Nov. 9, 1954 G. B. WALKER 2,693,863

SILENCER OR MUFFLER FOR ENGINE EXHAUSTS AND THE LIKE

Filed April 21, 1952

2 Sheets-Sheet 1

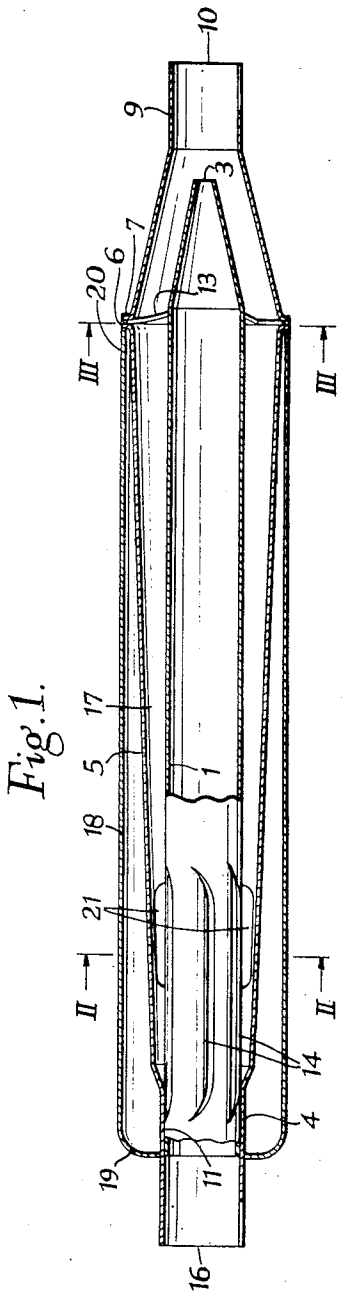

Fig. 1.

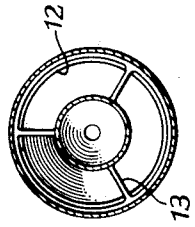

Fig. 3.

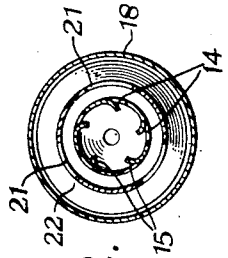

Fig. 2.

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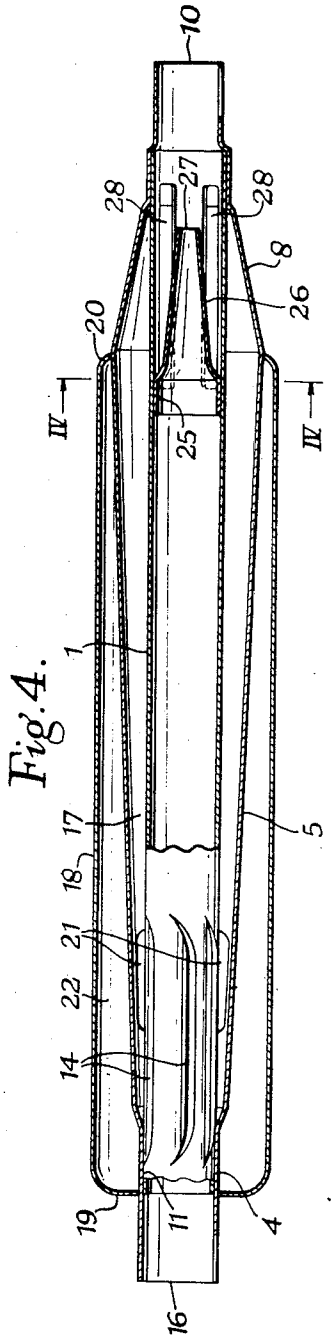

Fig. 4.

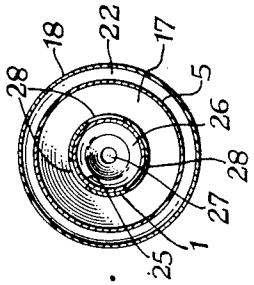

Fig. 5.

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SILENCER OR MUFFLER FOR ENGINE EXHAUSTS AND THE LIKE

George Bromhead Walker, London, England

Application April 21, 1952, Serial No. 283,368

Claims priority, application Great Britain May 25, 1951

8 Claims. (Cl. 181—44)

This invention relates to an improved silencer or muffler intended mainly for the exhausts of internal combustion engines, but suitable also for other exhausts. The object of the invention is to provide an exhaust gas silencer or muffler of relatively simple and inexpensive construction which, in use, has low back pressure and in other respects also is very efficient.

According to the invention there is provided a silencer or muffler for engine exhausts or the like comprising an outer tube having an inlet aperture at one end and a discharge aperture at the other end, said apertures being substantially in alignment with one another, an inner tube disposed within said outer tube coaxially therewith, said inner tube having an inlet end communicating with said inlet aperture and means providing a restricted outlet from said inner tube, said outlet being coaxial with said tubes and being disposed within an inwardly tapered portion of the outer tube, and the configuration of said inner tube and said outer tube being such that there is formed between said inner and outer tubes an annular passage which increases in cross-sectional area in the direction from the inlet to outlet ends of the silencer, and said inner tube having a plurality of circumferentially-spaced elongated apertures adjacent the inlet of said inner tube which afford communication between the interior of said inner tube and said annular passage, the wall of said inner tube being imperforate apart from said apertures.

In one form of the invention said means may be formed by the outlet end of said inner tube being tapered to provide said restricted outlet. The inner tube may be supported in the region of said restricted outlet by means, for example a spider, connected to said outer tube. In another form of the invention said means may comprise a tapered nozzle fitted into said inner tube. According to this form the inner tube may project into and fit within the outlet aperture of said outer tube, openings being provided in said inner tube to afford communication between said annular passage and said outlet aperture.

Preferably the inlet and outlet apertures of said outer tube are of substantially equal cross-sectional area.

Said outer tube may taper outwardly over the major portion of its length and may have a portion which tapers inwardly between the wide end of said outwardly tapered portion and said outlet aperture. Said outer tube may be formed in two parts, one of which comprises said inlet aperture and said outwardly tapered portion and the other of which comprises said inwardly tapered portion and said outlet aperture. An outer casing may be provided around said outwardly tapered portion of the outer tube, apertures being provided at or near the narrow end of said outwardly tapered portion of the outer tube to afford communication between said annular passage and the space within said outer casing.

In order that the invention may be more fully understood reference will now be made to the accompanying drawings in which:

Fig. 1 is a longitudinal section of a silencer according to one example of the invention.

Fig. 2 is a side sectional elevation on the line II—II of Fig. 1.

Fig. 3 is a side sectional elevation on the line III—III of Fig. 1.

Fig. 4 is a longitudinal section through a modified form of silencer constructed according to a second embodiment of this invention.

Fig. 5 is a side sectional elevation on the line IV—IV, Fig. 4.

According to the embodiment of the invention illustrated in Figs. 1–3, the silencer comprises an inner tube **1** which is substantially cylindrical along the major portion of its length, one end of the tube being tapered at **2** to form a restricted orifice **3** at said end. The outer tube comprises a cylindrical end portion **4** the open outer end of which forms an inlet aperture, said cylindrical portion **4** being integral with a portion **5** of tapered configuration, the widest portion of which is remote from the cylindrical portion and is formed with a radial flange **6** to which is connected a radial flange **7** formed on the wide end of a relatively short portion **8** which tapers inwardly away from the flange **7** and terminates in a short cylindrical portion **9**, the open end of which forms an outlet aperture **10**. The untapered end **11** of the inner tube fits tightly within the cylindrical portion **4** of the outer tube **5** and the tapered end **2** of the inner tube projects with the tapered portion **8** of the outer tube **5**. In order to support the tapered end **2** of the inner tube **1**, a spider is clamped between said flanges **6**, **7**, the spider comprising a ring **12** provided with three radially inward projecting arms **13**, the inner ends of which are welded to the inner tube adjacent the tapered portion **2** thereof. The inner tube **1** is provided with a plurality of elongated slots **14** which are spaced circumferentially around the tube, the slots commencing near the junction of the cylindrical portion **4** of the outer tube **5** with the tapered portion **5** thereof and extending over a relatively short length of the inner tube so that the latter is imperforate over the greater part of its length. Adjacent one edge of each slot is provided a deflector **15** in the form of a narrow plate extending along the length of the slot. The deflectors may be inwardly curved as illustrated in Fig. 2, being formed by bending the metal from the confines of slots **14**. Alternatively, the inwardly directed parts of the deflectors may be straight and be disposed at an obtuse angle to a radial plane defined by the axis of the inner and outer tubes and the inner edge of the plate. The deflector plates are all similarly curved or inclined.

Since the inner tube **1** is cylindrical and the outer tube tapers outwardly over the major portion of its length in the direction from the inlet aperture **16** to the outlet aperture **10**, an annular passage **17** is provided between the tubes **1** and **5** which proceeding from the inlet aperture to the outlet aperture is of progressively increasing cross-sectional area.

In the operation of the silencer above described the inlet end **16** thereof is push-fitted into or otherwise connected to the exhaust pipe of an engine, so that the exhaust gases pass directly into the inner tube **1**. Some of the gas issues from the restricted outlet **3** of the inner tube, and passes directly to the outlet **10** of the silencer in the form of a narrow stream. Since the restricted orifice **3** is of small cross-section as compared with the cross-section of the inner tube **1** some gas accumulates in the inner tube and forms a cushion for gas entering the inner tube on the high pressure phase, and on the low pressure phase the greater part of the gas passes into the annular passage **17** via the elongated slots **14**. Due to the deflectors **15** the gas entering the annular passage **17** has a rotary component of velocity imparted to it and the gas moves along said passage in a helical path. Due to the increasing cross-section of said passage the gases expand. Said gases issue from the annular passage **17** in the form of an annular stream surrounding the stream which issues from the restricted orifice **3** of the inner tube, the last-mentioned stream serving in the manner of an ejector to draw gas from the annular passage **17**. The expansion of the gases in the latter results in considerable cooling, and the acceleration of the gases offsets the resistance of the apertures formed between the spider arms **13**.

If desired, an outer casing or jacket may enclose part of the outer tube **4**, **5** in which part apertures are formed to provide communication between annular space **17** and the jacket space. As illustrated in Fig. 1, a cylindrical jacket **18** coaxial with the inner tube **1** has an outer curved end **19** connected as by welding to the

cylindrical portion 4 of the outer tube at a position intermediate its ends. The inner end 20 of the jacket terminates at the flange 6 of the outer tube and is connected thereto, as for instance by welding. Three circumferential, equi-spaced and elongated apertures 21 are provided in the tapered portion 5 of the outer tube in the region of the slots 14 therein, such apertures being located close to the narrow, high-pressure end of the tapered annular chamber as illustrated in Fig. 2. These apertures provide communication between the annular space 17 and the annular jacket space 22 which progressively decreases in cross-sectional area towards the inner end thereof. This outer jacket space serves as an expansion chamber or extra cushioning means for the exhaust gases entering the silencer, the apertures 21 being in effect breathers. If desired, the outer casing 18 may be of other shape than cylindrical and need not be materially greater in length than the part of the outer tube portion 5 in which the elongated slots 21 are provided.

A modified form of silencer according to this invention is illustrated in Figs. 4 and 5 in which parts similar to Figs. 1 and 3 are designated with the same reference numerals. According to the said modification, the outer tube comprising parts 4, 5, 8 and 9 is made in one piece. The inner end of the inner tube 1 instead of being formed with tapering portion 2 is extended and fits within the short cylindrical portion 9 which is formed with a shoulder 23 to serve as an abutment for the adjacent end of the tube 1. A nozzle comprising a cylindrical part 25 and a tapering part 26 is fitted into the outer end of the inner tube 1 with the internal surface of which the cylindrical part 25 of the nozzle is in tight engagement. The tapering part 26 fulfils the same function as the tapering part 2 of Fig. 1 and terminates in a restricted orifice 27 at its outer end which terminates short of the junction between the tapering part 8 and short cylindrical part 9 of the outer tube. A plurality of elongated slots 28 are provided in the inner tube 1, such slots extending at least the full length of the tapering portion 26 of the nozzle. As illustrated in Figs. 4 and 5, three circumferential slots 28 are provided equi-distant from one another and extend from adjacent the junction of the cylindrical part 25 and the tapering part 26 of the nozzle and terminate at a short distance within the cylindrical part 9 of the outer tube. With this modification, the spider 12, 13 illustrated in Figs. 1 and 3 is dispensed with. The inner end 20 of the outer jacket 18 is rounded and terminates at the junction between parts 5 and 8 of the outer tube where it may be welded.

The operation of the silencer according to Figs. 4 and 5 is substantially similar to the operation of the silencer according to Figs. 1–3. It will be appreciated, however, that the stream gases flowing in a helical path along the annular passage 17 makes its exit through the elongated slots 28 and issues as an annular stream surrounding the stream which issues from the restricted orifice 27 of the nozzle within the inner tube.

In both embodiments of the invention hereinbefore described one or more drainage vents may be provided in the tapered portion 5 of the outer tube close to the outer end thereof.

I claim:

1. A muffler for engine and other exhausts, comprising an outer tube including, in the direction from the inlet towards the outlet of the muffler, an outwardly tapering portion extending over the greater part of the muffler length followed by an inwardly tapering portion, a cylindrical inner tube disposed within said outer tube and formed with a plurality of elongated, circumferentially spaced apertures within the smaller diameter end part of the outwardly tapering portion of the outer tube, means for supporting said inner tube substantially in spaced relation to said outer tube, an inwardly tapering discharge nozzle secured to the inner tube to provide a restricted outlet therefor within the inwardly tapering portion of the outer tube, said inner and outer tubes defining therebetween an annular passage leading from said spaced apertures to the muffler outlet and surrounding a central passage through the inner tube and the discharge nozzle, which central passage communicates with the annular passage exclusively through said spaced apertures and through the outlet of the discharge nozzle.

2. A muffler according to claim 1, comprising in addition a plurality of deflector plates associated respectively with said elongated circumferentially spaced apertures, each deflector plate projecting at an inclination into the interior of the inner tube from one edge of the corresponding elongated aperture.

3. A muffler according to claim 2, and comprising an outer jacket enclosing and in spaced relation to a part of said outer tube, apertures being formed in said outer tube to provide communication between the jacket space and said annular passage between said inner and outer tubes.

4. A muffler according to claim 2, and comprising an outer cylindrical jacket enclosing and in spaced relation to said outwardly tapering part of said outer tube, elongated apertures being formed in said outer tube in the region of the apertures in said inner tube, said apertures in the outer tube providing communication between the space formed by the outer jacket and the outer tube and the space formed between said outer and inner tubes.

5. A muffler for engine and other exhausts, comprising an outer tube including a short cylindrical inlet portion at the inlet end of the muffler followed successively by an outwardly tapering portion extending over a substantial part of the muffler length, an inwardly tapering portion and a cylindrical portion terminating in a discharge aperture in substantial alignment with the inlet aperture of the cylindrical inlet portion, a cylindrical inner tube disposed coaxially within and substantially in spaced relation to said outer tube and fitted at one end within the cylindrical inlet portion of said outer tube, and fitted at the other end within the cylindrical portion terminating in the discharge aperture, and a nozzle fitted within said inner tube and including an inwardly tapering part disposed within the inwardly tapering portion of said outer tube, said inner tube and the outwardly tapering part of said outer tube defining therebetween an annular passage which increases in cross-sectional area between the inlet and outlet ends of the muffler, said inner tube being formed with a plurality of elongated circumferentially spaced apertures adjacent the narrow end of the outwardly tapering part of said outer tube but being otherwise imperforate circumferentially and said apertures providing communication between the interior of said inner tube and said annular passage and said inner tube also being formed with a plurality of elongated, circumferentially spaced apertures in the part thereof surrounded by the inwardly tapering portion of the outer tube.

6. A muffler according to claim 5, comprising in addition a plurality of deflector plates associated respectively with said elongated circumferentially spaced apertures, each deflector plate projecting at an inclination into the interior of the inner tube from one edge of the corresponding elongated aperture.

7. A muffler according to claim 6, and comprising an outer jacket enclosing and in spaced relation to a part of said outer tube, apertures being formed in said outer tube to provide communication between the jacket space and said annular passage between said inner and outer tubes.

8. A muffler according to claim 5, and comprising an outer cylindrical jacket enclosing and in spaced relation to said outwardly tapering part of said outer tube, apertures being formed in said outer tube in the region of said apertures in said inner tube adjacent the narrow end of the outwardly tapering part of said outer tube, said apertures in the outer tube providing communications between the space formed by the outer jacket and the outer tube and the space formed between said outer and inner tubes.

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