



(11)

EP 4 575 196 A1

(12)

EUROPEAN PATENT APPLICATION
published in accordance with Art. 153(4) EPC

(43) Date of publication:
25.06.2025 Bulletin 2025/26

(51) International Patent Classification (IPC):
F01N 1/10 (2006.01)

(21) Application number: **23854237.7**

(52) Cooperative Patent Classification (CPC):
F01N 1/10

(22) Date of filing: **01.08.2023**

(86) International application number:
PCT/CN2023/110561

(87) International publication number:
WO 2024/037333 (22.02.2024 Gazette 2024/08)

(84) Designated Contracting States:
**AL AT BE BG CH CY CZ DE DK EE ES FI FR GB
GR HR HU IE IS IT LI LT LU LV MC ME MK MT NL
NO PL PT RO RS SE SI SK SM TR**
Designated Extension States:
BA
Designated Validation States:
KH MA MD TN

(72) Inventors:
• **TIAN, Yu**
Suzhou, Jiangsu 215345 (CN)
• **HUANG, Jiaming**
Suzhou, Jiangsu 215345 (CN)

(74) Representative: **MERH-IP Matias Erny Reichl
Hoffmann**
Patentanwlte PartG mbB
Paul-Heyse-Strae 29
80336 Mnchen (DE)

(30) Priority: **17.08.2022 CN 202222165963 U**

(71) Applicant: **Autoflight (Kunshan) Co., Ltd.**
Kunshan City, Jiangsu Province (CN)

(54) **ENGINE NOISE REDUCTION STRUCTURE**

(57) This invention relates to the field of unmanned aerial vehicle noise reduction technology and discloses an engine noise reduction structure, comprising a housing, one end of which is connected to a fuel engine exhaust pipe, at least one exhaust port is provided on the housing, and at least two noise reduction plates and at least one filter plate are provided inside the housing; wherein each noise reduction plate is arranged in a staggered manner to form a curved noise reduction exhaust channel, and a filling material is provided inside the noise reduction exhaust channel; wherein exhaust gas enters the housing through the fuel engine exhaust pipe, and is guided to discharge from the exhaust port through the filter plate and the staggered noise reduction plates in sequence. In the present invention, the engine noise reduction structure is provided with a curved noise reduction exhaust channel formed by a staggered arrangement of multiple noise reduction plates, and a filling material is set in the noise reduction exhaust channel, so that the exhaust gas is reflected multiple times through the curved noise reduction exhaust channel, greatly reducing the intensity of noise and achieving the silencing function of a large hybrid unmanned aerial vehicle.

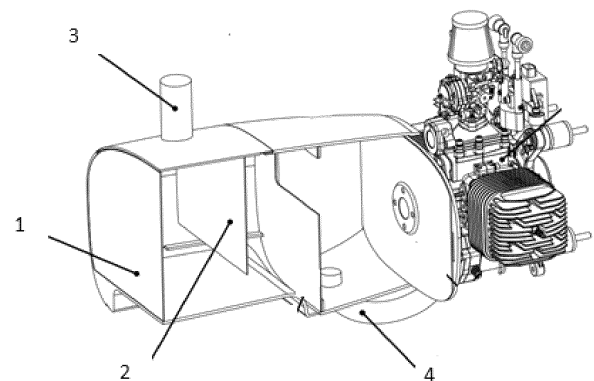


Figure 1

Description

Cross referencing of related applications

[0001] This patent application claims priority to the Chinese patent application filed on August 17, 2022, with application number 202222165963.X and invention name "Engine Noise Reduction Structure". The entire text of the aforementioned application is incorporated herein by reference.

Technical Field

[0002] This invention belongs to the field of unmanned aerial vehicle noise reduction technology and relates to an engine noise reduction structure.

Background

[0003] In order to eliminate the exhaust noise of unmanned aerial vehicle engines as much as possible, cooling covers are mainly installed on the exhaust pipe silencing, and a volume chamber is formed on the outer peripheral side of the exhaust pipe in the exhaust passage. Acoustic materials are filled in the volume chamber to reduce the noise generated when exhaust gas passes through. If the density of the filled acoustic materials is too low, it is not conducive to fully absorbing noise, resulting in poor noise reduction effect of the silencing exhaust pipe. If the density of the filled acoustic materials is too high, it is easy to cause blockage, and it is not easy to clean the blockage, which is time-consuming and labor-intensive.

Specification

[0004] The purpose of this invention is to provide an engine noise reduction structure, which greatly reduces the intensity of noise and achieves the noise reduction function of a large hybrid unmanned aerial vehicle.

[0005] To achieve this goal, the present invention adopts the following technical solution.

[0006] The invention provides an engine noise reduction structure, comprising a housing, one end of which is connected to a fuel engine exhaust pipe, at least one exhaust port is provided on the housing, and at least two noise reduction plates and at least one filter plate are provided inside the housing;

wherein each noise reduction plate is arranged in a staggered manner to form a curved noise reduction exhaust channel, and a filling material is provided inside the noise reduction exhaust channel; wherein exhaust gas enters the housing through the fuel engine exhaust pipe and is guided to discharge from the exhaust port through the filter plate and the staggered noise reduction plates in sequence.

[0007] As a preferred technical solution of the present invention, the noise reduction plates comprise at least a layer of diatomaceous earth.

[0008] As a preferred technical solution of the present invention, the surface of the noise reduction plates is provided with porous silencing cotton.

[0009] As a preferred technical solution of the present invention, the surface of the noise reduction plates has a serrated structure shape.

[0010] As a preferred technical solution of the present invention, the noise reduction exhaust channel formed by the staggered arrangement of adjacent noise reduction plates is S-shaped.

[0011] As a preferred technical scheme of the invention, the size and shape of each noise reduction plates are the same or different.

[0012] As a preferred technical solution of the present invention, the housing comprises multiple exhaust ports.

[0013] As a preferred technical solution of the present invention, the surfaces of the housing and the noise reduction plates are both provided with insulation layers.

[0014] As a preferred technical solution of the present invention, the material of the insulation layer is asbestos.

[0015] Compared with existing technology, the beneficial effects of this invention are:

In the present invention, the engine noise reduction structure is provided with a curved noise reduction exhaust channel formed by a staggered arrangement of multiple noise reduction plates, and a filling material is set in the noise reduction exhaust channel, so that the exhaust gas is reflected multiple times through the curved noise reduction exhaust channel, greatly reducing the intensity of noise and achieving the silencing function of a large hybrid unmanned aerial vehicle.

Description

[0016]

Figure 1 is an overall schematic diagram of the engine noise reduction structure of a fuel engine provided in a specific embodiment of the present invention.

Figure 2 is an external schematic diagram of the engine noise reduction structure provided in a specific embodiment of the present invention.

Specific implementation method

[0017] It should be understood that in the description of the present invention, the terms "center", "longitudinal", "transverse", "up", "down", "front", "back", "left", "right", "vertical", "horizontal", "top", "bottom", "inside", "outside" and other directional or positional relationships indicated are based on the directional or positional relationships shown in the accompanying drawings, only for the convenience of describing the present invention and simplifying the description, and do not indicate or imply that the

device or component referred to must have a specific orientation, be constructed and operated in a specific orientation, and therefore cannot be understood as a limitation of the present invention. In addition, the terms "first", "second", etc. are only used for descriptive purposes and cannot be understood as indicating or implying relative importance or implying the number of technical features indicated. Thus, features limited to "first", "second", etc. may explicitly or implicitly include one or more of these features. In the description of this invention, unless otherwise specified, the meaning of "multiple" refers to two or more.

[0018] It should be noted that in the description of this invention, unless otherwise specified and limited, the terms "setting", "connection", and "connection" should be broadly understood, for example, they can be fixed connections, detachable connections, or integral connections. It can be a mechanical connection or an electrical connection. It can be directly connected, indirectly connected through an intermediate medium, or connected internally between two components. For ordinary technical personnel in this field, the specific meanings of the above terms in this invention can be understood through specific situations.

[0019] It should be understood by those skilled in the art that the present invention necessarily includes necessary pipelines, conventional valves, and universal pump equipment for achieving process integrity. However, the above content does not belong to the main invention points of the present invention. Those skilled in the art can add layouts based on the process flow and equipment structure selection, and the present invention does not have special requirements or specific limitations on this.

[0020] The technical solution of the present invention will be further explained through specific implementation methods in conjunction with the accompanying drawings.

[0021] This embodiment provides an engine noise reduction structure, as shown in Figures 1 and 2.

[0022] The engine noise reduction structure includes a housing 1, which is the skin of the aircraft body and is a hollow structure. One side of the housing 1 is connected to a fuel engine exhaust pipe 4 at the bottom, and the other side is equipped with two exhaust ports 3 at the top. The interior of the housing 1 is equipped with four noise reduction plates 2 and a filter plate (not shown in the figure). Each noise reduction plate 2 is arranged in a staggered manner to form an "S" - shaped noise reduction exhaust channel. The exhaust gas enters the housing 1 through the fuel engine exhaust pipe 4, and is reflected and guided to the exhaust port 3 through the filter plate and the staggered noise reduction plates 2 before being discharged. Exhaust port 3 can be two or more, and there is no specific limitation on it here.

[0023] In some embodiments, the surface of the noise reduction plates 2 includes at least a layer of diatomaceous earth, which can provide good sound-absorbing

effect. In addition, porous silencing cotton is installed on the noise reduction plates 2 to absorb noise.

[0024] In the present invention, the engine noise reduction structure is provided with a curved noise reduction exhaust channel formed by a staggered arrangement of multiple noise reduction plates, and a filling material is set in the noise reduction exhaust channel, so that the exhaust gas is reflected multiple times through the curved noise reduction exhaust channel, greatly reducing the intensity of noise and achieving the silencing function of a large hybrid unmanned aerial vehicle.

[0025] In some embodiments, the surface of the noise reduction plates 2 has a serrated structure shape, which can more effectively reflect noise and reduce noise. It should be noted that this invention does not have specific requirements or special limitations on the structural characteristics such as size, shape, and material of the noise reduction plates 2. The function of the noise reduction plates 2 in this invention is to arrange it in a staggered manner inside the housing 1, forming a curved exhaust channel, thereby reducing the intensity of noise. Therefore, it can be understood that other noise reduction plates 2 that can achieve such functions can be used in this invention. Technical personnel in this field can adaptively adjust the size, shape, and material of the noise reduction plates 2 according to the usage scenario and testing conditions.

[0026] Each noise reduction plate 2 is arranged alternately on the inner surface of the housing 1. Furthermore, the size and shape of each noise reduction plate 2 are the same or different. It should be noted that the connection between the noise reduction plate 2 and the housing 1 in this invention can be a fixed connection or a movable connection, in order to ensure a curved exhaust channel. Therefore, there is no special limitation on the connection method between the noise reduction plates 2 and the housing 1. Technical personnel in this field can adjust the specific position of the noise reduction plates 2 inside the housing 1 according to the actual situation.

[0027] The noise reduction exhaust channel formed by the staggered arrangement of adjacent noise reduction plates 2 is S-shaped. It should be noted that this invention does not have specific requirements or special limitations on the shape of the noise reduction exhaust channel. The function of the noise reduction exhaust channel in this invention is to perform multiple fold reflection noise reduction on the gas entering the housing 1. For example, the noise reduction exhaust channel can be S-shaped. Therefore, it can be understood that other shapes of noise reduction exhaust channels that can achieve such functions can be used in this invention. Technical personnel in this field can adaptively adjust the shape of the noise reduction exhaust channel according to the usage scenario and testing conditions.

[0028] The filler in the noise reduction exhaust channel is any one or at least two or more combinations of foam plastic, sponge, asphalt particles, rubber particles or silica gel particles.

[0029] The housing 1 is a closed shell or an open shell, and further, the housing 1 is the skin of the aircraft body. It should be noted that this invention does not have specific requirements or special limitations on the structural characteristics such as size, shape, and material of the housing 1. The role of the housing 1 in this invention is to connect the external fuel engine exhaust pipe 4, so that the gas can achieve the purpose of noise reduction after being set inside the housing 1. The housing 1 can be a fully closed shell connected to the external exhaust pipe 4, with exhaust port 3 on the surface, or a hollow shell, with one end connected to exhaust pipe 4 and the other end as exhaust port 3. Therefore, it can be understood that other shells that can achieve such functions can be used in this invention. Those skilled in the art can adjust the size, shape, and material of the housing 1 adaptively according to the usage scenario and testing conditions.

[0030] The surfaces of the housing 1 and noise reduction plates 2 are both provided with insulation layers. Furthermore, the material of the insulation layer is asbestos. It should be noted that in this invention there is no specific requirements or special limitations on the structural characteristics such as size, shape, and material of the insulation layer. The function of the insulation layer in this invention is to be set on the surface of housing 1 and noise reduction plates 2 to avoid damage to the inner wall of housing 1 and noise reduction plates 2 imposed by high-temperature gases. For example, asbestos is used as the insulation layer because asbestos is a material or lining for transmission, insulation, thermal insulation, insulation, sealing and other components, with low cost and high availability. Therefore, it can be understood that other insulation layers that can achieve such functions can be used in this invention. Personnel can adjust the size of the insulation layer based on the usage scenario and testing conditions.

[0031] The applicant declares that the above is only a specific implementation of the present invention, but the scope of protection of the present invention is not limited to this. Those skilled in the art should understand that any changes or substitutions that can be easily thought of by those skilled in the art within the technical scope disclosed in the present invention fall within the scope of protection and disclosure of the present invention.

Claims

1. An engine noise reduction structure, comprising a housing (1), one end of which is connected to a fuel engine exhaust pipe (4), at least one exhaust port (3) is provided on the housing (1), and at least two noise reduction plates (2) and at least one filter plate are provided inside the housing (1);

wherein each noise reduction plate (2) is arranged in a staggered manner to form a curved noise reduction exhaust channel, and a filling

material is provided inside the noise reduction exhaust channel;

wherein exhaust gas enters the housing (1) through the fuel engine exhaust pipe (4), and is guided to discharge from the exhaust port (3) through the filter plate and the staggered noise reduction plates (2) in sequence.

2. The engine noise reduction structure according to claim 1, **characterized in that** the noise reduction plates (2) comprise at least a layer of diatomaceous earth.
3. The engine noise reduction structure according to claim 1, **characterized in that** the surface of the noise reduction plates (2) is provided with porous silencing cotton.
4. The engine noise reduction structure according to claim 1, **characterized in that** the surface of the noise reduction plates (2) has a serrated structure shape.
5. The engine noise reduction structure according to claim 1, **characterized in that** the noise reduction exhaust channel formed by the staggered arrangement of adjacent noise reduction plates (2) is S-shaped.
6. The engine noise reduction structure according to claim 1, **characterized in that** the size and shape of each noise reduction plates (2) are the same or different.
7. The engine noise reduction structure according to claim 1, **characterized in that** the housing (1) comprises multiple exhaust ports (3).
8. The engine noise reduction structure according to claim 1, **characterized in that** the surfaces of the housing (1) and the noise reduction plates (2) are both provided with insulation layers.
9. The engine noise reduction structure according to claim 8, **characterized in that** the material of the insulation layer is asbestos.

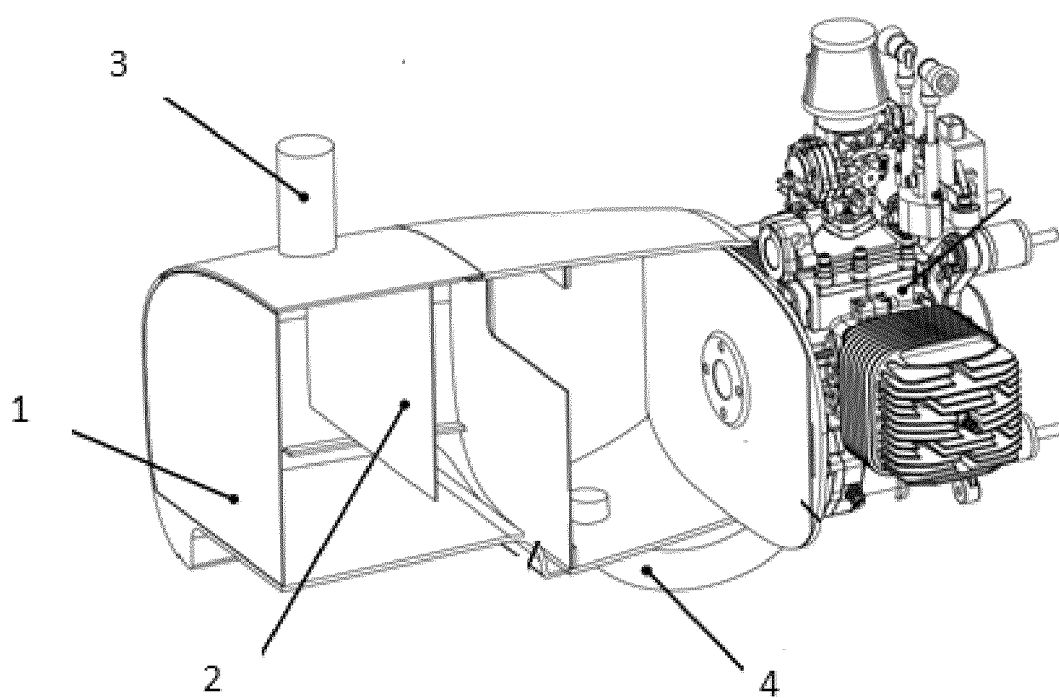


Figure 1

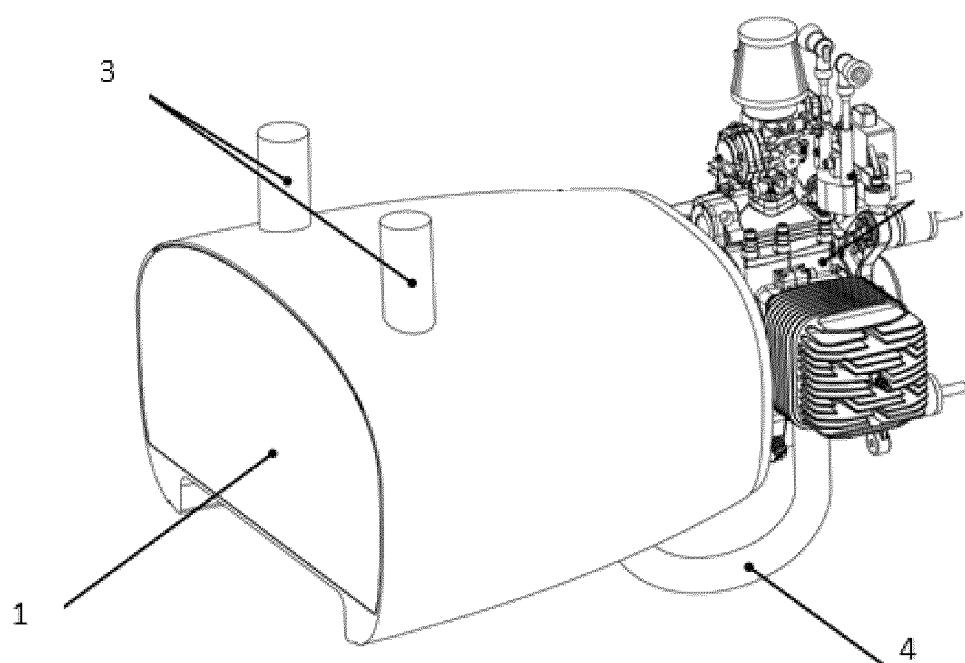


Figure 2

INTERNATIONAL SEARCH REPORT

International application No.

PCT/CN2023/110561

A. CLASSIFICATION OF SUBJECT MATTER

F01N1/10(2006.01)i

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC: F01N

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

CNABS; CNTXT; VEN; CNKI; USTXT; EPTXT; WOTXT: 发动机, 消音, 燃油, 排气, 过滤, 交错, 填充, engine, damp+, silenc
+, noise, fuel, oil, exhaust, filtrate, interv+, fill

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
PX	CN 218493661 U (AUTOFLIGHT AVIATION TECHNOLOGY (KUNSHAN) CO., LTD.) 17 February 2023 (2023-02-17) claims 1-9	1-9
X	JP 3081208 U (HUANG QINGYUAN) 26 October 2001 (2001-10-26) description, paragraphs [0001] and [0017]-[0029], and figures 1 and 2	1-9
X	CN 214741558 U (TIANJIN JIUZE YONGKUN MACHINERY TECHNOLOGY CO., LTD.) 16 November 2021 (2021-11-16) description, paragraphs [0024]-[0034], and figures 1-4	1-9
X	CN 216342408 U (WUTINESS HEJU METAL PRODUCT SCIENCE AND TECHNOLOGY CO., LTD.) 19 April 2022 (2022-04-19) description, paragraphs [0031]-[0041], and figures 1-3	1-9
X	CN 215408811 U (SHENZHEN SHENRI ENVIRONMENTAL PROTECTION SCIENCE & TECHNOLOGY CO., LTD.) 04 January 2022 (2022-01-04) description, paragraphs [0027]-[0030], and figures 1-3	1-9

☒ Further documents are listed in the continuation of Box C.☒ See patent family annex.

* Special categories of cited documents:

“A” document defining the general state of the art which is not considered to be of particular relevance

“D” document cited by the applicant in the international application

“E” earlier application or patent but published on or after the international filing date

“L” document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

“O” document referring to an oral disclosure, use, exhibition or other means

“P” document published prior to the international filing date but later than the priority date claimed

“T” later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

“X” document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

“Y” document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

“&” document member of the same patent family

Date of the actual completion of the international search

09 October 2023

Date of mailing of the international search report

17 October 2023

Name and mailing address of the ISA/CN

China National Intellectual Property Administration (ISA/
CN)
China No. 6, Xitucheng Road, Jimenqiao, Haidian District,
Beijing 100088

Authorized officer

Telephone No.

INTERNATIONAL SEARCH REPORT

International application No.

PCT/CN2023/110561

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	CN 112360606 A (YANTAI ENGINEERING & TECHNOLOGY COLLEGE (YANTAI TECHNICIAN COLLEGE)) 12 February 2021 (2021-02-12) description, paragraphs [0034]-[0036], and figures 1-5	1-9

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.

PCT/CN2023/110561

5

10

15

20

25

30

35

40

45

50

55

Patent document cited in search report			Publication date (day/month/year)	Patent family member(s)	Publication date (day/month/year)
CN	218493661	U	17 February 2023	None	
JP	3081208	U	26 October 2001	None	
CN	214741558	U	16 November 2021	None	
CN	216342408	U	19 April 2022	None	
CN	215408811	U	04 January 2022	None	
CN	112360606	A	12 February 2021	None	

REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

- CN 202222165963X [0001]