United States Patent

Malkiewicz

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[54] **FIVE PASS MUFFLER**

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[52] **U.S. Cl.** **181/54,** 181/55, 181/61, 181/63

[51] **Int. Cl.** **F01n 1/08,** F01n 7/18

[58] **Field of Search** 181/53–56, 61–63, 181/49, 35, 41

[56] **References Cited**

UNITED STATES PATENTS

858,455	7/1907	Hedstrom	181/53 X
1,318,890	10/1919	MacKenzie	181/53
2,150,811	3/1939	Starkweather et al.	181/55
3,036,654	5/1962	Powers	181/54

FOREIGN PATENTS OR APPLICATIONS

246,497	4/1966	Austria	181/54
310,942	1/1956	Switzerland	181/55

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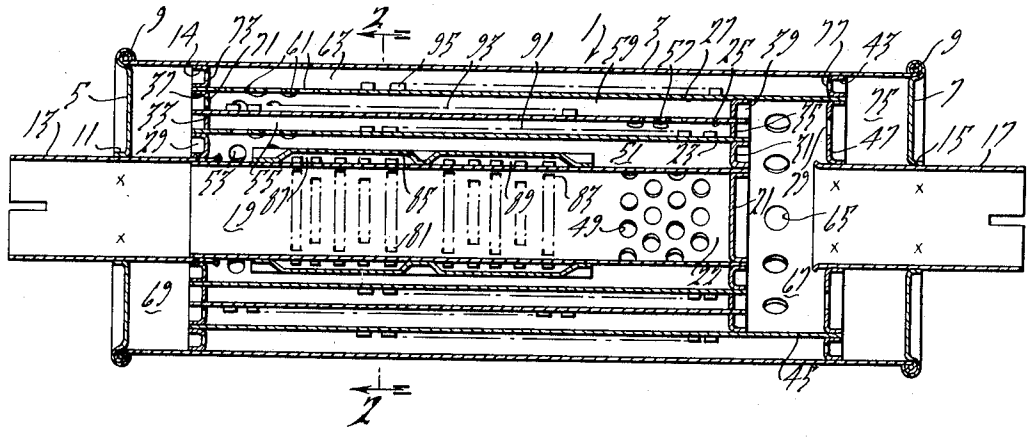
[57] **ABSTRACT**

A short five pass muffler producing a high degree of broad band attenuation comprises a gas flow tube surrounded by a plurality of shells which furnish reversely directed gas flow paths for the gas passing through the muffler.

9 Claims, 2 Drawing Figures



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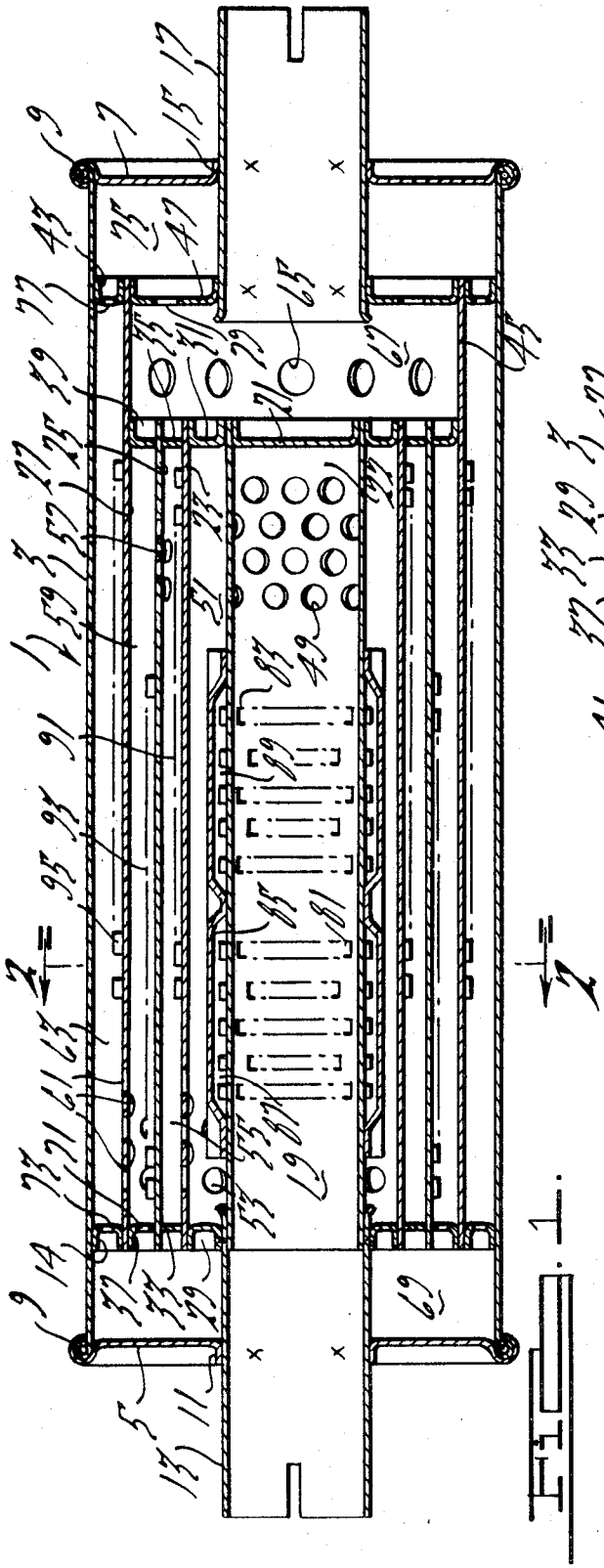

FIG. 1.

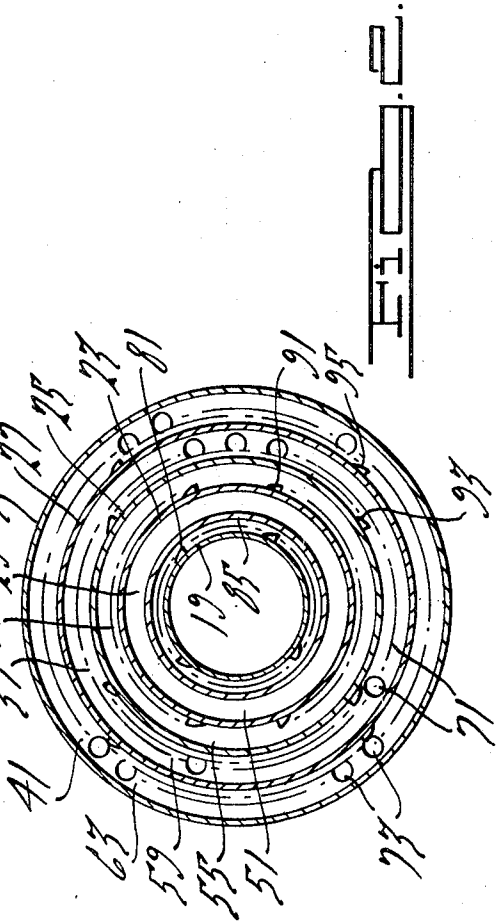

FIG. 2.

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FIVE PASS MUFFLER

BRIEF SUMMARY OF THE INVENTION

It is the purpose of the invention to provide a muffler with a high degree of broad band sound attenuation within a very small housing and with a minimum backpressure.

The invention accomplishes this by a concentric shell arrangement that causes the gas to flow back and forth in the muffler through five passes before it reaches the muffler outlet.

DESCRIPTION OF THE DRAWINGS

FIG. 1 is a longitudinal cross section through a muffler embodying the invention; and

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

DETAILED DESCRIPTION OF THE INVENTION

The muffler 1 has a tubular casing 3 of circular cross section which is closed at one end by an inlet header 5 and at the other end by an outlet header 7, the headers being interlocked at 9 with the ends of the shell 3. The inlet header 5 has an outwardly extending collar 11 in which is supported an inlet bushing 13 and the outlet header 7 has an outwardly extending collar 15 in which an outlet bushing 17 is supported. A central gas flow tube 19 has its inlet end supported in the inlet bushing 13 and its outlet end is closed by partition 21 to form an inlet chamber 22.

Three concentric tubular shells or annular longitudinal partitions 23, 25, and 27 surround the inlet tube 19. The shell 23 is spaced from the inlet bushing 13 by an annular transverse partition 29 and from the tube 19 by an annular transverse partition 31 at the other end of the shell. The shell 25 is spaced from the shell 23 by a partition 33 at the inlet end of the muffler and the partition 35 at the outlet end. The shell 27 is spaced from the shell 25 by a partition 37 at the inlet end and a partition 39 at the outlet end and is spaced from the outer casing 3 by a partition 41 at the inlet end and a partition 43 at the outlet end.

The outer shell 27 is substantially longer than the center tube 19 of the intermediate shells 23 and 25 by virtue of an extended portion 45, the latter being spaced from the outlet bushing 17 by means of an annular flange 47.

The various flanges and partitions are spotwelded together to provide structural strength for the assembly and to provide a bridge support of the bushings 13 and 17 which are spotwelded to the header collars as well as to the internal partition structure.

The downstream end of the inlet tube 19 has four rows of staggered relatively large holes 49 which act together to provide an outlet for gas in the inlet chamber 22 so that it can reach the longitudinal chamber 51 between the tube and the adjacent shell 23. The inlet end of the shell 23 has a similar pattern of staggered holes 53 which provide an outlet for gas in chamber 51 to reach the chamber 55 between the shells 23 and 25. Similarly, the shell 25 has a four-row pattern of staggered holes 57 at the outlet end which provide an outlet for gas in chamber 55 to reach the chamber 59 between the shell 25 and the shell 27. Gas in the chamber 59 has an outlet provided by a four-row staggered hole pattern of holes 61 at the muffler inlet

end of the shell 27 which enable the gas to reach the longitudinal chamber 63 between the shell 27 and the casing 3. Gas in the chamber 63 passes through the relatively large holes 65 in the extension 45 of shell 27 to reach an outlet chamber 67 defined in part by the extension 45 and therefore reaches the outlet bushing 17 so that it can pass out of the muffler.

The space within the casing 3 between the inlet header 5 and the various partitions at the inlet ends of the interior shells comprises a chamber 69 which can be reached by gas pulses in chambers 59 and 63 through holes 71 and 73 in the partitions 37 and 41. Gas in the chamber 63 can also reach a chamber 75 that is formed in the casing 3 between the inlet header 7 and the partitions 47 and 43 by passing through holes 77 in the partition 43. Gas in the chamber 75 can leave through holes 79 in partition 47 to enter the outlet chamber 67.

The inlet tube 19 is provided with a pair of louver patches or perforated areas 81 and 83 which are surrounded by a shell structure 85 that provides a closed chamber 87 communicating through louvers 81 with the inside of tube 19 and a closed chamber 89 communicating through louvers 83 with the inside of tube 19. The major portion of the lengths of each of the shells 23, 25, and 27 are provided with louver patches or perforated areas 91, 93 and 95, which areas are overlapping but also staggered because of the alternate ends at which the various outlets are placed so as to provide a retroverted gas flow from tube 19 to the outlet chamber 67.

In operation, gas enters the inlet bushing 13 and is forced by the closed end partition 21 to flow outwardly through holes 49 into the chamber 51. The chambers 87 and 89 attenuate some of the high frequency sounds and roughness in the gas passing through the tube 19. The gas in chamber 51 is reversed in flow direction and flows toward the inlet end of the muffler until it reaches the hole patch 53 through which it can flow to reach chamber 55 and reverse its direction of flow to pass toward the outlet end of the muffler. Partition 35 forces it to leave the chamber 55 through the holes 57 to enter the chamber 59 where it reverses direction again to flow back toward the inlet end of the muffler. From chamber 59 the gas can flow through the hole structure 61 into the chamber 63 and then toward the outlet end where most of it can leave the chamber 63 through openings 65, flow into the outlet chamber 67, and then into the outlet bushing 17. Chamber 75 has an attenuating effect on medium frequencies as does chamber 69 which communicates with chambers 59 and 63 through openings 71 and 73.

While following this zig-zag flow path substantial acoustic energy across a broad band of frequencies is lost but the restrictions to flow in the total areas of the various outlet openings 49, 53, 57, 61, and 65 are controlled so as to provide a minimum backpressure. In addition to the attenuation of roughness and high frequencies provided by the louver patches 91, 93, and 95 these perforated areas also permit cross-bleeding and therefore tend to reduce back pressure. Additional pressure relieving outlet flow, as well as silencing, occurs by passage of gas through holes 77 into chamber 75 and then through openings 79 into the outlet chamber 67.

Thus, a muffler especially useful with small or two-cycle engines is provided by the structure shown. A high level of performance, at minimum back pressure, across a broad band of frequencies in a short, small overall size is achieved, and modifications may be made in specific features without departing from the spirit and scope of the invention.

I claim:

1. A muffler comprising a housing having an inlet at one end and an outlet at the other end, an inlet tube connected to the inlet, first transverse partition means adjacent the downstream end of the inlet tube, three radially separated annular partitions surrounding the inlet tube and supported at one end by the first partition means, second transverse partition means adjacent the inlet end of the housing supporting the other ends of the annular partitions, said inlet tube providing a first longitudinal pass for gas flow and having outlet means for gas to flow into a first annular space between the inlet tube and the smallest of said annular partitions, said first annular space comprising a second longitudinal pass for gas flow and said smallest of said annular partitions having outlet means for gas to flow into a second annular space between it and the intermediate size annular partition, said second annular space comprising a third longitudinal pass for gas flow and said intermediate size annular partition having outlet means for gas to flow into a third annular space between it and the largest annular partition, said third annular space comprising a fourth longitudinal pass for gas flow and said largest annular partition having outlet means for gas to flow into a fourth annular space between it and the housing, said fourth annular space comprising a fifth longitudinal pass for gas flow, and third transverse partition means adjacent the outlet and acting with the first transverse partition means to form an outlet chamber opening into said outlet, said fourth annular space having an outlet opening into said outlet chamber.

2. A muffler as set forth in claim 1 wherein said second and third transverse partitions act with the housing to define end chambers, certain of said annular spaces communicating with said end chambers.

3. A muffler as set forth in claim 1 wherein said largest annular partition is supported on the third transverse partition and defines a wall of the outlet chamber and has openings therein connecting the fourth annular space to the outlet chamber.

4. In a muffler, a housing having an inlet at one end and an outlet at the other end, an inlet tube connected to the inlet, three radially separated annular partitions surrounding the inlet tube, means supporting the tube and partitions in the housing, said inlet tube providing a first longitudinal pass for gas flow and having outlet means for gas to flow into a first annular space between the inlet tube and the smallest of said annular partitions, said first annular space comprising a second longitudinal pass for gas flow and said smallest of said annular partitions having outlet means for gas to flow into a second annular space between it and the intermediate size annular partition, said second annular space comprising a third longitudinal pass for gas flow and said intermediate size annular partition having outlet means for gas to flow into a third annular space between it and the largest annular partition, said third annular space comprising a fourth longitudinal pass for gas flow and said largest annular partition having outlet means for gas to flow into a fourth annular space between it and the housing, said fourth annular space comprising a fifth longitudinal pass for gas flow, gas passage means connecting said fourth annular space to said outlet, a first transverse partition means in the housing adjacent the inlet thereof and supporting the inlet tube and the annular partitions, a second transverse partition means in the housing adjacent the downstream end of the inlet tube supporting the annular partitions, and a third transverse partition means in the housing adjacent the outlet thereof and acting with the second transverse partition means to define an outlet chamber forming part of said gas passage means, said largest annular partition having outlet means opening into said outlet chamber to connect said fourth annular space thereto.

5. A muffler as set forth in claim 4 wherein at least one of said first and third transverse partition means acts with an end of the housing to define an end chamber and has openings therein to communicate at least one of the annular spaces with the end chamber.

6. A muffler as set forth in claim 5 wherein both said first and third transverse partition means act with an end of the housing to define end chambers at the inlet and at the outlet ends respectively of the housing and both said first and third transverse partition means have openings therein to respectively communicate at least one annular space with the end chambers.

7. A muffler as set forth in claim 6 wherein said inlet and outlet include bushings extending respectively through the inlet end chamber and the outlet end chamber and supported respectively by the first and third transverse partition means.

8. A muffler as set forth in claim 7 wherein said third transverse partition means has openings therein connecting the outlet end chamber with said outlet chamber.

9. A muffler as set forth in claim 8 wherein said inlet tube is perforated and a closed shell surrounds the perforated portion of the inlet tube and is located in said first annular space.

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