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MUFFLER

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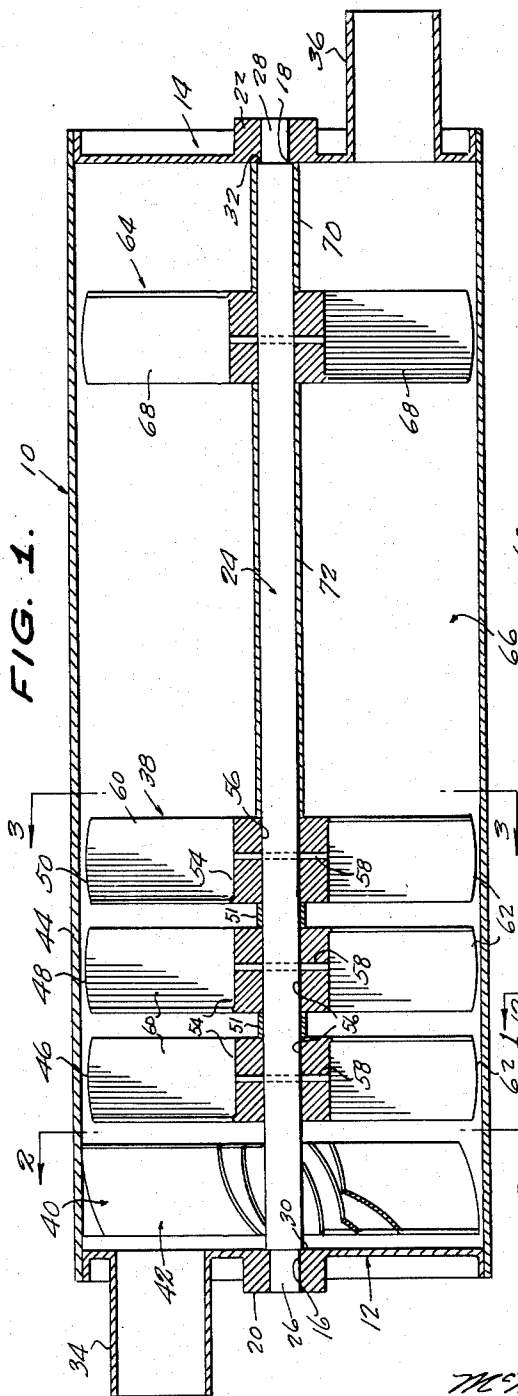


FIG. 2.

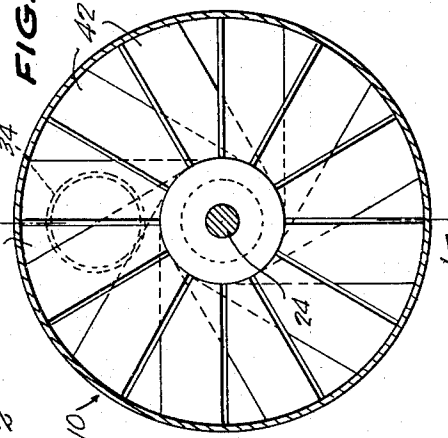


FIG. 3.

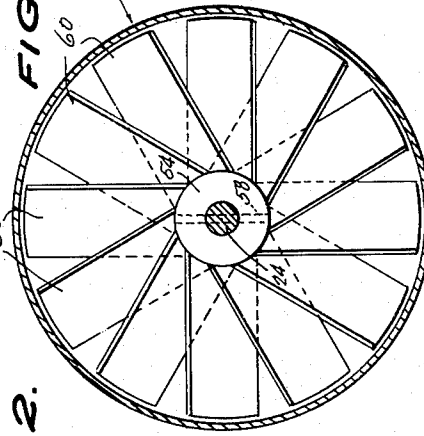
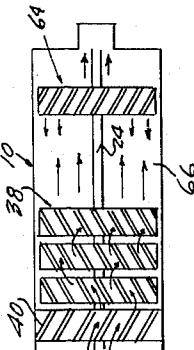


FIG. 4.



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This invention relates to an improved internal combustion engine muffler of the type having exhaust gas impelled means for reducing back pressure and noise within the muffler.

The primary object of the invention is to provide a more effective and efficient muffler of the kind indicated, which has turbine rotor means therein, driven by the entrance of engine exhaust gases into the muffler, which consist of a first rotor unit which serves to turn a single shaft and a second rotor unit, fixed like the first unit on the shaft, but pitched oppositely to the first unit, a space within the muffler between the first and second units being provided which serves as a turbulence chamber, in which the gases moving from the first unit toward the second unit meet with gases being moved by the second unit in an opposite or counter-current-direction, so that sound waves are cancelled and the silencing effect of the muffler is enhanced.

Another object of the invention is to provide a muffler of the character indicated above, in which the single shaft is externally journaled, so as to eliminate corrosion of shaft bearings which would be inherent with shaft bearings located in the interior of the muffler and in contact with gases and moisture passing through or collecting in the muffler.

A further object of the invention is to provide a muffler of the character indicated above, which, through eliminating internal barrels and partitions, can be made lighter in weight than conventional mufflers, and less subject to deterioration through corrosion, because of the consequent absence of pockets or chambers wherein exhaust gas formed acids can collect.

A still further object of the invention is to provide a muffler of the character indicated above wherein the turbine rotor units turn at speeds proportionate to the speed at which the associated engine is operated, so that proportionately increased reduction of back pressures in the muffler accompanies increases in speed of operation of the engine, so that a relatively constant rate of reduction of back pressure in the muffler is provided.

Other important objects and advantageous features of the invention will be apparent from the following description and the accompanying drawings, wherein, for purposes of illustration only, a specific form of the invention is set forth in detail.

In the drawings:

FIGURE 1 is a longitudinal section of a muffler of the present invention taken on the line 1—1 of FIGURE 2;

FIGURES 2 and 3 are transverse sections taken on the lines 2—2 and 3—3, respectively, of FIGURE 1; and

FIGURE 4 is a diagrammatic view, on a reduced scale, showing the flows of exhaust gases in the muffler, when the associated engine is in operation.

Referring in detail to the drawings, wherein like numerals designate like parts throughout the several views, the illustrated muffler comprises an elongated tubular

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cylindrical closed and imperforate shell or casing 10, preferably of uniform diameter, having a forward end wall 12 and a rear end wall 14. These end walls have axial openings 16 and 18, which are surrounded by suitable anti-friction, and suitable gas-sealed, external bearings 20 and 22, respectively.

A single shaft 24 extends axially in the casing 10, and between the end walls 12 and 14, and is journaled at its ends in the bearings, the shaft having reduced end portions 26 and 28, which are engaged in the bearings 20 and 22, respectively, and which define thrust shoulders 30 and 32, respectively, on the shaft, which bear against inward ends of the bearings.

The casing end walls 12 and 14 have therein eccentrically positioned longitudinal intake and outlet necks 34 and 36, respectively, which can be substantially similar, but which are diametrically opposed to each other, the engine exhaust pipe (not shown) being connected to the intake neck 34, and the exhaust tailpipe (not shown) being connected to the outlet neck 36.

A forward multiple turbine rotor unit, generally designated 38, is fixed on the shaft 24 close to but spaced from the forward end wall 12. In the space between the forward end wall 12 and the forward rotor unit 38, is positioned a stationary guide vane or blade assembly 40, which serves to direct the exhaust gases, entering the muffler through the intake neck 34, to the forward rotor unit 38 at a suitable angle for rotating the unit 38, and hence the shaft 24.

The stationary vane assembly 40 can comprise a plurality of circumferentially spaced radial vanes 42, which partially overlap each other, and have, as seen in FIGURE 1, concavo-convex cross sectional shapes. The inward ends of the vanes 42 are suitably spaced from the shaft 24 and the outward ends thereof are suitably fixed to the casing side wall 44.

The forward rotor unit 38 is here shown as composed of three equally spaced and substantially similar bladed rotors 46, 48 and 50, which are equally spaced from each other along the shaft 24 by spacer sleeves 51 carried by the shaft 24. Each of the rotors comprises a hub 54 having an axial bore, receiving the shaft 24, and fixed on the shaft by suitable means, such as diametrical pins 58 extending therethrough. Formed on and suitably fixed, at their inward ends, to the hub 54 are similarly angled turbine blades 60, which have outward ends 62 which are spaced from and run close to the casing side wall 44. The blades 60 can be of any suitable forms, but are preferably thin and of concavo-convex cross section, and substantially of the same width from end to end.

A rear turbine rotor unit 64 is fixed on the shaft 24, at a point spaced rearwardly from the forward rotor unit 38, preferably greater than the length of the forward unit 38, and, in any case, at a point to provide between the forward rotor unit 38 and rear rotor unit 64, a turbulence chamber 66 which occupies a substantial, if not major part of the length of the casing 10.

The rear rotor unit 64 is spaced forwardly from the rear end wall 14 of the casing 10 at a substantial distance which can be greater than the length of the stationary vane unit 40. The rear rotor unit 64 consists of a single rotor, which can be substantially similar to the rotors 46, 48 and 50, its blades 68 are reversely angled with respect to the blades of the rotors of the forward

rotor unit 38. A spacer sleeve 70 on the shaft 24 spaces the rear rotor unit 64 from the rear end wall of the muffler casing, and the forward and rear rotor units 38 and 64 are spaced from each other, by such as a spacer sleeve 72 on the shaft 24.

In operation, engine exhaust gases entering the casing 10 eccentrically at its forward end, through the inlet neck 34, strike the stationary vanes 42 and pass between vanes 42 and are thereby directed, at angles to the axis of the shaft 24, against the blades 60 of the forward rotor unit 38, so as to turn the unit 38 and the shaft 24. When thus driven at speed, the rotor 38 drives the gases passing therethrough, rearwardly in the turbulence chamber 66, and against the rear rotor unit 64. While part of the gases moving rearwardly in the turbulence chamber 66 pass directly through the rear rotor unit 64, to the outlet neck 36, and into the tail pipe connected thereto, a major part of the gases striking the gear rotor unit 64 are directed forwardly therefrom into the turbulence chamber 66, counter-current to the gases moving rearwardly in the chamber. The resultant collision of and intermingling of the counter-current gas streams effects cancellation and attenuation of sound waves borne by the streams, which substantially enhance the silencing function of the muffler.

It is obvious that as the associated engine is operated at different speeds, so that exhaust gases at corresponding volumes and pressures enter the muffler, the turbine units will be rotated at substantially proportionate rates of speed, with proportionately increased or reduced rates of reductions of back pressure in the muffler, whereby the operating efficiency of the engine, in so far as it is influenced by back pressure in the muffler, is maintained at a constant level, at high, low, and intermediate speeds. It will also be observed that the above described muffler is desirably devoid of chambers or pockets, wherein moisture and exhaust gas acids could collect and corrode the muffler and shorten its life, and that the blower actions of the turbine units serves to sweep out of the muffler, through the outlet neck 36, any vagrant or potential accumulations of such deleterious material within the casing 10. The locations of the intake neck 34 at the upper part of the casing 10, and the location of the outlet neck 36 at the lower part thereof, are in aid of this scavenging of the muffler, especially of accumulations which collect at the lower side or bottom of the casing 10. The shaft bearings 20, 22, being outside of, rather than inside of the casing 10, makes them longer-wearing, because they are thereby kept cooler than otherwise and are not subjected to the corrosive effects of direct exposure to exhaust gases within the casing.

Although there has been shown and described herein a preferred form of the invention, it is to be understood that the invention is not necessarily confined thereto, and that any change or changes in the structure of and in the relative arrangements of components thereof are contemplated as being within the scope of the invention as defined by the appended claims.

What is claimed is:

1. An internal combustion engine muffler comprising an elongated closed and imperforate casing having a cylindrical side wall and forward and rear end walls, intake and outlet necks on related end walls and communicating with the interior of the casing, a stationary guide vane unit extending across the interior of the casing close to said forward end wall, forward and rear bearings fixed axially on said end walls, a shaft extending axially in said casing and journaled at related ends thereof in the bearings, said shaft extending through said guide vane unit, said guide vane unit comprising a plurality of spaced radial vanes partially overlapping each other and having the inward ends spaced from said shaft and having the outward ends fixed to said casing side wall, a forward turbine unit extending across the interior of the casing and positioned directly behind said guide vane

unit, said forward turbine unit comprising bladed rotor means fixed axially on said shaft, a rear turbine unit fixed axially on said shaft, said rear unit being spaced forwardly from said rear end wall, said rear unit being spaced rearwardly from said forward unit so as to define a turbulence chamber in the casing therebetween, said rear unit comprising a rotor having blades reversed in angle with respect to the blades of the forward unit.

2. An internal combustion engine muffler comprising an elongated closed and imperforate casing having a cylindrical side wall and forward and rear end walls, intake and outlet necks on related end walls and communicating with the interior of the casing, a stationary guide vane unit extending across the interior of the casing close to said forward end wall, forward and rear bearings fixed axially on said end walls, a shaft extending axially in said casing and journaled at related ends thereof in the bearings, said shaft extending through said guide vane unit, a forward turbine unit extending across the interior of the casing and positioned directly behind said guide vane unit, said forward turbine unit comprising bladed rotor means fixed axially on said shaft, a rear turbine unit fixed axially on said shaft, said rear unit being spaced forwardly from said rear end wall, said rear unit being spaced rearwardly from said forward unit so as to define a turbulence chamber in the casing therebetween, said rear unit comprising a rotor having blades reversed in angle with respect to the blades of the forward unit, said forward turbine unit comprising a plurality of rotors spaced from each other along said shaft, each of said rotors of said forward turbine unit including a hub circumposed about and fixed to said shaft, and a plurality of angled turbine blades projecting from said hub, the outer ends of the blades of each of said rotors of said forward unit being close to the casing side wall.

3. An internal combustion engine muffler comprising an elongated closed and imperforate casing having a cylindrical side wall and forward and rear end walls, intake and outlet necks on related end walls and communicating with the interior of the casing, a stationary guide vane unit extending across the interior of the casing close to said forward end wall, forward and rear bearings fixed axially on said end walls, a shaft extending axially in said casing and journaled at related ends thereof in the bearings, said shaft extending through said guide vane unit, said guide vane unit comprising a plurality of spaced radial vanes partially overlapping each other and having the inward ends spaced from said shaft and having the outer ends fixed to said casing side wall, a forward turbine unit extending across the interior of the casing and positioned directly behind said guide vane unit, said forward turbine unit comprising bladed rotor means fixed axially on said shaft, a rear turbine unit fixed axially on said shaft, said rear unit being spaced forwardly from said rear end wall, said rear unit being spaced rearwardly from said forward unit so as to define a turbulence chamber in the casing therebetween, said rear unit comprising a rotor having blades reversed in angle with respect to the blades of the forward unit, said forward turbine unit comprising a plurality of rotors spaced from each other along said shaft, each of said rotors of said forward turbine unit including a hub circumposed about and fixed to said shaft, and a plurality of angled turbine blades projecting from said hub, the outer ends of the blades of each of said rotors of said forward unit being close to the casing side wall.

4. An internal combustion engine muffler comprising an elongated closed and imperforate casing having a cylindrical side wall and forward and rear end walls, intake and outlet necks on related end walls and communicating with the interior of the casing, a stationary guide vane unit extending across the interior of the casing close to said forward end wall, forward and rear bearings fixed axially on said end walls, a shaft extending axially

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in said casing and journaled at related ends thereof in the bearings, said shaft extending through said guide vane unit, a forward turbine unit extending across the interior of the casing and positioned directly behind said guide vane unit, said forward turbine unit comprising 5 bladed rotor means fixed axially on said shaft, a rear turbine unit fixed axially on said shaft, said rear unit being spaced forwardly from said rear end wall, said rear unit being spaced rearwardly from said forward unit so as to define a turbulence chamber in the casing 10 therebetween, said rear unit comprising a rotor having

blades reversed in angle with respect to the blades of the forward unit, said chamber occupying a major part of the length of the casing, with the outward ends of the blades of the turbine units running close to the casing side wall.

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