Sept. 26, 1950 J. M. CAMPBELL 2,523,260

BAFFLE TYPE MUFFLER WITH REFRACTORY LINING

Filed March 28, 1946

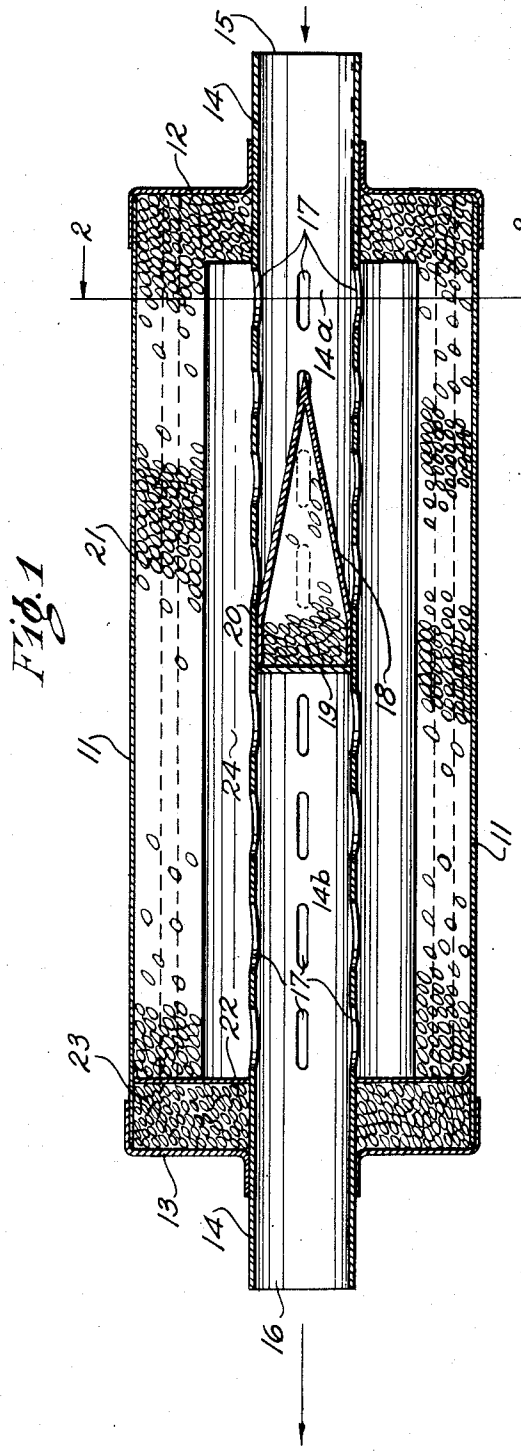


Fig. 1

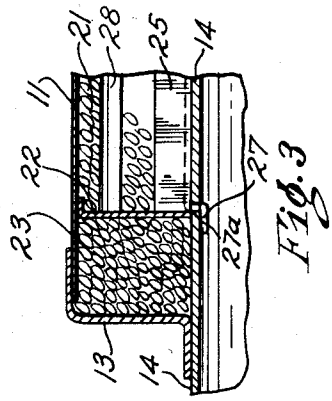


Fig. 3

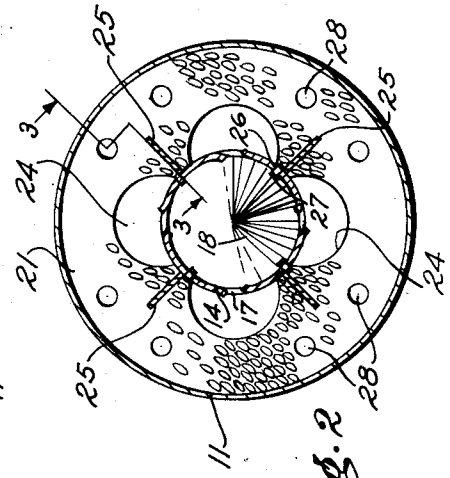


Fig. 2

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Patented Sept. 26, 1950 2,523,260

UNITED STATES PATENT OFFICE

2,523,260

BAFFLE TYPE MUFFLER WITH REFRACTORY LINING

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Application March 28, 1946, Serial No. 657,643

11 Claims. (Cl. 181—49)

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This invention relates to mufflers, particularly to a muffler for internal combustion engines.

An object of the invention is to provide a muffler which combines a high degree of sound absorption with a minimum of interference to flow of gases.

Another object of the invention is to provide a muffler employing sound absorbing material having sufficient strength to make possible the elimination of liners in the muffler chambers.

A further object of the invention is the provision of a muffler which will have a high degree of resistance to vibration, heat, and chemical action.

A still further object of the invention is the provision of a muffler which, though highly effective, is particularly adapted to economical production.

A still further object of the invention is a muffler in which provision is made for reducing the transmission of sound through a mass of porous sound absorbing material.

Other objects and advantages more or less ancillary to the foregoing and the manner in which all the various objects are realized will appear in the following description, which, considered in connection with the accompanying drawings, sets forth the preferred embodiment of the invention.

Referring to the drawings:

Fig. 1 is a longitudinal section of a muffler embodying the principles of the invention;

Fig. 2 is a transverse section taken on the plane indicated by the line 2—2 in Fig. 1; and

Fig. 3 is a partial longitudinal section taken on the plane indicated by the line 3—3 in Fig. 2.

Mufflers, as generally known in the art, depend, by and large, for their action upon baffles placed in the path of gas flow, on resonance chambers, on the use of a sound absorbing material of a porous material, or upon a combination of two or more of these principles.

The improved muffler described herein depends for its action upon a combination of the principles of baffling, resonance, and absorption. The invention lies in the novel design of the muffler, which provides for the effective operation of all three of these principles while retaining simplicity, ease of construction, ruggedness, and a minimum of resistance to the flow of gas.

Referring first, to Fig. 1, the muffler of the preferred embodiment of the invention is encased in a cylindrical sheet metal shell 11, and end caps 12 and 13, spot-welded or otherwise secured thereon. A thin walled tube 14, disposed along the axis of the shell, is mounted in flanges formed in the center of the end caps 12 and 13. The open ends 15 and 16 of the tube 14, constitute inlet and outlet ports of the muffler, respectively. The tube 14 is provided with a number of elongated openings 17, within the shell 11. Four rows of eight such openings, as shown, have been found to be a desirable arrangement. It is, of course, possible to vary the number and shape of the openings, varying the size accordingly. Whatever the number of the openings, the total area should not be less than twice the cross-sectional area of the inlet 15.

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The muffler includes a plurality of main or gas-receiving and conducting chambers. For example, the tube 14 is divided into an inlet chamber 14a and an outlet chamber 14b by a conical deflector 18, which completely blocks the tube at its central point. The deflector 18 is filled with sound absorbing material such as a composition formed principally of exfoliated vermiculite with a binder of clay; however, other sound absorbing materials known to the art, such as steel wool, spun glass, and rock wool, with or without a binder, may be employed. The deflector 18 and the disc 19, which serves as a retainer for the deflector, are secured in the tube 14 by spot welding or in any other suitable manner.

The shell 11 is provided with a liner 21 of sound absorbing material, preferably exfoliated vermiculite with a binder of a character that may be handled in a plastic state during the manufacture of the muffler. It is an object of the invention to employ a material having sufficient strength to serve as a substitute for liners of a perforated metal or wire screen, such as are commonly employed in the art. Such liners not only increase the complexity and expense of construction of the muffler, but decrease the effectiveness of the sound absorbing materials, increase the resistance to gas flow, and are subject to damage from the corrosive action of the hot exhaust gases. A composition of exfoliated vermiculite, clay, and other materials, such as is disclosed in my copending applications Nos. 593,964 and 593,963 filed May 15, 1945, now Patent Numbers 2,481,391 and 2,481,390, respectively, issued September 6, 1949, is the preferred material for lining the shell 11 and the deflector 18. It has sufficient mechanical strength, resistance to heat, corrosion, and scouring action, and high sound absorption, and does not calcine or vitrify under temperatures reached in an internal combustion engine muffler. The liner 21 is formed to com-

pletely line the shell 11 and the end cap 12, and also provide a plurality of roughly semicircular gas-receiving and sound-absorbing chambers 24 (Fig. 2) extending in contiguous relationship to the tube 14. Each chamber 24 communicates with the inlet and outlet chambers 14a and 14b through the openings 17.

In order to reinforce the lining material 21, longitudinal fins 25 protrude outward from the tube 14 into the septa between the cavities 24. The fins 25 are formed with a flange 26, bent to support the major body of the fin in radial relation to the tube when welded in place thereon. The ends 27 of the flanges extend beyond the fin end, as shown in Fig. 3, are inserted in slots 27a in the tube then doubled back against the inner wall of the tube to provide a temporary anchorage for the part during the spot welding operating.

The foraminous liner 21 has formed therein as at 28 a plurality of secondary chambers 28 (Fig. 2) extending from the end cap 12 to the rear end of chambers 24 provided in the liner 21. The secondary chambers 28 are of appreciable cross-sectional area as compared with the interstices between the foraminous particles and minimize the conduction of sound therethrough and dampen the vibrations transmitted to the shell 11. The rear ends of the chambers 24 and the secondary chambers 28 are closed by an annular disk 22, the intermediate space 23 being filled with a sound absorbing material of the character employed in liner 21.

As will be seen in Fig. 2, the material of tube 14 is deformed at the edges of the slots 17. One side of each slot is distended outwardly while the other side thereof is depressed. By virtue of this structure, the gases leaving the tube are biased relative to the radius thereof, thus producing substantial turbulence in the chambers 24.

In the preferred method of constructing the muffler, the shell 11, the end cap 12, the central tube 14, and the deflector 18, 19 are first brought into assembled relation. The material of the liner 21, while in a plastic condition, is forced into place into the void defined by the shell and the central tube, a moulding form or core being provided to define the chambers 24 and secondary chambers 28. The annular disk 22 is next put in place, then a lining material 23 is applied thereover whereupon the end cap 13 is mounted in place and welded to the tube and shell. The muffler is then dried to harden the lining material 20, 21, and 23.

In the operation of the improved muffler, gases entering the chamber 14a at the opening 15, pass through the slots 17 into the plurality of parallel chambers 24 wherein sound waves are absorbed by the porous material 21. The gases then pass through the slots 17 into the outlet chamber 14b formed by the outer portion of tube 14. It will be seen that the flow of gas is deflected and baffled as it passes into the sound-absorbing chambers 24 and as it is discharged therefrom. A certain amount of resonant action takes place both in tube 14, and in the sound-absorbing chambers 24, absorption of the vibrations being accomplished by the liner 21 of chambers 24. The deflector 18 secures a more uniform distribution of the gas as it passes into chambers 24 through slots 17 and the absorbing material therein minimizes direct transmission of sound between the chambers 14a and 14b. In addition, the entire inner opening of the muffler, that is, the chambers 14a, 14b, and 24, constitutes one gas-receiving and conducting chamber of irregular form in which sound may reverberate, being partially reflected by the wall of the tube 14 and partially passing through the openings 17.

Although the foregoing description is necessarily of a detailed character, in order that the invention may be completely set forth, it is to be understood that the specific terminology is not intended to be restrictive or confining, and that various rearrangements of parts and modifications of detail may be resorted to without departing from the scope or spirit of the invention as herein claimed.

I claim:

1. A muffler comprising a tube, an obstruction in the tube dividing it into intake and outlet portions, a shell surrounding the tube, and a lining of porous refractory material within the shell formed to provide a plurality of gas-receiving chambers, each chamber extending longitudinally of the exterior of both portions of the tube, both portions of the tube being provided with slots communicating with each chamber, the slots being disposed longitudinally of the tube, the material of the tube adjacent the slots being bent radially outwardly so as to direct gas flow through the slots obliquely to the radius of the tube.

2. A muffler comprising a tube, an obstruction in the tube dividing it into intake and outlet portions, a shell surrounding the tube, and a lining of porous refractory material within the shell formed to provide a plurality of chambers, each chamber extending longitudinally of the exterior of both portions of the tube, both portions of the tube being provided with slots communicating with each chamber, the obstruction being a conical shell having its apex directed into the intake portion and being filled with a porous refractory material.

3. A muffler comprising a tube, an obstruction in the tube dividing it into intake and outlet portions, a shell surrounding the tube, and a lining of porous refractory material within the shell formed to provide a plurality of chambers extending longitudinally of the exterior of the tube, both portions of the tube being provided with perforations communicating with each chamber, and the tube being provided with longitudinal fins extending into the refractory material between the chambers.

4. In a muffler, a gas-receiving and sound-absorbing chamber having a minor part of its wall area formed by a perforate non-absorbent material through which gas flows into and out of the chamber, and having a major part of its wall area formed by a thick envelope of a foraminous self-supporting refractory material, said envelope having a plurality of secondary chambers formed therein and isolated from said gas-receiving chamber.

5. In a muffler, a gas-receiving and sound-absorbing chamber having a minor part of its wall area formed by a perforate non-absorbent material through which gas flows into and out of the chamber, and having a major part of its wall area formed by a thick self-supporting envelope composed of exfoliated vermiculite and a binder therefor, said envelope having secondary chambers formed therein and isolated from said gas-receiving chamber.

6. In a muffler, a shell, and a lining of porous rigid refractory material within the shell formed to define at least one gas-receiving and sound-absorbing chamber within the lining, the lining being formed to define a plurality of secondary

chambers disposed intermediate the shell and chamber, said secondary chambers also constituting sound-absorbing cavities to dampen the transmission of vibrations through the lining, and being isolated from the flow path through the muffler.

7. In a muffler, a gas-receiving and sound-absorbing chamber having a minor part of its wall area formed by a perforate non-absorbing material through which gas flows into and out of the chamber, and having a major part of its wall area formed by a thick envelope of porous rigid refractory material having secondary chambers formed therein isolated from the gas-receiving chamber, said secondary chambers forming sound-absorbing cavities to dampen the transmission of vibrations through the material.

8. In a muffler, a shell, a plurality of parallel gas-receiving and sound-absorbing chambers within the shell, each having a minor part of its wall area formed by a perforate non-absorbing material through which gas flow into and out of the chamber is accomplished, and having a major part of its wall area, including the wall between adjacent chambers, formed by a thick envelope of a porous rigid refractory material, said refractory material having isolated secondary chambers formed therein between the gas-receiving chambers and the shell.

9. In a muffler, a shell, a porous self-supporting lining composed of exfoliated vermiculite and a binder within the shell, the lining being formed to define a gas-receiving and sound-absorbing chamber therein, a closed slotted tube section entering the chamber for the admittance of gases, a closed slotted tube section entering the chamber for the discharge of gases, the slots in the tube section being formed to direct the flow of gas obliquely to the radius of the tube sections, and anchoring means extending from the tube sections into the lining, said lining having closed secondary chambers formed therein.

10. A muffler comprising a tube, an obstruction in the tube dividing it into intake and outlet portions, a shell surrounding the tube, and a lining of porous refractory material within the shell formed to provide a plurality of chambers,

each chamber extending longitudinally of the exterior of both portions of the tube, both portions of the tube being provided with slots communicating with each chamber.

11. A muffler comprising a tube, an obstruction in the tube dividing it into intake and outlet portions, a shell surrounding the tube, and a lining of porous refractory material within the shell formed to provide a plurality of chambers, each chamber extending longitudinally of the exterior of both portions of the tube, both portions of the tube being provided with slots communicating with each chamber, the slots being disposed longitudinally of the tube, the material of the tube being formed adjacent the slots so as to direct gas flow through the slots obliquely to the radius of the tube by forming the material of the tube so that one edge of each slot is farther removed from the axis of the tube than the other edge of the slot so that the aperture defined by the edges of the slot is oblique to the radius of the tube.

JOHN M. CAMPBELL.

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