

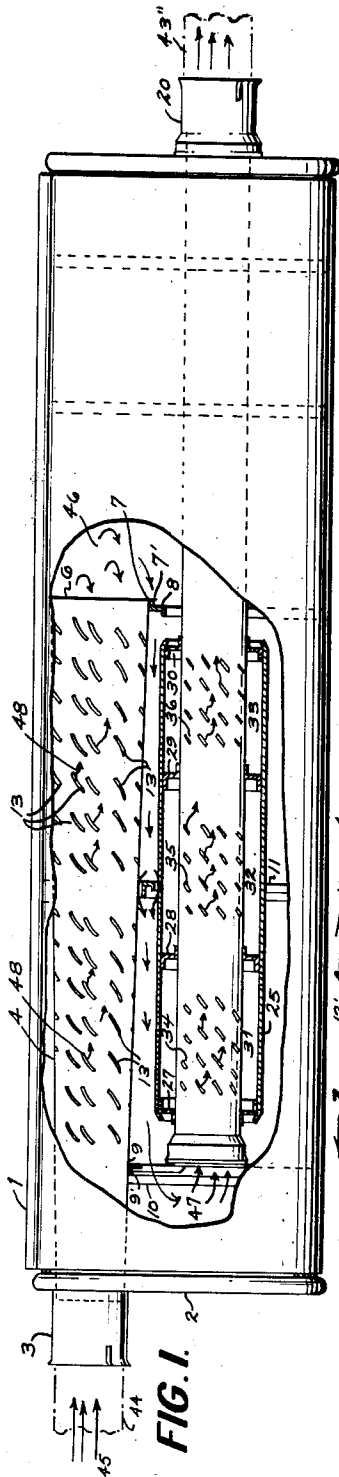
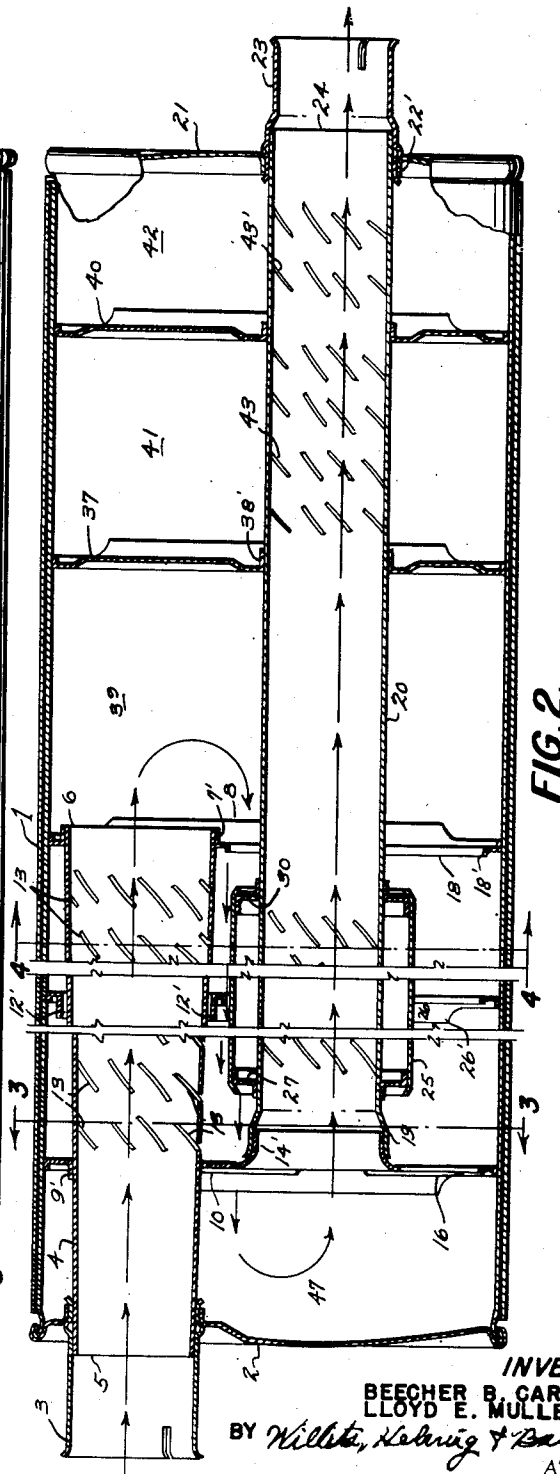
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B. B. CARY ET AL
RETROVERTED FLOW MUFFLER

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2 Sheets-Sheet 1



INVENTORS
BEECHER B. CARY
LLOYD E. MULLER
BY *Willems, Kohnig & Daiblin*
ATTORNEY

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B. B. CARY ET AL

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FIG.3.

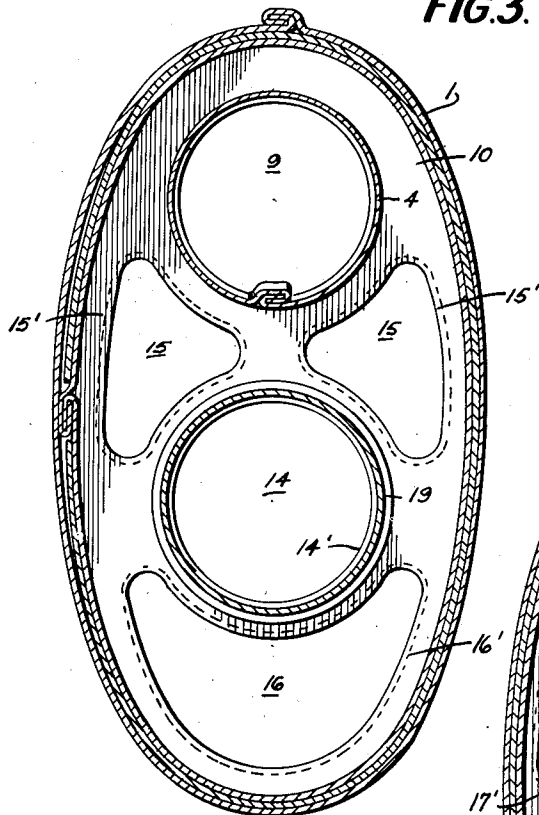


FIG. 4.

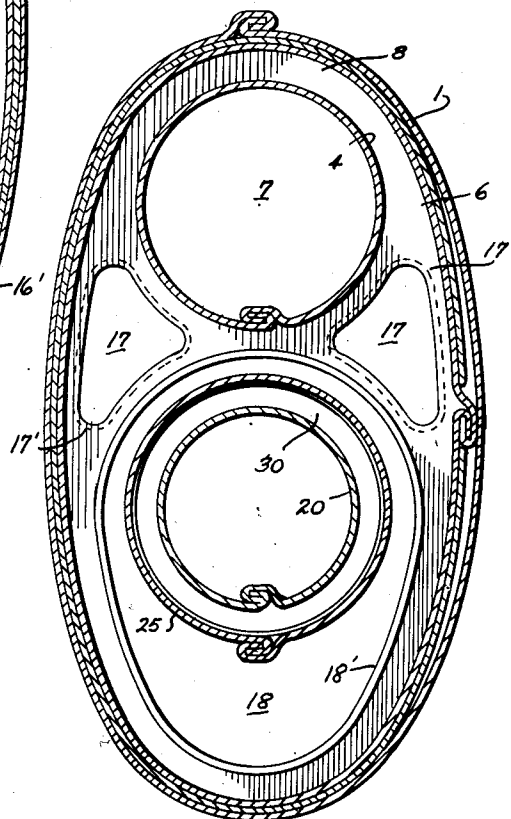
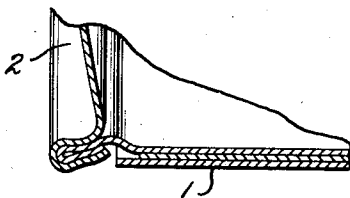


FIG. 5.



INVENTORS
BEECHER B. GARY
LLOYD E. MULLER

BY *Willits, Helmig & Baillet*

ATTORNEY

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2,800,973

RETROVERTED FLOW MUFFLER

Beecher B. Cary, Rocky River, Ohio, and Lloyd E. Muller, Flint, Mich.; said Muller assignor to General Motors Corporation, Detroit, Mich., a corporation of Delaware

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4 Claims. (Cl. 181—57)

This invention relates to sound attenuation apparatus and more particularly to mufflers for the exhaust gases of internal combustion engines.

It is a primary consideration in the construction of mufflers for automotive vehicles to reduce to a minimum the power loss incident to the sound attenuation of the exhaust gases prior to discharge to the atmosphere.

Accordingly it is an object of this invention to provide a muffler which dissipates a minimum amount of power and yet provides a maximum effectiveness of sound attenuation and to accomplish this object without imposing limitations upon the external structural design or the type of internal sound attenuation structure employed.

It is a particular object to provide a muffler of the retroverted gas flow type in which the energy loss incident to the reversal of the direction of flow is minimized.

A further object is to provide a muffler in which the gas velocity is converted into static pressure which aids in the discharge of the exhaust gases through the remainder of the system.

A further object is to provide a muffler in which the velocity of the exhaust gas is reduced smoothly without turbulence.

These and other objects will appear more fully hereinafter. The manner of accomplishment is set forth in the description which follows together with the accompanying drawings in which:

Figure 1 is a plan view of a muffler embodying the invention in which a portion of the outer casing is cut away to reveal the internal structure.

Figure 2 is a foreshortened sectional view of the muffler showing in plan the internal structure.

Figure 3 is a sectional view taken transversely to the longitudinal axis of the device as indicated by the arrows 3—3 on Figure 2.

Figure 4 is a sectional view similarly taken at arrows 4—4 as indicated on Figure 2.

Figure 5 is a cutaway sectional view showing a detail of construction of the outer casing and end header.

According to the present invention, the inlet passage of the retroverted flow type of muffler is provided with a gradually increasing cross sectional area in the direction of gas flow. This construction permits the reduction of exhaust gas velocity without turbulence and, as a result of the decreased velocity, less kinetic energy is lost in reversing the gas flow. In addition the velocity head is converted to static head within the outer casing, and this static head is available to force the gas through the rest of the exhaust system.

Referring now to the drawings and particularly to Figures 1 and 2, the muffler structure includes an outer casing 1 which may be of the multiple layer type as illustrated and formed in oval or elliptically shaped cross section. Such external configuration requires a minimum of clearance and yet has desirable structural properties. The casing 1 is provided at the inlet end with an end header 2.

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The header 2 is secured to the casing 1 by any suitable means; for example, by crimping a peripheral double walled flange of the end header over an extension of the inner layer of casing 1 which is doubled upon itself.

5 This detail of construction is illustrated in Figure 5.

The housing structure thus far described encloses the attenuating system which embodies the present invention. The end header 2 is provided with a suitable opening offset from the central longitudinal axis of the casing for the reception of an inlet tube 3. The inner end of the inlet tube 3 is flared to receive in close supporting engagement, as by telescoping, the inlet conduit or casing 4 at its outer end 5. The inlet conduit 4 extends a substantial distance into the casing 1 and is received in supporting engagement adjacent its discharge end 6 by a flared edge 7' of an opening 7 in header 8. Intermediate its ends the inlet conduit 4 passes through an opening 9 in header 10 and is received thereby in close supporting relation by a flange 9' surrounding the opening, the openings in headers 8 and 10 being in alignment.

The inlet conduit 4 is tapered throughout its length to provide a cross sectional area which gradually increases from its outer end 5 to its discharge end 6. Intermediate the headers 8 and 10 is provided a third header 11 through which the inlet conduit 4 passes with a clearance between it and the flared edge 12' surrounding the opening 12. A plurality of perforations or louvers 13 are provided in the wall of conduit 4 between the headers 10 and 11, and between the headers 8 and 11.

Referring now to Figure 3 it will be seen that the header 10 having the axial flange 9' is of elliptical shape. It is fitted transversely in close engagement with the interior of the casing 1. The opening 9 is disposed on the major axis of, but offset above the center of the header. A similar circular opening 14 defined by axial flange 14' is likewise disposed on the major axis with its center positioned below the elliptical center. A pair of somewhat triangularly shaped openings 15 surrounded by flanges 15' are provided, one on each side of the major axis. Below the opening 14 is another opening 16 of suitable shape and of substantial area defined by flange 16'.

In Figure 4 the structure of the header 8 is illustrated to be similar to header 10 and has the circular opening 7 disposed above-center and provided with the adjacent pair of openings 17 defined by flanges 17'. An enlarged opening 18 surrounded by flanged edge 18' of ovoid shape is disposed in the lower portion of the elliptical header. The intermediate header 11 is similar to header 8 in that it has an upper circular opening 12 described by the flange 12' and a lower enlarged opening 26 defined by flanged edge 26'.

Referring again to Figure 2, it will be seen that the exterior of flange 14' around opening 14 in the header 10 receives the bell mouth end 19 of outlet conduit 20 in close supporting engagement. The conduit 20 extends from header 10 to an end header 21, and is disposed in lateral juxtaposition to conduit 4 to provide overlap of a substantial portion of the lengths of conduits 4 and 20 at the inlet end of casing 1. The end header 21 may be of the same construction as end header 2 and may be similarly secured to casing 1. The opening 22 in header 21 defined by flange 22' is in axial alignment with the opening 14 in the header 10. An outlet tube 23 having a bell mouth is received within flange 22' and suitably secured as by flaring the edge of the bell mouth. The discharge end 24 of conduit 20 is mounted in the bell mouth of outlet tube 23.

70 An outer tubular member 25 is mounted in coaxial relation with conduit 20 and extends thereover from the inlet bell mouth 19 through the opening 26 of header 11

to a point adjacent header 8. The conduit 20 is surrounded by axially disposed baffles 27, 28, 29 and 30. The baffles 27 and 28 define a resonating chamber 31 between tubes 20 and 25. Similarly, baffles 28 and 29 define a chamber 32, and baffles 29 and 30 define a chamber 33. The interior of conduit 20 communicates with chamber 31 through a plurality of perforations or louvers 34. Likewise conduit 20 communicates with chamber 32 through perforations 35 and with chamber 33 through perforations 36.

Intermediate the header 8 and the discharge end header 21 is positioned a transverse baffle 37 which is provided with an opening 38 surrounded by flange 38' to receive conduit 20 and suitably positioned to define an expansion chamber 39 generally included between baffle 37 and end header 2. A similar baffle 40 is disposed between baffle 37 and the end header 21 and defines resonating chambers 41 and 42. The interior of the conduit 20 communicates with chamber 41 through a plurality of perforations 43 and with chamber 42 through perforations 43'.

Viewed in its entirety as in Figures 1 and 2, it will now be apparent that the inlet conduit 4 discharges into expansion chamber 39. Outlet conduit 20 communicates with the expansion chamber 39 and with a series of resonating chambers 31, 32 and 33 suitably proportioned for the higher range of frequencies of acoustic energy, and 41 and 42 designed for a lower frequency range. Outlet conduit 20 may communicate with the atmosphere either directly or through a tail pipe 43'.

In the acoustic train each resonating chamber is adapted to damp out a predetermined frequency or frequency band of the acoustic energy accompanying the exhaust gas discharge. The tuning to the desired range is accomplished by suitable dimensioning and proportioning of the particular resonant chamber. The principle of operation of such an acoustic train is well understood in the art and the design may be varied within wide limits or equivalent acoustic energy damping devices may be substituted. In one embodiment of the invention the component parts were dimensioned as follows:

	Inches
Casing length.....	35
Elliptical cross section, major axis.....	9 1/4
Elliptical cross section, minor axis.....	5
Tapered inlet conduit length.....	20 3/4
Tapered inlet conduit outer end diameter.....	2 1/2
Tapered inlet conduit inner end diameter.....	3
Outlet conduit length.....	31 1/4
Coaxial tube, diameter.....	3 1/2
Chamber 31, length.....	4 1/2
Outlet conduit, diameter.....	2 1/2
Chamber 32, length.....	5
Chamber 33, length.....	4 3/4
Chamber 41, length.....	4 3/4
Chamber 42, length.....	3 3/4

It is to be understood that these dimensions are given for the purpose of illustration only and are not to be construed as a limitation.

In operation the exhaust gases from the engine are fed to inlet tube 3 from an exhaust pipe 44, the flow being represented by arrows 45. The gases enter tapered inlet conduit 4 and since the gas velocity will be inversely proportional to the cross sectional area, neglecting leakage, the gas velocity is gradually reduced as the flow progresses through the conduit 4. The gradual taper prevents turbulence and permits smooth flow. The portion of the flow 46 which emerges from the conduit 4 at end 6 must reverse its flow direction in order to reach the mouth 19 of the outlet conduit 20 as indicated by the flow path 47. This reversal of flow direction dissipates kinetic energy of the moving gas, but since the flow velocity has been reduced, less energy is lost in making the reversal than would otherwise be the case.

A portion of the incoming gas passes through perfora-

tions 13 in the wall of conduit 4 as indicated by arrows 48. Since the velocity head of the gas in conduit 4 is converted into static head as the flow proceeds, this static head forces an increased flow through the perforations 13 and thus reduces the quantity of gas required to make a reversal beyond the inner end of conduit 4. The static head developed from the velocity change is also available to force the gas through the remainder of the acoustic train.

The advantages achieved by the instant invention will be readily appreciated by those skilled in the art. Increased muffler efficiency is realized by reducing the energy loss without impairing the effectiveness of sound attenuation. Although the exemplary embodiment includes an elliptical casing and a particular attenuating system beyond the inlet conduit, it will be recognized that the invention may be embodied in other and conventional muffler structures. Many modifications and equivalents will occur to those skilled in the art and the illustrative embodiment is in no sense to be construed as a limitation. For a definition of the invention reference is to be had to the appended claims.

We claim:

1. In a sound attenuating apparatus of the retroverted flow type including a muffler housing having first and second end members means within said housing defining an expansion chamber, an inlet conduit which receives a gas flow at one end adjacent said first member and extends longitudinally into said housing terminating in an axial discharge opening in said expansion chamber, an outlet conduit having an intake mouth which receives said gas flow and disposed in said expansion chamber, said outlet conduit being disposed with its intake mouth longitudinally spaced from said discharge end and in spaced lateral juxtaposition to said inlet conduit and extending through said second member, means for supporting said conduits within said housing, said inlet conduit having a perforate wall defining lateral discharge openings distributed substantially throughout its length within the expansion chamber, said inlet conduit also having a cross sectional area which gradually and continuously increases in the direction of gas flow, and sound attenuation structure within said housing through which said gas flow passes at a reduced flow velocity by virtue of said increase in cross sectional area from said discharge end and said perforate wall to said intake mouth.

2. A muffler comprising a flattened elongated housing having a gas flow inlet at one end and a gas flow outlet at the other, a plurality of spaced supports in said housing, a perforated inlet conduit mounted in certain of said supports and laterally disposed in said housing, said inlet conduit terminating in an axial discharge mouth and having a gradually and continuously increasing cross section in the direction of gas flow into said housing whereby said gas flow undergoes a change to a reduced velocity and to an increased pressure, a perforated outlet conduit mounted in certain of said supports laterally of said inlet conduit and extending beyond the inner end of said inlet conduit to provide a substantial overlap between said conduits requiring a reversal of said gas flow at said reduced velocity, and sound attenuating chambers in said housing, said perforated conduits for conducting said gas flow at said increased pressure into the said chambers in such manner as to absorb undesired frequency components of the sound accompanying the gas flowing through said housing.

3. In a muffler for the internal combustion engine exhaust gases of an automotive vehicle, an elongated casing closed by an inlet end header and an outlet end header, a plurality of intermediate headers in said casing defining an expansion chamber and sound attenuation chambers, an outlet conduit supported by certain of said headers extending into said casing through said outlet end header and terminating in an intake mouth in said expansion chamber adjacent said inlet end header,

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an inlet conduit supported in certain of said headers extending into said casing through said inlet end header and terminating axially in a first discharge opening in said expansion chamber beyond said intake mouth, said inlet conduit having a perforate wall within said expansion chamber and providing a second discharge opening, means supplying said gases to said inlet conduit, said expansion chamber constituting a gas flow connection between said first and second discharge openings and said intake mouth requiring a reversal of flow direction, said inlet conduit defining a passage having a gradually and continuously increasing cross sectional area in the direction of gas flow effective to reduce the flow velocity without turbulence as the flow proceeds through said passage, said reduced velocity and the incident increase in static pressure being effective to cause increased flow through said second discharge opening and less kinetic energy loss incident to the flow direction reversal.

4. In a muffler for the internal combustion engine exhaust gases of an automotive vehicle, an oval casing closed by an inlet end header and an outlet end header, a first transverse baffle disposed in said casing defining an expansion chamber between said baffle and said inlet end header, a second transverse baffle disposed between said first baffle and said outlet end header defining a first set of resonating chambers, a plurality of intermediate headers in said expansion chamber, an outlet conduit extending into said expansion chamber through said outlet end header and said baffles to an intermediate header adjacent said inlet end header, a tubular member in external coaxial relation with said outlet conduit defining an axially extending annular chamber, a plurality of annular baffles disposed therein to define a second set of resonating chambers, the portions of said outlet conduit extending through said first and second sets of

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resonating chambers comprising a perforate wall, an inlet conduit extending into said expansion chamber through said inlet end header and said intermediate headers and terminating in a first discharge opening adjacent the said first baffle, said inlet conduit having a perforate wall providing second discharge opening and a gradually increasing cross sectional area in the direction of gas flow and disposed in lateral juxtaposition to said outlet conduit thereby requiring a reversal of flow direction of the portion of gas flow leaving the first discharge opening, said gradually increasing area of said inlet conduit effecting a decrease of flow velocity as the flow proceeds in the inlet conduit, whereby the resulting static pressure increase is effective to force additional flow through said second discharge opening reducing the quantity of gas leaving the first discharge opening required to undergo a flow reversal, and whereby the resulting decreased velocity decreases the energy loss incident to the flow reversal.

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