Sept. 22, 1936. E. C. HORTON 2,055,453

MUFFLER

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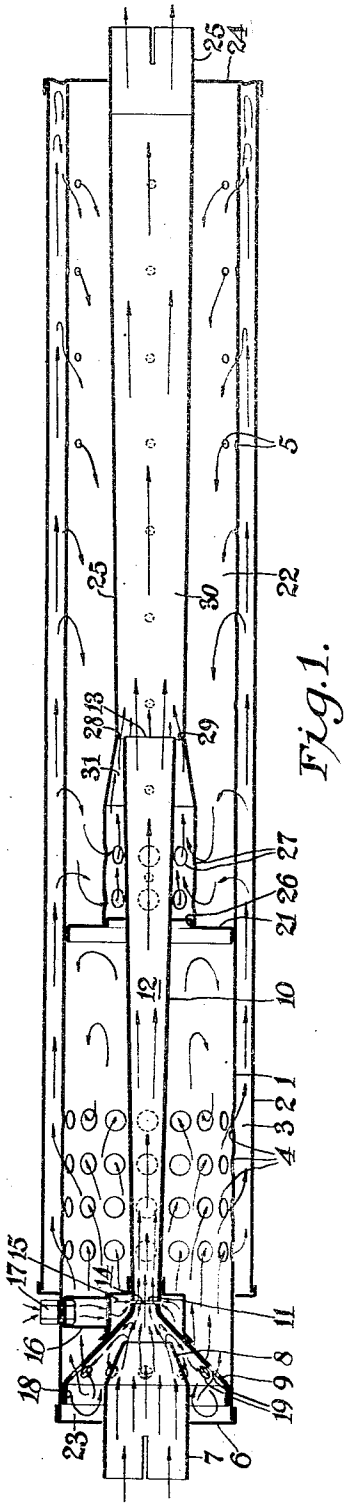

Fig. 1.

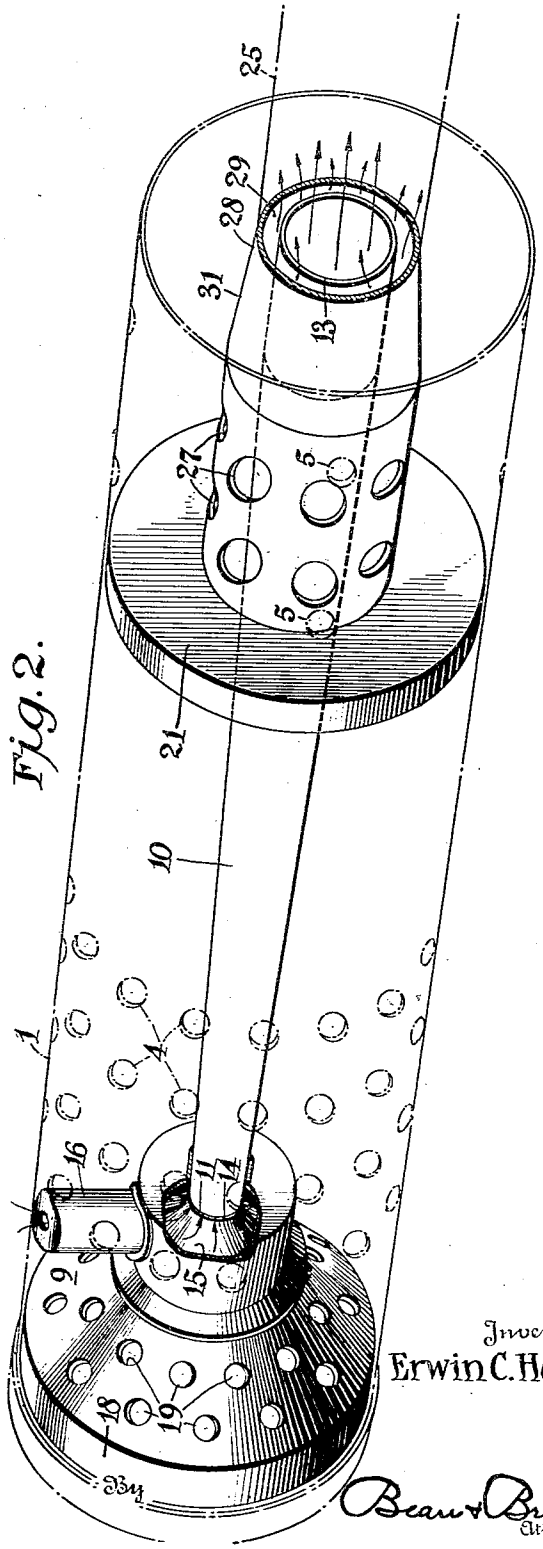

Fig. 2.

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MUFFLER

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7 Claims. (Cl. 181—44)

This invention relates primarily to a muffler for the exhaust of explosive engines and it has for an object to provide a construction which will efficiently muffle the exhaust noises without creating an objectionable degree of back pressure.

A further important object of this invention is to provide an efficient muffler embodying means therein for creating during the muffling action an induced flow of air into the exhaust gas stream in sufficient quantity to provide ample suction or low pressure for the operation of suction operated motors of automotive accessories, such as the windshield cleaner forming a part of the standard equipment of present day motor vehicles.

In the drawing, wherein one embodiment of the present invention is depicted:

Fig. 1 shows a muffler in longitudinal section, and

Fig. 2 is a fragmentary perspective view of the same with the shell illustrated in phantom and the injector modified only to the extent of having an increased number of overflow openings.

Referring more particularly to the illustrated embodiment, the muffler shell comprises a cylinder 1 enclosed for the major portion of its length by an outer cylinder 2 so as to provide an intervening space or chamber 3 between the walls of the cylinders. The inner cylinder of the shell is provided with a plurality of inlet openings 4 adjacent one end of the chamber 3, to permit ready inflow of gases thereinto, and a plurality of outlet openings 5 toward the opposite end of the chamber to permit return flow of the gases back into the cylinder 1, these outlet openings being increased in number toward the remote end of the chamber 3 so as to encourage the flow of the greater part of the gases for substantially the full length of the chamber.

The upstream end of the shell is provided with a head 6 through which opens the inlet pipe 7 which is adapted to be connected to the engine exhaust manifold. The inlet pipe tapers rather abruptly to form a nozzle 8 which will discharge the gases in a concentrated cone shaped blast at high velocity into the muffler shell.

The gases are discharged from this nozzle into an injector toward the throat thereof. According to the present showing the injector is of compound cone formation having an inlet cone 9 with a decided taper and an outlet cone 10 with a relatively gradual flare and greater length so that as the gases pass through the throat 11 of the injector they will emerge through the long expansion chamber 12, finally escaping from the discharge end 13 of the outlet cone.

The exhaust gases, as they discharge from the concentrating nozzle 8, are directed thereby into the throat 11 so that the concentrated, high velocity, stream of gases will be encouraged to crowd through the throat and provide a decided reduction in pressure at the entrance of the expansion chamber 12. This low pressure is utilized for creating suction for the operation of automotive accessories, the injector being provided with an opening 14 at the downstream side of the throat, such opening providing communication with a suction chamber 15. The opening 14 is in the form of a circumferential slit and preferably without substantial interruption at any one point so that air in the surrounding suction chamber 15 will flow radially inward from all sides. The suction chamber may be conveniently attached to both conical parts of the injector in a manner to firmly support and reinforce the structure about the apertured throat. The suction chamber 15 is in turn supported from the shell as by means of the nipple 16 through which communication is had with the chamber 15 from a suction operated accessory, the accessory conduit being attached to the nipple 16 by the coupling 17.

With the discharge nozzle being disposed within the inlet cone, or close to the restricted throat, the issuing gases will discharge in a concentrated blast into the throat of the Venturi-like injector and thereby be caused to move through the throat at a high velocity to induce an inflow of air through the slit 14 in sufficient volume to maintain a practical low pressure in the surrounding chamber 15. The apex of the conical nozzle is substantially at the throat in the preferred embodiment so that the issuing blast will be focused for the greatest efficiency. The inlet cone 9 may be flared outwardly and formed with a flange 18 for attachment to the inner wall of the shell so as to provide the necessary support for the injector and produce a sturdier muffler construction.

Provision is made for the escape of gases which emerge from the nozzle 8 and are not accommodated by the injector. To this end the interior of the shell member 1 is partitioned by a ring-like plate 21 into a fore compartment 20 and an aft compartment 22, and the outer portion of the inlet cone is provided with overflow or by-pass openings 19 which establish communication with the chamber 20. These overflow openings are preferably arranged rearwardly

from the discharge end of the inlet nozzle so that the overflow gases will be compelled to reverse their direction of flow. Fig. 2 differs from Fig. 1, as to the structure, in that an added row of overflow openings is illustrated. Compartment 20 has communication with the chamber 3 through the openings 4 whereas the compartment 22 has communication established with said chamber 3 by the openings 5. Consequently this unaccommodated or excess gas which escapes through the openings 19 will by-pass the injector through the openings 4, chamber 3 and openings 5. The partition plate has sealing contact with the inner wall of shell member 1 as well as the outer wall of the cone 10 and therefore aids in supporting the injector.

An annular channel 23 is formed by the opposed walls of tapering nozzle 8 and the encircling cone 9, the taper of the cone being preferably less than that of the cone so that the channel 23 will enlarge toward the escape openings 19 and thereby provide for the expansion of the gases as they move toward such openings, more in the nature of a Venturi tube. This will tend to accelerate such overflow movement of the gases as they back up from the crowded throat 11.

From the aft compartment 22 the by-passed gases find their escape to the outside atmosphere, but in so doing they are utilized to lower the pressure in the discharge end of the outlet cone 10 and thereby encourage the movement of the main gas stream through the injector for the production of greater suction in the chamber 15. This is accomplished by a Venturi tube 25. The down-stream end of the muffler shell is closed by a head 24 through which projects the discharge end of the venturi 25, the inner end of the latter being conveniently supported on a shoulder 26 of the partition plate 21. Adjacent the partition plate the venturi is provided with inlet openings 27 of a size to permit free ingress of the by-passed gases from the compartment 22.

The outlet cone 10 of the injector terminates in or adjacent the throat 28 of the venturi 25 and in spaced relation thereto so as to define therewith an annular throat orifice 29 about the discharge end 13. This forms a tubular body of the by-passed gases over the discharge end 13 of the outlet cone 10 and thereby pulls on the main gas stream and induces a faster flow thereof from the outlet cone 10. The main stream gases commingle with the by-pass gases in the expansion chamber 30 of the venturi and unite for joint discharge from the muffler.

From the foregoing description it is believed that the operation of the muffler will be clear, the discharge of the gases in a cone-like body from the nozzle 8 at a point close to and in substantial axial alignment with the throat of the injector serves to crowd the gases through the restricted throat of the injector whereby the latter will accommodate a larger volume at a high velocity and produce the desired degree of high vacuum in the chamber 15. The overflow of gases by-passed about the injector move through the chamber 3 and into the venturi 25 through the openings 27, being crowded by reason of the tapering chamber 31 through the ring-like throat orifice 29 so as to pull the main stream gases from the expansion chamber 12. This insures a maximum capacity for the injector, by reason of the pushing effect of the jet issuing from nozzle 8 and the conjoint pulling action of the reentering by-passed gases, so that a high degree of suction or vacuum in the chamber 15 is available for use in operating accessories. The concentrated intake with the overflow expansion channel 23, the multichambered by-pass, and the relatively longer expansion chambers 12 and 30 into which latter chamber the gases are reunited, all serve to afford a highly efficient muffling of the exhaust noises.

What is claimed is:

1. A muffler comprising an injector having a mouth discharging through a throat into an expansion chamber, said injector being provided with a suction opening on the downstream side of the throat, a concentrating inlet nozzle having a tapering discharge the apex of which is located substantially in the throat of the injector, and means for by-passing a portion of the gas about the throat.

2. A muffler comprising an injector having a mouth discharging through a restricted throat into an expansion chamber, an inlet nozzle having a tapering discharge into the throat, said injector being provided with an opening on the downstream side of the throat, means for by-passing a portion of the gas about the injector, and means for commingling the by-passed gases with the injector gases in a manner to increase the flow of gases through the injector.

3. A muffler comprising an injector having a mouth leading to a restricted throat, means providing for the by-pass of a portion of the gas from the mouth around the throat, and means for discharging the inflowing gases into the mouth at a point between the throat and said by-passing means whereby the by-passing gases will be compelled to reverse their flow within the mouth.

4. A muffler comprising an injector having a conical mouth opening through a restricted throat, an inlet nozzle disposed in the mouth and having an exterior wall tapering less than the opposing wall of the mouth whereby to define an annular rearwardly enlarging channel, and means communicating with the channel for by-passing a portion of the gas about the throat.

5. A muffler comprising an injector having a mouth opening through a restricted throat, an inlet nozzle disposed in the mouth and having an exterior wall tapering less than the opposing wall of the mouth whereby to define an annular rearwardly flaring channel, means communicating with the channel for by-passing a portion of the gas about the throat, a venturi having a throat into which the injector discharges, and means included in the first mentioned means for directing the by-passed gases through the throat of the venturi and about the discharge end of the injector to induce a faster discharge flow from the latter.

6. A muffler comprising an injector having a rearwardly flaring mouth defining a restricted throat and leading into an expansion chamber, a gas discharge nozzle located partially in the injector mouth, a venturi into which the injector extends to discharge into the throat thereof, a housing surrounding the injector and venturi, a transverse partition in the housing through which the discharge end of the injector extends, means communicating in by-passing relation from said mouth about the injector throat through the housing and around the partition into the venturi short of the discharge end of the injector for discharging by-passed gas into the venturi, and an opening in the throat of the injector communicating with the atmosphere.

7. In a muffler for internal combustion engines, a venturi having an entrance and a discharge end, a baffle plate connected to the entrance end of the venturi and having a central opening substantially alined with the Venturi throat, an injector having a discharge extension projecting through the baffle plate and terminating in spaced relation to the inner surface of the Venturi throat, said injector having a flaring entrance mouth, a gas directing nozzle disposed partially in the mouth and having greater gas capacity than the injector throat, said venturi having openings between its throat and the baffle plate, and double wall structure surrounding the venturi and injector and communicating from the injector mouth around the injector throat and into said openings of the venturi to by-pass gas from the mouth to the Venturi throat.

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