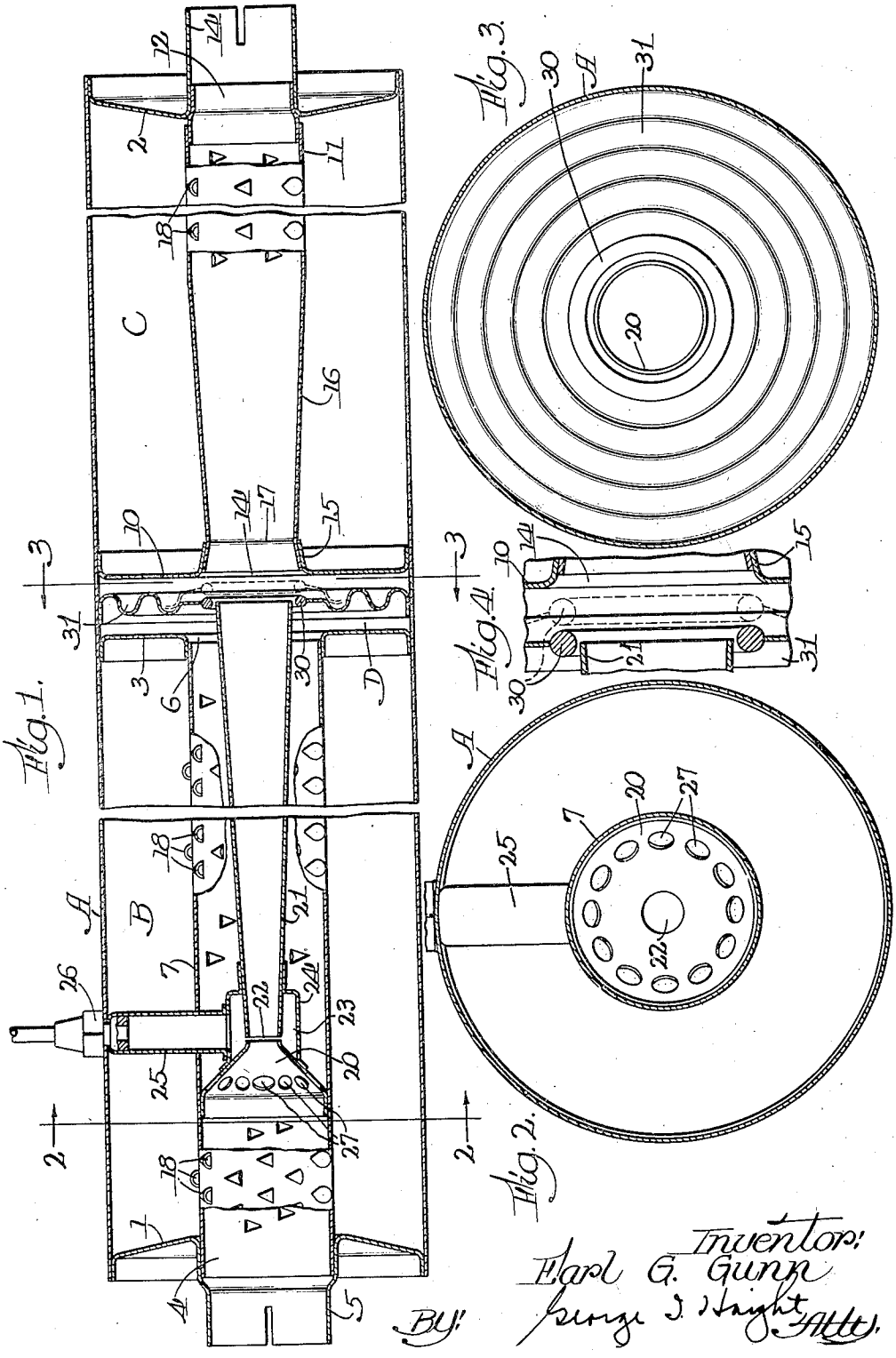
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VACUUM MUFFLER

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VACUUM MUFFLER

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My invention relates to an improved muffler such as used for the silencing of exhaust gas noises of internal combustion engines, in which the flow of gases through the muffler is utilized for the production or creation of a vacuum for serving other devices requiring a vacuum-operating medium.

One of the objects of my invention is to provide a muffler structure for silencing exhaust gas noises, and means in association therewith by which the gas flow through the muffler is caused to generate a vacuum which is made available for other operating purposes.

A further object is to provide means for automatically maintaining a vacuum within a suitable range for operating requirements, irrespective of the pressure variations of the exhaust gases passed through the muffler.

Other objects of the invention will appear from the following description and the accompanying drawing, which illustrate one embodiment of the invention.

In the drawing,

Fig. 1 is a central longitudinal sectional view of a structure embodying the invention;

Fig. 2 is an enlarged transverse section on the line 2—2 of Fig. 1;

Fig. 3 is an enlarged transverse section on the line 3—3 of Fig. 1; and

Fig. 4 is an enlarged detail section of the automatic valve and associated parts.

The muffler shown in the drawing embodies an elongated cylindrical shell A which houses the operating parts and which is of a diameter and length adapted to the available space on an automobile for the accommodation of a muffler. The shell is closed at its ends by flanged dish-shaped heads 1 and 2 which are secured to the ends of the cylinder wall by welding or otherwise. A flanged transverse partition wall 3 is secured in the shell at a distance from the head 1 and closes off a portion of the shell to provide a chamber B. The head 1 has a central opening 4 and a tubular extension 5 forming the inlet and adapted for connection to the exhaust pipe of the engine or other source of gas. The partition 3 likewise has a central flanged opening 6.

A straight through tube 7, of considerably less diameter than the shell, extends centrally through chamber B and connects at its ends with the openings in the head and partition 3, and forms a passage for the exhaust gas stream coming from the engine or other source.

In like manner another flanged transverse partition wall 10 is secured in the shell and closes off the other end portion thereof to provide a closed chamber C, and a centrally disposed tubular member 11 extends longitudinally through this chamber from partition 10 to the closure head 2 of the shell. The closure head has a central opening 12 and a tubular extension 13 forming the outlet or exhaust end of the muffler. The opening 14 in partition 10 is smaller in diameter and the flange 15 surrounding said opening is tapered to still smaller diameter. A portion 16 of the tube 11 is tapered down to the diameter of the flange opening and then flared in the flange 15, thus providing a throat opening 17 somewhat less in diameter than the main portion of tube 11. The tubes 7 and 11 and the several openings in the shell heads and partitions are all axially aligned.

The partitions 3 and 10 are spaced apart sufficiently to provide short chamber D in the shell, which chamber is in communication with both tubes 7 and 11 through openings 6 and 14, but is not in communication with either of the chambers B and C. This chamber D is provided for the accommodation of an automatic pressure responsive valve which controls the flow of gas through tube 7 into tube 16, and which will be hereinafter described.

The tube 7 and the tube 11, with the exception of its tapered portion 16, are provided with a large number of small louvered openings 18 distributed throughout their length and circumference, and these louvers are formed so as to face the openings in a circumferential or tangential direction relative to the tubes, and the openings form the only communication between the tube passages and the chambers B and C through which the tubes extend.

It is by means of the structure described that the muffling or sound destroying functions are performed. The gas stream enters the inlet end of tube 7 in a rapid series of sharp pulsations and the pressure and sound waves resulting therefrom expand into the closed chambers B and C through the openings 18 as the gas stream flows through the tubes. The gases entering the chambers are given a circumferential direction of movement in said chambers, and since they cannot escape from the chambers they re-enter the gas stream through the openings at other points in the tube lengths. The peaks of the pressure and sound waves are leveled off or reduced and the pressure of the gas stream is converted to a uniform or steady pressure, with the result that the

gases leaving the discharge outlet of the structure emit no appreciable audible sound.

Within the tube 7 is provided a means for utilizing the stream of gases through the muffler for creating a vacuum which can be utilized for operating other devices such as horns and windshield wipers. This means in the present structure comprises a Venturi tube disposed concentrically within the gas passage tube 7. This may be of any suitable construction for the purpose. In the structure shown, the Venturi tube is made of a short, sharply tapered section 20 and a long tapered section 21, placed end to end to form the throat of the venturi. These ends have openings of the same diameter but they are spaced apart slightly to provide a port or annular opening 22 which communicates with a small chamber 23 formed by an enclosure 24 which surrounds the end portions of the Venturi tube sections and which has no communication whatever with the tube 7 or chamber B for the reason that the vacuum is created in the chamber 23. Chamber 23 is connected by a stem 25 to a suitable fitting 26 on the exterior of shell A, so that suitable connection for the vacuum can be made with the devices to be operated thereby.

The Venturi section 20 spaces the interior of tube 7 and is secured to the wall thereof for support, but it has an annular series of opeings 27 through which the gases can flow into the portion of the tube beyond the member 20. In operation the gas stream entering the inlet end of tube 7 divides, partly through the Venturi tube and partly through the openings 27 and the remaining portion of tube 7, so that in a sense the passage in tube 7 may be referred to as a by-pass around the venturi. That portion, therefore, of the gases which flow through the venturi creates a vacuum in chamber 23 and the rest of the gases by-pass around the venturi.

The pressure and velocity of the incoming gases varies greatly with the speed of the engine from which the gases emanate, and this variation in pressure and velocity correspondingly effects the degree of vacuum produced. For instance, if the engine is idling, the pressure and velocity of the exhaust gases are so low that the velocity of the portion of the gases going through the Venturi tube is insufficient to develop a degree of vacuum sufficient for the operation of the devices connected therewith, whereas under running conditions of the engine the pressure and velocity of the gases are sufficient for the production of a high enough vacuum.

In the structure shown in the drawing, the end of the Venturi tube section 21 extends into the chamber D and is surrounded by a ring member 30 which is supported by a flexible diaphragm member 31, so that the ring member can move toward and from the rim of the Venturi tube 20, as shown in dotted lines in Fig. 1, and thereby vary the opening between the wall of the tube and the ring and allow more or less gas to pass from the tube 7 by-pass hereinbefore mentioned. The diaphragm 31, of course, acts as a flexible partition and to prevent the passage of gases through said chamber D other than that which is permitted by the position of the ring or valve member 30. Normally the ring valve is held by the tension in the diaphragm close to the tube so that the passage of gas is practically prevented. Now, if the engine is idling and the incoming gases are low in pressure and velocity, the ring valve prevents the by-passing of any of the gases through openings and tube 7, and practically all of the gas stream passes through the venturi. This is sufficient to produce a low enough vacuum for operative purposes. However, as the engine is speeded up and greater pressure and velocity is developed in the gases, a sufficient flow will occur through the venturi and the excess gases will pass through openings 27 and through tube 7 around the venturi. Under these conditions the pressure will act on the diaphragm to force the ring away from tube 20 and permit the gases to flow through the opening. At the same time there will be no appreciable back pressure developed in the muffler under any speed conditions of the engine.

I claim:

1. In a muffler of the character described, the combination of a shell having a tubular member therein for the passage of the exhaust gas stream, means within said tubular member responsive to the flow of the gas stream through said tubular member for producing a vacuum, and a pressure actuated device responsive to excess gas pressure in said tubular member for permitting the flow of gas through said tubular member independently of said vacuum producing means.

2. In a structure of the character described, the combination of a muffler including an outer shell for silencing the sound of exhaust gases and having a pair of tubular members within and spaced from said shell and forming concentric passages for the flow of gas therethrough, means associated with the inner of said tubes for producing a vacuum by virtue of the flow of gas therethrough, a device adjacent the end of said inner tube for controlling the flow of gases through the outer one of said passages, and means responsive to the pressure of gas in said outer passage for actuating said device.

3. In a structure of the character described, the combination of a muffler including means for silencing the sound of exhaust gases and having a pair of tubular members forming concentric passages for the flow of gas therethrough, the inner of said tubes including a Venturi tube for producing a vacuum by the flow of the gases therethrough, a transverse diaphragm in said muffler adjacent the ends of said tubes responsive to the pressure of the gas flowing in the outer of said tubes, and a member carried by said diaphragm for controlling the flow of gases through the outer of said tubes.

4. In a structure of the character described, the combination of a muffler having means including a tubular member for silencing the sound of exhaust gases, a Venturi tube in said tubular member for producing a vacuum in response to the flow of gas through said Venturi tube, said tubular member surrounding said Venturi tube and terminating adjacent the end thereof and forming a by-pass for gases around said Venturi tube, and a pressure responsive device positioned at the end of said tubular member for controlling the flow of gases through said by-pass.

5. In a structure of the character described, the combination of a muffler including a cylindrical shell and a straight through tubular member extending lengthwise of said shell and forming a passage for the gases, a Venturi tube vacuum producing device positioned within said tubular member to receive part of the flow of the gases through said tubular member and, a flexible transverse diaphragm partition in said shell having means adjacent the end of the Venturi tube for substantially preventing the flow of gas through the tubular member around the Venturi

tube until, the gas pressure exceeds that required to cause a sufficient flow of gas through said Venturi tube vacuum means.

6. In a structure of the character described, the combination of a muffler including a cylindrical shell and a straight through tubular member extending lengthwise of said shell and forming a passage for the gases, a Venturi tube vacuum producing device positioned within said tubular member to receive part of the flow of the gases through said tubular member, a flexible transverse diaphragm partition in said shell having means adjacent the end of the Venturi tube for substantially preventing the flow of gas through the tubular member around the Venturi tube until, the gas pressure exceeds that required to cause a sufficient flow of gas through said Venturi tube vacuum means, and a second tubular member in said shell axially aligned with the first tubular member and the Venturi tube to receive the flow of gases through both the Venturi tube and the first tubular member.

7. In a structure of the character described, the combination of a cylindrical shell closed at its ends, transverse intermediate partitions spaced apart to divide the interior of said shell into an intermediate chamber and end chambers, a straight tubular member extending from the end of the shell through one end chamber and communicating with said intermediate chamber, a second tubular member communicating with said intermediate chamber at its inner end and extending through the other end chamber, a Venturi tube positioned within said first tubular member and through which a portion of the gases flow for the purpose of producing a vacuum, the end of said Venturi tube extending into said intermediate chamber, and a flexible diaphragm in said intermediate chamber adjacent the end of said Venturi tube for preventing the flow of gas through said straight tubular member around the Venturi tube until the pressure of gas reaches a predetermined degree.

8. In a structure of the character described, the combination of a muffler including a tubular member, and a shell surrounding said tubular member providing an annular sound silencing chamber, said tubular member forming a tubular passage for the flow of gases, pressure responsive means operable to open said passage when the gases therein reach a predetermined pressure, and a vacuum producing device in said tubular passage responsive to the flow of the gases in said tubular member.

9. In a structure of the character described, the combination of a Venturi tube vacuum producing device responsive to the flow of gases therethrough, a tubular member surrounding said Venturi tube and forming a by-pass passage around said vacuum producing Venturi tube, a pressure responsive device controlling the flow of gases through said by-pass passage in response to the pressure of the gases therein, and means, including an outer shell surrounding said tubular member, for silencing the sound of the gases flowing through said tubular member.

10. In a muffler of the class described, the combination of an outer shell and an inner tubular member arranged to silence the sound of gases flowing through said inner tubular member, said inner tubular member having one end terminating within said shell, a vacuum producing Venturi tube positioned within said inner tubular member and having its discharge end positioned adjacent the end of said inner tubular member and spaced from said inner tubular member to form a passage for the flow of gases, and pressure responsive means at the end of said Venturi tube for controlling the flow of gases from said passage whereby the flow of gases from said passage adjacent the end of the Venturi tube will create suction in said Venturi tube to assist the flow of gases therethrough.

11. In a structure of the class described, the combination of a tubular member and a Venturi tube positioned within said tubular member and spaced from the wall thereof to form an annular passage for the gases surrounding said Venturi tube, a member for controlling the flow of gases from said annular passage and positioned at the end of the Venturi tube so that the gases flowing from said passage adjacent the end of the Venturi tube will create suction in said Venturi tube, means for rendering said member operable in response to an excess pressure in said tubular member, and means including a shell surrounding said tubular member for silencing the sound of gases flowing through said tubular member.

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