(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) **EP 2 853 709 A1**

(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
01.04.2015 Bulletin 2015/14

(51) Int Cl.:
F01N 13/14 *(2010.01)*

(21) Application number: **14181137.2**

(22) Date of filing: **15.08.2014**

(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 MK MT NL NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA ME

(30) Priority: **27.09.2013 US 201314038923**

(71) Applicant: **Deere & Company**
Moline, IL 61265 (US)

(72) Inventors:
- **Choudary, Nithin**
Davenport, IA Iowa 52807 (US)
- **Mattson, Mark L**
Erie, IL Illinois 61250 (US)
- **Wang, Xijun**
Bettendorf, IA Iowa 52722 (US)

(74) Representative: **Holst, Sönke**
John Deere GmbH & Co. KG
Mannheim Regional Center
Global Intellectual Property Services
John-Deere-Strasse 70
68163 Mannheim (DE)

(54) **Stepped down aftertreatment device shroud**

(57) A shroud (102) for an aftertreatment device (100) for treating exhaust gas from an internal combustion engine comprises a stepped conduit (126) configured to be disposed over an upper surface of the aftertreatment device (100) and extending over substantially the entire length of the aftertreatment device (100), wherein the stepped conduit (126) is configured to channel a flow of cleaning air longitudinally along the outer and upper surface of the aftertreatment device (100), wherein an inner surface of the stepped conduit (126) defines at least a first downwardly extending step (134, 136, 138) and a second downwardly extending step (134, 136, 138) that are spaced apart along the length of the aftertreatment device (100), to direct at least a portion of the flow of cleaning air downward.

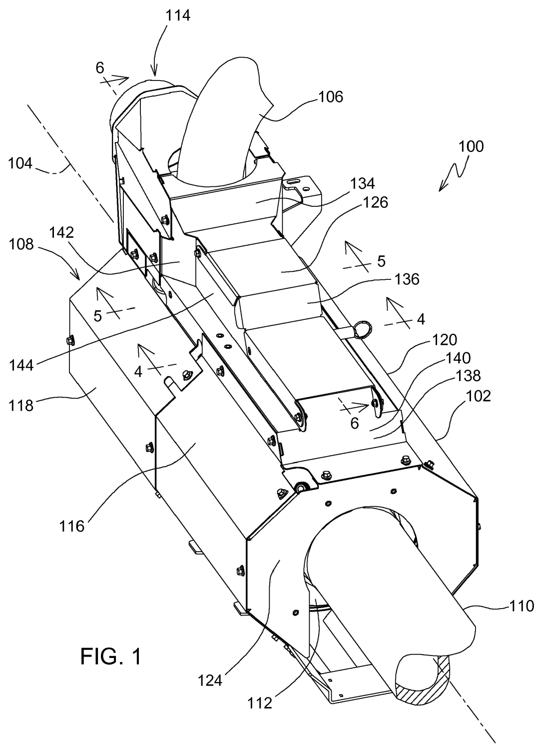


FIG. 1

EP 2 853 709 A1

Description

[0001] This invention relates to internal combustion engines. More particularly, it relates to aftertreatment devices for internal combustion engines. Even more particularly, it relates to shrouds for aftertreatment devices.

[0002] Modern internal combustion engines are provided with aftertreatment devices that process the exhaust gases to remove impurities. These aftertreatment devices operate at elevated temperatures and in dirty surroundings. They must be kept clean in order not to accumulate combustible matter that can catch fire and damage the aftertreatment device. For this reason, aftertreatment devices may be enclosed in insulated chambers, or provided with a supply of air that flows across their surface in order to keep combustible material from being deposited on the surface.

[0003] In one arrangement, an aftertreatment device was provided with a shroud that defined an elongate plenum extending along the length of the aftertreatment device. Below this plenum a wall with several apertures was provided. Air entering the plenum could freely travel the length of the plenum, and its force, direction, and intensity was controlled by the location of the apertures formed in the wall.

[0004] One problem with this arrangement is that impurities, dust, dirt and other combustible particles are deposited on the wall and gradually block the apertures themselves. Furthermore, the arrangement of a plenum enclosed at its bottom by a pierced wall reduced the power of the airflow and prevented it from thoroughly scrubbing the upper surfaces of the aftertreatment device.

[0005] What is needed, therefore, is a new arrangement of an aftertreatment device shroud that provides for greater airflow, and better cleaning ability of the air and also reduces potential blockages of the airflow.

[0006] It is an object of this invention to provide such an arrangement.

[0007] A shroud for an aftertreatment device for treating exhaust gas from an internal combustion engine is provided, the shroud comprising: a stepped conduit configured to be disposed over an upper surface of the aftertreatment device and extending over substantially an entire length of the aftertreatment device, wherein the stepped conduit is configured to channel a flow of cleaning air longitudinally along an outer and upper surface of the aftertreatment device, wherein an inner surface of the stepped conduit defines at least a first downwardly extending step and a second downwardly extending step that are spaced apart along a length of the aftertreatment device, to direct at least a portion of the flow of cleaning air downward.

[0008] The shroud may further comprise a first sidewall that is fixed to the stepped conduit along a first longitudinal side edge of the stepped conduit, wherein the first sidewall extends around and encloses a first side surface of the aftertreatment device, wherein the first sidewall is disposed to provide a narrow gap between the first sidewall and the first side surface of the aftertreatment device to receive the flow of cleaning air from the stepped conduit over substantially the entire length of the aftertreatment device and to direct the flow of cleaning air generally downward over the first side surface of the aftertreatment device.

[0009] The shroud may further comprise a second sidewall that is fixed to the stepped conduit along a second longitudinal side edge of the stepped conduit and is disposed on an opposite side of the stepped conduit from the first sidewall, wherein the second sidewall extends around and encloses a second side surface of the aftertreatment device, wherein the second sidewall is disposed to provide a narrow gap between the second sidewall and the second side surface of the aftertreatment device to receive the flow of cleaning air from the stepped conduit over substantially the entire length of the aftertreatment device and to direct the flow of cleaning air generally downward over the second side surface of the aftertreatment device.

[0010] The aftertreatment device may be elongate, generally cylindrical, and may have a central longitudinal axis that extends generally horizontally.
The aftertreatment device can have a top surface, and the stepped conduit extends generally horizontally and is disposed immediately over the top surface of the aftertreatment device.

[0011] The first downwardly extending step and the second downwardly extending step may be disposed above the top surface of the aftertreatment device and may be spaced apart along the top surface of the aftertreatment device.

[0012] The first downwardly extending step may be disposed immediately downstream of a first protrusion that extends upwardly from the top surface of the aftertreatment device.

[0013] The second downwardly extending step maybe disposed immediately downstream of a second protrusion that extends upwardly from the top surface of the aftertreatment device.

[0014] Each of the first protrusion and the second protrusion may comprise an annular ring extending about a circumference of the aftertreatment device.

[0015] An embodiment of the invention is shown in the drawings, in which:

Figure 1 is a perspective left side view of an aftertreatment device shroud enclosing an aftertreatment device in accordance with the present invention.

Figure 2 is a perspective right side view of the aftertreatment device shroud of Figure 1.

Figure 3 is a bottom view of the aftertreatment device shroud of Figures 1-2.

Figure 4 is a vertical cross-sectional view of the aftertreatment device of Figures 1-3 taken at section line 4-4 in Figure 1. The cutting plane defining the view of Figure 4 extends perpendicular to a longitudinal axis of the aftertreatment device and of the aftertreatment device shroud.

Figure 5 is a vertical cross-sectional view of the aftertreatment device of Figures 1-4 taken at section line 5-5 in Figure 1. The cutting plane defining the view of Figure 5 extends perpendicular to a longitudinal axis of the aftertreatment device and of the aftertreatment device shroud.

Figure 6 is a cross-sectional view of the aftertreatment device of Figures 1-5 taken at section line 6-6 in Figure 1. The cutting plane defining the view of Figure 6 extends vertically and extends longitudinally through the central longitudinal axis of the aftertreatment device.

[0016] The aftertreatment device and the shroud described herein are mirror-symmetric about the vertically and longitudinally extending cutting plane of Figure 6.

[0017] In the Figures herein, an aftertreatment device 100 is disposed in a shroud 102. The body of the aftertreatment device 100 is generally cylindrical and has a longitudinal central axis 104. An input exhaust conduit 106 that is generally cylindrical extends upward from a cylindrical side wall of the aftertreatment device 100 at a first end 108 of the aftertreatment device 100. An output exhaust conduit 110 that is generally cylindrical extends outward from the aftertreatment device 100 at a second end 112 of the aftertreatment device 100. The output exhaust conduit 110 is coaxial with the longitudinal central axis 104 of the aftertreatment device 100.

[0018] Exhaust gas is introduced into the input exhaust conduit 106. The exhaust gas then traverses the body of the aftertreatment device 100. The exhaust gas that exits the aftertreatment device 100 through the output exhaust conduit 110.

[0019] The shroud 102 surrounds substantially the entire aftertreatment device 100. The shroud 102 is formed of a single layer of sheet metal. The shroud 102 is spaced away from the outer surface of the aftertreatment device 100 to permit air introduced into the shroud 102 to flow over substantially the entire surface of the aftertreatment device 100.

[0020] This airflow performs a dual function. The air flow cools the inner surface of the shroud 102, thereby decreasing the temperature of the shroud 102 and reducing the risk of fire. The airflow also prevents the formation of a layer of combustible matter on the outer surface of the aftertreatment device 100.

[0021] The shroud 102 comprises an air inlet 114 is configured to receive air and conduct the air into the shroud 102 and across the upper surface of the aftertreatment device 100. The air inlet 114 is located immediately adjacent to the input exhaust conduit 106 such that it directs air in a horizontal direction around both sides of the input exhaust conduit 106.

[0022] The shroud 102 further comprises a shell 116. The shell 116 comprises a first sidewall 118, a second sidewall 120, a first endwall 122, a second endwall 124 and a stepped conduit 126.

[0023] The first sidewall 118 extends substantially the entire length of the aftertreatment device 100. The first sidewall 118 wraps around and encloses a first side of the aftertreatment device 100. The first sidewall 118 and the first side extend generally vertically. The first sidewall 118 is spaced slightly away from the first side of the aftertreatment device 100 in order to provide a narrow gap 128 between the first sidewall 118 and the first side of the aftertreatment device 100. The gap 128 forms an air channel that maintains a relatively constant airflow over substantially the entire first side of the aftertreatment device 100.

[0024] The second sidewall 120 extends substantially the entire length of the aftertreatment device 100. The second sidewall 120 wraps around and encloses a second side of the aftertreatment device 100. The second sidewall 120 and the second side extend generally vertically. The second sidewall 120 is spaced slightly away from the second side of the aftertreatment device 100 in order to provide a narrow gap 130 between the second sidewall 120 and the second side of the aftertreatment device 100. The gap 130 forms an air channel that maintains a relatively constant airflow over substantially the entire second side of the aftertreatment device 100.

[0025] An elongate outlet 132 is provided between the bottom edge of the first sidewall 118 and the second sidewall 120. The elongate outlet 132 extends substantially the entire length of the aftertreatment device 100.

[0026] The elongate outlet 132 provides a flow path for air that is introduced into the air inlet 114 to escape from the space defined between the inner surface of the shroud 102 and the outer surface of the aftertreatment device 100.

[0027] The ends of the shroud 102 are defined by the first endwall 122 and the second endwall 124 which enclose the ends of the aftertreatment device 100.

[0028] The first endwall 122 is fixed to the first sidewall 118, the second sidewall 120, and the input exhaust conduit 106 to enclose the first end 108 of the aftertreatment device 100.

[0029] The second endwall 124 is fixed to the first sidewall 118, the second sidewall 120, and the stepped conduit 126 to enclose the second end 112 of the aftertreatment device 100.

[0030] The stepped conduit 126 forms the upper surface of the shroud 102. The stepped conduit 126 encloses the upper surface of the aftertreatment device 100. The stepped conduit 126 is fixed to and extends between the upper edges of the first sidewall 118 and the second sidewall 120. The stepped conduit 126 extends substantially the entire length of the aftertreatment device 100 and is spaced away from the aftertreatment device 100 a distance substantially larger than the gap 128 or the gap 130.

[0031] Due to this larger spacing, the stepped conduit 126 has a decreased resistance to airflow in a direction parallel to the longitudinal extent of the aftertreatment device 100. This decreased resistance permits air to flow from the air inlet 114 at the first end 108 of the aftertreatment device 100, down the length of the stepped conduit 126 to the second end 112 of the aftertreatment device 100.

[0032] The cross-sectional area between the stepped conduit 126 and the top surface of the aftertreatment device 100 decreases over the length of the aftertreatment device 100 as the stepped conduit 126 extends from the first end 108 to the second end 112. The cross-sectional area between the stepped conduit 126 and the surface of the aftertreatment device 100 over which it extends does not decrease gradually and uniformly over the length of the stepped conduit 126, however. It decreases in a stepwise fashion. To provide this stepwise reduction the inner surface (and in this case the outer surface as well, since the stepped conduit 126 is formed of a single layer of sheet metal) is provided with a series of three downward steps (a step 134, a step 136, and a step 138) in a top surface 140 of the stepped conduit 126, as well as a laterally inward step 142 on a first side surface 144 of the stepped conduit 126 and an opposing laterally inward step 146 on a second side surface 148 of the stepped conduit 126. The laterally inward step 146 is on an opposing side of the stepped conduit 126 from the laterally inward step 142 on the first side surface 144.

[0033] The effect of these step changes in the inner surface of the stepped conduit 126 is to cause a disruption in the smooth flow of the air traveling longitudinally down the stepped conduit 126. This disruption in the flow of air directs a greater portion of the air downward into the gap 128 and gap 130.

[0034] This downward flow improves the scouring of the upper surface of the aftertreatment device 100. The scouring both removes pockets of otherwise combustible material that may have accumulated on the upper surface of the aftertreatment device 100. It also helps prevent the formation the formation of pockets of material on the upper surface of the aftertreatment device 100. The upper surface of the aftertreatment device 100 has protrusions extending upwardly therefrom. The protrusions comprise a first circumferential ring 150 and the second circumferential ring 152. In previous arrangements, dust and other combustible particles would accumulate on the upper and side surfaces of the aftertreatment device 100 downstream of these protrusions. The steps described herein.

Claims

1. A shroud (102) for an aftertreatment device (100) for treating exhaust gas from an internal combustion engine, the shroud comprising a stepped conduit (126) configured to be disposed over an upper surface of the aftertreatment device (100) and extending over substantially an entire length of the aftertreatment device (100), wherein the stepped conduit (126) is configured to channel a flow of cleaning air longitudinally along an outer and upper surface of the aftertreatment device (100), wherein an inner surface of the stepped conduit (126) defines at least a first downwardly extending step (134, 136, 138) and a second downwardly extending step (134, 136, 138) that are spaced apart along a length of the aftertreatment device (100), to direct at least a portion of the flow of cleaning air downward.

2. The shroud (102) of Claim 1, further comprising a first sidewall (118) that is fixed to the stepped conduit (126) along a first longitudinal side edge of the stepped conduit (126), wherein the first sidewall (118) extends around and encloses a first side surface of the aftertreatment device (100), wherein the first sidewall (118) is disposed to provide a narrow gap (128) between the first sidewall (118) and the first side surface of the aftertreatment device (100) to receive the flow of cleaning air from the stepped conduit (126) over substantially the entire length of the aftertreatment device (100) and to direct the flow of cleaning air generally downward over the first side surface of the aftertreatment device (100).

3. The shroud (102) of Claim 2, further comprising a second sidewall (120) that is fixed to the stepped conduit (126) along a second longitudinal side edge of the stepped conduit (126) and is disposed on an opposite side of the stepped conduit (126) from the first sidewall (118), wherein the second sidewall (120) extends around and encloses a second side surface of the aftertreatment device (100), wherein the second sidewall (120) is disposed to provide a narrow gap (130) between the second sidewall (120) and the second side surface of the aftertreatment device (100) to receive the flow of cleaning air from the stepped conduit (126) over substantially the entire length of the aftertreatment device (100) and to direct the flow of cleaning air generally downward over the second side surface of the aftertreatment device (100).

4. The shroud (102) of Claim 1, wherein the aftertreatment device (100) is elongate, generally cylindrical, and has a central longitudinal axis (104) that extends generally horizontally.

5. The shroud (102) of Claim 4, wherein the aftertreatment device (100) has a top surface, and wherein the stepped conduit (126) extends generally horizontally and is disposed immediately over the top surface of the aftertreatment device (100).

6. The shroud (102) of Claim 5, wherein the first downwardly extending step (134, 136, 138) and the second downwardly extending step (134, 136, 138) are disposed above the top surface of the aftertreatment device (100) and are spaced apart along the top surface of the aftertreatment device (100).

7. The shroud (102) of Claim 6, wherein the first downwardly extending step (134, 136) is disposed immediately downstream of a first protrusion (150, 152) that extends upwardly from the top surface of the aftertreatment device (100).

8. The shroud (102) of Claim 7, wherein the second downwardly extending step (134, 136) is disposed immediately downstream of a second protrusion (150, 152) that extends upwardly from the top surface of the aftertreatment device (100).

9. The shroud (102) of Claim 8, wherein each of the first protrusion (150, 152) and the second protrusion (150, 152) comprises an annular ring extending about a circumference of the aftertreatment device (100).

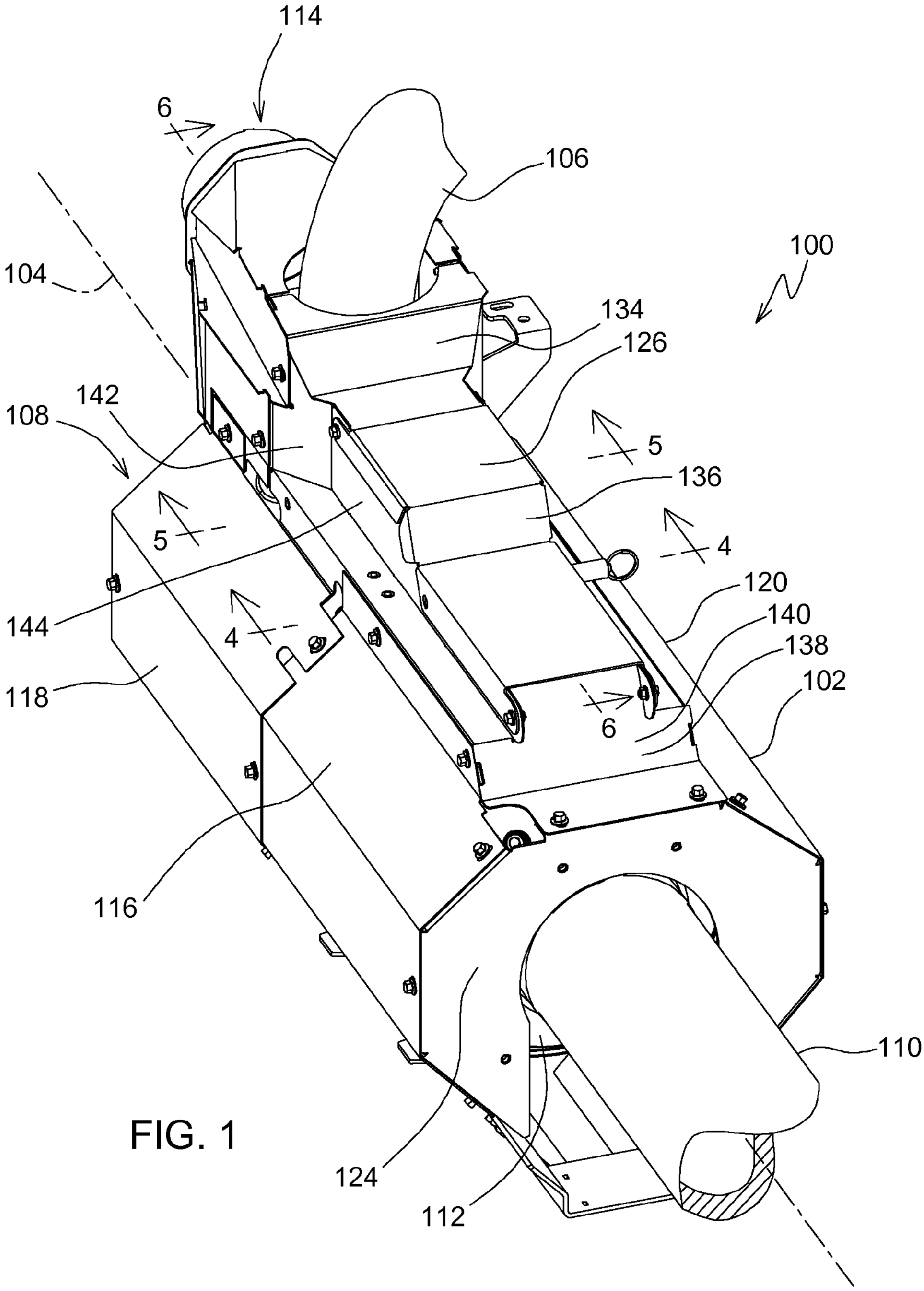

114
6
106
100
104
134
126
142
108
5
136
5
4
144
4
120
140
138
102
118
6
116
110
124
112

FIG. 1

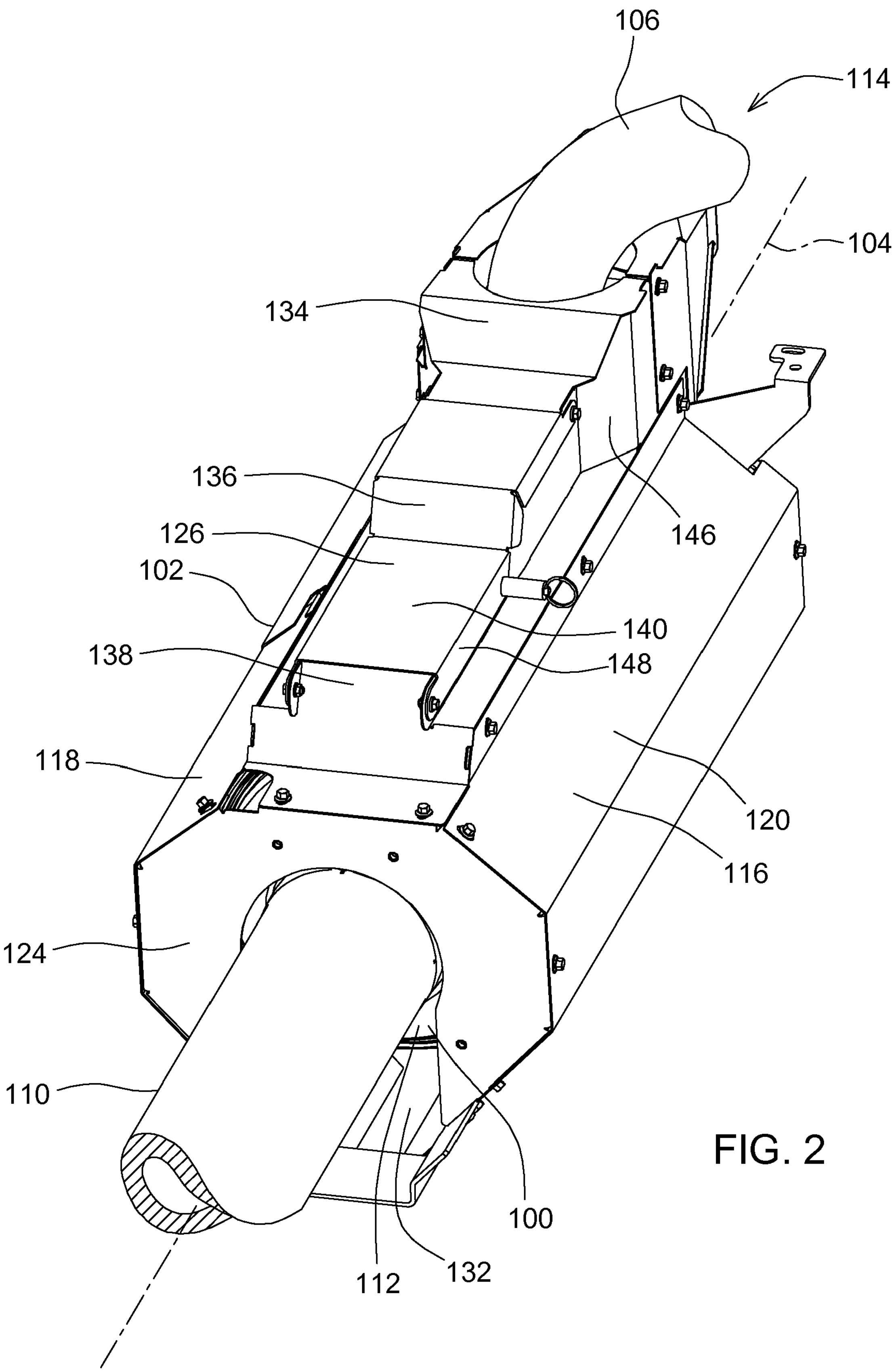

106
114
104
134
136
126
102
146
140
138
148
118
120
116
124
110
100
112
132

FIG. 2

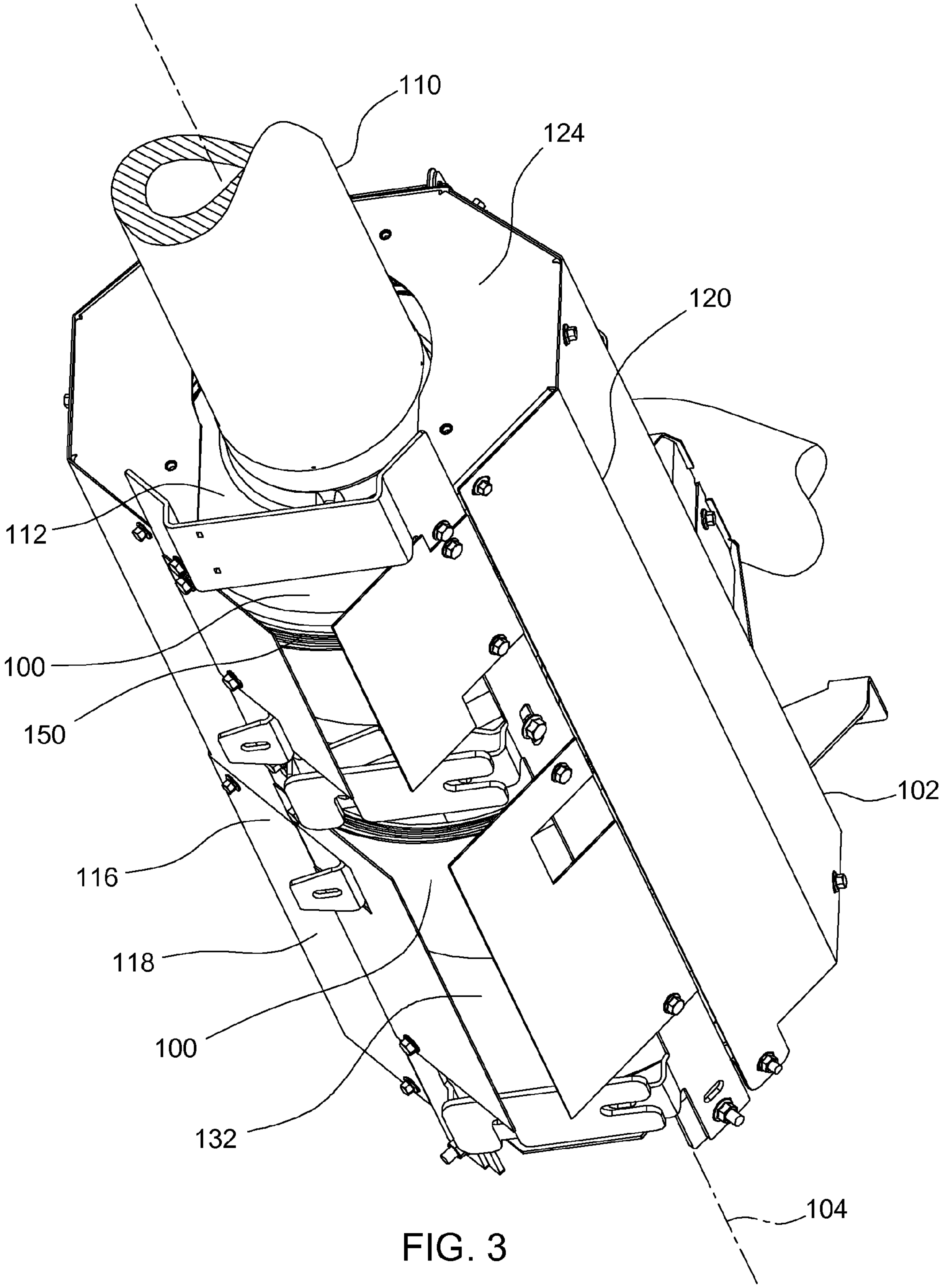


FIG. 3

FIG. 4

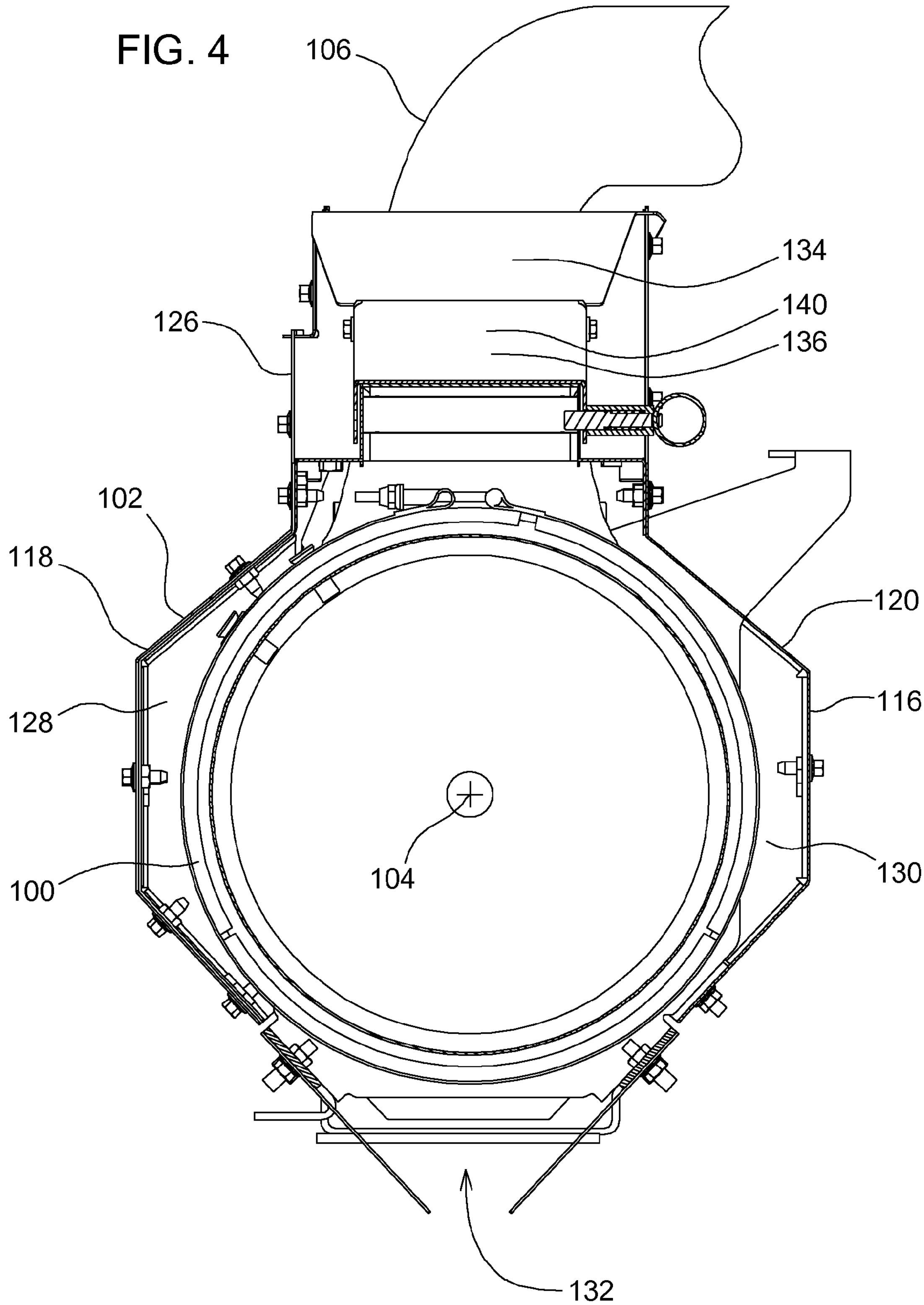
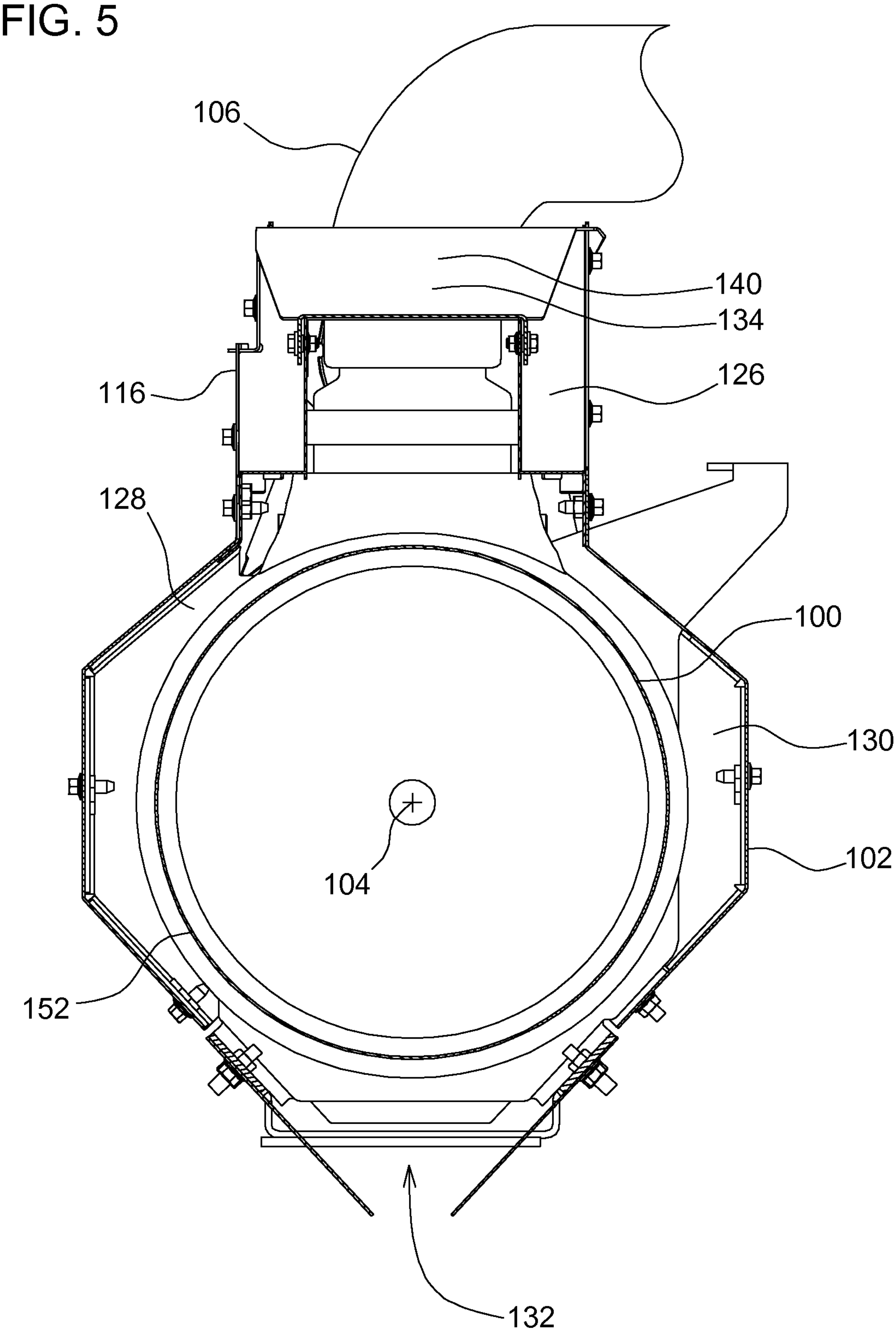
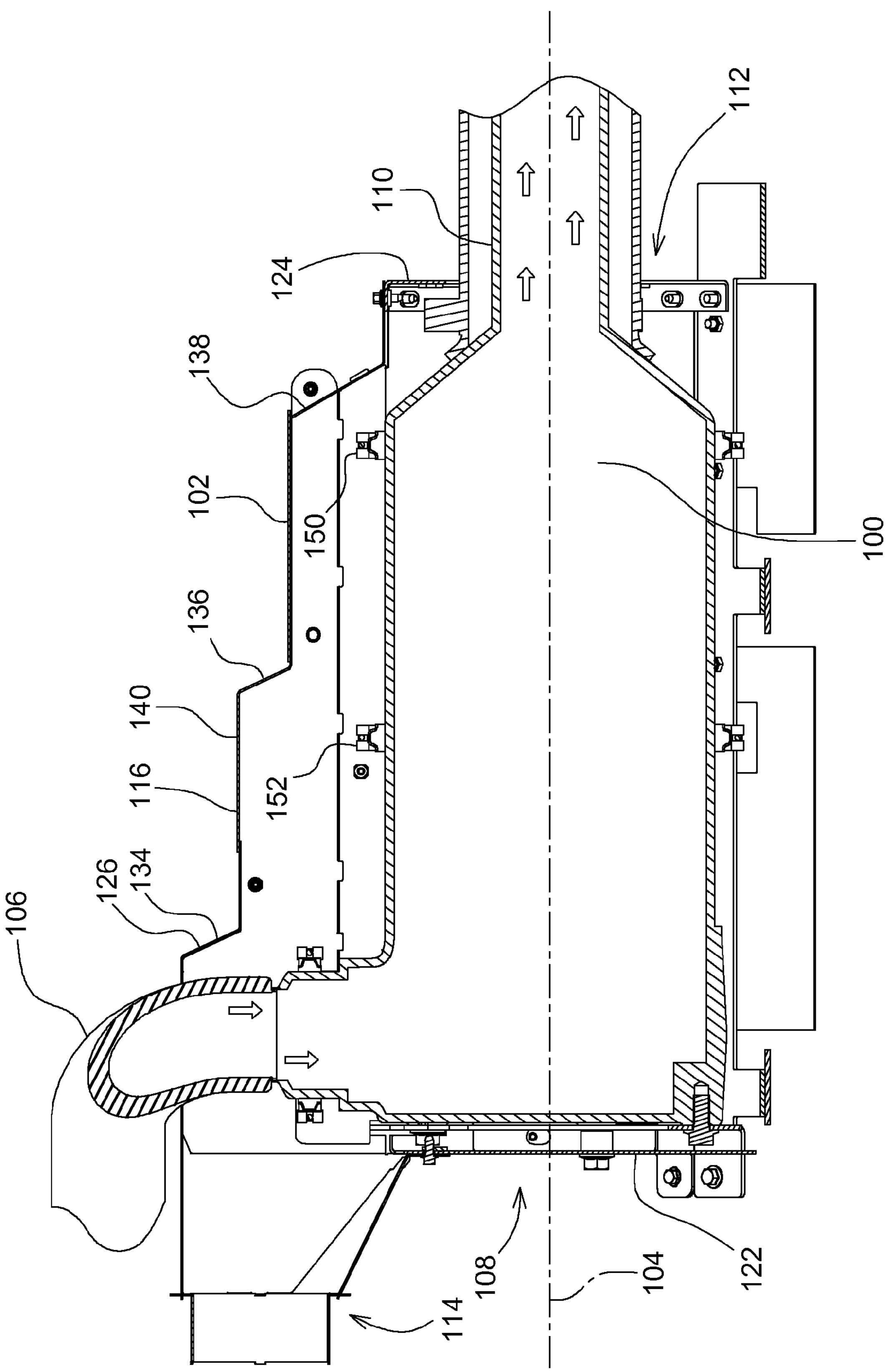


FIG. 5





112
110
124
138
102
150
100
136
140
152
116
126
134
106
108
104
122
114

FIG. 6

Europäisches Patentamt
European Patent Office
Office européen des brevets

EUROPEAN SEARCH REPORT

Application Number
EP 14 18 1137

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	EP 2 372 121 A1 (DEERE & CO [US]) 5 October 2011 (2011-10-05) * paragraphs [0017] - [0025]; figures 2,3 * -----	1-9	INV. F01N13/14
			TECHNICAL FIELDS SEARCHED (IPC)
			F01N

The present search report has been drawn up for all claims

1

Place of search	Date of completion of the search	Examiner
Munich	16 January 2015	Kolland, Ulrich

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons
....
& : member of the same patent family, corresponding document

EPO FORM 1503 03.82 (P04C01)

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 14 18 1137

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
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

16-01-2015

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
EP 2372121 A1	05-10-2011	EP 2372121 A1	05-10-2011
		US 2011239980 A1	06-10-2011

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82