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EXHAUST SILENCER

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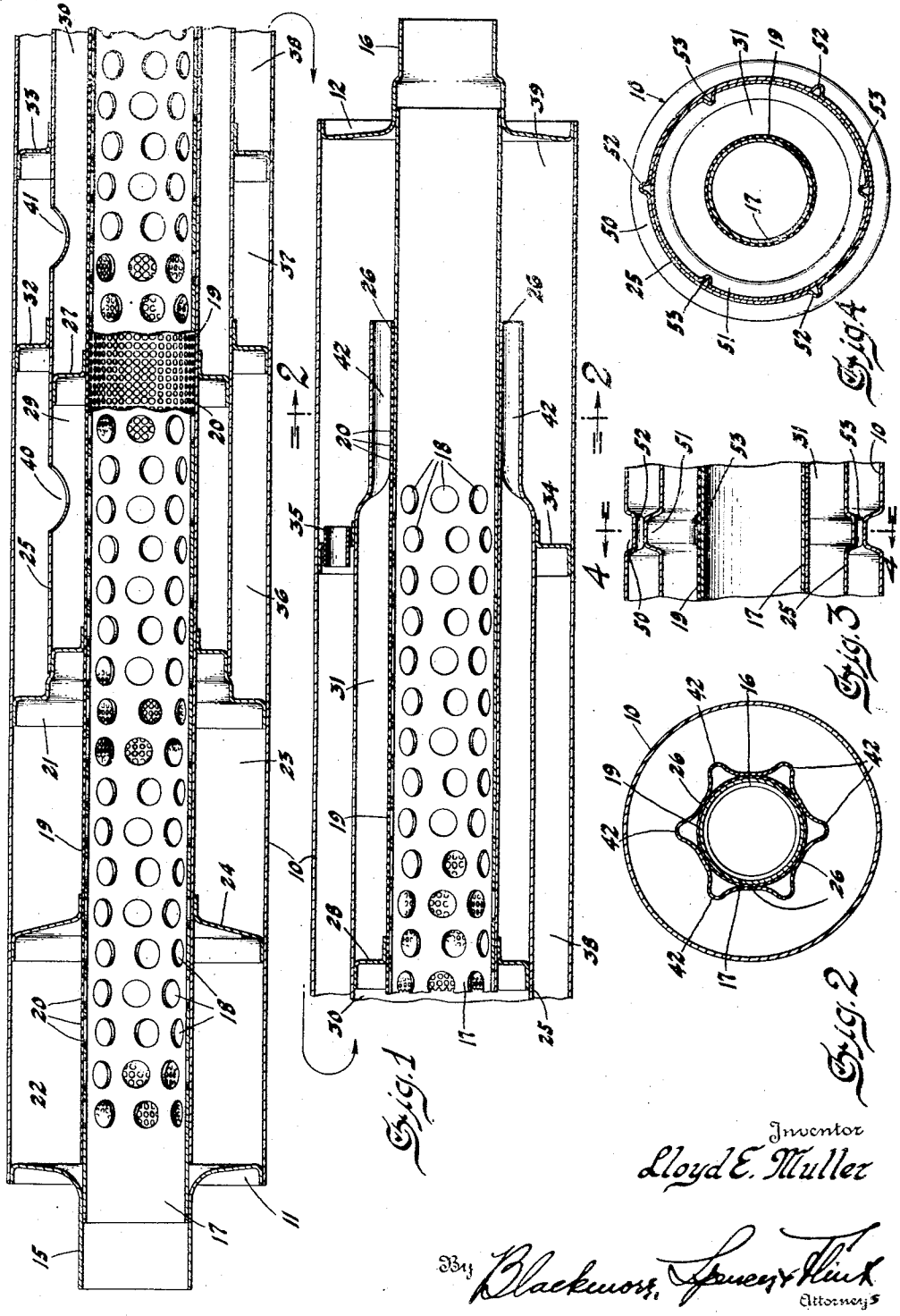

Fig. 1

Fig. 4

Fig. 3

Fig. 2

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EXHAUST SILENCER

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16 Claims. (Cl. 181—48)

This invention relates to silencers of the resonator type in which there are incorporated two or more telescopically related, radially spaced tubular elements and resides in a silencer of the mentioned type in which one of the tubular elements is so formed that a portion of it directly engages a next adjacent tubular element and in conjunction therewith provides a passage which communicates with the space between the tubular elements.

For a better understanding of the nature and objects of this invention, reference is made to the following specification wherein there are described the embodiments of the invention which are illustrated in the accompanying drawing.

In the accompanying drawing:

The two parts of Figure 1 constitute a longitudinal section through a silencer of the resonator type in which my invention is embodied.

Fig. 2 is a section taken on the line 2—2 of Figure 1.

Figure 3 is a fragmentary longitudinal section through a silencer of modified form.

Figure 4 is a section taken on the line 4—4 of Figure 3.

The silencer which is shown in the drawing consists of an imperforate tubular shell 10 in whose ends there are secured heads 11 and 12, through which extend centrally disposed openings which are surrounded by outwardly extending collars 15 and 16 in which the ends of an unobstructed tube 17 snugly fit. Throughout its circumference and length, except for a short portion adjacent the head 11 and a portion of considerable length adjacent the head 12, the tube 17 is pierced by a multitude of perforations 18 and is surrounded and snugly embraced by a tube 19 which is pierced throughout its circumference and length by a multitude of smaller, more closely spaced perforations 20.

The annular space between the shell 10, the tubular element 17—19 and the heads 11 and 12 is subdivided longitudinally by an imperforate stepped annular partition 21 and the annular space between the shell 10, the tubular element 17—19, the head 11 and the partition 21 is divided into resonance chambers 22 and 23 by an imperforate annular partition 24.

The portion of the tube 19 to the right of the partition 21 in the drawing is surrounded by a tubular element 25 which is radially spaced from it and the shell 10. One end of the tubular element 25 fits snugly around the intermediate tubular portion of the partition 21 and is supported thereby. The other end of the tubular element 25 is constricted so that there are provided therein circumferentially spaced portions 26 which engage and conform to the tube 19 and therebetween channels 42. The portions 26 may be welded or otherwise secured to the tube 19 or may be left free to slide thereon upon differential expansion of the tubular element 25 and the tube 19.

The tubular element 25 subdivides the annular space between the partition 21, the head 12, the shell 10 and the tubular element 17—19 into an inner annular space and an outer annular space. The inner annular space is divided by imperforate annular partitions 27 and 28 into resonance chambers 29, 30 and 31. The outer annular space is divided by imperforate annular partitions 32 and 33 and an annular partition 34 through which extend tubes 35 into resonance chambers 36, 37, 38 and 39. The resonance chambers 36 and 37 communicate with the resonance chambers 29 and 30, respectively, through openings 40 and 41 in the tubular element 25. The resonance chamber 39 communicates with the resonance chamber 38 through the tubes 35 in the partition 34 and with the resonance chamber 31 through the channels 42 between the portions 26 of the constricted end of the tubular element 25.

The simple resonators 20—18—22 and 20—18—23 and the compound resonators 20—18—29—40—36, 20—18—30—41—37 and 20—18—31—42—39—38 are so proportioned and dimensioned, in the manner set forth in the Wilson applications Serial Numbers 470,700 and 633,265 and the corresponding foreign patents, viz., Canadian Patents Nos. 348,037 and 353,352, British Patents Nos. 391,180 and 417,935, French Patents Nos. 720,611 and 754,580 and Italian Patents Nos. 300,037 and 324,615, that when the silencer which is shown in the drawing is installed in the exhaust system of the automotive vehicle for which it was designed with the exhaust pipe of the propelling engine connected to the collar 15 and the tail pipe of the system connected to the collar 16 the resonators will respond to and attenuate the sound waves which occur in the exhaust of the engine.

It is clear that by constricting the right end of the tubular element 25 in the manner shown in the drawing, I provide, without resorting to the use of a third element, means for supporting that end of the tubular element 25 from the tubular element 17—19 without interrupting communication between the resonance chambers 31 and 39. The expedient under consideration is particularly useful in the construction of silencers of the resonator type since the acoustical conductivity of the channels 42 can be varied by changing their number, shape and/or length.

Many applications and variations of the expedient under consideration in the next preceding paragraph will suggest themselves to those skilled in the art. Figures 3 and 4 of the drawing show fragmentarily a modified form of the silencer illustrated in the preceding figures in

which the expedient has been applied so as to eliminate the necessity of providing the partition 34. This is accomplished by constricting the shell 10 and expanding the tubular element 25 so that there are provided therein portions, 50 and 51, which mutually engage and conform to each other and therebetween channels 52 and 53 which communicate with the resonance chambers 38 and 39. Obviously, the channels 52 or the channels 53 may be omitted or the depressions 52 and 53 may be so disposed that each of the depressions 52 conjointly with one of the depressions 53 constitutes a single channel.

It will be apparent from a consideration of Figures 3 and 4 that the expedient under consideration may be applied when one desires to support an end of a tubular element from a tubular element which surrounds it rather than from one which it surrounds by expanding instead of constricting the end of the first-mentioned tubular element and that the construction illustrated in Figures 1 and 2 or the construction suggested in this paragraph may be modified by providing the channels in the supporting instead of the supported element or in both the supporting and the supported elements.

It will also be apparent from a consideration of Figures 3 and 4 that the construction illustrated in Figures 1 and 2 or the constructions suggested in the next preceding paragraph may be modified by expanding or constricting the supporting element instead of or in addition to constricting or expanding the supported element and from a consideration of Figures 1 and 2 that the construction illustrated in Figures 3 and 4 may be modified by expanding more the tubular element 25 and eliminating the constriction in the shell 10 or constricting more the shell 10 and eliminating the expansion in the tubular element 25.

I claim:

1. In a silencer, two telescopically related, radially spaced tubular elements which constitute walls of a chamber, a passage of which the chamber constitutes a side branch extending through the inner of the tubular elements—one of the tubular elements being deformed transversely throughout a portion only of its length so as to change its diameter throughout its circumference and bring it into contact with the other throughout a portion only of its circumference in order to provide means for supporting one of the tubular elements from the other and a passage which communicates with the chamber.

2. In a silencer, two telescopically related, radially spaced tubular elements which constitute walls of a chamber, a passage of which the chamber constitutes a side branch extending through the inner of the tubular elements—the outer of the tubular elements being corrugated longitudinally throughout a portion only of its length so that its external diameter is reduced and the inwardly directed corrugations contact with the inner of the tubular elements at points distributed around its circumference in order to provide means for supporting one of the tubular elements from the other and passages which communicate with the chamber.

3. In a silencer, two telescopically related, radially spaced tubular elements which constitute walls of a chamber, a passage of which the chamber constitutes a side branch extending through the inner of the tubular elements—one end of the outer of the tubular elements being deformed inwardly so as to change its diameter throughout its circumference and bring it into contact with the inner of the tubular elements throughout a portion only of its circumference in order to provide means for supporting one of the tubular elements from the other and a passage which communicates with the chamber.

4. In a silencer, two telescopically related radially spaced tubular elements which constitute walls of a chamber, a passage of which the chamber constitutes a side branch extending through the inner of the tubular elements, a tubular element of which a portion is surrounded by the outer of the first specified tubular elements and which surrounds a portion only of the inner of the first specified tubular elements and is radially spaced from the first specified tubular elements, an opening in the inner of the first specified tubular elements which communicates with the interior thereof and with the space between the inner of the first and the third specified tubular elements—one end of the third specified tubular element being corrugated longitudinally so that its external diameter is reduced and the inwardly directed corrugations contact with the inner of the first specified tubular elements at points distributed around its circumference in order to provide means for supporting the third specified tubular element from the inner of the first specified tubular elements and passages which communicate with the space between the inner of the first and the third specified tubular elements and the space between the first specified tubular elements beyond the end of the third specified tubular element.

5. In a silencer, two telescopically related, radially spaced tubular elements which constitute walls of a chamber, a passage of which the chamber constitutes a side branch extending through the inner of the tubular elements—one of the tubular elements being deformed transversely throughout a portion only of its length so as to provide in it longitudinally extending furrows and change its diameter throughout its circumference to bring it into contact with the other throughout a portion only of its circumference in order to provide support for one of the tubular elements from the other and a passage which communicates with the chamber.

6. A muffler having an inner shell provided with a plurality of relatively small perforations and having an imperforate portion, an outer imperforate shell having its ends closed, an intermediate shell, said inner and intermediate shells forming between them an inner chamber and said intermediate and outer shells forming between them an outer chamber, an end of said intermediate shell being provided with longitudinally and inwardly disposed grooves extending into engagement with said inner shell about said imperforate portion of said inner shell, the portions of said intermediate shell between said grooves forming restricted passages between said inner and intermediate shells which connect said inner and outer chambers.

7. A muffler having an inner shell provided with a plurality of relatively small perforations and with an annular imperforate portion, an outer imperforate shell having its ends closed, an intermediate shell, said inner and intermediate shells forming between them an inner chamber and said intermediate and outer shells forming between them an outer chamber, a portion of said intermediate shell extending about said imperforate portion of said inner shell being provided with

longitudinal grooves extending into engagement with said inner shell to form between said grooves passages connecting said inner and outer chambers, said passages being of greater length than breadth and forming with said outer chamber a neck type resonator.

8. A muffler comprising an inner shell through which gases and sound waves may pass from end to end, an intermediate shell arranged about said inner shell, said inner shell having an opening through which sound waves may pass into a space between said inner and intermediate shells, means for closing one end of said space, said intermediate shell having longitudinally extending portions thereof extending into contact with said inner shell and forming channels between said portions, and an outer shell having its ends closed and extending about said intermediate shell and forming therewith a resonance chamber, said channels connecting said space and said resonance chamber.

9. A muffler having an inner shell provided with a plurality of relatively small perforations and having an imperforate portion, an outer imperforate shell having its ends closed, an intermediate shell, said inner and intermediate shells forming between them an inner chamber and said intermediate and outer shells forming between them an outer chamber, said inner chamber receiving gases and sound waves from said inner shell through said perforations, and a passage connecting said inner and outer chambers and of less cross-sectional area than said inner chamber and of materially greater length than width and formed partly by said imperforate portion of the inner shell, for conducting gases and sound waves from said inner chamber to said outer chamber.

10. A muffler having an inner shell provided with a plurality of relatively small perforations, an outer imperforate shell having its ends closed, an intermediate shell, said inner and intermediate shells forming between them an inner chamber and said intermediate and outer shells forming between them an outer chamber, and connecting passages between said inner and outer chambers through which gases and sound waves may travel in a direction lengthwise of the muffler, said passages being of greater length than their width in a radial direction and of lesser cross-sectional area than the cross-sectional area of said inner chamber and being formed by longitudinal ridges formed on at least one of the shells forming said passages.

11. A muffler comprising an inner perforate shell forming a passage for gases through the muffler, an outer shell and an intermediate shell surrounding said inner shell and arranged in spaced relation to said inner shell and to each other, heads closing the ends of said outer shell and having openings communicating with said inner shell, baffles forming inner chambers between said inner and intermediate shells and into which sound waves pass through the perforations of said inner shell, and elongated channels of greater length than transverse dimensions between said inner and intermediate shells for conducting sound waves from said inner shell to the space between said outer and intermediate shells.

12. A muffler including an inner shell through which gases and sound waves pass, an outer shell and an intermediate shell extending about said inner shell, transversely extending members arranged between said intermediate and outer shells to form therewith a resonance chamber, said inner shell having a perforated portion and an imperforate portion, and longitudinally extending inwardly pressed portions formed in said intermediate shell and extending into contact with said imperforate portion of said inner shell to form a restricted passage connecting said resonance chamber and the space between said inner and intermediate shells.

13. A muffler including an inner shell through which gases and sound waves pass, an outer shell and an intermediate shell extending about said inner shell, transversely extending members arranged between said intermediate and outer shells to form therewith a resonance chamber, said inner shell having a perforated portion and an imperforate portion, said intermediate shell having longitudinal inwardly extending portions thereof engaging said imperforate portion of said inner shell to form restricted channels between said extending portions connecting said resonance chamber and the space between said inner and intermediate shells and forming bottle necks for said resonance chamber.

14. In a silencer, a tubular member, another tubular member which encircles and is radially spaced from the first-specified tubular member to define with it a chamber, and a passage through which gases and sound waves may travel extending through the inner of the tubular members, the chamber being connected to the passage as a side branch, one of the tubular members having in it throughout a portion only of its length deformations which extend into engagement with the other of the tubular members and are separated from each other circumferentially so as to leave between them open-ended apertures which communicate at one end with the chamber.

15. In a silencer, a tubular member, another tubular member which encircles and is radially spaced from the first-specified tubular member to define with it a chamber, and a passage through which gases and sound waves may travel extending through the inner of the tubular members, the chamber being connected to the passage as a side branch, the outer of the tubular members having in it throughout a portion only of its length corrugations which extend lengthwise of it and into engagement with the inner of the tubular members and are separated from each other circumferentially so as to leave between them open-ended apertures which communicate at one end with the chamber.

16. In a silencer, a tubular member which defines a passage through which gases and sound waves may travel, a second tubular member which encircles and is radially spaced from the first-specified tubular member to define with it a chamber, a third tubular member which encircles and is radially spaced from the second-specified tubular member to define with it another chamber, an aperture in the first-specified tubular member which opens into the first-mentioned chamber, the second-specified tubular member having in it at one end deformations which extend into engagement with one of the others of the tubular members and are separated from each other circumferentially so as to leave between them open-ended apertures which communicate at one end with one and at the other end with the other of the mentioned chambers.

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