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Strunk

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[54] **SOUND ATTENUATING MUFFLER**

[75] Inventor: **Larry E. Strunk**, Jackson, Mich.

[73] Assignee: **Tenneco Inc.**, Racine, Wis.

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[51] **Int. Cl.** **F01n**

[58] **Field of Search** 181/41, 55, 49, 48, 181/57, 47, 59

[56] **References Cited**

UNITED STATES PATENTS

2,047,443	7/1936	Starkweather	181/41
2,150,811	3/1939	Starkweather	181/55
2,583,366	1/1952	Engles	181/55
3,680,660	8/1972	Dubois	181/55

Primary Examiner—Richard B. Wilkinson
Assistant Examiner—P. Salce
Attorney—J. King Harness et al.

[57] **ABSTRACT**

A muffler suitable for use in an internal combustion engine exhaust system has a tubular member extending the full length of an outer shell to provide a gas passage connecting the inlet end to the outlet end of the shell and has a reduced diameter central portion which is surrounded by an inner shell that communicates with the interior of the gas flow passage by means of perforations in the wall of the tubular member, the tubular member also containing perforations on opposite sides of the inner shell that open into a chamber between a tubular member and the outer shell.

13 Claims, 5 Drawing Figures

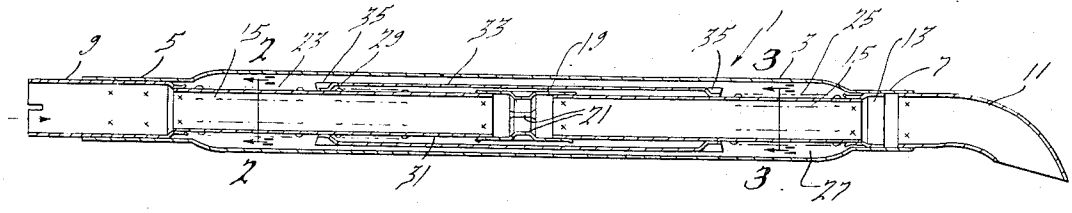


Fig. 1.

Fig. 5.

Fig. 3.

Fig. 4.

Fig. 2.

SOUND ATTENUATING MUFFLER

BRIEF SUMMARY OF THE INVENTION

It is the purpose of this invention to provide a compact straight through flow type exhaust muffler with improved means for attenuating sound.

The invention accomplishes this purpose by means of a muffler in which inner and outer chambers surround a tubular straight through flow gas passage that is perforated to open into each chamber and which contains a centrally located restriction.

DESCRIPTION OF THE DRAWINGS

FIG. 1 is a longitudinal cross section through one form of an exhaust gas muffler embodying the invention;

FIG. 2 is a cross section along the line 2—2 of FIG. 1;

FIG. 3 is a cross section along the line 3—3 of FIG. 1;

FIG. 4 is a longitudinal cross section through another form of muffler embodying the invention; and

FIG. 5 is a cross section along the line 5—5 of FIG. 4.

DETAILED DESCRIPTION OF THE INVENTION

The muffler 1 of FIGS. 1 – 3 has a tubular outer housing 3 of circular cross section which has an inlet end portion 5 of reduced diameter and an outlet end portion 7 of reduced diameter. A slotted inlet bushing 9 for attachment to an exhaust gas conduit (not shown) is spotwelded within the portion 5 as indicated by the "*x's* ", which throughout the drawings indicate a spotweld connection. An outlet spot 11 is spotwelded in the outlet portion 7 of the shell and conveys gas to atmosphere indicating that the unit 1 may be used at the outlet end of an exhaust gas system. The outlet portion 7 also has a bushing 13 disposed inside of it. This bushing and the inlet bushing 9 have reduced diameter inner portions which serve to support the opposite ends of an open-ended gas flow conduit of circular cross section, the inlet bushing 9 supporting the outer end of tube section 15 and the outlet bushing 13 supporting the outer end of a tube section 17. Tubes 15 and 17 are coaxial and interconnected at their inner ends by a connector tube 19 so that they form a straight through passage for conveying gas from the inlet bushing 9 to the outlet spout 11.

The connector tube element 19 has U-shaped pinched sections 21 formed in it to reduce its diameter and provide resistance or obstruction to gas flowing through the passage provided by the tubes 15 and 17. The tube 15 has a patch of louvers 23 formed in the wall thereof adjacent its upstream end and the tube 17 has a patch 25 of louvers formed in it adjacent its downstream end. These patches of louvers connect the interior of the tubes with an outer chamber 27 that is formed between the shell 3 and the tubes. The obstruction provided by the reduced diameter of the connector 19 at pinches 21 causes some of the gas in the muffler to flow out of the patch 23 and along the length of chamber 27 and into the outlet patch 25 to reach the spout 11. In accordance with the teaching of a copending U.S. application of Ralph J. Haren, Ser. No. 304,770, filed Nov. 8, 1972, entitled "Muffler With Rotary Gas Flow," assigned to the assignee of the present invention, the louvers in patch 23 preferably face

in the opposite tangential direction to those in the patch 25 as seen by comparing FIGS. 2 and 3.

In accordance with the present invention, the inlet tube 15 is further perforated to connect its interior with an inner chamber 31 that is formed by an inner shell 33, the perforations preferably being a louver patch 29. The shell 33 is imperforate so that the chamber 31 is closed except for openings 29. The shell is attached at opposite ends to the tubes 15 and 17, respectively, by means of necked-down end sections formed by the U-shaped pinches 35. The louver patch 29 is located adjacent the upstream end of the chamber 31 which in muffler 1 extends over a major portion of the length of the muffler. Thus, the combination of the patch 29 and the chamber 31 is adapted to tune a relatively low frequency, as by making the distance between the midpoint of the patch 29 and the downstream end of the chamber 31 substantially one quarter wave length of a troublesome frequency that it is desired to attenuate.

In operation, gas entering the inlet bushing 9 will flow through the muffler to exit by way of the curved spout 11. As the gas flows straight through the tubes 15 and 17 sound attenuation will occur as it passes each of the louver patches 23, 25, and 29 in addition to attenuation adjacent the reduced diameter section in connector 19 provided by pinches 21. Additionally, as just indicated, there will be an attenuation of a low frequency to which the chamber 31 and louvers 29 are tuned. The obstruction provided by the pinches 21 will force some of the gas to flow through the chamber 27 from the louver patch 23 to the louver patch 25. Attenuation will occur As the gas passes out of and into the louvers and by virtue of the directional disposition of the louvers, as seen in FIGS. 2 and 3, particularly efficient attenuation occurs. The various component parts are secured together as indicated by the spotweld connections "*x*," it being noted that the bushing 13 is free to shift within the outlet portion 7 so as to accommodate relative expansion between the inner gas flow tube assembly and the outer housing 3.

In FIGS. 4 and 5, the muffler 101 has a round tubular outer shell 103 which is reduced in diameter at opposite ends to form an inlet bushing 105 and an outlet bushing 107 which are adapted to be connected to gas conveying conduits (not shown) in an exhaust system. An open-ended gas flow tube 109 of circular cross section is concentric with the outer shell 103 and supported at opposite ends in the bushings 105 and 107. A series of radial U-shaped pinches 111 in the center portion of the tube 109 provide it with a reduced diameter center section 113 to impede gas flow along the length of the tube 109. The tube 109 is perforated throughout its length as indicated by the holes 115, though it will be understood that the holes can be in the form of louvers such as those shown in FIGS. 1 – 3.

A center shell 117 surrounds the mid-portion of the tube 109 and is tightly secured to the tube 115 by means of necked-down ends formed by the pinches 119. It forms an inner chamber 121 that communicates with gas flowing through the tube 115 on both sides of section 113 by means of the holes 115. The shell 117 is preferably imperforate but may be perforated to provide a controlled amount of open area if desired. Its length and diameter can also be adjusted as can the length and diameter of section 113 in accordance with design control factors.

An outer chamber **123** is defined by the inside of the shell **103** and the outside of the shell **117** and the tube **109.** The perforations **115** along the length of the tube connect its interior with the chamber **123** along the full length of the shell **103.** The chamber **123** is preferably packed with glass fibers or other suitable acoustic absorbent material **125.**

In operation of the muffler **103,** some of the gas will flow straight through the muffler by way of the flow tube **109.** The restriction provided by the reduced diameter portion **113,** however, will force some of the gas to flow in parallel through the chamber **121** by way of the perforations on either side of section **113.** If pressure is sufficient to overcome the resistance provided by the acoustic material, the gas may also flow in parallel to tube **109** through the outer chamber **123.**

The muffler **101** will be especially effective on relatively high frequencies by virtue of the attenuation provided by the absorbent material and/or the chamber **123** in conjunction with the shorter chamber **121.** This is accomplished with the benefits of the straight through flow design giving relatively low and controlled back pressure. The size and number of perforations or louvers in the tube **109** can be varied to provide an open area that suits the particular application, one particular application having a 26 percent open area though substantially more or less open area may be desirable in different applications.

It will be seen that the invention provides a small diameter, low back pressure muffler construction in which concentric inner and outer chambers are utilized in conJunction with a reduced diameter portion of a gas flow tube to provide effective sound attenuation, particularly of the higher frequencies. Modifications may be made in the specific structures shown without departing from the spirit and scope of the invention.

I claim:

1. An exhaust gas muffler or the like comprising an elongated tubular outer shell having an inlet and an outlet at oppostie ends, a gas flow conduit connecting the inlet and outlet and extending straight through the shell and providing a straight through gas flow path for gas to pass through the muffler, an inner shell mounted on the gas flow tube conduit and extending along a substantial part of the central portion of the conduit, flow obstructing means in the conduit and located axially within that portion of the conduit covered by the inner shell, said outer shell defining an outer chamber around the conduit and said inner shell defining an inner chamber around the conduit, said conduit having first perforations opening into the inner chamber on at least one side of the obstruction means, said conduit having second perforations opening into the outer chamber on each side of said inner shell.

2. A muffler as set forth in claim **1** wherein said first perforations are only on the upstream side of the obstructing means.

3. A muffler as set forth in claim **1** wherein said first perforations and said inner chamber are tuned to attenuate a predetermined sound frequency.

4. A muffler as set forth in claim **3** wherein said inner chamber has a length extending from said first perforations that is substantially equal to one quarter wave length of said frequency.

5. A muffler as set forth in claim **1** wherein said first perforations are located only at an end of said inner chamber and said inner chamber has a length substantially equal to a quarter wave length of said frequency.

6. A muffler as set forth in claim **5** wherein said first perforations are located on the upstream side of said obstructing means.

7. A muffler as set forth in claim **6** wherein said first perforations are louvers.

8. A muffler as set forth in claim **1** wherein said first perforations are located on both the upstream and downstream sides of said obstructing means.

9. A muffler as set forth in claim **8** wherein said outer chamber is substantially filled with sound absorbent material.

10. A muffler as set forth in claim **1** wherein said obstructing means comprises a reduced diameter section in said conduit.

11. A muffler as set forth in claim **10** wherein said conduit has angularly spaced radially extending U-shaped pinches therein to form said reduced diameter section.

12. A muffler as set forth in claim **11** wherein said conduit comprises axially separated coaxial inlet and outlet tubes and a connector tube element joining said inlet and outlet tubes, said reduced diameter section being formed in said connector tube element.

13. A muffler as set forth in claim **12** wherein said connector tube element is spotwelded to both tubes and including means spotwelding one outer end of one of the tubes to the shell, the outer end of the other of said tubes being axially shiftably supported in said shell.

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