(19) Europäisches Patentamt
European Patent Office
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(11) **EP 4 530 540 A1**

(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
02.04.2025 Bulletin 2025/14

(21) Application number: **24201818.2**

(22) Date of filing: **23.09.2024**

(51) International Patent Classification (IPC):
F24C 15/20 *(2006.01)* *F24F 13/24* *(2006.01)*

(52) Cooperative Patent Classification (CPC):
F24C 15/20; F24F 13/24

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

(30) Priority: **29.09.2023 IT 202300020220**

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(54) HOUSEHOLD APPLIANCE INCLUDING A SOUND-ABSORBING DEVICE

(57) The present invention relates to a household appliance (1) comprising:
- a chassis (2) defining an internal volume (3) and having at least one wall (20) delimiting said internal volume (3),
- a source (4) connected to the chassis (2) and responsible for emitting sound waves during operation of the household appliance (1),
- a sound-absorbing device (5) arranged in the internal volume (3) in contact with the wall (20) and exposed to the sound waves emitted by the source (4), the sound-absorbing device (5) comprises:
- a contact portion (50) arranged in contact with the wall (20) of the chassis (2),
- a main surface (51) opposite the contact portion (50) along a thickness direction (S-S),
- a frame (52) peripherally delimiting the sound-absorbing device (5) and extending along the thickness direction (S-S) from the main surface (51) to the contact portion (50), the frame (52) defining with the main surface (50) a cavity (6),

wherein the wall (20) of the chassis (2) closes the cavity (6) on the opposite side with respect to the main surface (51) along the thickness direction (S-S).

The household appliance that is the object of the present invention is characterized in that it comprises a partition element (7) that extends in the cavity (6) along the thickness direction (S-S) from the main surface (51) to the contact portion (50) so as to partition the cavity (6) into a plurality of chambers (8).

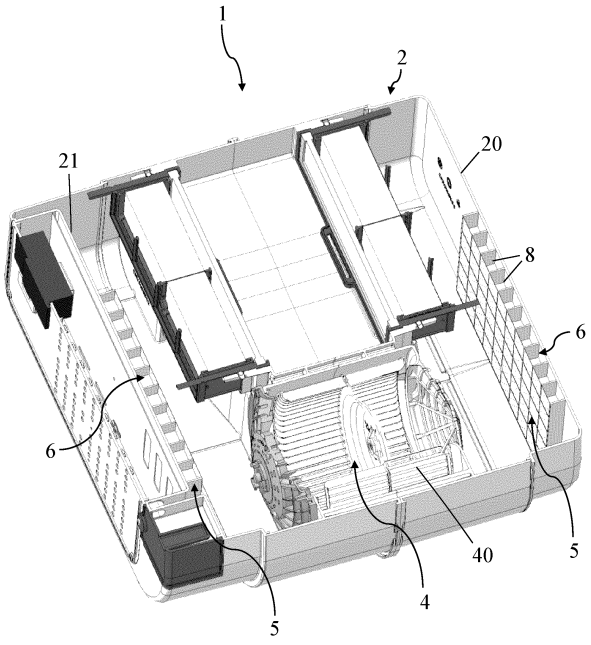

Fig. 5

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Description

Technical Field

[0001] The present invention relates to a household appliance comprising a sound-absorbing device, in accordance with the preamble of claim 1.

[0002] The object of the present invention is used in the field of household appliances, in particular kitchen household appliances for extracting cooking fumes.

State of the art

[0003] There is a need felt in the state of the art to limit the noise pollution produced by household appliances during their operation.

[0004] To this purpose, sound-absorbing/sound-insulating panels are typically used, i.e. acoustic devices that can be integrated into household appliances and configured to dissipate the sound waves generated by the latter.

[0005] The known panels comprise a pair of external walls which are spaced in a thickness direction from an interspace and connected to a frame around the perimeter.

[0006] In detail, the external walls are oriented perpendicular to the thickness direction and delimit the interspace from above and below. The frame, on the other hand, extends along the thickness direction, delimiting the cavity on the side.

[0007] Typically, such known panels are installed in special compartments of household appliances, in the vicinity of noise sources such as, for example, the suction units of the hoods or the motor means of dishwashers or washing machines.

[0008] In detail, the panels are applied to one or more walls of the compartments of the household appliances by adhering, totally or partially, one of the external surfaces.

[0009] In the state of the art, there is also a need to reduce the consumption of raw materials used in production processes to safeguard the environment, as well as reduce production costs.

[0010] Known sound-absorbing/sound-insulating panels, entirely confining the cavity both along the thickness direction (upper, lower) and laterally, require the use of considerable material resources and the execution of various production phases.

[0011] CN 209688947 U describes a sound-absorbing hood panel having a top wall connected to a perimeter wall to define an open-bottom cavity. To improve the acoustic performance of the panel, CN 209688947 U teaches filling the cavity with sound-absorbing material.

[0012] It should be noted that known sound-absorbing materials - such as, for example, wood, cork, rock wool or glass - tend to degrade over time, especially when exposed to a humid current such as that of cooking fumes.

[0013] Thus, disadvantageously, the sound-absorbing panel described in CN 209688947 U requires periodic maintenance operations in which the sound-absorbing material must be replaced. The maintenance operations, in addition to being inconvenient for the user, also have an environmental impact as they generate waste that cannot be recycled.

Object of the invention

[0014] In this context, the task of the skilled person underlying the present description is to provide a household appliance that is ecologically sustainable to produce and, at the same time, has low noise impact during its operation.

[0015] In particular, it is an object of the present invention to provide a household appliance having an operating noise at least comparable to that of household appliances integrating the known sound-absorbing/sound-insulating panels and, at the same time, able to minimize the raw materials used in its production process or in maintenance operations.

[0016] In addition, it is an object of the present invention to provide a practical household appliance that does not require periodic maintenance operations in order to maintain a good acoustic performance.

SUMMARY OF THE INVENTION

[0017] In accordance with the features of claim 1, the subject matter of the present disclosure is a household appliance comprising a chassis defining an internal volume delimited by at least one wall thereof, a source responsible for the emission of sound waves during operation of the household appliance, and a sound-absorbing device configured to dissipate at least some of the sound energy produced by the source.

[0018] The sound-absorbing device is placed in the internal volume in contact with the wall, so as to be exposed to the sound waves emitted by the source during the operation of the household appliance.

[0019] In detail, the sound-absorbing device comprises a counter portion arranged in contact with the chassis wall, a main surface opposite to the contact portion along a thickness direction, and a frame extending along the thickness direction from the main surface to the contact portion.

[0020] In detail, the frame peripherally delimits the sound-absorbing device and defines a cavity with the main surface.

[0021] In the household appliance that is the object of the present disclosure, said cavity is closed by the chassis wall along the thickness direction from the opposite side with respect to the main surface.

[0022] The household appliance of the present disclosure also includes a partition member extending in the cavity along the thickness direction from the main surface to the contact portion so as to partition the cavity into a plurality of chambers. Each chamber is then delimited by opposite parts along the thickness direction from the

main surface and the chassis wall.

[0023] Please note that the partition element is different from the sound-absorbing material of CN 209688947 U in that the latter fills the cavity but does not partition it into a plurality of chambers.

Advantages of the invention

[0024] It should therefore be noted that the chassis wall cooperates synergistically with the frame and the main surface of the sound-absorbing device to close the cavity and thus create a confined environment.

[0025] Advantageously, this results in a saving of raw material necessary to make the sound-absorbing device since the latter, unlike known sound-absorbing/sound-insulating panels, does not need to be closed at the lower edge to define a confined environment.

[0026] It is therefore evident that the household appliance that is the subject of the present description is able to minimize the raw materials used in the production process without negatively impacting its operating noise.

[0027] It should also be noted that the partition element allows the creation of a plurality of acoustic resonators capable of dissipating sound energy and that, unlike the sound-absorbing material of CN 209688947 U, it does not require periodic maintenance replacement operations.

LIST OF FIGURES

[0028] Further features and advantages of the present invention will become more apparent from the description of an exemplary, but not exclusive, and therefore non-limiting preferred embodiment of a household appliance, as illustrated in the appended drawings, in which:

- figure 1 shows an axonometric sectional view of a first embodiment of a household appliance according to the present invention;
- figure 2a shows a further axonometric sectional view of the household appliance in figure 1;
- figure 2b shows an enlargement of some details of figure 2a;
- figure 3 shows a frontal sectional view of some details of the household appliance of figure 1;
- figure 4 shows an axonometric sectional view of a second embodiment of a household appliance according to the present invention;
- figure 5 shows a further axonometric sectional view of the household appliance in figure 4;
- figure 6a shows an axonometric view of some components of the household appliance of figure 1 and figure 4,
- figure 6b shows an enlargement of some details of figure 6a;
- figure 7 shows an axonometric view from below of the component of figure 6a;
- figure 8 shows an axonometric sectional view of the component of figure 6a
- figure 9a shows a sectional view of the side of the component of figure 6a during the installation procedure in the household appliance figure 1 or 4.
- figure 9b shows a sectional view from the side of the component in figure 6a when installed in the household appliance in figure 1 or 4.

DETAILED DESCRIPTION

[0029] Even if not explicitly highlighted, the individual features disclosed with reference to the specific embodiments shall be understood as accessory to and/or interchangeable with other features disclosed with reference to other embodiments.

[0030] With reference to the attached figures, the present description relates to a household appliance 1 such as, for example, a hood for the suction of cooking fumes (Fig. 1-3), be it of the suction or filtering type, or a suction cooking hob (Fig. 4, 5).

[0031] This household appliance 1 comprises a chassis 2, preferably box-like, defining an internal volume 3.

[0032] In the context of the present description, "internal volume 3" means a three-dimensional spatial region, internal to the household appliance 1, and at least partially confined by the chassis 2. Examples of internal volumes are the suction chambers or ducts of the cooking hoods or extractor hobs.

[0033] With reference to figures 1-5, the chassis 2 comprises at least one wall 20 delimiting the internal volume 3 partially or totally.

[0034] In the embodiment shown in figures 1-3, the chassis 2 comprises four walls defining a duct with a quadrangular section, while in the embodiment of figures 4 and 5 it has a plurality of walls defining a substantially parallelepiped-shaped chamber.

[0035] The household appliance 1 further comprises a source 4 connected to the chassis 2 and responsible for the emission of sound waves during operation of the household appliance 1.

[0036] In the embodiments shown in figures 1-5, the source 4 is a suction unit configured to generate a depression in the internal volume 3 (duct/suction chamber) and, therefore, a suction flow of the cooking fumes.

[0037] It should be specified that by suction unit is meant an apparatus comprising an impeller 40 driven in rotation by an electric motor 41 and configured to generate a suction air flow. It should be noted that, in use, the rotation of the impeller 40 generates mechanical vibrations and aerodynamic rustling that translate into noise and add to the sounds produced by the electric motor drive.

[0038] According to one aspect, the source 4 is arranged internally of the internal volume 3 defined by the chassis 2.

[0039] The household appliance 1 further comprises a sound-absorbing device 5 configured to dissipate the sound waves generated by the source 4 during its opera-

tion. The sound-absorbing device 5 is individually shown in figures 6-8 and is installed in the household appliance in figures 1-5.

[0040] With reference to figures 1-5, the sound-absorbing device 5 is arranged in the internal volume 3 of the household appliance 1, in contact with the at least one wall of the 20 of the chassis 2, so as to be exposed to the sound waves emitted by the source 4.

[0041] Preferably, the sound-absorbing device 5 faces the source 4.

[0042] It should be noted that in alternative embodiments to those shown in the attached figures, the sound-absorbing device 5 can be placed in contact with two or more walls of the chassis 2 at the same time.

[0043] In detail, the sound-absorbing device 5 comprises a contact portion 50 arranged in abutment against the wall of the chassis 2.

[0044] Furthermore, the sound-absorbing device 5 comprises a main surface 51 which is opposite the contact portion along a thickness direction S-S.

[0045] According to one aspect, the contact portion 50 and the main surface 51 are oriented transversely to the thickness direction S-S.

[0046] It should be specified that, as shown in figure 3, the thickness direction S-S is oriented transversely, preferably orthogonally, to the wall 20 of the chassis 2. Therefore, as shown in figure 9b, the sound-absorbing device 5 projects from the wall 20 along the thickness direction S-S.

[0047] The main surface 51 can have both a flat conformation and partially or totally corrugated conformation.

[0048] The sound-absorbing device 5 further comprises a frame 52 delimiting it peripherally, in particular along a direction of width X-X and length Y-Y. It should be specified that the width and length directions X-X, Y-Y make a Cartesian triad with the thickness direction Z-Z.

[0049] The frame 52 extends along the thickness direction S-S from the main surface 51 to the contact portion 50.

[0050] According to an aspect shown in figure 7, the frame 52 defines a perimeter edge B 1 of the contact portion 50.

[0051] Preferably, the sound-absorbing device 5 has a panel conformation in which the contact portion 50, the main surface 51, and the frame 52 respectively define the lower portion, the upper portion, and the side wall of the panel.

[0052] It should be noted that the frame 52, extending along the thickness direction S-S projecting from the main surface 51, defines a cavity 6 with the latter.

[0053] It should be specified that the cavity 6 is delimited by the frame 52 along the width and length direction X-X, Y-Y and by the main surface 51 along the thickness direction S-S.

[0054] Considering the sound-absorbing device 5 (figures 6-8) individually, i.e. when not installed with respect to the chassis 2, the cavity 6 is open along the thickness direction S-S from the opposite side with respect to the main surface 51. In other words, the sound-absorbing device 5 has an opening 53 opposite to the main surface 51 and at the contact surface 50.

[0055] In other words, the sound-absorbing device 5 does not have a closing surface opposite to the main surface 51 along the thickness direction S-S, adapted to close the cavity 6.

[0056] Advantageously, as shown in figures 2-5, when the sound-absorbing device 5 is installed in the household appliance, then the wall 20 of the chassis 2 closes the cavity 6 from the opposite side to the main surface 51 along the thickness direction S-S.

[0057] In other words, the wall 20 of the chassis 2 receiving in abutment the contact portion 50 of the sound-absorbing device 5 obstructs the cavity 6 from the opposite side with respect to the main surface 51.

[0058] Thus, the wall 20 of the chassis 2 cooperates with the frame 52 and the main surface 51 of the sound-absorbing device 5 to confine the cavity 6 and generate an air gap.

[0059] In this way, it is advantageously obtained that when the sound-absorbing device 5 is mounted on the chassis 2, that is, when the contact portion 50 abuts against the wall 20 of the chassis 2, the cavity 6 is a three-dimensional spatial region confined along the width, length and thickness directions X-X, Y-Y, S-S.

[0060] Then, the wall 20 of the chassis 2 stops the opening 53 of the sound-absorbing device 5.

[0061] Preferably, the opening 53 has the S-S thickness direction as its axis and the wall 20 obstructs the opening 53 along the S-S thickness direction.

[0062] When the sound-absorbing device 5 is exposed to sound waves, part of the sound energy is dissipated by the resonance of the main surface.

[0063] Further, when the sound-absorbing device 5 is exposed to the sound waves, the air volume inside the cavity (air gap) resonates, dissipating a further part of the sound energy.

[0064] According to a detailed aspect in figure 6b, the main surface 51 of the sound-absorbing device 5 has a plurality of openings 51a (holes, micro-holes, cuts) passing through the main surface 51 along the thickness direction S-S. These openings 51a put the internal volume 3 of the chassis 2 in fluid (and sound) communication with the cavity 6 of the sound-absorbing device 5.

[0065] It should be noted that the cavity-openings system constitutes what in acoustics is defined as acoustic resonator or Helmholtz resonator. It has long been known that acoustic resonators can be employed to generate sound dissipations in a specific frequency range. Such a range of dissipated frequencies varies depending on multiple parameters, including: material used to make the resonator (density, elastic modulus, damping), surface extension of the opening, geometric shape of the opening, volume of the resonance chamber.

[0066] Therefore, by optimizing the geometric parameters of the sound-absorbing device 5 it is possible

to concentrate the dissipation effect of the Helmholtz resonator in the frequency range where the source 4 emits the most.

[0067] Preferably, the main surface 51 has a thickness - extension in the S-S thickness direction - between 0.1 and 0.5 mm.

[0068] Preferably, the frame 52 has a thickness - extension along the width or length direction X-X, Y-Y depending on the frame section 52 considered - between 0.5 and 5 mm.

[0069] Preferably, the plurality of openings 51a has a diameter in the range of 0.1-1.0 mm.

[0070] Preferably, the main surface 51 has a surface porosity value of less than 1%. It should be specified that in the context of the present description the surface porosity value is defined as the ratio of the sum of the surface extensions of the openings 51a and the surface extension of the main surface 51

In formula:

$$P = \frac{\sum_{j=1}^{N} A_{a,j}}{A_p}$$

[0071] Where P is the surface porosity value of the main surface 51, N is the number of openings present on the main surface, Aa,j is the surface extension of the j-th opening of the main surface, Ap is the surface extension of the main surface.

[0072] The frame 52 can be impervious (i.e. devoid of openings) or also have a plurality of openings (not shown in the figures).

[0073] The sound-absorbing device 5 comprises a partitioning element 7 configured to partition the cavity 6, i.e. divide the volume of the cavity into a plurality of portions of smaller volumetric extension.

[0074] In detail, the partition member 7 extends in the cavity 6 along the thickness direction S-S from the main surface 51 to the contacted portion 50 by partitioning the cavity into a plurality of chambers 8.

[0075] Each chamber 8 is delimited by opposite parts along the thickness direction S-S from the main surface 51 and from the wall 20 of the chassis 2.

[0076] Preferably, each chamber 8 is delimited laterally along the width and length directions X-X, Y-Y (i.e. transversely to the thickness direction Z-Z) by the partition element 7 or by the partition element 7 in combination with the frame 3.

[0077] According to an aspect shown in figure 2b, the chambers 8 are "ducts", for example of quadrangular section, which extend along the thickness direction S-S between the main surface 51 and the wall 20 of the chassis 2.

[0078] Preferably, at least one opening 51a of the main surface 51 is associated with each chamber 8. Thus, the partition member 7 generates a plurality of acoustic resonators (Helmholtz resonators) in the sound-absorbing device 5.

[0079] In the embodiment shown in figure 7, each chamber 8 has the same geometry, however, in alternative embodiments the chambers 8 may have different geometrical conformations both in section and in extension along the thickness direction S-S. For example, if the main surface 51 has a corrugated geometry, the chambers 8 will have a different extension along the thickness direction S-S. This allows acoustic resonators with different properties to be generated and, consequently, the range of absorbed frequencies to be expanded.

[0080] According to one aspect, the partition element 7 has an alveolar conformation.

[0081] In the embodiment of figure 7, the partition member 7 defines a plurality of edges B2 of the contact portion 50.

[0082] Preferably, the partition element 7 is made in one piece with the frame 52. This facilitates the production process by minimizing the number of components to be made. For example, the partition member 7 and the frame 52 may be made in a monolithic structure through a plastic injection molding process.

[0083] According to one aspect, the frame 52 and/or the partition member 7 are fixed to the main surface 51 by the heat-sealing or ultrasonic welding process.

[0084] The sound-absorbing device 5 can be made of different types of materials and/or combination thereof such as, for example, metal, plastic or glass.

[0085] The sound-absorbing device 5 is anchored to the wall 20 of the chassis, for example, by magnetic means 9 configured to interact magnetically with the metal material of the chassis 2.

[0086] Referring to figure 8, preferably, the magnetic means 9 are arranged at the contact portion 50. In particular, for example, the partition element 7 has at least one cavity 70 adapted to receive the magnetic means 9.

[0087] In the embodiment of figures 4 and 5, the chassis 2 comprises a pair of walls 20, 21 that delimit the internal volume 3 from opposite parts and the source 4 is at least partly interposed between said pair of walls 20, 21.

[0088] Furthermore, in the embodiment of figure 4 and 5, the household appliance comprises a pair of sound-absorbing devices 5 and each mounted on a respective wall 20, 21 in accordance with the above.

[0089] It should be noted that, in the embodiment of figures 4 and 5, the cavity 6 of each sound-absorbing panel 5 is closed by a respective wall 20, 21 of the chassis 2 along the respective thickness direction S-S, as described above.

[0090] The sound-absorbing devices 5 installed in the internal volume 3 of the chassis 2 may or may not have the same geometry depending on the cases, in particular depending on the geometric characteristics of the walls to which they are fixed.

Claims

1. Household appliance (1) comprising:

    - a chassis (2) defining an internal volume (3), the chassis (2) comprising at least one wall (20) delimiting said internal volume (3),
    - a source (4) connected to the chassis (2) and responsible for the emission of sound waves during the operation of the household appliance (1),
    - a sound-absorbing device (5) arranged in the internal volume (3) in contact with the wall (20) and exposed to the sound waves emitted by the source (4), said sound-absorbing device (5) comprising:

        - a contact portion (50) arranged in contact with the wall (20) of the chassis (2),
        - a main surface (51) opposite the contact portion (50) along a thickness direction (S-S),
        - a frame (52) extending along the thickness direction (S-S) from the main surface (51) to the contact portion (50), said frame (52) peripherally delimiting the sound-absorbing device (5) and defining with the main surface (50) a cavity (6), wherein the wall (20) of the chassis (2) closes the cavity (6) on the opposite side with respect to the main surface (51) along the thickness direction (S-S)

    characterized in that it comprises a partition element (7) extending in the cavity (6) along the thickness direction (S-S) from the main surface (51) to the contact portion (50) so as to partition the cavity (6) into a plurality of chambers (8), each chamber (8) being delimited on opposite sides along the thickness direction (S-S) by the main surface (51) and from the wall (20) of the chassis (2).

2. Household appliance (1) according to claim 1, wherein each chamber (8) is delimited laterally transverse to the thickness direction (Z-Z) by the partition element (7) or by the partition element (7) in combination with the frame (52).

3. Household appliance (1) according to any one of the preceding claims, wherein the partition element (7) has an alveolar conformation.

4. Household appliance (1) according to any one of the preceding claims, wherein:

    - the main surface (51) has a plurality of openings (51a) configured to put the internal volume (3) of the chassis (2) in fluid communication with the cavity (6) of the sound-absorbing device (5),
    - at least one opening (51a) of the main surface (51) is associated with each chamber (8).

5. Household appliance (1) according to any one of the preceding claims, wherein the partition element (7) is made in one piece with the frame (52).

6. Household appliance (1) according to any one of the preceding claims, wherein the main surface is at least partly corrugated.

7. Household appliance (1) according to any one of the preceding claims, wherein the source (4) is arranged internally to the internal volume (3) defined by the chassis (2) and the sound-absorbing device (5) faces the source (4).

8. Household appliance (1) according to claim 7, wherein:

    - the chassis (2) comprises a pair of walls (20, 21) delimiting the internal volume (3) on opposite sides, the source (4) being at least partly interposed between said pair of walls (20, 21),
    - the household appliance (1) comprises a pair of sound-absorbing devices (5) each mounted on a respective wall (20,21) of said pair of walls.

9. Household appliance (1) according to any one of the preceding claims, wherein the sound-absorbing device (5) is connected to the wall by magnetic means (9).

10. Household appliance (1) according to any one of the preceding claims, wherein:

    - the household appliance (1) is a hood for sucking the cooking fumes of the suction or filtering type or is a suction hob,
    - the source (4) is a suction group configured to generate a suction flow of the cooking fumes.

11. Household appliance (1) according to any one of the preceding claims, wherein the sound-absorbing device (5) does not have a closing surface, opposite to the main surface (51) along the thickness direction (S-S), adapted to close the cavity (6).

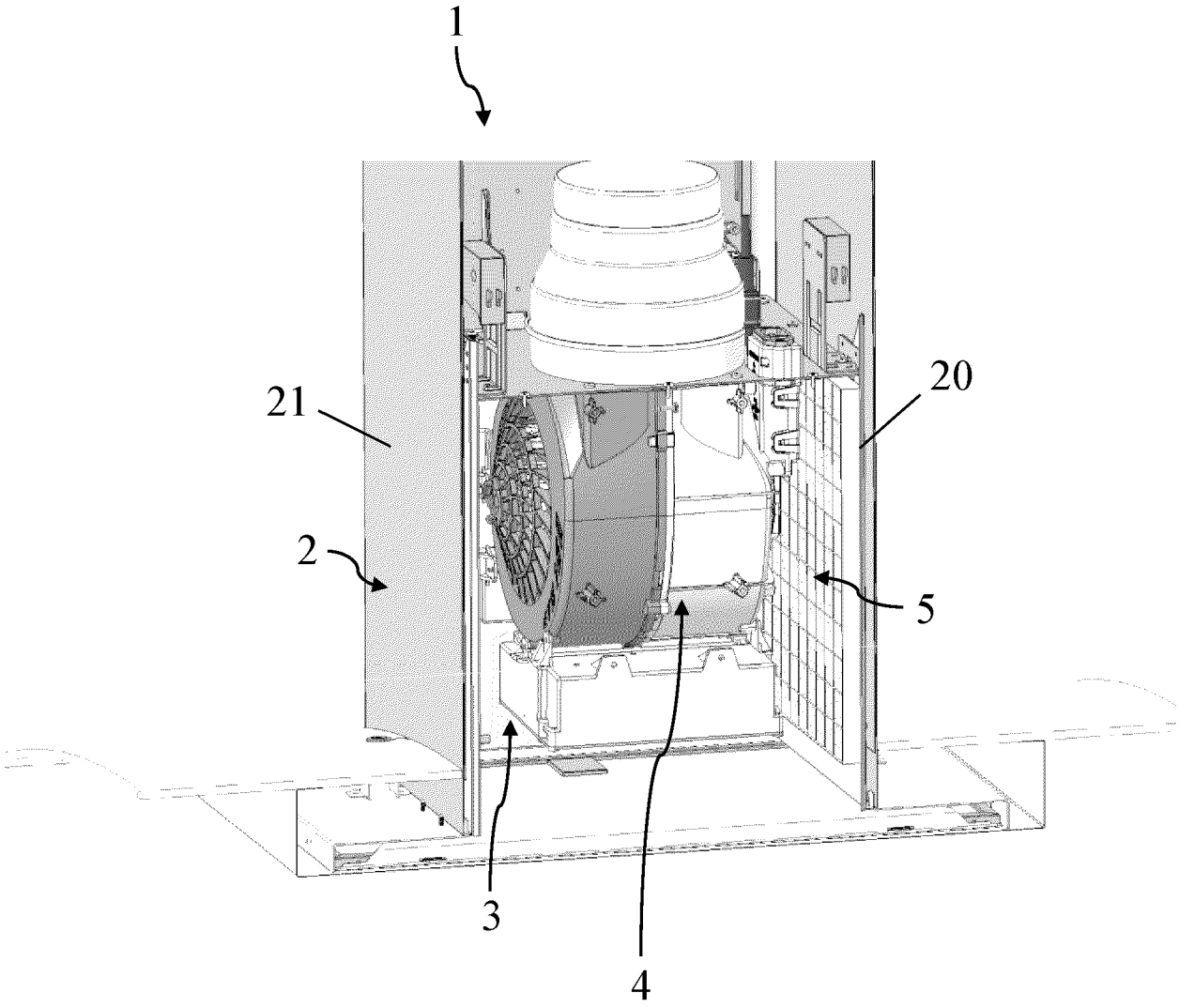

Fig. 1

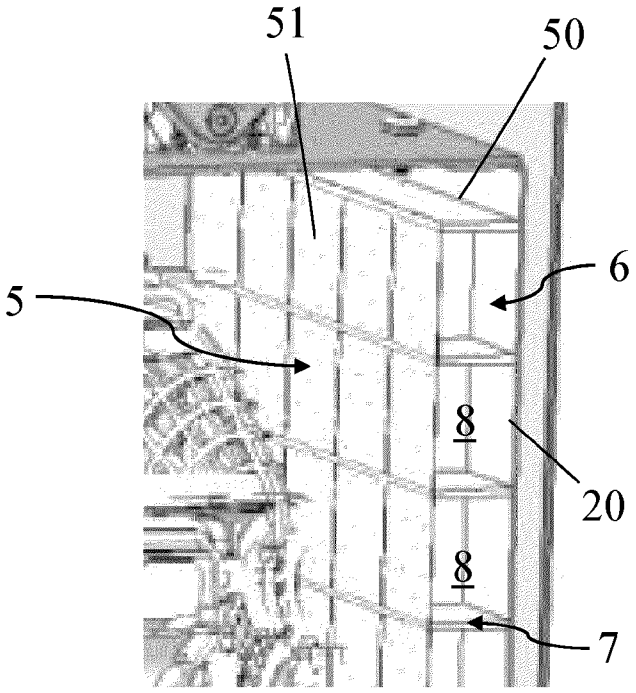

Fig. 2b

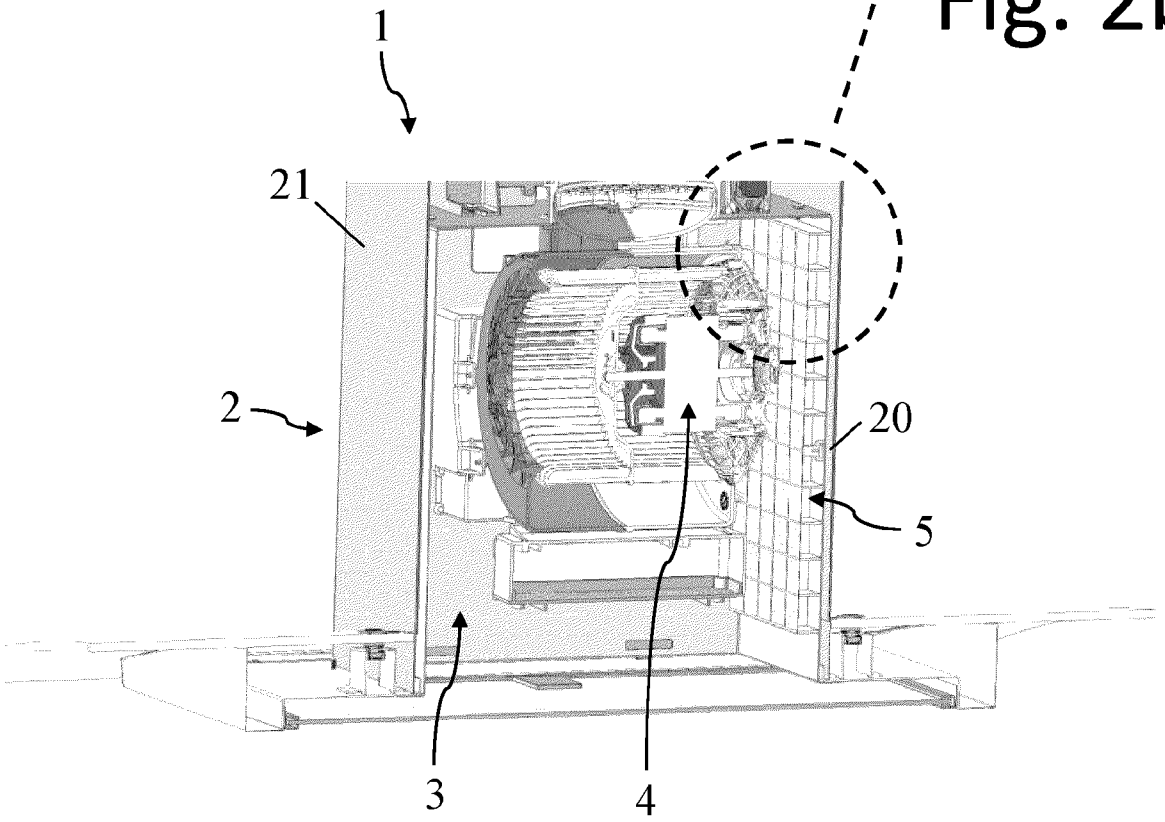

Fig. 2a

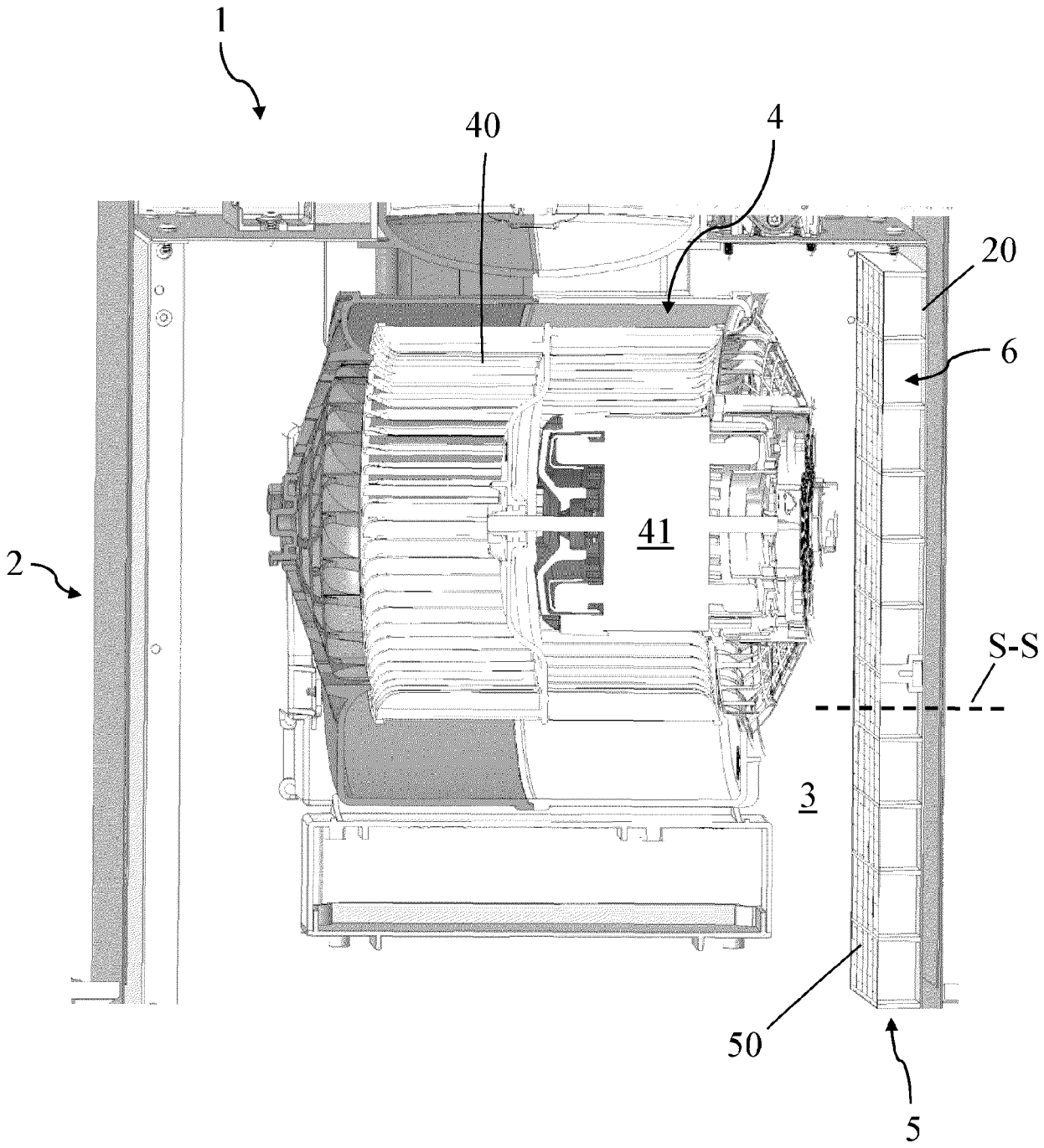

Fig. 3

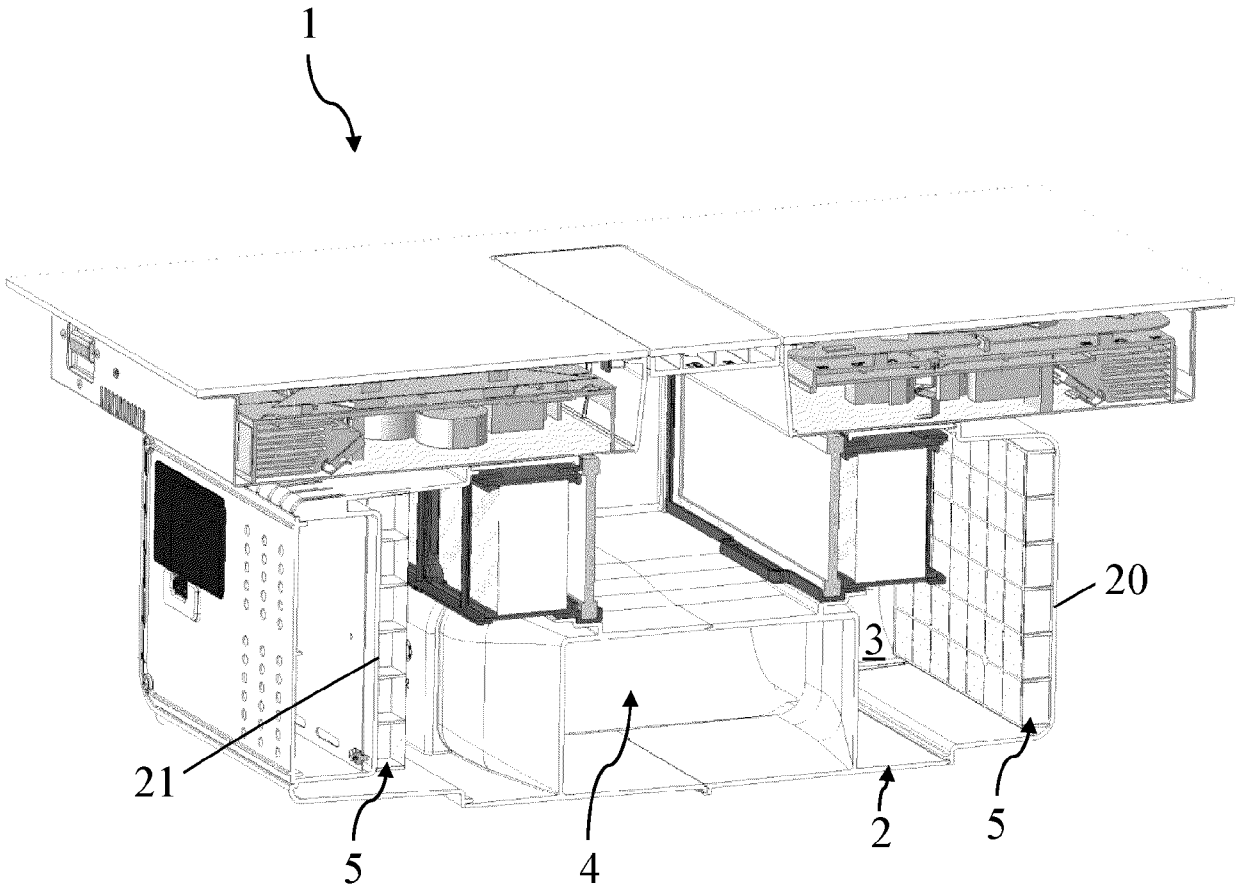

Fig. 4

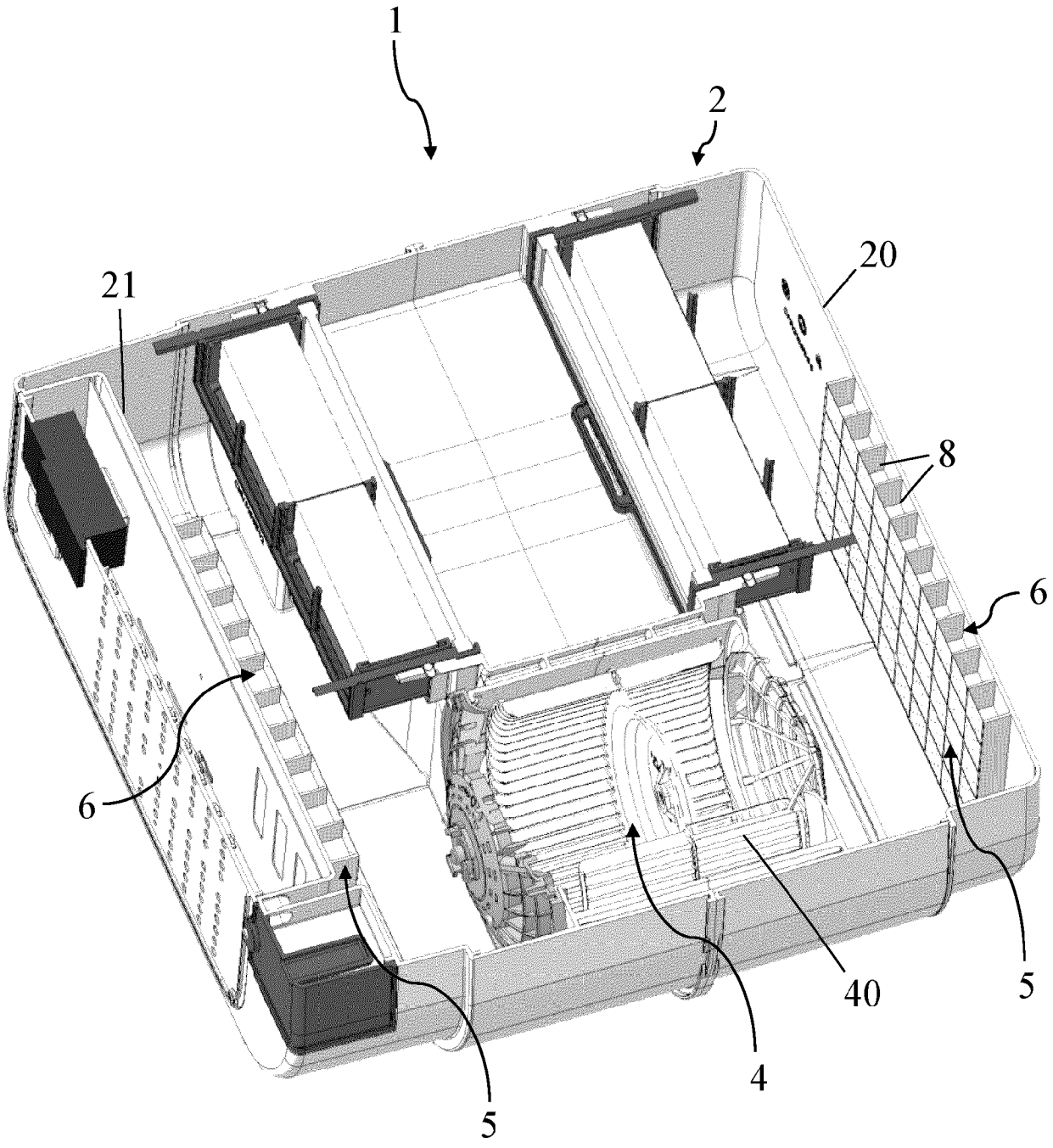

Fig. 5

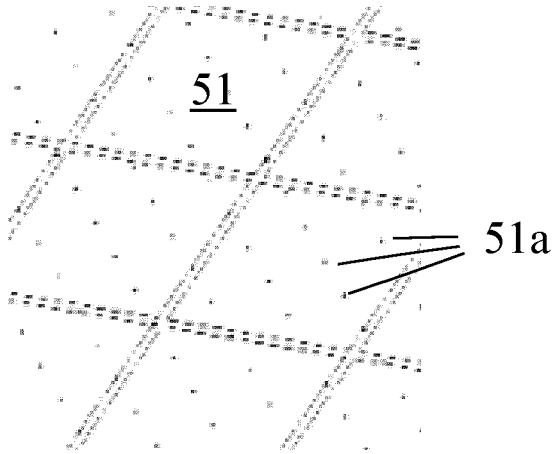

Fig. 6b

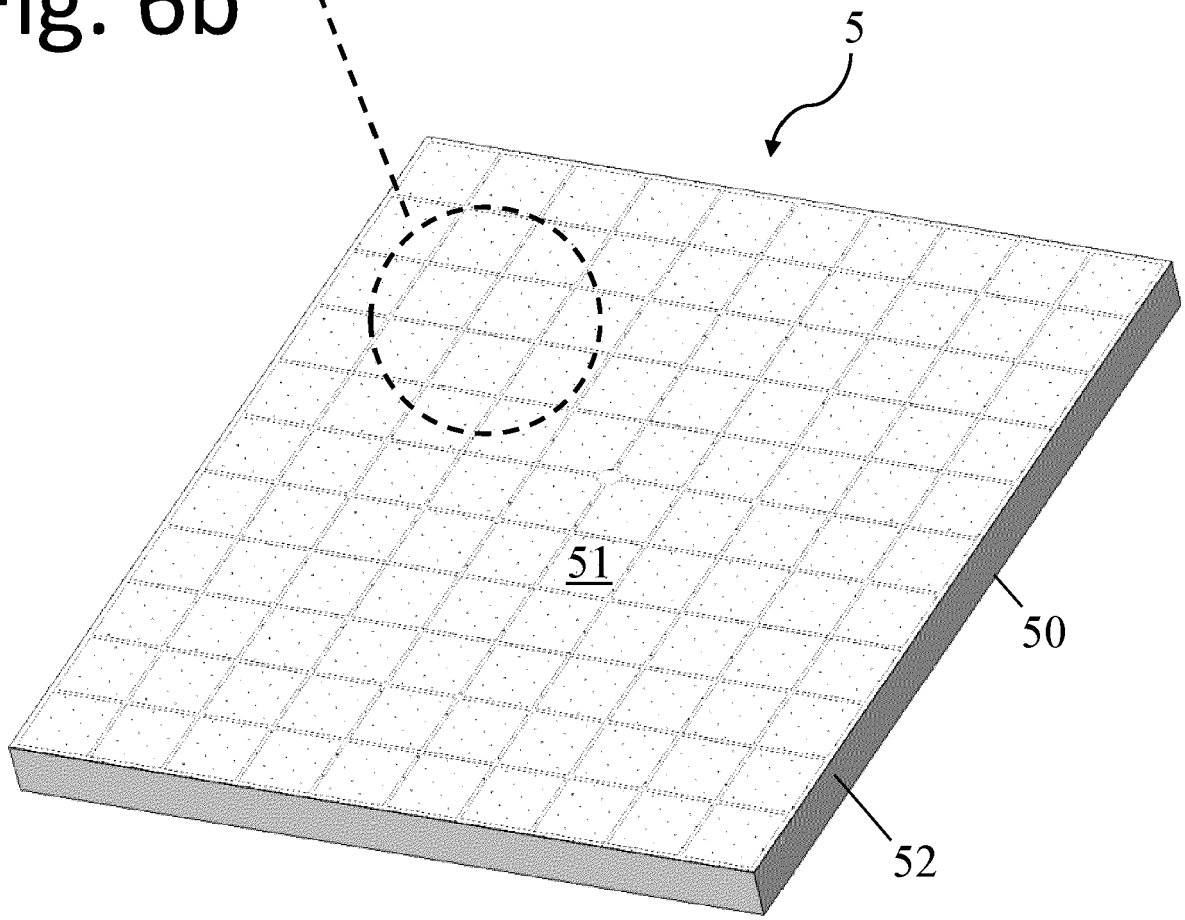

Fig. 6a

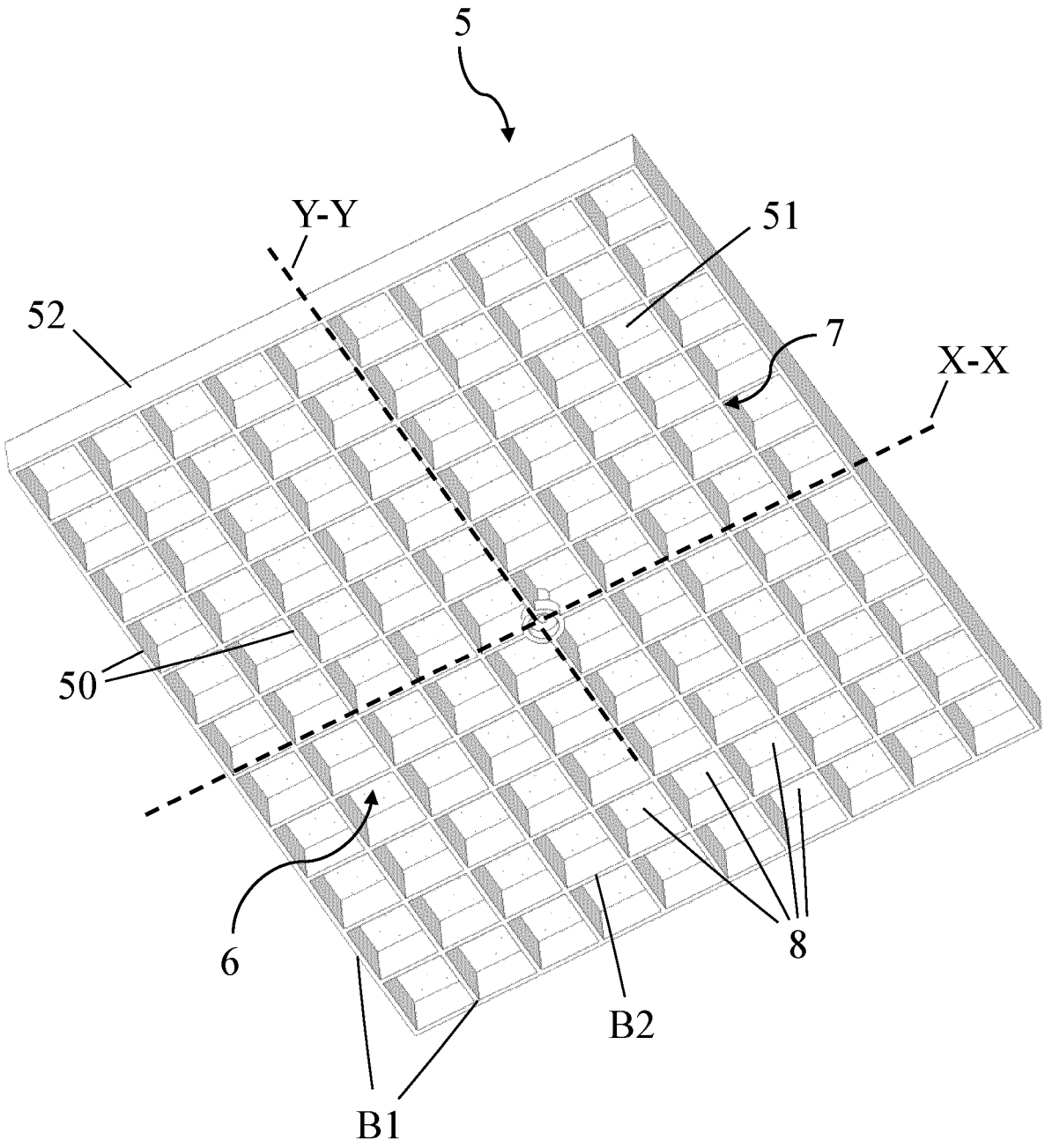

Fig. 7

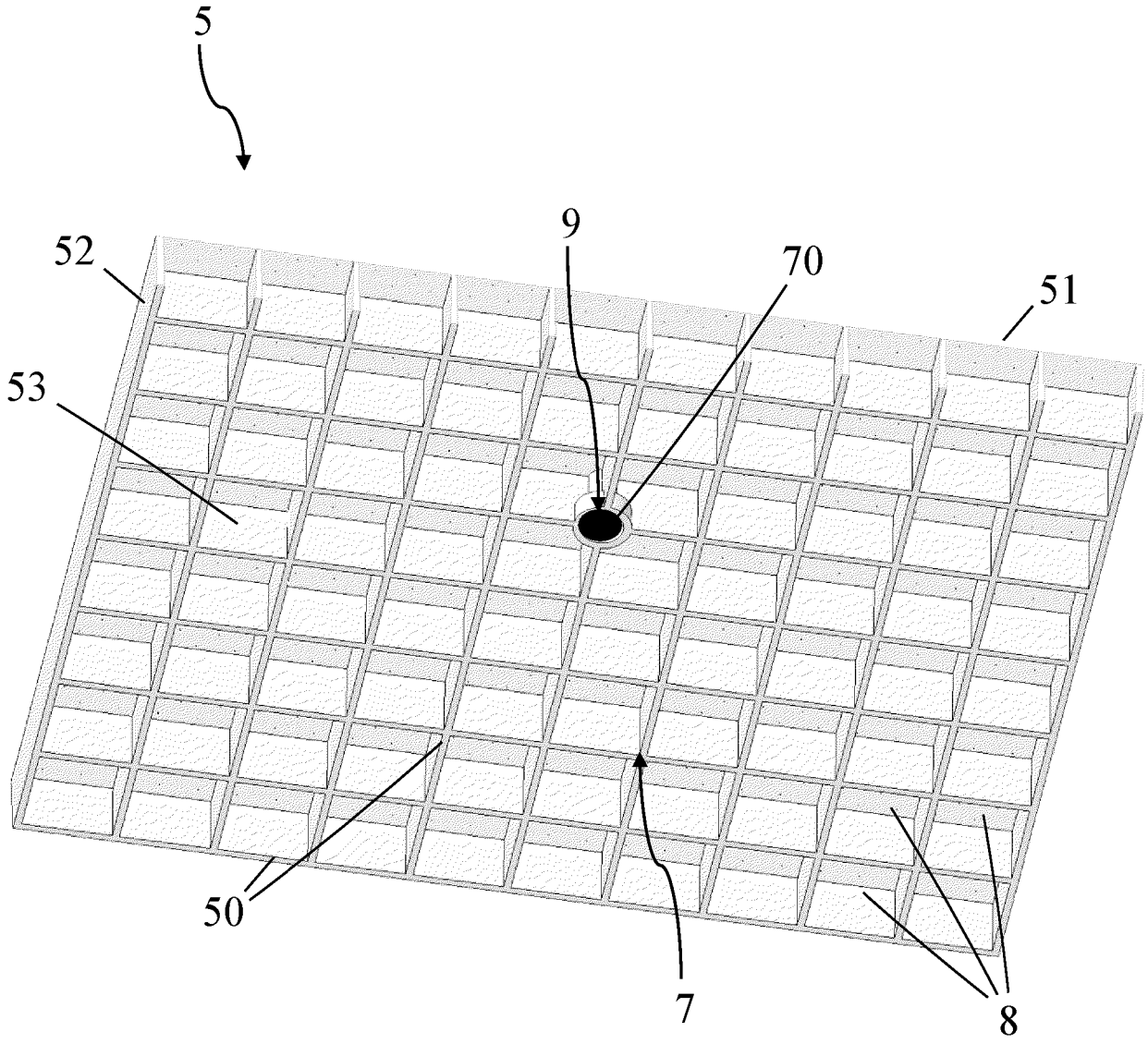

Fig. 8

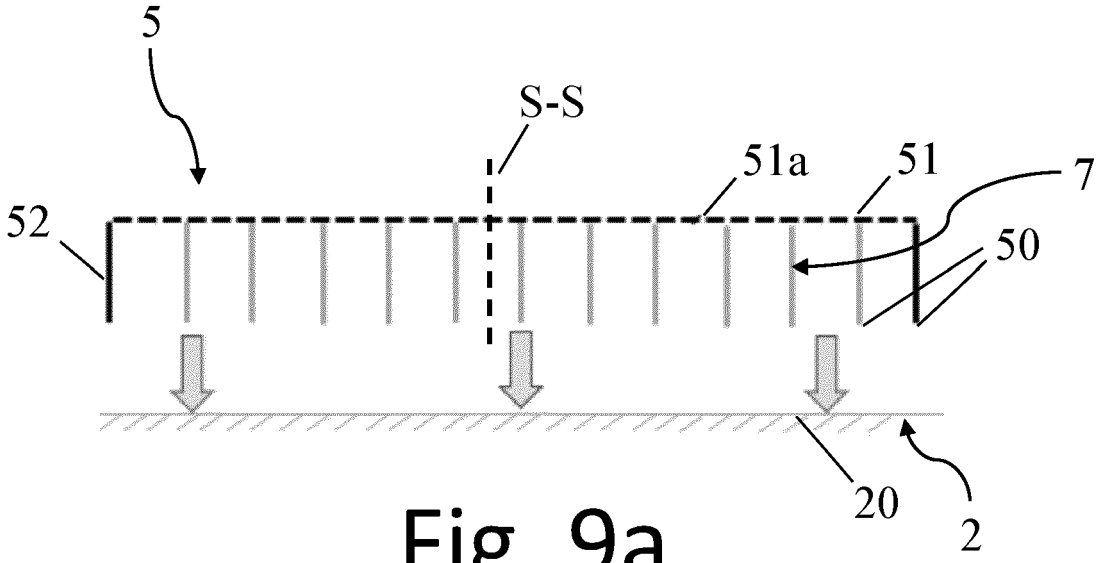

Fig. 9a

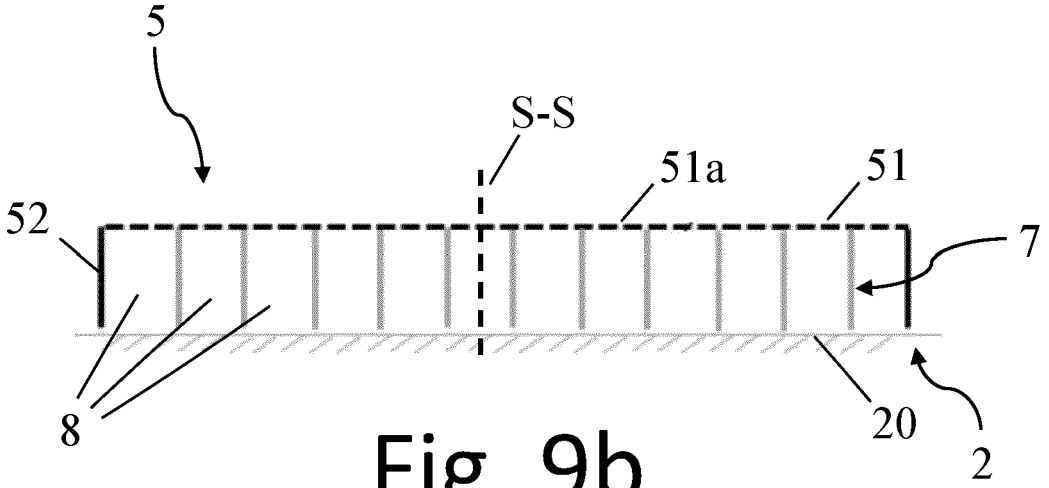

Fig. 9b

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Place of search	Date of completion of the search	Examiner
The Hague	4 February 2025	Jalal, Rashwan

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