

United States Patent

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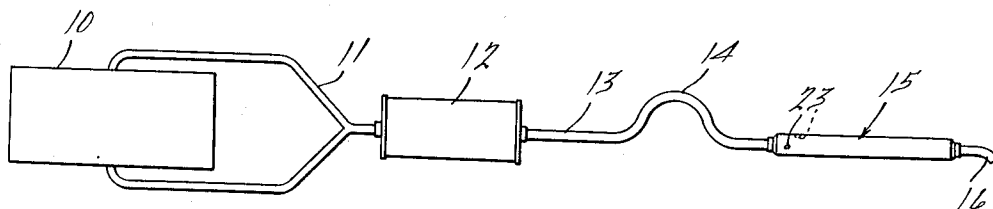
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[54] **AUTOMOBILE EXHAUST MUFFLER**
3 Claims, 3 Drawing Figs.

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F01n 1/08
 [50] Field of Search..... **181/36,**
36.2, 48, 54, 59, 64.1, 61, 62

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ABSTRACT: An upstream exhaust pipe section is spaced axially from a coaxial tailpipe section of reduced diameter to provide an annular sound wave generating or driving gap for a reflective type tuning column defined by an outer housing secured coaxially at its upstream and downstream ends respectively to the upstream section adjacent the gap and to the tailpipe section. The latter is also supported coaxially at its upstream end adjacent the gap by a sliding interference fit with inward projections from the housing that accommodate relative thermal expansion. Exhaust gases discharging axially across the annular gap from the upstream section into the tailpipe section generate in the tuning column a muffling wave of length and amplitude determined respectively by the length and cross-sectional area of the tuning column, the amplitude of the muffling wave being enhanced by the impingement of exhaust gases against the tuning column around the periphery of the reduced tailpipe section.



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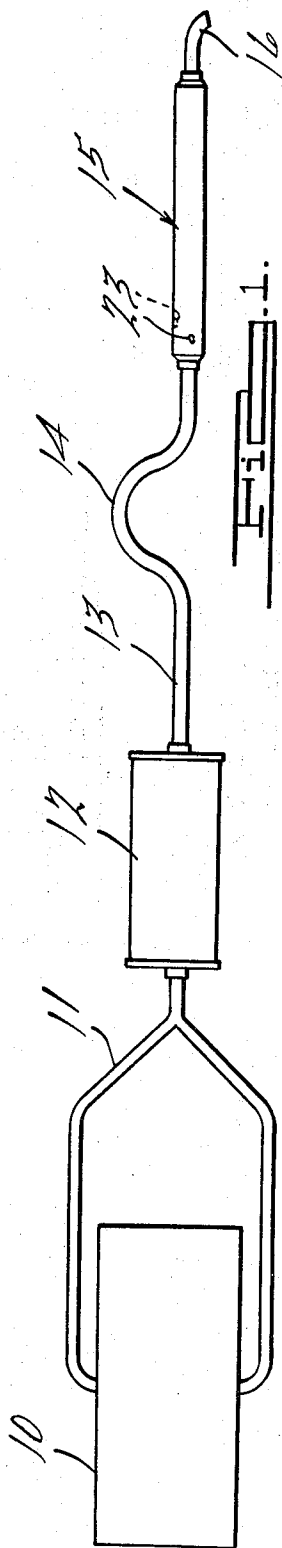


FIG. 1.

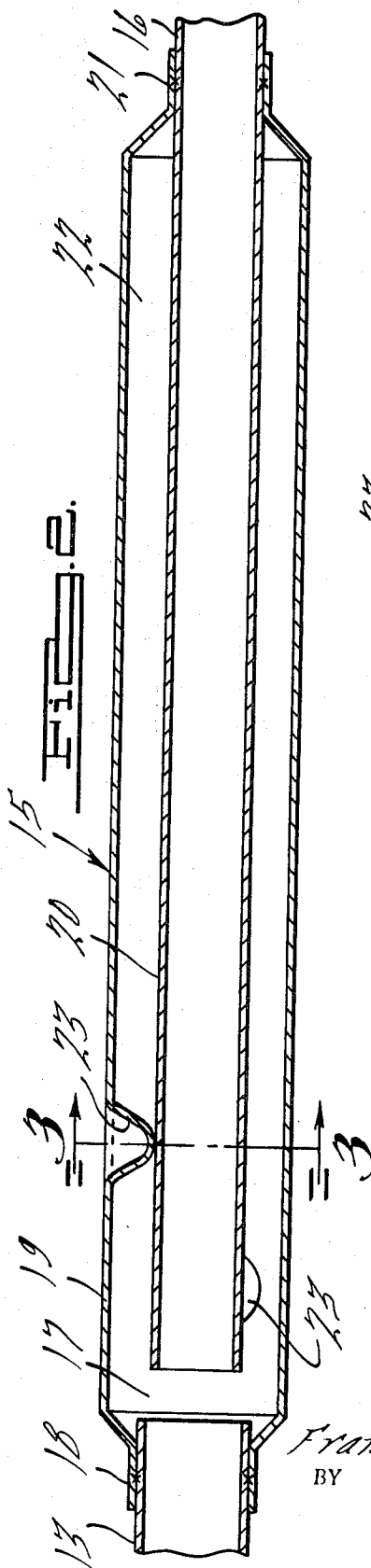


FIG. 2.

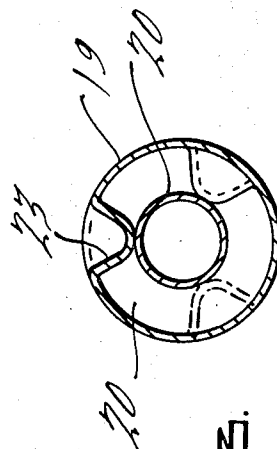


FIG. 3.

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AUTOMOBILE EXHAUST MUFFLER

BACKGROUND AND SUMMARY OF THE INVENTION

This invention relates to a muffler for the exhaust gases from an automobile engine and in particular to a rear or auxiliary muffler located downstream of the conventional primary muffler for the purpose of attenuating comparatively low frequency sounds that pass through the primary muffler. Coaxial straight-through mufflers of the general configuration disclosed herein are well known to the art, as illustrated for example in Cassel U.S. Pat. No. 3,348,629 and Hanchett U.S. Pat. No. 3,323,613.

Such mufflers however are adaptations of the Helmholtz resonator comprising a tuning neck or throat acoustically connecting the exhaust gas passage and a resonator or tuning chamber so as to dampen sound vibrations in a frequency range determined substantially by the length and diameter of the tuning neck and the volume of the tuning chamber. In order to obtain the necessary volume for the tuning chamber and at the same time minimize "shell noise" characteristic of such mufflers, especially when the same are appreciably elongated it is necessary to increase the overall diameter. With the increasing demand for a low silhouette vehicle body, the road clearance for such mufflers is not adequate for other than optimum smooth road conditions.

An object of the present invention is to provide an improved muffler of the above character wherein the customary resonator chamber is replaced by a reflective type tuning column that depends on its length rather than its volume for its muffling range, whereby the customary tuning neck is rendered unnecessary and a particularly efficient auxiliary muffler of simplified and economical construction and reduced overall diameter is achieved as compared to comparable mufflers available heretofore.

Another object is to provide such a muffler that obtains the structural advantages of the above-mentioned Cassel type muffler, including the employment of the exhaust passage as part of the muffler assembly, wherein the usual tailpipe section of the exhaust passage is spaced coaxially from an adjacent discharge end of an upstream portion of the exhaust passage to provide an annular driving or sound wave generating gap comprising the sole acoustical connection between the exhaust gases and the aforesaid tuning column.

The latter comprises an outer shell secured coaxially around the exhaust passage in sliding engagement with the tailpipe section adjacent and downstream of the driving gap to support the tailpipe section in the desired coaxial relationship. The tailpipe section is of slightly smaller diameter than the aforesaid adjacent portion of the exhaust conduit upstream of the driving gap, such that the reflective tuner is driven by direct impingement of the exhaust gases which materially increases the efficiency of the muffler. Also by virtue of the shell of the tuning column supporting the tailpipe section, and the annular driving gap spacing the tailpipe section from the adjacent upstream exhaust pipe section, the maximum effective length for the tuning column is obtained with a minimum overall muffler length with consequent economies and increased utility where length is a consideration, as for example on some compact automobiles.

Other objects of this invention will appear in the following description and appended claims, reference being had to the accompanying drawings forming a part of this specification wherein like reference characters designate corresponding parts in the several views.

FIG. 1 is a diagrammatic sketch of the automobile exhaust system embodying the present invention.

FIG. 2 is an enlarged longitudinal section through the auxiliary muffler illustrated in FIG. 1.

FIG. 3 is a transverse section taken in the direction of the arrows substantially along the lines 3-3 of FIG. 2.

It is to be understood that the invention is not limited in its application to the details of construction and arrangement of parts illustrated in the accompanying drawings, since the in-

vention is capable of other embodiments and of being practiced or carried out in various ways. Also it is to be understood that the phraseology or terminology employed herein is for the purpose of description and not of limitation.

BRIEF DESCRIPTION OF THE INVENTION

Referring to the drawings, a particular embodiment of the present invention is illustrated in FIG. 1 showing an automobile engine 10 having the V-pipe 11 extending from exhaust manifolds to a conventional muffler 12. The latter discharges through an upstream exhaust pipe section 13, over a hump 14 for the rear axle, and thence via a low frequency muffler 15 to an exhaust outlet 16.

FIG. 2 shows details of low frequency muffler 15 wherein the upstream exhaust pipe section 13 terminates at an annular sound wave generating or driving gap 17 and is welded at 18 immediately upstream of the gap 17 to a reduced flange of a coaxial tubular shell or housing 19. Downstream of the gap 17, a smaller diameter tailpipe continuation 20 of the exhaust conduit extends coaxially through the housing 19 to the outlet 16. The downstream end of the housing 19 is provided with a reduced annular flange 21 welded to the tailpipe section 20 to complete a closed "quarter-wave" tuning column 22 open only at the annular gap 17 into the exhaust gas flow. A plurality of staggered and circumferentially located dimples 23 formed in the housing 19 snugly engage the upstream end of the tailpipe 20 at a sliding interference fit to accommodate thermal expansion.

Ordinarily the conventional muffler 12 does not adequately muffle low frequency sounds so that the auxiliary low frequency muffler 15 is employed. The frequency of the sound to be muffled depends solely on the length of the tuning column 22 rather than on its volume as in the typical Helmholtz resonator. Pressure variations within a lower frequency audible sound range and traveling with the exhaust gas flow generate a damping sound or pressure waves at the gap 17 that travel the length of the tuning column and are reflected back to the gap 17 substantially out of phase with the pressure waves in the exhaust gases, thereby to dampen the amplitude of such waves in accordance with well established theory.

The sliding interference fit between the tailpipe section 20 and shell 19 avoids mechanical vibration between these members and maintains the desired coaxial alinement of the parts so that gases discharging from the periphery of the upstream exhaust pipe section 13 impinge against the upstream end of the column 22, thereby to increase the amplitude of the muffling wave generated at the gap 17 without necessitating increased cross-sectional area for the tuning column 22. In consequence a tuning column 22 of minimum cross-sectional area and outer diameter is achieved. Also the annular gap 17 opening radially into the axial column 22 achieves an overall auxiliary muffler 15 of optimum efficiency and simplicity with minimum axial and radial dimensions for a muffler of the type shown.

The cross-sectional area of the annular column 22 is on the order of magnitude of the annular area across the gap 17 and is a function of the energy or amplitude of the sound wave to be attenuated. An automobile muffler suitable for damping sound vibrations in the low frequency range of approximately 100 cycles per second or somewhat greater employs a wave generating gap 17 of approximately five-eighths of an inch in axial length and a tuning column 22 approximately 30 inches long, which will be approximately one-fourth or one-eighth of the wave length of the primary sound waves to be attenuated.

The drawings are for illustrative purposes only and are not to scale.

The overall length of the column 22 could in some instances be slightly greater than the length of a Helmholtz resonator of comparable effectiveness but in the usual instance, the added length creates no problem. On the other hand the reduced diameter achieved by the present construction and the resulting increased road clearance are major advantages over conventional auxiliary muffler constructions.

I claim:

1. In a reflective type exhaust muffler for an engine, conduit means for conducting exhaust gases from the engine and terminating in an upstream exhaust pipe section, a downstream tailpipe section extending coaxially from the terminal of said upstream section to receive exhaust gases therefrom, said tailpipe section having a forward end spaced from the terminal of said upstream section to provide an annular sound wave generating gap, an outer shell spaced coaxially from said tailpipe section a distance comparable to the length of said gap, said shell overlapping said gap and extending rearwardly therefrom, closure means connecting the forward end of said shell to said upstream section adjacent and upstream of said gap and connecting the rearward end of said shell to said tailpipe section to effect a reflective tuning column closed at its opposite ends and opening at said gap directly into the flow of said exhaust gases for attenuating sound waves of length predetermined substantially by the length and independently

of the volume of said tuning column, and cooperating means on said shell and tailpipe section for slidably supporting the forward end of the latter in coaxial spaced relationship with respect to said upstream section and shell to accommodate relative axial expansion and contraction of said tailpipe section and shell.

2. In a muffler according to claim 1, said downstream tailpipe section having an external diameter slightly less than the internal diameter of said upstream exhaust pipe section to effect direct impingement of gases discharging from said first pipe into the inner periphery of said tuning column.

3. In the combination according to claim 1, said cooperating means comprising a plurality of spaced projections extending from at least one of the members comprising said downstream tailpipe section and shell and slidably engaging the other of said members.

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