Feb. 24, 1942. C. F. RAUEN 2,274,461

MUFFLER

Filed Oct. 14, 1937

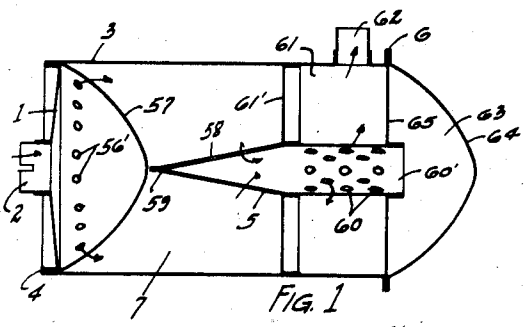


FIG. 1

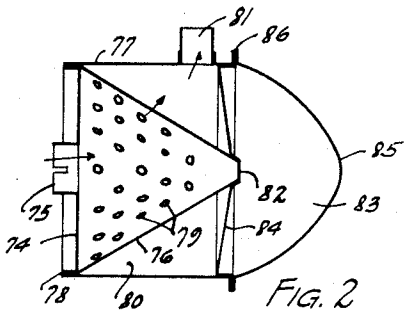


FIG. 2

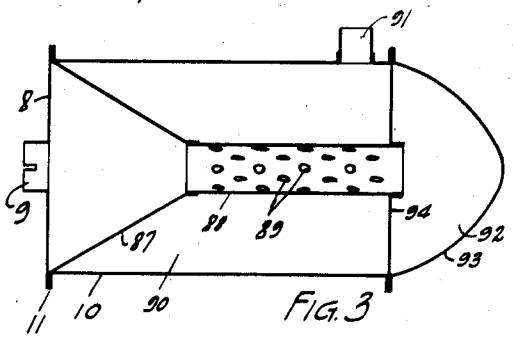


FIG. 3

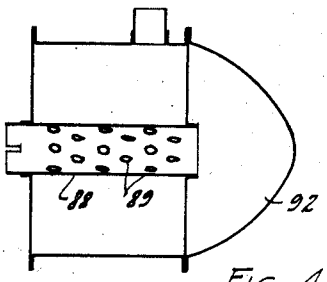


FIG. 4

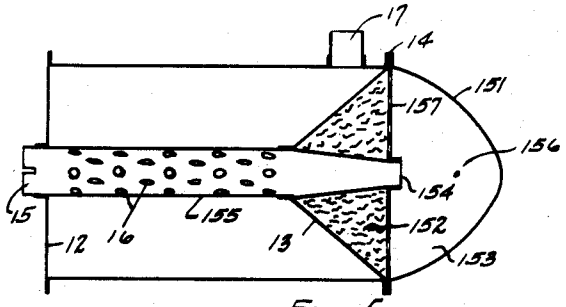


FIG. 5

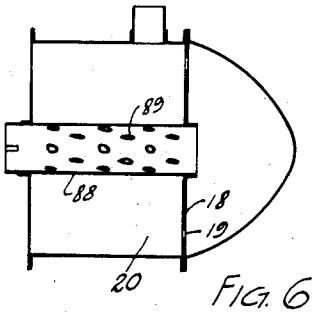


FIG. 6

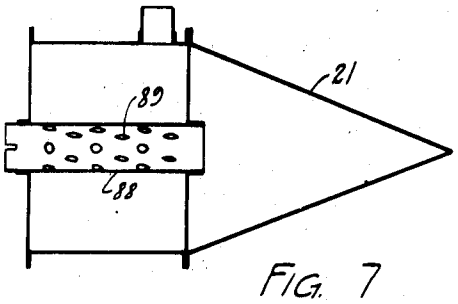


FIG. 7

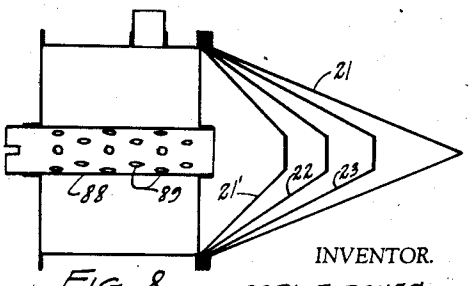


FIG. 8

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UNITED STATES PATENT OFFICE

2,274,461

MUFFLER

Carl F. Rauen, Grosse Pointe, Mich.

Application October 14, 1937, Serial No. 168,946

35 Claims. (Cl. 181—59)

(Granted under the act of March 3, 1883, as amended April 30, 1928; 370 O. G. 757)

The invention described herein may be manufactured and used by or for the Government for governmental purposes, without the payment to me of any royality thereon.

This invention relates to mufflers for silencing the exhaust of internal combustion engines, the intake of air compressors and the like.

Heretofore, exhaust noises have been silenced primarily by restricting the flow of the gases by means of several baffles. These baffles are usually either in series so that the gas passes directly from one to the other, or so arranged that the gases reverse their flow after passing through each baffle. These methods of silencing cause a high degree of back pressure. Since back pressure is detrimental to the operation of an internal combustion engine, it is desirable to eliminate it or reduce it to a very low degree.

With my designs I can muffle the exhaust gases from internal combustion engines, with little or no back pressure, and with mufflers relatively smaller than those now in use.

A primary object, therefore, of this invention is to separate the sound energy from the exhaust gas stream, with little or no restriction on the flow of the gas stream; that is, to separate the sound from the gas stream by directing it to one place until its energy is destroyed, while the gas stream is allowed to escape at another place.

To obtain this control of the sound and gas, I make use of what I term sound trap chambers, which will be hereinafter more fully explained, and the reflecting and focusing properties of the conic sections, and other shapes, to reflect focus, concentrate and destroy sound; I also make use of the sound absorbing and destroying properties of such materials as steel wool, mineral wool, asbestos, etc., which are so arranged in the muffler that the sound is absorbed or destroyed by entering the interstices of the material, where it travels devious and tortuous paths, while the exhaust gas stream is led through the muffler with little or none of it passing through this absorbing material. A further property of the above material is its comparative softness; that is, it does not reflect sound like hard material.

The chamber referred to herein as a "sound trap chamber" is a substantially closed chamber, having communication with the gas passageway of a muffler and so arranged that little or none of the exhaust gas passes through said chamber on its way to atmosphere, said communication forming an acoustic coupling between said gas passageway and said chamber and opening abruptly into said sound trap chamber, the area of said communication being substantially less than the cross sectional area of said chamber, whereby the sound, after passing through said communication into said chamber, expands, as is its natural tendency, and is destroyed by reflection or otherwise, and little or none of said sound returns to said passageway, due to the restriction offered by said communication.

It is a well known fact that sound can be reflected and focused substantially in the same manner as light, by means of reflectors, and hence I make use of the reflecting and focusing properties of reflectors shaped to the conic sections; that is, the parabolic, hyperbolic, elliptical, or spherical reflectors, or any combination of the above, to control the sound energy and produce silencing by reflecting, focusing, or concentrating the sound at one place by means of the foregoing methods, either separately or in any combination, until its energy is destroyed, while the gas stream is allowed to escape from another place. The expressions, side-branch chamber, dead chamber, sound attenuating chamber, and acoustic chamber are used herein synonymously with the term "sound trap chamber."

Use is also made of the reflecting properties of flat plates and inclined surfaces or, for that matter, any shape of enclosure wherein the sound can be trapped and caused to lose its energy by rapid reflection between the walls of said enclosure, into which it has been introduced, while the gas stream is led to atmosphere by a separate path, minus the greater part of the sound energy.

Since sound can be focused or concentrated by various types of reflectors, I have designed and built mufflers wherein the exhaust sound is concentrated or trapped by one or more reflectors, or sound traps, while the gas is permitted to escape at a place where the least amount of sound can escape with it.

Due to the high efficiency of the methods of silencing used in my invention, very little restriction need be put on the flow of the gas stream, in order to confine the sound to the muffler until it is destroyed, and in consequence of this high silencing efficiency, a much smaller and cheaper muffler can be made to do the work of the larger ones now in use.

It is understood that any hard surface will reflect sound, regardless of its shape, in a manner complying with the well known laws of reflection, and that soft surfaces absorb sound. It is further understood that every time sound is reflected, it loses some of its energy. The muffler designs

shown in this application preferably are made of sheet metal stampings which are fastened together as by welding. They can, however, be made of castings.

A still further object is to provide a muffler that is highly efficient, simple in construction and cheap to manufacture.

A further object of this invention is to provide a muffler with relatively small chambers, so that the sound energy will be destroyed in a very short time within said chambers.

A still further object of this invention is to prevent the re-combining of the sound wave fronts after being broken up by baffles.

This application is a continuation in part of my co-pending application Serial No. 427,312, filed February 10, 1930, for Muffler, now Patent No. 2,183,510, granted November 29, 1938.

With the foregoing and other objects in view, as will hereinafter appear, my invention consists of certain novel features of construction, combinations and arrangements of parts, as will be hereinafter described in detail and particularly set forth in the appended claims.

For a better understanding of the invention, reference may be had to the accompanying drawing, in which:

Fig. 1 is a longitudinal cross-sectional view of one embodiment of my invention;

Fig. 2 is a longitudinal cross-sectional view of a modified form of muffler embodying my invention;

Fig. 3 is a longitudinal sectional view showing a still further modification of my invention;

Fig. 4 is a longitudinal cross-sectional view of a modification of Fig. 3;

Fig. 5 is a longitudinal cross-sectional view of another modification embodying my invention;

Fig. 6 is a modification of Fig. 4; and

Figs. 7 and 8 are further modifications of Fig. 4.

Referring to Fig. 1, there is shown a header 1 having an opening 2 for attachment to the exhaust pipe of an engine. The header 1 is nested in the cup-shaped plate 57, which is preferably formed to one of the conic sections and the parabola in particular, and this plate 57 is provided with openings 56' and is nested in the body of the muffler 3 and welded thereto at 4.

A transverse partition plate 61' is mounted in the body 3 and supports a tube 5, which has one end thereof wedge shaped and provided with perforations 58. The other end of the tube 5 is preferably cylindrical in form and is provided with perforations 60. The open end 60' of the tube 5 is supported by the plate 65 and opens into the sound trap chamber 63 formed by the plate 65 and the cup-shaped plate 64. The plates 64 and 65 are welded to the body at 6.

The operation of this muffler is as follows: The exhaust gas enters the opening 2 and impinges on the cup-shaped member 57, and if this member is formed as a parabola, the sound energy entrained with the exhaust gas is reflected more or less to the focus point of the parabola, while the gas passes out through the holes 56 into the chamber 7, and any sound that escaped with the gas enters the wedge-shaped tube 5 through the holes 58. The gas also enters the holes 58 and passes out the holes 60 into the chamber 61 and thence to atmosphere through the outlet 62, while any sound that entered the openings 58 passes down the tube 5 and through the opening 60' into the sound trap chamber 63, where it is attenuated or destroyed by reflection therein.

In Fig. 2 there is a header 14 provided with an inlet opening 15 for attachment to the exhaust pipe of the engine and is nested in a perforated conical member 16, which member in turn is nested in the body 17 and welded thereto at 18. The small end of the conical member 16 is provided with an opening 82 which opens into the sound trap chamber 83 formed by the plates 84 and 85. The plates 84 and 85 are welded to the body 17 at 86.

The operation of this muffler is as follows: The exhaust gas enters the opening 15 and passes through the holes 19 in the conical member 16 into the chamber 80, and from there to atmosphere through the outlet 81 formed in the body 17, while the sound energy passes down the inside surfaces of the cone 16 and through the small opening 82 into the sound trap chamber 83, where it is confined, and due to the fact that sound energy expands in any opening, it will be reflected back and forth within the confines of the sound trap chamber 83, the method of reflection depending upon the shape of the plates 84 and 85. It will be seen that as the area of the sound trap chamber 83 is appreciably greater than the opening 82, there will be very little tendency for any sound to pass from the chamber 83 into the cone 16 through the opening 82.

In Fig. 3 the header 8 is provided with an opening 9 for attachment to the exhaust pipe of the engine, and is welded to the body 10 at 11, together with the cone-shaped member 87. The cone-shaped member supports one end of the tube 88, the other end of which is supported by the plate 94, which, with the cup-shaped member 93, forms the sound trap chamber 92. The tube 88 is provided with openings 89 through which the gas passes to the outlet 91, and the operation of this muffler is similar to that of Fig. 2.

Fig. 4 is the same as Fig. 3, except that the conical member 87 is omitted, and its operation will be similar also to that of Fig. 3.

In Fig. 5 there is a header 12 provided with an opening for supporting the tube 155. The other end of said tube is reduced in diameter and is supported by the perforated plate 157 and also the cone-shaped plate 13, and the space between the plates 13 and 157 is filled with sound absorbing material, such as copper wool, asbestos, blast furnace slag, or any other type of sound absorbing material satisfactory for this purpose. The plates 13 and 157 are welded to the body at 14, as is also the cup-shaped plate 151, which in this case is shown as a parabola with a focus at the point 156. The plates 13, 157 and 151 form the sound trap chamber.

The operation of this muffler is as follows: The exhaust gas enters the tube 155 at 15 and passes out the perforations 16, and from thence to atmosphere through the outlet 17, while the sound energy travels down the tube 155 and out the opening 154 in the small end of said tube and expands into the sound trap chamber 153, where it is destroyed by reflection against the sound absorbing material 152 held in place by the perforated plate 157.

Fig. 6 is similar to Fig. 4 and differs therefrom only in that the plate 18 is provided with a few openings 19 to provide an acoustic coupling effect with the chamber 20.

Fig. 7 is similar to Fig. 4 and differs therefrom

in that the enclosure 21 of the sound trap chamber is made to the shape of a complete cone, and its operation is similar to that of Fig. 4.

Fig. 8 is a modification of Fig. 7 and differs therefrom in that a plurality of truncated cones 21', 22 and 23 are placed within the sound trap chamber of Fig. 7 in nested relationship and form acoustic side branch chambers acoustically coupled to the main sound and gas conducting channel 88 and in general its operation is similar to that of Fig. 4.

It will be noted that in the foregoing designs the exhaust gas does not have to pass through the sound trap chambers on its way to atmosphere and that the cross-sectional area of the sound trap chambers progressively decreases from a point adjacent the opening of said sound trap chamber to the extreme end thereof.

I have found by experiment that the sound traps illustrated can be of various shapes without affecting the silencing characteristics thereof. The sound energy, after entering the sound traps, destroys itself within the sound traps, and very little, if any, of said sound energy which passes into the sound traps escapes therefrom, due to the fact that the sound energy, after passing into the sound traps, expands, and the communication between the sound trap and the tube through which the exhaust gas stream flows is relatively restricted.

The idea in the foregoing designs is to cause a destruction of sound energy by providing a closed chamber or sound trap through which there is substantially no gas flow but into which the sound energy can pass and be trapped until it is dissipated, while the gas stream passes to atmosphere substantially free of all or a major portion of the sound energy.

While several modifications of the invention have been described with some detail, it is to be understood that the description is for the purpose of illustration only and is not definitive of the inventive idea, but is to be limited only by the scope of the appended claims.

What I claim and desire to secure by Letters Patent is:

1. An acoustic silencer for flowing gases comprising a hollow member forming at least a part of a main sound and gas conducting channel and one or more closed sound trap chambers through which little or none of said gases flow, acoustically coupled directly to the channel and having a cross-sectional area decreasing progressively with the distance from a zone adjacent its coupling to the closed end of the sound trap chamber.

2. An acoustic silencer for flowing gases comprising a hollow member forming at least a part of a main sound and gas conducting channel and one or more closed sound trap chambers through which little or none of said gases flow, acoustically coupled to the channel and formed in the shape of a complete circular cone open to the sound channel at its base.

3. In an acoustic silencing device for sound entrained flowing gases having a main sound and gas conducting channel, a closed conical sound trap chamber through which little or none of said gases flow having a restricted opening in its base which provides an acoustic coupling from said chamber to said channel.

4. A sound attenuating device for sound entrained flowing gases comprising a casing having a gas inlet opening at one end thereof, a gas outlet opening at the other end thereof and a closed sound trap chamber through which little or none of said gases flow, in the form of a complete cone having an opening in its base positioned in adjacency to said gas outlet opening, the cross sectional area of said opening being materially less than that of the base of said cone.

5. An acoustic silencer for sound entrained flowing gases comprising a main sound and gas conducting channel and one or more closed sound trap chambers through which little or none of said gases flow, acoustically coupled to the channel and having a cross sectional area decreasing progressively with the distance from the point of coupling to the channel, the area of coupling between said sound trap and the channel being substantially less than the area of the main channel.

6. An acoustic silencer for sound entrained flowing gases comprising a main sound and gas conducting channel and one or more closed sound trap chambers through which little or none of said gases flow, acoustically coupled to the channel and having a cross sectional area decreasing progressively with the distance from the point of coupling to the channel, the area of coupling between said sound trap and the channel being different than the area of the main channel.

7. An acoustic silencer for sound entrained flowing gases of internal combustion engines comprising a casing having an inlet port and an outlet port, a main channel through which the gas passes on its way from the inlet to the outlet port, a sound attenuating chamber acoustically coupled directly to said gas channel, said chamber decreasing in cross-sectional area progressively with the distance from its coupling to the main channel to its minimum area, said chamber being formed in part to a conic section.

8. An acoustic silencer for sound entrained flowing gases of internal combustion engines comprising a casing having an inlet port and an outlet port, a main channel for conducting said gases and through which the gas passes on its way from the inlet to the outlet port, a sound attenuating chamber acoustically coupled directly to said gas channel, said chamber decreasing in cross-sectional area progressively with the distance from its coupling to the main channel to its minimum area, said chamber being conical in part.

9. An acoustic silencer for sound entrained gases of internal combustion engines comprising a casing having a header at one end thereof, said header being provided with an inlet port, said silencer being provided with an outlet port, means providing at least part of a gas passageway within said casing through which the gas passes on its way from the inlet to the outlet port, a header at the other end of said casing, a partition within said casing, said partition supporting said means, said gas passageway having an opening into the space formed by one of said headers and said partition, said partition being provided with a plurality of small openings, the space formed by said last-mentioned header and said partition constituting an acoustic chamber acoustically coupled to said gas passageway and adapted to attenuate the sound entrained in the gases.

10. An acoustic silencer for sound entrained gases of internal combustion engines comprising a casing having a header at one end thereof, said header being provided with an inlet port, said silencer being provided with an outlet port, means providing at least part of a gas passageway within said casing through which the gas passes on its

way from the inlet to the outlet port, a header at the other end of said casing, a partition within said casing, said partition being substantially normal to the axis of said casing and supporting said means, said gas passageway having an opening into the space formed by one of said headers and said partition, said opening being at one side of the axis of the casing, the space formed by said last mentioned header and said partition constituting an acoustic chamber acoustically coupled to said gas passageway and adapted to attenuate the sound entrained in the gases.

11. A silencer for exhaust gases comprising a muffling unit through which the exhaust gas stream flows on its way to atmosphere and having provision at one end thereof for connection to the exhaust pipe of an engine, said muffling unit having in combination a tube of substantially uniform cross sectional area, said tube being provided with an exhaust gas inlet opening and separate outlet open areas, one of said open areas being formed in the walls of said tube by a series of relatively small openings and of sufficient relative effective area to provide a substantially unrestricted gas opening to atmspohere, the other of said open areas being formed at the end of said tube and constituting a sound energy opening, and means defining a sound trap chamber substantially closed on all sides except for an opening which is acoustically coupled with the later mentioned opening, a part of a wall of said sound trap chamber when cut by a plane being formed to one of the conic sections and provided with a plate forming one end thereof, said plate having formed therein said acustic opening, said chamber being of decreasing cross-sectional area from said opening to the other side of said chamber.

12. A silencer for exhaust gases comprising a muffling unit through which the exhaust gas stream flows on its way to atmosphere and having provisions for connection to the exhaust pipe of an engine and to a tail pipe leading to atmosphere, said muffling unit having in combination a tube, said tube being provided with an exhaust gas inlet opening at one end thereof, an outlet opening in the walls, and a further outlet opening at the other end thereof, one of said openings comprising a plurality of relatively small openings extending annularly and axially of said tube, one of said outlet openings constituting an exhaust gas outlet having communication with atmosphere through said tail pipe, the other outlet opening constituting a sound energy outlet having communication with means providing a relatively large chamber, said communication being such that there is a restriction to the return flow of the sound from said chamber to said tube, said chamber being closed on all sides except for said communication and constituting a sound trap, and an expansion chamber disposed at the inlet end of said tube and in communication with the inlet opening thereof.

13. An acoustic silencer for sound entrained flowing gases of internal combustion engines comprising a casing having gas inlet and outlet ports, a tube within said casing forming at least a part of a path for the flow of exhaust gas and operatively connected to said ports, means, including a plate extending transversely of said casing, providing a sound trap chamber for extracting sound from said gases, said chamber having said tube extending therethrough, and means, including an opening in said plate, providing an acoustic coupling between said chamber and said path, said chamber being arranged so as not to form a part of the path traversed by the major portion of said gases.

14. An acoustic silencer for sound entrained flowing gases of internal combustion engines comprising a casing having gas inlet and outlet ports, a tube forming at least a part of a path for the flow of exhaust gas between said ports, means providing sound trap chambers within said casing for extracting sound from said gases, one of said chambers having said tube extending therethrough and the other of said chambers being arranged at one end of said casing, said chambers being acoustically coupled to said path in such a way as not to form part of the path traversed by the major portion of said gases.

15. A muffling unit for silencing flowing gases of an internal combustion engine comprising a casing through which the gas stream flows having inlet and outlet openings and a path for the flow of gases between said openings, perforated means, in the shape of a cone, disposed across said path in such a manner that said gases flow through said perforated means and having an opening in the small end thereof, and means defining a sound trap chamber within said casing acoustically coupled to said path by said opening in such a manner that little or none of said gases flow through said chamber.

16. A muffling unit for silencing flowing gases of an internal combustion engine comprising a casing through which the gas stream flows having inlet and outlet openings and a path for the flow of gases between said openings, perforated means, in the shape of a cone, disposed across said path in such a manner that said gases flow through said perforated means and having an opening in the small end thereof, means defining a sound trap chamber within said casing acoustically coupled to said path by said opening in such a manner that little or none of said gases flow through said chamber, said sound trap chamber being formed in part by a partition extending across one end of said casing, said partition having an opening therein of materially less cross section than the cross section of said chamber and which opening forms a part of said acoustic coupling.

17. An acoustic silencer for sound entrained flowing gases of internal combustion engines and the like comprising means affording a passageway for the flow of gas through said silencer, means defining a sound attenuating chamber within the confines of said silencer, said chamber having a plurality of portions, and means providing a substantially parallel acoustic coupling between said gas passageway and said chamber portions.

18. An acoustic silencer for sound entrained flowing gases of internal combustion engines and the like comprising means affording a passageway for the flow of gas through said silencer, means defining a sound attenuating chamber within the confines of said silencer, said chamber having a plurality of portions, means providing an acoustic coupling between said gas passageway and said chamber portions, the sound energy emerging from said coupling being exposed substantially simultaneously to the silencing effect of both of said portions.

19. An acoustic silencer for sound entrained flowing gases of internal combustion engines comprising a casing having gas inlet and outlet ports, a tube within said casing forming at least a part of the path for exhaust gas and operatively connected to said ports, means providing a sound

trap chamber for extracting sound from said gases, said tube being perforated and arranged relative to the flow of gas so as to produce a double baffling effect on the flow of gases between said ports, said sound trap chamber being acoustically coupled to said path in such a manner that little or none of said gases flow therethrough, the cross sectional area of said chamber being appreciably greater than that of said coupling.

20. An acoustic silencer for sound entrained flowing gases of an internal combustion engine comprising a casing having inlet and outlet ports, means defining a main channel through which the gas passes on its way from the inlet to the outlet port, means defining a sound attenuating chamber acoustically coupled to said gas channel, said chamber being arranged at the outlet end of said silencer and in such a manner that little or none of said gases flow through said chamber, a second sound attenuating chamber, a partition common to said chambers, and tubular sound conducting means attached to said partition.

21. An acoustic silencer for sound entrained flowing gases of internal combustion engines comprising a casing having an inlet port and an outlet port, a tube within said casing forming at least a part of a path for exhaust gas and operatively connected to said ports, means, including a pair of plates extending transversely of said casing and in spaced relationship to the end walls thereof, defining a sound trap chamber for extracting sound from said gases, said chamber having said tube extending therethrough, and means providing an acoustic coupling between said chamber and said path, said chamber being arranged so as not to form a part of the path traversed by the major portion of said gases.

22. An acoustic silencer for sound entrained flowing gases of internal combustion engines comprising a casing having gas inlet and outlet ports, a tube forming at least part of a path for the flow of exhaust gases between said ports, means providing sound trap chambers within said casing for extracting sound from said gases, one of said chambers being formed at least in part by a pair of plates extending transversely of said casing in spaced relationship to one end thereof and having said tube extending therethrough, the other of said chambers being arranged at one end of said casing, means providing an acoustic coupling between said chambers and said path, the cross sectional area of at least one of said chambers being appreciably greater than that of said coupling.

23. An acoustic silencer for sound entrained flowing gases of internal combustion engines comprising a casing having gas inlet and outlet ports, a tube forming at least part of a path for the flow of exhaust gases between said ports, means providing sound trap chambers within said casing for extracting sound from said gases, one of said chambers being formed at least in part by a pair of plates extending transversely of said casing in spaced relationship to one end thereof and having said tube extending therethrough, the other of said chambers being formed at least in part by said one end of said casing and one of said plates, means including an opening in one of said plates providing an acoustic coupling between said chambers and said path, the cross sectional area of at least one of said chambers being appreciably greater than that of said coupling.

24. An acoustic silencer for sound entrained flowing gases of internal combustion engines comprising a casing having gas inlet and outlet ports, means forming a path for exhaust gas and operatively connected to said ports, means providing a sound trap chamber for extracting sound from said gases, perforated baffle means comprising a single tube having two sets of perforations through which gas flows in passing between said ports, means providing an acoustic coupling between said chamber and said path, said sound trap chamber being coupled to said path in such a manner that little or none of said gases flow therethrough, said chamber being abruptly enlarged adjacent said coupling.

25. An acoustic silencer for sound entrained flowing gases of internal combustion engines comprising a casing having gas inlet and outlet ports, a tube forming at least a part of a path within said casing for exhaust gas and operatively connected to said ports, one end of said tube having perforated means extending transversely thereof through which gas flows, means including a plate arranged in spaced relation to one end of said casing providing a sound trap chamber for extracting sound from said gases, means providing an acoustic coupling between said chamber and said path, the cross sectional area of said chamber being appreciably greater than that of said coupling.

26. In an acoustic silencing device for sound entrained flowing gases having a main sound and gas conducting channel defined at least in part by a tubular member through which the gases flow, a closed sound trap chamber through which little or none of said gases flow and having a restricted opening in its base to which one end of said tubular member is connected, said restricted opening providing an acoustic coupling from said chamber to said channel, said chamber being formed at least in part by a conical member.

27. An acoustic silencer for sound entrained flowing gases of an internal combustion engine comprising a casing having inlet and outlet ports, means including two expansion chambers spaced lengthwise of the casing and a perforated tube in gas flow relationship therewith defining a channel through which gas passes on its way from the inlet to the outlet port, means defining a sound attenuating chamber acoustically coupled to said gas channel, said chamber being arranged at the outlet end of the silencer and in such a manner that little or none of the gases flow through said chamber.

28. An acoustic silencer for sound entrained flowing gases of internal combustion engines comprising a casing having gas inlet and outlet ports, a tubular member forming at least part of a path for exhaust gas between said ports, means providing sound trap chambers within said casing for extracting sound from said gases, a plate forming a wall common to said chambers and having an open area therein, one of said chambers having said tubular member extending therethrough and the other of said chambers being arranged at one end of said casing, said chambers being acoustically coupled to said path in such a way as not to form part of the path traversed by the major portion of said gases.

29. An acoustic silencer for sound entrained flowing gases of internal combustion engines comprising a casing having gas inlet and outlet ports, a tubular member forming at least part of a path for exhaust gas between said ports, means providing sound trap chambers within said casing for extracting sound from said gases, a

plate forming a wall common to said chambers and having an open area therein, one of said chambers having said tubular member extending therethrough and the other of said chambers being arranged at one end of said casing, the cross sectional area of said chambers being materially greater than that of said tubular member.

30. An acoustic silencer for sound entrained flowing gases of internal combustion engines comprising a casing having gas inlet and outlet ports, means forming a path for exhaust gas between said ports, means including a partition extending transversely of said casing and providing a plurality of sound trap chambers for extracting sound from said gases and a perforated plate forming a wall common to said chambers, and means including a tubular member extending between said path and one of said chambers and through the other of said chambers, providing an acoustic coupling between said chambers and said path, said chambers being arranged so as not to form a part of the path traversed by the major portion of said gases.

31. An acoustic silencer for sound entrained flowing gases of internal combustion engines comprising a casing having gas inlet and outlet ports, means forming a path for exhaust gas between said ports, means including a partition extending transversely of said casing and providing a plurality of sound trap chambers for extracting sound from said gases and a perforated plate forming a wall common to said chambers, and means including a tubular member extending between said path and one of said chambers and through the other of said chambers, providing an acoustic coupling between said chambers and said path, the cross sectional area of said chambers being materially greater than that of said tubular member.

32. An acoustic silencer for silencing the noise of sound entrained flowing gases of the intake and/or exhaust system of an internal combustion engine such as are used in motor vehicles, said noise comprising a conglomeration of pitches, said silencer comprising a casing having inlet and outlet openings for said gases, and provision for connecting one of said openings to a gas conducting member which communicates with the cylinders of the engine, means defining a gas passageway within said casing between said openings, baffle means comprising a tubular member provided with perforations, said perforations forming at least a part of said passageway, means defining a sound trap chamber within said casing, separate from and acoustically coupled to said passageway, said acoustic coupling providing a restricted communication from said sound trap chamber to said passageway, said sound trap chamber being abruptly enlarged adjacent said communication to permit the rapid expansion of sound energy therein, said tubular member extending through a substantial portion of said chamber.

33. An acoustic silencer for silencing the noise of sound entrained flowing gases of the intake and/or exhaust system of an internal combustion engine such as are used in motor vehicles, said noise comprising a conglomeration of pitches, said silences comprising a casing having inlet and outlet openings for said gases, and provision for connecting one of said openings to a gas conducting member which communicates with the cylinders of the engine, means defining a gas passageway within said casing between said openings, means defining an expansion chamber and forming a part of said passageway, baffle means comprising a tubular member provided with perforations, through which gas flows from said expansion chamber to the interior of said tubular member on its way from said inlet to said outlet openings, means defining a sound trap chamber within said casing separate from and acoustically coupled to said passageway, said acoustic coupling providing a restricted communication from said sound trap chamber to said passageway, said sound trap chamber being abruptly enlarged adjacent said communication to permit the rapid expansion of sound energy therein.

34. An acoustic silencer having means providing a sound attenuating acoustic chamber, means affording a path for the flow of sound entrained gas through said silencer, said chamber having an opening in a wall thereof and to one side of the axis of said silencer by means of which said chamber is acoustically coupled directly to said path.

35. An acoustic silencer comprising a casing having ends, transverse partition means within said casing and located between said ends, said partition means and one of said ends forming at least part of an acoustic sound attenuating chamber, a tube forming at least a part of the path for the flow of gas through said silencer, said chamber being provided with an opening in a wall thereof, said opening being eccentrically disposed with respect to said casing, said opening forming an acoustic coupling directly between said chamber and said path and being of materially less effective cross-sectional area than the cross-sectional area of said chamber.

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