

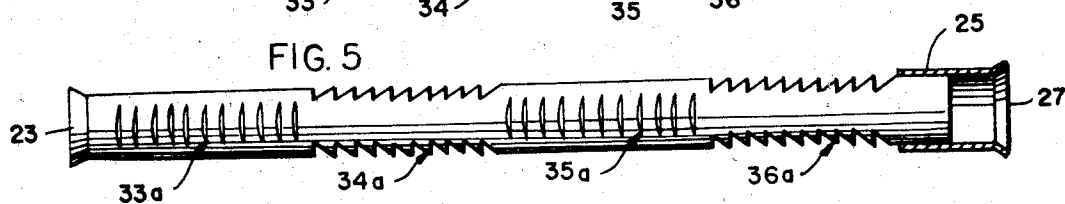
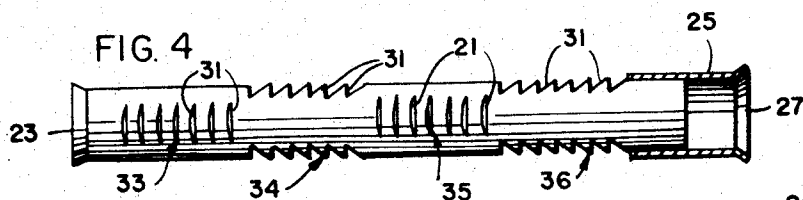
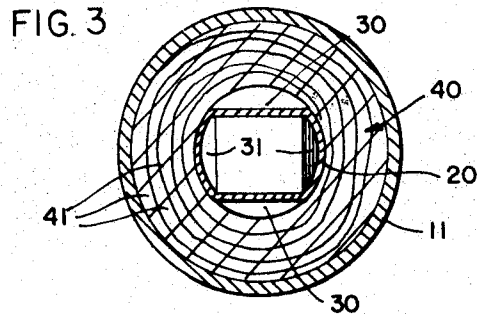
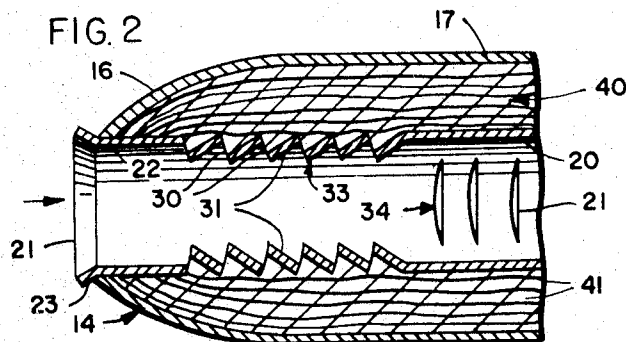
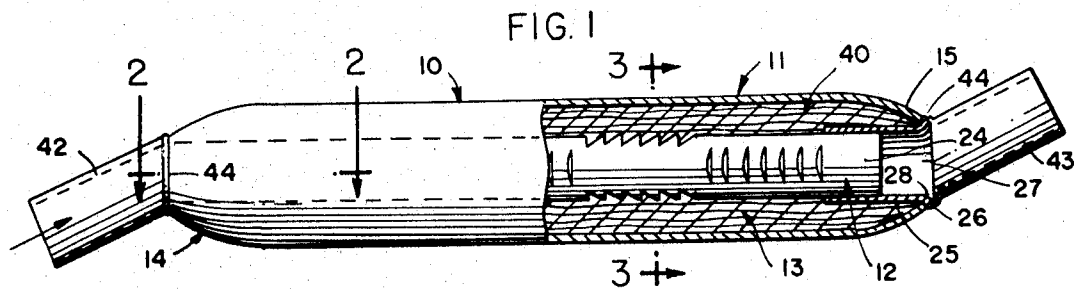
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GLASS-PACKED MUFFLER

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GLASS-PACKED MUFFLER

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7 Claims

ABSTRACT OF THE DISCLOSURE

Glass-packed mufflers with straight-through tubular core providing improvements in straight-through mufflers which are more collective of exhaust sound or noise; tubular core with circumferentially offset sets of louvers or vanes arranged in rows with two oppositely disposed rows in each set; tubular shell with dome-shaped end or nose portions of wall thickness about 1.25 or more the wall thickness of the tubular shell.

BACKGROUND OF INVENTION

The invention herein concerns improvements in straight-through mufflers for exhaust systems of internal combustion engines, e.g., automotive engine exhaust systems. Straight-through mufflers give improved engine performance over the baffle-type muffler currently installed in the exhaust systems of most automobiles. These straight-through mufflers create considerably less back pressure of the exhaust on the engine and thereby increase the available horsepower of the engine and also increase gas mileage. The major disadvantage of straight-through mufflers over baffle-type mufflers is their higher noise level in exhaust sound. The invention herein concerns improvements in louver or vane structures in the tubular core of straight-through mufflers to provide more efficient collection of exhaust noise and also to improvements in the structure of the shell of the muffler at the most critical areas where most shell failures or burn-outs occur, i.e., at the upstream and downstream ends of the muffler.

BRIEF DESCRIPTION OF THE INVENTION

The invention herein concerns improvements in straight-through mufflers and particularly in improvements in the straight-through, tubular core of such mufflers and in improvements in tubular-type shells of mufflers. A tubular core extends axially through the shell. Sound absorbing means, such as woven or matted glass fibers, is provided in the annular space between the shell and the core. This annular space is connected with the tubular core by a plurality of louvers or vanes in the tubular wall of the core. The louvers extend transversely of the longitudinal axis of the core. They are arranged on the core in a plurality of circumferentially staggered columns or rows extending longitudinally along the core. The louvers are pitched relative to the longitudinal axis of the core with the openings between contiguous louvers facing the upstream end of the core. These louvers or vanes are arranged in the wall of the core preferably in at least four longitudinally disposed sets. Each set comprises a pair of said columns in substantially diametrically disposed relationship. The columns or rows of respective sets are circumferentially staggered in longitudinal sequence along the tubular core. The amount of circumferential staggering is in the range of about 45 to 90°, preferably about 90°.

The openings between louvers are defined along their upper edge by the arc of the upstream edge of one louver or vane and along the bottom edge by the upstream edge of the immediately preceding vane or louver. The latter edge preferably is substantially flat.

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The straight-through, tubular core improvements reside in arrangements of louvers or vanes in the tubular wall of the core whereby the noise collection by the muffler is considerably improved. The vanes or louvers may be formed by cutting and bending the wall of the tubular core to provide vanes or louvers pitched at an acute angle to the longitudinal axis of the core with the entrant portion of passages therebetween facing the upstream end of the core.

The vanes or louvers are arranged in sets composed of a plurality of louvers or vanes of the character aforesaid arranged in respective pairs of columns or rows on diametrically opposite sides of the tubular core. The core preferably contains at least four sets of said oppositely disposed pairs of columns or rows circumferentially staggered along the length of the core. This staggering preferentially is a 90° circumferential staggering in alternating sequence.

Another improvement of the invention relates to tubular shells for mufflers in general and for straight-through mufflers in particular. The two hottest zones of a muffler are the upstream and downstream ends. Most burn-outs or failures in muffler shells occur at the upstream and downstream ends. The invention herein provides improvements in tubular muffler shells wherein the upstream and downstream ends have a dome-like shape providing respective nose portions having wall thicknesses considerably greater than the wall thickness of the main body of the tubular shell. These nose portions may be formed by swaging a tubular sheet metal shell of substantially uniform wall thickness into the aforesaid domed shape at each end. The inward shaping of these nose portions into dome shapes in the swaging operation provides wall thickness of the dome portions which are at least about 1.25 times the wall thickness of the major or intermediate portion of the tubular shell.

DESCRIPTION OF DRAWING

Preferred embodiments of the invention are illustrated in the drawing wherein:

FIG. 1 is a side elevation, partly in diametric cross section, of a preferred embodiment of a straight-through muffler of the subject invention;

FIG. 2 is a fragmentary, enlarged, diametric cross section taken on section plane 2—2 of FIG. 1;

FIG. 3 is a transverse cross section of said embodiment taken on section plane 3—3 of FIG. 1;

FIG. 4 is a side elevation of a straight-through core and its expansion sleeve for a relatively short muffler with the sleeve shown in diametric cross section; and

FIG. 5 is a side elevation similar to FIG. 4 of a straight-through core and its expansion sleeve for a relatively long muffler.

DESCRIPTION OF PREFERRED EMBODIMENT

The preferred embodiment illustrated in FIG. 1 is a straight-through muffler 10. Its basic parts are a tubular shell 11, a straight-through core 12 and a fibrous, heat insulating, noise absorbent lining or packing 13 interposed therebetween. The tubular core 11 may be made of relatively light gauge sheet metal. Its upstream and downstream ends 14 and 15 have a dome shape which preferably provides dome walls 16 at opposite ends of the muffler having a thickness substantially greater than the thickness of the walls 17 of the major portion of the shell 11. The latter feature can be attained by swaging a cylindrically tubular shell having a uniform wall thickness as shown for the wall portion 17 in a swaging machine having a dome shape female die. As the end portions of the tubular shell are deformed inwardly by the swaging die, the metal in the dome-shaped ends 14 and 15 builds

up to a thickness at least about 1.25 times the original wall thickness of the end portions of the shell. The extra thickness in the wall of the dome-shaped portions provides considerable improvements in the service life of the muffler. The two hottest spots in mufflers are the upstream and downstream ends thereof. Heat causes oxidative scaling and metal failure. It is generally accepted in the muffler industry that most burn-outs or other metal failures in muffler shells occur in the aforesaid hottest spots in the muffler. The extra wall thicknesses in the dome-shaped ends add to the service life of the muffler by providing additional metal at the failure-critical ends of the muffler.

An economic value of the aforesaid muffler shells resides in the additional wall thicknesses gained at the dome-shaped ends. For example, a muffler made of fourteen gauge metal but without the extra wall thickness in the dome-shaped ends would have a given statistical average service life under a given set of conditions of use. Under the same conditions of use, a muffler with a tubular shell having the dome-shaped end wall structure with the extra wall thickness in the dome-shaped portions can be made of sixteen gauge metal and still have substantially the same average service life by virtue of the gain in domed wall thickness to about fourteen gauge. If, of course, the latter muffler shell were made from fourteen gauge metal, it would have an average service life well above that of the first mentioned muffler shell.

The tubular core 12 extends axially through the tubular shell 11. It comprises a metal tube 20 having its upstream end 20 projecting through the axial opening 22 in the dome-shaped end 14. The projecting end 21 may be circumferentially outwardly flared to provide a flared annular lip or shoulder 23 which precludes the projecting end 21 from slipping back inside the opening 22. The downstream end 24 of the core 12 preferably has a tubular expansion sleeve 25 tightly but slidably fitted thereover. The purpose of such sleeve is to relieve stresses in the tubular core 12 which would otherwise occur when the core 12 expands under the heat of exhaust gases flowing therethrough. The downstream end of the sleeve 25 may have a flared lip or shoulder 26 similar to the flared lip or shoulder 23 to preclude the projecting end of such sleeve from slipping into the axial opening 28 in the domed downstream end 15 of the shell 11.

The vanes or louvers 31 in the tubular core 12 are provided in the tubular wall. They extend substantially at right angles to the longitudinal axis of the core 12 and are arranged in groupings of respective rows or columns 33-36. The slots or openings 30 between vanes or louvers face the upstream end of the core. The openings 30 are defined along their upper edge by the arc of the upstream edge of one louver or vane 31, corresponding substantially in curvature to the circumference of tubular core 12, and along the bottom edge by the substantially flat upstream edge of the immediately preceding vane or louver. Looking directly into the openings 30, they have a shape substantially that of a portion of a circle cut by a chord. The depth of opening between the crest of the upper edge and the lower edge is generally about $\frac{1}{16}$ inch to $\frac{1}{8}$ inch.

The louvers or vanes 31 are arranged in sets composed of substantially diametrically opposite rows or columns 33-36, respectively. These sets are respectively staggered on the circumference of the tubular core 12, most preferably in an alternating sequence of about 90° circumferential stagger as illustrated in the drawing. Each row or column contains at least five vanes or louvers.

The vanes or louvers 31 may be formed in any suitable manner. One preferred technique is that of punching and forming the tubular wall of the core 12 into the vanes or louvers 31 in the arrangement above described. As a general rule of thumb, there are about five to twelve louvers or vanes per column or row and four to eight sets of pairs of oppositely disposed columns or rows in the tubular cores 12. It is generally preferred that the

number of vanes or louvers in each column or row be the same, but a variance of plus or minus two, or even three in long tubular cores, vanes or louvers per column or row is tolerable. The circumferential stagger in longitudinal sequence of said rows or columns may be in the range of about 45-90° but most preferably, as aforesaid, is about 90°.

The annular space between the core 30 and the shell 11 contains a heat resistant, sound absorbing, preferably fibrous material 40. Glass fibers are particularly well suited for this purpose because of their high heat resistance. The fibrous packing 40 may compose a sheet of loosely matted or loosely woven glass fibers wrapped about the core 12 in superposed layers 41 as shown in FIGS. 1-3. Such packing can be conveniently installed in the muffler by wrapping it around the core and inserting the wrapped core into the shell 11 before both ends of the shell 11 are swaged into the domed shapes.

The muffler is assembled by wrapping the packing 40 about the tubular core 12 and inserting them into the tubular shell 11. The ends 14 and 15 of the latter are swaged into the dome shapes until the openings 22 and 28 are contiguous to or tight against the core 11 immediately behind the lips or shoulders 23. Connector tubes 42 and 43, for telescopic connection with exhaust tubing or pipes in the automotive exhaust systems, are then welded by annular welds 44 to the shoulders or lips 23 and ends of shell 11. Welds 44 also serve as fillers in the junctions of the openings 22 and 28, lips or shoulders 23 and 27, and connector tubes 42 and 43, respectively. The connector tubes 42 and 43 may be axially aligned with the tubular core 12 or may be angularly disposed thereto, depending on the dictates of a given exhaust system arrangement.

The core illustrated in FIG. 4 is a short core for a short muffler such as a seventeen inch muffler. Such core has four sets of diametrically opposed vanes or louvers with seven vanes or louvers in each column or row 33-36. The core illustrated in FIG. 5 is a core for a longer muffler, e.g., a twenty-seven inch muffler. The vanes or louvers 31 are arranged in four sets containing ten vanes or louvers in each column or row 33a-36a. In each illustrated core, the rows or columns 33-36 and 33a-36a (and the respective sets composed of opposite pairs thereof) are staggered circumferentially in alternating sequence in alternating circumferential displacements of about 90°. These arrangements of the vanes or louvers 31 have been found to be the preferred arrangements for good collection of exhaust sound. Also an improvement has been noted in the decrease in length of the period of deceleration rapping, viz., the sequence of loud exhaust sounds, each of short duration, which occurs when the engine is suddenly decelerated.

It is thought that the invention and its numerous attendant advantages will be fully understood from the foregoing description, and it is obvious that numerous changes may be made in the form, construction and arrangement of the several parts without departing from the spirit or scope of the invention, or sacrificing any of its attendant advantages, the form herein disclosed being a preferred embodiment for the purpose of illustrating the invention.

The invention is hereby claimed as follows:

1. An internal combustion engine exhaust muffler having a straight-through tubular core comprising a muffler shell, a tubular core extending axially through said shell, sound absorbing means between said shell and core, and a plurality of louvers in the tubular wall of said core, said louvers extending transversely of the longitudinal axis of said core and being arranged in a plurality of circumferentially staggered columns of said louvers, said columns extending longitudinally along said core, and said louvers being pitched relative to said longitudinal axis with the openings between contiguous louvers facing the upstream end of said core.

2. A muffler as claimed in claim 1 wherein said louvers are arranged in the wall of said core in at least four

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longitudinally disposed sets, each set comprising a pair of said columns in oppositely disposed relationship, and the columns of respective sets being circumferentially staggered by about 90° in longitudinal sequence.

3. A muffler as claimed in claim 2 wherein said openings are respectively defined along their respective upper edges by the arcuate downstream edge of one louver and along their respective lower edges by the upstream edge of the next adjacent louver.

4. A muffler as claimed in claim 1 wherein said columns of louvers are circumferentially staggered relative to the next adjacent column along the length of said core.

5. A muffler as claimed in claim 1 wherein said sound absorbing means is a packing of heat resistant fibers.

6. A muffler as claimed in claim 1 wherein said openings are respectively defined along their respective upper edges by the arcuate downstream edge of one louver and along their respective lower edges by the upstream edge of the next adjacent louver.

7. An internal combustion engine exhaust muffler as claimed in claim 1, and the axial ends of said shell being formed into dome-shaped nose portions with wall thicknesses at least about 1.25 times the wall thickness of the axially intermediate portion of said shell.

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