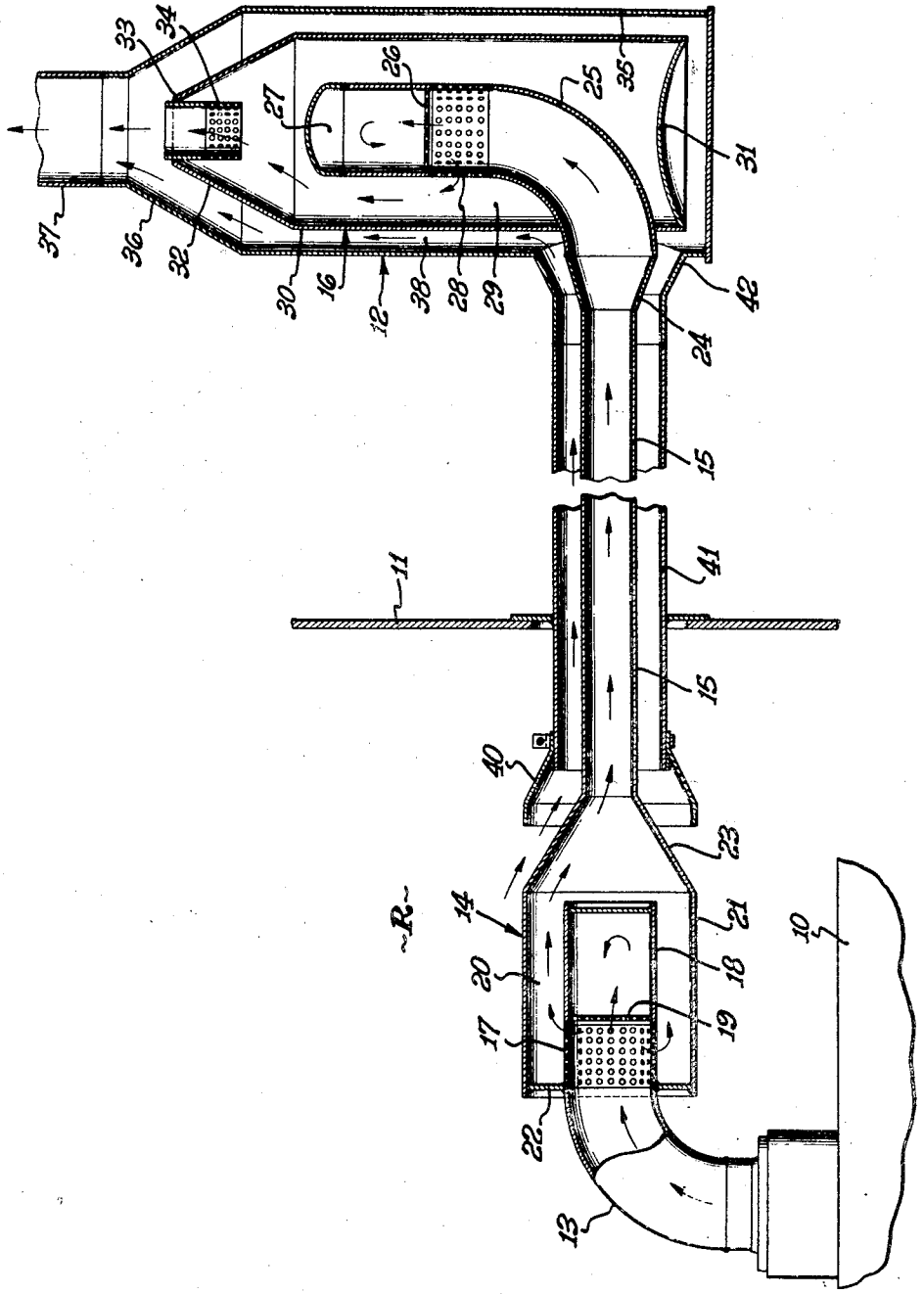
March 28, 1950 J. R. FLUOR ET AL 2,501,767

MUFFLER WITH INTERNAL SIDE BRANCH CHAMBER

Filed March 1, 1948



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Patented Mar. 28, 1950

2,501,767

UNITED STATES PATENT OFFICE

2,501,767

MUFFLER WITH INTERNAL SIDE BRANCH CHAMBER

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Application March 1, 1948, Serial No. 12,376

9 Claims. (Cl. 181—59)

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This invention has to do broadly with the elimination or dampening of pulsations in gas streams, and is concerned particularly, though typically, with the muffling of engine exhaust gas streams for the removal of pulsations predominating in the audible frequency range. In the illustrative embodiment hereinafter described, the invention has adaptability to particular advantage for muffling the exhaust gas discharge from stationary engines, e. g., as used in compressor plant installations.

One of our major objects is to effect more efficient muffling of audible sound frequencies by equipment characterized by its advantages from standpoints of production facility and substantially reduced cost in comparison with conventional apparatus of comparable efficiency.

In certain of its aspects the invention is directed to muffling equipment applicable to an engine in a building or room, and from which the exhaust gas is discharged to the outside, as within a stack shell. As adapted to such installations the invention contemplates a dual chamber arrangement in the nature of a pair of acoustical capacitances respectively inside and outside the engine room, and an elongated pipe interconnecting the chamber for series flow of the gas therethrough, and having characteristics of an acoustical inductance. As will appear, the invention incorporates the practical feature of employing the vertical outside stack shell as a second capacitance.

A further important feature and object of the invention is the use in conjunction with an acoustical capacitance chamber, and specifically with each of the chambers in the above mentioned dual chambers system, of a communicating closed space or chamber itself serving to cancel out gas stream pulsations by reason of its individual characteristics as an acoustical filter. In this respect, the invention contemplates use of a closed chamber having a restricted inlet communication with a secondary chamber, the gas surging into and out of the closed chamber through the restricted inlet, and the chamber and inlet being so proportioned as to form an acoustical filter having a resonant frequency corresponding substantially to the dominating pulsation frequency in the gas stream.

The above mentioned as well as various additional features and objects of the invention will be understood to better advantage from the following detailed description of an illustrative

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embodiment shown generally in section by the accompanying drawing.

Referring to the drawing, an internal combustion engine, diagrammatically indicated at 10, is shown to be contained in a room R, with the exhaust gas discharge conducted through the room wall 11 to the stack assembly 12 at the outside. Exhaust gases are discharged from the engine through a pipe 13 into a first chamber assembly generally indicated at 14, and thence through an elongated pipe 15 to a second chamber arrangement 16 in the stack assembly 12.

The exhaust pipe 13 communicates by way of a perforated tubular section 17 with a closed chamber 18, the latter being closed in the sense that exhaust gases can enter and leave the chamber only by surging flow through a restricted inlet. Preferably, such inlet is formed by a perforated plate 19, the total apertured area of which is such as to restrict the exhaust gas flow into chamber 18. This closed chamber, together with restricted inlet, constitutes essentially an acoustical filter which may be designed, by proportioning the chamber volume and the effective restriction to gas flow presented by the perforated plate 19, as to have a resonant frequency (i. e., frequency of gas surge into and out of the chamber) corresponding substantially to the frequency of the dominating pulsations in the gas stream. Thus the effect of the chamber 18 is to accomplish an initial canceling out of pulsation effects, particularly while functioning in conjunction with a second chamber 20 having restricted communication with the exhaust gas feed through the perforated tubular section 17.

Chamber 20 is formed by an outer shell 21 axially aligned with the inner chamber 18 and having an end closure 22 about the inlet 13. The forward end of shell 21 is tapered at 23 to connect with the elongated pipe 15. The latter in turn is connected at 24 with an enlarged pipe section 25 having restricted communication through perforated plate 26 with chamber 27, the structural and functional characteristics of which are similar to those previously described with reference to chamber 18. Pipe 25 has restricted communication through the perforated tubular section 28 with the enlarged chamber 29 in the vertically extending stack shell 30, the latter having a bottom closure 31 and a convergent upper end 32 containing an outlet which may be formed by pipe 33 having a perforated section 34.

Where it may be desirable that the muffling

assembly be air-cooled, or the energy of the exhaust gas stream utilized to withdraw air from the engine room R, provision may be made for inducing air flow from the room by the exhaust gas discharge from the outlet 33. For this purpose, shell 30 may be contained within and annularly spaced from the outer shell 35 having a convergent head 36 and stack 37 forming a Venturi throat, the exhaust gas discharge into which from outlet 33 induces air flow through the inter-shell space 38. At this point it may be mentioned that because of the exceptionally high degree to which the muffling system acts to remove the exhaust gas stream pulsations, the air displacement efficiency, i. e., the ratio of induced air to exhaust gas, is exceptionally high. The air flow is induced from the engine room through the flared inlet 40 and conduit 41 annularly spaced about the pipe 15 and connecting at 42 with the shell 35.

In the operation of the muffling system, gas stream pulsations initially are subjected to the nullifying or canceling effect of the acoustical filter system consisting of the chambers 18 and 20 and the restrictions presented by the perforated elements 17 and 19. The exhaust gas stream then passes through the extended inductance pipe 15 wherein its flow is restricted with relation to chambers 20 and 25. Any remaining pulsations in the gas stream then become subjected to canceling out by the acoustical filter system presented by chambers 27 and 29, and the gas passage restrictions presented by the perforated areas 26 and 28.

We claim:

1. Apparatus for eliminating gas stream pulsations comprising an outer shell having a gas outlet, an inner shell extending longitudinally within and spaced from said outer shell and having a closed end toward said outlet, an inlet pipe connected to said shells, and means forming a plurality of restrictions in the end of said inner chamber toward the inlet pipe and through which the inlet gas surges into and out of the inner chamber and flows into said outer chamber to the outlet.

2. Apparatus for eliminating gas stream pulsations comprising an outer shell having a tapered end forming a gas outlet, an inner shell extending longitudinally within and spaced from said outer shell and having a closed end toward said outlet, an inlet pipe connected to said shells, and means forming a plurality of restrictions in the end of said inner chamber toward the inlet pipe and through which the inlet gas surges into and out of the inner chamber and flows into said outer chamber to the outlet.

3. Apparatus for eliminating gas stream pulsations comprising an outer shell having a gas outlet, an inner shell extending longitudinally within and spaced from said outer shell and having a closed end toward said outlet, an inlet pipe connected to said shells, and a perforated plate forming the end of said inner chamber toward the inlet pipe and through which the inlet gas surges into and out of the inner chamber and flows into said outer chamber to the outlet.

4. Apparatus for eliminating gas stream pulsations comprising an outer shell having a gas outlet, an inner shell extending longitudinally within and spaced from said outer shell and having a closed end toward said outlet, an inlet pipe connected to said shells, means forming a plurality of restrictions in the end of said inner chamber toward the inlet pipe and through which the inlet gas surges into and out of the inner chamber and flows into said outer chamber to the outlet, and means forming a plurality of restrictions at the inlet side of the first mentioned restrictions and through which the gas passes in flowing outwardly into said outer shell.

5. Apparatus for eliminating gas stream pulsations comprising an outer shell having a gas outlet, an inner shell extending longitudinally within and spaced from said outer shell and having a closed end toward said outlet, an inlet pipe connected to said shells, and means forming a plurality of restrictions in the end of said inner chamber toward the inlet pipe and through which the inlet gas surges into and out of the inner chamber and flows into said outer chamber to the outlet, said inlet pipe being a perforated section through which the gas at the inlet side of the first mentioned restrictions passes in flowing outwardly into said outer shell.

6. Apparatus for eliminating gas stream pulsations, comprising a pair of shell assemblies through which the gas flows in series, each of said assemblies comprising an outer shell having a gas outlet, an inner shell extending longitudinally within and spaced from said outer shell and having a closed end toward said outlet, an inlet pipe connected to said shells, means forming a plurality of restrictions in the end of said inner chamber toward the inlet pipe and through which the inlet gas surges into and out of the inner chamber and flows into said outer chamber to the outlet, the inlet pipe connecting with the shells of the second shell assembly leading from the gas outlet of the outer shell of the first assembly.

7. Apparatus as claimed in claim 6, in which said inlet pipe connecting with the shells of the second shell assembly is elongated and has considerably smaller diameter than said outer shells.

8. Apparatus as claimed in claim 6, in which said inlet pipe connecting with the shells of the second shell assembly has enlarging tapered connections with the second shell assembly and with the gas outlet of the outer shell of the first assembly.

9. Apparatus as claimed in claim 6, in which the outer shell of the second shell assembly is a vertically positioned stack located remote from the first shell assembly.

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