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(54) **Exhaust silencer for internal combustion engine**

(57) The invention relates to a sound-absorbing exhaust system for an internal combustion engine. The system comprises a receptacle (2), an inlet (3) which is arranged in the receptacle (2) and through which exhaust gases can be directed into the same, and a discharge pipe (4), which connects the interior of the receptacle (2) to the ambient air and through which exhaust gases can be discharged from the same. The dis-

charge pipe (4) has, at its end positioned outside the receptacle (2), a seal (5), which substantially seals the discharge pipe (4) at this end. The discharge pipe (4) has at least one, but preferably a plurality of radial holes (6), which are positioned outside the receptacle (2). The system further has a sleeve (7), which wholly or partially surrounds the discharge pipe (4) outside the receptacle (2). This arrangement reduces the emission of exhaust gas noise from the system.

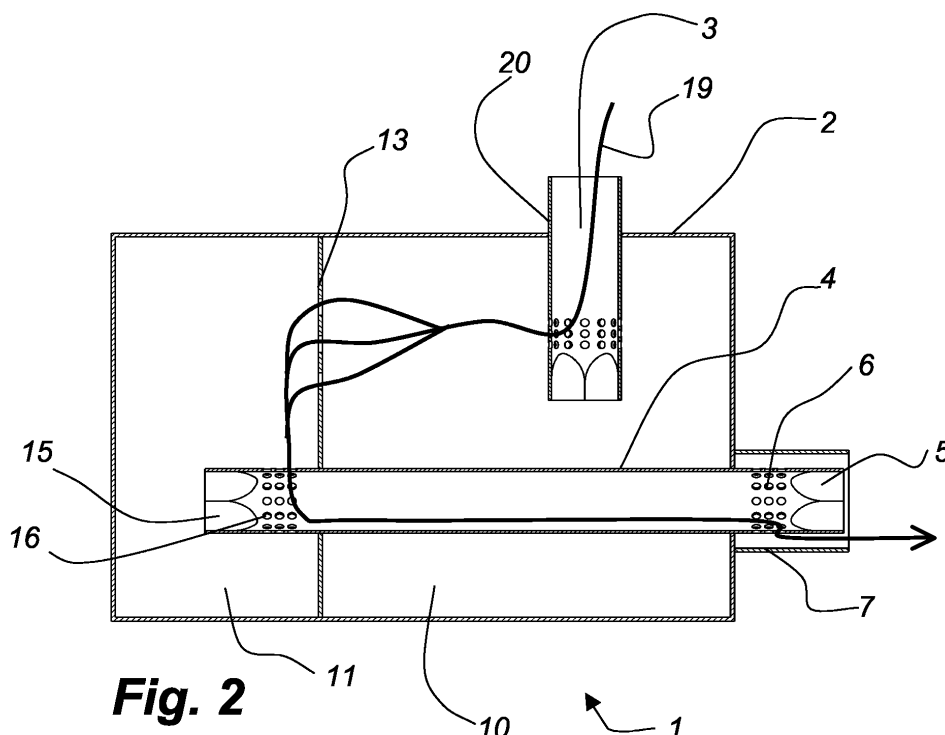


Fig. 2

Description

Field of the Invention

[0001] The present invention relates to a sound-absorbing exhaust system for an internal combustion engine, said exhaust system comprising a receptacle, an inlet which is arranged in the receptacle and through which exhaust gases can be directed into the receptacle, and a discharge pipe, which connects the interior of the receptacle to the ambient air and through which exhaust gases can be discharged from the receptacle.

Background Art

[0002] Such sound-absorbing exhaust systems are used for internal combustion engines of various types, preferably small ones, which are used, for instance, in mopeds, lawnmowers and the like.

[0003] The sound-absorbing exhaust system serves to reduce the noise arising as exhaust gases leave the internal combustion engine, for the purpose of reducing acoustic nuisances.

[0004] Even if sound absorbers of the type above reduce the emission of noise to a considerable extent, there remains a need to further reduce the noise of exhaust gases from internal combustion engines.

Summary of the Invention

[0005] It is thus an object of the present invention to provide a sound-absorbing exhaust system which further reduces the noise emission from an internal combustion engine.

[0006] This object is achieved by a sound-absorbing exhaust system as claimed in claim 1.

[0007] More specifically, the invention relates to a sound-absorbing exhaust system of the above type where the discharge pipe at its end positioned outside the receptacle has a seal, which substantially seals the discharge pipe at this end, where the discharge pipe has at least one radial hole, which is positioned outside the receptacle, and where a sleeve wholly or partially surrounds the discharge pipe outside the receptacle.

[0008] Such an arrangement significantly reduces the noise emission from an internal combustion engine. Tests have demonstrated that the exhaust gas noise from the engine typically decreases by 3dB. Moreover the frequency content of the remaining noise will be such that it is experienced as less "sharp", and therefore the noise is less disturbing also for this reason.

[0009] The discharge pipe preferably has a plurality of radial holes, which are positioned outside the receptacle. This means that the exhaust gases are spread in the space between the discharge pipe and the sleeve in a suitable manner.

[0010] Preferably the seal comprises a star crimp. This can be easily provided and requires no further com-

ponents.

[0011] The sleeve, which preferably is attached to the receptacle, suitably projects from the receptacle to the same extent as does the discharge pipe, which results in improved absorption.

[0012] In a preferred embodiment, the receptacle is elongate in the longitudinal direction of the discharge pipe, and the discharge pipe extends into the receptacle, at least along half the length of the receptacle.

[0013] The receptacle is, in the longitudinal direction, suitably divided into a plurality of chambers by means of one or more gas-permeable partitions. This results in improved sound-absorption.

[0014] In a preferred embodiment, the discharge pipe has at its end positioned in the receptacle a seal and a plurality of radial holes. Thus the discharge pipe can have the same design in both ends, which is advantageous in terms of manufacture.

Brief Description of Figures

[0015]

Fig. 1 is a perspective view of a sound-absorbing exhaust system according to an embodiment of the invention.

Fig. 2 is a schematic longitudinal section through the exhaust system in Fig. 1.

Fig. 3 shows the result of a comparison between a conventional exhaust system and an exhaust system according to an embodiment of the invention.

Description of Preferred Embodiments

[0016] Fig. 1 is a perspective view of a sound-absorbing exhaust system 1 according to an embodiment of the invention. The exhaust system 1 is adapted to be connected to an internal combustion engine and comprises a receptacle 2 of welded sheet metal. The receptacle defines an inner space of a certain volume. An inlet 3 is arranged in the receptacle 2, as shown with a connecting pipe. Exhaust gases from the internal combustion engine can be directed through the inlet 3 into the receptacle 2. The exhaust system 1 further has a discharge pipe, which connects the interior of the receptacle 2 to the ambient air and through which exhaust gases can be discharged from the receptacle 2. Of the discharge pipe, Fig. 1 shows only an end, which is provided with a seal 5. That part of the discharge pipe which projects out of the receptacle is radially surrounded by an outer sleeve 7, which preferably is concentric with the discharge pipe. The sleeve 7 is arranged so that a space is formed between the sleeve 7 and the discharge pipe, through which space exhaust gases can flow.

[0017] Fig. 2 is a schematic longitudinal section through the exhaust system in Fig. 1. Fig. 2 shows that the discharge pipe 4 extends into the receptacle 2. In a typical implementation, the discharge pipe can be about

40 cm long, have an outer diameter of 32 mm and a material thickness of 1.5 mm. At its end positioned outside the receptacle 2, the discharge pipe 4 has, as mentioned above, a seal 5, which substantially seals the discharge pipe 4 at this end. By "substantially seals" is meant that the seal 5 largely seals the discharge pipe 4, but that a certain degree of leakage through the seal 5 can still be allowed. Preferably, the seal 5 is provided by what is referred to as a star crimp, i.e. the outer end of the discharge pipe 4 is folded so that a seal is provided. The star crimp is easy to provide and can be made in one operation. However, other ways of arranging the seal of the pipe are conceivable; for instance a sealing plate can be welded to the end of the pipe, or the end of the pipe can be threaded and sealed by a screw cap.

[0018] The discharge pipe 4 has at least one, but preferably a plurality of, for instance about 50, radial holes 6, distributed in three rows for instance, which holes are positioned outside the receptacle 2. The holes are radial with regard to the longitudinal (axial) direction of the discharge pipe and can, for instance, have a diameter of 3.5 mm. Preferably the discharge pipe 4 has also at the end positioned in the receptacle 2 a seal 15 and a plurality of radial holes 16. Thus both ends of the discharge pipe can have the same appearance. As shown, also the inner part of a discharge pipe 20 can be configured in the same way.

[0019] Outside the receptacle 2 the outer sleeve 7 wholly or partially surrounds the discharge pipe 4 in the radial direction. In a typical implementation, the sleeve is 5 cm long and has an outer diameter of 5 cm. The sleeve 7 is preferably attached to the receptacle 2, for instance welded to the same.

[0020] The sleeve 7 projects preferably to about the same extent from the receptacle 2 as does the discharge pipe 4, but can also be longer or shorter than that.

[0021] The sleeve 7 gives, together with the seal 5 and the radial holes 6, a pressure, pulse and flow equalising effect, which reduces the noise level of the system. These additional features can further be provided at a very low cost.

[0022] The receptacle 2 is elongate in the longitudinal direction of the discharge pipe 4. The discharge pipe 4 extends into the receptacle 2, at least along half the length of the receptacle 2.

[0023] As is evident from Fig. 2, the receptacle can be divided in the longitudinal direction into a plurality of (for instance, as shown, two) chambers 10, 11 by partitions 13 which are gas permeable in various ways. In another preferred embodiment, the receptacle 2 can have three chambers.

[0024] Fig. 2 also illustrates an exhaust gas flow 19 through the exhaust system 1. The exhaust gases enter the system through an inlet pipe 20, which is inserted into the opening 3 of the receptacle 2. The exhaust gases then reach, through a radial hole in the inlet pipe 20, a first chamber 10. Subsequently the exhaust gases

pass on to a second chamber 11 through a partition 13, which is perforated. After that the exhaust gases pass into the discharge pipe 4 through radial holes 16 at the inner end thereof. The exhaust gas flow 19 then follows the discharge pipe 4 and passes out of the same through the radial holes 6 at the outer end, to the space between the discharge pipe 4 and the surrounding sleeve 7. From this space the exhaust gas flow 19 finally reaches the ambient air.

[0025] Fig. 3 shows the result of a comparison between a conventional exhaust system and an exhaust system modified according to the invention. The conventional system does not have the sleeve 7 in Figs 1-2, the discharge pipe does not have the seal 5 at the outer end and the radial holes 6 outside the receptacle. Otherwise the systems are identical. The graph in Fig. 3 shows the noise level at different frequency bands for the conventional system (dotted line) and for the system according to an embodiment of the invention (solid line). The measurement at the distance 4 m relates to the exhaust gas noise only, since the actual engine (one-cylinder engine) has been made sound-insulated on the occasion of measurement.

[0026] On the whole, the noise level is typically about 3 dB lower for the system according to the invention. In addition, the reduction is achieved substantially in the range of 400 Hz - 5 kHz, which gives a significantly less sharp and disturbing sound.

[0027] The invention is not limited to the embodiment described above and can be varied within the scope of the appended claims.

Claims

1. A sound-absorbing exhaust system for an internal combustion engine, said exhaust system comprising a receptacle (2), an inlet (3) which is arranged in the receptacle (2) and through which exhaust gases can be directed into the receptacle, and a discharge pipe (4), which connects the interior of the receptacle (2) to the ambient air and through which exhaust gases can be discharged from the receptacle (2), **characterised in that** the discharge pipe (4) at its end positioned outside the receptacle (2) has a seal (5), which substantially seals the discharge pipe (4) at this end, that the discharge pipe (4) has at least one radial hole (6), which is positioned outside the receptacle (2), and that a sleeve (7) wholly or partially surrounds the discharge pipe (4) outside the receptacle (2).
2. A sound-absorbing exhaust system as claimed in claim 1, in which the discharge pipe (4) has a plurality of radial holes (6), which are positioned outside the receptacle.
3. A sound-absorbing exhaust system as claimed in

claim 1 or 2, in which the seal (5) comprises a star crimp.

4. A sound-absorbing exhaust system as claimed in any one of the preceding claims, in which the sleeve (7) is attached to the receptacle (2). 5
5. A sound-absorbing exhaust system as claimed in claim 4, in which the sleeve (7) projects from the receptacle (2) to the same extent as does the discharge pipe (4). 10
6. A sound-absorbing exhaust system as claimed in any one of the preceding claims, in which the receptacle (2) is elongate in the longitudinal direction of the discharge pipe (4), and the discharge pipe (4) extends into the receptacle (2), at least along half the length of the receptacle (2). 15
7. A sound-absorbing exhaust system as claimed in claim 6, in which the receptacle in the longitudinal direction is divided into a plurality of chambers (10, 11) by means of at least one gas-permeable partition (13). 20
8. A sound-absorbing exhaust system as claimed in any one of the preceding claims, in which the discharge pipe (4) at its end positioned in the receptacle (2) has a seal (15) and a plurality of radial holes (16). 25 30

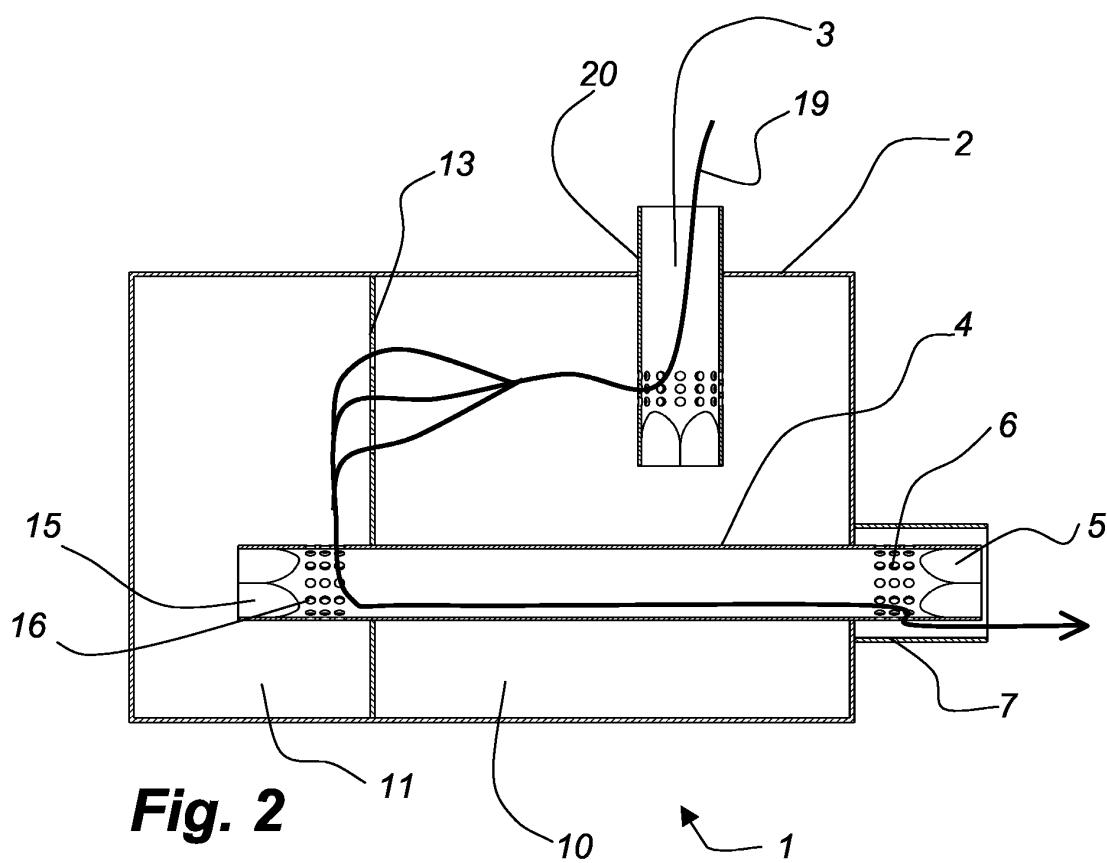
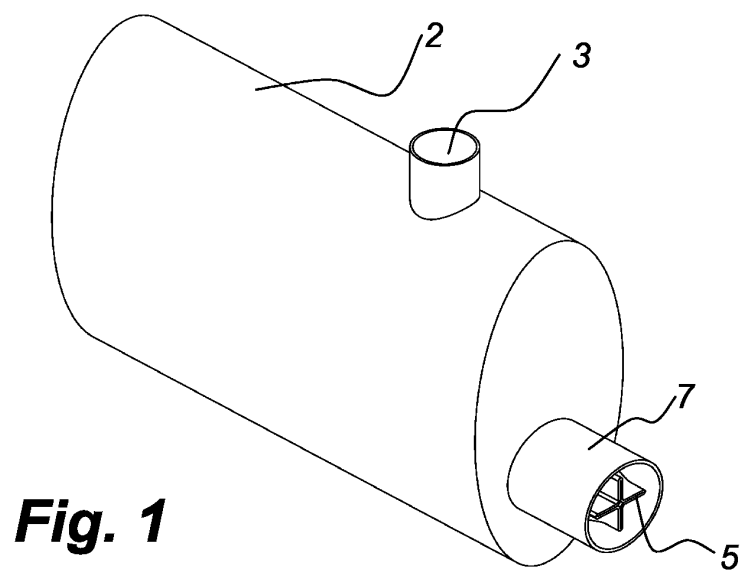
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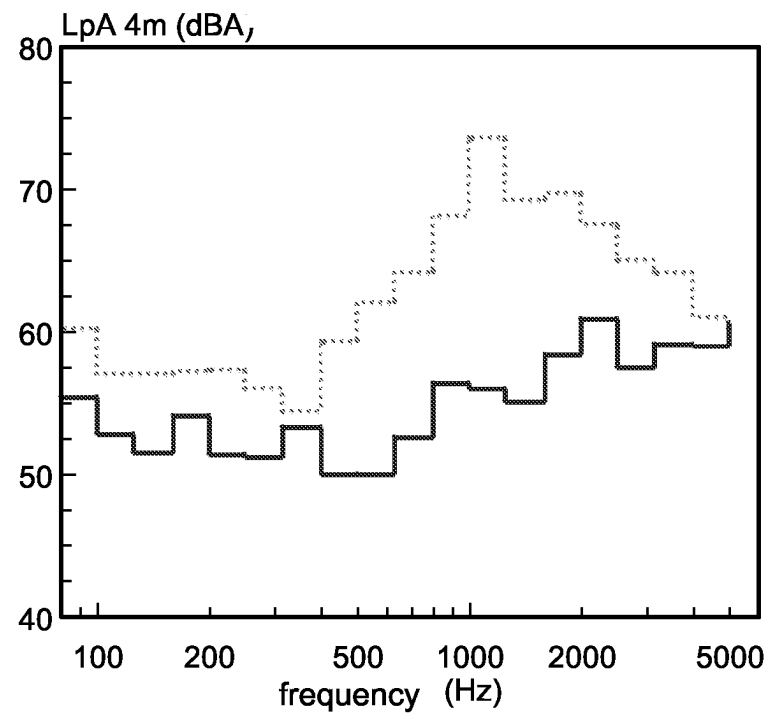


Fig. 3



European Patent
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EUROPEAN SEARCH REPORT

Application Number
EP 05 10 5236

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The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 3 August 2005	Examiner Tatus, W
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EPO FORM 1503 03.92 (P04C01)

**ANNEX TO THE EUROPEAN SEARCH REPORT
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EP 05 10 5236

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
The members are as contained in the European Patent Office EDP file on
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