



(11)

EP 3 480 450 A1

(12)

EUROPEAN PATENT APPLICATION

(43) Date of publication:
08.05.2019 Bulletin 2019/19

(51) Int Cl.:
F02M 35/02 (2006.01)

(21) Application number: **18203644.2**

(22) Date of filing: **31.10.2018**

(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
Designated Validation States:
KH MA MD TN

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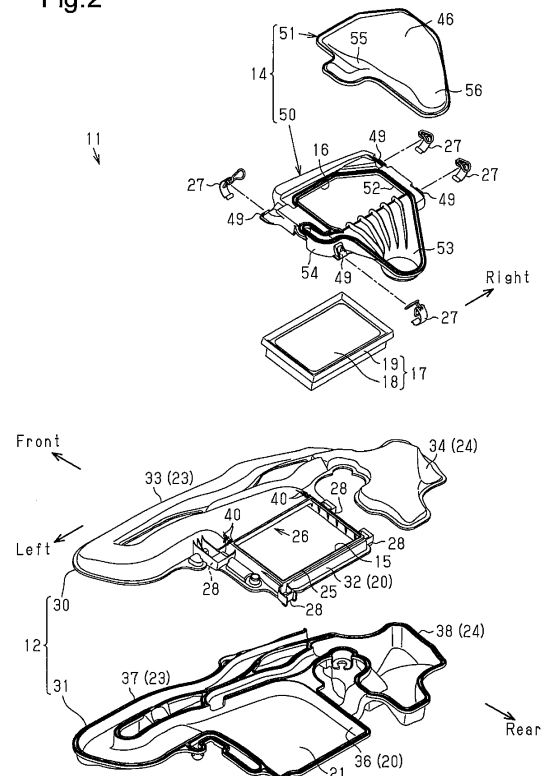
(30) Priority: **06.11.2017 JP 2017213848**

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(54) **AIR CLEANER**

(57) An air cleaner (11) includes a case (12), a cap (14), and a filter element (17). The case (12) includes a case body (22) and an inlet (23), wherein the case body (22) includes a case opening (15) and a case peripheral wall (20) surrounding the case opening (15), and the inlet (23) is connected to the case peripheral wall (20). The cap (14) includes an outlet (13) and a cap opening (16) that faces the case opening (15). The filter element (17) includes a filter (18) and an annular sealing portion (19) arranged on a circumferential edge of the filter (18), wherein the filter element (17) is arranged between the case opening (15) and the cap opening (16). The case (12) includes an annular sealing surface (25) disposed on a circumferential edge of the case opening (15) on an outer surface of the case body (22), wherein the sealing portion (19) of the filter element (17) contacts the sealing surface (25). The inlet (23) includes a connection portion (26) connected to the case body (22). The sealing surface (25) includes a part of an outer surface of the connection portion (26).

Fig.2



Description

BACKGROUND

[0001] The following description relates to an air cleaner arranged in the intake passage of an internal combustion engine.

[0002] Japanese Laid-Open Patent Publication No. 2016-121584 discloses an air cleaner of this type. Such an air cleaner includes a case with an inlet, a cap with an outlet, and a filter element. The filter element is positioned between a case opening of the case and a cap opening of the cap that faces the case opening. Intake air suctioned from the inlet is filtered through the filter element and is then supplied from the outlet to the internal combustion engine.

[0003] The air cleaner described above may be large, and space is limited since it is placed in a narrow space in the engine compartment of a vehicle.

SUMMARY

[0004] It is an object of the present invention to provide a downsized air cleaner.

[0005] Means to achieve the above object and its operational advantages will be described below.

[0006] An air cleaner to achieve the above object includes a case including a case body and an inlet, wherein the case body includes a case opening and a case peripheral wall surrounding the case opening, and the inlet is connected to the case peripheral wall; a cap including an outlet and a cap opening that faces the case opening; and a filter element including a filter and an annular sealing portion arranged on a circumferential edge of the filter, wherein the filter element is arranged between the case opening and the cap opening. The case includes an annular sealing surface disposed on a circumferential edge of the case opening on an outer surface of the case body, wherein the sealing portion of the filter element contacts the sealing surface. The inlet includes a connection portion connected to the case body. The sealing surface includes a part of an outer surface of the connection portion.

[0007] According to this configuration, a part of the outer surface of the connection portion in the inlet for the case body constitutes a part of the sealing surface, so that the height of the peripheral wall (case peripheral wall) of the case body is reduced. This provides a downsized air cleaner.

[0008] Other aspects and advantages of the embodiments will become apparent from the following description, taken in conjunction with the accompanying drawings, illustrating by way of example the principles of the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

[0009] The embodiments, together with objects and

advantages thereof, may best be understood by reference to the following description of the presently preferred embodiments together with the accompanying drawings in which:

Fig. 1 is a perspective view showing the general configuration of an air cleaner;

Fig. 2 is an exploded perspective view of the air cleaner shown in Fig. 1;

Fig. 3 is a cross-sectional view taken along line 3-3 of Fig. 1;

Fig. 4 is a perspective view showing a case in the embodiment seen from the front;

Fig. 5 is an enlarged view showing a main part of Fig. 4;

Fig. 6 is a perspective view showing a first case molding in the embodiment seen from the rear;

Fig. 7 is an enlarged view showing a main part of the first case molding of Fig. 6 seen from the front; and

Fig. 8 is an enlarged view showing the main part of the first case molding of Fig. 6 seen from the right side.

DETAILED DESCRIPTION

[0010] An air cleaner 11 according to embodiments will now be described with reference to the drawings. The air cleaner 11 is configured to serve as the air cleaner of an on-board internal combustion engine mounted in the engine compartment of a vehicle. In the following description, the front and the rear of the front and rear direction of the vehicle will be simply referred to as "the front" and "the rear," and the right side and the left side when the vehicle is seen from behind will be simply referred to as "the right side" and "the left side."

[0011] As shown in Figs. 1 to 3, the air cleaner 11 includes a case 12, a cap 14, and a filter element 17. The case 12 has a case opening 15, which is formed on the upper portion of the case 12 and has a rectangular shape in a plan view. The cap 14 has an outlet 13 and a cap opening 16, which is formed on the lower portion of the cap 14 and has a rectangular shape that faces the case opening 15. The filter element 17 is arranged between the case opening 15 and the cap opening 16.

[0012] The filter element 17 includes a rectangular filter 18 and a rectangular loop-shaped sealing portion 19 arranged on the circumferential edge of the filter 18. The filter 18 is formed by folding a filter material sheet such as nonwoven fabric or filter paper. The sealing portion 19 is formed by an elastic member such as closed-cell polyurethane.

[0013] The case 12 includes a flat case body 22, an inlet 23, and a resonator 24. The case body 22 includes the case opening 15, a case peripheral wall 20 surrounding the case opening 15, and a bottom wall 21. The inlet 23 is connected to the case peripheral wall 20. The resonator 24 is connected to an intermediate position of the inlet 23. The inlet 23, as shown in Fig. 1, has a portion

that acts as an intake duct that forms an intake passage. The resonator 24 is integrally formed with the inlet 23.

[0014] As shown in Figs. 3 and 4, a rectangular loop-shaped sealing surface 25 is formed on the entire circumferential edge of the case opening 15 on the upper surface (outer surface) of the case body 22. The sealing portion 19 of the filter element 17 is brought into contact with the sealing surface 25. The inlet 23 has a connection portion 26 connected to the case body 22. In this case, the sealing surface 25 includes a part of the outer surface of the connection portion 26 in the inlet 23. That is, the part of the outer surface of the connection portion 26 in the inlet 23 constitutes a part of the sealing surface 25. Specifically, the part of the outer surface of the connection portion 26 in the inlet 23 constitutes a long side of the sealing surface 25 on the front.

[0015] Four latches 28, with which clamps 27 (see Figs. 1 and 2) for fastening the case 12 and the cap 14 are engaged, are arranged on positions that correspond to the corners of the case body 22.

[0016] The connection portion 26 of the inlet 23 is connected to the front surface of the case peripheral wall 20. In other words, the connection portion 26 is connected to a portion of the case peripheral wall 20 that corresponds to the front surface of the case body 22. That is, the connection portion 26 is connected, in the entire width of the case opening 15, to a portion of the case peripheral wall 20 that corresponds to one of the long sides of the case opening 15. The circumferential edge of the inlet 23 extends from the connection portion 26 toward the left side in the vehicle width direction, and then makes a U-turn and extends toward the right side.

[0017] As shown in Figs. 2 and 4, the case 12 is separately formed by a first case molding 30 and a second case molding 31 placed beneath the first case molding 30. The first case molding 30 and the second case molding 31 may be made of a rigid synthetic plastic, but is not limited thereto.

[0018] The first case molding 30 includes a first case peripheral wall 32 surrounding the case opening 15, a first inlet half 33, which has a shape of a half tube and extends from the first case peripheral wall 32, and a first resonator half 34, which has a shape of a half tube and extends from the first inlet half 33.

[0019] The second case molding 31 includes the bottom wall 21, a second case peripheral wall 36 extending from the bottom wall 21, a second inlet half 37, which has a shape of a half tube and extends from the second case peripheral wall 36, and a second resonator half 38 that has a shape of a half tube and extends from the second inlet half 37. The edge of the first case molding 30 and the edge of the second case molding 31 are joined together by vibration welding, for example, to form the case 12.

[0020] Specifically, the edge of the first case peripheral wall 32 and the edge of the second case peripheral wall 36 are joined together to form the case body 22. Further, the edge of the first inlet half 33 and the edge of the

second inlet half 37 are joined together to form the inlet 23. Further, the edge of the first resonator half 34 and the edge of the second resonator half 38 are joined together to form the Helmholtz resonator 24.

[0021] As shown in Figs. 4 and 5, outer ribs 40 are formed on the outer surface of the upper wall of the connection portion 26 of the inlet 23 (first inlet half 33). Specifically, the outer surface of the upper wall of the connection portion 26 includes a portion that constitutes a part of the sealing surface 25, and a pair of outer ribs 40 is formed on both sides of that portion in the extension direction. As shown in Figs. 4 and 5, the extension direction corresponds to the right and left direction serving as the vehicle width direction. The outer ribs 40 extend in the right and left direction. The outer ribs 40 of each pair are arranged such that the outer ribs 40 are slightly spaced apart in the front and rear direction. In this case, the outer ribs 40 of each pair are arranged on the corner of one of the right and left ends of the connection portion 26 such that the outer ribs 40 reach the upper surface and the corresponding side surface of the outer surface of the connection portion 26.

[0022] As shown in Figs. 4, 6, and 7, a lattice rib 41, serving as an example of an inner rib, is arranged on the inner surface positioned on the reverse side of the outer surface of the upper wall of the connection portion 26 of the inlet 23 (first inlet half 33). The lattice rib 41 is formed by arranging, in a lattice-like manner, plate-like first ribs 42 extending in a protruding direction of the connection portion 26 from the case body 22 and plate-like second ribs 43 extending in a direction orthogonal to (crossing) the protruding direction. As shown in Figs. 6 and 7, the protruding direction corresponds to the front direction and the direction orthogonal to (crossing) the front direction, which is the protruding direction, corresponds to the right and left direction. As shown in Fig. 7, the number of the first ribs 42 may be eleven and the number of the second ribs 43 may be three.

[0023] As shown in Figs. 7 and 8, the three second ribs 43 are arranged to be adjacent to the case opening 15. Specifically, these three second ribs 43 extend to the full width in the right and left direction of the upper wall of the connection portion 26 such that they are evenly spaced apart in parallel in the front and rear direction. Both ends of each second rib 43 in the right and left direction are curved to reach the inner surface of the upper wall and the inner surfaces of the right and left side walls of the connection portion 26.

[0024] The eleven first ribs 42 are arranged to the full width in the right and left direction of the upper wall of the connection portion 26 such that they are evenly spaced apart in parallel in the right and left direction. Each first rib 42 extends from the rearmost second rib 43 among the three second ribs 43 toward the front beyond the forwardmost second rib 43. Each first rib 42 has a streamlined portion in the front beyond the forwardmost second rib 43 among the three second ribs 43. That is, each first rib 42 has a rear portion that forms a lattice with

each second rib 43 and a streamlined front portion.

[0025] As shown in Figs. 1 and 3, the cap 14 includes a flat cap body 47 and the outlet 13 integrally formed with the flat cap body 47. The cap body 47 includes a cap peripheral wall 45 surrounding the cap opening 16 and a top wall 46. A flange 48 is formed on the entire circumferential edge of the cap opening 16. Four supports 49 for tiltably supporting the clamps 27 are arranged on positions that correspond to the corners of the cap body 47. The outlet 13 is connected to the rear surface of the cap peripheral wall 45 of the cap body 47 and protrudes to the rear. The end of the downstream side of the outlet 13 is directed downward.

[0026] As shown in Figs. 2 and 3, the cap 14 is separately formed by a first cap molding 50 and a second cap molding 51 placed on the first cap molding 50. The first cap molding 50 and the second cap molding 51 may be made of a rigid synthetic plastic, but are not limited thereto.

[0027] The first cap molding 50 includes a first cap peripheral wall 52 surrounding the cap opening 16 and a first outlet molding 53 extending toward the rear from the first cap peripheral wall 52. The first cap molding 50 includes an outer peripheral wall 54 for covering the outer surface of the cap body 47. The outer peripheral wall 54 has the supports 49.

[0028] As shown in Figs. 1 and 2, the second cap molding 51 includes the top wall 46 of the cap body 47, a second cap peripheral wall 55 extending from the top wall 46, and a second outlet molding 56 extending toward the rear from the second cap peripheral wall 55. The edge of the first cap molding 50 and the edge of the second cap molding 51 are joined together by vibration welding, for example, to form the cap 14.

[0029] Specifically, the edge of the first cap peripheral wall 52 and the edge of the second cap peripheral wall 55 are joined together to form the cap body 47. Further, the edge of the first outlet molding 53 and the edge of the second outlet molding 56 are joined together to form the outlet 13.

[0030] In addition, as shown in Fig. 3, the sealing surface 25 of the case body 22 and the flange 48 of the cap 14 pinch the sealing portion 19 of the filter element 17, so that the space between the flange 48 of the cap 14 and the sealing portion 19 of the filter element 17 is sealed.

[0031] An operation of the air cleaner 11 configured as described above will now be described.

[0032] In the air cleaner 11, the sealing surface 25 of the case body 22 includes a part of the outer surface of the connection portion 26 in the inlet 23 for the case body 22. Further, the connection portion 26 is connected, in the entire width of the case opening 15, to a portion of the case peripheral wall 20 that corresponds to one of the long sides of the case opening 15. Accordingly, the connection portion 26 has a flat shape, which is long in the right and left direction, and the height of the case peripheral wall 20 of the case body 22 is reduced, so that

the air cleaner 11 is reduced in size.

[0033] When the air cleaner 11 is mounted in the engine compartment of the vehicle, where the temperature becomes high due to the heat of the engine, the upper wall of the connection portion 26 having the flat shape, which is long in the right and left direction, is likely to experience creep deformation such that the upper wall sags downward. However, according to present embodiments, the connection portion 26 is reinforced on the inside and outside with the lattice rib 41 and the outer ribs 40. This effectively prevents the creep deformation of the connection portion 26. In addition, the lattice rib 41 is arranged on the inner surface of the connection portion 26 out of the main flow of intake air. This prevents an increase in the pressure loss of the intake air by the lattice rib 41.

[0034] The embodiments described in detail above may provide the following advantages.

(1) In the air cleaner 11, the sealing surface 25 of the case body 22 includes a part of the outer surface of the upper wall of the connection portion 26 in the inlet 23 for the case body 22. This reduces the height of the case peripheral wall 20 of the case body 22, so that the air cleaner 11 is reduced in size.

(2) In the air cleaner 11, the lattice rib 41 (inner rib) having a lattice-like shape is arranged on the inner surface of the upper wall of the connection portion 26. The lattice rib 41 includes the first ribs 42 extending in a protruding direction of the connection portion 26 from the case body 22 and the second ribs 43 extending in the direction orthogonal to the protruding direction. Normally, when a part of the outer surface of the upper wall of the connection portion 26 of the inlet 23 constitutes a part of the sealing surface 25, the strength of the portion constituting the sealing surface 25 of the connection portion 26 is less likely to be maintained. However, according to embodiments, the portion constituting the sealing surface 25 of the connection portion 26 is effectively reinforced with the lattice rib 41 arranged on the inner surface of the upper wall of the connection portion 26. This effectively prevents a reduction in the strength of the connection portion 26.

(3) In the air cleaner 11, the outer surface of the upper wall of the connection portion 26 includes a portion that constitutes a part of the sealing surface 25. The outer ribs 40 are formed on both sides of the portion in the extension direction of the portion, the portion constituting the part of the sealing surface 25. This effectively reinforces the connection portion 26 with the outer ribs 40.

(4) In the air cleaner 11, the case opening 15 of the case body 22 has a rectangular shape in a plan view. The inlet 23 is connected to a portion of the case peripheral wall 20 that corresponds to one of the long sides of the case opening 15. This may ensure an opening area of the inlet 23, so that even if the height

of the case peripheral wall 20 is reduced, a pressure loss of air flowing from the inlet 23 into the case body 22 is reduced.

Modifications

[0035] The present examples and embodiments are to be considered as illustrative and not restrictive, and the invention is not to be limited to the details given herein, but may be modified within the scope and equivalence of the appended claims.

[0036] The case opening 15 of the case body 22 may not necessarily have a rectangular shape in a plan view. That is, the case opening 15 may have a square shape in a plan view, for example.

[0037] The inlet 23 does not necessarily need to be connected to a portion of the case peripheral wall 20 that corresponds to one of the long sides of the case opening 15. That is, the inlet 23 may be connected to a portion of the case peripheral wall 20 that corresponds to one of the short sides of the case opening 15.

[0038] The connection portion 26 of the inlet 23 does not necessarily need to be connected, in the entire width of the case opening 15, to a portion that corresponds to one of the long sides of the case opening 15 in the case peripheral wall 20.

[0039] The number and the shape of the outer ribs 40 may be changed where necessary.

[0040] The outer ribs 40 may be omitted.

[0041] The inner rib does not necessarily need to be the lattice rib 41. That is, the inner rib may be configured by the first ribs 42 alone or the second ribs 43 alone.

[0042] In the lattice rib 41, the number and the shape of the first ribs 42 and the second ribs 43 may be changed according to use.

[0043] The lattice rib 41 (inner rib) may be omitted.

[0044] The air cleaner 11 does not necessarily need to be the air cleaner of an onboard internal combustion engine mounted in the engine compartment of a vehicle. That is, the air cleaner 11 may be employed for a device other than onboard internal combustion engines.

[0045] The present examples and embodiments are to be considered as illustrative and not restrictive, and the invention is not to be limited to the details given herein, but may be modified within the scope and equivalence of the appended claims.

[0046] An air cleaner (11) includes a case (12), a cap (14), and a filter element (17). The case (12) includes a case body (22) and an inlet (23), wherein the case body (22) includes a case opening (15) and a case peripheral wall (20) surrounding the case opening (15), and the inlet (23) is connected to the case peripheral wall (20). The cap (14) includes an outlet (13) and a cap opening (16) that faces the case opening (15). The filter element (17) includes a filter (18) and an annular sealing portion (19) arranged on a circumferential edge of the filter (18), wherein the filter element (17) is arranged between the case opening (15) and the cap opening (16). The case

(12) includes an annular sealing surface (25) disposed on a circumferential edge of the case opening (15) on an outer surface of the case body (22), wherein the sealing portion (19) of the filter element (17) contacts the sealing surface (25). The inlet (23) includes a connection portion (26) connected to the case body (22). The sealing surface (25) includes a part of an outer surface of the connection portion (26).

Claims

1. An air cleaner, comprising:

a case (12) including a case body (22) and an inlet (23), wherein the case body (22) includes a case opening (15) and a case peripheral wall (20) surrounding the case opening (15), and the inlet (23) is connected to the case peripheral wall (20);
a cap (14) including an outlet (13) and a cap opening (16) that faces the case opening (15); and
a filter element (17) including a filter (18) and an annular sealing portion (19) arranged on a circumferential edge of the filter (18), wherein the filter element (17) is arranged between the case opening (15) and the cap opening (16),
the air cleaner being **characterized in that** the case (12) includes an annular sealing surface (25) disposed on a circumferential edge of the case opening (15) on an outer surface of the case body (22), wherein the sealing portion (19) of the filter element (17) contacts the sealing surface (25),
the inlet (23) includes a connection portion (26) connected to the case body (22), and
the sealing surface (25) includes a part of an outer surface of the connection portion (26).

2. The air cleaner according to claim 1, **characterized in that** an inner rib (41) is arranged on an inner surface positioned on a reverse side of the outer surface of the connection portion (26).

3. The air cleaner according to claim 2, **characterized in that**

the inner rib is a lattice rib (41) having a lattice-like shape, and
the lattice rib (41) includes a plurality of first ribs (42) extending in a protruding direction of the connection portion (26) from the case body (22) and a plurality of second ribs (43) extending in a direction crossing the protruding direction.

4. The air cleaner according to any one of claims 1 to 3, **characterized in that** the outer surface of the connection portion (26) includes a portion that consti-

tutes a part of the sealing surface (25), wherein an outer rib (40) is formed on both sides of the portion in an extension direction of the portion, the portion constituting the part of the sealing surface (25).

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5. The air cleaner according to any one of claims 1 to 4, **characterized in that**

the case opening (15) has a rectangular shape in a plan view, and

the inlet (23) is connected to a portion of the case peripheral wall (20) that corresponds to one of long sides of the case opening (15).

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Fig.1

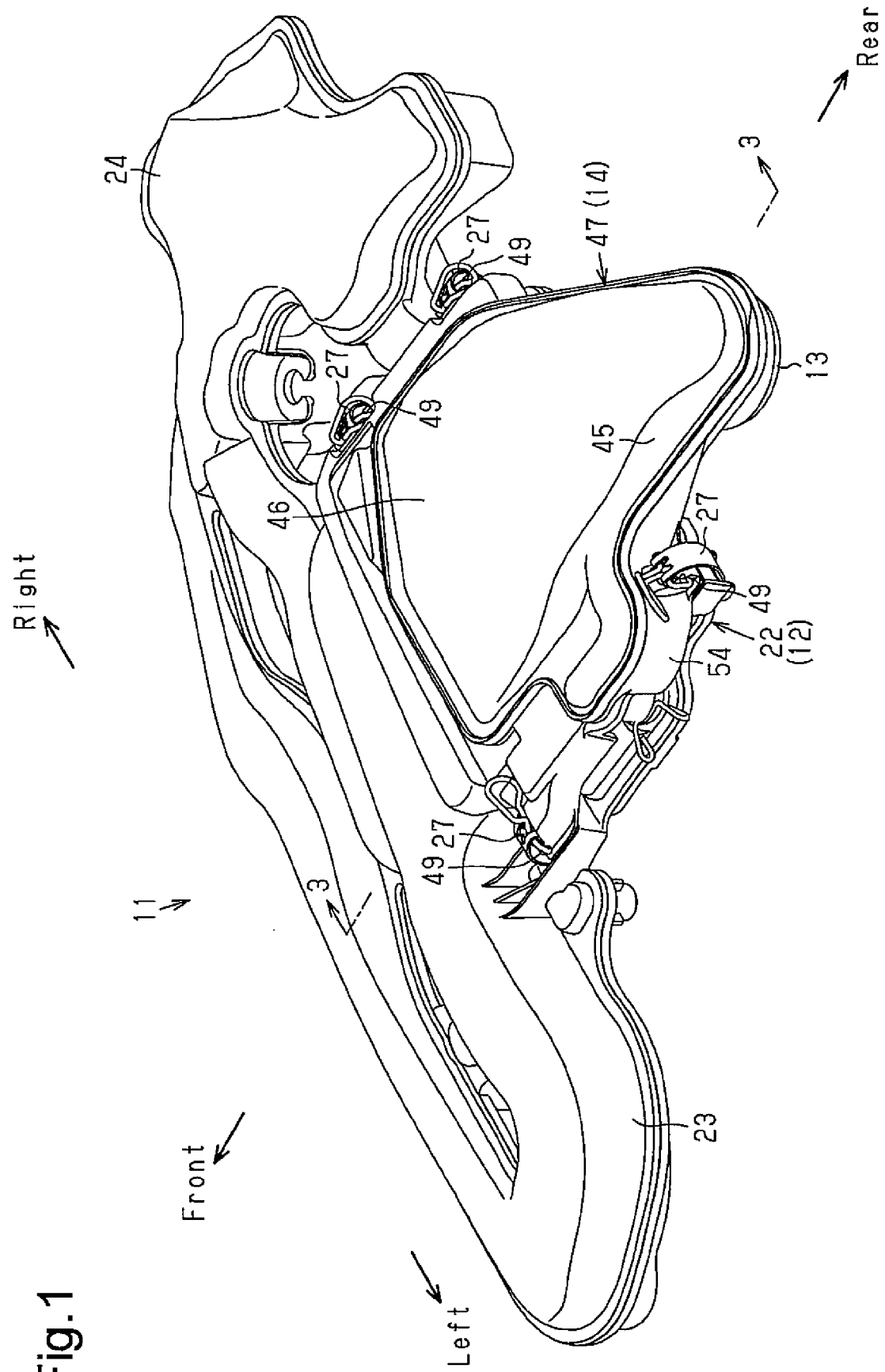
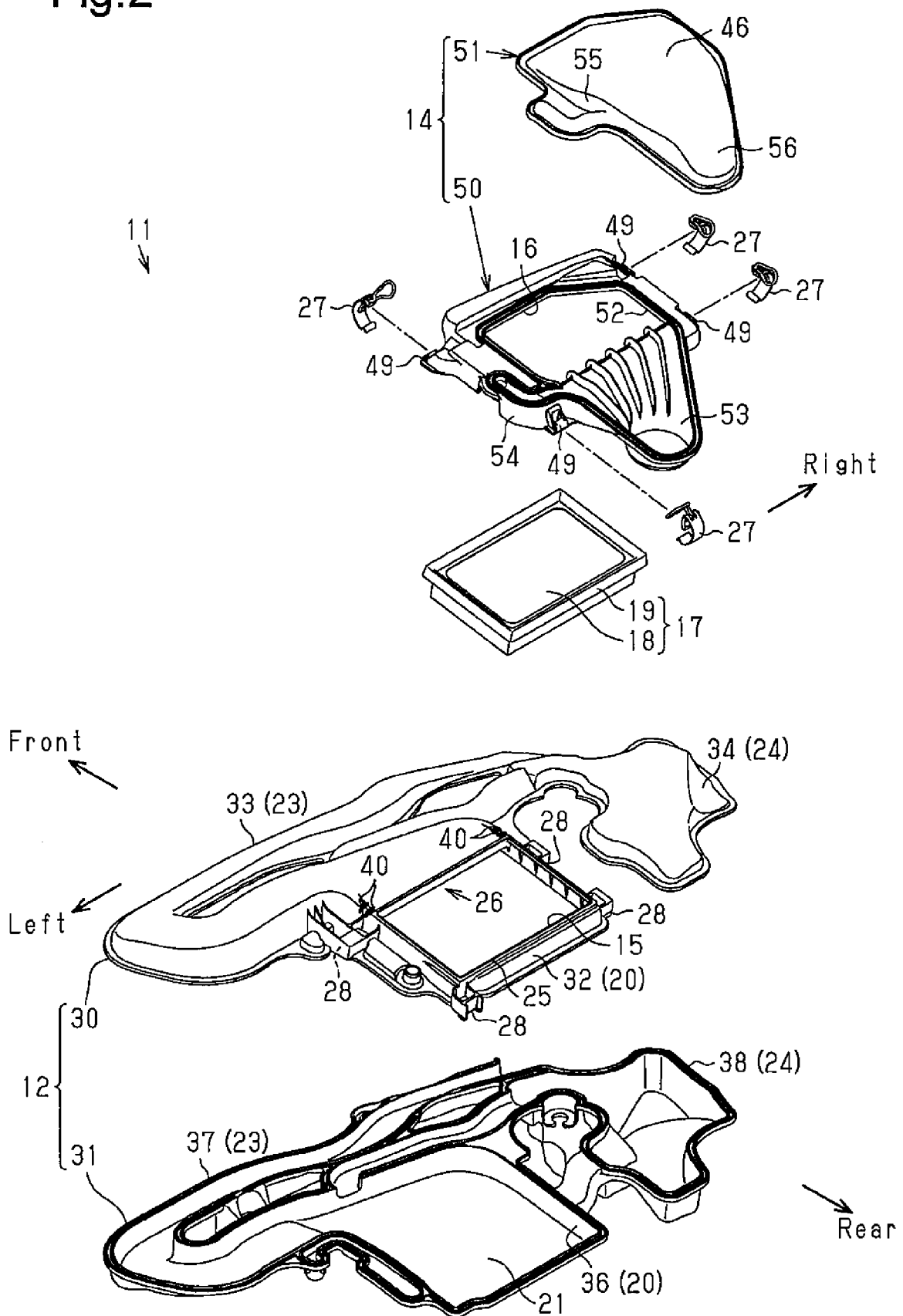


Fig.2



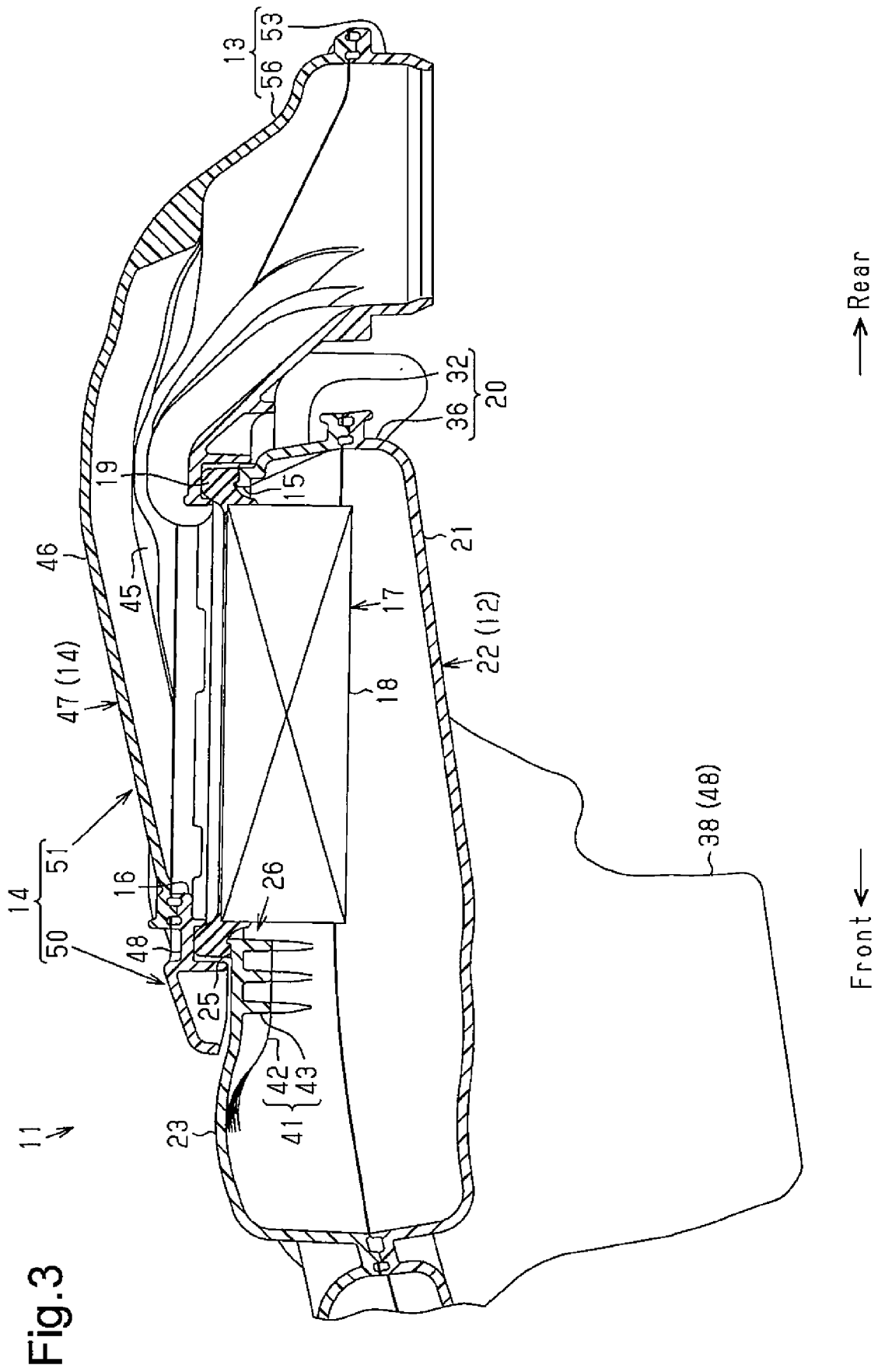
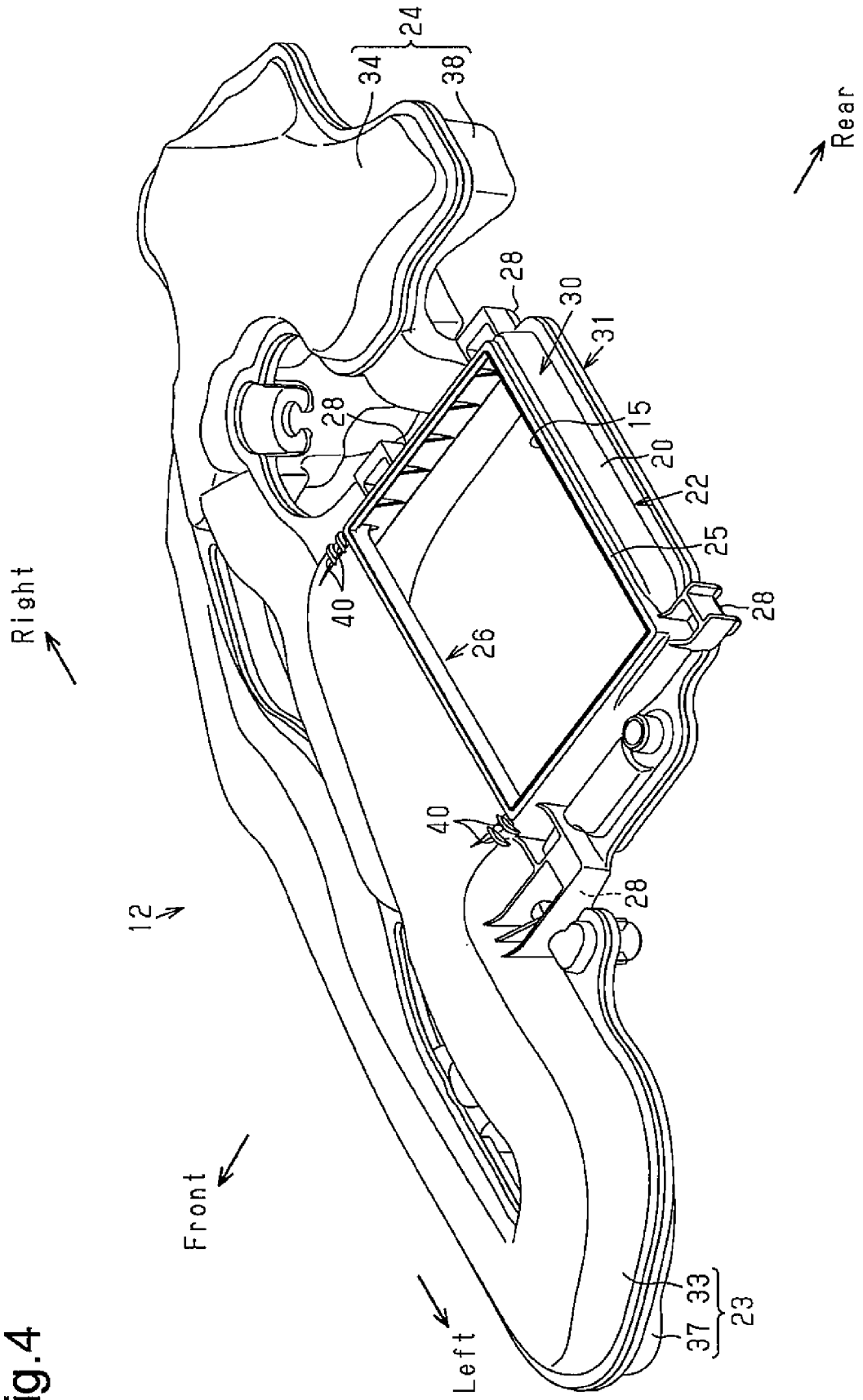


Fig.4



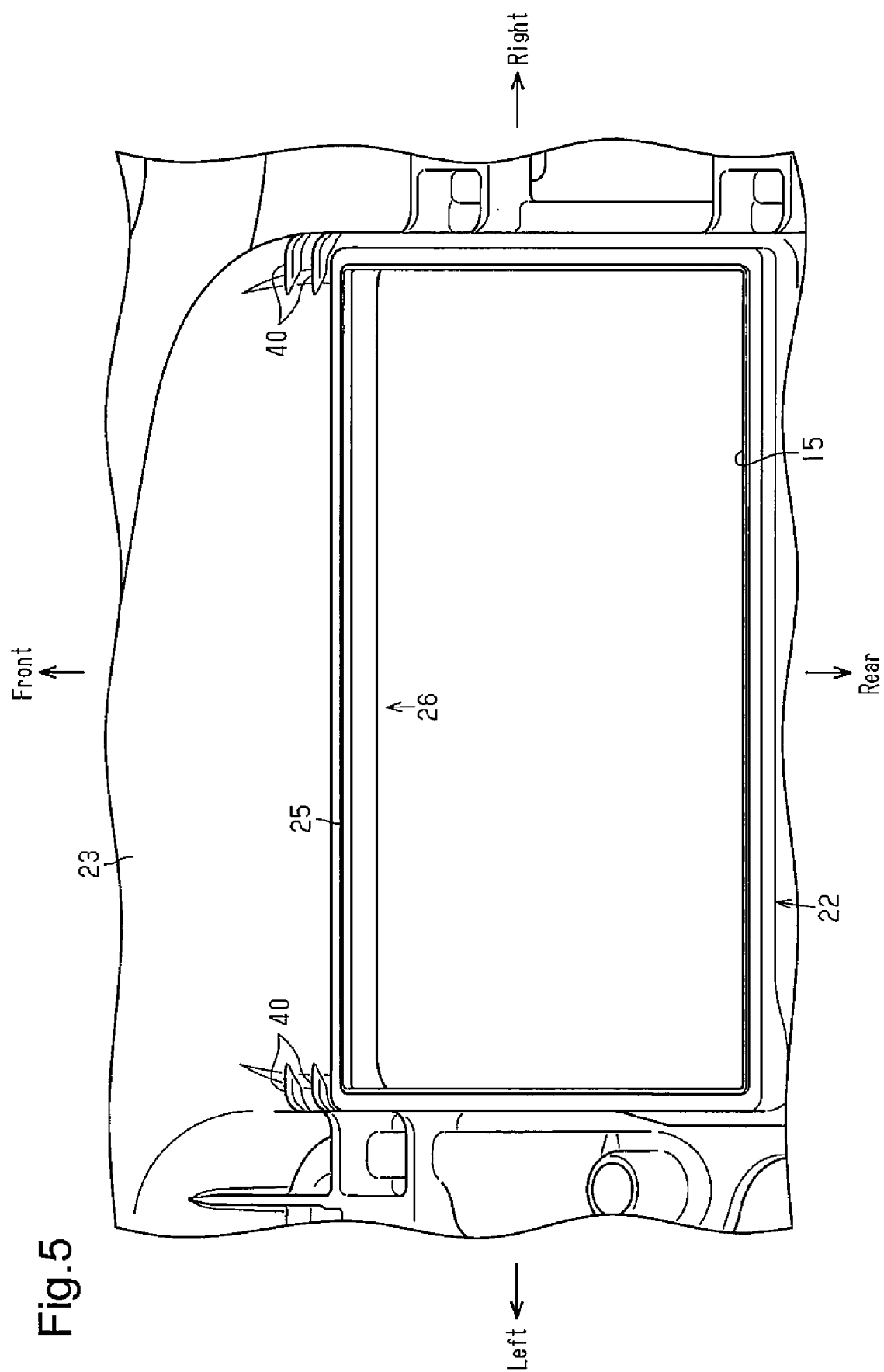
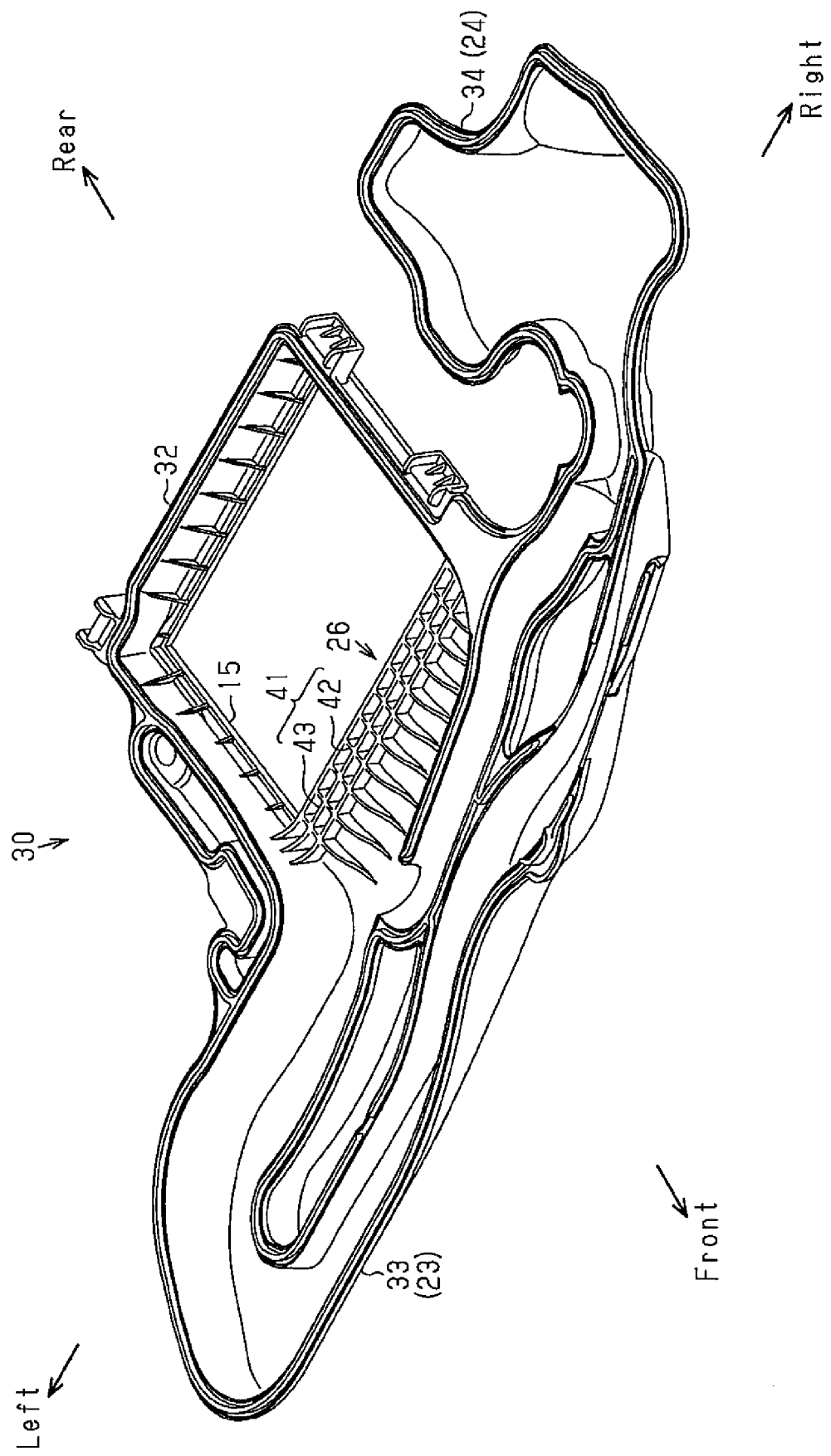


Fig. 5

Fig.6



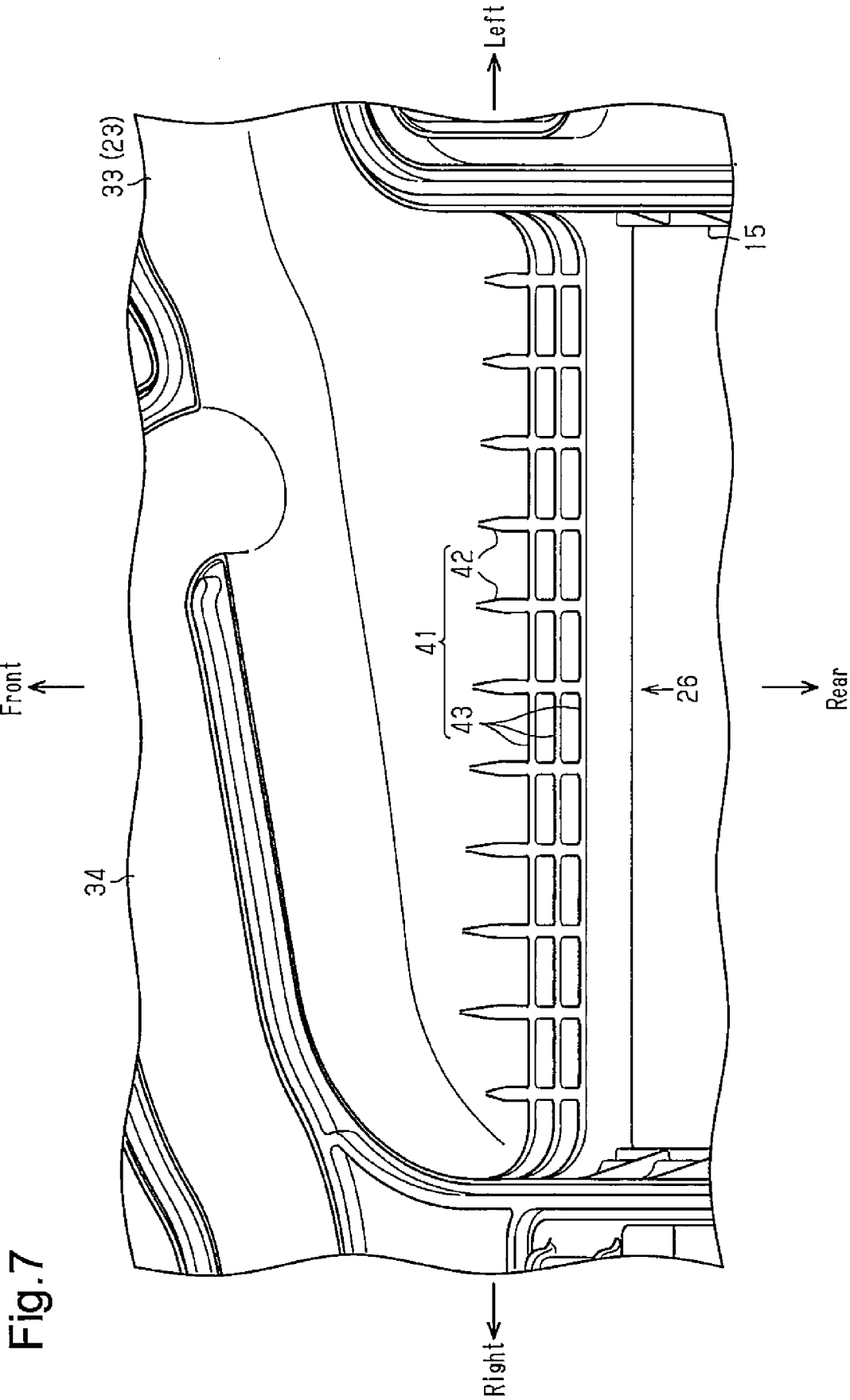
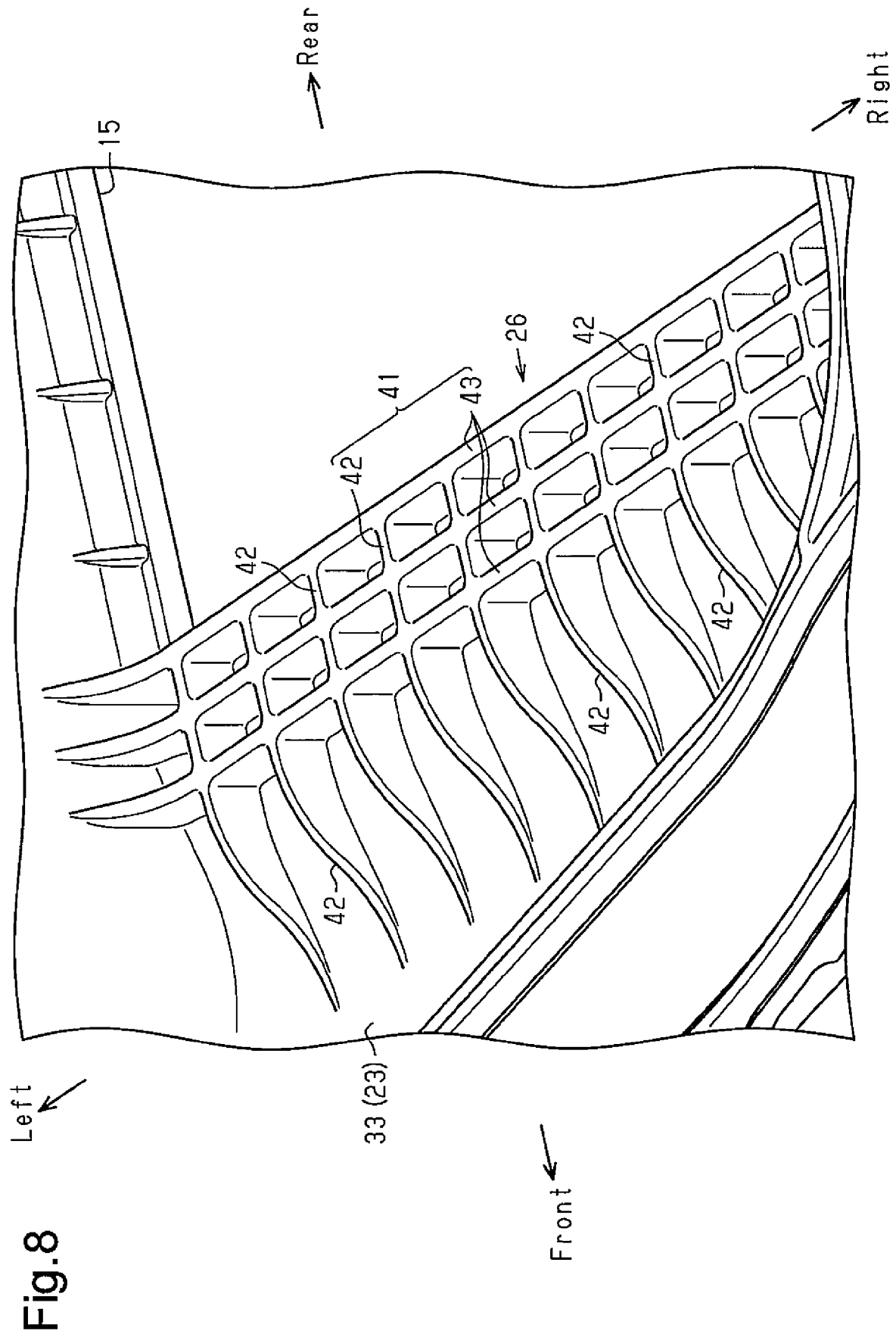


Fig. 7





EUROPEAN SEARCH REPORT

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**ANNEX TO THE EUROPEAN SEARCH REPORT
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