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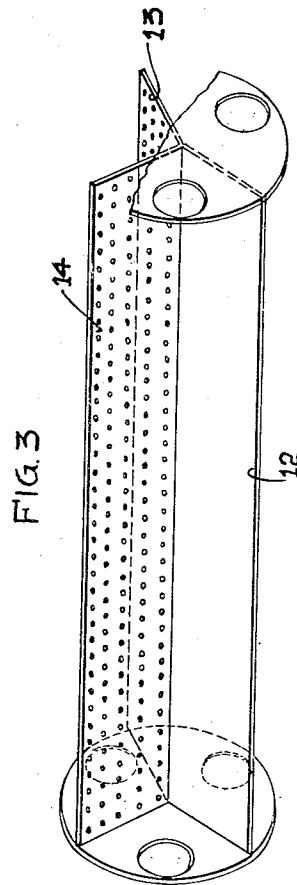
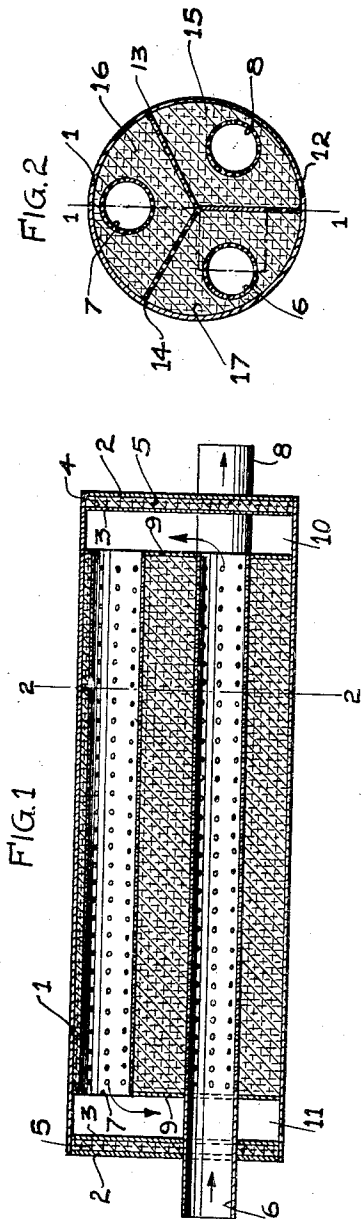
P. G. PEIK

2,009,343

MUFFLER

Filed July 30, 1932

2 Sheets-Sheet 1



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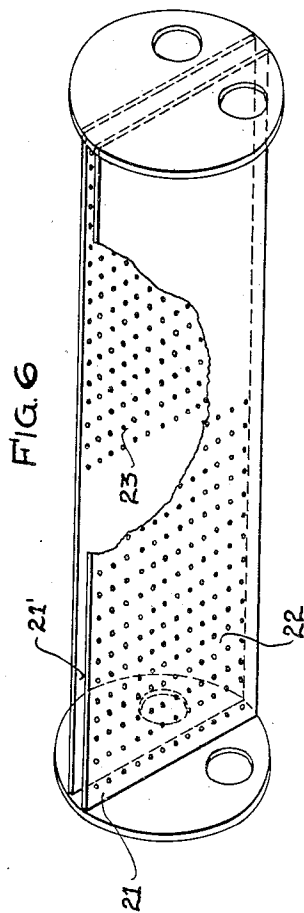
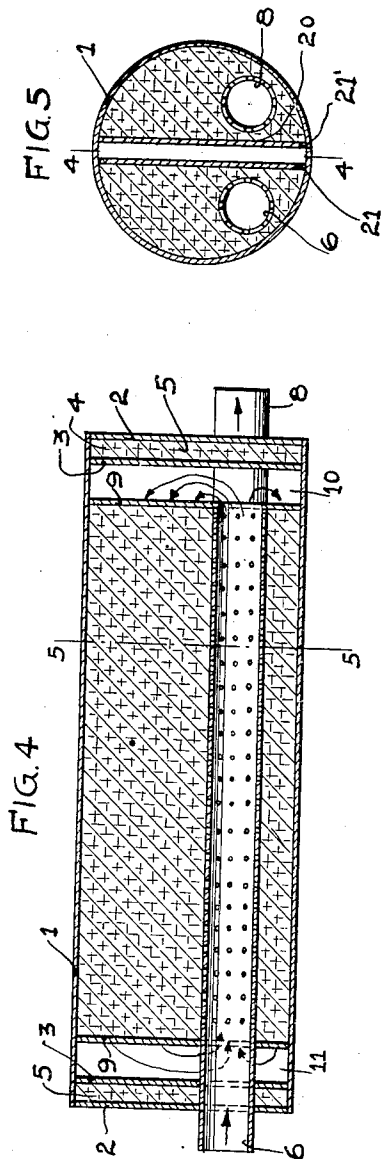
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2 Sheets-Sheet 2



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UNITED STATES PATENT OFFICE

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MUFFLER

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1 Claim. (Cl. 137—160)

My invention relates to mufflers for silencing the exhaust noise of engines, particularly internal combustion engines.

The general object of the invention is to provide a muffler having a very high degree of silencing or muffling efficiency and relatively low back pressure.

A further object of the invention is to provide a muffler in which condensation will be eliminated under all operating conditions.

Another object of the invention is the provision of a muffler capable of scavenging efficiently under all operating conditions.

A still further object of the invention is to provide an extremely compact structure adapted to occupy but very little space, particularly in its longitudinal dimension.

Other objects and advantages of the invention will be apparent as the specification is considered in connection with the accompanying drawings, in which:

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

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

Figure 3 is a perspective view of the skeleton inset supporting the tubes and subdividing the cylinder in parallel compartments;

Figure 4 is a longitudinal sectional view of a modified form of the muffler according to the invention, the section being taken on line 3—3 of Figure 5;

Figure 5 is a cross sectional view on line 5—5 of Figure 4; and

Figure 6 is a perspective view partly broken away of the skeleton inset supporting the tubes and subdividing the cylinder in parallel compartments.

Referring more particularly to the drawings, my improved muffler comprises an outer preferably cylindrical sheet metal shell 1, closed at its ends by end walls 2, also of sheet metal. Inner walls or partitions 3 slightly spaced from end walls 2 form narrow spaces 4 at the ends of the cylinder which spaces are filled with pads of foraminous sound absorbing material 5, such as expanded mica, steel wool and the like. These packed end sound absorbing spaces are not absolutely necessary to the proper functioning of the muffler, and therefore may in most instances be eliminated.

Mounted within the shell 1 are a series of parallel perforated tubes 6, 7 and 8 through which exhaust gases pass in the order named. Aper-
tured sheet metal disks 9 within and adjacent each end of cylinder 1 serve as supports for tubes 6, 7 and 8 and also form chambers 10 and 11, between said disks and the end walls of the cylinder for reversing the flow of gas. Tube 6 extends

at its intake end through end wall 2 at the intake end of the cylinder for connection with the engine exhaust, not shown, and at its other end exhausts into reverse flow chamber 10. The tube 8, communicates with chamber 11 at its inner end and exhausts through end wall 2 at the exhaust end of cylinder 1, and tube 7 supported solely by the apertured disks 9 communicates at opposite ends with the respective flow reversing chambers 10 and 11. Disks 9 are preferably of imperforate metal except where provided with openings for the tubes 6, 7 and 8. Three longitudinally extending fins 12, 13 and 14 radiating from the axial center of cylinder 1 to the outer walls thereof, divide the latter into three longitudinal compartments 15, 16 and 17, each of which accommodates one of the tubes. These compartments are packed with sound absorbing material such as used in the end spaces 4, which material occupies the space around the perforated tubes and completely fills each compartment. The fins are welded or otherwise suitably secured at their ends to the disks 9 and at their longitudinal edges to the inner face or wall of the cylinder 1. Fins 13 and 14 are perforated while fin 12 is of solid metal for reasons which will be presently explained. That portion of the tube 6 which passes through reversing chamber 11 at the front or inlet end of cylinder 1, as well as that part of tube 8 which passes through reversing chamber 10 at the rear or exhaust end of the cylinder are solid, that is the perforations formed in the remainder of these tubes are omitted.

Exhaust gases flow through tube 6, into reverse flow chamber 10 thence back through tube 7 to reverse flow chamber 11 and finally into and through tube 8 to the atmosphere. This flow is possible because tubes 6 and 8, in which the flow of gas is in the same direction, are separated from each other against direct communication by solid fin 12, whereas tube 7 has direct communication with the tubes 6 and 8 through the perforated fins 13 and 14 respectively.

The use of the perforated dividing fins is a most important feature of my invention. If these fins were solid, it would be necessary to make the diameter of the cylinder 1 much larger in order to provide compartments 15, 16 and 17 large enough for the efficient absorption of sound in the sound absorbing material packed therein. However, by virtue of these perforated fins, the impulses in the gas stream passing through any one tube are not confined to the compartment housing that tube but to the contrary are free to expand through the perforations in the fins directly into the next adjacent tube in which the flow of gases is in the opposite direction. Thus impulses in the stream of exhaust gases flow through tubes 6 and 8 in the same direction, that is from the

front to the rear of the muffler, are not free to merge directly with each other, but only indirectly through tube 7, whereas the impulses in the stream of gases flowing through tube 7 in a direction opposite to that of the flow through tubes 6 and 8, are free to merge with the latter, and vice versa. It will be noted that the gas flow in the tubes separated by the perforated fins 13 and 14 is opposite in direction in each case. This makes it possible for the high impulses in one gas stream to expand through the perforated fin into and merge with the low impulses of the gas stream passing through the adjacent tube on the opposite side of this fin, and this merging of the high and low impulses is constantly taking place throughout the entire muffler. Furthermore, as the gas streams are flowing in opposite directions the merging action is greatly multiplied and consequently an extremely high degree of muffling efficiency is attained in a muffler of very short length.

Due to the fact that the direction of flow of gases passing through tubes 6 and 8 is the same in each tube, and because the shearing or merging action previously referred to could not take place under such conditions, an imperforate fin is employed to separate these tubes from each other. If the fin 12 were perforated as in the case of fins 13 and 14, the merging efficiency between tubes 6 and 8 would be no greater than that of a conventional straight stream acoustic muffler, because in the relatively small muffler practicable with my invention any muffling effect thus attained would be neutralized by the short cut part of the gases would take from tube 6 to tube 8. However, if the dimensions of the muffler are increased any appreciable extent beyond the extreme minimum which it is possible to employ according to my invention, fin 12 may be perforated to advantage. As a matter of fact even where fin 12 is solid or imperforate as illustrated herein, an indirect merging of impulses between tubes 6 and 8 and their compartments takes place through the compartment 16 in which tube 7 is located.

The acoustic material between disks 3 and end walls 2 has a material effect on muffling efficiency and acts favorably upon the gas stream as it expands in the reversing chambers 10 and 11. However, as previously stated, the disks 3 and 4 the packing between these disks and the end walls 2 may be omitted without any noticeable effect with many engines now on the market, particularly with eight or twelve cylinder engines.

The action of the gases previously described, that is the expansion of the high gas impulses in one chamber into the low areas in the adjoining chamber and vice versa, provides the necessary expansion for efficient muffling in a muffler in which the chambers are much smaller than would be necessary in a conventional acoustic structure. It also materially reduces back pressure. Experiments with reverse stream mufflers having non perforating dividing fins show that there is a very material increase in back pressure, as compared to that of straight stream mufflers of the same capacity, due to the fact that the entire gas stream is completely reversed two times in the former structure, whereas according to my invention there is a progressive transfer of exhaust gases from the compartment

15 enclosing tube 6 to the compartment 16 of tube 7, and thence on into compartment 17 of tube 8. This transfer action more than compensates for or neutralizes the increase in back pressure set up by the two reversals of the main stream. Thus the part of the gas stream going through the reversing chambers 10 and 11 is approximately one half that which would pass through a reverse stream muffler of the nonperforated fin type, and consequently the action is equivalent to that obtained with a conventional muffler having an expansion chamber two times as large. This progressive transfer or merging of impulses also results in a highly efficient scavenging action, as the gases are not trapped inside the outer wall as is the case in mufflers of conventional acoustic structure, but are constantly passing along the inner circumference of the shell from one chamber to the next so that the entire muffler becomes hot and is maintained at a temperature above the condensation point, even in cold weather and under conditions of intermittent and slow driving.

The modified form of the invention shown in Figures 4, 5 and 6 functions in substantially the same manner as the preferred form just described. In this modification the gas passage or tube 7 of the preferred form is eliminated and the reverse gas passage 20 is formed by two spaced parallel dividing fins or plates 21 and 21' of a width equal to the diameter of shell 1 and which extends from one plate 9 to the other plate 9. The outer end of plate 21 is perforated as at 22 and the inner end of plate 21' is perforated as at 23. The exhaust gases flow outwardly or rearwardly through tube 6 thence into reverse chamber 10 and back through passage 20 to and through reverse chamber 11 into and forwardly through tube 8. It will thus be seen that communication between tubes 6 and 8 can be had only indirectly through passage 20.

Having thus described my invention, what I claim is:

A reverse stream muffler comprising an imperforate shell having end walls, plates spaced from the end walls to form reversing chambers, a perforated tube extending between said plates and communicating at opposite ends with said reversing chambers, a pair of gas communicating tubes, one of said tubes communicating at one end with one of said chambers and at its other end extending into and through the other of said reversing chambers and its end wall, and the other of said tubes communicating at one end with said last chamber and extending at its other end into and through said first chamber and its end wall, the portions of the tubes extending through the said reversing chambers being solid and the portions extending between the said plates being perforated, a plurality of fins radiating from the axis of said shell extending between said plates and forming walls between said tubes, said fins subdividing said shell into three compartments one for said perforated tube and one each for said gas tubes, the fin separating said gas tubes being solid and the fins between the perforated tube and the gas tubes being perforated, and a packing of foraminous material substantially filling said compartments.

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