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(71) Applicant: **Mitsubishi Heavy Industries Meiki Engines Co.,Ltd.**
Nakamura-ku,
Nagoya-shi,
Aichi 4530862 (JP)

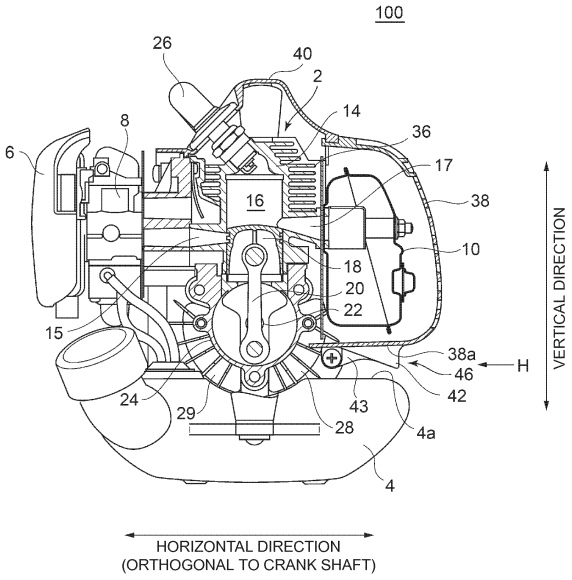
(72) Inventors:
- **SHIMOGAMI, Jun**
Tokyo 108-8215 (JP)
- **UENOYAMA, Kazuyuki**
Tokyo 108-8215 (JP)

(74) Representative: **Studio Torta S.p.A.**
Via Viotti, 9
10121 Torino (IT)

(54) MUFFLER COVER AND ENGINE

(57) A muffler cover is mountable to an engine so as to cover an exhaust muffler of the engine, and includes: a tank facing surface formed so as to face a muffler side surface of a fuel tank of the engine via a gap when mounted to the engine, and configured to guide cooling air to an outside-air intake port of a cooling fan of the engine with the muffler side surface; and at least two ribs being independent from each other and being formed so as to protrude toward the muffler side surface of the fuel tank from the tank facing surface.

FIG. 4



EP 3 315 740 A1

Description

TECHNICAL FIELD

[0001] The present disclosure relates to a muffler cover and an engine.

BACKGROUND ART

[0002] For instance, an engine to be used as a driving power source of operating machines such as a string trimmer may be provided with a guard part such as grating and mesh that covers an inlet of a cooling fan for sucking in outside air, so as to prevent foreign materials such as grass and foliage from entering the outside-air inlet.

[0003] Patent Document 1 discloses an intake port guard device provided with a guard part that covers an outside-air intake port of a cooling fan at the side of a carburetor, so as to prevent grass or the like from being sucked into the outside-air intake port of the cooling fan from the carburetor side of the engine.

[0004] Patent Document 2 discloses covering an outside-air intake port of a cooling fan with a muffler cover and providing a heat insulating plate between a muffler and a bottom plate of the muffler cover, so as to prevent a finger of an operator from entering the outside-air intake port from the muffler side of the engine (through a gap between the muffler and a fuel tank), as well as to suppress heating of the fuel tank due to heat radiation from the muffler.

Citation List

Patent Literature

[0005]

Patent Document 1: JPH5-21609U (Utility Model)
Patent Document 2: JPS58-148215U (Utility Model)

SUMMARY

Problems to be Solved

[0006] In the guard device of Patent Document 1, the guard part covering the carburetor side of the outside-air intake port of the cooling fan of the engine prevents grass or the like from being sucked into the outside-air intake port from the carburetor side. However, the guard part is covering the outside-air intake port on the carburetor side, and provision of the guard part causes pressure loss of air for cooling, which is likely to deteriorate the cooling performance of the cooling fan. Furthermore, Patent Document 1 does not disclose any approach for preventing grass or the like from being sucked into the outside-air intake port from the muffler side of the engine (through the gap between the muffler and the fuel tank).

[0007] In the muffler cover disclosed in Patent Document 2, the outside-air intake port of the engine is covered with a muffler cover, such that air for cooling flows toward the outside-air intake port from the outer side of the muffler cover through the ventilation passage inside the muffler cover, and thus the cooling performance of the cooling fan is likely to deteriorate due to pressure loss of the air for cooling in the ventilation passage.

[0008] The present invention was made in view of the above typical problem, and an object is to provide a muffler cover capable of suppressing entry of grass and foliage to an outside-air intake port of a cooling fan of an engine and suppressing deterioration of the engine cooling performance of the cooling fan, as well as an engine having the same.

Solution to the Problems

[0009]

(1) A muffler cover according to at least one embodiment of the present invention is mountable to an engine so as to cover an exhaust muffler of the engine, and comprises: a tank facing surface formed so as to face a muffler side surface of a fuel tank of the engine via a gap when mounted to the engine, and configured to guide cooling air to an outside-air intake port of a cooling fan of the engine with the muffler side surface; and at least two ribs being independent from each other and being formed so as to protrude toward the muffler side surface of the fuel tank from the tank facing surface.

With the muffler cover (1), it is possible to, with the at least two independent ribs protruding from the tank facing surface of the muffler cover toward the muffler side surface of the fuel tank, suppress entry of grass and foliage, for instance, into the outside-air intake port of the cooling fan from the gap between the tank facing surface and the muffler side surface. Furthermore, as compared to a case in which the outside-air intake port of the cooling fan is covered with a guard part such as grating and mesh or a muffler cover itself to suppress entry of grass and foliage, a flow-passage area for sucking in outside air can be easily ensured outside the outside-air intake port with the at least two independent ribs, which makes it possible to reduce pressure loss of cooling air upstream the outside-air intake port. Accordingly, it is possible to suppress entry of grass and foliage into the outside-air intake port of the cooling fan, for instance, and to suppress deterioration of the cooling performance of the cooling fan. Furthermore, by providing the rib, it is possible to increase the strength of the muffler cover.

(2) In some embodiments, in the above muffler cover (1), the tank facing surface is configured such that at least a part of the outside-air intake port of the cooling fan of the engine is positioned between the

tank facing surface and the muffler side surface, when the gap is seen in a direction orthogonal to an axial direction of a crank shaft of the engine.

With the above muffler cover (2), a part of cooling air is sucked into the outside-air intake port of the cooling fan in a straight path along the tank facing surface or the muffler side surface from the gap between the tank facing surface and the muffler side surface, and thus it is possible to enhance the effect to reduce pressure loss of cooling air upstream the outside-air intake port. Accordingly, it is possible to enhance the effect to suppress deterioration of the cooling performance of the cooling fan.

(3) In some embodiments, in the above muffler cover (1) or (2), at least one of the ribs includes an inclined portion formed such that a height decreases toward the outside-air intake port.

With the above configuration, when the ribs receive grass and foliage that approaches from the outside of the ribs (opposite side of the ribs from the outside-air intake port), the ribs are relatively tall at a position remote from the outside-air intake port, and thus it is possible to receive grass and foliage at a position remote from the outside-air intake port. Furthermore, the ribs are relatively short at a position proximate to the outside-air intake port, and thus it is possible to ensure a flow passage area for sucking in outside air in a region proximate to the outside-air intake port, which makes it possible to reduce pressure loss of cooling air upstream the outside-air intake port and to suppress deterioration of the cooling performance of the cooling fan. Accordingly, it is possible to enhance the effect to suppress deterioration of the engine cooling performance of the cooling fan, while receiving grass and foliage at a position remote from the outside-air intake port.

(4) In some embodiments, in the above muffler cover (3), at least one of the ribs is formed to have a triangular shape as seen in an axial direction of a crank shaft of the engine.

With the above muffler cover (4), it is possible to achieve the effect described in the above (3), and to realize a high rib strength against collision with grass and foliage that approaches flying from outside the ribs (opposite to the outside-air intake port).

(5) In some embodiments, in the muffler cover according to any one of the above (1) to (4), the muffler side surface of the fuel tank includes: a flat surface portion extending in a first direction as seen in an axial direction of a crank shaft of the engine; and a muffler side R portion connecting to an end portion of the flat surface portion, disposed on a remote side from the outside-air intake port in the first direction, the muffler side R portion being formed such that a distance from the tank facing surface increases with distance from the outside-air intake port in the first direction. An end portion of at least one of the ribs, disposed on a remote side from the outside-air intake port in the first direction, is positioned in an existence range of the muffler side R portion in the first direction.

With the above muffler cover (5), as compared to a case in which the outer end portion of the rib is in the existence range of the flat surface portion in the first direction, it is possible to receive grass and foliage at a position remote from the outside-air intake port, and thus to ensure a flow-passage area for introducing outside air easily in the region close to the outside-air intake port. Furthermore, in a hypothetical case in which the outer end portion of the rib is disposed outside the existence range of the muffler side R portion in the first direction (opposite to the outside-air intake port), the tip portion and the muffler side R portion of the rib may function as a guide to the outside-air intake port, depending on the flying direction of grass and foliage, thus allowing a part of the grass and foliage to enter the outside-air intake port. In this regard, according to the above muffler cover (5), the outer end portion of the rib is in the existence range of the muffler side R portion in the first direction, and thus the rib is less likely to function as the above described guide. Accordingly, it is possible to enhance the effect to suppress entry of grass and foliage, for instance, into the outside-air intake port of the cooling fan.

(6) In some embodiments, in the muffler cover described in any one of the above (1) to (5), each of the ribs extends such that a longitudinal direction of each rib intersects with an axial direction of a crank shaft of the engine.

With the above muffler cover (6), in the engine configured to be capable of introducing cooling air to the outside-air intake port of the cooling fan in a direction that intersects with the axial direction of the crank shaft of the engine, each of the ribs extends along the intake direction of cooling air, and thus the ribs do not obstruct the flow of the cooling air as much. Accordingly, it is possible to enhance the effect to reduce pressure loss of cooling air outside the outside-air intake port. Accordingly, it is possible to enhance the effect to suppress deterioration of the cooling performance of the cooling fan.

(7) In some embodiments, in the above muffler cover (6), each of the ribs extends such that a longitudinal direction of each rib is orthogonal to the axial direction of the crank shaft of the engine.

With the above muffler cover (7), in the engine configured to be capable of introducing cooling air to the outside-air intake port of the cooling fan in a direction that is orthogonal to the axial direction of the crank shaft of the engine, each of the ribs extends along the intake direction of cooling air, and thus the ribs do not obstruct the flow of the cooling air as much. Accordingly, it is possible to enhance the effect to reduce pressure loss of cooling air outside the outside-air intake port. Accordingly, it is possible to en-

hance the effect to suppress deterioration of the cooling performance of the cooling fan.

(8) In some embodiments, in the above muffler cover (6), the at least two ribs include two ribs having a distance therebetween reducing with distance from the outside-air intake port along the tank facing surface.

With the above muffler cover (8), it is possible to suppress entry of grass and foliage, for instance, that approaches flying the outside-air intake port, from entering the outside-air intake port through the gap between the ribs.

(9) In some embodiments, in the muffler cover described in any one of the above (1) to (8), each of the at least two ribs includes a linear portion extending linearly along a direction orthogonal to an axial direction of a crank shaft of the engine along the tank facing surface, and a plate-shaped portion extending between the tank facing surface and the muffler side surface so as to intersect with the linear portion.

With the above muffler cover (9), there may be some merits, which is to suppress entry of grass and foliage, for instance, that approaches flying the outside-air intake port, into the outside-air intake port through the gap between the ribs, and to insulate heat that transmits from the exhaust muffler to the fuel tank with the plate-shaped portion.

(10) An engine according at least one embodiment of the present invention comprises: a cylinder; a piston forming a combustion chamber with the cylinder; a crank shaft for converting reciprocating motion of the piston into rotational motion; an exhaust muffler through which exhaust gas from the combustion chamber passes; and a muffler cover configured to cover the exhaust muffler. The muffler cover is the muffler cover described in any one of the above (1) to (9).

With the above engine (10), the engine is provided with the muffler cover described in any one of the above (1) to (9), and thus it is possible to, with the at least two independent ribs protruding from the tank facing surface of the muffler cover toward the muffler side surface of the fuel tank, suppress entry of grass and foliage, for instance, into the outside-air intake port of the cooling fan from the gap between the tank facing surface and the muffler side surface. Furthermore, as compared to a case in which the outside-air intake port of the cooling fan is covered with a guard part such as grating and mesh or a muffler cover itself to suppress entry of grass and foliage, a flow-passage area for sucking in outside air can be easily ensured with the at least two independent ribs, which makes it possible to reduce pressure loss of cooling air upstream the outside-air intake port. Accordingly, it is possible to suppress overheat or the like of the engine by suppressing deterioration of the cooling performance of the cooling fan, and to operate the engine stably.

Advantageous Effects

[0010] According to at least one embodiment of the present invention, it is possible to provide a muffler cover capable of suppressing entry of grass and foliage to an outside-air intake port of a cooling fan of an engine and suppressing deterioration of the performance of the cooling fan to cool the engine, as well as an engine having the same.

BRIEF DESCRIPTION OF DRAWINGS

[0011]

FIG. 1 is a front view of an engine 100 according to an embodiment.

FIG. 2 is a back view of the engine 100.

FIG. 3 is a side view (as seen in direction H in FIG. 1) of the engine 100.

FIG. 4 is a partial cross-sectional view showing A-A cross-section (see FIG. 3) of the engine 100.

FIG. 5 is a partial cross-sectional view showing B-B cross-section of the engine 100.

FIG. 6 is a front view of a muffler cover 38 according to an embodiment (as seen in direction H in FIG. 1).

FIG. 7 is a side view of the muffler cover 38 (as seen in the same direction as FIG. 1).

FIG. 8 is a side view of the muffler cover 38 (as seen in the same direction as FIG. 2).

FIG. 9 is a bottom view of the muffler cover 38.

FIG. 10 is an enlarged view of the vicinity of a rib 42 in FIG. 1, for explaining the function of the rib 42 and the rib 43 to receive foliage and a flow of cooling air.

FIG. 11 is an enlarged view of the vicinity of a rib 43 in FIG. 2, for explaining the function of the rib 42 and the rib 43 to receive foliage or the like, and a flow of cooling air.

FIG. 12 is an enlarged view of the vicinity of the rib 42 in FIG. 1, for explaining the configuration of the rib 42 in detail.

FIG. 13 is an enlarged view of the vicinity of the rib 43 in FIG. 2, for explaining the configuration of the rib 42 in detail.

FIG. 14 is an enlarged view of the vicinity of the rib 42 according to an embodiment.

FIG. 15 is an enlarged view of the vicinity of the rib 42 according to an embodiment.

FIG. 16 is a bottom view of the first modified example of the muffler cover 38.

FIG. 17 is a side view of the second modified example of the muffler cover 38.

FIG. 18 is a side view of the third modified example of the muffler cover 38.

FIG. 19 is a side view of the fourth modified example of the muffler cover 38.

FIG. 20 is a side view of the fourth modified example of the muffler cover 38.

FIG. 21 is a bottom view of the fourth modified ex-

ample of the muffler cover 38.

FIG. 22 is a perspective view of the fifth modified example of the muffler cover 38.

FIG. 23 is a side view of the fifth modified example of the muffler cover 38.

FIG. 24 is a side view of the fifth modified example of the muffler cover 38.

FIG. 25 is a front view of the fifth modified example of the muffler cover 38.

FIG. 26 is a bottom view of the fifth modified example of the muffler cover 38.

FIG. 27 is a side view of the sixth modified example of the muffler cover 38.

FIG. 28 is a front view of the sixth modified example of the muffler cover 38.

DETAILED DESCRIPTION

[0012] Embodiments of the present invention will now be described in detail with reference to the accompanying drawings. It is intended, however, that unless particularly specified, dimensions, materials, shapes, relative positions and the like of components described in the embodiments shall be interpreted as illustrative only and not intended to limit the scope of the present invention.

[0013] For instance, an expression of relative or absolute arrangement such as "in a direction", "along a direction", "parallel", "orthogonal", "centered", "concentric" and "coaxial" shall not be construed as indicating only the arrangement in a strict literal sense, but also includes a state where the arrangement is relatively displaced by a tolerance, or by an angle or a distance whereby it is possible to achieve the same function.

[0014] For instance, an expression of an equal state such as "same" "equal" and "uniform" shall not be construed as indicating only the state in which the feature is strictly equal, but also includes a state in which there is a tolerance or a difference that can still achieve the same function.

[0015] Further, for instance, an expression of a shape such as a rectangular shape or a cylindrical shape shall not be construed as only the geometrically strict shape, but also includes a shape with unevenness or chamfered corners within the range in which the same effect can be achieved.

[0016] On the other hand, an expression such as "comprise", "include", "have", "contain" and "constitute" are not intended to be exclusive of other components.

[0017] FIG. 1 is a front view of an engine 100 according to an embodiment. FIG. 2 is a back view of the engine 100. FIG. 3 is a side view (as seen in direction H in FIG. 1) of the engine 100. FIG. 4 is a partial cross-sectional view showing A-A cross section (see FIG. 3) of the engine 100. FIG. 5 is a partial cross-sectional view showing B-B cross section of the engine 100. The engine 100 is a two-cycle one-cylinder reciprocating engine which is used as a driving power source of mowers, tea picking machines, string trimmers, and brush cutters, for instance.

[0018] As shown in at least one of FIGs. 1 to 5, the engine 100 includes an engine body 2, a fuel tank 4, an air cleaner 6, a carburetor 8, an exhaust muffler 10, a cooling fan 12, a recoil starter 13, a muffler cover 38, and a cylinder cover 40.

[0019] As shown in at least one of FIGs. 4 and 5, the engine body 2 includes a cylinder 14, a piston 18 forming a combustion chamber 16 with the cylinder 14, a crank shaft 22 coupled to the piston 18 via a connecting rod 20, for converting reciprocal motion of the piston 18 into rotational motion, a crank case 24 housing the crank shaft 22, and an ignition plug 26 attached to an end portion of the cylinder 14.

[0020] The fuel tank 4 is configured to house fuel to be supplied to the carburetor 8. As shown in FIG. 4 for instance, the fuel tank 4 extends from below the carburetor 8 to below the exhaust muffler 10, along the horizontal direction that is orthogonal to the axial direction of the crank shaft 22.

[0021] An air cleaner 6 has an intake filter (not shown) for removing dust and the like from outside air. Ambient air sucked in via the intake filter of the air cleaner 6 is supplied to the carburetor 8.

[0022] As shown in FIG. 4 for instance, the carburetor 8 is disposed on the side of the intake port 15 of the cylinder 14, and is configured to produce mixed gas of fuel supplied from the fuel tank 4 and air supplied from the air cleaner 6, and to supply the mixed gas into the combustion chamber 16.

[0023] As shown in FIG. 5 for instance, the cooling fan 12 is a centrifugal-type cooling fan, and is configured to supply cooling air (outside air) to a fin 36 of the cylinder 14. Cooling air is sucked in from outside-air intake ports 28, 29 of the cooling fan 12 (for instance, see FIGs. 1 to 4), and rotation of a flywheel 30 (see FIG. 5) connected to the crank shaft 22 imparts kinetic energy to the cooling air. The flywheel 30 is provided with a clutch unit 31 (centrifugal clutch) attached thereto, and the clutch unit 31 is configured to rotate integrally with the flywheel 30. In some cases, such as in horizontal specifications, a recoil pulley may be attached. With kinetic energy imparted thereto by the cooling fan 12, the cooling air passes through a cooling-air passage 34 formed between the crank case 24 and the fan case 32, is sprayed to the fin 36 of the cylinder 14, and is discharged outside the engine 100 through a cooling-air discharge port 44 formed on a cylinder cover 40.

[0024] In the engine 100 shown in FIGs. 1 to 5, the cooling fan 12 is disposed on one end side of the crank shaft 22, and the recoil starter 13 is disposed on the other end side of the crank shaft 22. The cooling fan is configured to be capable of sucking in cooling air from a direction orthogonal to the axial direction of the crank shaft 22.

[0025] As shown in FIG. 4 for instance, the exhaust muffler 10 is disposed on the side of the exhaust port 17 of the cylinder 14, and is configured to reduce exhaust noise by reducing the pressure and temperature of ex-

haust gas when exhaust gas from the combustion chamber 16 passes through the exhaust muffler 10.

[0026] FIG. 6 is a front view of a muffler cover 38 (as seen in direction H in FIG. 1). FIG. 7 is a side view of the muffler cover 38 (as seen in the same direction as FIG. 1). FIG. 8 is a side view of the muffler cover 38 (as seen in the same direction as FIG. 2). FIG. 9 is a bottom view of the muffler cover 38. FIG. 10 is an enlarged view of the vicinity of a rib 42 in FIG. 1. FIG. 11 is an enlarged view of the vicinity of a rib 43 in FIG. 2. The direction H in FIG. 1 is the horizontal direction orthogonal to the axial direction of the crank shaft 22 (see FIGs. 4 and 5).

[0027] As shown in FIG. 4 for instance, the muffler cover 38 is configured to be attachable to the engine 100 so as to cover the exhaust muffler 10. Furthermore, as shown in FIGs. 1 to 4 and 6 to 11, the muffler cover 38 includes a tank facing surface 38a (bottom surface of the muffler cover 38 in the depicted embodiment) formed so as to face, via a gap 46, a muffler side surface 4a (surface facing the muffler cover 38, of the upper surface of the fuel tank 4, in the depicted embodiment) of the fuel tank 4. As shown in FIGs. 10 and 11, the tank facing surface 38a is configured to guide the cooling air F to the outside-air intake port 28 of the cooling fan 12 of the engine 100, with the muffler side surface 4a. In other words, the tank facing surface 38a and the muffler side surface 4a form a guide flow passage for guiding the cooling air F flowing from outside toward the outside-air intake port 28. Furthermore, as shown in FIGs. 1 to 4, and 6 to 11, the muffler cover 38 includes two ribs 42, 43 provided independently from each other, so as to protrude toward the muffler side surface 4a of the fuel tank 4 from the tank facing surface 38a. The ribs 42, 43 being independent from each other means that the ribs 42, 43 protruding from the tank facing surface 38a do not intersect with each other on the tank facing surface 38a, but are disposed at an interval from each other from the root ends to the tip ends.

[0028] With the above configuration, as shown in FIGs. 10 and 11 for instance, it is possible to, with the at least two independent ribs 42, 43 protruding from the tank facing surface 38a of the muffler cover 38 toward the muffler side surface 4a of the fuel tank 4, suppress entry of grass and foliage, for instance, into the outside-air intake port 28 of the cooling fan 12 from the gap 46 between the tank facing surface 38a and the muffler side surface 4a. Furthermore, as compared to a case in which the outside-air intake port 28 of the cooling fan 12 is covered with a guard part such as grating and mesh or a muffler cover itself to suppress entry of grass and foliage, a flow-passage area for sucking in outside air can be easily ensured outside the outside-air intake port 28 with the at least two independent ribs 42, 43, which makes it possible to reduce pressure loss of cooling air outside the outside-air intake port 28. Accordingly, it is possible to suppress deterioration of the cooling performance of the cooling fan 12.

[0029] In an embodiment, the tank facing surface 38a of the muffler cover 38 is, as shown in FIG. 3 for instance, when the gap 46 is seen in a direction orthogonal to the axial direction of the crank shaft 22 of the engine 100 (direction H in the embodiment shown in FIG. 3), at least a part of the outside-air intake port 28 of the cooling fan 12 of the engine 100 is positioned between the tank facing surface 38a and the muffler side surface 4a.

[0030] With this configuration, a part of cooling air (e.g. cooling air F1 in FIG. 10) is sucked into the outside-air intake port 28 of the cooling fan 12 in a straight path along direction H (see FIG. 1) along the tank facing surface 38a or the muffler side surface 4a from the gap 46 between the tank facing surface 38a and the muffler side surface 4a, and thus it is possible to enhance the effect to reduce pressure loss of cooling air outside the outside-air intake port 28. Accordingly, it is possible to enhance the effect to suppress reduction of the cooling performance of the cooling fan 12.

[0031] In an embodiment, as shown in FIG. 12 or 13 for instance, the rib 42 includes an inclined portion 42a formed so as to decrease in height toward the outside-air intake port 28, and the rib 43 includes an inclined portion 43a formed so as to decrease in height toward the outside-air intake port 28.

[0032] With this configuration, when the rib 42 and the rib 43 receive grass and foliage that approaches from the outside of the rib 42 and the rib 43 (opposite side of the rib 42 and the rib 43 from the outside-air intake port 28), the rib 43 and the rib 43 are relatively tall at a position remote from the outside-air intake port 28, and thus it is possible to receive grass and foliage at the position P1 remote from the outside-air intake port 28. Furthermore, the rib 42 and the rib 43 are relatively short at a position proximate to the outside-air intake port 28, and thus it is possible to ensure a flow passage area for sucking in outside air in region D proximate to the outside-air intake port 28, which makes it possible to reduce pressure loss of cooling air outside the outside-air intake port 28 and to enhance the effect to suppress deterioration of the cooling performance of the cooling fan 12. Accordingly, it is possible to enhance the effect to suppress deterioration of the cooling performance of the cooling fan 12, while receiving grass and foliage at a position remote from the outside-air intake port 28.

[0033] In an embodiment, for instance as shown in FIGs. 7 and 12, the rib 42 is formed to have a triangular shape, as seen in the axial direction of the crank shaft 22 of the engine 100.

[0034] With the above configuration, in addition to the above effect exerted by the inclined portion 42a, it is possible to achieve a high rib strength against collision with grass and foliage that approaches from outside of the rib 42 (opposite side of the rib 42 to the outside-air intake port 28).

[0035] In an embodiment, as shown in FIG. 12 for instance, the muffler side surface 4a of the fuel tank 4 includes a flat surface portion 48 extending in the first direction (in the drawing, horizontal direction) as seen in

the axial direction of the crank shaft 22 of the engine 100, and a muffler side R portion 52 (muffler side curved surface portion) connecting to an end portion 50 of the flat surface portion 48, disposed on the remote side from the outside-air intake port 28 in the first direction. The muffler side R portion 52 is formed such that the distance from the tank facing surface 28a decreases with distance from the outside-air intake port 28 in the first direction. Furthermore, as shown in FIG. 12, an end portion of the rib 42, on the remote side from the outside-air intake port 28 in the first direction (hereinafter, referred to as an outer end portion 54), is positioned within the existence range S1 of the muffler side R portion 52 in the first direction.

[0036] Accordingly, as compared to a case in which the outer end portion 54 of the rib 42 is in the existence range S2 of the flat surface portion 48 in the first direction (see FIG. 14), it is possible to ensure a flow-passage area for introducing outside air in the region D close to the outside-air intake port 28, while receiving grass and foliage at a position remote from the outside-air intake port 28. Furthermore, in a hypothetical case (see FIG. 15) in which the outer end portion 54 of the rib 42 is disposed outside the existence range S1 of the muffler side R portion 52 in the first direction (opposite to the outside-air intake port 28), the tip portion 56 and the muffler side R portion 52 of the rib 42 may function as a guide to the outside-air intake port 28, depending on the flying direction of grass and foliage, thus allowing a part of the grass and foliage to enter the outside-air intake port 28. In this regard, according to the configuration shown in FIG. 2, the outer end portion 54 of the rib 42 is in the existence range S1 of the muffler side R portion 52 in the first direction, and thus the rib 42 is less likely to function as the above described guide. Accordingly, it is possible to enhance the effect to suppress entry of grass and foliage, for instance, into the outside-air intake port 28 of the cooling fan 12.

[0037] For a similar reason, as shown in FIG. 13, an end portion of the rib 43, on the remote side from the outside-air intake port 28 in the first direction (hereinafter, referred to as an outer end portion 58), is preferably positioned within the existence range S1 of the muffler side R portion 52 in the first direction.

[0038] In an embodiment, as shown in FIGs. 12 and 13 for instance, each of the ribs 42, 43 extends such that the longitudinal direction (in the drawing, first direction) of each rib intersects with the axial direction of the crank shaft 22 of the engine 100 (direction of axis O of the crank shaft 22, i.e., direction perpendicular to the page).

[0039] With the above configuration, in the engine 100 configured to be capable of introducing cooling air to the outside-air intake port 28 of the cooling fan 12 in a direction (e.g. direction H in FIG. 4) that intersects with the axial direction of the crank shaft 22 of the engine 100, each of the ribs 42, 43 extends along the intake direction of cooling air, and thus the ribs 42, 43 do not obstruct the flow of the cooling air as much. Thus, it is possible to enhance the effect to reduce pressure loss of cooling air outside the outside-air intake port 28. Accordingly, it is possible to enhance the effect to suppress deterioration of the cooling performance of the cooling fan 12.

[0040] In an embodiment, as shown in FIGs. 12 and 13 for instance, each of the ribs 42, 43 extends such that the longitudinal direction (in the drawing, first direction) of each rib is orthogonal to the axial direction of the crank shaft 22 of the engine 100.

[0041] With the above configuration, in the engine 100 configured to be capable of introducing cooling air to the outside-air intake port 28 of the cooling fan 12 in a direction (e.g. direction H in FIG. 4) that is orthogonal to the axial direction of the crank shaft 22 of the engine 100, each of the ribs 42, 43 extends along the intake direction of cooling air, and thus the ribs 42, 43 do not obstruct the flow of the cooling air as much. Thus, it is possible to enhance the effect to reduce pressure loss of cooling air outside the outside-air intake port 28. Accordingly, it is possible to enhance the effect to suppress deterioration of the cooling performance of the cooling fan 12.

[0042] Embodiments of the present invention were described in detail above, but the present invention is not limited thereto, and various amendments and modifications may be implemented.

[0043] For instance, while the ribs 42, 43 are parallel to each other (see FIG. 9) in the above described engine 100, the ribs 42, 43 may be configured such that the distance 'd' therebetween decreases with distance from the outside-air intake port 28 along the tank facing surface 38a, as shown in FIG. 16.

[0044] With this configuration, it is possible to suppress entry of grass and foliage, for instance, that approaches flying the outside-air intake port 28, from entering the outside-air intake port 28 through the gap between the ribs 42, 43.

[0045] Furthermore, in the embodiment shown in FIG. 6, the distance between the rib 42 and the rib 43 is constant regardless of the distance from the tank facing surface 38a. However, the rib 42 and the rib 43 may be configured such that the distance 'd' between the rib 42 and the rib 43 increases with distance from the tank facing surface 38a, as shown in FIG. 17. Furthermore, the rib 42 and the rib 43 may be configured such that the distance 'd' between the rib 42 and the rib 43 decreases with distance from the tank facing surface 38a, as shown in FIG. 18. In either one of the embodiments shown in FIGs. 17 and 18 (particularly in the embodiment shown in FIG. 17), it is possible to effectively suppress entry of grass and foliage, for instance, that approaches flying the outside-air intake port 28, from entering the outside-air intake port 28 through the gap between the ribs 42, 43.

[0046] Furthermore, while the muffler cover 38 includes two ribs 42, 43 in the above embodiment, the muffler cover 38 may include three or more ribs. With a greater number of ribs, entry of grass and foliage into the outside-air intake port 28 can be suppressed more easily, but the pressure loss of cooling air outside the outside-air intake port 28 increases. Thus, a suitable number of

ribs may be set depending on the structure of the engine 100.

[0047] Furthermore, while the muffler cover 38 and the cylinder cover 40 are provided as separate members in the above embodiment, they may be formed integrally as a single piece. That is, the muffler cover 38 may be configured to cover only the exhaust muffler 10, or may cover other member such as the cylinder 14, in addition to the exhaust muffler 10.

[0048] Furthermore, in an embodiment, instead of the above ribs 42, 43, the muffler cover 38 may include two T-shaped ribs 60, 61 provided independently from each other, formed so as to protrude toward the muffler side surface 4a of the fuel tank 4 from the tank facing surface 38a as shown in FIGs. 19 to 21 for instance. In this case, as shown in FIGs. 19 to 21, the T-shaped rib 60 may include an inclined portion 60a formed linearly such that its height decreases toward the outside-air intake port, and a linear portion 60b formed linearly so as to be orthogonal to an end portion 60a1 of the inclined portion 60a remote from the outside-air intake port. Furthermore, the T-shaped rib 61 may also include an inclined portion 61 a formed linearly such that its height decreases toward the outside-air intake port, and a linear portion 60b formed linearly so as to be orthogonal to an end portion 60a1 of the inclined portion 61 a remote from the outside-air intake port. In the depicted embodiment, the inclined portion 60a connects to the linear portion 60b at the center position, in the longitudinal direction, of the linear portion 60b, and the inclined portion 61a connects to the linear portion 60b at the center position, in the longitudinal direction, of the linear portion 61b. With the above configuration, it is possible to receive grass and foliage with the linear portions 60b, 61b at a position away from the outside-air intake port 28. Furthermore, a flow passage area for sucking in outside air can be ensured easily in region E on the inner side of the inclined portions 60a, 61a (proximate to the outside-air intake port), which makes it possible to enhance the effect to suppress deterioration of the engine cooling performance of the cooling fan 12.

[0049] Furthermore, in an embodiment, instead of the above ribs 42, 43, the muffler cover 38 may include at least two T-shaped ribs 62, 63 provided independently from each other, formed so as to protrude toward the muffler side surface 4a of the fuel tank 4 from the tank facing surface 38a as shown in FIGs. 22 to 26 for instance. In this case, as shown in FIG. 23, the T-shaped rib 62 may include a linear portion 62a formed linearly along a direction orthogonal to the axial direction of the crank shaft 22 such that its height decreases toward the outside-air intake port 28, and a plate-shaped portion 62b extending between the tank facing surface 38a and the muffler side surface 4a so as to intersect with the linear portion 62a. Furthermore, as shown in FIG. 24, the T-shaped rib 63 may also include a linear portion 63a formed linearly along a direction orthogonal to the axial direction of the crank shaft 22 such that its height decreases toward the outside-air intake port 28, and a plate-shaped portion 63b extending between the tank facing surface 38a and the muffler side surface 4a so as to intersect with the linear portion 62a. In the depicted embodiment, the linear portion 62a connects to the plate-shaped portion 62b at the center position of the plate-shaped portion 62 in the axial direction of the crank shaft 22, and the linear portion 63a connects to the plate-shaped portion 63b at the center position of the plate-shaped portion 63b in the axial direction of the crank shaft 22. In this embodiment, the shape advantageously enables insulation of heat transmitted from the exhaust muffler 10 to the fuel tank 4.

[0050] As described above, in some embodiments, the muffler cover may be attachable to the engine so as to cover the exhaust muffler of the engine, formed so as to face the muffler side surface of the fuel tank of the engine via a gap when attached to the engine, and include a tank facing surface configured to guide cooling air to the outside-air intake port of the cooling fan of the engine with the muffler side surface, and at least two independent T-shaped ribs formed so as to protrude toward the muffler side surface of the fuel tank from the tank facing surface.

[0051] In an embodiment, as shown in FIGs. 27 and 28, inside each of the ribs 42, 43, an opening portion 64 (cavity, or window) penetrating in the axial direction of the crank shaft 22 may be provided. Accordingly, it is possible to improve the intake fluidity.

Description of Reference Numerals

[0052]

2	Engine body
4	Fuel tank
4a	Muffler side surface
6	Air cleaner
8	Carburetor
10	Exhaust muffler
12	Cooling fan
13	Recoil starter
14	Cylinder
15	Intake port
16	Combustion chamber
17	Exhaust port
18	Piston
20	Connecting rod
22	Crank shaft
24	Crank case
26	Ignition plug
28	Outside-air intake port
29	Outside-air intake port
30	Flywheel
31	Clutch unit
32	Fan case
34	Cooling-air passage
36	Fin

38	Muffler cover
38a	Tank facing surface
40	Cylinder cover
42	Rib
42a	Inclined portion
43	Rib
43a	Inclined portion
44	Cooling-air discharge port
46	Gap
48	Flat surface portion
50	End portion
52	Muffler side R portion
54	Outer end portion
56	Tip portion
58	Outer end portion
60	Rib
60a	Inclined portion
60a1	End portion
60b	Linear portion
61	Rib
61a	Inclined portion
61a1	End portion
61b	Linear portion
62	Rib
62a	Inclined portion
62a1	Tip portion
62b	Linear portion
63	Rib
63a	Inclined portion
63a1	Tip portion
63b	Linear portion
64	Opening portion
100	Engine

Claims

1. A muffler cover which is mountable to an engine so as to cover an exhaust muffler of the engine, the muffler cover comprising:

a tank facing surface formed so as to face a muffler side surface of a fuel tank of the engine via a gap when mounted to the engine, and configured to guide cooling air to an outside-air intake port of a cooling fan of the engine with the muffler side surface; and

at least two ribs being independent from each other and being formed so as to protrude toward the muffler side surface of the fuel tank from the tank facing surface.

2. The muffler cover according to claim 1,
wherein the tank facing surface is configured such that at least a part of the outside-air intake port of the cooling fan of the engine is positioned between the tank facing surface and the muffler side surface, when the gap is seen in a direction orthogonal to an axial direction of a crank shaft of the engine.

3. The muffler cover according to claim 1 or 2,
wherein at least one of the ribs includes an inclined portion formed such that a height decreases toward the outside-air intake port.

4. The muffler cover according to claim 3,
wherein at least one of the ribs is formed to have a triangular shape as seen in an axial direction of a crank shaft of the engine.

5. The muffler cover according to any one of claims 1 to 4,
wherein the muffler side surface of the fuel tank includes:

a flat surface portion extending in a first direction as seen in an axial direction of a crank shaft of the engine; and

a muffler side R portion connecting to an end portion of the flat surface portion, disposed on a remote side from the outside-air intake port in the first direction, the muffler side R portion being formed such that a distance from the tank facing surface increases with distance from the outside-air intake port in the first direction, and

wherein an end portion of at least one of the ribs, disposed on a remote side from the outside-air intake port in the first direction, is positioned in an existence range of the muffler side R portion in the first direction.

6. The muffler cover according to any one of claims 1 to 5,
wherein each of the ribs extends such that a longitudinal direction of each rib intersects with an axial direction of a crank shaft of the engine.

7. The muffler cover according to claim 6,
wherein each of the ribs extends such that a longitudinal direction of each rib is orthogonal to the axial direction of the crank shaft of the engine.

8. The muffler cover according to claim 6,
wherein the at least two ribs include two ribs having a distance therebetween reducing with distance from the outside-air intake port along the tank facing surface.

9. The muffler cover according to any one of claims 1 to 8,
wherein each of the at least two ribs includes a linear portion extending linearly along a direction orthogonal to an axial direction of a crank shaft of the engine along the tank facing surface and, a plate-shaped portion extending between the tank facing surface

and the muffler side surface so as to intersect with the linear portion.

10. An engine comprising:

a cylinder;
a piston forming a combustion chamber with the cylinder;
a crank shaft for converting reciprocating motion of the piston into rotational motion;
an exhaust muffler through which exhaust gas from the combustion chamber passes; and
a muffler cover configured to cover the exhaust muffler,
wherein the muffler cover is the muffler cover according to any one of claims 1 to 9.

FIG. 1

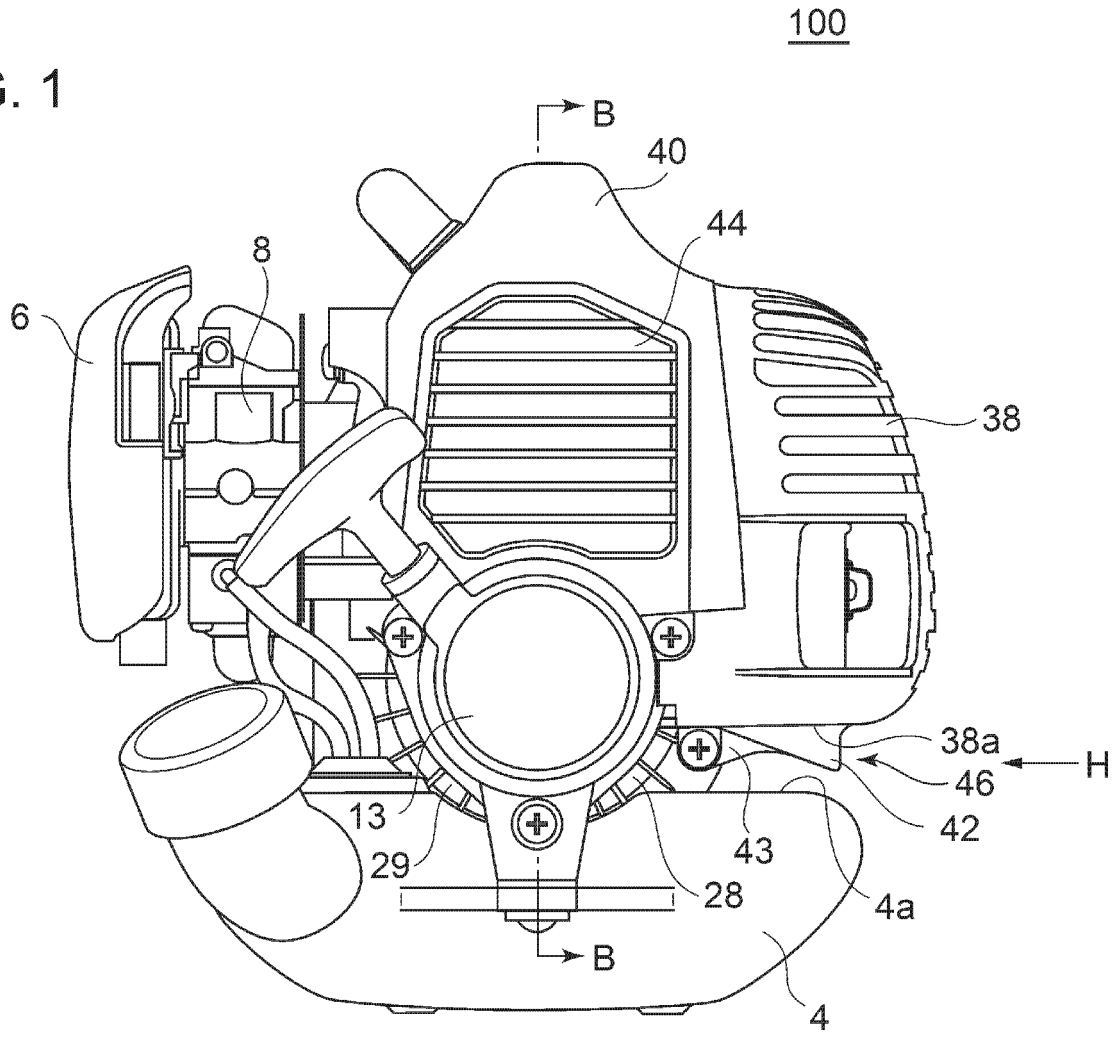


FIG. 2

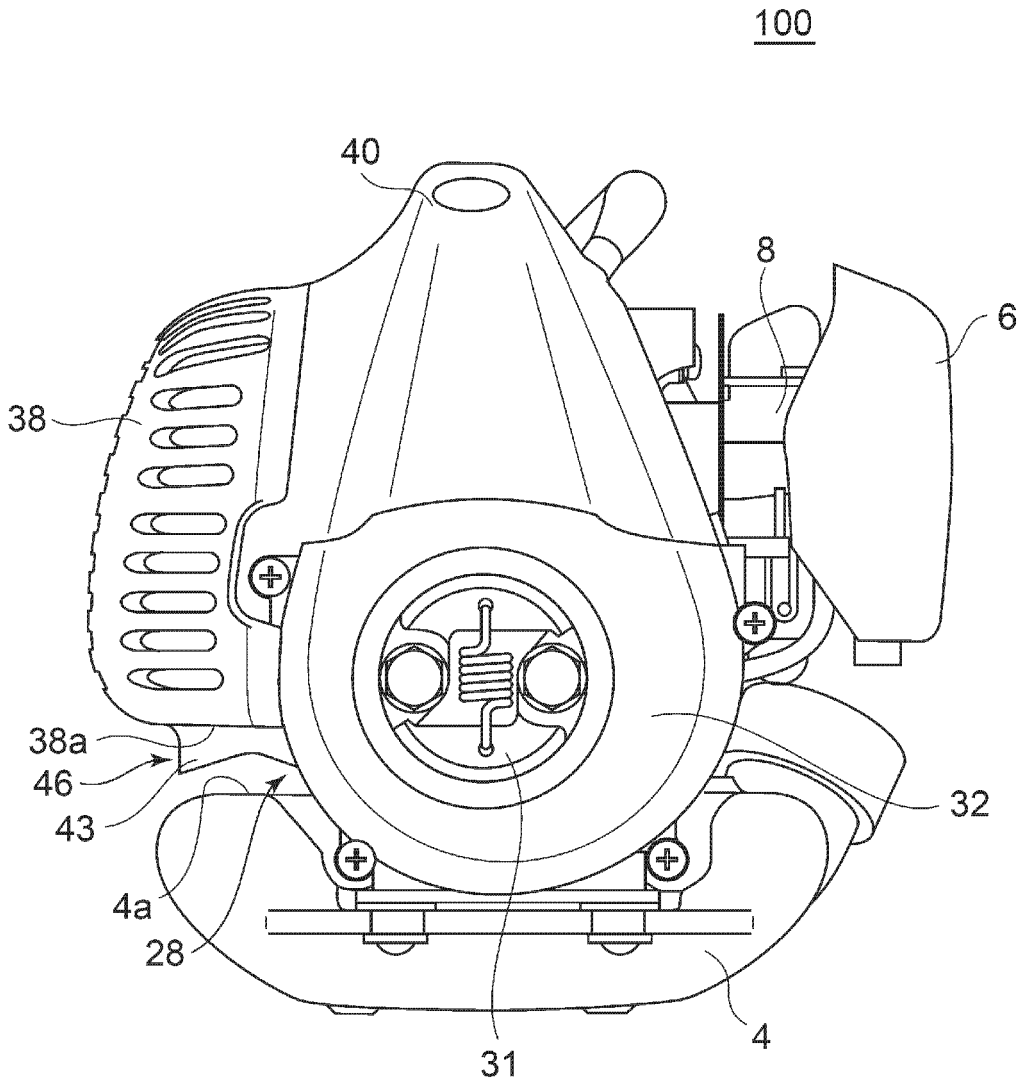


FIG. 3

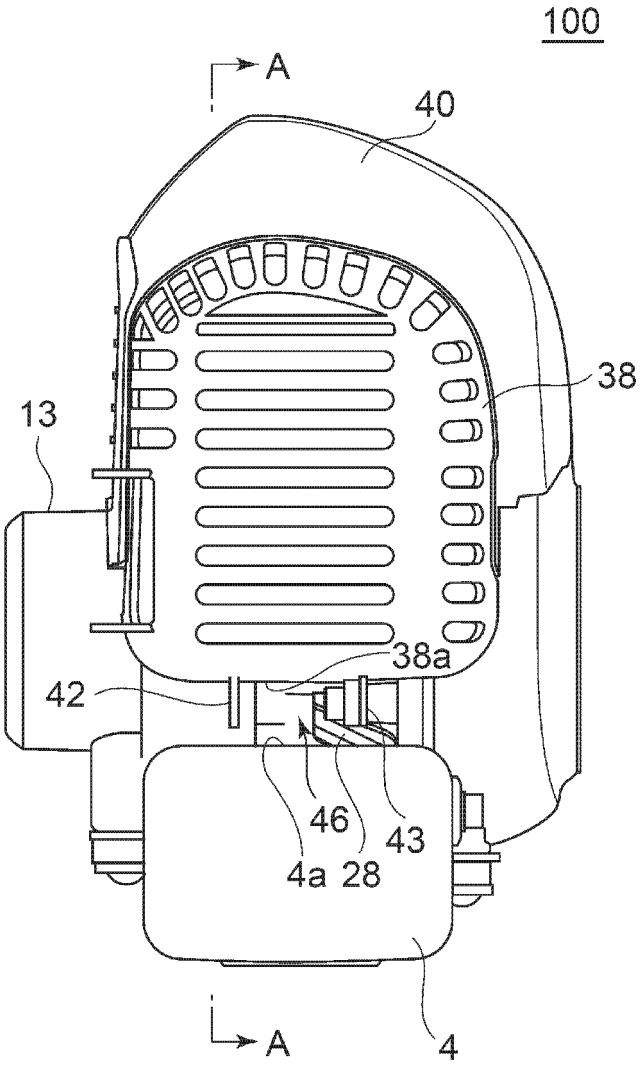


FIG. 4

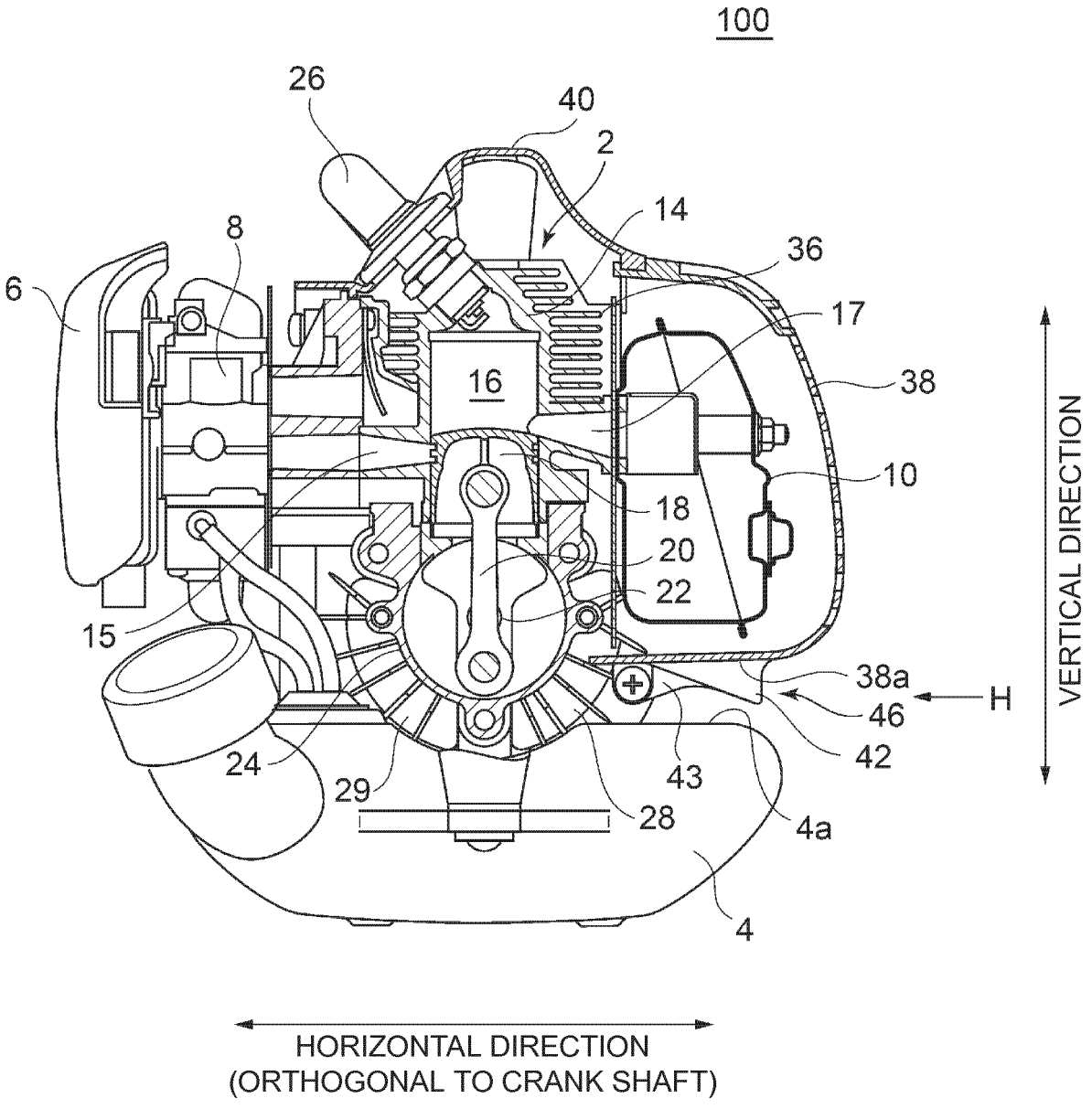

100
26
40
2
14
8
36
6
17
16
38
10
18
20
22
15
38a
H
46
42
24
29
43
28
4a
4
VERTICAL DIRECTION
HORIZONTAL DIRECTION
(ORTHOGONAL TO CRANK SHAFT)

FIG. 5

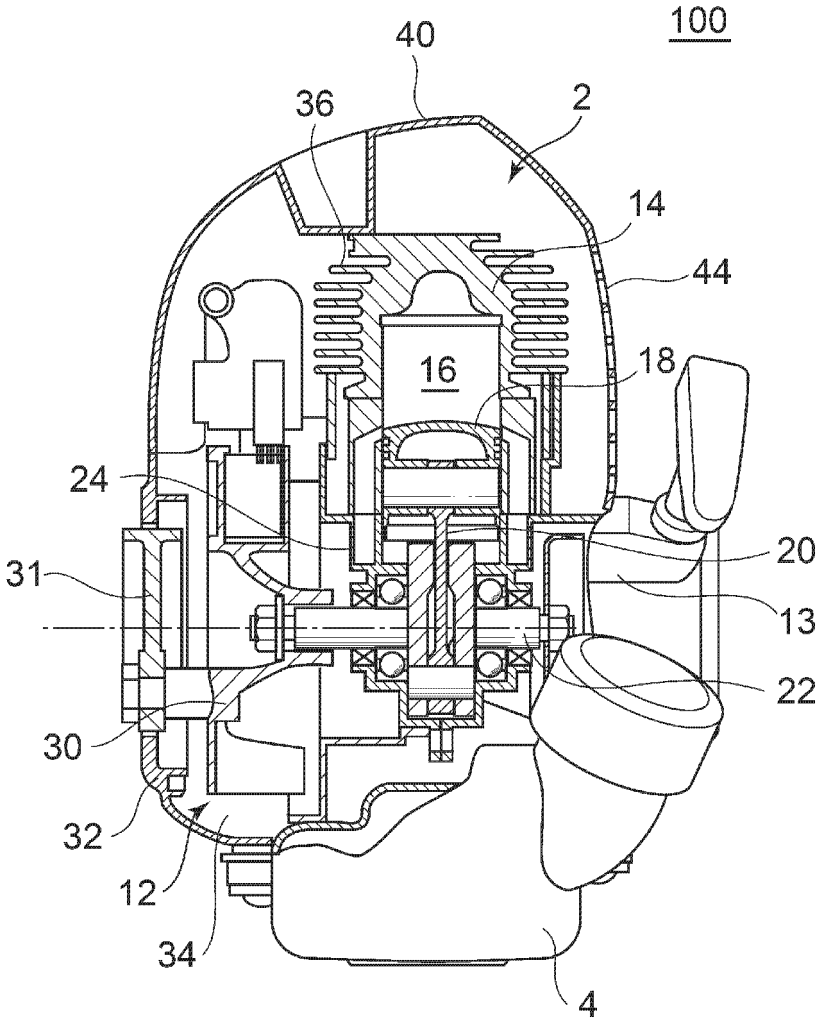


FIG. 6

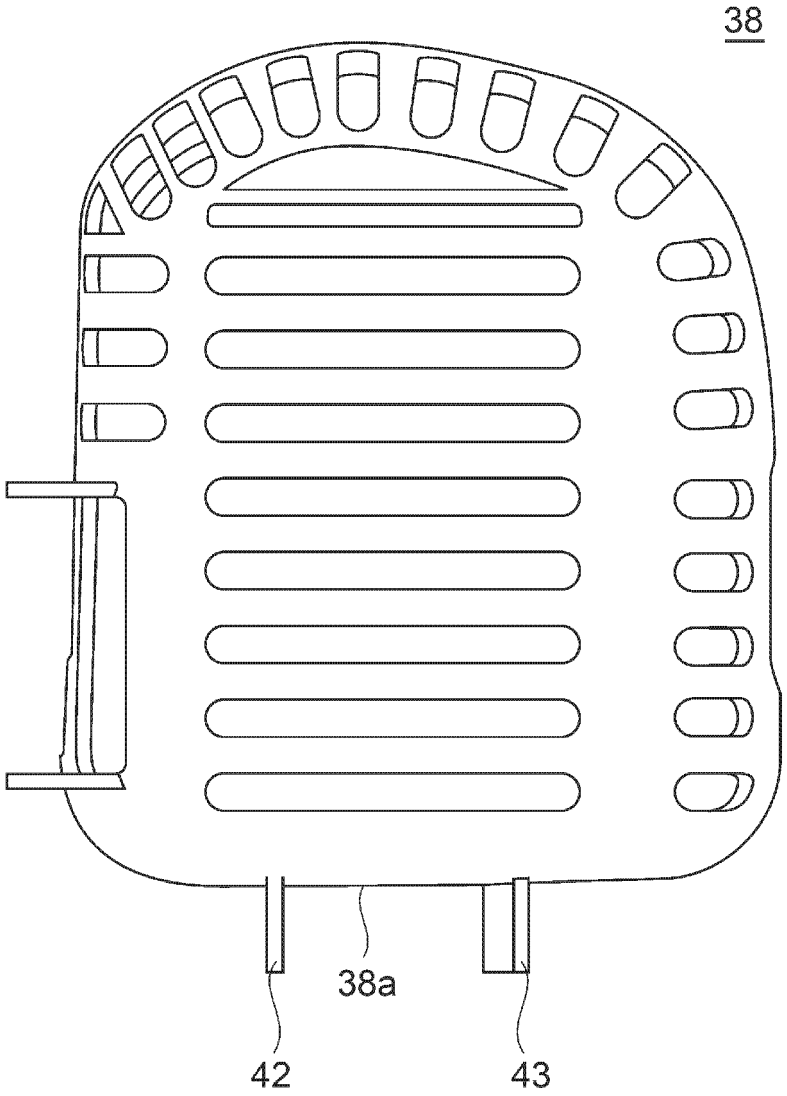


FIG. 7

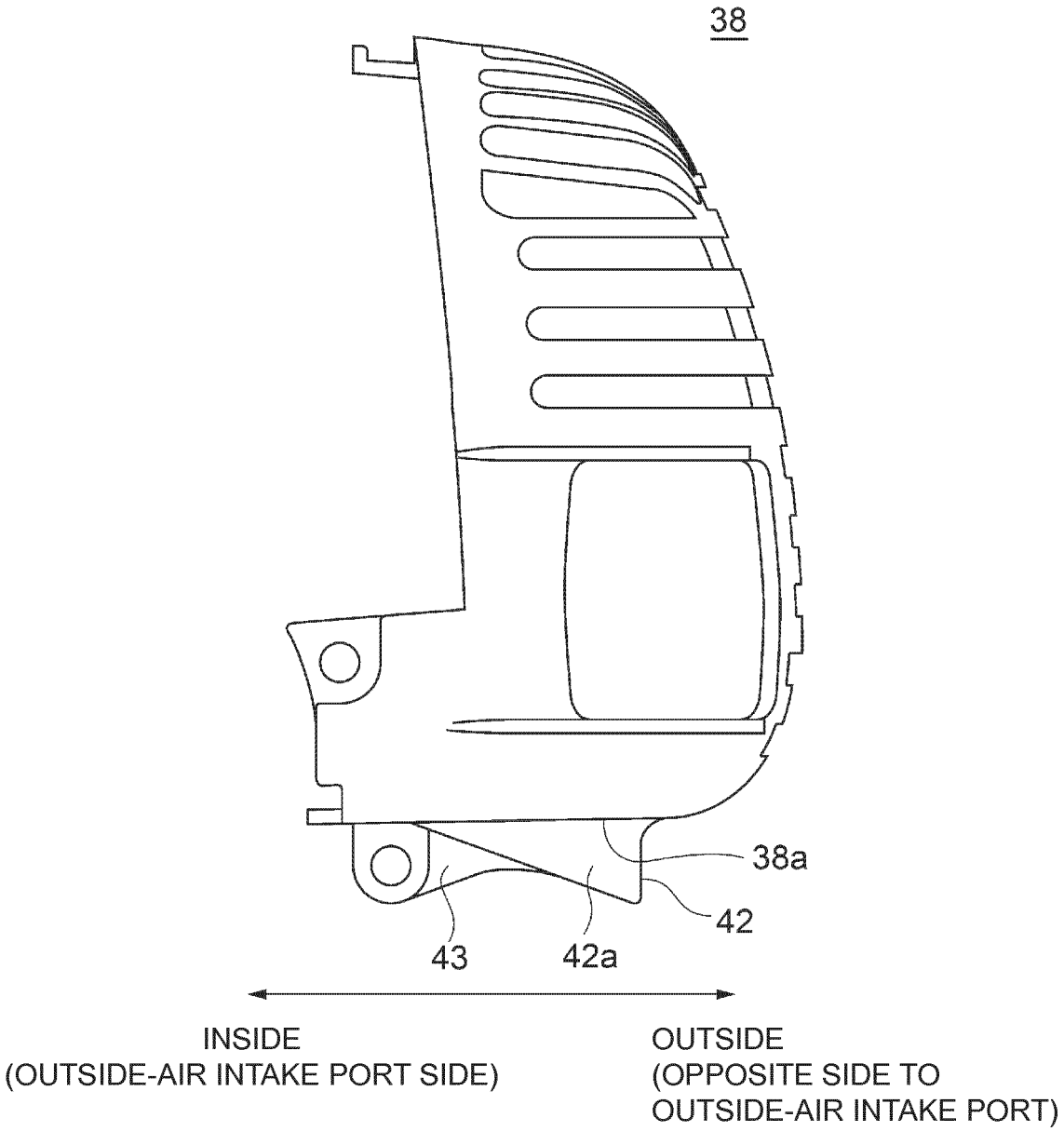

38
38a
42
43
42a
INSIDE
(OUTSIDE-AIR INTAKE PORT SIDE)
OUTSIDE
(OPPOSITE SIDE TO
OUTSIDE-AIR INTAKE PORT)

FIG. 8

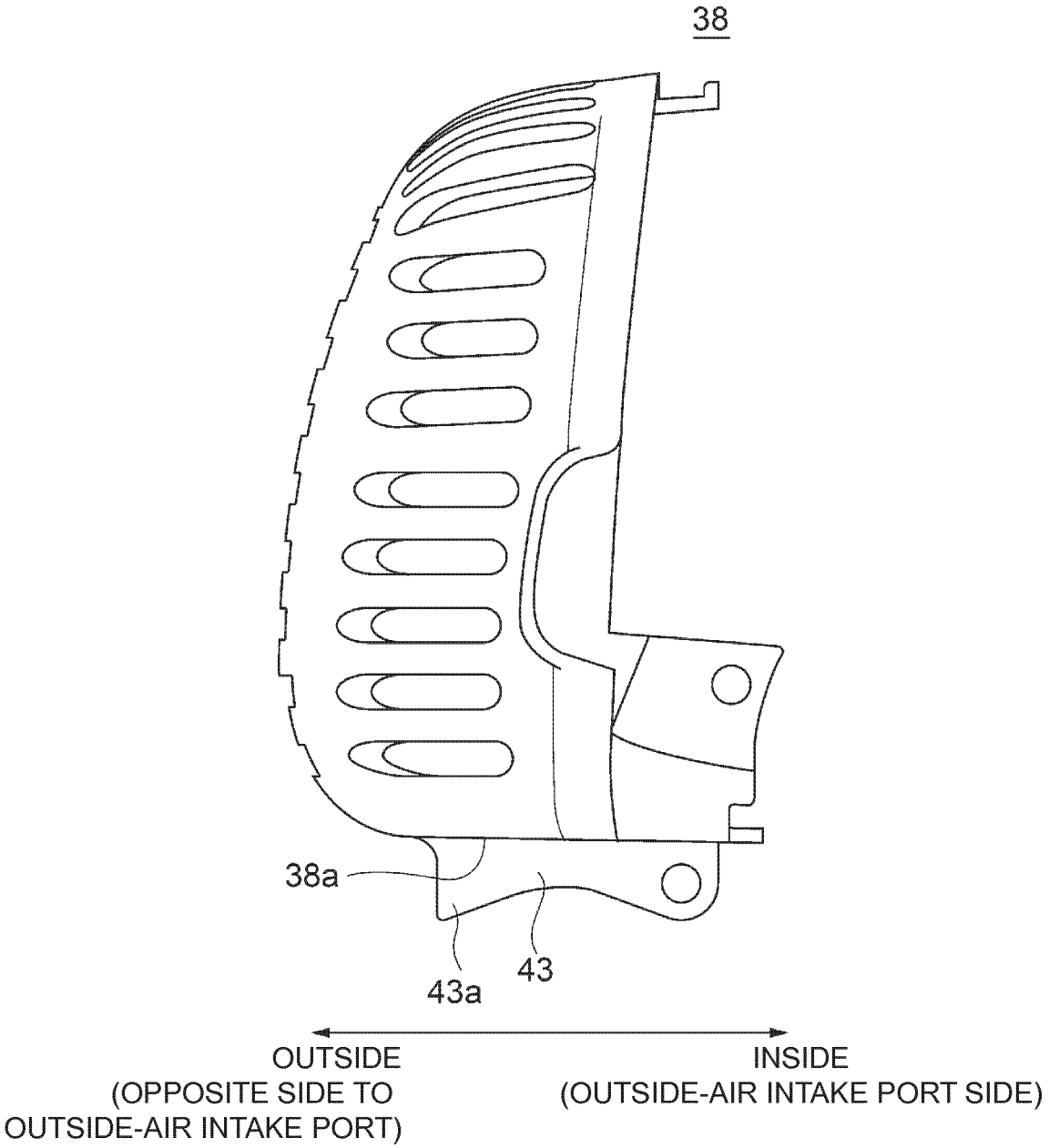

38
38a
43a
43
OUTSIDE
(OPPOSITE SIDE TO
OUTSIDE-AIR INTAKE PORT)
INSIDE
(OUTSIDE-AIR INTAKE PORT SIDE)

FIG. 9

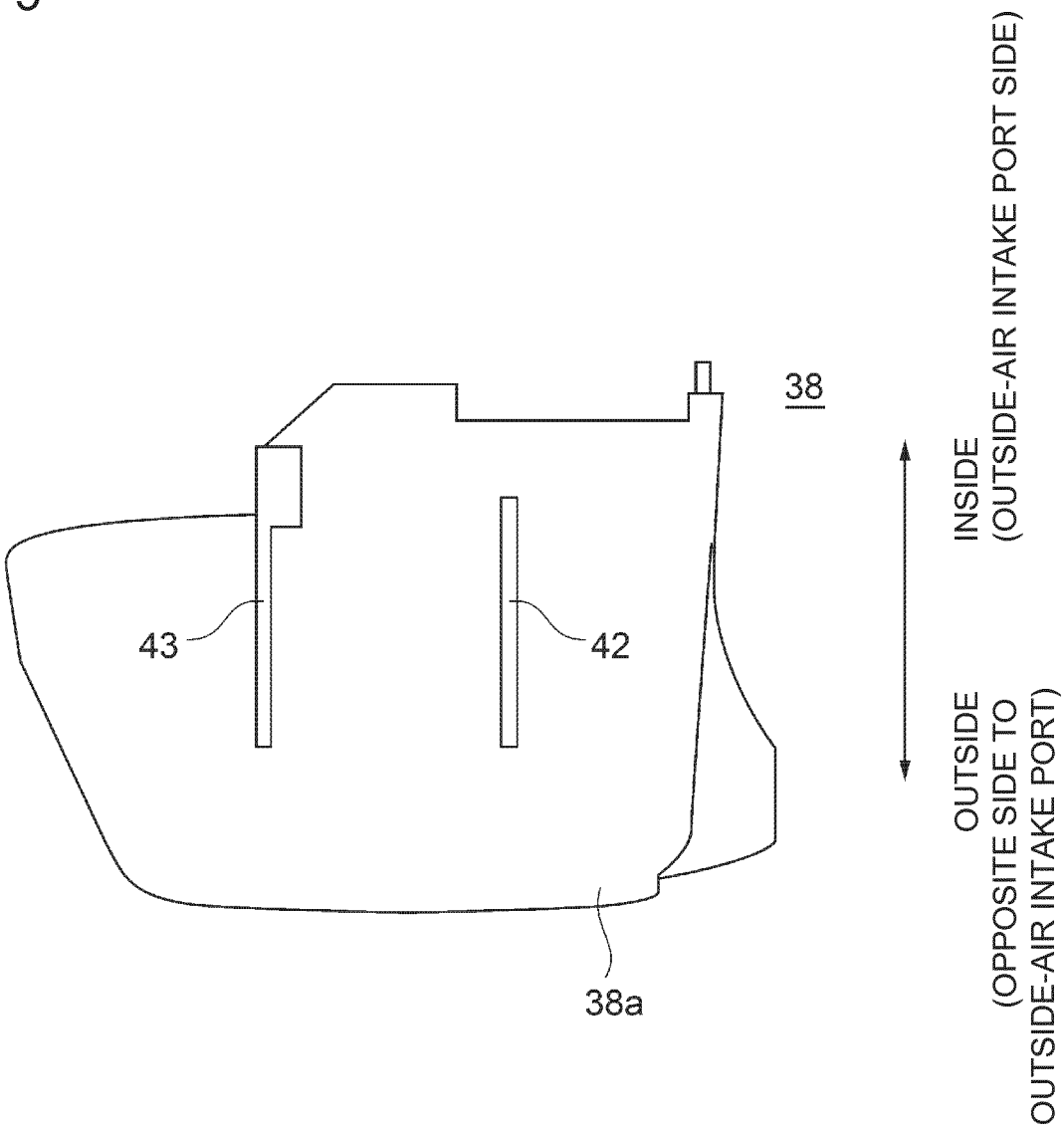

38
43
42
38a
INSIDE
(OUTSIDE-AIR INTAKE PORT SIDE)
OUTSIDE
(OPPOSITE SIDE TO
OUTSIDE-AIR INTAKE PORT)

FIG. 10

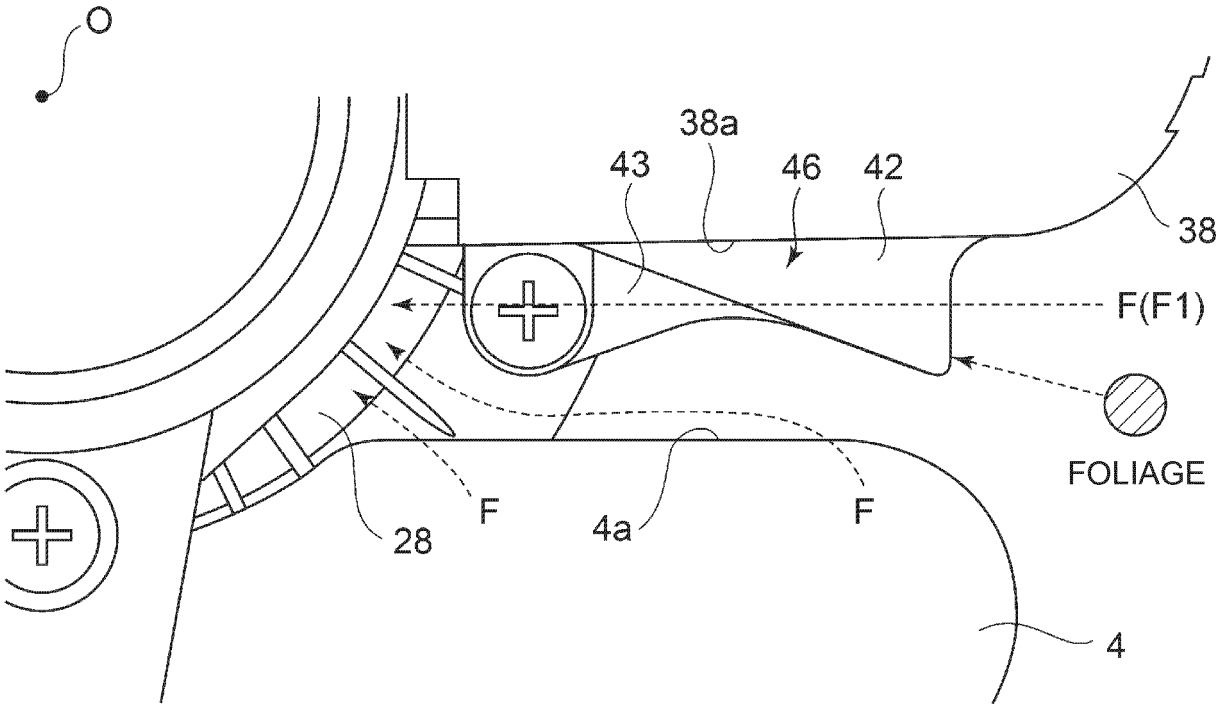


FIG. 11

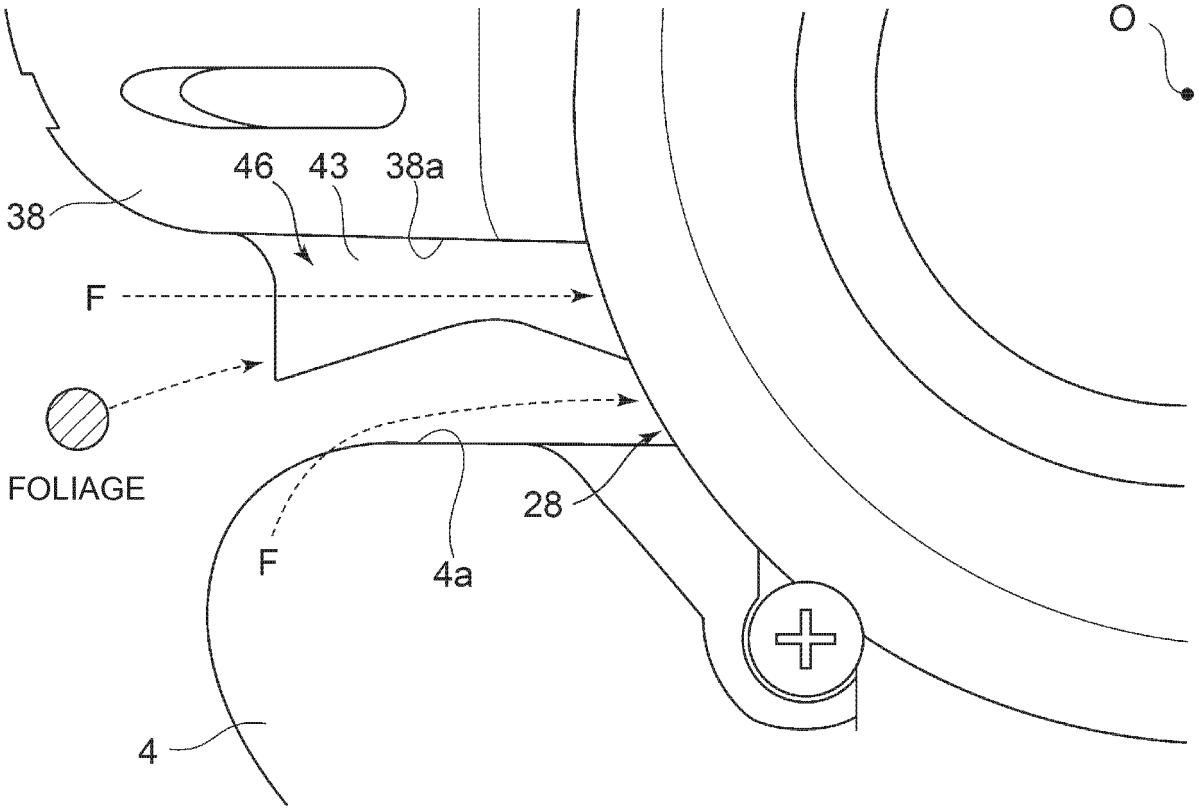


FIG. 12

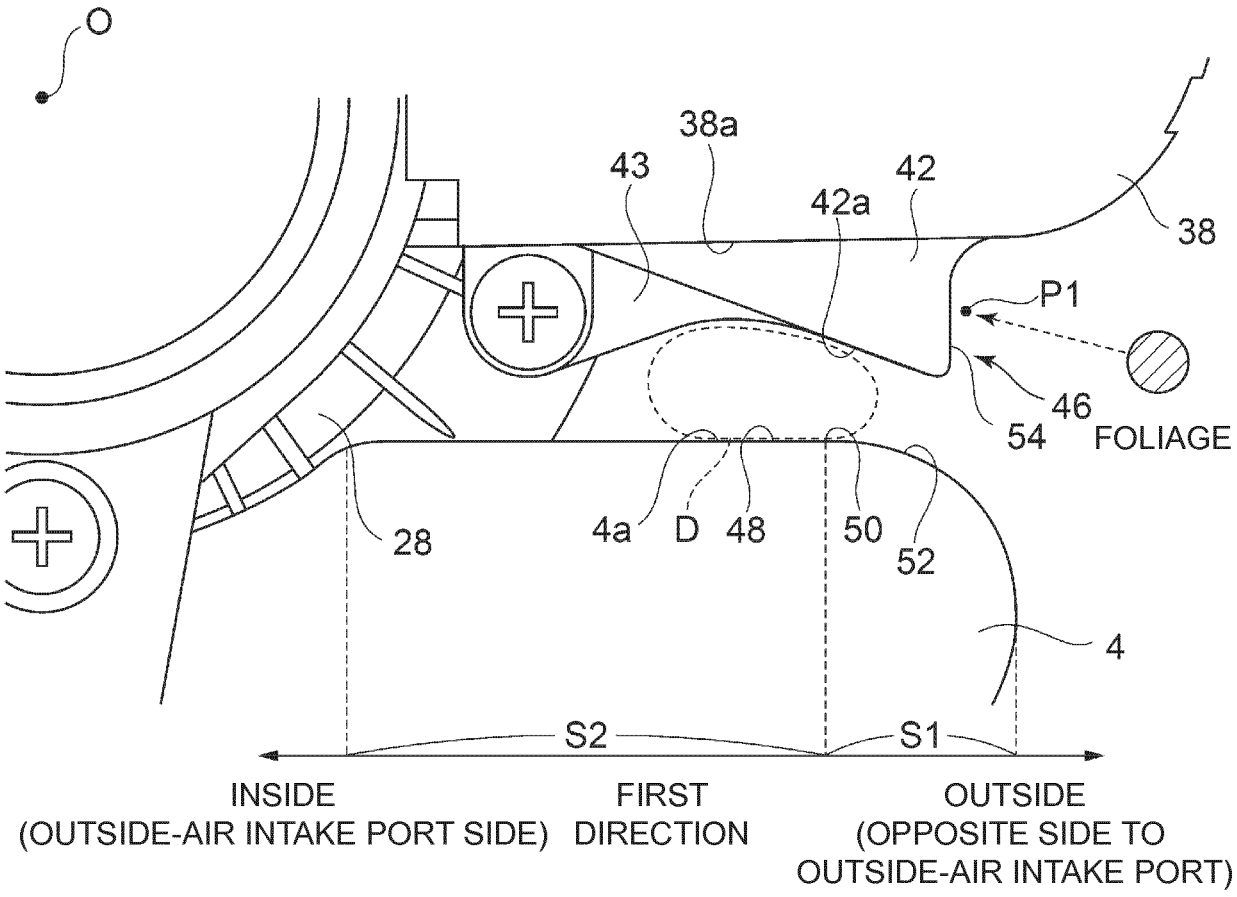

O
38a
43
42
42a
38
P1
46
54
FOLIAGE
28
4a
D
48
50
52
4
S2
S1
INSIDE
(OUTSIDE-AIR INTAKE PORT SIDE)
FIRST
DIRECTION
OUTSIDE
(OPPOSITE SIDE TO
OUTSIDE-AIR INTAKE PORT)

FIG. 13

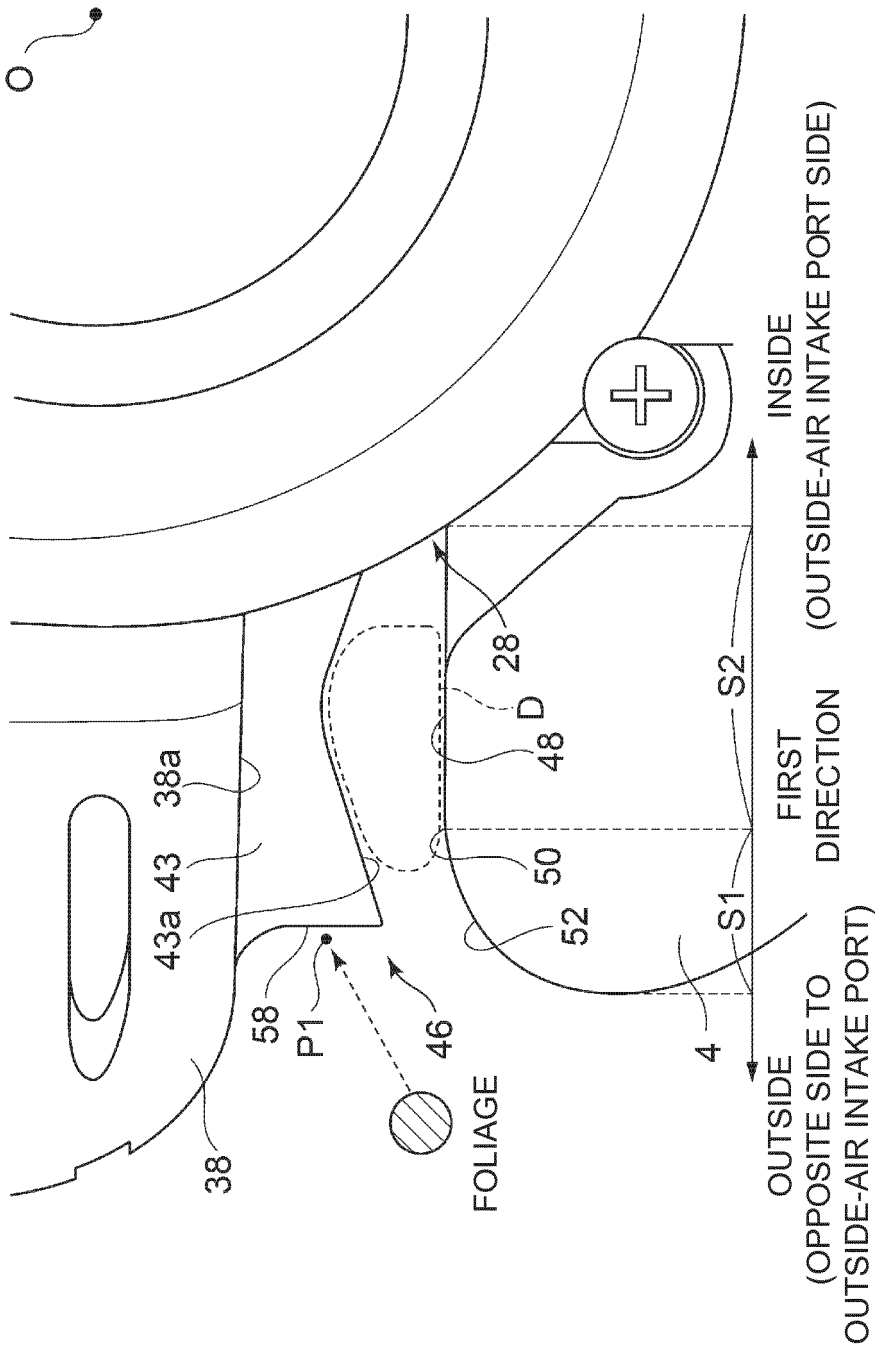

O
38
38a
43
43a
58
P1
46
FOLIAGE
28
D
48
50
52
4
S1
S2
FIRST DIRECTION
OUTSIDE (OPPOSITE SIDE TO OUTSIDE-AIR INTAKE PORT)
INSIDE (OUTSIDE-AIR INTAKE PORT SIDE)

FIG. 14

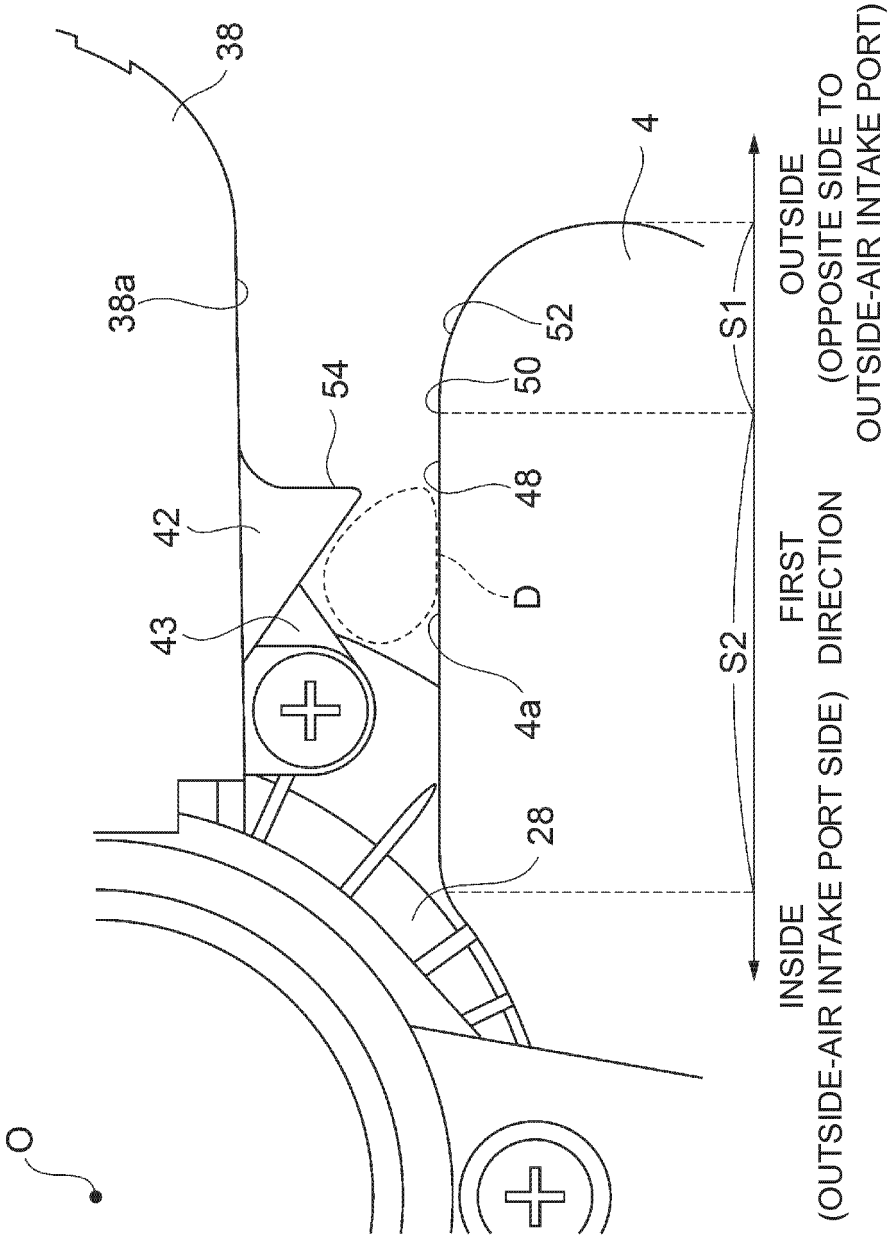

O
38
38a
54
42
43
4a
28
48
D
50
52
4
S1
S2
INSIDE
(OUTSIDE-AIR INTAKE PORT SIDE)
FIRST
DIRECTION
OUTSIDE
(OPPOSITE SIDE TO
OUTSIDE-AIR INTAKE PORT)

FIG. 15

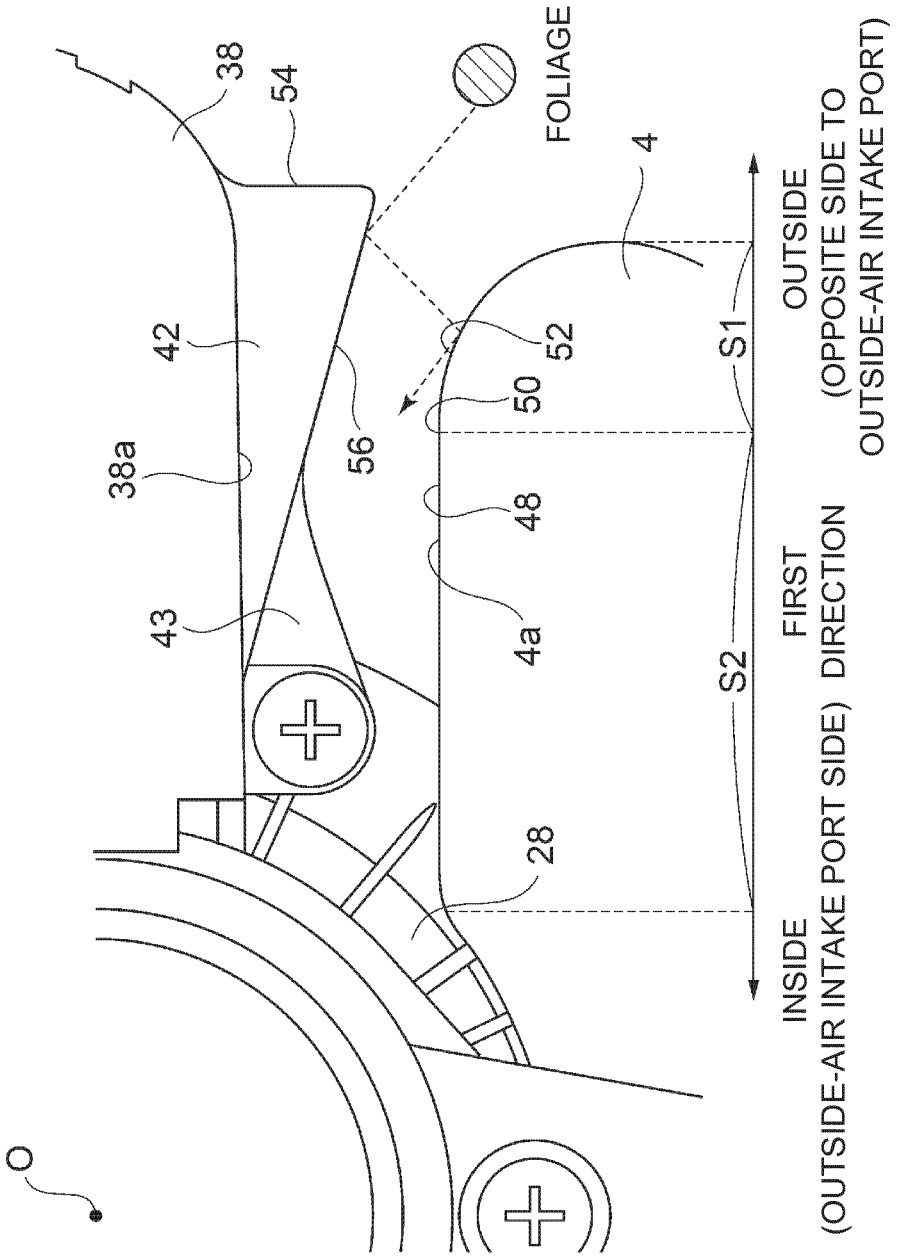

O
38
54
FOLIAGE
4
42
52
S1
OUTSIDE
(OPPOSITE SIDE TO
OUTSIDE-AIR INTAKE PORT)
38a
56
50
48
43
4a
S2
FIRST
DIRECTION
28
INSIDE
(OUTSIDE-AIR INTAKE PORT SIDE)

FIG. 16

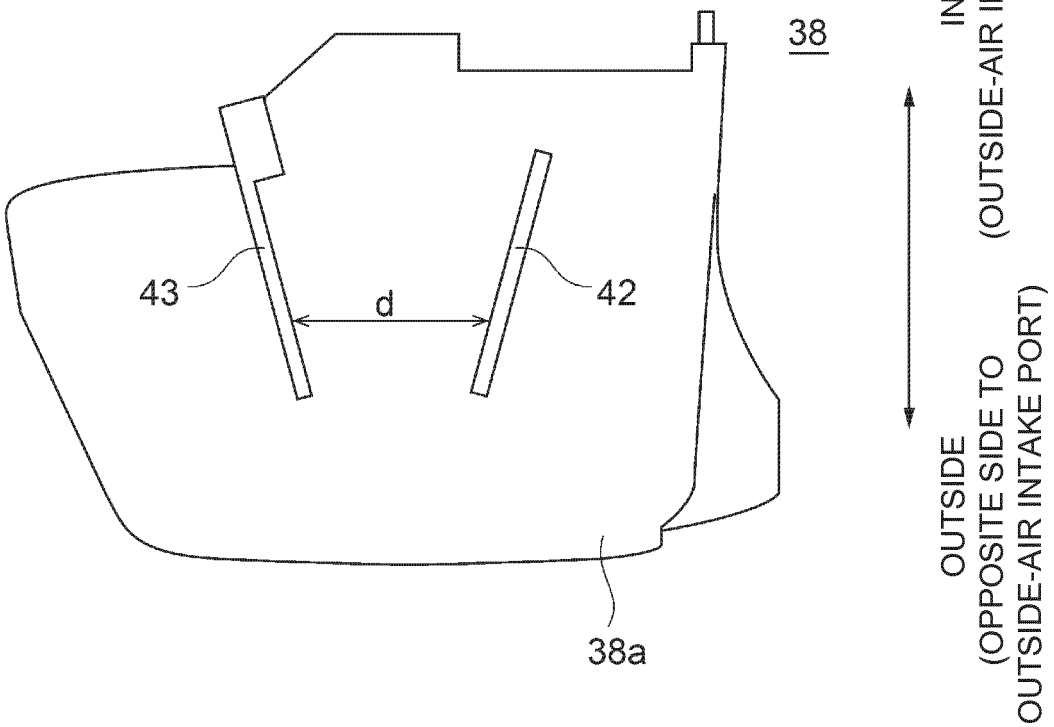

38
43
d
42
38a
INSIDE
(OUTSIDE-AIR INTAKE PORT SIDE)
OUTSIDE
(OPPOSITE SIDE TO
OUTSIDE-AIR INTAKE PORT)

FIG. 17

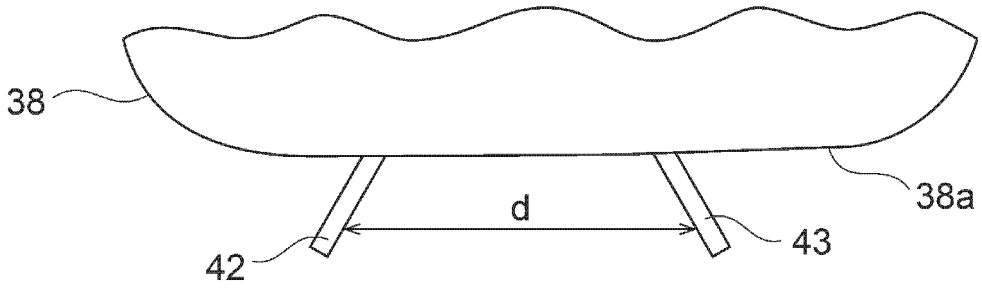


FIG. 18

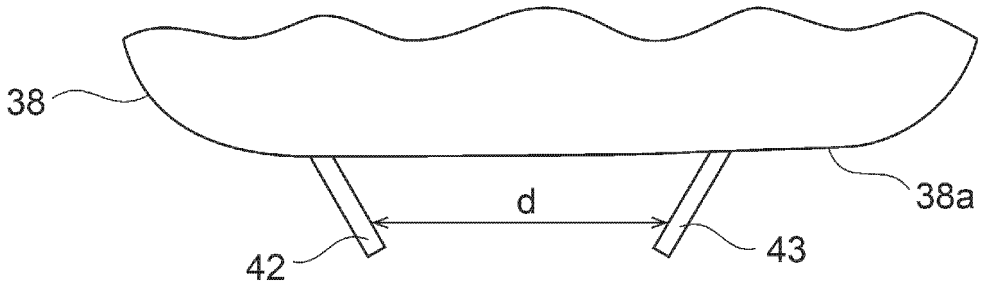


FIG. 19

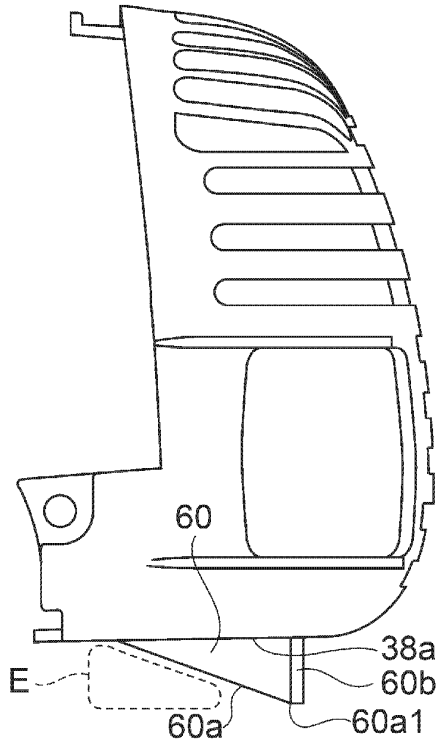

38
60
38a
60b
E
60a
60a1
INSIDE
(OUTSIDE-AIR INTAKE PORT SIDE)
OUTSIDE
(OPPOSITE SIDE TO
OUTSIDE-AIR INTAKE PORT)

FIG. 20

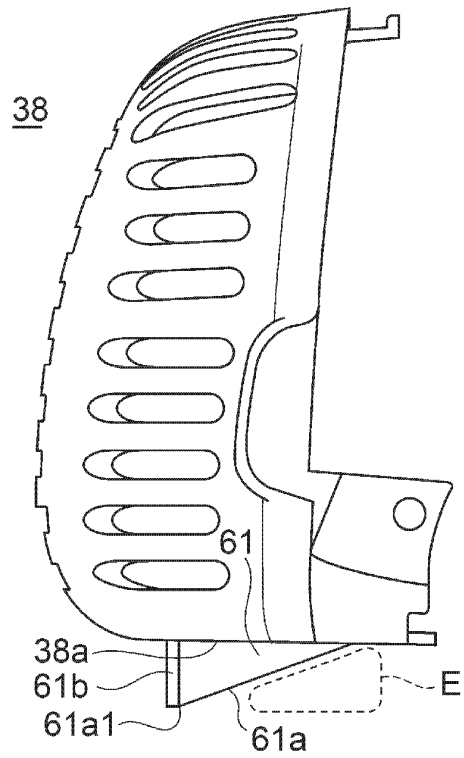

38
61
38a
61b
61a1
E
61a
OUTSIDE
(OPPOSITE SIDE TO
OUTSIDE-AIR INTAKE PORT)
INSIDE
(OUTSIDE-AIR INTAKE PORT SIDE)

FIG. 21

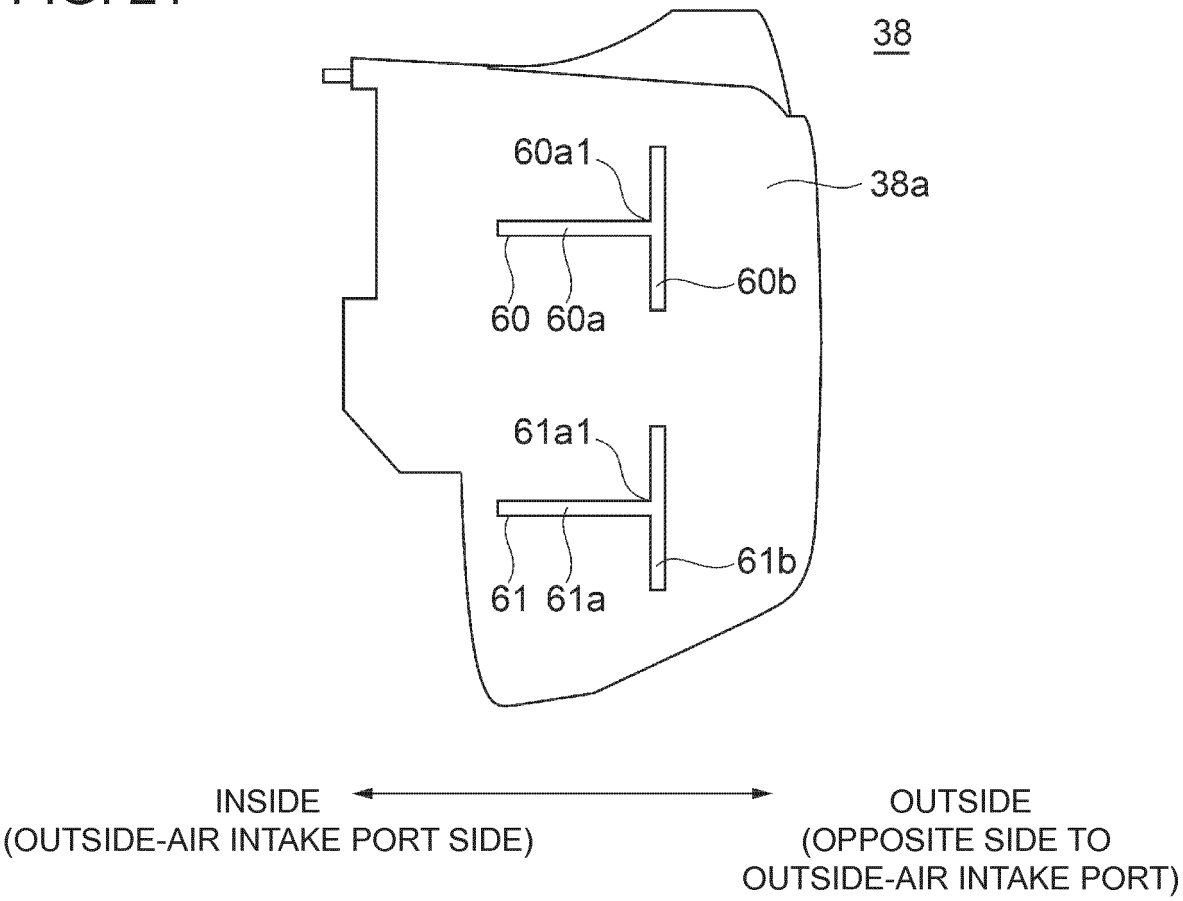

38
60a1
38a
60b
60
60a
61a1
61b
61
61a
INSIDE
(OUTSIDE-AIR INTAKE PORT SIDE)
OUTSIDE
(OPPOSITE SIDE TO
OUTSIDE-AIR INTAKE PORT)

FIG. 22

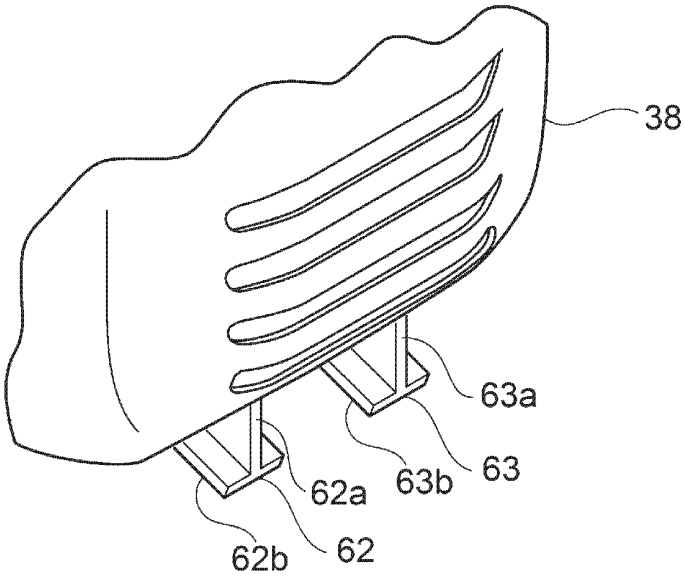
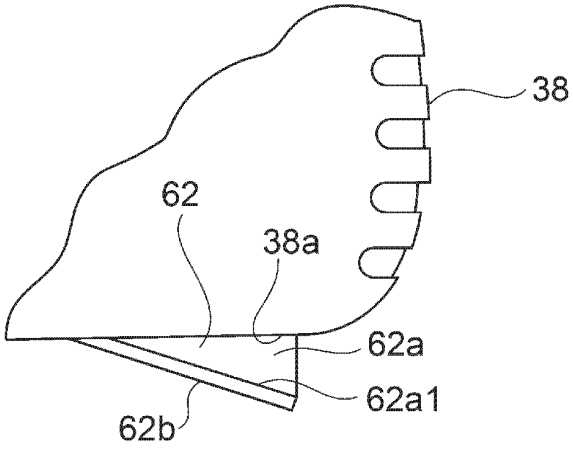


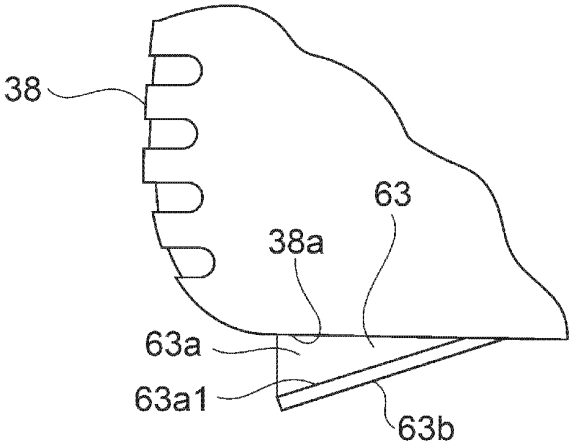
FIG. 23



INSIDE
(OUTSIDE-AIR INTAKE PORT SIDE)

OUTSIDE
(OPPOSITE SIDE TO
OUTSIDE-AIR INTAKE PORT)

FIG. 24



OUTSIDE
(OPPOSITE SIDE TO
OUTSIDE-AIR INTAKE PORT)

INSIDE
(OUTSIDE-AIR INTAKE PORT SIDE)

FIG. 25

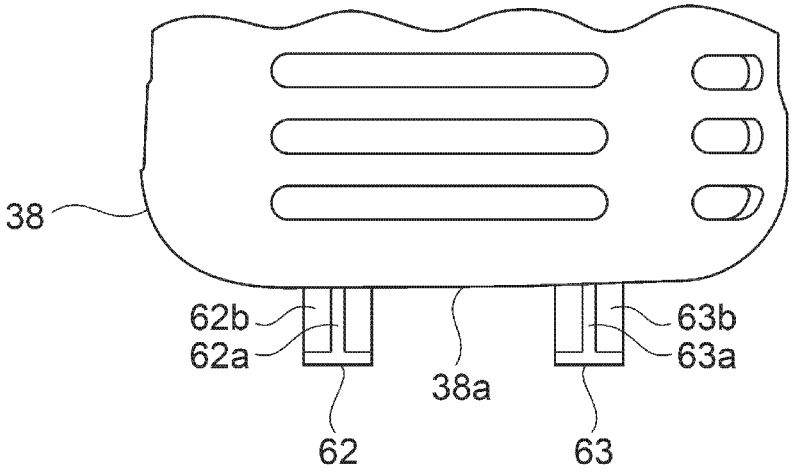
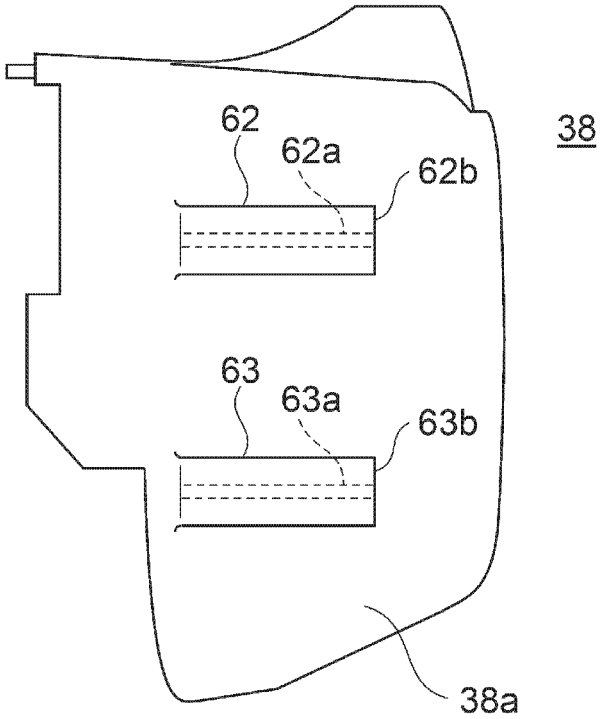


FIG. 26



INSIDE
(OUTSIDE-AIR INTAKE PORT SIDE)

OUTSIDE
(OPPOSITE SIDE TO
OUTSIDE-AIR INTAKE PORT)

FIG. 27

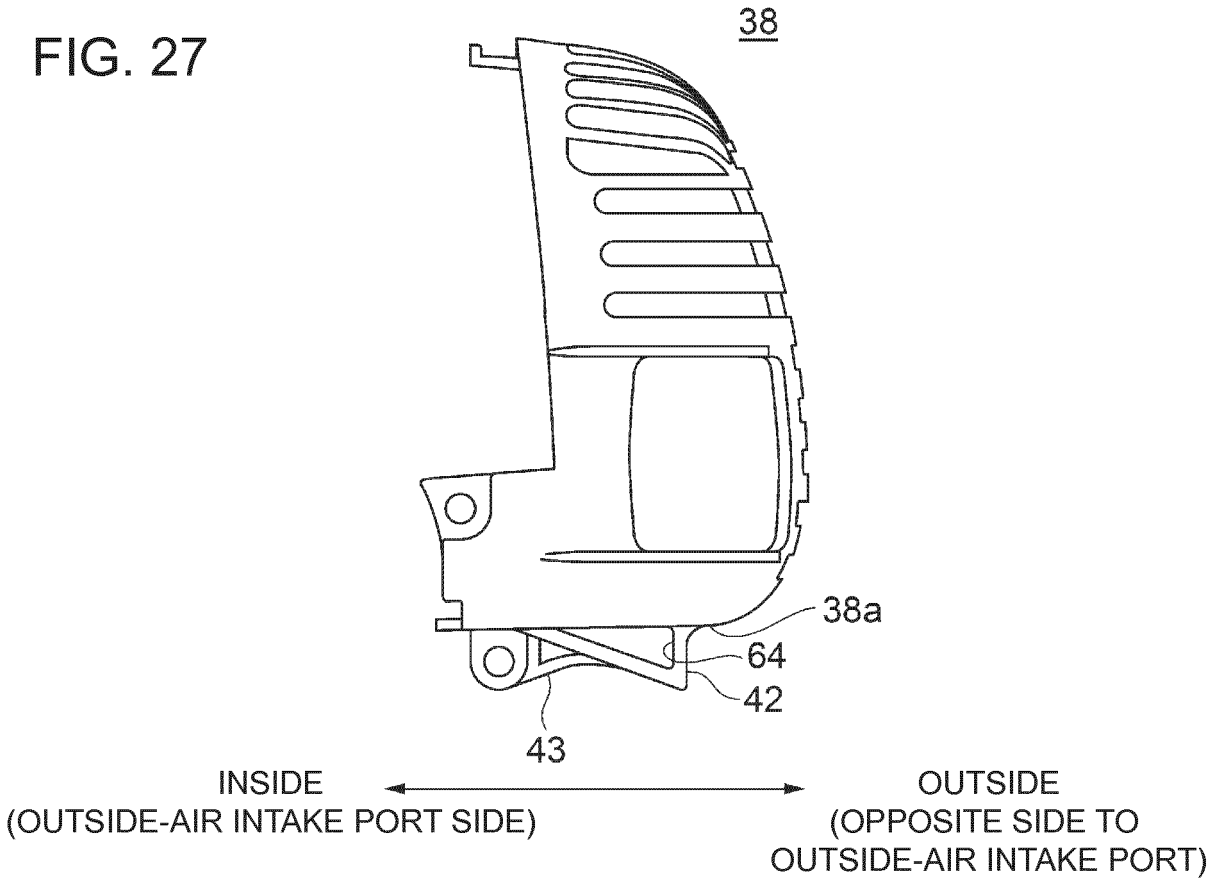
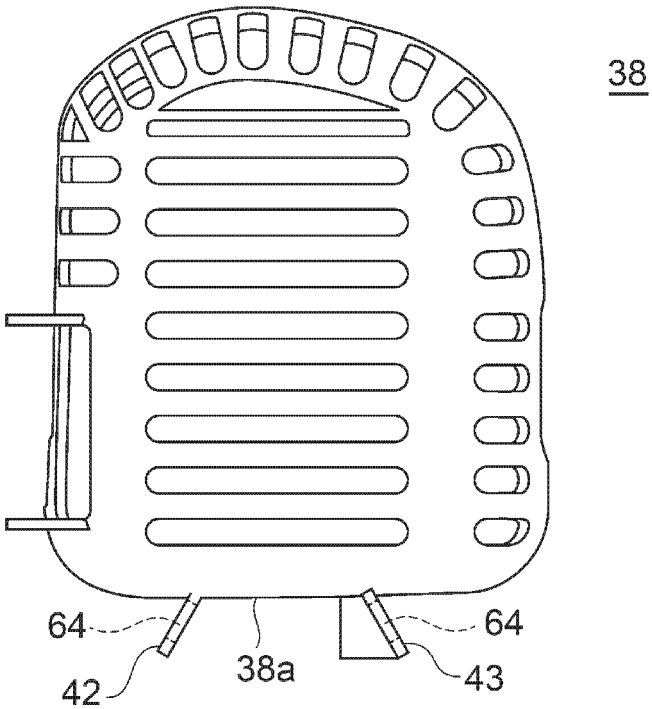

38
38a
64
42
43
INSIDE
(OUTSIDE-AIR INTAKE PORT SIDE)
OUTSIDE
(OPPOSITE SIDE TO
OUTSIDE-AIR INTAKE PORT)

FIG. 28


38
64
64
42
38a
43

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2016/068605

A. CLASSIFICATION OF SUBJECT MATTER
F01P5/06(2006.01)i, *F02M35/06*(2006.01)i, *F02B63/00*(2006.01)i, *F01N13/14*(2010.01)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)
F01P5/06, F02M35/06-35/10, F02B63/00-63/04, F01N13/14

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
Jitsuyo Shinan Koho 1922-1996 Jitsuyo Shinan Toroku Koho 1996-2016
Kokai Jitsuyo Shinan Koho 1971-2016 Toroku Jitsuyo Shinan Koho 1994-2016

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

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	Microfilm of the specification and drawings annexed to the request of Japanese Utility Model Application No. 44740/1982(Laid-open No. 148215/1983) (Komatsu Zenoah Co.), 05 October 1983 (05.10.1983), entire text; all drawings (Family: none)	1-10
A	JP 2000-328940 A (Honda Motor Co., Ltd.), 28 November 2000 (28.11.2000), abstract & EP 1054147 A2 abstract & US 6331740 B1 & CN 1274799 A	1-10

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

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Date of the actual completion of the international search	Date of mailing of the international search report
02 September 2016 (02.09.16)	13 September 2016 (13.09.16)
Name and mailing address of the ISA/ Japan Patent Office 3-4-3,Kasumigaseki,Chiyoda-ku, Tokyo 100-8915,Japan	Authorized officer Telephone No.

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INTERNATIONAL SEARCH REPORT

International application No.
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C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	Microfilm of the specification and drawings annexed to the request of Japanese Utility Model Application No. 125335/1983(Laid-open No. 32544/1985) (Honda Motor Co., Ltd.), 05 March 1985 (05.03.1985), claim 1 (Family: none)	1-10
A	JP 11-198663 A (Toyota Motor Corp.), 27 July 1999 (27.07.1999), abstract; all drawings (Family: none)	1-10
A	JP 2006-46270 A (Yanmar Co., Ltd.), 16 February 2006 (16.02.2006), abstract; all drawings & US 2008/0105220 A1 abstract; all drawings & WO 2006/008868 A1 & EP 1775442 A1 & KR 10-2007-0044020 A & CN 1989322 A	1-10

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REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP H521609 U **[0005]**
- JP S58148215 U **[0005]**