United States Patent

[11] 3,590,945

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[54] **TUNED RESONANCE MUFFLERS**
11 Claims, 5 Drawing Figs.

[52] **U.S. Cl.** **181/40, 181/65**
[51] **Int. Cl.** **F01n 1/08, F01n 1/22, F01n 7/10**
[50] **Field of Search** ..... 181/36, 40, 47, 47.1, 56, 64, 60—62, 64.1, 65

[56] **References Cited**
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3,482,649	12/1969	Murphy	181/40
3,497,031	2/1970	Kedziora	181/40 X

Primary Examiner—Robert S. Ward, Jr.
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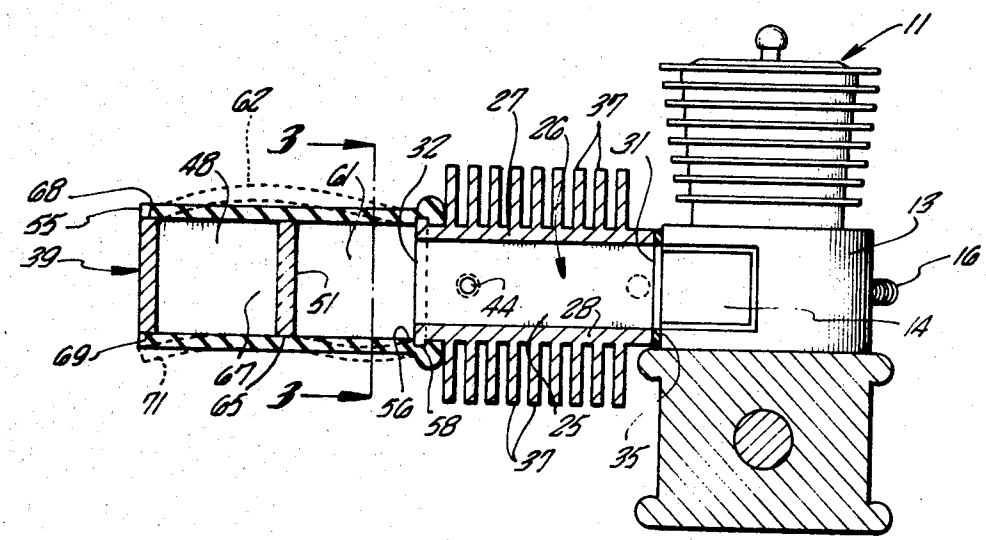
ABSTRACT: An exhaust tube has transverse cooling fins extending from two opposite sides. A restrictive band circles the exhaust gas emitter to hold the tube entry port against the emitter exhaust port. A U-shaped bracket extends from adjacent the exit port of the tube, which has either a fixed or an adjustable baffle secured transversely of the legs of the U. A resilient sheath covers the bracket and is sealed to the tube at one end and open at the other end but blocked by the base bar of the U-shaped bracket. Gas passes about each transverse edge of the baffle, distending the sheath. Gas passes the end base bar, also, so that the sheath pulsates in two zones in accordance with the gas output and the position of the baffle with respect to the length of the gas column.



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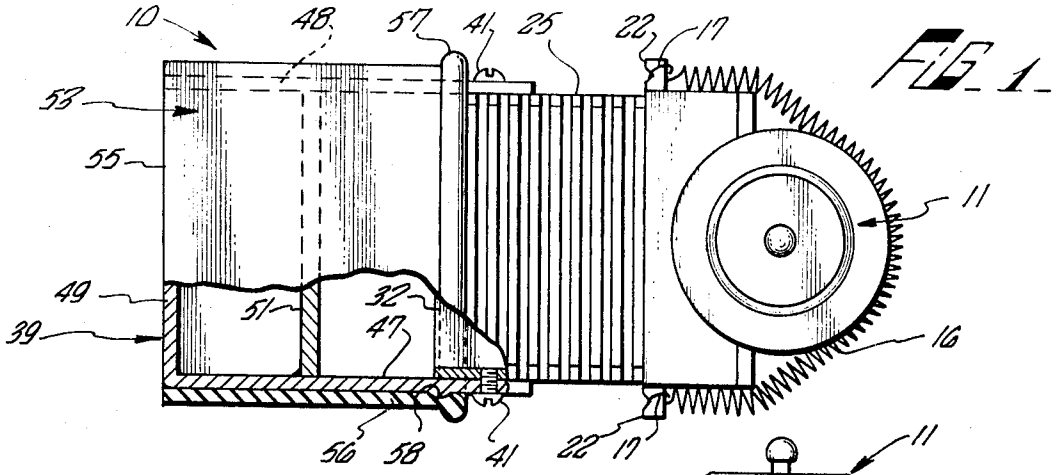

FIG. 1

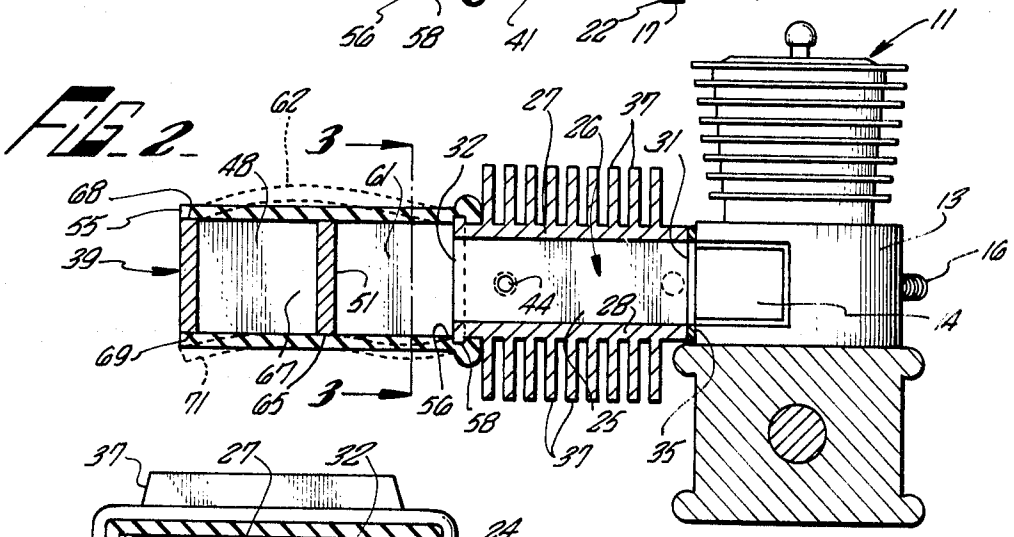

FIG. 2

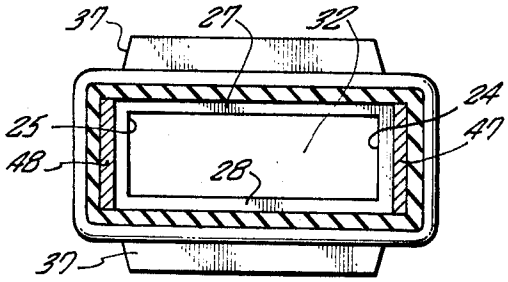

FIG. 3

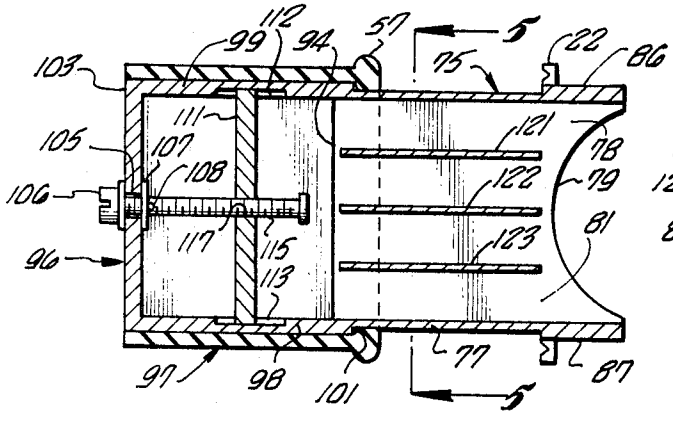

FIG. 4

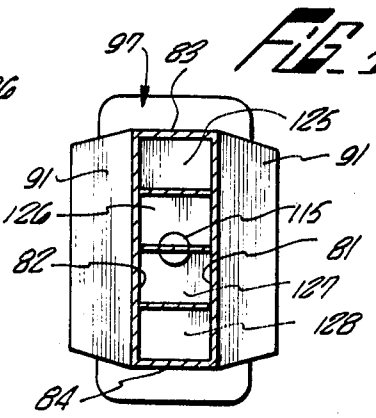

FIG. 5

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TUNED RESONANCE MUFFLERS

BACKGROUND OF THE INVENTION

The invention relates to mufflers for devices emitting gas under pressure, such as Jacobs brake systems, and also small combustion engines such as shown in my U.S. Pat. No. 3,482,649 entitled "Exhaust Muffler for Combustion Engines" issued Dec. 9, 1969.

Certain air-exhausting devices and combustion product emitting devices (such as fractional horsepower or relatively small internal combustion engines) emit unpleasant whines or howls or other noises due to the velocity of escaping gases. Such noises sometimes interfere with use of the devices and with the enjoyment of hobbies when such engines are used in miniature craft, such as boats, autoracers and airplanes. In particular, the high revolutions per minute of the fractional horsepower engines results in a high-pitched sound which is most unpleasant. Conventional mufflers adapted to use with these fractional horsepower engines cause back pressure which reduces the power output.

Because of the relatively high velocity at which miniature craft operate, it is desirable that the components be economical in price since crashes of various sorts usually result in some damage to the devices. The present invention not only proffers devices which obviate the problems set forth above, but embodies the solution to such problems in a device in which the muffler can be resonance tuned for finer device performance.

SUMMARY OF THE INVENTION

The invention contemplates a tuned resonance muffler for exhaust gases emerging from an emitting device and comprises a metallic tube having entry and exit openings with means such as a flexible band to secure the tube at the emitter gas exhaust port. The exit outlet of the tube has an adjacent support bracket extending from the tube. The support bracket is preferably U-shaped with its base bar remote from the tube outlet. A transverse baffle is supported in the bracket and a flexible sheath surrounds the bracket, preferably defining with the bracket a rectangular volume.

One end of the sheath is secured in gastight fashion to the metallic tube while the other end of the sheath is open but blocked by the base bar of the bracket. The end inner surfaces of the sheath are in movable contact with the base bar edge surfaces and the median portion of the sheath is in displaceable contact with the transverse baffle. As the exhaust gases pulsate through the muffler, the sheath fluctuates into and out of contact with the base bar and the baffle periodically to exhaust the gases past those members. The metallic tube preferably has heat-dissipating means on the tube, such as fins.

In a preferred embodiment of the invention the baffle is secured within the support bracket by means adjustable to change the position of the baffle with respect to the length of the gas column defined by the muffler.

The invention accomplishes the objects of lowering both the noise volume and the tone pitch and accomplishes these objectives without measurable loss of power. The invention also affords a muffler which can be resonance tuned and in which the tuning of a preferred muffler can be adjustable.

The advantages of the invention are therefore afforded in a muffler which is adapted to a wide range of gas emitters and which is economical and easy to fabricate with conventional methods and tools and may be fabricated from presently available materials. Other advantages of the invention are apparent from the following detailed description and drawing in which like parts are designated by like reference numbers.

BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 is a plan view, partly in section, of a muffler in accordance with the invention in place on a fractional horsepower engine;

FIG. 2 is a longitudinal section of the muffler of FIG. 1;

FIG. 3 is a transverse section taken along line 3–3 of FIG. 2;

FIG. 4 is a plan section of an alternate embodiment of the invention; and

FIG. 5 is a transverse section taken along line 5–5 of FIG. 4.

In the embodiment of FIGS. 1—3 a muffler **10** in accordance with the invention is attached to a fractional horsepower engine **11** such as a 0.049-cubic-inch model airplane engine as made by Cox and other hobby goods manufacturers. The engine has an exterior wall **13** having an exhaust port **14** (see FIG. 2) about which the muffler **10** is attached. The means of attachment may be a helically wound spring wire **16**. The ends **17, 18** of the wire are fixed removably to exterior a pair of pegs **21, 22** which extend oppositely from opposite walls **24, 25** of a metallic exhaust tube **26**. As can be seen from FIG. 3, walls **24, 25** are joined by spaced parallel walls **27, 28** to define a rectangular volume. The walls terminate oppositely in an inlet opening **31** and an outlet opening **32**, outlet opening **32** being remote from exhaust port **14** of the engine.

The tension of the spirally wound spring wire **16** holds the tube against the cylinder wall and a sealing gasket **35** seals between the wall and the tube end.

The opposite walls **27, 28** of the exhaust tube **26** have extending from them a plurality of cooling fins **37**. Preferably the fins are integrally formed with the metallic tube. The fins serve as heat radiators and aid in cooling the exhaust gases.

A U-shaped bracket **39** is secured to the tube **26** by fasteners such as the bolts **41** which are threadably engaged with tapped holes **44** in the walls **25, 26** near exit opening **32** of the metallic tube. Each screw extends through a leg **47, 48** of the support bracket **39**, fixing the bracket to the exhaust tube.

The legs are integral with a base bar **49** of the U-shaped bracket and support a resonance baffle **51** intermediate their extent. The baffle is tack-welded or brazed at a selected distance from tube opening **32**, said distance being computed to establish the proper tuned resonance for the muffler considering the engine to which it is attached.

The support bracket **39** is encompassed by a resilient sleevelike sheath **53**. The sheath is rectangular in transverse cross section and open at both ends. The outer end **55**, in normal configuration, approximates the configuration of base bar **49** which acts as a closure for the end **55** of the sheath. An inner end **56** is normally slightly smaller than the outer transverse configuration of the opening **32** of the exhaust tube **26**. A continuous thickened band **57** surrounds inner end **56** of the sheath and restricts that end of the sheath about a continuous bead **58** on the outer periphery of the exhaust tube opening. The bead and the restricting band combine to form a gastight seal between the sheath and the exhaust tube.

In operation, gas is discharged from the engine port **14**, progresses through tube **26**, losing heat through the conduction of the metallic tube and its fins **37**, and emerges into a first chamber **61** defined by the end of the exhaust tube and the baffle **51**. Gases expand the sheath wall between the legs **47, 48** of the support bracket in the dotted lines **62** of FIG. 2, passing gas over the transverse edges **64, 65** of the baffle **51**. The gas then passes into a second chamber **67** defined by the baffle and the base bar **49** within the sheath and discharges about the transverse edges **68, 69** of the baffle by displacing the sheath in the configuration shown at dotted lines **71** of FIG. 2. The sheath is alternately displaced such that both of its internally exposed walls are in the attitude of the dotted lines **62** and then both walls are in the attitude of the dotted lines **71**. The two attitudes are shown together in FIG. 2 for the purposes of illustration only and the sheath is not believed to assume both configurations at the same instant.

The sleevelike sheath may be of **30** to **60** shore silicone rubber or Neoprene and have a wall thickness of one-sixteenth to three thirty-seconds of an inch when used for model engines. The alternate configurations of the sheath under the pulsations of discharged gases are approximately sinusoidal and the force necessary to distend the sheath appears to damp the noise of the exhaust gases without appreciably affecting the power output of the engine.

The metallic exhaust tube may vary in thickness with the material used. A metallic tube of 0.030-inch-thick magnesium has performed successfully. An aluminum tube 0.045-inch-thick wall has given performance characteristics substantially equal to that of the magnesium tube. Those exhaust tubes defining a rectangular volume appear to have better performance characteristics than those tending toward cylindrical configurations. It is thought that the greater metallic surface needed to define a rectangular volume than to define a cylindrical volume leads to a greater heat exchange, with a consequent lowering of gas pressures, which may affect performance.

The transverse dimension of the exhaust tube may vary from 1¼ inches to 1½ inches, depending upon the cubic displacement of the engine to which the muffler is attached. The initial placement of the tuning baffle **51** can be determined for the particular engine with which the muffler is to be used prior to assembly of the baffle in the support bracket.

In certain instances it may be desirable to have a resonance baffle which is adjustable after assembly of the muffler. The muffler could then be tuned to the particular engine and fuel to be used while in place on the engine. The embodiment of FIGS. **4** and **5** has such a capability. In those Figures a tuned resonance muffler **75** comprises a substantially rectangular exhaust tube **77** having an inlet opening **78** with a concave engine-abutting surface **79** on both the upper and lower walls **81**, **82**, respectively. Sidewalls **83**, **84** have thickened inlet portions **86**, **87** from which transverse pins **22** extend to afford anchor points for a tension band (not shown) to attach the muffler to a given engine. A plurality of fins, such as the fins **91**, extend at spaced intervals from the upper and lower walls **81**, **82**. Like the previously described embodiment, the fins **91** aid in the dissipation of heat by conducting the heat away from the discharged gas.

Walls **81**, **82** terminate at an outlet opening **94** at which point the gases are discharged into a substantially rectangular volume defined by a U-shaped support bracket **96** and a resilient sleevelike sheath **97**. Sheath **97** is similar in characteristics and configuration to the sheath **53** of the previously described embodiment. However, the U-shaped support bracket **96** of the embodiment of FIG. **4** is formed integrally with the sidewalls **83**, **84** of the exhaust tube. Proximate the outlet opening **94** of the exhaust tube, the sidewalls increase in thickness to define bracket legs **98**, **99**. The line of thickening of the legs defines a shoulder **101** which is carried continuously around outlet **94** to combine with a continuous sheath bead **57** in a gastight seal. The bracket has a base bar **103** in which a threaded adjustment member **105** is journaled. An exterior head **106** and an interior flat washer **107** retained by a transverse pin **108** through the adjustment member combine to secure the adjustment member rotatably in base bar **103**.

A resonance baffle **111** extends across the support bracket between baffle guide slots **112**, **113** in the bracket legs. The adjustment member has a threaded periphery **115** which is threadably engaged within a central threaded aperture **117** of the resonance baffle. By rotating the adjustment member the baffle is caused to move longitudinally within the support bracket, changing the length of the gas column from the exhaust port of an engine (not shown) to the baffle.

It has been found that engine performance is improved by dividing the muffler tube into two or more parallel ducts. It is thought that the walls defining the ducts enhance heat dissipation and lessen gas turbulence within the muffler. Therefore, the embodiment of FIG. **4** is provided with longitudinal inner walls **121**, **122** and **123** which divide the tube into ducts **125**, **126**, **127** and **128**, to channel gas flow.

In operation the embodiment of FIG. **4** is substantially the same as the previously described embodiment, with the exception that the resonance baffle may be adjusted or "tuned" while attached to the engine.

Other variations within the scope of the invention will occur to those skilled in this particular art, and I therefore desire that the aforementioned embodiments be regarded as illustrative only.

I claim:

1. A tuned resonance muffler for exhaust gases emerging from an emitting device having an exhaust port and comprising a metallic tube, an entry port on the tube, means adapted to secure the tube at the gas exhaust port such that the gases exhaust into the tube entry port, an exhaust outlet on the tube, an open support bracket extending from the tube outwardly of the outlet, a transverse baffle across the bracket, a flexible sheath surrounding the bracket, means securing an end of the sheath to the tube in gastight fashion, the other end of the sheath being open and in movable contact with the bracket surface and the median portion of the sheath being in displaceable contact with the baffle so as to fluctuate from the baffle to periodically exhaust gases past the baffle, and heat-dissipating means on the tube.

2. A muffler in accordance with claim **1** wherein the sheath and the support bracket define a normally closed rectangular volume.

3. A muffler in accordance with claim **1** wherein the transverse baffle is adjustable longitudinally of the bracket.

4. A muffler in accordance with claim **1** wherein the bracket comprises parallel side members each fixed at one end to the tube, an end member remote from the tube approximating the size and configuration of the end opening of the sheath, a longitudinally adjustable support shaft mounted in the end member, and means securing the baffle to the support shaft such that longitudinal motion of the shaft imparts motion to the baffle to reposition the baffle for tuning the muffler resonantly.

5. A muffler in accordance with claim **1** wherein the means adapted to secure the tube at the gas exhaust port comprises an elastic loop.

6. A muffler in accordance with claim **5** wherein the elastic loop comprises a spirally wound steel wire fixed at each of its ends to the tube.

7. A muffler in accordance with claim **1** wherein the heat-dissipating means comprises outwardly extending fins.

8. A muffler in accordance with claim **7** wherein the heat-dissipating means further comprises longitudinal metallic spaced walls within the tube in contact with the inner periphery of the tube.

9. A muffler in accordance with claim **1** wherein the sheath comprises a tube of approximately rectangular transverse configuration, said tube being of silicone rubber of 30 to 60 shore quality.

10. A muffler in accordance with claim **1** wherein the fit between the sheath and the bracket is such that pulsating exhaust gases cause alternate lifting of the sheath from a portion of the bracket and restriction of the sheath against the bracket portion.

11. A muffler in accordance with claim **1** wherein the support bracket comprises spaced side members each fixed at one end to the tube, an end member remote from the tube exhaust outlet, and a transverse tuning baffle fixed to the side members intermediate the end member and the outlet.