

Nov. 26, 1963

E. LUDLOW

3,112,008

SOUND ATTENUATING RESONATOR

Filed Dec. 11, 1961

Fig. 1.

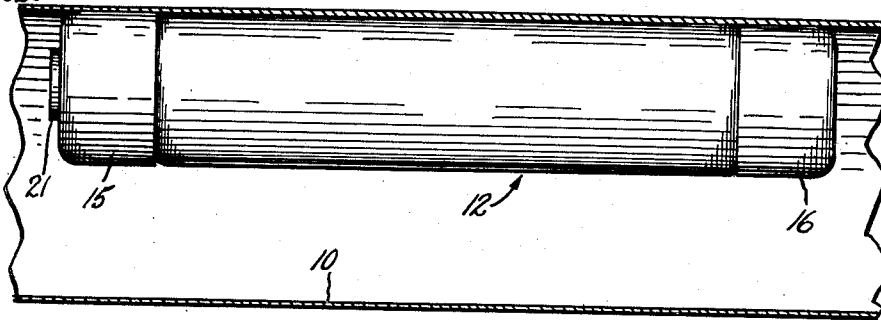


Fig. 2.

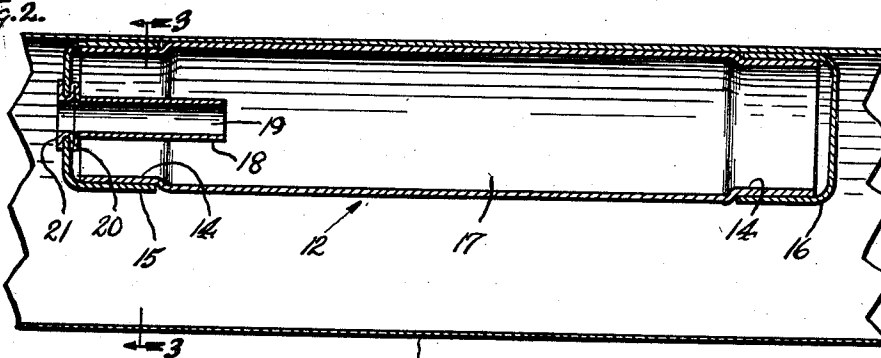


Fig. 3.

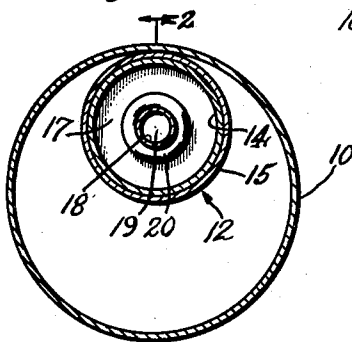


Fig. 5.

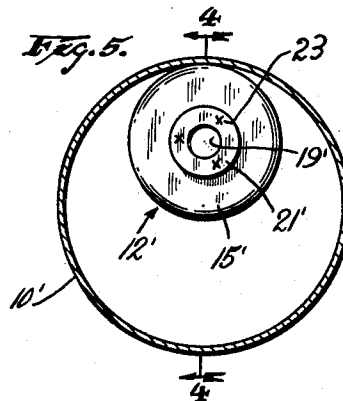
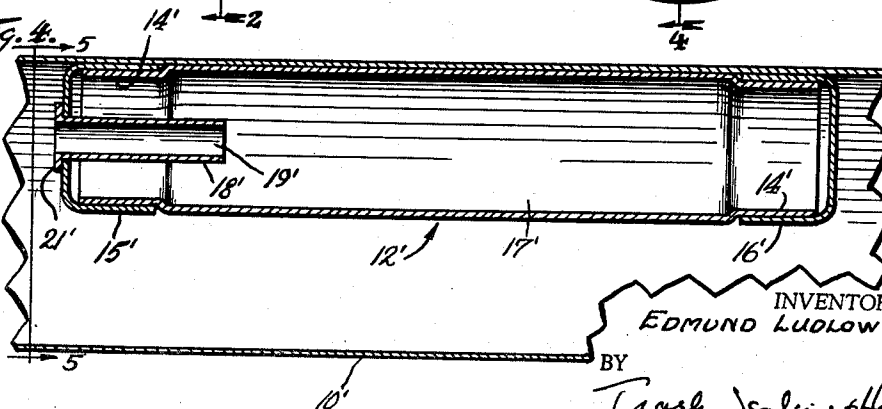


Fig. 4.



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3,112,008

SOUND ATTENUATING RESONATOR

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Filed Dec. 11, 1961, Ser. No. 153,456
3 Claims. (Cl. 181-59)

This invention relates to a sound attenuating resonator, and more particularly to a sound attenuating resonator mountable in a gas-carrying conduit for attenuating the noise level of the gases moving therethrough.

It is an object of this invention to provide a sound attenuating resonator which can be economically manufactured from inexpensive sheet-metal stampings and metal-tubing which can be tuned to attenuate undesired sound wave frequencies, and which may be mounted directly to the wall of a gas-carrying conduit.

This invention is concerned with the construction of a sound attenuating resonator which may be mounted directly on the inner wall of a gas-carrying conduit. Said resonator comprises an elongated tubular member having a pair of end caps mounted on its opposed ends, whereby said tubular member and end caps define a resonator volume. Mounted in an opening in one of said end caps is a length of tubing having one of its ends open to the interior of said volume and its opposite end open outside the extent of said volume, as open to the interior of the gas-carrying conduit to which the resonator may be mounted, to form a resonator throat acoustically coupling said volume to a source of sound power. Means are provided on said tubing rigid with the portions of said one end cap forming the opening in which said tubing is received for rigidly connecting said tubing to said one end cap.

Other objects and features of the invention will become apparent from the more detailed description which follows and from the accompanying drawing, in which:

FIG. 1 is a fragmentary longitudinal section of a gas-carrying conduit having a sound attenuating resonator embodying my invention mounted therein;

FIG. 2 is a fragmentary longitudinal section of the gas-carrying conduit and sound attenuating resonator shown in FIG. 1 and taken on the line 2-2 of FIG. 3;

FIG. 3 is a vertical section taken on the line 3-3 of FIG. 2;

FIG. 4 is a fragmentary longitudinal section taken on the line 4-4 of FIG. 5 and showing a gas-carrying conduit having a different embodiment of my sound attenuating resonator mounted therein; and

FIG. 5 is a vertical section taken on the line 5-5 of FIG. 4.

My resonator construction is particularly well adapted for use in a conduit leading from an internal combustion engine in an automotive vehicle to a suitable gas discharge point. The essential feature characterizing the invention is the inexpensive construction of a resonator which may be mounted in such a conduit for attenuating the noise level of the exhaust gases passing through said conduit.

As illustrated in the drawing, my resonator may be welded or otherwise secured directly to the inner wall of a gas-carrying conduit 10. The resonator shown in FIG. 1 comprises a length of pipe 12 having its end portions shouldered inwardly, as at 14. A pair of end caps 15 and 16, conveniently formed as sheet-metal stampings, are press-fit over the shouldered ends of said pipe, whereby said end caps and pipe define a resonator volume 17. Conveniently, the ends of the pipe 12 are shouldered inwardly a distance approximating the thickness of the side walls of the end caps 15 and 16, so that the outer axially extending faces of said end caps and pipe are coplanar

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for mounting the resonator in line contact with the conduit 10 along the length of said resonator.

The end cap 15 has an opening formed therein in which a length of tubing 18 is carried. Said tubing has one of its ends in open communication with the interior of the resonator volume 17 and its opposite end in open communication with the interior of the conduit 10 to form a resonator throat 19 acoustically connecting the volume 17 with the interior of said conduit, whereby said volume and throat will attenuate the noise level of the gases passing through said conduit. In the embodiment shown in FIGS. 1-3, an annular outwardly projecting bead 20 is formed in the tubing adjacent one of its ends and said tubing is then inserted in the opening formed in the end cap 15 to abut the portion of said end cap defining the said opening. The end of the tubing disposed on the opposite side of said end cap is then flanged outwardly as at 21, against the opposite face of said end cap. In this manner, the portions of the end cap defining the edges of the opening in which the tubing 18 is received are bindingly retained between the bead 20 and the flanged tubing end 21, and said tubing is thus rigidly retained in the end cap 15.

As will be understood from known principles of acoustics, the length and cross-sectional area of the throat 19 and the size of the volume 17 determine the sound wave frequencies which the resonator formed by said volume and throat will attenuate. If said throat has a relatively long length and/or a relatively large cross-section, the resonator will attenuate relatively low sound wave frequencies. Conversely, resonators having shorter throats and/or smaller cross-sections will attenuate higher sound wave frequencies. Thus, the resonator shown in FIG. 2 may be tuned by controlling the length and/or cross-sectional extent of the tubing 18.

It is also known that the frequencies of sound waves increase with increases in the temperature of the medium in which they are carried. However, with the resonator carried directly in the gas stream moving through the conduit 10 with the major portions of its wall surfaces spaced from the walls of said conduit, the temperature of the resonator will follow the temperature of the gas stream, and it will thus remain in tune with the frequency which it is to attenuate.

A different embodiment of my resonator construction is illustrated in FIGS. 4 and 5. As shown, said resonator is mounted in a gas-carrying conduit 10', and comprises a length of pipe 12' having inwardly shouldered ends 14' upon which end caps 15' and 16' are mounted, conveniently as press-fits. The end caps 15' and 16' and the pipe 12' form a resonator volume 17'.

The end cap 15' has an opening formed therein in which a length of tubing 18' is carried, said tubing having one of its ends in open communication with the interior of the volume 17' and its opposite end in open communication with the interior of the conduit 10' to form a resonator throat 19' acoustically coupling the volume 17' with the gas stream moving through the conduit 10'. As shown in FIG. 4, one end of the tubing 18' is flanged radially outwardly, as at 21', and is rigidly secured, as by welds 23, to the portion of the end cap 15' defining the edges of the opening in which the tubing 18' is received to rigidly mount said tubing in said end cap.

Although we have shown the lengths of tubing forming the resonator throats as projecting only inwardly into the resonator volumes, it is to be understood, of course, that said tubing may, if desired, also project substantially outwardly from the ends of the resonators.

I claim as my invention:

1. A sound attenuating resonator comprising,
 - (a) an elongated tubular member having inwardly

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- shouldered ends to provide said member with a reduced internal diameter at its ends,
- (b) a pair of end caps press-fit over the outer faces of the shouldered ends of said tubular member, whereby said end caps and tubular member form a resonator volume. 5
- (c) the outer faces of the walls of the end caps press-fit over the ends of said tubular member being coplanar with the outer face of said tubular member between said end caps, 10
- (d) a length of tubing mounted in an opening formed in one of said end caps,
- (e) one end of said tubing being open to the interior of said volume and the opposite end of said tubing being open outside the extent of said volume, whereby said tubing forms a resonator throat acoustically coupling said volume to a source of sound power, and 15
- (f) at least one radially extending wall on said tubing abutting the portions of said one end cap adjacent the opening therein in face to face contact and rigidly connected thereto for rigidly connecting said tubing to said one end cap. 20
2. A sound attenuating resonator comprising,
- (a) an elongated tubular member having inwardly shouldered ends to provide said member with a reduced internal diameter at its ends, 25
- (b) a pair of end caps press-fit over the outer faces of the shouldered ends of said tubular member, whereby said end caps and tubular member form a resonator volume, 30
- (c) the outer faces of the walls of the end caps press-fit over the ends of said tubular member being coplanar with the outer face of said tubular member between said end caps, 35
- (d) a length of tubing mounted in an opening formed in one of said end caps,
- (e) one end of said tubing being open to the interior of said volume and the opposite end of said tubing being open outside the extent of said volume, whereby said tubing forms a resonator throat acoustically coupling said volume to a source of sound power, and 40

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- (f) a pair of axially spaced radially projecting walls on said tubing bindingly engaging the opposed faces of the wall portions on said one end cap adjacent the opening formed therein in face to face contact for rigidly connecting said tubing to said one end cap.
3. A silencing element for an exhaust gas conduit, comprising
- (a) an elongated tubular member having inwardly shouldered ends rigidly connected to the inner wall of said conduit,
- (b) a pair of end caps press-fit over the outer faces of the shouldered ends of said tubular member, whereby said end caps and said tubular member form a resonator volume,
- (c) the outer faces of the walls of said end caps press-fit over the ends of said tubular member being coplanar with the outer face of said tubular member between said ends caps,
- (d) a length of tubing mounted in an opening formed in one of said end caps,
- (e) one end of said tubing being open to the interior of said volume and the opposite end of said tubing being open to the interior of said conduit, whereby said tubing forms a resonator throat acoustically coupling said volume to said conduit, and
- (f) at least one radially extending wall on said tubing abutting the portions of said one end cap adjacent the opening therein in face to face contact and rigidly connected thereto for rigidly connecting said tubing to said one end cap.

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