

[54] AIR INTAKE SILENCER

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[58] Field of Search: 181/33 D, 33 E, 33 F, 33 H, 181/33 HA, 33 L, 35 R, 35 A, 40, 48, 59

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[57] ABSTRACT

An air intake silencer that can be quickly attached to the carburetor of a snowmobile's internal combustion engine. The silencer contains a tuning chamber which is sized for a given engine speed in order to reflect pressure waves to provide the greatest engine torque output. The air intake silencer also contains a silencing chamber which silences the audible sound waves which are emitted from the engine. A third chamber acts as a balancing chamber between the first two chambers to further improve the engine performance.

4 Claims, 3 Drawing Figures

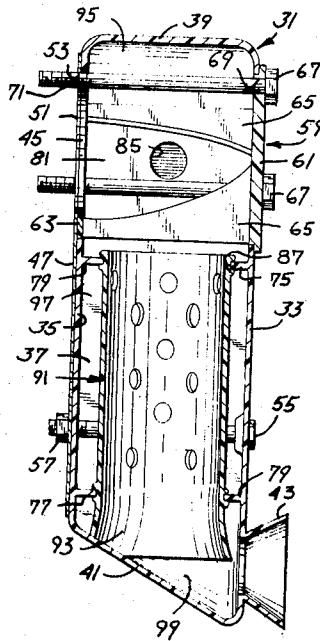


Fig. 1

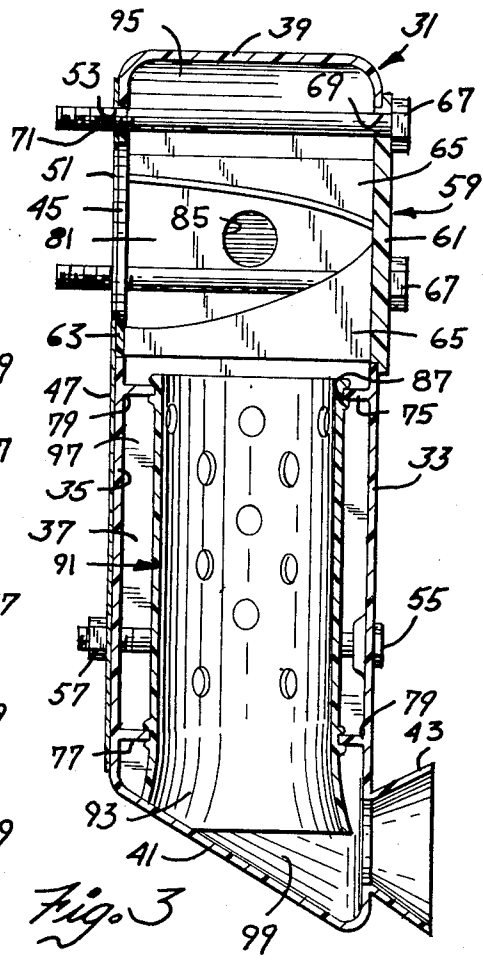
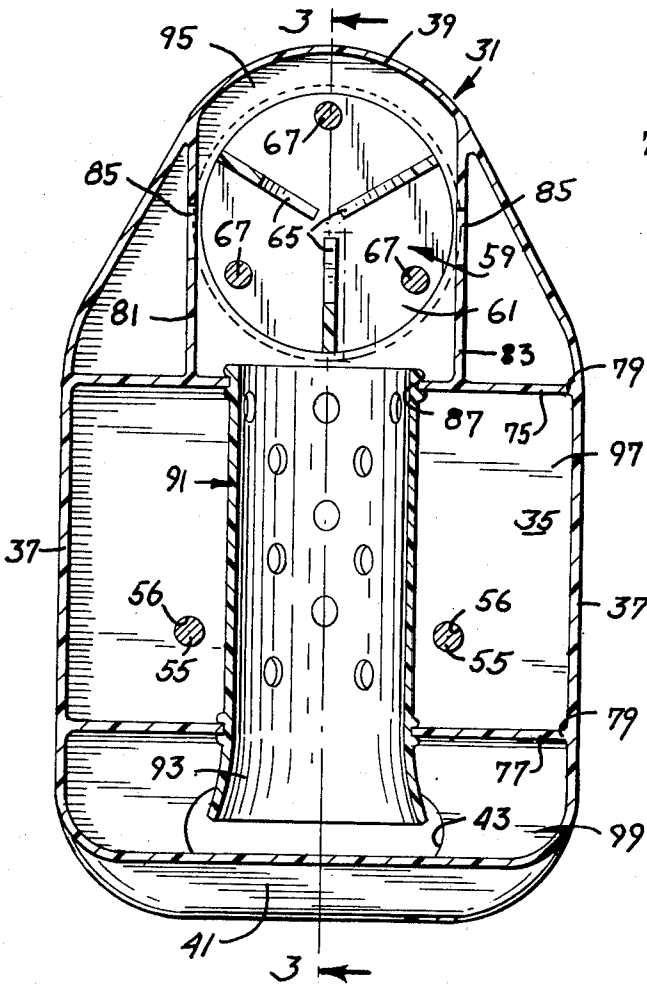
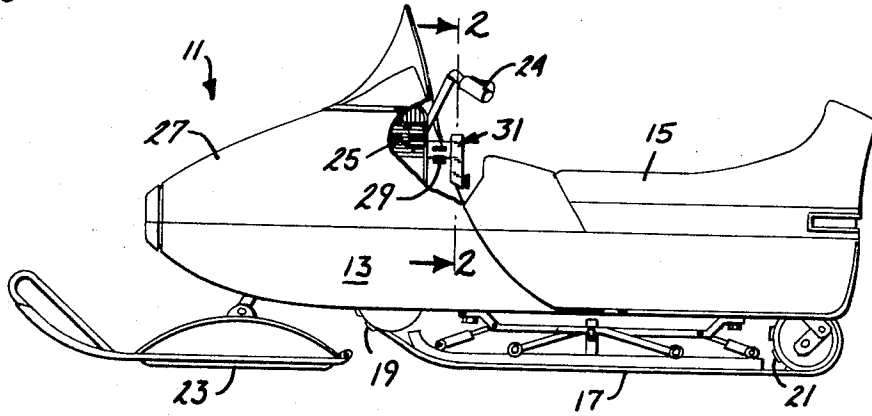


Fig. 2

Fig. 3

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AIR INTAKE SILENCER

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates generally to noise silencers for internal combustion engines and more specifically concerns air intake silencers for use with snowmobiles which muffle noises escaping from the air intake system and which also improve the engine's performance.

2. Description of the Prior Art

The design and manufacture of snowmobiles is attended by a number of problems. Among these is the keeping of the number of necessary components to a minimum to enable competitive manufacture while still providing a structurally sound, relatively noiseless pleasure vehicle. Of extreme importance is the necessity of attenuating a significant portion of the sound generated by the generally noisy two-stroke cycle engine which snowmobiles utilize. The prior art has dealt with this problem by muffling the exhaust system. However, in addition to muffling the exhaust path, a silencer should be provided in the air intake path to muffle noises escaping therethrough.

SUMMARY OF THE INVENTION

The present invention pertains to an air intake silencer for an internal combustion engine. The silencer provides a path for air to be supplied to the engine while it muffles noises escaping from the engine through the air intake system. The silencer contains three chambers which act to destruct the pressure waves generated by the engine which cause audible noise and which tend to reduce engine performance. The first chamber is a tuning chamber which is sized so as to change the phase of those pressure waves which are reflected back toward the engine. This reflected wave destructively interferes with pressure waves leaving the engine and properly calibrated increases engine performance. The second chamber acts as a noise silencing chamber and it has a perforated tube through the center thereof, which combination has the effect of changing the phase of sound pressure waves providing for their destructive interference with other sound waves. The third chamber is a balancing chamber of the first two chambers which further changes the phase of pressure waves thus further effecting the engine performance.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a side elevation view of a snowmobile having the air intake silencer mounted thereon;

FIG. 2 is a view taken along line 2—2 of FIG. 1 showing the internal portions of the air intake silencer; and

FIG. 3 is a view taken along line 3—3 of FIG. 2.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring first to FIG. 1, a snowmobile represented generally by the numeral 11 is shown to include a body 13, a seat 15 on which a driver and a passenger may ride, an endless track 17 driven by a drive sprocket 19 and supported by idler sprocket 21, a pair of front-running skis 23 (only one of which is shown), and a steering wheel or handle 24 which controls the position of skis 23 and determines the direction of travel of snowmobile 11.

Drive sprocket 19 is driven by a two-stroke cycle engine 25 which is mounted in an engine compartment within engine hood 27. For the supply of an air-fuel mixture to the engine crankcase a carburetor 29 is provided. Air intake silencer 31 is shown attached to carburetor 29 by apparatus which will be described later.

Referring now to FIGS. 2 and 3, the air intake silencer 31 is shown in greater detail. Silencer 31 can be built from polyethylene or any other suitable material. The silencer 31 is generally encased by front wall 33, back wall 35 and side walls 37. These walls further define a top portion 39 and a bottom portion 41. A bell-shaped air inlet port 43 is provided near the bottom portion 41 of air intake silencer 31 to allow air to flow through the air intake silencer 31 and out an air outlet port 45 to the carburetor 29.

In order to provide structural support and to dampen out shell noise in the polyethylene air silencer 31, a rigid backing plate 47 is attachable to the silencer 31. Backing plate 47 has mounting holes (not shown) for mounting to the silencer 31 and additionally has an air outlet opening 51 and carburetor adapting holes 53. Bolts 55 are insertable through holes 56 in walls 33 and 35 and through the holes (not shown) in backing plate 47 and held therein by nuts 57.

An adapter, generally designated 59, is provided to adapt silencer 31 to carburetor 29. Adapter 59 has a front portion 61, a back portion 63, and structural members 65. The distance between front portion 61 and back portion 63 is shorter than the distance between wall 33 and wall 35 in order that when bolts 67 are inserted through holes 69 in front portion 61, through holes 71 in back portion 63, through holes 53 in backing plate 47, and screwed within carburetor 29, the walls will be compressed toward each other which will serve to damp out shell noises within the silencer 31.

Located within air silencer 31 are a pair of parallel baffle plates 75 and 77. Baffle plates 75 and 77 are mounted to walls 33 at their peripheral edges 79. A second set of baffle plates 81 and 83 are shown abutting baffle plate 75 and top portion 39. Baffle plates 81 and 83 additionally have a hole 85 located therein.

Extending through hole 87 in baffle plate 75 and rigidly mounted thereto, and through hole 87 in baffle plate 77, and rigidly mounted thereto, is a perforated tube 91. Tube 91 is generally axial (along line 3—3) with respect to air intake silencer 31 and has a portion 93 extending past baffle plate 77 with a gradually increasing diameter.

A tuning chamber 95 is shown in the top portion of air silencer 31 and is generally defined by baffle plate 75, walls 33 and 35 and top portion 39. A second chamber 97 acts as a silencing chamber and is generally defined by baffle plate 75, baffle plate 77, walls 33 and 35, and side walls 37. A third chamber 99 acts as a balancing chamber and is generally defined by baffle plate 77, walls 33 and 35, and bottom portion 41. As shown, balancing chamber 99 is open to the air by way of bell-shaped air intake port 43, and tuning chamber 95 is open to carburetor 29 through opening 15.

In the operation of snowmobile two-stroke cycle engines an air-fuel mixture is transferred from the carburetor to the engine crankcase through an air intake port. This mixture is then transported to the engine

cylinder where it is exploded to drive a piston downwardly thus turning a functionally attached shaft to drive the drive sprocket 19. The movement of the piston within the cylinder and the cranking within the crankcase tends to be extremely noisy in two-cycle engines. This noise is detected by the human ear since pressure waves of various amplitudes and frequencies emanate from the engine through the exhaust system and additionally through the air intake system. It is a purpose of the present invention to silence these noises which escape through the air intake system. The silencing is accomplished by the silencer chamber 97 with the perforated tube 91 therein. This combination acts essentially as a Helmholtz resonator to destroy a certain band of frequencies. Although the mechanics of the resonator are well known in the art, in general, the combination has the effect of changing the phase of pressure waves within the chamber in order that they can destructively interfere with other pressure waves to reduce the amplitude of the resultant pressure wave and thus attenuate the audible noise. With two-stroke cycle engines, we attenuate the low amplitude (0.001 psi) high frequency (100-10,000 cps) audible pressure waves.

Additionally, the present invention deals with the power loss which is associated with silencing. Power output from the two-stroke cycle engine depends principally upon having an air-fuel mixture which is under high crankcase pressure in order to flow to the cylinder and to push the burned gases out of the cylinder exhaust port. However, with the piston reciprocating within the cylinder at rapid speeds, high-amplitude (higher than approximately 0.001 psi), low-frequency waves (20-300 cps) are generated from the crankcase and through the air intake system. If the pressure within the crankcase is low at the closing of the air intake port, the power output will consequently also be low. When providing a restriction in the air intake path in order to silence the high-frequency, low-amplitude audible waves, the restriction may reflect back toward the engine crankcase a higher amplitude, low-frequency pressure wave which is in phase with pressure waves leaving the crankcase and thus further reduce the crankcase pressure at air intake port closing. We found that this destructive interference does occur. Thus, in order to increase power output, the air intake silencer provides apparatus which in addition to silencing the noises emanating from the engine tends to increase the pressure of the fuel-air mixture within the crankcase at air intake port closing. The tuning chamber 95 provides this function. Tuning chamber 95 reflects pressure waves back through the air intake system, and to the crankcase, which are of different phase than pressure waves emanating therefrom in order to cause their destructive interference. A pressure-time history is desired which provides peak pressure at air intake closing. For an engine at a selected typical speed, the optimal volume and shape of the tuning chamber 95 can be determined empirically by measuring engine torque output. The actual wave reflection is accomplished by the volume defined by top portion 39, baffle plates 81 and 83, walls 33 and 35, and baffle plate 75. The volume outside of baffle plates 81 and 83 offers very little additional tuning but is provided to make silencer 31 more structurally sound and aesthetically pleasing.

We found that the silencing chamber 97 tends to destroy the performance of tuning chamber 95 since silencing chamber 97 reflects some high-amplitude, low-frequency waves which are in phase with the waves emitting from the engine. In order to correct this, balancing chamber 99 is provided for further increasing the engine performance. Balancing chamber 99 reflects waves back through the air intake system which arrive in chamber 99 at a later time than at tuning chamber 95 and when reflected are further out of phase than waves reflected from tuning chamber 95. These waves destructively interfere with waves emitting from the crankcase and with waves reflected by silencing chamber 97 in order to increase crankcase pressure at air intake port closing thus increasing engine performance. We found that by protruding tube 93 into balancing chamber 99 and by providing an increasing diameter on tube 93, waves are gathered easier which further increases engine performance.

What is claimed is:

1. For a snowmobile having a two-stroke cycle engine and a carburetor for supplying an air-fuel mixture thereto, an air intake silencer, comprising:
 - a. a housing having a plurality of chambers therein;
 - b. an air intake port mounted on said housing for the transfer of air to said housing;
 - c. an air outlet port for the transfer of air out of said housing;
 - d. means attaching said housing to said carburetor for the transfer of air from said outlet port to said carburetor;
 - e. a tuning chamber defined by said housing for the reflection of pressure waves of different phase from pressure waves emanating from said two-stroke cycle engine through said air outlet port;
 - f. a balancing chamber defined by said housing and disposed therein so that pressure waves emanating from said engine reach said balancing chamber at a later time than when said pressure waves reach said tuning chamber for the reflection of pressure waves of different phase than said waves reflected from said tuning chamber and different in phase from said waves emanating from said two-stroke cycle engine; and
 - g. a silencing chamber defined by said housing and disposed therein so that pressure waves emanating from said engine reach said silencing chamber at a later time than when said pressure waves reach said tuning chamber and prior to when said pressure waves reach said balancing chamber, said silencing chamber having a perforated tube mounted therein with one end extending into said tuning chamber and the other end having a gradually increasing diameter and extending into said balancing chamber for changing the phase of sound pressure waves providing for their destructive interference with other sound pressure waves.
2. An air intake silencer for internal combustion engines, comprising:
 - a. a housing;
 - b. an air intake port mounted on said housing for the transfer of air through said housing;
 - c. an air outlet port for the transfer of air out of said housing;

- d. first means disposed within said housing for changing the phase of sound pressure waves providing for their destructive interference with other sound pressure waves;
 - e. second means disposed within said housing for the reflection of pressure waves of different phase from pressure waves emanating from said internal combustion engine through said air outlet port; and
 - f. third means disposed within said housing for the reflection of pressure waves of different phase than said pressure waves reflected by said second means, different in phase from any pressure waves reflected by said first means, and different in phase from pressure waves emanating from said internal combustion engine.
3. The apparatus of claim 2, wherein:
- a. said second means includes a tuning chamber defined by said housing;
 - b. said third means includes a balancing chamber defined by said housing; and
 - c. said first means includes a silencing chamber defined by said housing with a perforated tube mounted therein with one end extending into said tuning chamber and the other end having a gradually increasing diameter and extending into said silencing chamber.
4. An air intake silencer for internal combustion engines, comprising:
- a. a casing having walls, a top portion, a bottom por-

- tion, and an air inlet port for receiving air into said silencer and an air outlet port for the transfer of air out of said silencer;
- b. first and second baffle plates mounted within said casing, said baffle plates having their peripheral edges secured to the interior of said walls and being spaced from each other and from the top and bottom portions of said casing, said first baffle plate associating with said top portion and said walls to define a tuning chamber, said outlet port opening said tuning chamber for the transfer of air out of said silencer, said first baffle plate and said second baffle plate associating with said walls to define a silencing chamber, said second baffle plate associating with said bottom portion and with said walls to define a balancing chamber, said inlet port connecting said balancing chamber to a source of air, each of said baffle plates having an opening therein; and
- c. a tube having a top end and a bottom end, said tube being mounted in said opening in said top baffle plate and in said opening in said bottom baffle plate, said top end thereof extending into said tuning chamber, and said bottom end thereof extending into said balancing chamber, said tube having a gradually increasing diameter at the bottom end thereof extending into said balancing chamber, said tube having perforations in the walls thereof communicating with said silencing chamber.

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