

June 8, 1948.

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2,442,773

SOUND SUPPRESSOR

Filed May 5, 1944

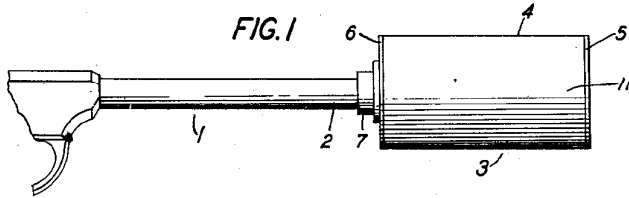


FIG. 1

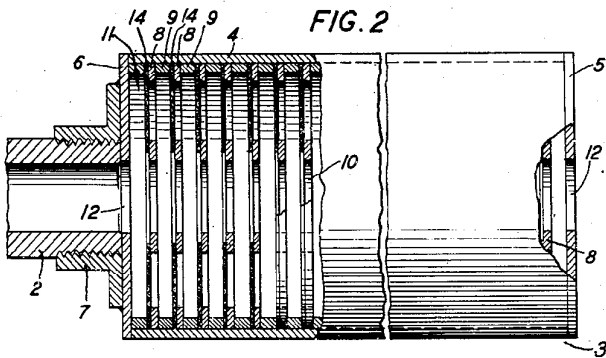


FIG. 2

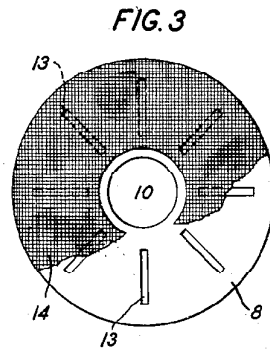


FIG. 3

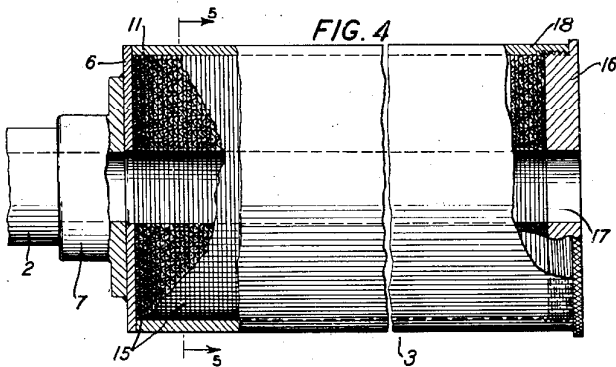


FIG. 4

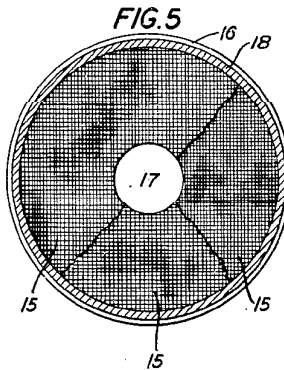


FIG. 5

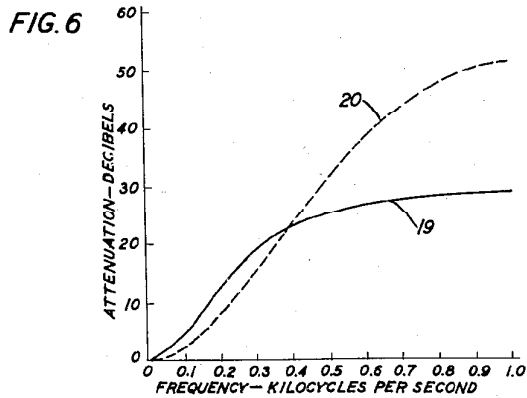


FIG. 6

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2,442,773

SOUND SUPPRESSOR

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Application May 5, 1944, Serial No. 534,259

1 Claim. (Cl. 181—42)

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This invention relates to the transmission of acoustic energy and more particularly to a device for suppressing sound waves in a gas.

The principal object of the invention is to attenuate or suppress sound waves in a gas, especially high pressure waves in a hot gas. Other objects are to reduce the size, weight and cost of silencers or mufflers and to increase the effective suppression band and the efficiency of such devices.

In designing devices to suppress sound waves of the type associated with the muzzle blast of a firearm or the exhaust of an internal combustion engine ordinary acoustic filter theory is inapplicable because of the high pressure in the wave and the high temperature of the gas. In accordance with the present invention a combination of principles is employed to provide silencers and mufflers which are very efficient in suppressing the sound over a wide frequency range and yet are comparatively simple in construction, low in cost, small in size and light in weight.

These principles include expanding the gas to reduce the pressure, cooling the gas and dissipating the energy associated with the sound wave before the gas is discharged into the atmosphere. The preferred embodiment of the device comprises an expansion chamber into which the gas is directed, an exit for the gas and metal screen within the chamber disposed in the path of the gas. In one form the screen may be placed over apertures in transversely disposed metal plates. In another form the transverse members are made entirely of screen and stacked one upon another so as substantially to fill the chamber. When used for firearms the silencer is attached to the muzzle and, of course, a passageway is provided for the bullet.

The nature of the invention will be more fully understood from the following detailed description and by reference to the accompanying drawings in which like reference characters refer to similar or corresponding parts, and in which:

Fig. 1 is a side view showing a silencer in accordance with the invention in place on a firearm;

Fig. 2 is a side view, partly in section, of the silencer shown in Fig. 1;

Fig. 3 shows one of the plates used in the silencer of Figs. 1 and 2, with the associated layer of screen partly cut away;

Fig. 4 is a side view, partly in section, of a modified form of the silencer shown in Figs. 1 and 2;

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Fig. 5 is a cross-section of the silencer of Fig. 4 taken along the line 5—5, with the first two screen sections partly cut away; and

Fig. 6 shows typical attenuation-frequency characteristics obtainable with the silencer of Figs. 1, 2 and 3.

Taking up the figures in more detail, Fig. 1 shows a portion of a firearm 1 to the muzzle 2 of which is attached a silencer 3 in accordance with the invention. The silencer 3 comprises an expansion chamber 11 formed by a metallic cylinder 4 and two annular end plates 5 and 6. To one of the end plates is secured an internally threaded collar 7 which is screwed onto the externally threaded muzzle 2 to hold the silencer 3 in place.

As shown in Fig. 2, within the chamber 11 are a comparatively large number of closely spaced, transversely disposed metal plates 8 separated by the metallic rings 9. The plates 8 and the rings 9 are welded or otherwise securely attached at their periphery to the cylinder 4. As shown more clearly in Fig. 3, each plate has a circular central hole 10. The holes 10 in the plates 8 and the holes 12 in the end plates 5 and 6 are lined up with the bore of the fire arm 1 and preferably are only sufficiently large to permit free passage of the bullet. Each of the plates 8 has a number of apertures 13 covered by a layer of fine metal screen 14 which may be soldered or otherwise secured to the plate 8, preferably on the side facing the muzzle 2. In Fig. 3 a portion of the screen 14 has been removed to show more clearly the plate 8.

Figs. 4 and 5 show a modified form of the silencer 3 in which the chamber 11 is substantially filled with annular sections 15 of metal screen stacked one upon another and held under compression by the threaded plug 16 which screws into the internally threaded end of the tube 18. Each of the sections 15 has a central circular hole 17 preferably only large enough to permit free passage of the bullet. The sections 15 are preferably made of a metal which is a good conductor of heat such, for example, as copper. In the cross-section of Fig. 5 a part of each of the first two screen sections 15 has been removed to show a portion of the following section.

As compared with a silencer comprising only non-dissipative branches, the dissipative type of silencer disclosed herein has the advantages that, for a given size, it will provide more attenuation over a wider range of frequencies and, furthermore, it will not accentuate certain frequencies which may correspond to the natural reso-

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nances of the branches. The chamber 11 permits an expansion and consequent reduction in pressure of the gas after it leaves the muzzle 2. In Fig. 2 the metallic plates 8 and the screen 14 and in Fig. 4 the sections of screen 15 rapidly cool the gas and overcome the resonance effects which would otherwise contribute to the sound. Another important function of the screens 14 and 15 is to introduce a viscous resistance which slows down the gas flow, reduces the sharp pressure wave in the chamber 11 and dissipates the energy.

Fig. 6 shows typical attenuation characteristics obtainable with the silencer of Figs. 1, 2 and 3. The attenuation in decibels is plotted against the frequency of the pressure wave in kilocycles per second. The solid line curve 19 applies to a silencer having twenty-nine plates 8 spaced 0.13 of an inch between centers. The plates 8 are two inches in diameter and have central holes 10 one-half of an inch in diameter. The eight apertures 13 in each plate 8 have a total area of 0.064 of a square inch and are covered by copper screen 14 of 100 mesh per inch made of four mil wire. The broken line curve 20 applies to a silencer which is similar except that the area of the aperture 13 has been reduced by half. It will be noted that the curve 20 shows somewhat less attenuation at frequencies below 0.4 kilocycle but considerably more at the higher frequencies. It is seen, therefore, that increasing the area of the apertures 13 will improve the attenuation at the low frequencies at the sacrifice of attenuation at the higher frequencies. In addition to the attenuation shown by the curves 19 and 20 of Fig. 6 there will be a reflection loss which may add as much as eight decibels at high frequencies and more at low frequencies. The attenuation may be increased by increasing either the cross-sectional area or the length of the chamber.

In the silencer shown in Figs. 4 and 5, the effectiveness in reducing sound is a maximum for sections of screen 15 in the neighborhood of 16 to 20 mesh per inch and decreases if the screen is either finer or coarser. In this type also the attenuation increases with either the length or cross-sectional area of the chamber 11.

In either of the silencers if the diameter of the chamber 11 becomes large enough to obstruct the line of sight the passageway for the bullet may be moved toward the top so that the silencer may

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be mounted on the muzzle 2 in a lower position.

Although the embodiments of the invention shown are particularly adapted for use as silencers for firearms, it will be recognized that the principles involved are also applicable to other types of sound suppressors such, for example, as mufflers for internal combustion engines. When the device is adapted for use as a muffler the holes 10 in the plates 8 and the holes 17 in the sections of screen 15 may, in some cases, be made much smaller or entirely eliminated.

What is claimed is:

A silencer for firearms comprising a cylindrical expansion chamber, means for attaching said chamber at one end to the muzzle of a firearm, a comparatively large number of closely spaced metal plates extending transversely across said chamber, and spacing rings positioned between said plates, said plates and said rings being securely attached at their periphery to the walls of said chamber, said plates having aligned circular holes only sufficiently large to permit free passage of the bullet therethrough, each of said plates having a plurality of comparatively narrow radial slots covered on the side of the plate facing the muzzle of the firearm by fine copper screen of the order of 100 mesh per inch secured to said plate, and the total area of said slots in each of said plates being small compared to the area of the plate.

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