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E. E. BRYANT

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EXHAUST SILENCER FOR INTERNAL-COMBUSTION ENGINES

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2 Sheets-Sheet 1

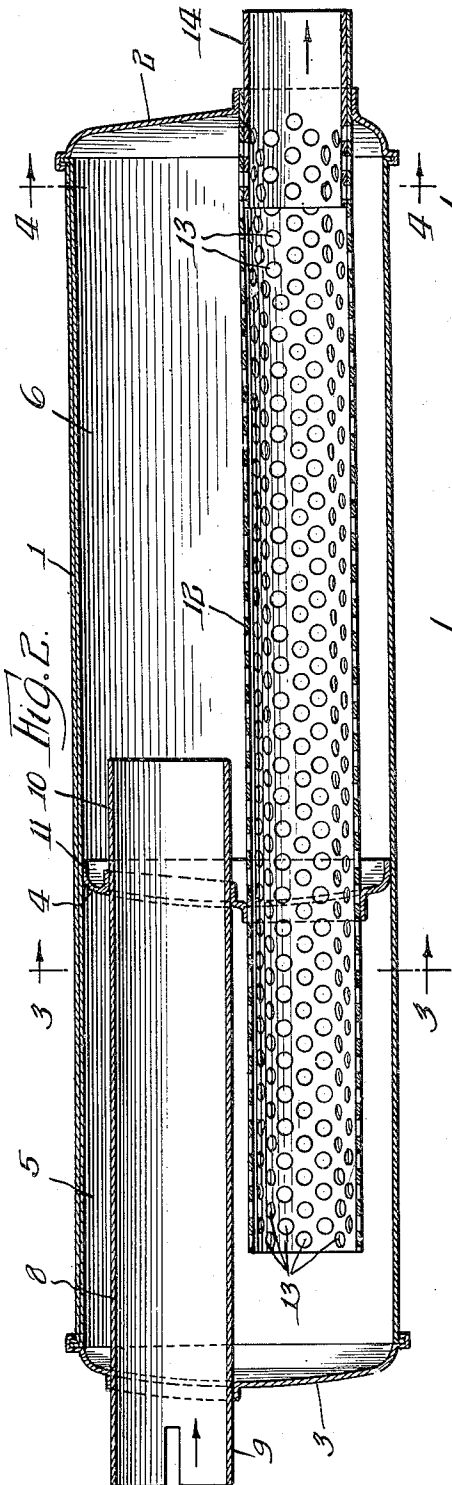


Fig. 1.

Fig. 3.

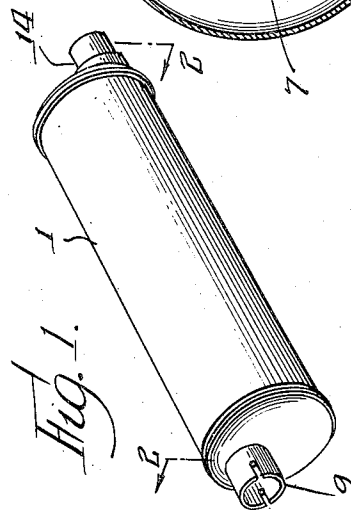
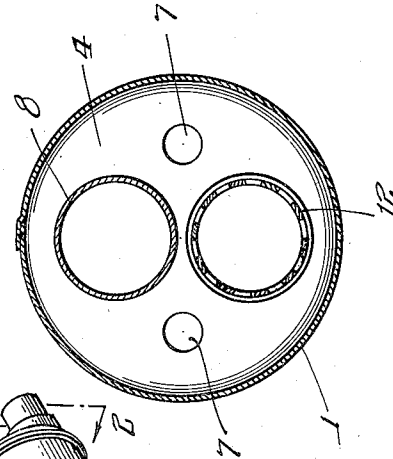
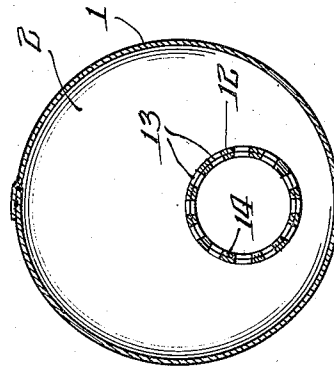


Fig. 3.



INVENTOR.
Edwin E. Bryant
BY
Moore, Olson & Tiedin
attys.

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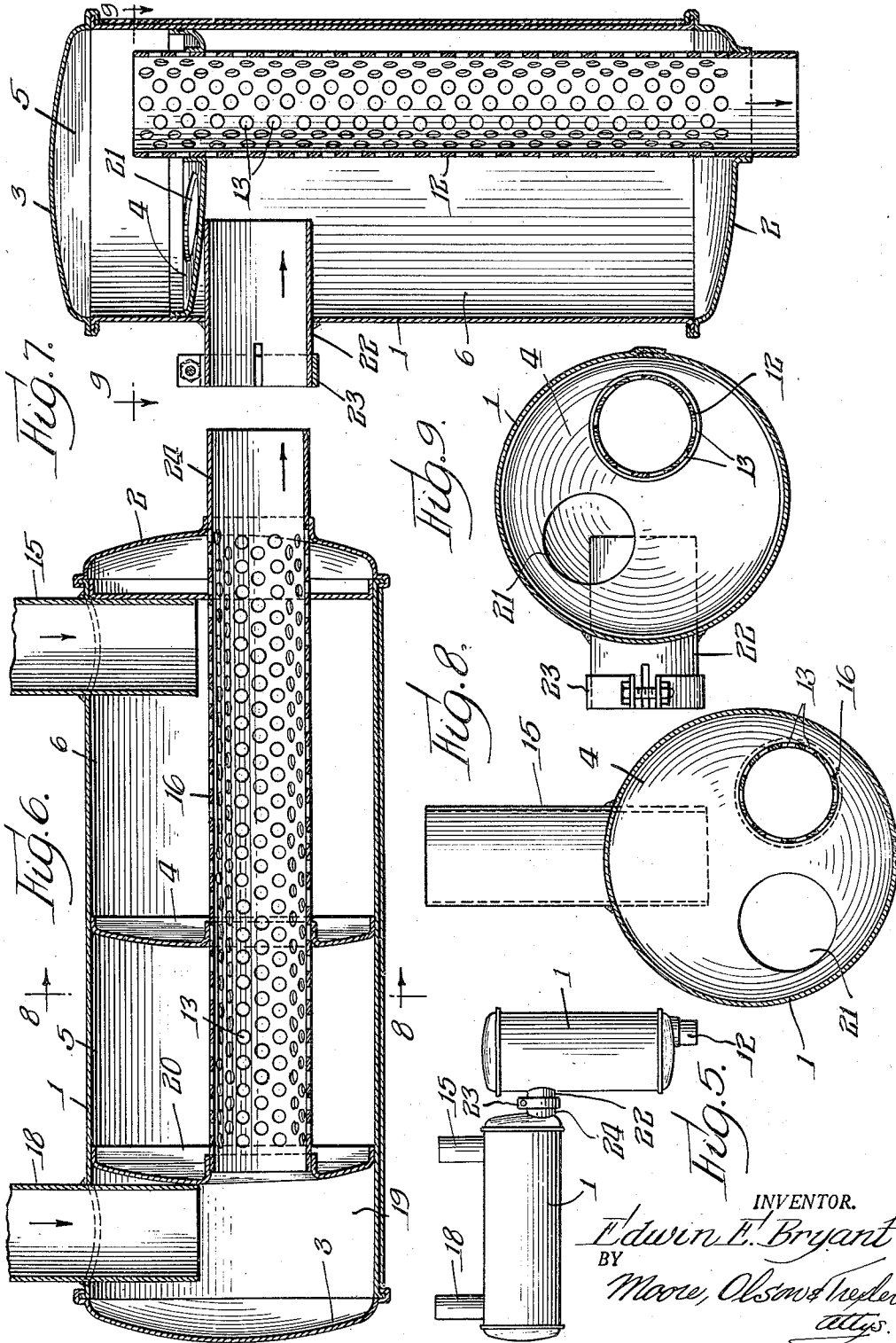
E. E. BRYANT

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EXHAUST SILENCER FOR INTERNAL-COMBUSTION ENGINES

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2 Sheets-Sheet 2



INVENTOR.

Edwin E. Bryant

BY

Moore, Olson & Hedder
attys.

UNITED STATES PATENT OFFICE

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EXHAUST SILENCER FOR INTERNAL-COMBUSTION ENGINES

Edwin E. Bryant, Stoughton, Wis., assignor to
Nelson Muffler Corporation, Stoughton, Wis., a
corporation of Wisconsin

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This invention relates to engine exhaust silencers, and more particularly to a device of improved construction and improved operating characteristics adapted to eliminate the noise from the exhaust of internal combustion engines of all types.

It is desirable in most types of internal combustion engines for maximum efficiency to keep back pressure at a minimum in the exhaust system. Mufflers which depend upon baffling and giving the exhaust gases a circuitous path following the structures of the prior art, frequently tend to increase back pressure beyond desired limits.

One object of the present invention is to provide a strongly and rigidly constructed, simple, and readily assembled silencer for the exhaust of internal combustion engines.

Another object of this invention is to provide an improved silencer which will effect a high degree of quieting with a minimum amount of back pressure.

Another object of this invention is to provide an improved muffler which is more efficient in operation, effects better heat dissipation, and produces a more effective out of phasing of the exhaust pulsations.

Still another object of this invention is to provide a construction which will minimize the danger of muffler failure due to the explosion of unburnt gases, by allowing the built up pressures under such conditions to dissipate readily.

Other and further objects of the invention will appear from the following description.

In the accompanying drawings, which form part of the instant specification and which are to be read in conjunction therewith, certain preferred structural embodiments are set forth, in which like reference numerals are used to indicate like parts in the various views.

Fig. 1 is a perspective view of the exterior of a muffler constructed in accordance with one preferred form and embodying this invention;

Fig. 2 is a longitudinal sectional view of the structure of Fig. 1 on an enlarged scale and taken along the line 2-2 thereof;

Fig. 3 is a transverse sectional view taken along the line 3-3 of Fig. 2;

Fig. 4 is a transverse sectional view taken along the line 4-4 of Fig. 2;

Fig. 5 is an exterior elevation on a small scale of a muffler assembly constructed according to this invention in a modified form;

Fig. 6 is a longitudinal sectional view of one of the elements of the combination shown in Fig. 5;

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Fig. 7 is a longitudinal sectional view of another of the elements shown in the combination of Fig. 5;

Fig. 8 is a transverse sectional view taken along the line 8-8 of Fig. 6; and

Fig. 9 is a transverse sectional view taken along the line 9-9 of Fig. 7.

In general, the present invention provides an improved arrangement of parts in a muffler structure, providing a plurality of paths of travel for the exhaust gases arranged to produce a maximum out of phasing of the exhaust pulsations with a minimum of back pressure. The several paths of travel are of different length and are so arranged relative to each other that an effective interference of both sound and pressure waves will result.

More particularly stated, the exhaust gases are first introduced into a relatively large chamber, and then dissipated and divided for travel along a plurality of paths, the flow along at least one of said paths then being further divided and dissipated in a manner so as to effect out of phasing. The means providing the plurality of paths of travel for the exhaust gases are also of large area so that a minimum increase of back pressure is obtained, the travel paths being unobstructed to allow the ready dissipation of the exhaust pressures and prevent the building up of back pressure within the muffler structure.

The invention further provides an arrangement of parts for effecting a maximum reduction and dissipation of heat.

The exhaust gases may be discharged into the muffler chamber parallel to the axis thereof, or at right angles to the axis thereof, and if desired a plurality of mufflers embodying the invention may be connected in series.

More particularly, referring now to the drawings, Figs. 1-4, a shell 1 of any suitable construction is provided with a pair of end walls 2 and 3. Within the shell there is provided a partition 4 dividing the space within the shell 1 into two chambers 5 and 6 of unequal size. A plurality of openings 7 are provided in the partition 4 so that communication exists between the chambers 5 and 6.

The exhaust gases are discharged into the larger chamber 6 through an imperforate inlet pipe 8, the exhaust being delivered to the outer end 9 of the pipe 8 from the engine. The inner end 10 of the pipe 8 discharges into the large chamber 6. It will be observed that the inlet pipe 8, passing between end partition 3 and partition 4, strengthens the assembly and acts as a support

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for partition 4 which is tack welded or otherwise fastened to the shell 1 by means of a flange portion 11. Also, the partition 4 firmly holds the tube 8, acting with the end wall 3 to provide a firm and strong and vibration resistant mounting for the tube.

Extending from partition 2 through partition 4 into the smaller chamber 5, there is provided a perforated tube 12 having a large number of perforations 13. The tube 12 is connected with a tube 14 which passes to the atmosphere or connects with a pipe leading to atmosphere.

It will be observed that the pipe 12 is rigidly supported by the partition 2 and the partition 4, a strong tube support thus being provided. Tube 12 also cooperates with the pipe 8 to strengthen the assembly. There is thus provided by the construction a very rigid assembly which is resistant to vibration. The tube 8 may be made of relatively thick and special heat resisting metal if necessary or desired. It will be seen that the general construction provides a very large area for heat radiation and a large chamber for expansion cooling so that the exhaust gases may be cooled as they expand directly into the large chamber 6 from the inlet tube 8.

The original pulse is discharged from pipe 8 into chamber 6 which communicates through holes 7 with the chamber of different size 5, the size of the chambers 5 and 6 and the communicating means 7 being such that maximum dissonance is obtained. Some of the exhaust gas will pass from chamber 6 to chamber 5 whereas other portions of the gas will pass directly from chamber 6 to the interior of the perforated tube 12 through the openings 13. Some of the exhaust gases entering chamber 5 will likewise pass directly into the tube 12 through the openings 13 within chamber 5, whereas other gases will pass into the tube end, and may also react against the end wall 3. In this manner a large number of paths of different lengths of travel for the exhaust gases are provided, the paths being arranged to cause cancellation of the pulses by the difference in the phase relationships.

The sum of the area of the perforations 13 may be larger than the cross-sectional area of the pipe 10. This reduces back pressure of the muffler to a minimum and contributes to the efficiency of the structure. Similarly, there is a large vent area in the event of explosion of unburned gases, which tends to reduce possibility of rupture to the muffler. Then, too, the balancing of pressures on both sides of the partition 4 likewise minimizes the possibility of damage from explosion.

Referring now to Fig. 6, it will be observed that the same basic principles present in the construction just described are provided. The exhaust gases are introduced into the larger chamber 6 through a pipe 15 which extends at right angles to a perforated pipe 16. The exhaust is also introduced through pipe 18 into a chamber 19 formed by an imperforate partition 20 and the end partition 3. The partition 4 which divides the shell 1 into the larger chamber 6 and the smaller chamber 5 is provided in this instance with a large opening 21 instead of a plurality of smaller openings 7. The same principles governing a plurality of paths of differing lengths to the outlet pipe 16 are provided in order to produce varying phase relations in the sound waves and pressure pulsations which thus tend to cancel each other and produce a minimum of sound as well as a slowing down of the velocity of the gas

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pulsations. The two chambers 5 and 6 produce a maximum dissonance. Again a minimum of back pressure is presented and the principles heretofore discussed apply.

In Fig. 7 there is shown a muffler substantially the same as that shown in Fig. 2 with the exception that the exhaust gases are introduced through pipe 22 into the larger chamber 6 at right angles to the axis of the muffler. Then, too, a large opening 21 is provided in the partition 4 instead of a plurality of smaller openings 7 such as shown in Fig. 2. There is a greater difference in size between the small chamber 5 and the large chamber 6. The optimum positioning of the partition 4 which determines the relative sizes of the small chamber and the large chamber depends upon the type of internal combustion engine which is being muffled.

In order to get even more complete muting, two of the mufflers of this invention may be connected in series. This is shown by Fig. 5 in which the two mufflers of Figs. 6 and 7 having side introduction of exhaust gases are connected in series by means of a clamp 23, the end 24 of perforated pipe 16 being adapted to telescope within pipe 22.

It will be seen that the invention accomplishes its objects, due to the fact that there are multiple paths of travel for the gases so arranged as to cause controlled interference between both the sound and gas pressure waves, reducing their intensity. In this connection it will be understood that the size and number of the openings in the central partition plate may be varied in accordance with the proportioning of the cooperative parts, whereby to produce the desired results.

The different impedances of the various paths of travel for the gases produce out of phasing, but without physical restriction of the gases in their movements, whereby to minimize back pressure and also minimize the danger of damage to the structure in the event of explosion.

The inlet of the exhaust gases into a large expansion chamber effects a substantial temperature drop in the gases and a structure which effects ready heat dissipation. The structure is simple and easy to assemble, yet rigid and strong throughout.

The use of the plurality of chambers of different size, separated by a partition having openings therethrough of controlled size, and in combination with a perforated exhaust tubing results in the interference of the sound and pressure waves, as stated, reducing the intensity and velocity of the gas pulsations at the muffler outlet.

It will be understood that certain features and sub-combinations of the structures set forth are of utility and may be employed without reference to other features and sub-combinations. This is contemplated by and is within the scope of the claims. It is further obvious that various changes may be made in details within the scope of the claims without departing from the spirit of the invention. It is, therefore, to be understood that this invention is not to be limited to the specific details shown and described.

The invention is hereby claimed as follows:

1. An exhaust silencer comprising an elongated tubular shell closed at its opposite ends, a transverse partition within the shell dividing the shell into a plurality of longitudinally spaced chambers, said partition being perforated to provide gas passage means therethrough of predetermined size, an inlet pipe extending through the

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inlet end of the shell and through said partition and having an open end exhausting into the chamber adjacent the exhaust end of the shell, an exhaust pipe extending through the exhaust end of the shell and through said partition and having an open end opening into the chamber adjacent the inlet end of the shell, said exhaust pipe being perforated along its length within both said chambers, said pipes and said perforated partition comprising the complete gas transfer means within the shell.

2. An exhaust silencer comprising a tubular shell closed at its opposite ends, a transverse partition within the shell dividing the shell into a plurality of longitudinally spaced chambers, said partition being perforated to provide gas passage means therethrough, an inlet pipe extending through one end of the shell and through said partition, said pipe having an imperforate peripheral wall and an open end exhausting into the chamber adjacent the end of the shell opposite the inlet to the shell, an exhaust pipe extending through said opposite end of the shell and through said partition, said exhaust pipe having an open end opening into the chamber adjacent the inlet of said shell and being perforated along its length within both of said chambers, said pipes and said perforated partition comprising the complete gas transfer means within the shell.

3. An exhaust silencer as in claim 2 in which the chamber adjacent the inlet to said shell is smaller than the chamber adjacent the outlet of said shell.

4. An exhaust silencer comprising an elongated tubular shell closed at its opposite ends, a transverse partition within the shell and dividing the same into a plurality of longitudinally spaced chambers, said partition being perforated to provide gas passage means therethrough of predetermined size, an exhaust pipe extending through the exhaust end of the shell and through said partition and having an open end opening into the chamber adjacent the inlet end of the shell,

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said exhaust pipe being perforated along its length within both said chambers, an imperforate inlet pipe having its inner open end exhausting into the chamber adjacent the exhaust end of the shell and providing with said exhaust pipe and said perforated partition a complete gas transfer means within the shell.

5. An exhaust silencer as claimed in claim 4, wherein there is provided a second partition subdividing the chamber remote from the exhaust end of the shell and wherein said perforated exhaust pipe opens through said second partition into the adjacent end subdivision of the subdivided chamber.

6. An exhaust silencer as claimed in claim 5, wherein conduit means are provided for introducing a portion of the gases to be silenced into the said end subdivision of the subdivided chamber.

7. An exhaust silencer as claimed in claim 6, wherein the conduit means is disposed at substantially right angles to the axis of the exhaust pipe.

8. An exhaust silencer as claimed in claim 4, wherein the inlet pipe is disposed at substantially right angles to the axis of the exhaust pipe.

EDWIN E. BRYANT.

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