

Oct. 13, 1959

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Fig. 1-

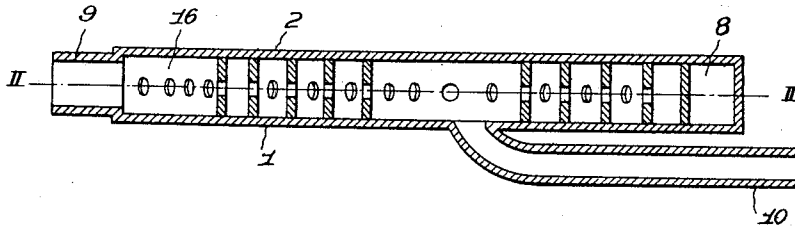
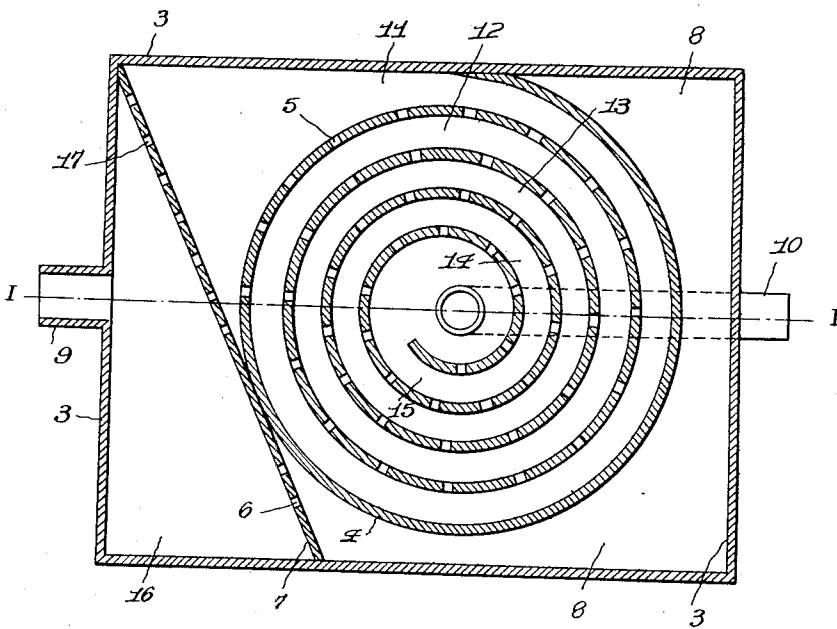


Fig. 2-



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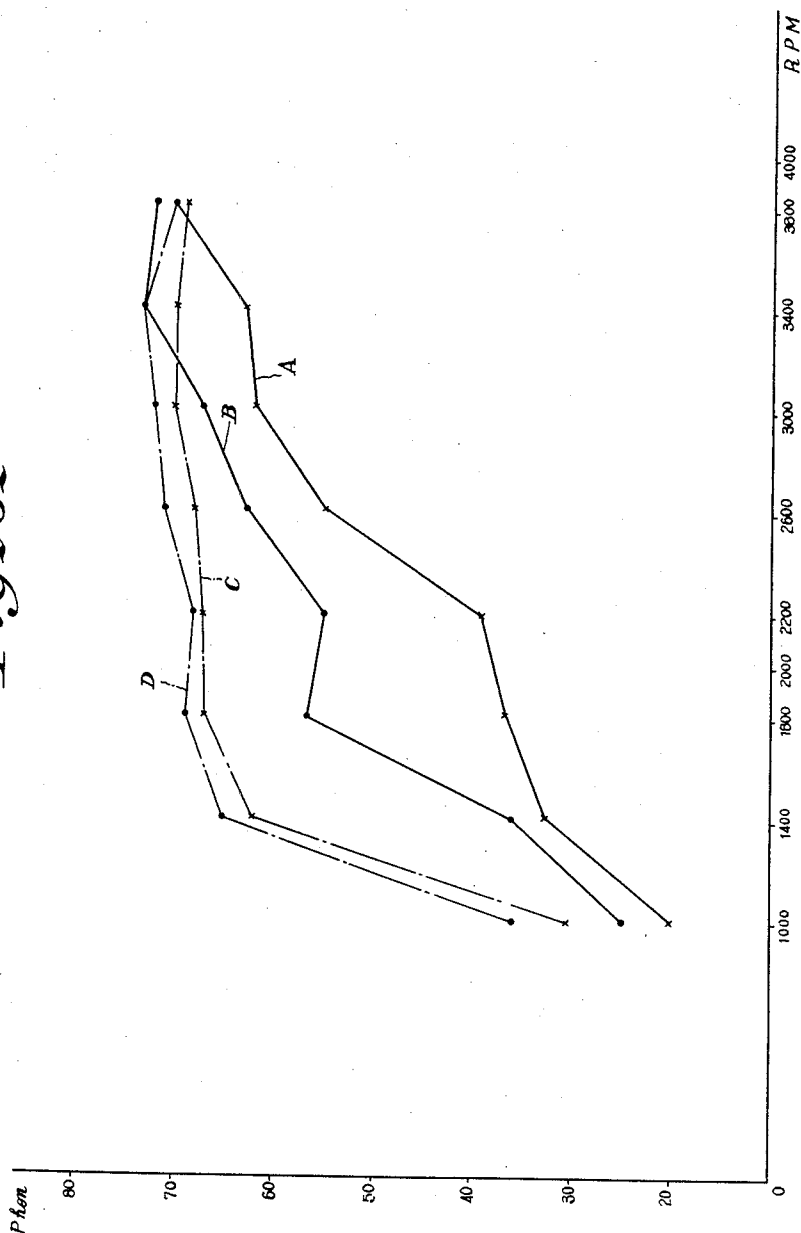
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Fig. 3-



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3 Claims. (Cl. 181—59)

The present invention relates to a muffler suitable for use as an exhaust muffler or suction muffler for internal combustion engine or as a muffler in general pipe lines.

The object of the present invention is to provide a muffler which can effectively eliminate sound or noise.

Another object of the present invention is to provide a muffler with low back pressure.

Still another object of the present invention is to provide a muffler which is of rugged construction and easy to manufacture.

The muffler of the present invention comprises a spiral passage mechanism having a plurality of spirally wound turns, the adjacent turns of passage being communicated with each other by a plurality of small openings perforated through the wall defining said turns; a diffusion chamber positioned at one end of said spiral passage and communicated therewith through a plurality of small openings; and a shunt resonant chamber communicated with said spiral passage or diffusion chamber by way of small openings.

According to the muffler as described above, sound is effectively eliminated by the combined action of said spiral passage, diffusion chamber and resonant chamber.

Thus, impulsive flow of gas entering into the muffler from the inlet first enters into the diffusion chamber and loses some of its energy by diffusion. A part of the gas will enter into the shunt resonant chamber to create a muffling phenomena by resonance and the remainder of gas will reach one end of the spiral passage and then flow through said spiral passage to the exit end thereof.

During this flow of gas through the spiral passage, the sound is eliminated by the action of continuous interference of sound and dual mutual filtering action.

For the more complete understanding of the present invention, reference may be made to the following detailed description taken in connection with the accompanying drawings, in which:

Figure 1 shows a vertical section of a muffler embodying the present invention, taken along the line I—I of Fig. 2.

Figure 2 shows a horizontal section of the muffler shown in Fig. 1, taken along the line II—II of Fig. 1.

Figure 3 shows a set of curves showing phon v. revolutions per minute characteristics of a conventional muffler and improved muffler embodying the present invention.

Referring to Figs. 1 and 2 of the accompanying drawings which illustrate one embodiment of the present invention, a spiral passage having a plurality of turns is formed by disposing a spirally wound long ribbon plate 4 in a casing comprising two flat plates 1, 2 and an outer frame 3, adjacent turns of the spiral passage being interconnected by a plurality of small openings 5 which are provided in said plate 4 except its outermost turn. A partition 7 is provided to form a diffusion chamber 16

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and a shunt resonant chamber 8 which are interconnected with each other by means of small openings 6 in the partition 7.

The resonant chamber 8 is partitioned by the outside convolution of the ribbon plate 4 and the outer frame 3 and is completely enclosed except said openings 6. The spiral passage is in series communication with the diffusion chamber 16 through a plurality of openings 17 provided in the partition 7. An inlet pipe 9 is connected to one side of the outer frame 3 and an outlet pipe 10 is connected at the center of the spiral.

If the muffler is used in connection with an internal engine, the various parts of the muffler may be made of any suitable heat resistant material and can be assembled in position by any suitable means such as welding.

In the construction illustrated, the outer frame 3 is made to have rectangular shape, the spirally wound plate 4 is positioned slightly right to the center of the rectangle and the partition 7 is positioned obliquely starting from the left upper corner of the frame to the position being in tangential contact with the outermost convolution of the spirally wound plate 4. However, it will be obvious to those skilled in the art that various modifications may be permissible.

The operation of the present muffler is as follows:

The impulsive flow of gas coming through the inlet pipe 9 enters into the diffusion chamber 16 where it expands abruptly and loses some of its energy. A part of gas enters into the shunt resonant chamber 8 through the small openings 6 to create a resonance phenomena which is effective to muffle. Remainder of the gas flows through the openings 17 and then passes along the successive turns 11, 12, 13, 14 and 15 of the spiral passage to the outlet pipe 10. A part of the gas passes through the small openings 5 in the ribbon plate 4, thus short-circuiting the turns to create a continuous interference and dual filtering action which are very effective to eliminate the sound caused by the gas flow. This short-circuiting flow of the gas through the openings 5 also serves to reduce greatly the back pressure of the muffler without causing any undue direct flow of gas through the muffler.

Heretofore, many types of mufflers for internal combustion engines have been used among which may be mentioned those including a plurality of barriers in the muffler, protruding type muffler in which a protruding pipe provided with many small holes in its peripheral wall is inserted in a muffler cylinder, and those provided with a plurality of tortuous passages, but none of them proved satisfactory in sound eliminating efficiency or back pressure reduction.

As explained above, the present muffler is characterized in that it comprises a spiral passage mechanism having a plurality of spirally wound turns, the adjacent turns of passage being communicated by a plurality of small openings in a wall defining said turns, a diffusion chamber connected in series with said passage through a plurality of small openings and a resonance chamber connected in parallel with said passage through small openings.

The Table I below shows the test results of the present improved muffler and a new Hillman type muffler which was selected as a representative of conventional mufflers. The test was carried out on a Hillman 1500 cc. automobile engine at 4/4 load, the back pressure being at 30 mm. mercury column for both cases. The noise meter used in the test was of Reutlinger type and its microphone was situated 2 m. apart from the exit of the exhaust port.

Table I

Number of revolution of engine r.p.m.	Improved muffler of this invention					New Hillman type muffler				
	fre- quency, cycles per second	amplitude, μbar/sec.		Magnitude of sound, phon		fre- quency, cycles per second	amplitude, μbar/sec.		Magnitude of sound, phon	
		1 3%	2 all	3%	all		3%	all	3%	all
1,000.....	33	16	26	20	25	33	40	85	30	36
1,400.....	47	37	48	33	36	47	130	180	62	65
1,800.....	60	35	70	37	57	60	180	210	67	69
2,200.....	74	32	50	39	55	74	140	170	67	68
2,600.....	87	36	70	55	63	87	140	190	68	71
3,000.....	100	60	100	62	67	100	150	140	70	72
3,400.....	113	55	180	63	73	113	140	180	70	73
3,800.....	129	110	140	70	72	127	110	130	69	70

1 3%—employed a selective amplifier of 3% band width.
2 all—employed a wide band amplifier covering all frequencies.

The data of Table I are shown by a set of curves A, B, C and D of Figure 3 in which abscissa represents the number of revolutions per minute of the engine while ordinate represents the magnitude of sound in phon. Curves A and B represent, respectively, the phon-r.p.m. characteristics for "3%" and "all" of the present improved muffler and curves C and D represent, respectively, the phon-r.p.m. characteristics for "3%" and "all" of the new Hillman muffler. As will be seen from the data of Table I and curves of Fig. 3, the present improved muffler is much more effective in reducing the level of sound over the conventional muffler.

Although I have shown and described the present invention in connection with a preferred embodiment, it will be understood that the present invention is not limited thereto but many modifications will be clear to those skilled in the art without departing from the true spirit and scope of the present invention.

What I claim:

1. A muffler comprising a spirally wound plate having a plurality of spiral turns forming a flat spiral wall defining a spiral passage, the adjacent turns of said spiral passage communicating with each other by a plurality of small openings in said flat spiral wall; a diffusion chamber, a portion of which is connected in series with one end of said spiral passage communicating therewith through small openings; and a resonant chamber connected to the other portion of said diffusion chamber

communicating therewith through small openings, said resonant chamber being in shunt relationship to said spiral passage.

2. A muffler which comprises a rectangular frame, a pair of plates closing the upper and lower sides of said frame, a spirally wound plate disposed in said frame to form a spiral passage of gas, said plate being provided with a plurality of small openings in the convolutions of said spirals except in that portion of the plate forming the outermost convolution of said spiral, a diffusion chamber partitioned by a partition and being in communication with one end of said passage through a plurality of small openings in said partition, a shunt resonant chamber formed between said frame and said outermost convolution without opening and being in communication with said diffusion chamber through small openings, an inlet pipe connected to said diffusion chamber, and an outlet pipe connected at the middle of said spiral.

3. A muffler according to claim 2 characterized in that said partition is tangentially in contact with the outermost convolution of said spirally wound plate.

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