Dec. 8, 1931. E. HUBY 1,835,053

MUFFLER

Filed Jan. 9, 1929

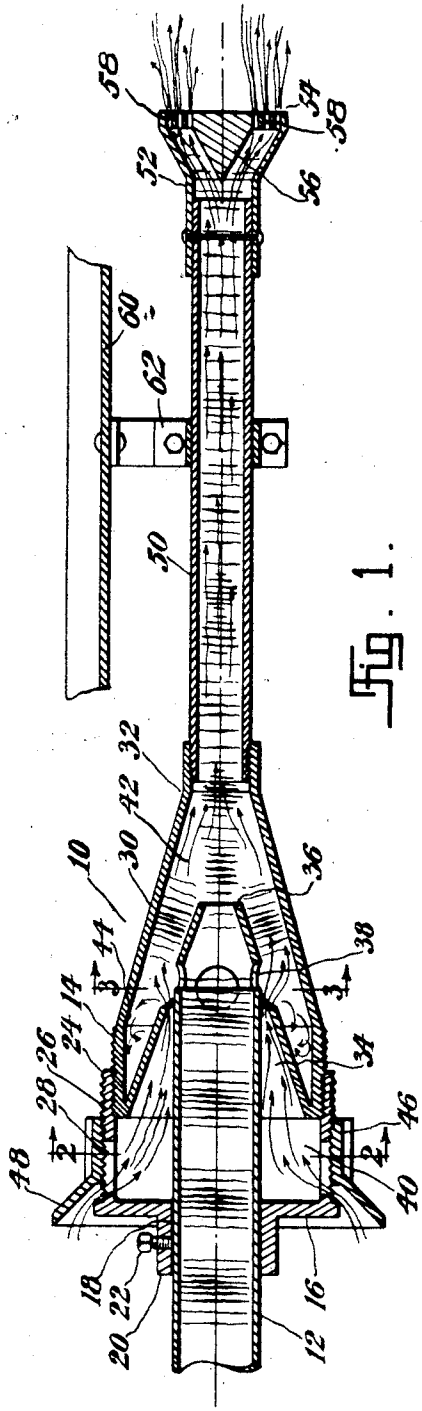

Fig. 1.

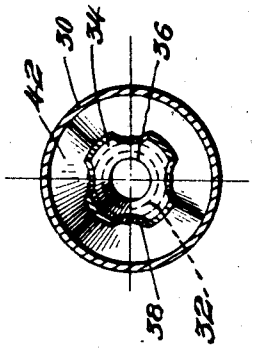

Fig. 3.

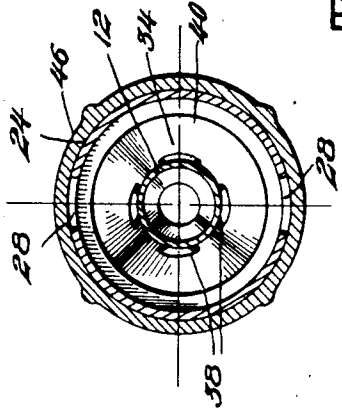

Fig. 2.

INVENTOR.
Ernest Huby
BY Thomas A. Jenckes Jr.
ATTORNEY.

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UNITED STATES PATENT OFFICE

ERNEST HUBY, OF PROVIDENCE, RHODE ISLAND

MUFFLER

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My invention relates to improvements in mufflers for internal combustion engines, particularly adapted for use in muffling sound produced by automobile, aeroplane and other types of internal combustion engines.

An object of my invention is to substantially muffle both velocity and pressure pulsations in the exhaust from an internal combustion engine without causing any substantial amount of back pressure or causing a loss in power. As the result of the back pressure being substantially eliminated, it is obvious that the improved muffler also functions as a power increaser as it lowers the exhaust pressure in the engine to substantially atmospheric and permits more explosive mixture to be introduced when the inlet valves are opened, the device in this manner functioning to lessen the knock in the engine and to minimize carbon formation as a further result of the better scavenging of the exhaust gas from the cylinders.

I preferably divide the pulsating flow in the main exhaust stream, throttle and also preferably absorb pressure pulsations in one portion thereof and also preferably substantially convert the pressure energy of the other portion thereof into velocity energy, by increasing the velocity thereof, entrain said throttle portion into said velocity increased portion, preferably delivering the pulsations of said throttled portion to said velocity increased portion substantially between the pulsations thereof and also preferably equalize the velocity of said combined portions, whereby pressure and velocity pulsations of an acoustic nature are substantially eliminated.

In my preferred embodiment I provide the usual exhaust pipe, a pressure pulsation absorbing chamber of substantial volume, throttling orifices connecting said exhaust pipe and chamber, a nozzle on the rear end of the exhaust pipe down stream of said throttling orifices, a converging bypass exterior of said nozzle connecting said throttling orifices and said chamber to the rear end of said nozzle and a velocity equalizing passage connected to the rear junction of the bypass. As stated hitherto, the frequency of the pulsations in the bypass will preferably permit them to be entrained between the pulsations of the velocity increased mains stream discharged rearwardly through the nozzle. In my preferred embodiment, the bypass preferably comprises a converging cone connected to a pressure pulsation absorbing chamber of substantial volume so that the pressure pulsations therein may be substantially absorbed before discharge into said main stream. The muffler is preferably so constructed as to substantially discharge the pulsations of the bypass stream into the main stream between the pulsations thereof at the normal operating rates for a standard type of engine. In order that my improved muffler, however, may be employed on different makes of engines operating at different cycles, I preferably provide means to regulate the velocity of the shunt bypass stream so that the pulsations thereof may be discharged into the main stream below the nozzle intermediate the pulsations therein. Also in addition to permit the pressure pulsation absorbing chamber to absorb the pulsations in said bypass stream, I preferably additionally employ an air vent in said pressure pulsating absorbing chamber and I preferably so construct my improved muffler that the air vent for said chamber may also be adjustable to admit the desired amount of air to regulate the velocity of the bypass stream for different makes of engines in their actual operating range.

These and such other objects of my invention as may hereinafter appear will be best understood from a description of the accompanying drawings, which illustrate an embodiment thereof.

In the drawings, Fig. 1 is a longitudinal

sectional view of a muffler constructed in accordance with my invention showing the means I additionally provide to attach the elongated velocity equalizing passage to the frame of an automobile.

Fig. 2 is a cross sectional view taken along the line 2—2 of Fig. 1.

Fig. 3 is a cross sectional view taken along the line 3—3 of Fig. 1.

In the drawings, wherein like characters of reference indicate like parts throughout, 10 generally indicates an improved type of muffler constructed in accordance with the teachings of my invention.

When my invention is attached to an automobile the usual exhaust pipe 12 is cut off at a point near the center of the automobile and my improved muffler attached thereto projecting rearwardly therefrom.

To provide the various bypass and pressure pulsation absorbing chambers of my invention, I preferably provide near the front end thereof a casing 14 having a closed front end 16 provided with a central hole 18 for mounting on said exhaust pipe 12 and a forwardly projecting cylindrical collar 20 provided with the set screw 22 for detachable securement of said casing around said exhaust pipe. Said casing 14 is provided with a substantially cylindrical front portion 24 provided preferably with an externally threaded periphery 26 and radial air holes 28 near the front end thereof for a purpose later to be described. Said casing 24 is also provided with a conical rear end 30 gradually tapering to a restricted orifice 32, said conical portion forming a Venturi converging cone.

For a reason to be described, said casing is provided with a conical flange 34 projecting inwardly substantially centrally thereof from the inner periphery of the cylindrical portion 24 thereof and terminating in a restricted nozzle 36 of smaller diameter than and spaced forwardly from said casing rear orifice 32. Said conical flange is preferably provided with the preferably equally spaced radial holes or throttling orifices 38 therein spaced from the nozzle 36 thereof and adapted to receive therein the rear end of the exhaust pipe 12 to form when attached to said exhaust pipe a forward frustro-conical pressure pulsation absorbing chamber 40 in front of said throttling orifices 38 and a rear hollow frustro-conical expansion chamber or bypass 42 leading to said casing orifice 32 to form a bypass from said throttling orifices 38 to down stream of said nozzle 36, also preferably provided with the enlarged pressure equalizing front end 44 in front of said radial throttling orifice 38. Though I have shown the casing 14 as formed in two portions in the drawings, it is obvious that it may be constructed integral if desired.

The operation of the part of my invention so far described consists in dividing the main flow stream discharged from the pipe 12, permitting a portion thereof to flow directly rearwardly through the nozzle 36 and the other portions to expand radially outwardly through the throttling orifices 38 into the bypass 42. It is obvious that the pressure pulsations in the portion of said stream expanding outwardly through said throttling orifices will be substantially absorbed in the front end 44 of the bypass 42 and in the pressure pulsation absorption chamber 40. The flow of the main stream has its pressure energy substantially converted into a velocity energy through the medium of the velocity increasing nozzle 36. It is thus obvious that the main stream will flow with increased velocity and that the portion of the stream bypassed through the throttling orifices 38 and bypass 42 will be entrained in said velocity increased stream down stream of said nozzle 36. It is also apparent that the internal pressure variations within the nozzle 36 are greatly decreased through the medium of the leakage outward through said throttling orifices 38 and subsequent pressure absorption in the chambers 40 and 44. As explained the parts of my invention are preferably so constructed as to permit the pulsations of said throttled portion to be delivered to said velocity increased main stream substantially between the pulsations thereof at the normal operating rates of the internal combustion engine.

In order that my invention may be attached to different types of internal combustion engines operating at different rates I preferably provide means to regulate the speed of the shunt bypass stream to permit the pulsations thereof to be entrained in the main stream between the pulsations thereof below the nozzle 36. It is also desirable that the pressure pulsation absorption chamber 40, in order that it may better absorb pressure pulsations, have a slight leak or air vent therein, which as shown discharges through the shunt bypass stream as said pressure pulsating absorbing chamber is connected to said shunt stream. It is obvious that the means to provide a leakage in said pressure pulsating absorption chamber and the means to increase the velocity of the shunt stream may be combined into one, and I thus preferably make an air vent or vents 28 in the front end of the casing. In order that said air vent may be adjustable to regulate the speed of the shunt stream, I preferably provide my improved muffler with an adjustable ring 46 threaded on the threaded periphery 26 of said front casing 14 and I also preferably provide it with the air deflecting cone 48 on the front end thereof to guide air rearwardly and radially inwards through said casing air holes 28 as shown by the arrows. As said ring may be adjustably threaded on said casing, it is obvious that the size

of the air holes may be adjustably varied to correspondingly vary the speed of the shunt stream.

I provide an elongated throat velocity equalizing passage 50 attached to said rear casing orifice 32. It is thus obvious that, in flowing through said velocity equalizing passage, the velocity of the combined portions, namely, the flow from the main stream and the bypass shunt stream may be substantially equalized, the velocity pulsations of an acoustic nature, thereby being substantially eliminated. Said chamber may be suitably secured to the automobile frame 60 by means of the supporting bracket 62 projecting downwardly therefrom.

I also preferably provide a novel type of a rear discharge end 52 for my muffler, said end, as shown, preferably comprising the diverging cone 52 preferably with the solid rear end 54. Said rear end 54 is provided with the solid cone 56 projecting forwardly therefrom forming a flow splitter and a plurality of axial air discharging holes 58 preferably of a combined area greater than that of the equalizing passage 50 exterior of said conical flow splitter 56. It is thus obvious that if any type of pulsations remain at the end of the discharge through the equalizing passage 50, there will be an even split rearward flow of the exhaust gases through the small axial holes 56 which will function to sieve out any remaining noise.

It is understood that my invention is not limited to the specific embodiments shown and methods described and that various deviations may be made therefrom without departing from the spirit and scope of the appended claims.

What I claim is:

1. A muffler for internal combustion engines, comprising a casing having a closed front end provided with a central hole for an exhaust pipe and a forwardly projecting cylindrical collar for mounting thereof on said exhaust pipe and further having a substantially cylindrical front portion provided with an externally threaded periphery and radial air holes near the front end thereof and a conical rear end gradually tapering to a restricted orifice forming a Venturi converging cone, and a conical flange projecting inwardly and rearwardly substantially centrally from the inner periphery of the cylindrical portion thereof terminating in a restricted nozzle of smaller diameter than and spaced from said casing rear orifice and having spaced radial holes therein spaced from the nozzle thereof adapted to receive the rear end of the exhaust pipe therein to form when attached to said exhaust pipe, a forward frusto conical pressure equalizing pulsation absorbing chamber in front of said holes and a rear hollow frusto-conical expansion chamber leading to said casing orifice, whereby the pulsating flow from the exhaust stream may be broken to allow a portion thereof to flow directly in pulsating manner through the nozzle and portions thereof to expand radially outwardly into said frusto-conical expansion chamber and contract in the narrow rear end thereof intermediate the pulsations of the exhaust stream, an adjustable ring threaded on the periphery of the front casing end having an air deflecting inlet cone on the front end thereof to guide air radially inwards through said casing air holes, an elongated throat equalizing passage attached to said rear casing orifice and a Venturi diverging cone at the rear end thereof provided with a solid cone projecting forwardly from the rear end thereof and a plurality of axial discharge holes.

2. A muffler for internal combustion engines, comprising, a casing having a closed front end provided with a central hole for an exhaust pipe and a forwardly projecting cylindrical collar for mounting thereof on said exhaust pipe and further having a substantially cylindrical front portion and a conical rear end gradually tapering to a restricted orifice forming a Venturi converging cone, and a conical flange projecting inwardly and rearwardly substantially centrally from the inner periphery of the cylindrical portion thereof terminating in a restricted nozzle of smaller diameter than and spaced forward from said casing rear orifice and having spaced radial holes therein spaced forward from the nozzle thereof adapted to receive the rear end of the exhaust pipe therein to form when attached to said exhaust pipe, a forward frusto covered pressure equalizing pulsation absorbing chamber in front of said holes and a rear hollow frusto-conical expansion chamber leading to said casing orifice, whereby the pulsating flow from the exhaust stream may be broken to allow a portion thereof to flow directly in pulsating manner through the nozzle and portions thereof to expand radially outwardly into said frusto-conical expansion chamber and contact in the narrow rear end thereof intermediate the pulsations of the exhaust stream, an elongated throat equalizing passage attached to said rear casing orifice and a Venturi diverging cone at the rear end thereof provided with a solid cone projecting forwardly from the rear end thereof and a plurality of axial discharge holes of a greater combined area than said equalizing passage exterior of said cone.

3. In a muffler, an imperforate exhaust pipe, a casing having a contracting rear portion terminating in an open end, a wall contracting from substantially the center of said casing to an exhaust nozzle spaced forwardly from said open end having radial discharge ports therein and adapted to receive the exhaust pipe end and to form a bypass expan-

sion and contraction chamber for a portion of the exhaust gases exterior thereof and a front pressure pulsation absorption chamber interior thereof, said wall being so shaped that the exhaust stream may be broken to allow a portion thereof to flow in pulsating manner through the nozzle and other pulsating portions thereof to expand radially outwardly into and through said bypass to join the other flow stream portion intermediate the pulsations thereof at the normal operating rate.

4. In a muffler, an exhaust pipe, a casing having a contracting rear end terminating in an open end, a wall contracting from substantially the center of said casing to an exhaust nozzle spaced forwardly from said open end having radial discharge ports therein and adapted to receive the exhaust pipe end and to form a bypass expansion and contraction chamber for a portion of the exhaust gases exterior thereof and a front pressure pulsation absorption chamber interior thereof, said exhaust pipe terminating substantially in the plane of said ports, said wall being so shaped that the exhaust stream may be broken to allow a portion thereof to flow in pulsating manner through the nozzle and other pulsating portions thereof to expand radially outwardly into and through said contracting bypass to join the other flow stream portion intermediate the pulsations thereof at the normal operating rate.

5. In a muffler, in combination, a non-restricting main flow passage having a nozzle therein, a contracting bypass therefor shaped to split the pulsations of the main flow stream and to permit the pulsating split portions thereof to rejoin the main stream intermediate the pulsations thereof at normal operating rates beyond said nozzle to form a more steady and even stream, and a pressure pulsation absorbing chamber of substantial volume communicating with said bypass and having an adjustable air vent therein.

6. In a muffler, in combination, a non-restricting main flow passage, a bypass therefor and a pressure pulsation absorption chamber of substantial volume communicating with said bypass having an adjustable air vent therein.

7. In a muffler, in combination, a non-restricting exhaust pipe, a pressure pulsation absorption chamber of substantial volume, throttling orifices affording communication between said exhaust pipe and chamber, a nozzle on the rear end of the exhaust pipe downstream of said throttling orifices, a converging bypass exterior of said nozzle affording communication between said throttling orifices and a chamber to the rear of said nozzle and a velocity equalizing passage connected to the rear end of the last mentioned chamber.

8. In a muffler, in combination, a non-restricting exhaust pipe, a pressure pulsation absorption chamber of substantial volume having an adjustable air vent therein, throttling orifices affording communication between said exhaust pipe and chamber, a nozzle at the rear end of the exhaust pipe downstream of said throttling orifices and a converging bypass exterior of said nozzle affording communication between said throttling orifices and a chamber to the rear of said nozzle.

In testimony whereof I affix my signature.

ERNEST HUBY.