

[54] **TRANSVERSE TUNING TUBE**  
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[22] Filed: **April 29, 1971**  
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[52] **U.S. Cl.** ..... **181/54, 181/59, 181/63**  
[51] **Int. Cl.** ..... **F01n 1/04, F01n 1/08, F01n 7/18**  
[58] **Field of Search** ..... **181/48, 53, 54, 59, 61-63, 181/33 D, 47, 57, 58, 35 C**

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[57] **ABSTRACT**

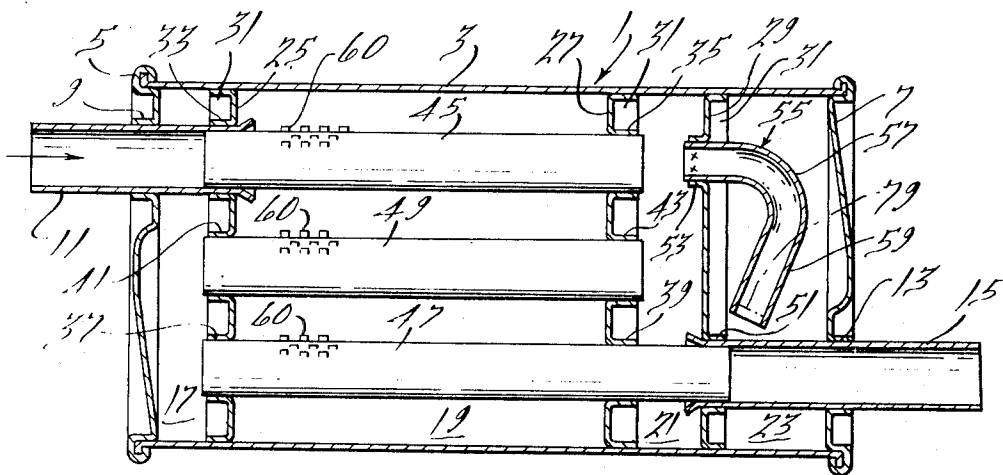
A tubular tuning tube element is attached to a transverse partition in a muffler and has a major portion of its length extending transversely of the length of the muffler inside of a tuning chamber.

[56] **References Cited**

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**4 Claims, 4 Drawing Figures**



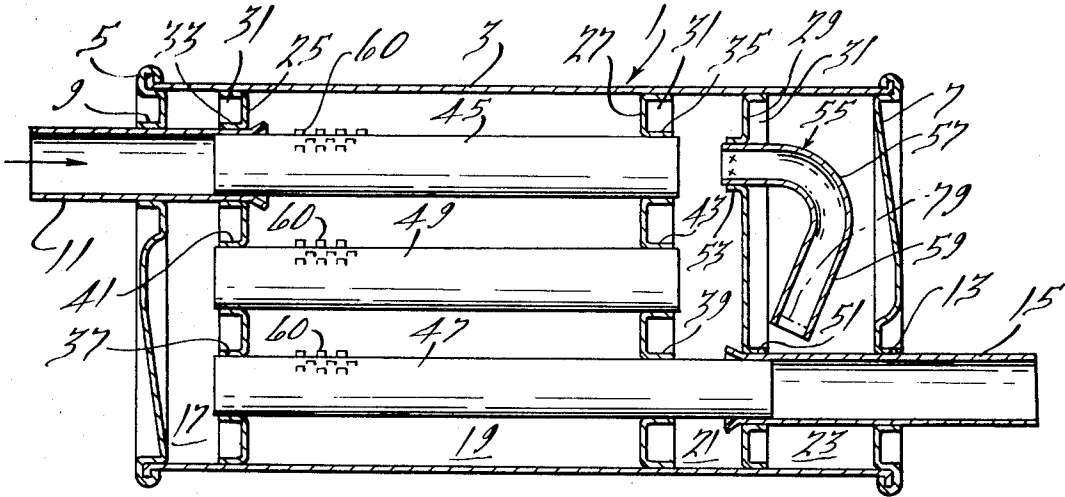


FIG. 1.

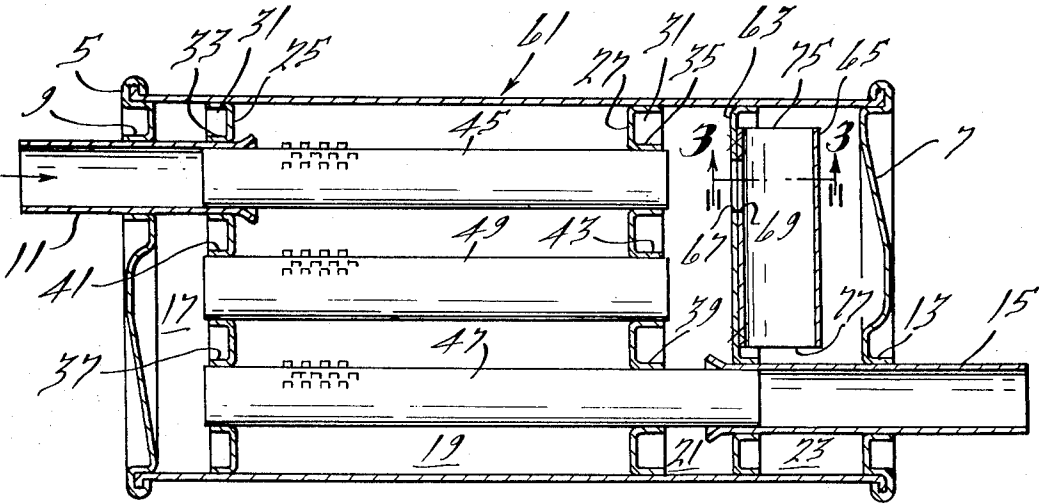


FIG. 2.

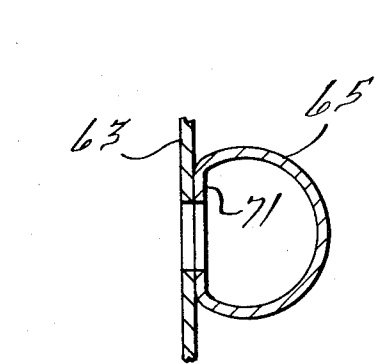


FIG. 3.

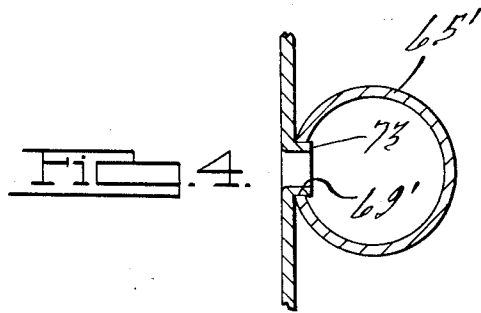


FIG. 4.

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## TRANSVERSE TUNING TUBE

## BRIEF SUMMARY OF THE INVENTION

It is the purpose of this invention to enable a relatively short tuning chamber to be used to attenuate a greater range of frequencies.

The invention accomplishes this purpose by attaching a tuning tube to one of the partitions defining the short tuning chamber and constructing the tuning tube in such a way that a substantial portion of its length extends transversely to the length of the muffler, i.e., substantially parallel to the wall of the partition.

## DESCRIPTION OF THE DRAWINGS

FIG. 1 is a longitudinal cross section through a muffler embodying one form of the invention;

FIG. 2 is a longitudinal cross section through a muffler embodying a second form of the invention;

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

FIG. 4 is a cross section similar to FIG. 3 showing a modified form of tuning tube of the type shown in FIG. 2.

## DESCRIPTION OF THE INVENTION

The muffler 1 of FIG. 1 has an elongated tubular shell 3 which may be oval or round in cross section and which is closed at its inlet end by a header 5 and at its outlet end by a header 7. The header 5 has an outwardly turned collar 9 in which is secured an inlet bushing 11; while the outlet header 7 has an outwardly turned collar 13 in which is secured an outlet bushing 15.

The space within the shell 3 is subdivided into four longitudinally adjacent chambers 17, 19, 21, and 23 by three flat transverse walls or partitions 25, 27, and 29 which have outer peripheral flanges 31 that engage the inner surface of the shell 3 and may be spotwelded to it. Partitions 25 and 27 have a first pair of outwardly extending aligned collars 33 and 35 which are aligned with the inlet collar 9 and a second pair of aligned outwardly extending collars 37 and 39 which are aligned with the outlet collar 13. Located between the two pairs of collars is a third pair of aligned collars 41 and 43. The inlet bushing 11 is supported in the collar 33 and on the inside of the inner end of the bushing 11 is supported the upstream end of a louvered inlet gas flow tube 45, its downstream end being supported in the collar 35. A louvered outlet gas flow tube 45 is supported at its upstream end in the collar 37 and adjacent the downstream end in the collar 39. The opposite ends of a louvered intermediate or return flow tube 49 are supported in the collars 41 and 43. The transverse partition 29 has an outwardly extending collar 51 which receives and supports the inner end of the outlet bushing 15 which in turn receives and supports the downstream end of the return flow tube 47.

In accordance with this invention, the partition 29 has a collar 53 that is substantially in alignment with the tube 45 and supported in it is one end of a tuning tube 55 of a desired cross sectional shape, preferably circular. The tube is inside of chamber 23 but it is within the broad purview of the invention for the tube to be in chamber 21. The tube 55 has a bend section 57 so that the outer end 59 of the tube, comprising a major

portion of its length, extends transversely of the muffler i.e., substantially parallel to the flat partition 29, and in fact angles back toward the upstream end of the muffler to a slight degree as can be seen in FIG. 1. The bent portion of the tuning tube 55 occupies space that extends transversely of the chamber 23 so that the tube can be considerably longer than if it were straight and coaxial with the collar 53. Thus, the length of the chamber 23 is minimized and the overall length of the muffler is reduced as compared with the use of a straight tuning tube. In other words, the use of the bent tube 55 makes it possible to obtain a desired tuning tube length in instances where the tuning chamber 23 is too short for the use of a conventional straight tuning tube. It is understood that the length and cross sectional area of the tube 55 and the volume of the chamber 23 are interrelated in accordance with the Helmholtz formula so that they are tuned to attenuate a desired relatively low frequency of sound associated with the gas flowing through the muffler.

In operation of the muffler 1, gas enters the inlet bushing 11 and flows through the inlet tube 45 to the chamber 21 where it reverses direction to flow backwardly through the return flow tube 49 until it reaches the chamber 17. Gas in the chamber 17 enters the outlet tube 47 and flows out of the muffler through the outlet bushing 15. The expansion and contraction of gases entering and leaving chambers 21 and 17 removes energy as does the acoustic coupling of the gas streams in the tubes 45, 47 and 49 by virtue of the perforations or louvers 60 opening into the chamber 19. As indicated, the tuning tube 55 in combination with the chamber 23 can be tuned to attenuate a frequency lower than that which will be efficiently removed by the gas flow through the other parts of the muffler.

The muffler 61 of FIG. 2 is the same as the muffler 1 except for the tuning tube and partition construction and, accordingly, the various structural features are given the same reference numerals except for the tuning tube and partition. In the muffler 61, the partition 63 corresponds to the partition 29 of the muffler 1 and the tuning tube 65 corresponds to the tuning tube 55. Aligned holes 67 and 69 are formed in the wall of the partition 63 and the wall of the tuning tube 65. As indicated in FIG. 3 the tuning tube 65 may have a flat wall portion 71 that engages and is spotwelded to the inside face of the partition so that the holes 67 and 69 register with each other. In the embodiment of FIG. 4 the tuning tube 65' has a hole 69' which fits over a collar 73 that is formed in the wall of the partition. This enables the tube 65' to be truly circular in cross section whereas the tube 65 is only substantially circular in cross section since it is flat on one face. In both cases the tubes are spotwelded in place on the partition 63. Since the holes 67 and 69 are located between the opposite open ends 75 and 77 of the tube 65 or 65' there are actually two lengths of tuning tube effective as a connection between the chamber 21 and the tuning chamber 23 so that the tube in chamber 23 may be tuned to attenuate two different frequencies in accordance with the Helmholtz formula.

In the tuning tube arrangements of the muffler 1 and the muffler 61 the tuning tubes furnish the only inlet and outlet to the chamber 23. It is apparent that the end of the tube 55 (as indicated by the line 79) and one

or both ends of the tube 65 or 65' could be closed to provide a quarter wave length tuning tube arrangement disposed within the chamber 23 or within chamber 21 if the mounting is reversed. Where the end of the tube 55 is closed and both ends of the tube 65 or 65' are closed the chamber 23 would then be made useful as a sound attenuating space by providing louvers or perforations in the bushing 15 or partition 29 or 63 and in that instance it will be effective on somewhat higher frequencies than when it is used with a length of tuning tube.

I claim:

1. A sound attenuating muffler for flowing gases comprising a housing having an inlet and an outlet, gas passage means in the housing providing a gas path connecting the inlet and outlet, transverse partition means in the housing including a substantially flat wall subdividing the space in the housing into first and second longitudinally adjacent chambers, and a tubular element in one of said chambers mounted on said wall and having a major portion of its length extending substantially parallel to said wall, said tubular element being in predetermined tuned relationship with at least one of the frequencies of sound vibration to be attenuated, said wall having an opening in it, said tubular element having a portion covering said opening and substantially coaxial with it and a bend portion connecting said coaxial portion with said major portion, the ends of said tubular element being open, said tubular element being located in said second chamber and providing the only opening connecting the chamber to the gas path, the length and area of the tubular element and the volume of the second chamber being interrelated to attenuate said one frequency.

2. A sound attenuating muffler for flowing gases comprising a housing having an inlet and an outlet, gas passage means in the housing providing a gas path connecting the inlet and outlet, transverse partition means in the housing including a substantially flat wall subdividing the space in the housing into first and second longitudinally adjacent chambers, a tubular element in one of said chambers mounted on said wall and having a major portion of its length extending substantially parallel to said wall, said tubular element being in predetermined tuned relationship with at least one of the frequencies of sound vibration to be attenuated, said wall having an opening in it, said tubular element comprising a straight tube having an axis parallel to and

spaced from the wall, one side of said tubular element having an opening in it and said side being secured to said wall so that said openings are in registry, said tubular element having a flat surface formed along its entire length to form said one side.

3. A sound attenuating muffler for flowing gases comprising a housing having an inlet and an outlet, gas passage means in the housing providing a gas path connecting the inlet and outlet, transverse partition means in the housing including a substantially flat wall subdividing the space in the housing into first and second longitudinally adjacent chambers, a tubular element in one of said chambers mounted on said wall and having a major portion of its length extending substantially parallel to said wall, said tubular element being in predetermined tuned relationship with at least one of the frequencies of sound vibration to be attenuated, said wall having an opening in it, said tubular element comprising a straight tube having an axis parallel to and spaced from the wall, one side of said tubular element having an opening in it and said side being secured to said wall so that said openings are in registry, wherein said tube opening being located intermediate the ends of the tubular element and at least one end of the element being open and the length and area of the passage between said open end and said tube opening and the volume of said second chamber being interrelated to attenuate said one frequency.

4. A sound attenuating muffler for flowing gases comprising a housing having an inlet and an outlet, gas passage means in the housing providing a gas path connecting the inlet and outlet, transverse partition means in the housing including a substantially flat wall subdividing the space in the housing into first and second longitudinally adjacent chambers, said wall having a collar therein defining an opening interconnecting the first and second chambers, a tubular element in the second of said chambers and mounted on said wall in the second chamber, said tubular element being in predetermined tuned relationship with at least one of the frequencies of sound vibration to be attenuated, said tubular element comprising a substantially straight section of a substantially round tube having an axis parallel to and spaced from the wall, one side of said tube having an opening in it fitting around said collar whereby the first chamber is connected through the collar to the inside of the tube.

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