June 3, 1958 H. C. SAWYER 2,837,169

COMBINED ENGINE MUFFLER AND COMBUSTION CHAMBER

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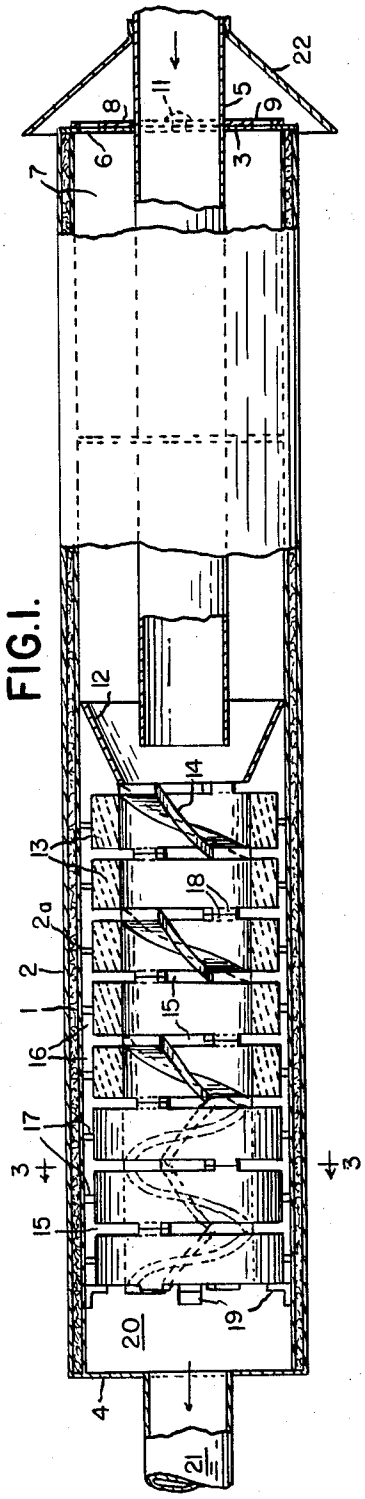

FIG. 1.

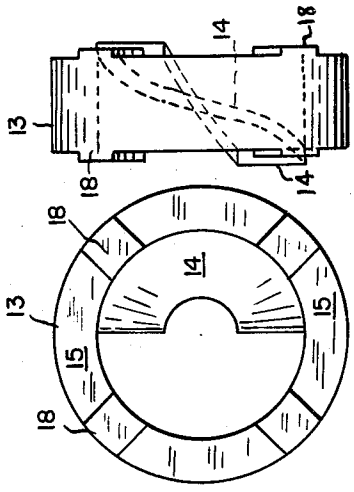

FIG. 5.

FIG. 4.

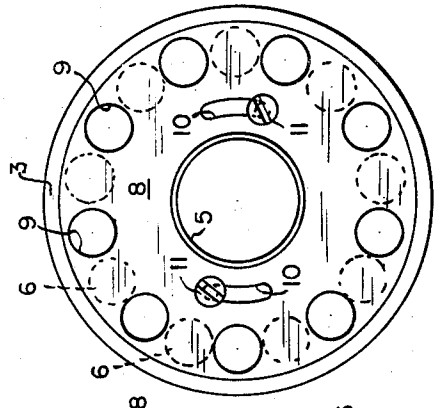

FIG. 2.

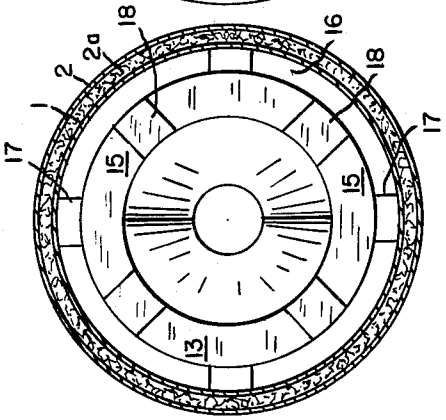

FIG. 3.

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COMBINED ENGINE MUFFLER AND COMBUSTION CHAMBER

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3 Claims. (Cl. 183—6)

This invention relates to internal combustion engine mufflers such as commonly serve to minimize noise induced by exhaust from such engines.

It is common knowledge that internal combustion engines fail to effect complete combustion of their fuels during idling or deceleration of such engines, and that consequently under such conditions, the exhaust gases include a large percentage of noxious ingredients and particularly carbon monoxide. Other such ingredients are tetra-ethyl lead and tri-cresyl phosphate and their lead and phosphoric compounds, sulphuric acid and sulphur dioxide, and other sulphur compounds, and ethyl and lead bromides, these being released primarily by certain fuel additives quite commonly used. When such noxious ingredients are present, the resultant pollution of the air is highly objectionable, contributing to various diseases and causing death if such pollution is concentrated.

An object of the invention is to provide a muffler exercising the added function of exposing the exhaust gases to a temperature adequate to complete combustion of unconsumed hydrocarbons, and thus transforming any poisonous carbon monoxide into harmless carbon dioxide, and similarly oxidizing any other combustible exhaust ingredients.

Another object is to deliver into a muffler, in addition to exhaust gases, a quantity of preheated air adequate to fully support such combustion as is required within the muffler.

Another object is to afford the exhaust gases flowing through a muffler a large area of contact with a refractory material of high thermal capacity, such as to maintain a temperature adequate with a suitable air supply to complete the combustion of such gases.

Another object is to form of refractory material a helical turbulator within the muffler, such as to retain heat and also impose on the gases a sinuous rotating turbulence in the axial area of the turbulator, thus tending to draw into the muffler such air as is required to support the desired combustion.

Another object is to admit air to the described muffler through a chamber surrounding a pipe delivering hot gases to a turbulator, and to so restrict the air flow in advance of the turbulator, as to derive a Venturi effect materially adding to such flow and automatically increasing the air supply as the volume and speed of the exhaust flow are increased.

Another object is to provide a regulation for the volume of air delivered to the described muffler, so that such volume will be substantially suited to the exhaust flow determined by the size of engine producing such flow.

Another object is to provide within a muffler a turbulator forming a helical passageway for exhaust gases, such passageway lying within a cylindrical portion of the turbulator, having numerous outlets from the helical passageway to an outer passageway surrounding said cylindrical portion, whereby the turbulator has a desirably large area of contact with the mixture of air and exhaust

gases, assuring an ample heat transfer to effect a required complete combustion.

These and various other objects are attained by the construction hereinafter described and illustrated in the accompanying drawing, wherein:

Fig. 1 is an axial sectional view of the improved muffler.

Fig. 2 is a view of the front or gas inlet end of the muffler.

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

Fig. 4 is an end view of one of the units forming a turbulator within the muffler.

Fig. 5 is a side elevational view of such unit.

In these views, the reference characters 1 and 2 designate inner and outer coaxial sheet metal shells jointly forming the elongated cylindrical body of the muffler. Between such shells is packed a suitable heat insulation 2*a* such as asbestos. The front and rear ends of said body are closed by sheet metal heads 3 and 4 rigidly secured to the shells in any suitable manner, as by welding. Extending centrally through the front head is an exhaust delivery pipe 5 of materially less diameter than the described body, such pipe being inserted in said body to the mid portion thereof. The front head is formed with a circular series of air inlets 6 similarly outwardly spaced from the pipe 5, such inlets delivering air to the elongated annular passage 7 formed between said pipe and the muffler body. An air flow regulating disk 8 is rotatively fitted on the pipe 5 against the front face of the head 3 and is formed with a circular series of inlets 9, duplicating said inlets 6. By rotation of the regulating disk, the inlets thereof may be more or less registered with the inlets 6 to predetermine the amount of air admitted to the passage 7. For positively maintaining any selective adjustment thereof, the regulating disk is formed with a pair of opposite arcuate slots 10, through which extend headed screws 11 carried by the head 3, such screws being tightened to clamp the disk 8 in any desired position of rotation.

Surrounding the open rear end of the pipe 5 is a frusto-conical interceptor 12, having its larger end snugly fitted in the shell 1, the diameter of its smaller end slightly exceeding that of said pipe. This arrangement derives a Venturi effect, air being rapidly drawn from the passage 7 by the exhaust gases and mixed with such gases.

Rearwardly extending from the interceptor, is an elongated turbulator consisting of a hollow cylinder 13 and a helical baffle 14 disposed within and integrally joined to said cylinder. The turbulator is formed of highly refractory material such as to withstand a high temperature derived from the exhaust gases, and will have a high capacity for storing heat thus derived. At regular longitudinally spaced intervals, the cylinder 13 is formed with radial passages 15, and preferably there are sets of circumferentially spaced passages of such intervals. These passages deliver a mixture of exhaust gas and air from the helically baffled interior of the turbulator to a narrow annular passage 16 which spaces the cylinder 13 inwardly from the shell 1. Such passage is maintained by a plurality of spacers 17 disposed at suitable intervals along and around the turbulator. To simplify its manufacture, the turbulator comprises a number of units abutting one another endwise and each including an annulus and a suitable portion of the helical baffle integrally joined to such annulus, the illustrated portion extending through one hundred and eighty degrees. The passages 15, in the illustrated construction, occur at the junctures of the abutting units, and thus may readily be formed in the process of molding such units. It is preferred to elongate the radial passages circumferentially of the units, disposing such passages between lugs 18 which project from the end faces of the cylinder-forming annuli 13, the abutting rela-

tion of such annuli being established through such lugs. The helical member of each unit has its ends projecting sufficiently beyond the ends of the corresponding annulus to radially abut the helical members of the next adjacent units.

The rear end of the turbulator abuts suitable stops 19 interiorly carried by the shell 1, such end being adequately spaced from the rear head 4 of the muffler to form a chamber 20 through which all gases discharging from the turbulator may pass to the usual tail pipe 21 opening centrally through and rearwardly extending from the head 4 and materially less in diameter than the muffler body.

In use of the described muffler, its silencing effect derives from turbulating the gases and subdividing their flow, whereby any sound wave formations are broken up and reduced to a negligible value. The helical baffle imparts a whirling travel to the advancing gases and deflects them outwardly, such deflection increasing the inherent tendency of the gases toward outward expansion and thus inducing a considerable flow through each of the radial passages 15. In entering the outer annular passage 16, the gases are subjected to an abrupt change of direction, as is evident from Fig. 1. Radial admission to the passage 16 of numerous currents spaced apart both longitudinally and circumferentially of such passage results in extreme turbulence destructive to wave formations.

In functioning as a combustion chamber, the velocity under which the gases discharge from the pipe 5 into the turbulator sets up a proportionate air flow through the passage 7, whereby such gases are mixed with ample oxygen to support combustion of any combustible ingredients. The Venturi effect derived from the interceptor 12 contributes essentially to the desired air flow. The entire turbulator acquires at least the temperature of the gas and air mixture, due to the large surface area making contact with such mixture. The heat-retaining property of the turbulator tends to maintain its raised temperature, and due to the presence of ample oxygen and to the relatively prolonged exposure of the mixture to such temperature, in circuitously flowing through and around the turbulator, there is created in the muffler a condition affording combustion of any combustible ingredients in the flowing mixture. Occurrence of any such combustion tends to elevate the temperature of both the gases and turbulator, thus promoting further combustion. The heat-insulated nature of the muffler body is a further factor in maintaining the desired high temperature within and around the turbulator. At installation of the described construction, the air regulating disk 8 is set according to the estimated average volume of exhaust gas to be treated, such volume being determined primarily by the size of the engine emitting such gas. Thus there may be avoided excessive air with a consequent undue cooling effect. It is to be here noted that any such cooling effect is minimized by preheating the air in its flow through the front portion of the muffler body. It is to be also noted that heating of the

air preliminary to its mixing with the exhaust flow adds heat units to such flow to facilitate such combustion as is desired.

Due to the combustion feature of the described construction, the discharge from the tail pipe will consist primarily of carbon dioxide, mixed with some steam and possibly a small proportion of weak phosphoric acid, such exhaust being innocuous under ordinary circumstances. A minor advantage derived from the construction is elimination of the long tail pipes now commonly required as a safeguard against leakage of noxious gas into the body of a motor vehicle.

To prevent any clogging of the air inlets 6 and 9 with mud or the like, it is preferred to secure a conical shield 22 on the pipe 5 with its concave face spaced slightly forward from the front end of the muffler, such shield slightly exceeding the muffler in diameter. Thus the convex face of said shield forms an effective deflector for mud or the like.

What I claim is:

1. An engine muffler comprising an elongated hollow body formed at its ends respectively with an inlet and an outlet for exhaust gases, and a turbulator within and substantially coaxial with said body and inwardly spaced from the body to form an annular outer passage for said gases, said turbulator being formed by a plurality of units of highly refractory material abutting one another in an end to end relation, each such unit including an annulus and a helical baffle fixed upon and within such annulus, such baffles jointly forming a substantially continuous helix and each baffle terminally projecting sufficiently beyond the corresponding annulus to abut the baffles of adjoining units, said units jointly forming an inner passage for the exhaust gases, and said baffles occupying such inner passage, the turbulator being formed between its units with passages for delivering gases from said inner to said outer passage.

2. An engine muffler as set forth in claim 1, each annulus having lugs on at least one of its end faces to establish the abutting relation of the turbulator units, and such lugs being circumferentially spaced to form the last-mentioned passages.

3. In an engine muffler as set forth in claim 1, a plurality of spacers disposed within said outer passage and against said hollow body and effective on said units to maintain said substantially coaxial relation of the turbulator to said body.

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