

Dec. 13, 1938.

K. P. DURHAM

2,139,736

VORTICAL MUFFLING DEVICE

Filed Nov. 19, 1936

2 Sheets-Sheet 1

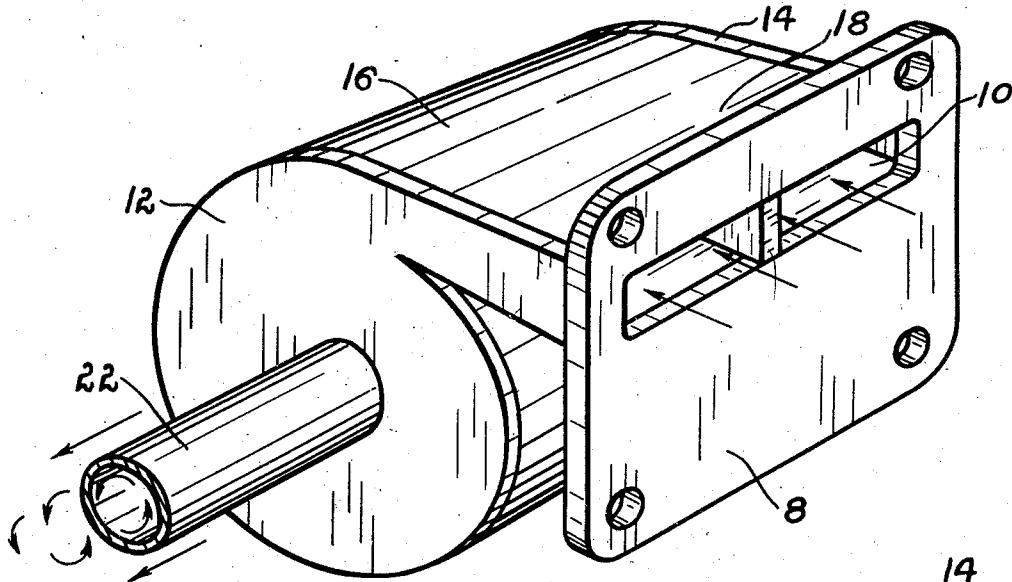


Fig. 1

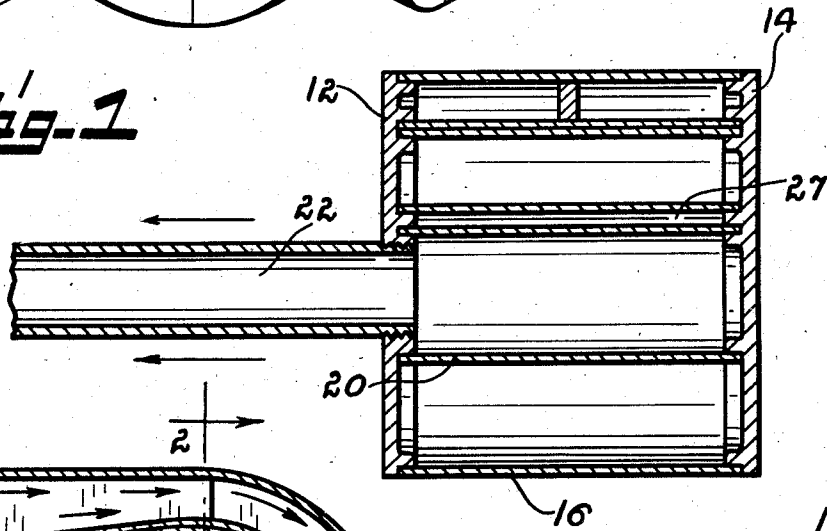


Fig. 2

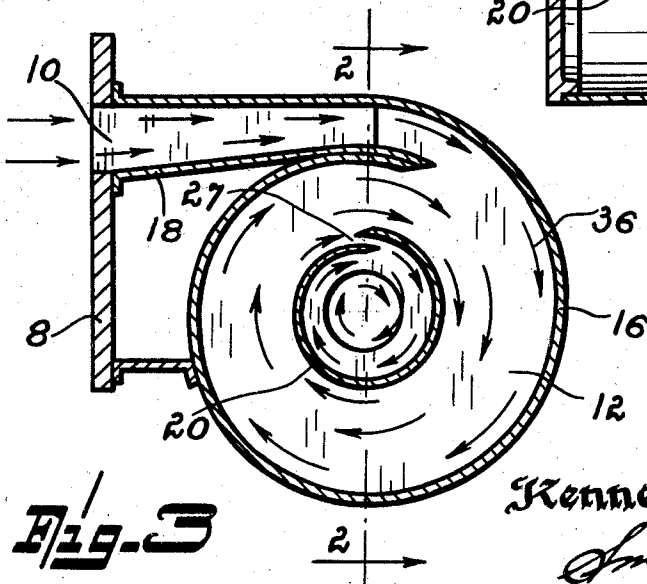


Fig. 3

INVENTOR
Kenneth P. Durham
BY
Smith & Tuck
ATTORNEYS

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2 Sheets-Sheet 2

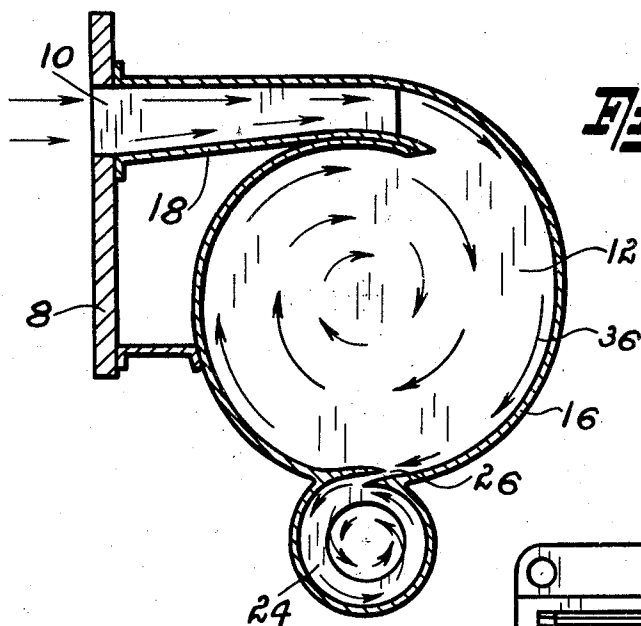


Fig. 4

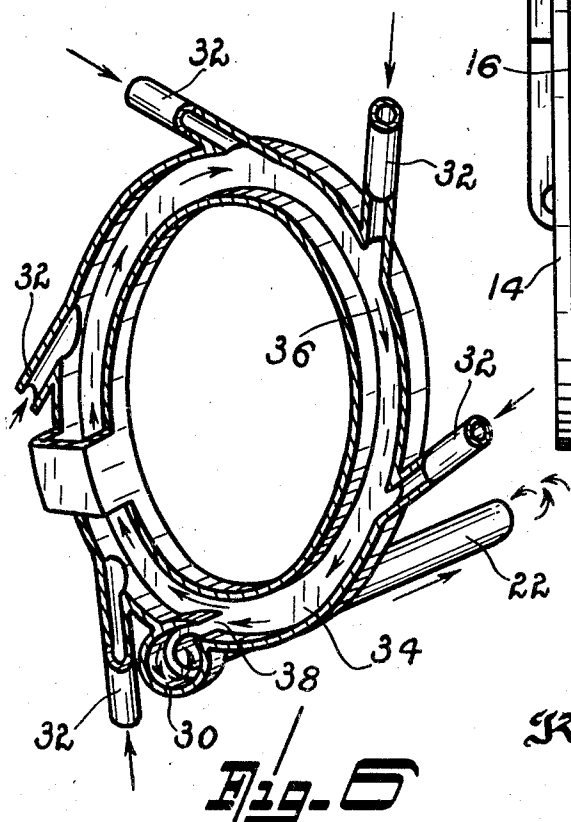


Fig. 5

INVENTOR
Kenneth P. Durham
Smith & Tuck
ATTORNEYS

UNITED STATES PATENT OFFICE

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VORTICAL MUFFLING DEVICE

Kenneth P. Durham, Seattle, Wash.

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2 Claims. (Cl. 181—58)

My present invention relates to the general art of mufflers such as are used for silencing the pulsating exhaust of gases under pressure produced by the various types of internal combustion engines, pneumatic motors, tools, machine guns, and the like. More specifically, my invention relates to a vortical muffling device.

In the construction of mufflers and silencing devices for gases under pressure, many conflicting theories have been employed as the basis of design. The outstanding requirement for such service is that the muffler be relatively small in size and, particularly, that it builds up, in the case of internal combustion engines, the least possible pressure on the exhaust gases, for such pressure is, in effect, a loss of efficiency. It has long been customary to provide against such losses in racing cars, racing motor boats, and the like, by discarding the silencing devices entirely. It is believed that I have, in my present design, overcome many of the faults inherent in prior muffler construction.

My muffler consists essentially of a chamber large enough to contain the exhaust product from a plurality of successive explosions. These gases are caused to circulate, or revolve, in a chamber having an outer wall substantially circular in form. This is accomplished by having the gases enter the chamber on a tangent to the periphery thereof. In this manner the gases are kept moving at high speed and each successive exhaust impulse adds further impetus to the speeding gases, so that the initial force of the exhaust gases, instead of being liberated to produce the usual report, which is a result of the pulsating pressures in the exhaust line, will be caused to revolve at high speed much as a fly wheel, attached to an internal combustion engine, revolves. Each successive explosion tends to accelerate the movement of the gases which have tended to slow up during the brief interval between explosions. Means are further provided for drawing the exhaust gases out of the exhaust chamber in a steady stream, so that the discharge from the muffler is, in effect, a steady, continuous flow of gas. This flow of gas is released without the usual report so common when explosions are emitted as successive discharges. With my present arrangement the condition causing such reports does not exist; this condition is, namely, the continual building up of reoccurring pressures which expels the gases from the outlet leaving successive voids which, in turn, rapidly fill with air.

Other and more specific objects will be appar-

ent from the following description taken in connection with the accompanying drawings, wherein

Figure 1 is a perspective view showing a muffler made after the teachings of my present invention.

Figure 2 is a longitudinal, sectional view through my muffler taken along the line 2—2 of Figure 3.

Figure 3 is a typical cross-sectional view through the muffler of Figure 1.

Figure 4 is a view showing a modified construction of the muffler shown in Figures 1, 2, and 3.

Figure 5 is an elevation of the muffler shown in Figure 4, certain parts being broken away and shown in section.

Figure 6 is a perspective view showing in general the application of my principles to a muffler suitable for a radially disposed engine, such as is used on airplanes and coming into more general use on rail-coaches, and the like.

Referring to the drawings, throughout which like reference characters indicate like parts, 8 designates the supporting flange for my muffler. This must of necessity be made of a shape and size to fit the exhaust opening of the motor, or equipment, with which my muffler is used. It is provided with the exhaust inlet opening 10 which should be of a size to admit the gases freely to the muffler body. While the exact construction of my muffler will vary in accordance with the installation requirements I find a convenient method of making it is to provide two end plates as 12 and 14 which are grooved on their inner faces in such a way as to accommodate the outer shell 16, the intake passage 18, and the exhaust scoop arrangement 20. A discharge tube 22, substantially concentric with the scoop member 20, is provided so that the exhaust may be led off to the desired discharge point. This may be under water in the case of a marine engine; to the rear of the fuselage in the case of an airplane; and to the rear of an automobile.

In Figures 4 and 5 I have shown an alternate arrangement in which the scoop member 24 is disposed on the periphery of the exhaust chamber. In this instance it will be understood that the discharge opening 26 should be somewhat reduced in size from the discharge opening 27 of the form shown in Figures 1, 2, and 3, in view of the fact that for corresponding sizes the pressure will be less at the center than at the outside.

In Figure 6 I have indicated another form of construction which would adapt my present arrangement to the radial type motor where it

might not be convenient to collect the exhaust from the various cylinders and lead them into a common duct which would communicate with the intake opening 10 of the muffler proper. In this modification the scoop tube arrangement 30 may be on the inside after the showing somewhat of Figure 3 or on the outside as indicated in the form shown in Figure 4. In some instances, however, installation requirements will of necessity indicate the form shown in Figure 6. Here a plurality of exhaust pipes 32 are led into an annular chamber so as to circulate the exhaust gases around the annular chamber, thus following the principles of my device in which the exhaust gases themselves are propelled around inside of the chamber to, in effect, produce a fly-wheel action.

Method of operation

In operating my device it will be noted that there is no tortuous path for the exhaust gases to traverse in going through the muffler; as a consequence the motor working at low speed and particularly in starting is not operating against any back pressure. As the exhaust discharge gains in frequency the gases begin to revolve within the exhaust chamber as indicated by arrows 36 and they are maintained in high speed rotation by the succession of exhaust discharges.

In designing a muffler for a certain motor it should be kept in mind that the exhaust chamber should be of sufficient size to accommodate several exhaust impulses so that the succeeding impulses will not tend appreciably to increase the pressure within the exhaust chamber and the gases will be traveling at substantially the same speed at which they are being discharged from the motor, or other device. The discharge from the exhaust chamber is accomplished by providing a scoop, as is illustrated in Figures 3, 4, and 6. This consists of a lip which provides the restricted discharge openings as 26, 27, and 38. Here a steady stream of exhaust gases are deflected from the rapidly revolving mass of exhaust gases and issues, with preferably a whirling movement, out through the exhaust discharge pipe 22. This whirling action tends to provide a more constant speed of travel for the exhaust gases and assists in their silent discharge.

The stationary scoop 26, 27, or 38, opposed to the rapidly rotating gases has relatively the same action as if the scoop were mechanically moved or revolved in a stationary gaseous medium. It is thus analogous to a turbine and, utilizing the kinetic energy of the rapidly rotating exhaust gases tends to pump the gases from the exhaust

chamber in a uniform stream and thus reduce the pressure in the exhaust chamber. When so operated it has been found also that there is actually a decided suction action at certain phases of the operating cycle. Each successive impulse imparts a certain amount of its kinetic energy to the moving column of gases, then during the period of decreased pressure, between exhaust impulses, the rapidly flowing gas carries on by virtue of its inertia, tending to draw out of the exhaust chamber a goodly portion of the gases contained therein. Experience has proved that with the proper proportioning of passageway, namely, the jet like arrangement of passageway 12 balanced against the restricted openings, as 26, 27, or 38, a muffler is produced with no appreciable back pressure. This characteristic adds in a marked degree to the smooth, quiet operation of the prime mover with no noticeable loss of power due to the balancing of the mean effective pressures by the pressure built up within the muffler. Such action, of course, is a net loss; and if this loss can be reduced appreciably, the actual power output of the unit in question is increased.

The foregoing description and the accompanying drawings are believed to clearly disclose a preferred embodiment of my invention but it will be understood that this disclosure is merely illustrative and that such changes in the invention can be made as are fairly within the scope and spirit of the following claims.

I claim:

1. In a muffling device, the combination with a substantially cylindrical casing having a tangentially disposed inlet duct for introducing gas under pressure against an inner wall of said casing, of a substantially concentric interior wall forming a separate discharge chamber having an outlet therefrom, said interior wall having a longitudinally extending restricted opening therethrough, the wall-ends forming said opening being overlapped with the outer wall-end projecting into the exhaust chamber, to form a scoop facing the path of movement of said gas.

2. In a muffler having a cylindrical expansion chamber, means for introducing gas under pressure tangentially against an inner wall of said chamber, said chamber having a restricted exhaust port in its wall, and a scoop located at said port extending slightly into the whirling gases in said chamber at an angle opposed to the direction of rotation of such gases.

KENNETH P. DURHAM.