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McCormick

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[54] **LOW BACKPRESSURE STRAIGHT THROUGH MUFFLER**

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[52] **U.S. Cl.** ..... **181/50**, 23/288 F, 55/276, 55/DIG. 30, 55/DIG. 21, 181/42, 181/57, 181/59, 181/36 C, 181/48

[51] **Int. Cl.** **F01n 1/04**

[58] **Field of Search** ..... 23/288 F, 2 E; 55/276, DIG. 30, DIG. 21; 181/50, 42, 57, 59, 36 C, 48

[56] **References Cited**

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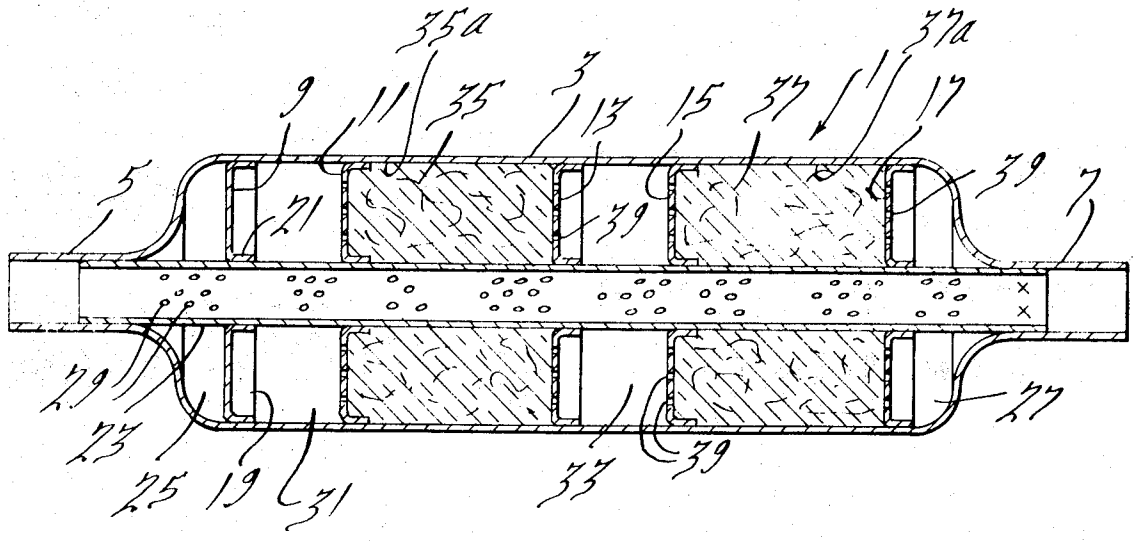
[57] **ABSTRACT**

A low backpressure, straight through type sound attenuating muffler, adapted particularly for use with internal combustion engines, comprises a series of spaced annular bodies of sound deadening material, the inner diameters of which define a gas flow path and the side faces of which define chambers within the muffler housing.

6 Claims, 4 Drawing Figures



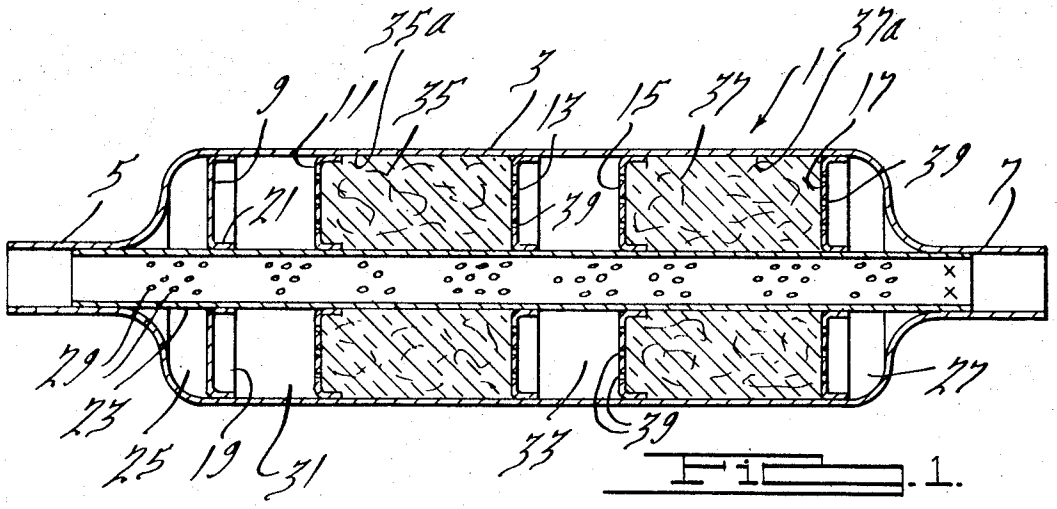


Fig. 1.

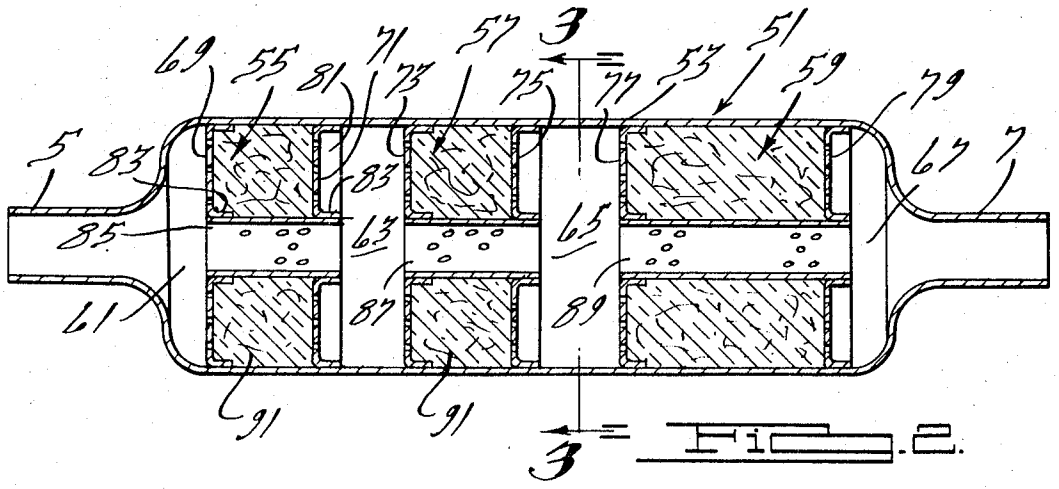
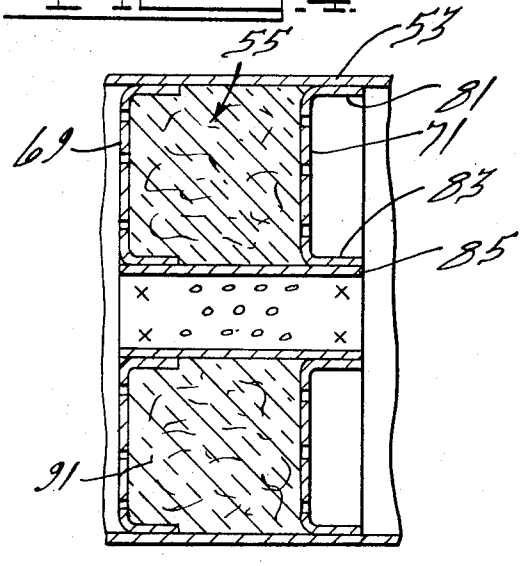


Fig. 2.

Fig. 4.



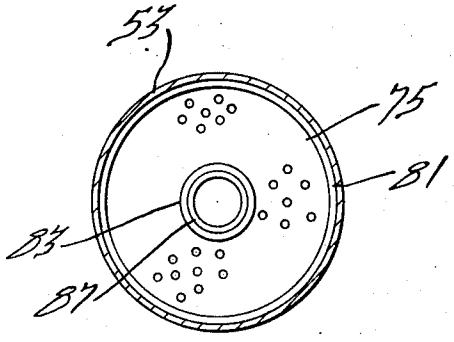


Fig. 3.

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LOW BACKPRESSURE STRAIGHT THROUGH MUFFLER

BRIEF SUMMARY OF THE INVENTION

It is the purpose of the invention to provide a low backpressure muffler that is particularly effective in removing high and medium frequency sounds and is therefore adapted particularly for use in connection with modern sports cars where certain low frequencies are permitted to pass through the exhaust system.

The invention accomplishes this by use of a plurality of annular sound absorbing bodies which are transversely spaced from each other and acoustically exposed to gas on their side faces and inner diameters. The inner diameters are aligned and define a low backpressure straight through flow path for gas.

DESCRIPTION OF THE DRAWINGS

FIG. 1 is a longitudinal cross section through a muffler containing one embodiment of the invention;

FIG. 2 is a longitudinal cross section through a muffler containing another embodiment of the invention;

FIG. 3 is a cross section along the line 3-3 of FIG. 2; and

FIG. 4 is an enlarged view of one of the sound absorbing subassemblies used in the muffler of FIG. 2.

DESCRIPTION OF THE INVENTION

The muffler 1 of FIG. 1 has an outer tubular shell 3 which is reduced in diameter at opposite ends to provide an inlet bushing 5 and an outlet bushing 7 which may be connected respectively to the exhaust pipe and a tailpipe of an exhaust system for internal combustion engines. Located inside of the shell 3 are a series of transverse partitions 9, 11, 13, 15 and 17. The partitions have outer peripheral flanges 19 which engage the inner wall surface of the shell 3, at least some of them preferably being spotwelded to the shell. The partitions also have inner peripheral flanges or necks 21 which receive and support a continuous, uniform diameter, straight through flow tube 23 which is supported at opposite ends in the bushings 5 and 7. At least some of the partitions are preferably spotwelded to the tube 23 and the tube is preferably spotwelded to one of the bushings 5 and 7.

The partition 9 and the inlet end of the shell 3 define an inlet chamber 25; while the partition 17 and the outlet end of the shell define an outlet chamber 27. Chambers 25 and 27 are empty but communicate with gas flowing through the tube 23 by virtue of the perforations 29 which run the full length of the tube within the shell 3. These perforations may be simple holes or they may be of various formations, such as louvers.

The space between the partitions 9 and 11 constitutes an empty chamber 31 in communication with the gas flowing through the tube 23; and, similarly, the space between the partitions 13 and 15 constitues an empty chamber 33 that communicates with gas flowing through the tube 23.

The space between the partitions 11 and 13 comprises a chamber 35*a* that is filled with a sound absorbent material 35 such as glass fibers, asbestos, or any particulate sound deadening material, including catalyst material capable of promoting the combustion of unburned constituents in the exhaust gas. Similarly, the space between the partitions 15 and 17 comprises a chamber 37*a* which is filled with particulate sound absorbing material 37. The chambers 35*a* and 37*a* communicate acoustically with gas flowing through the tube 23 by virtue of the perforations 29 in the tube portions within the chamber. Additionally, the partitions 11, 13, 15, and 17 are preferably perforated, as indicated by the holes 39, so that the chambers 31, 33, and 27 can communicate with the sound absorbing material 35 and 37 through the partitions.

The partition 9 is preferably imperforate. The housing 3 can be round or oval in cross section; and the chambers can be of various sizes as indicated.

In operation, gas enters the inlet bushing 5 and flows straight through the flow tube 23 to the outlet bushing 7. Pulses of gas can expand into the various side chambers 25, 31, 35*a*, 33, 37*a* and 27 as the gas flows downstream through the muffler. Furthermore, pulses of gas in the empty chambers 31, 33, and 27 can flow into the adjacent packed chambers 35*a* and 37*a*. The differential pressures in the various chambers affect the flow of gases and expansion into the respective chambers through the partitions as well as through the sidewall of the flow tube 23. The overall structure is a variety of perforations or louvers, empty chambers, and packed chambers that function to abstract sound energy from the gas and attenuate to a marked degree the intermediate and high frequencies.

In FIGS. 2 to 4, the muffler 51 has a housing or shell 53 which is reduced in diameter at each end to provide an inlet bushing 5 and an outlet bushing 7 which may be connected, respectively, to an exhaust pipe and a tailpipe of an exhaust system. The shell contains three similar annular sound deadening subassemblies 55, 57, 59 and these subdivide the space within the shell 53 into empty chambers 61, 63, 65, and 67.

The subassembly 55 has spaced perforated transverse partitions 69 and 71; the subassembly 57 has spaced perforated transverse partitions 73 and 75; and the subassembly 59 has spaced perforated transverse partitions 77 and 79. All of these partitions have outer circumferential flanges 81 whereby they are mounted inside the shell 53 and these partitions may be spotwelded to the shell to fix the position of the respective subassemblies.

The partitions 69 through 79 have inner peripheral flanges or necks 83 and these support individual gas flow tubes for each subassembly, i.e., perforated flow tubes 85, 87 and 89. The flow tubes are preferably spotwelded to the necks 83 on each of its partitions so as to fix the spacing between the partitions and provide for a fixed dimension subassembly. The space between the pair of partitions and the flow tube is filled with a particulate sound deadening material 91, and where the subassemblies 55, 57, and 59 are to be assembled outside of the housing 53 means are provided to keep the sound absorbing material in the space between the partitions and tube as by wrapping a sheet of suitable material, such as paper, around the respective partitions. Other means to facilitate handling as a subassembly may also be employed such as incorporating the sound absorbing particles in an organic binder which will burn off due to the heat of the exhaust gas.

In operation, gas entering the inlet bushing 5 can expand into chamber 61, flow through tube 85 and then expand into chamber 63, flow through tube 87 and then expand into chamber 65, flow through tube 89 and then expand into chamber 67, and then flow out through the bushing 7. Successive expansions of the gas

remove significant acoustic energy and are particularly effective in attenuating medium and low frequencies. The gas in the various expansion chambers as well as in the various tubes communicates through the perforations in the partitions and tubes with the various sound deadening bodies so that the high frequencies over a substantial spectrum are efficiently attenuated.

As indicated, the length of the various sound absorbing subassemblies **55, 57,** and **59** can vary, as can the number of holes or acoustic couplings, as may the diameter of the center gas flow tubes. The design of the muffler **51** is such as to give a low backpressure due to the straight through flow while effectively attenuating a substantial range of medium and high frequency sound.

The mufflers shown herein are especially useful in automotive exhaust systems but may also be used in other applications. Further, the invention may be incorporated in larger or more complex sound attenuating devices, and modifications may be made in the specific structures illustrated without departing from the spirit and scope of the invention.

I claim:

1. In a muffler for attenuating sound in flowing gas, a shell providing an elongated inner space having a longitudinal axis and having an inlet means for the space at one end and an outlet means for the space at the other end, a plurality of sound absorbing bodies in said space and extending transversely across said space having registering central apertures, said bodies being longitudinally separated to define empty transverse chambers in said space extending across substantially the full width of the space, perforated tube means in said central apertures defining a gas flow path through the bodies, said gas flow path passing through and communicating with said transverse chambers and with the bodies, transverse partition means in said space and engaging said shell and having central apertures in line with said gas flow path, said partition means defining said transverse chambers, said partition means comprising a plurality of transverse partitions, one of said partitions being longitudinally spaced from said bodies and being imperforate.

2. The invention as set forth in claim **1** wherein a second transverse partition acts with said one imperforate partition to define a transverse chamber, said second transverse partition being perforate and defining a longitudinal face of one of said bodies.

3. The invention as set forth in claim **1** wherein said bodies each comprise a subassembly of a pair of axially spaced annular transverse partitions and a tube secured to each of said partitions and forming a part of said gas flow path, the space between said partitions and around the tube being filled with said sound absorbing material.

4. In a muffler for attenuating sound in flowing gas, a shell providing an elongated inner space having a longitudinal axis and having an inlet means for the space at one end and an outlet means for the space at the other end, a plurality of sound absorbing bodies in said space and extending transversely across said space having registering central apertures, said bodies being longitudinally separated to define empty transverse chambers in said space extending across substantially the full width of the space, means including said central apertures forming a gas flow path passing through and communicating with said transverse chambers and with the bodies, said bodies each comprising a subassembly of a pair of axially spaced annular transverse partitions and a perforated tube affixed to each of said partitions and forming a part of said gas flow path, the space between said partitions and around the tube being filled with said sound absorbing material.

5. In a muffler for attenuating sound in flowing gas, a shell providing an elongated inner space having a longitudinal axis and having an inlet means for the space at one end and an outlet means for the space at the other end, a plurality of sound absorbing bodies in said space and extending transversely across said space having registering central apertures, said bodies being longitudinally separated to define empty transverse chambers in said space extending across substantially the full width of the space, perforated tube means in said central apertures defining a gas flow path through the bodies, said gas flow path passing through and communicating with said transverse chambers and with the bodies, transverse partitions in said space and engaging said shell and having central apertures in line with said gas flow path, said partitions defining said transverse chambers, said partitions and bodies being located to provide empty transverse chambers at the inlet and outlet ends of the gas flow path.

6. A muffler as set forth in claim **5** wherein one of said bodies is located longitudinally adjacent each end chamber and there is a perforated partition separating each said end chamber and body.

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