A dual mode exhaust muffler for the engine of a vehicle that may be shifted between a quiet mode and a loud mode. A single muffler, a dual transverse muffler with two independent exhaust flow streams, and a dual transverse muffler with a combined exhaust flow stream embodiments are disclosed. An inlet tube may be a solid wall tube to minimize sound attenuation in the loud mode. The dual transverse muffler embodiments utilize an exhaust flow path that passes out through a reticulated wall of one tube and passes into a reticulated wall of a second tube. A vacuum switch having a two position on/off slide actuator may be used with any of the muffler assemblies.
Fig - 10

Fig - 11
DUAL MODE EXHAUST MUFFLER

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application claims the benefit of U.S. provisional application Ser. No. 61/027,173 filed Feb. 8, 2008.

BACKGROUND OF THE INVENTION

[0002] 1. Field of the Invention
[0003] The present invention relates to an exhaust muffler for a vehicle that is shiftable between a quiet mode and a loud mode.

[0004] 2. Background Art
[0005] Vehicle mufflers receive exhaust gases from an engine, such as an internal combustion engine or a diesel engine, for the purpose of attenuating the noise associated with the moving gas stream. Mufflers generally include a plurality of tubes and sound attenuating chambers formed by baffles and/or chambers within a shell. The walls of the tubes may include small openings to attenuate sound waves and reduce noise levels. While in most instances mufflers are designed to reduce noise and provide a low sound volume/low sound pressure level, absent undesirable resonance, some drivers of high performance vehicles prefer a louder sound and reduced back pressure.

[0006] A durable and reliably manufactured high performance exhaust muffler offering dual operating modes is provided by Applicants’ invention. As shown in the attached drawings, the following detailed description is of several illustrated embodiments.

SUMMARY OF THE INVENTION

[0007] According to one embodiment of the present invention, a muffler assembly is provided for a vehicle. The muffler assembly comprises a shell, an inlet tube, a plurality of sound attenuating tubes, a valve, and an outlet tube. The inlet tube is disposed within the shell and extends from an inlet end to a first chamber. The inlet tube is a solid wall tube. All of the exhaust gases flow through the inlet tube from the inlet end to the first chamber. The plurality of sound attenuating tubes are disposed within the shell that have a plurality of sound attenuating orifices spaced along the length of the sound attenuating tubes. The sound attenuating tubes extend from the first chamber through a plurality of baffles disposed inside of the shell. The valve closure element directs the exhaust gases through the sound attenuating tubes in a first mode of operation. The valve closure element directs exhaust gases after flowing through the inlet tube that does not have sound attenuating orifices from the first chamber into a second chamber in a second mode of operation. The outlet tube receives exhaust gases that are routed through the sound attenuating tubes in the first mode of operation. The outlet tube has a direct flow port through which exhaust gases are received from the second chamber in the second mode of operation that have not been circulated through the sound attenuating tubes. The outlet tube discharges the exhaust gases from the muffler assembly in both modes.

[0008] According to another embodiment of the present invention, a dual transverse muffler assembly for a vehicle is provided that has a combined flow path. The dual transverse muffler assembly with a combined flow path comprises a first inlet tube through which exhaust gases flow into a shell. The first inlet tube is partially disposed within the shell and extends from the a first end wall to an interior chamber. A second inlet tube is partially disposed within the shell that extends from a second end wall to the interior chamber. A sound attenuating tube is disposed within the shell that has a first plurality of sound attenuating orifices spaced along its length. The sound attenuating tube extends from the interior chamber through a plurality of baffles disposed inside of the shell. A valve closure element directs the exhaust gases through the sound attenuating tube in a first mode of operation. The valve closure element directs exhaust gases from the first chamber into a second chamber in a second mode of operation. An outlet tube extends through the shell from a first outlet tube opening through the first end wall to a second outlet tube opening through the second end wall. The outlet tube receives exhaust gases from the sound attenuating tube in the first mode of operation through a portion of the outlet tube that has a second plurality of sound attenuating orifices. The outlet tube also has a direct flow opening through which exhaust gases are received from the second chamber in the second mode of operation. Exhaust gases are discharged from the shell in both the first and second modes of operation through the first and second outlet openings.

[0009] According to yet another embodiment of the present invention, a dual transverse muffler assembly for a vehicle is provided that has a dual independent flow path. The dual transverse muffler assembly with a dual independent flow path comprises a shell that is divided by a central baffle that divides the shell into two parts. First and second sets of muffler components are provided within the shell on opposite sides of the central baffle with one set of muffler components being provided in each of the two parts. Each set of muffler components has a first baffle provided within the shell that is spaced relative to the first baffle on the opposite side of the first baffle from the end wall, an a second baffle provided within the shell between the second baffle and the central baffle. An inlet tube directs the flow of exhaust gases into the shell through the first and second baffles to an interior chamber. A sound attenuating tube is disposed within the shell that has a first plurality of sound attenuating orifices spaced along the length of the sound attenuating tube. The first sound attenuating tube extends from an inlet that opens into the interior chamber through the first and second baffles to a first end chamber defined between the end wall and the first baffle. A valve opening ring is disposed in the third baffle and is provided with a valve closure element. The valve closure element directs exhaust gases through the sound attenuating tube in a quiet mode of operation. The valve closure element directs exhaust gases from the first interior chamber through the valve opening ring and into a direct exhaust chamber defined between the third baffle and the central baffle in a loud mode of operation. An outlet tube extends through the shell from a outlet tube opening through the first end wall to the central baffle, the outlet tube has a plurality of sound attenuating orifices that receive exhaust gases that pass through the first plurality of sound attenuating orifices of the sound attenuating tube in the quiet mode of operation. The outlet tube has at least one direct flow opening through which exhaust gases are received from the direct exhaust chamber in the loud mode of operation that have not been circulated through the sound attenuating tube. Exhaust gases are discharged from the shell in both the first and second modes of operation through the tailpipe opening.
The above features and other advantageous features of the present invention will be better understood in view of the attached drawings and the following detailed description of the disclosed embodiments.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a perspective view of an exhaust muffler assembly;
FIG. 2 is a perspective view of an exhaust muffler assembly with the shell removed;
FIG. 3 is an exploded perspective of the exhaust muffler assembly;
FIG. 4 is a plan view of an exhaust muffler assembly;
FIG. 5 is a cross-sectional view taken along line 5-5 in FIG. 4;
FIG. 6 is a plan view of an exhaust muffler assembly with the shell removed and operating in a quiet mode;
FIG. 7 is a plan view an exhaust muffler assembly with the shell removed and operating in a loud mode;
FIG. 8 is a diagrammatic plan view of a dual transverse driver controlled exhaust having two independent exhaust flow streams operating in a quiet mode;
FIG. 9 is a diagrammatic plan view of a dual transverse driver controlled exhaust having two independent exhaust flow streams operating in a loud mode;
FIG. 10 is a diagrammatic plan view of a dual transverse driver controlled exhaust system having a combined exhaust gas flow stream operating in a quiet mode;
FIG. 11 is a diagrammatic plan view of a dual transverse driver controlled exhaust system having a combined exhaust gas flow stream operating in a loud mode;
FIG. 12 is a diagrammatic plan view of a vacuum switch in an open position; and
FIG. 13 is a diagrammatic plan view of a vacuum switch in a closed position.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT(S)

Referring to FIG. 1, a muffler assembly 10 is illustrated that is made in accordance with one embodiment of the present invention. Other embodiments of the invention are possible within the scope of the present invention. The muffler assembly 10 includes a shell 12 that may be oval, circular or oblong in shape. The component parts of the muffler assembly 10 may be formed of stainless steel or ferritic stainless steel to eliminate or minimize corrosion. An inlet end wall 16 is assembled to one end of the shell 12 by welding or by a hem flange connection. An inlet tube 18 is received in the inlet end wall 16. A vacuum diaphragm actuator 20 is also assembled to the inlet end wall 16. Instead of the illustrated vacuum diaphragm actuator 20, a manual actuator or an electrical solenoid actuator may be provided. An outlet end wall 22 is provided at the opposite end of the shell 12 from inlet end wall 16. An outlet tube 24 is received in the outlet end wall 22. A return spring adjustment mechanism 26 is assembled to outlet end wall 22. The internal components and structure of the muffler assembly 10 that are enclosed by the shell 12 will be more specifically described with reference to FIGs. 2-7 below.

Referring to FIG. 2, portions of the muffler assembly 10 are shown with the shell 12 removed. The inlet tube 18 extends through the inlet end wall 16 and also through an inlet end interior baffle 30. An inlet tube extension 28 extends from the inlet tube 18 between inlet end interior baffle 30 and an intermediate interior baffle 32. Inlet tube 18 and inlet tube extension 28 may be formed from a single piece of tubing or may be made from different pieces of tubing and assembled together. A valve opening ring 40 is provided on a valve plate baffle 34 that defines a valve opening 36. The valve opening is adapted to be opened and closed by means of a valve closure element 38, or valve closure plate. The valve closure element 38 engages the valve opening 36 when the muffler assembly is in its normal, or quiet, mode of operation. The valve closure element 38 may be flat, curved or partially spherical in shape to facilitate better sealing against the valve opening ring 40. A first reticulated tube 42 and a second reticulated tube 44 are oriented parallel to the inlet tube extension 28 and extend between the inlet end interior baffle 30 and the intermediate interior baffle 32. A plurality of openings 48 are formed in the first and second reticulated tubes 42, 44. The openings 48 form small outlets in the walls of the tubes 42 and 44 through which exhaust gases may flow. The flow of exhaust gases into the openings 48 attenuates sound waves of various wavelength and reduces the noise emitted from muffler assembly 10. Additional tube receiving openings 52 are formed in the inlet end interior baffle 30. Additional tube receiving openings 52 are formed in the inlet end interior baffle 30 to receive the reticulated tubes 42 and 44. Additional tube receiving openings 54 are formed in the intermediate interior baffle 32. In this way, the inlet tube extension 28 and first and second reticulated tubes 42 and 44 are supported on opposite ends by the inlet end interior baffle 30 and the intermediate interior baffle 32.

A support bracket 60 is assembled to the inlet end wall 16. The vacuum diaphragm actuator 20 is assembled to a bracket 60 to hold it in a fixed relationship relative to the inlet end wall 16. The support bracket 60 includes an actuator rod opening 62 through which an actuator rod 64 is connected to the vacuum diaphragm actuator 20. A clevis 66 is attached to the actuator rod 64 and to an operator 68 that is moved by the vacuum diaphragm actuator 20. The operator 68 moves axially relative to the vacuum diaphragm actuator 20 to turn move the actuator rod 64 in a generally axial direction. The actuator rod 64 extends from the return spring adjustment mechanism 26 located on the outer side of the outlet end wall 22 to the clevis 66. The valve closure element 38 is secured to the actuator rod 64 by two collars 69. The actuator rod 64 extends through the first reticulated tube 42 and the outlet end wall 22, valve plate baffle 34, intermediate interior baffle 32, the inlet end interior baffle 30 and the inlet end wall 16. The actuator rod 64 may be disposed at a angle relative to the central axis of the first reticulated tube 42.

The valve plate baffle 34 includes a tube receiving opening 70 that receives an extended portion 72 of the second reticulated tube 44. The extended portion 72 does not include openings 48. The extended portion 72 is received over a
necked down portion 74 of the outlet tube 24. The outlet tube 24 is received in an outlet opening 76 formed in the outlet end wall 22. Direct flow ports 78 are provided in the outlet tube 24 through which exhaust gases may flow directly from the inlet tube 18 through the inlet tube extension 28 and the valve opening ring 40 when the valve closure element 38 is shifted to its open position.

[0029] Referring to FIG. 4, the muffler assembly 10 is shown in a plan view with the shell 12 assembled over the internal components of the muffler assembly 10. The inlet tube 18 is assembled to the inlet end wall 16. The vacuum diaphragm actuator 20 is attached by means of the support bracket 60 to the inlet end wall 16. The clevis 66 is secured by a pin or other appropriate connector to the operator 68 of the vacuum diaphragm actuator 20. The outlet tube 24 and return spring adjustment mechanism 26 are both connected to the outlet end wall 22.

[0030] Referring to FIG. 5, the arrangement of the inlet tube extension 28, first and second reticulated tubes 42 and 44 and the shell 12 are shown in cross-section. The openings 48 of the first and second reticulated tubes 42 and 44 are provided with louvers 80 that are arcuate or linear recesses in the first and second reticulated tubes 42 and 44 formed adjacent to and in conjunction with the openings 48. As gas flows through the reticulated tubes 42, 44, a portion of the exhaust gases flowing through the tubes may be diverted into the space between the inlet end interior baffle 30 and the intermediate interior baffle 32. This space may also be filled with an acoustic absorption medium 82. The acoustic absorption medium 82 may be glass wool, steel wool, stainless steel wool, ceramic wool, or the like. Combinations of different acoustic absorption materials may be used and various preformed media may also be used. The acoustic absorption medium 82 serves to absorb acoustic energy from the exhaust gas flow and deaden or quiet the noise emitted from the muffler assembly when the exhaust gases flow through the first and second reticulated tubes 42 and 44. A stainless steel wool sock 83, or tube, may be assembled over the reticulated tubes 42 and 44 to inhibit particles of the acoustic absorption medium 82 from flowing into the reticulated tubes 42 and 44.

[0031] Referring to FIG. 6, operation of the muffler assembly 10 in a quiet mode is illustrated. In the quiet mode, exhaust gases are received in the inlet tube 18 that directs the exhaust gases through the inlet tube extension 28 that extends between the inlet end interior baffle 30 and the intermediate interior baffle 32. Exhaust gas flow is shown diagrammatically by means of the phantom arrows 84. The exhaust gas flow reverses direction after passing through the intermediate interior baffle 32 and is directed through the first reticulated tube 42. The gas flow then reverses direction again as it passes between inlet end wall 16 and the inlet end interior baffle 30. After reversing direction, the exhaust flow path 84 flows through the second reticulated tube 44 and into the extended portion 72, and ultimately through the outlet tube 24. As the exhaust gases flow through the first and second reticulated tubes 42 and 44, a portion of the exhaust gases pass through the openings 48 and into the space defined between inlet end interior baffle 30 and the intermediate interior baffle 32. The acoustic absorption medium 82 is preferably wrapped or assembled around the tubes 42 and 44 to provide additional sound attenuation and desired acoustic properties.

[0032] Referring to FIG. 7, the muffler assembly 10 is shown in its loud mode with the valve closure element 38 shifted by the vacuum diaphragm actuator 20 to open the valve opening 36 (shown in FIG. 3). In the loud mode, exhaust gases flow into the inlet tube 18 and through the inlet end wall 16 and inlet end interior baffle 30 to the inlet tube extension 28. A loud mode exhaust flow path 86 is shown by phantom arrows in FIG. 7. As shown in FIG. 7, the exhaust flows from the inlet tube extension 28 into the space between the intermediate interior baffle 32 and the valve plate baffle 34. The exhaust gas flow is then directed through the valve opening ring 40. The valve closure element 38 is separated from the valve opening ring 40 and closes off the reticulated tube 42 to direct the exhaust gases to flow through the valve opening 36 and into the space defined between valve plate baffle 34 and the outlet end wall 22. An exhaust flow path 86 then flows into the direct flow ports 78 formed in the outlet tube 24 and through the outlet tube 24. In the loud mode shown in FIG. 7, exhaust flow is not directed through the reticulated tubes 42 and 44. No portion of the acoustic energy is absorbed by the openings 48 or the acoustic absorption medium 82 and no sound attenuation is provided by the inlet end interior baffle 30 or the intermediate interior baffle 32. A limited amount of sound attenuation is obtained as the loud mode exhaust flow path 86 flows through the inlet tube extension 28 and through the valve opening ring 40 to the direct flow port 78.

[0033] The driver of the vehicle can shift the muffler assembly 10 from the quiet mode shown in FIG. 6 to the loud mode shown in FIG. 7 by selectively porting vacuum from the engine or other vacuum source to the vacuum diaphragm actuator 20. A vacuum valve control, such as that illustrated in FIGS. 12 and 13, or an electrical switch (not shown) may be assembled to the dashboard of the vehicle (not shown) may be actuated to provide vacuum to the vacuum diaphragm actuator 20.

[0034] In FIG. 7, vacuum provided to the vacuum diaphragm actuator 20 retracts the operator 68 into the actuator 20. This movement of the operator 68 is communicated through the clevis 66 to the actuator rod 64. The actuator rod 64 is shifted toward actuator 20 when vacuum is provided. Shifting the actuator rod 64 causes the return spring adjustment mechanism 26 to compress a spring 88 of the return spring adjustment mechanism 26. When the actuator rod 64 shifts, the valve closure element 38 is moved into engagement with one end of the reticulated tube 42. This shifts the gas flow from flowing through the reticulated tubes 42 and 44 to cause the gas to flow through the valve opening ring 40, as previously described.

[0035] The return spring adjustment mechanism 26 may be adjusted by tightening a nut 90 or other conventional adjustment mechanism to locate the valve closure element 38. The return spring adjustment mechanism 26 should be adjusted to facilitate sealing between the valve closure element 38 and the valve opening ring 40 in the quiet mode shown in FIG. 6. The return spring adjustment mechanism 26 should also be adjusted to facilitate sealing between the valve closure element 38 and the end of the reticulated tube 42 in the loud mode.

[0036] The clevis 66 is connected to the operator 68 of the vacuum diaphragm actuator 20 by means of a pin 92 that accommodates the slight axial offset of the actuator rod 64 relative to actuator 20. The pin 92 and clevis 66 permits the actuator 20 to be connected to the actuator rod 64 without binding or restriction because the clevis 66 is permitted to pivot on the pin 92. The position of the valve closure element
The dual transverse muffler 100 is described with reference to the left side of the muffler 100 shown in FIGS. 8 and 9. The right and left sides of the dual transverse muffler 100 are essentially mirror images of each other and the description of the right side is not repeated for brevity. The same reference numerals are used to describe the internal parts on the left side of the muffler 100 as are used on the right side of the muffler 100.

Referring to FIG. 8, a dual transverse muffler having two independent flow paths is illustrated in a quiet mode. The muffler 100 includes a shell 102 that is closed on one end by a first end wall 104 and on the opposite end by a second end wall 106. A first inlet tube 108 is partially disposed within the shell 102 and extends through the first end wall 104. A second inlet tube 110 is partially disposed in the shell 102 and extends through the second wall 106. A first outlet tube 112 is partially disposed within the shell 102 and extends through the second end wall 106.

A first baffle 116 is assembled within the shell 102 to be the baffle that is closest to the first end wall 104. A second baffle 118 is assembled within the shell 102 inboard of the first baffle 116. A third baffle 120 is assembled within the shell 102 between second baffle 118 and a central baffle 122. The baffles 116, 118, 120 and 122 divide the internal space within the shell 102 into chambers.

An intermediate reticulated tube 126 is assembled to the first baffle 116 and the second baffle 118. A plurality of sound attenuating ports 128 are provided in the intermediate reticulated tube 126. The sound attenuating ports 128 may also be referred to as openings that are provided with louvers that define arcuate or linear recesses, as previously described with reference to FIGS. 1-7. An intermediate section 130, or intermediate chamber, is defined between the first baffle 116 and the second baffle 118. A plurality of sound attenuating ports 132 are provided in the intermediate section 130. A valve opening ring 134 defines an opening (not shown) through the third baffle 120 that is similar to the opening 36 in the embodiment of FIGS. 1-7. A valve closure plate 136, or valve closure element, is provided to open and close the valve opening ring 134 depending upon whether the muffler 100 is to be operated in the quiet mode or loud mode.

A rod 138 is assembled to the valve closure plate 136 and extends through the intermediate reticulated tube 126 and the first end wall 104. For the right hand side, the rod 138 extends through the second end wall 106. Vacuum diaphragm actuators 140 are provided on each of the first end wall 104 and the second end wall 106. The rod 138 is connected to the vacuum diaphragm actuator 140 on one end of the rod 138. The other end of the rod 138 is provided with a return spring 142. Return spring 142 is attached to the central baffle 122 on the opposite side of the central baffle 122 from the remainder of the rod 138. The first and second outlet tubes 112, 114 define direct flow ports 146 between the third baffle 120 and the central baffle 122. An inlet end 148 of the intermediate reticulated tube 126 is selectively opened and closed by the valve closure plate 136 depending upon whether the dual transverse muffler 100 is in the quiet mode or in the loud mode. The reticulated tube 126 and intermediate section 130 may be wrapped in a stainless steel wool sock and an acoustic absorption medium as previously described with reference to FIG. 5.

Operation of the dual transverse muffler 100 in the quiet mode is described with continuing reference to FIG. 8. The dual transverse muffler 100 operating in the quiet mode creates an exhaust flow path identified by reference numeral 150 in FIG. 8. The exhaust flow path 150 is introduced into the first inlet tube 108 that directs the exhaust gases through the first end wall 104, first baffle 116, and second baffle 118. The valve closure plate 136 closes the annular valve opening ring 134 which causes the exhaust gases to flow into the intermediate reticulated tube 126. Exhaust gases flow in an intermediate flow path 152 from the sound attenuating ports 128 in the intermediate reticulated tube 126 through the intermediate section 130 to the sound attenuating ports 132 formed in the first outlet tube 112. Exhaust gases then flow through the first outlet tube 112 and out of the muffler into the atmosphere.

Operation of the dual transverse muffler 100 is described in the loud mode with reference to FIG. 9. In the loud mode, the exhaust gases flow through the first inlet tube 108 through the first end wall 104, the first baffle 116, and the second baffle 118. In the loud mode, the valve closure plate 136 is moved to close the inlet end 148 of the intermediate reticulated tube 126. The valve closure plate 136 is moved by the vacuum diaphragm actuator 140 and the rod 138. An exhaust gas flow path in the loud mode is indicated by reference numeral 154. After the exhaust gases flow through the inlet tube 108, they flow through the chamber defined by the second baffle 118 and the third baffle 120 through the valve opening ring 134. The exhaust gas then flows through the chamber defined between the third baffle 120 and the central baffle 122 to the direct flow ports 146 that are formed in the first outlet tube 112. Exhaust gases then flow through the first outlet tube 112 and into the atmosphere.

Referring to FIG. 10, a dual transverse muffler 160 having a combined exhaust flow path is described. The dual transverse muffler 160 is shown in the quiet mode in FIG. 10. The dual transverse muffler 160 is shown in the loud mode in FIG. 11.

The dual transverse muffler 160 includes a shell 162 that is closed on one side by a first end wall 162 and is closed on the opposite lateral side by a second end wall 166. A first inlet tube 168 is partially disposed within the shell 162 and extends through the first end wall 164. A second inlet tube 170 is partially disposed within the shell 162 and extends through the second end wall 166. A first outlet tube 172 extends through the shell 162 and also through the first and second end walls 164 and 166.

A first baffle 176 is assembled inside the shell 162 near the first end wall 164. A second baffle 178 is provided within the shell 162 near the inner end of the first inlet tube 168. A third baffle 180 is provided within the shell 162 between the second baffle 178 and the second end wall 166. The inner end of the second inlet tube 170 extends through the third baffle 180. The baffles may be solid walls or may have openings depending upon the performance requirements for the muffler.

An intermediate reticulated tube 182 is assembled within the shell and is connected through the first baffle 176 and second baffle 178. A plurality of sound attenuating ports 184 are provided in the intermediate reticulated tube 182 in an intermediate section 186 of the intermediate reticulated tube.
The intermediate section 186, or intermediate chamber, is defined within the shell between the first baffle 176 and the second baffle 178. A plurality of sound attenuating ports 188 are provided in the outlet tube 172. A valve opening ring 190 is provided in the third baffle 180. A valve closure plate 192 closes the valve opening ring 190 when operating in the quiet mode as shown in FIG. 10. A rod 194 connects the valve closure plate 192 to a vacuum diaphragm actuator 196 and a return spring 198. The vacuum diaphragm actuator 196 is assembled to the first end wall 164. The return spring 198 is assembled to the rod 194 and the second end wall 166.

A plurality of direct flow ports 202 are provided in the outlet tube 172 between the third baffle 180 and the second end wall 166. The inlet end 204 of the intermediate reticulated tube 182 is open as shown in FIG. 10. The valve closure plate 192 is disposed in a sealing relationship over the valve opening ring 190 leaving the inlet end 204 open. A quiet exhaust flow path is identified by reference numeral 206 in FIG. 10. Exhaust gases are introduced into the muffler 160 through the first inlet tube 168 and the second inlet tube 170. Exhaust gases flow from the inlet tubes into the chamber formed between the second baffle 178 and the third baffle 180. With the valve closure plate closing the valve opening ring 190, exhaust gases are directed through the inlet end 204 of the intermediate reticulated tube 182. Exhaust gases flow through the sound attenuating ports 184 in the intermediate reticulated tube 182 through the intermediate section 186 to the sound attenuating ports 188 formed in the outlet tube 172. The reticulated tube 182 and outlet tube 172 may be wrapped in a stainless steel wool sock and an acoustic absorption medium as previously described with reference to FIG. 5. Exhaust gases then flow through both ends of the outlet tube 172 and into the atmosphere.

Referring to FIG. 11, a loud exhaust flow path is indicted by reference to the flow path arrows by reference numeral 208. In the loud mode, exhaust gases are introduced into the muffler 160 through the first inlet tube 168 and the second inlet tube 170. Exhaust gases flow from the inlet tubes into the chamber formed between the second baffle 178 and the third baffle 180. In the loud mode of operation, the valve closure plate 192 closes or seals the inlet end 204 of the intermediate reticulated tube 182. The exhaust gases flow through the valve opening ring 190 into the chamber formed between the third baffle 180 and the second end wall 166. From there, the exhaust gases flow into the flow ports 202 formed in the outlet tube 172. The exhaust gases then flow out of both ends of the outlet tube 172 and into the atmosphere.

Referring to FIG. 12, a vacuum switch 212 is illustrated that may be used to operate the vacuum diaphragm actuator in any of the above embodiments. The vacuum switch 212 is supplied from a vacuum source such as the inlet manifold of an internal combustion engine, or the like. Vacuum is provided through tubing (not shown) to the vacuum diaphragm actuator 20, 140, 196 to shift the muffler 10, 100, 160 from the quiet to the loud mode of operation. The vacuum switch 212 is actuated by moving a control rod 220. The vacuum switch 212 includes a housing 224 and a valve body 226 that is shiftable within the housing 224. A chamber 228 is defined between the valve body 226 and the housing 224 that selectively allows vacuum to be provided from the vacuum source port 216 to the vacuum supply port 218.

In the loud mode position shown in FIG. 12, the valve body 226 is shifted to the right end of the housing 224 by pulling the control rod 220. An oval ring seal 230 is provided that also, in part, defines the chamber 228 and forms a seal between the housing 224 and the valve body 226. In this position, vacuum is ported from the vacuum source port 216 to the vacuum supply port 218. Vacuum is provided to the vacuum diaphragm actuators 20, 140, 196 that holds the valve closure elements 38, 136, 196 over the inlet opening of the intermediate reticulated tubes 42, 126, 182 and opens the respective valve openings 36, 134, 190.

Referring to FIG. 13, the vacuum switch 212 is shown in the quiet operation mode. In the quiet mode, the valve closure elements 38, 136, 196 close the respective valve openings 36, 134, 190 and open the inlet opening of the intermediate reticulated tubes 42, 126, 182. A circular seal ring 232 is provided to seal the vacuum source port 216 between the housing 224 and valve body 226. The circular seal ring 232 seals the gap between the housing 224 and the valve body 226 when the control rod 220 is pushed to shift the valve body 226 to the left side of the housing 224 as shown in FIG. 13. In this position, vacuum supplied through the vacuum source port 216 is sealed by the circular seal ring 232.

The vacuum switch 212 is normally set to the quiet mode operation. It should be understood that the normal mode of operation could be reversed, however, it is preferred that the muffler be in the quiet mode of operation when vacuum is not provided to the various diaphragm actuators so that in the event of a system failure the muffler would operate in the quiet mode. The system could also be operated on a pressurized fluid basis by connecting the switch 212 to a pressure source and providing a pressure diaphragm actuator to operate the mufflers.

While embodiments of the invention have been illustrated and described, it is not intended that these embodiments illustrate and describe all possible forms of the invention. Rather, the words used in the specification are words of description rather than limitation, and it is understood that various changes may be made without departing from the spirit and scope of the invention.

What is claimed is:

1. A muffler assembly for a vehicle comprising:
   a. An inlet tube disposed within the shell that extends from the
      an inlet end to a first chamber and through which exhaust
      gases flow, the inlet tube is a solid wall tube;
   b. A plurality of sound attenuating tubes are disposed within the
      shell that have a plurality of sound attenuating orifices spaced along the length of the sound attenuating tubes, the sound attenuating tubes extend from the first chamber through a plurality of baffles disposed inside of the shell;
   c. A valve closure element directs the exhaust gases flowing through the inlet tube that does not have sound attenuating orifices through the sound attenuating tubes in a first mode of operation, the valve closure element directs exhaust gases from the first chamber into a second chamber in a second mode of operation; and
   d. An outlet tube discharges the exhaust gases from the muffler assembly, the outlet tube receives exhaust gases that are routed through the sound attenuating tubes in the first mode of operation, the outlet tube has an opening through which exhaust gases are received from the second chamber in the second mode of operation that have not been circulated through the sound attenuating tubes.

2. The muffler assembly of claim 1 further comprising a vacuum diaphragm actuator that is operatively connected to
the valve closure element by a rod, the rod having a clevis on one end that is pivotally connected to an operator of the actuator by a pin, wherein the rod has a collar that secures the valve closure element to the rod at a selected position, and wherein an adjustable actuator connector has a spring that biases the valve closure element into the first mode of operation.

3. The muffler assembly of claim 2 further comprising a vacuum control switch having an inlet port that is connected to a source of vacuum by a inlet tube, the vacuum control switch having an outlet port that is connected to the vacuum diaphragm actuator by an outlet tube, the vacuum control switch having a manually engaged actuator that is movable from a normal position wherein no vacuum is ported to the outlet port and the valve closure element is in the first mode of operation to an activation position wherein vacuum is ported to the outlet port and the valve closure element is shifted to the second mode of operation.

4. The muffler assembly of claim 1 wherein the valve closure element is a flat disk that is moved between a first position in which the flat disk blocks the flow of exhaust gases from the first chamber to the second chamber while permitting the flow of exhaust gases through the sound attenuating tubes and a second position in which the flat disk permits the flow of exhaust gases from the first chamber to the second chamber while blocking the flow of exhaust gases through the sound attenuating tubes.

5. The muffler assembly of claim 1 wherein the sound attenuating tubes are disposed in an acoustic absorption medium.

6. The muffler assembly of claim 5 wherein the sound attenuating tubes are wrapped in a stainless steel wool sock that inhibits the passage of particulates from the acoustic absorption medium into the sound attenuating tubes.

7. A dual transverse muffler assembly for a vehicle comprising:
   a shell;
   a first inlet tube through which exhaust gases flow into the shell that is partially disposed within the shell that extends from the a first end wall to an interior chamber; a second inlet tube through which exhaust gases flow into the shell that is partially disposed within the shell that extends from a second end wall to the interior chamber;
   at least one sound attenuating tube disposed within the shell that has a first plurality of sound attenuating orifices spaced along the length of the sound attenuating tube, the sound attenuating tubes extend from the interior chamber through a plurality of baffles disposed inside of the shell;
   a valve closure element directs the exhaust gases through the sound attenuating tube in a first mode of operation, the valve closure element directs exhaust gases from the first chamber into a second chamber in a second mode of operation;
   an outlet tube extends through the shell from a first outlet tube opening through the first end wall to a second tailpipe opening through the second end wall, the outlet tube receives exhaust gases through a portion of the outlet tube that has a second plurality of sound attenuating orifices that were routed through the sound attenuating tube in the first mode of operation, the outlet tube has a direct flow opening through which exhaust gases are received from the second chamber in the second mode of operation that have not been circulated through the sound attenuating tube, and wherein exhaust gases are discharged from the shell in both the first and second modes of operation through the first and second tailpipe openings.

8. The dual transverse muffler assembly of claim 7 further comprising a vacuum diaphragm actuator that is operatively connected to the valve closure element by a rod, the rod having a clevis on one end that is pivotally connected to an operator of the actuator by a pin, wherein the rod has a collar that secures the valve closure element to the rod at a selected position, and wherein an adjustable actuator connector has a spring that biases the valve closure element into the first mode of operation.

9. The dual transverse muffler assembly of claim 8 further comprising a vacuum control switch having an inlet port that is connected to a source of vacuum by a inlet tube, the vacuum control switch having an outlet port that is connected to the vacuum diaphragm actuator by an outlet tube, the vacuum control switch having a manually engaged actuator that is movable from a normal position wherein no vacuum is ported to the outlet port and the valve closure element is in the first mode of operation to an activation position wherein vacuum is ported to the outlet port and the valve closure element is shifted to the second mode of operation.

10. The dual transverse muffler assembly of claim 7 wherein the valve closure element is a flat disk that is moved between a first position in which the flat disk blocks the flow of exhaust gases from the first chamber to the second chamber while permitting the flow of exhaust gases through the sound attenuating tubes and a second position in which the flat disk permits the flow of exhaust gases from the first chamber to the second chamber while blocking the flow of exhaust gases through the sound attenuating tubes.

11. The dual transverse muffler assembly of claim 7 wherein the sound attenuating tubes are disposed in an acoustic absorption medium.

12. The dual transverse muffler assembly of claim 11 wherein the sound attenuating tubes are wrapped in a stainless steel wool sock that inhibits the passage of particulates from the acoustic absorption medium into the sound attenuating tubes.

13. A dual transverse muffler assembly for a vehicle comprising:
   a shell;
   a central baffle provided within the shell that divides the shell into two parts;
   first and second sets of muffler components provided within the shell on opposite sides of the central baffle with one set of muffler components being provided in each of two parts, wherein each set of muffler components comprise:
   a first baffle provided within the shell proximate the end wall;
   a second baffle provided within the shell at a spaced location relative to the first baffle on the opposite side of the first baffle from the end wall;
   a third baffle provided within the shell between the second baffle and the central baffle;
   an inlet tube through which exhaust gases flow into the shell that is partially disposed within the shell and that extends from the an end wall through the first and second baffles to an interior chamber;
   a sound attenuating tube is disposed within the shell that has a first plurality of sound attenuating orifices
spaced along the length of the sound attenuating tube, the first sound attenuating tube extends from an inlet that opens into the interior chamber through the first and second baffles to a first end chamber defined between the end wall and the first baffle; a valve opening ring disposed in the third baffle; a valve closure element disposed in the shell between the inlet in the sound attenuating tube and the valve opening ring that directs the exhaust gases through the sound attenuating tube in a quiet mode of operation, the valve closure element directs exhaust gases from the first interior chamber through the valve opening ring and into a direct exhaust chamber defined between the third baffle and the central baffle; an outlet tube extends through the shell from a outlet tube opening through the first end wall to the central baffle, the outlet tube has a plurality of sound attenuating orifices that receive exhaust gases that pass through the first plurality of sound attenuating orifices of the sound attenuating tube in the quiet mode of operation, the outlet tube has at least one direct flow opening through which exhaust gases are received from the direct exhaust chamber in the loud mode of operation that have not been circulated through the sound attenuating tube, and wherein exhaust gases are discharged from the shell in both the first and second modes of operation through the tailpipe opening.

14. The dual transverse muffler assembly of claim 13 wherein the muffler components further comprise a vacuum diaphragm actuator, a rod that is operatively connected to the vacuum diaphragm actuator, a clevis is provided on one end of the rod that is pivotally connected to the actuator by a pin, a collar secures the valve closure element to the rod at a selected position, and wherein a return spring biases the valve closure element into engagement with the valve opening ring in the first mode of operation.

15. The dual transverse muffler assembly of claim 14 further comprising a vacuum control switch having an inlet port that is connected to a source of vacuum by a inlet tube, an outlet port is connected to the vacuum diaphragm actuator by an outlet tube, the vacuum control switch having a manually engaged actuator that is movable from a normal position wherein no vacuum is ported to the outlet port in the quiet mode of operation to an activation position wherein vacuum is ported to the outlet port and the vacuum diaphragm actuator is shifted to the loud mode of operation.

16. The dual transverse muffler assembly of claim 13 wherein the valve closure element is a flat disk that is moved between a first position in which the flat disk blocks the flow of exhaust gases from the interior chamber to the direct flow chamber while directing the flow of exhaust gases through the sound attenuating tube and a second position in which the flat disk permits the flow of exhaust gases from the interior chamber to the direct flow chamber while blocking the flow of exhaust gases through the sound attenuating tube.

17. The dual transverse muffler assembly of claim 13 wherein the sound attenuating tube is disposed in an acoustic absorption medium.

18. The dual transverse muffler assembly of claim 17 wherein the sound attenuating tubes are wrapped in a stainless steel wool sock that inhibits the passage of particulates from the acoustic absorption medium into the sound attenuating tubes.