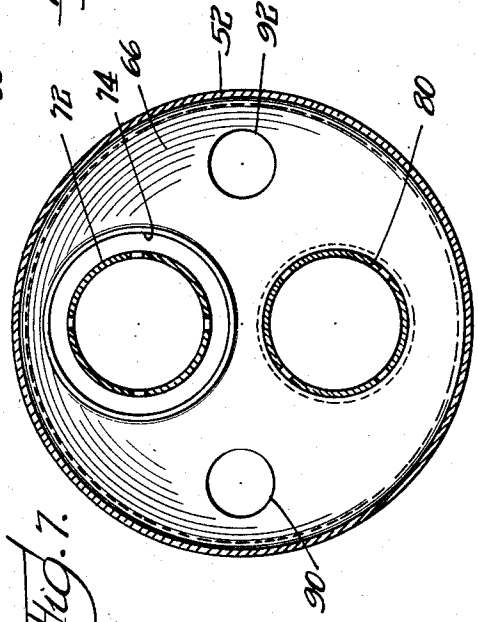


Fig. 7.

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EXHAUST MUFFLER

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Application June 18, 1954, Serial No. 437,629

3 Claims. (Cl. 181—47)

The present invention relates to a novel exhaust muffler or silencer for internal combustion engines.

An object of the present invention is to provide a novel internal combustion engine exhaust muffler of relatively simple construction, which novel muffler has substantially improved exhaust noise silencing characteristics.

Another object of the present invention is to provide a novel muffler of the above described type which is of rugged and economical construction. Other objects of the present invention will become apparent from the following description and the accompanying drawings wherein:

Fig. 1 is a perspective view of an internal combustion engine exhaust muffler embodying the principles of this invention;

Fig. 2 is a vertical cross sectional view taken along line 2—2 in Fig. 1;

Fig. 3 is a cross sectional view taken along line 3—3 in Fig. 2;

Fig. 4 is a cross sectional view taken along line 4—4 in Fig. 2;

Fig. 5 is a cross sectional view taken along line 5—5 in Fig. 2;

Fig. 6 is a cross sectional view of a muffler embodying a modification of the present invention;

Fig. 7 is an enlarged cross sectional view taken along line 7—7 in Fig. 6; and

Fig. 8 is an enlarged cross sectional view taken along line 8—8 in Fig. 6.

Referring now more specifically to the drawings wherein like parts are designated by the same numerals throughout the various figures, an exhaust muffler 10 embodying the features of the present invention includes an elongated tubular shell 12 having opposite ends thereof closed by dish-shaped end members 14 and 16. The interior of the shell 12 is divided into chambers 18, 20, 22, 24 and 26 by means of partitions 28, 30, 32 and 34. These partitions as well as the end members 14 and 16 are preferably provided with peripheral flanges which are welded to the tubular shell to give the structure the desired strength and rigidity. Tubes 36 and 38 extend into the shell through the end members 14 and 16 and as will appear from the description hereinbelow the muffler may be arranged so that each of these tubes may be used as either the exhaust gas inlet or the outlet tube.

The tube 36 extends through the partitions 28, 30 and 32 and opens into the chamber 24. The tube 38 similarly extends through the partitions and opens into the chamber 20. It should be noted that the partitions 30 and 32 are respectively provided with openings 40 and 42 through which the tubes extend. These openings are substantially larger than the tubes so as to provide gas passageways between the chambers 20, 22 and 24. In addition, assembly of the tubes is facilitated since the large openings 40 and 42 in the partitions need not be in exact axial alignment with the tubes and the small openings in the other partitions through which the tubes

extend. With this arrangement it is seen that exhaust gases entering the muffler through either of the tubes are discharged into one of the chambers 20 or 24 at opposite sides of the chamber 22 from where the gases may pass through the chamber 22 and into the other of the chambers 20 and 24 for discharge through the other of the tubes. As the gases pass into and through the chambers 20, 22 and 24, the gases are expanded, cooled, and reflected by the partitions so that out of phasing of the exhaust impulses is effected. The out of phasing of the exhaust impulses and hence the muffling of exhaust noises may be more effectively accomplished by increasing the number of paths along which the exhaust gases may flow within the muffler and therefore the tubes 36 and 38 are preferably provided with perforations. In the particular embodiment illustrated the tubes 36 and 38 are provided with perforations throughout their entire lengths except, of course, for the portion extending beyond the ends of the shell. As will be understood the exhaust impulses and sound frequencies to be muffled will be different for different installations of the muffler. The sound frequencies may vary from low frequencies of less than 300 cycles per second to high frequencies at the limit of the audible range and the size and spacing of the perforations in the tubes should be varied in accordance with the particular frequencies to be muffled to provide the most efficient operation.

However, in order to obtain the most efficient muffling action the percentage of opening in the portions of the tubes located within the chambers 18 and 26 should be substantially greater than the percentage of opening in the portions of the tubes located within the remaining chambers. When muffling higher frequencies for example, it has been found that good results are obtained when the tube portions within the chambers 18 and 26 are provided with about 5 percent of perforated area while the remaining portions of the tubes have about 1 percent of their areas perforated.

While the muffling action obtained by passing exhaust gases through the chambers 20, 22 and 24 in the manner described above is satisfactory for many installations, it has been found that a substantial improvement in the silencing action of the muffler is obtained by providing resonator chambers at opposite ends of the muffler. In the embodiment illustrated, the partitions 28 and 34 are imperforate except, of course, for the openings snugly receiving the tubes. The resonator chambers 18 and 26 are, thus, closed from the remainder of the muffler except for the perforations in the tubes. Assuming the tube 36 to be the inlet tube, exhaust gases will surge into the chamber 18 through the perforated tube section 44 and then surge back into the tube. This surging action effects substantial out of phasing of the exhaust impulses and at the same time the back pressure created is unobjectionable since the gases are almost immediately expanded into the chambers 22 and 24. It is understood that a similar surging action of the exhaust gases into and out of the chamber 26 will effect a further silencing of the exhaust noises. While maximum silencing action is obtained by providing the resonating chambers at both ends of the muffler certain installations will be satisfactory with only one resonator chamber provided at either the inlet end of the muffler or the outlet end. When only one resonator chamber is to be used, maximum silencing action may be obtained by locating the resonator chamber at the outlet end of the muffler in order to absorb not only the original exhaust noise but also any secondary noises that may be created within the muffler.

When providing a muffler of the type contemplated herein for silencing low frequency exhaust impulses, it is important that the inlet and outlet tubes be arranged so

that they overlap each other a considerable amount. For such a muffler, the location of resonator chambers at the ends of the shell may necessitate making the muffler too long for certain installations. However, it has been found that a resonator chamber may be provided as shown in the embodiment of the present invention illustrated in Figs. 6 through 8, whereby substantially improved muffling action is obtained without unduly increasing the overall length of the muffler. More specifically, in Figs. 6 through 8 there is shown a muffler 50 which includes an elongated tubular shell 52 which is closed at its opposite ends by end members 54 and 56. The interior of the shell 52 is divided into a plurality of chambers 58, 60, 62 and 64 by partitions 66, 68 and 70.

A perforated exhaust inlet tube 72 extends through the end 54 and the partitions and opens into the chamber 64. It should be noted that the partition 66 is provided with a relatively large opening 74 through which the tube 72 extends. It will be appreciated that the large opening 74 not only facilitates assembly of the tube through the partition 66 but also provides a gas passageway between the chambers 58 and 60. The tube 72 is snugly received in openings 76 and 78 in the partitions 68 and 70, and as will become more apparent from the following description, the tube 72 provides the only passageway permitting gases to enter into and escape from the chamber 62 whereby the chamber 62 is a resonator chamber functioning in a manner similar to the resonator chamber described above.

A perforated exhaust outlet tube 80 extends through the outlet end 56 of the muffler and the partitions and opens into the chamber 58. The partitions 68 and 70 dividing the resonator chamber 62 are respectively provided with relatively large openings 82 and 84 for facilitating assembly of the tube 80. In order to prevent gases from escaping from the resonator chamber 62 through the openings 82 and 84, an imperforate tube 86 extends through the resonator chamber which is snugly received in the openings 82 and 84. It should be noted that the tube 86 which has a diameter substantially greater than the diameter of the perforated tube 80 also provides a gas passageway connecting the chambers 60 and 64. The inner end of the tube 80 extends through and is supported within an opening 88 in a partition 66. If desired, the partition 66 may be provided with openings 90 and 92 as shown in Fig. 7 which form gas passageways in addition to the passageway provided by the opening 74.

The main flow of exhaust gases through the muffler 50 is through the inlet tube and into the chamber 64, then back to the chamber 58 through the tube 86 and the chamber 60 and finally out the tube 80. Other portions of the gases flow either into or out of the perforations in the tubes 72 or 80 and serve to break up the exhaust impulses and increase the efficiency of the muffler. Still other portions of the gases surge into and out of the resonator chamber 62 through the perforations in the section of the tube 72 extending through the resonator chamber. Preferably, the section of the tube 72 within the resonator chamber has a larger percentage of perforated area than the remaining sections of the tube 72 and the tube 80, and for example: the section of the tube 72 within the resonator chamber may have about 5% of its area perforated while the other sections of the tube 72 and the tube 80 may have about 1% of their area perforated. The efficiency of the muffler 50 is further increased by the concentric alignment of the tubes 80 and 86 which provide an elongated narrow annular passageway which serves to promote more acoustic attenuation of the exhaust impulses of the gases flowing therethrough than would be provided by a single open tube having the same cross sectional area as the annular passageway.

From the above description, it is seen that the present invention has provided a novel exhaust muffler of simple construction which muffler is capable of substantially improved silencing action. Furthermore, it is seen that the present invention has provided a novel muffler which may be easily and economically assembled to provide a strong and rigid structure having a long useful working life.

While the preferred embodiments of the present invention have been described and illustrated herein, it is obvious that many structural details may be changed without departing from the spirit and scope of the appended claims.

The invention is claimed as follows:

1. An exhaust muffler comprising an elongated shell closed at opposite ends thereof, at least three transverse partitions spaced longitudinally within said shell and providing first and second end chambers respectively adjacent opposite outlet and inlet ends of the shell and a third resonator chamber and a fourth chamber between said end chambers, an inlet tube extending through the inlet end of said shell and said partitions and opening into said first chamber, an outlet tube extending through the outlet end of said shell and said partitions and opening into said second chamber, each of said tubes having perforations substantially throughout their entire lengths and in each of the chambers through which they extend, an imperforate tube extending through the resonator chamber and surrounding a portion of one of said perforated tubes and providing a gas passageway between one of said end chambers and said fourth chamber, the perforations in a section of the other of said perforated tubes extending through said resonator chamber providing the only means for permitting gases to enter into and escape from the resonator chamber, and means providing a gas passageway in addition to the perforated tubes between said fourth chamber and an adjacent end chamber, each of said perforated tubes having only about one percent of its area perforated except that said tube section has a larger percentage of its area perforated.

2. An exhaust muffler, as defined in claim 1, wherein said imperforate tube surrounds a portion of said outlet tube, and said tube section is in said inlet tube and has about five percent of its area perforated.

3. An exhaust muffler comprising an elongated shell closed at opposite ends thereof, at least three transverse partitions spaced longitudinally within said shell and providing first and second end chambers respectively adjacent opposite outlet and inlet ends of the shell and a third resonator chamber and a fourth chamber between said end chambers, an inlet tube extending through the inlet end of said shell and said partitions and opening into said first chamber, an outlet tube extending through the outlet end of said shell and said partitions and opening into said second chamber, each of said tubes having perforations substantially throughout their entire lengths and in each of the chambers through which they extend, an imperforate tube extending through the resonator chamber and surrounding a portion of one of said perforated tubes and providing a gas passageway between one of said end chambers and said fourth chamber, the perforations in a section of the other of said perforated tubes extending through said resonator chamber providing the only means for permitting gases to enter into and escape from the resonator chamber, and means providing a gas passageway in addition to the perforated tubes between said fourth chamber and an adjacent end chamber.

References Cited in the file of this patent

UNITED STATES PATENTS

2,138,477	Ludlow	Nov. 29, 1938
2,144,725	Manning	Jan. 24, 1939
2,235,705	Haas et al.	Mar. 18, 1941
2,357,791	Powers	Sept. 5, 1944
2,614,647	Bryant	Oct. 21, 1952
2,652,128	Cary	Sept. 15, 1953
2,655,220	Tyskewicz	Oct. 13, 1953