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ASSEMBLY OF A BIOMASS HEATING SYSTEM AND A SOUND ABSORBING DEVICE

- (57) An assembly (1) of biomass heating system (2) and sound-absorbing device (3) comprises a biomass heating system (2) and a sound-absorbing device (3). The biomass heating system (2) comprises a casing (21), and a noise source (24a, 24b) inside the casing (21). The sound-absorbing device (3) has an inner wall (33) con-

figured to be turned towards the noise source (24a, 24b), an outer wall (34) opposite the inner wall (33), and a gap (35), comprised between the inner wall (33) and the outer wall (34). The inner wall (33) has a plurality of through openings (38) configured to be turned towards the noise source (24a, 24b), and the outer wall (34) is impervious.

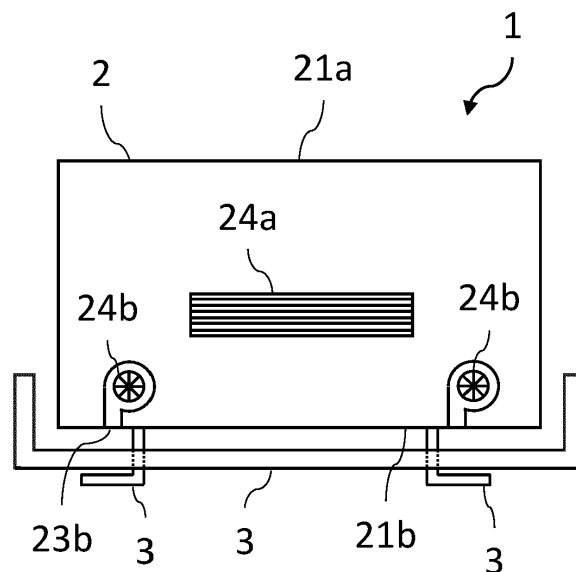


Fig. 4

Description*Technical Field*

[0001] The invention is developed in the technical field of biomass heating systems. In particular, the invention concerns an assembly of a biomass heating system, for example a stove, a thermostove, a boiler or a fireplace, and a sound-absorbing device.

Prior art

[0002] Biomass heating systems are known in the art. In detail, the biomass heating systems comprise a casing, inside which there is a combustion chamber in which a flame is produced. The heat generated by the flame is diffused to an external environment, to be heated, through one or more fans. Usually, openings are provided in the casing of the biomass heating system for the air to pass.

Problem of the prior art

[0003] The actuation of the fans internal to the biomass heating system, in order to ventilate it, often causes annoying noise, which would be desirable to eliminate.

Aim of the invention

[0004] In this context, the technical task underlying the present invention is to reduce the noise generated by the biomass heating system reaching the external environment, with a specific sound-absorbing device for biomass heating systems.

[0005] In particular, the aim of the present invention is to provide an assembly of a biomass heating system and a sound-absorbing device, which overcomes the drawbacks of the aforementioned prior art.

[0006] The defined technical task and the specified aims are substantially achieved by an assembly of a biomass heating system and a sound-absorbing device comprising the technical characteristics set forth in one or more of the appended claims.

[0007] Advantageously, the assembly comprises a sound-absorbing device suitable for the biomass heating systems that optimally dampens noises generated by such biomass heating systems to which it is applied. The device has an inner wall turned towards the biomass heating system. The inner wall has openings, which allow acoustic waves to enter a gap of the device. The gap is closed on the opposite side by an impervious outer wall. The noise is therefore dampened inside the gap.

LIST OF FIGURES

[0008] Further features and advantages of the present invention will become more apparent from the indicative and thus non-limiting description of a preferred but non-

exclusive embodiment of an assembly of a biomass heating system and a sound-absorbing device, as illustrated in the attached drawings in which:

- 5 - figure 1 is a perspective view of an assembly of a biomass heating system and a sound-absorbing device in accordance with the invention,
- figure 2 is a schematic perspective view of a biomass heating system,
- 10 - figure 3 is a schematic perspective view of an assembly of the heating system of figure 2 and some sound-absorbing devices according to a preferred embodiment of the invention,
- figure 4 shows a schematic sectional top view of an assembly of a biomass heating system and some sound-absorbing devices according to an embodiment of the invention,
- 15 - figure 5 is a schematic perspective view of an assembly of a heating system and some sound-absorbing devices according to an alternative embodiment of the invention,
- 20 - figure 6 is a schematic sectional top view of an assembly of a heating system and some sound-absorbing devices according to an alternative embodiment of the invention,
- 25 - figures 7a-7l are schematic top views of ten embodiments of the assembly of the invention, and
- figures 8a-8e are sectional top views of portions of five other embodiments of sound-absorbing devices of the assembly of the invention.
- 30

DETAILED DESCRIPTION

[0009] The present invention relates to an assembly 1 of a biomass heating system 2 and a sound-absorbing device 3.

[0010] Biomass heating system refers to a device configured to produce heat starting from the combustion of biomasses, such as pellets or wood chips. Preferably, the biomass heating system 2 is one of the following: a stove, a thermostove, a boiler or a fireplace. In the following, the invention will be schematically described and illustrated with reference to a preferred embodiment wherein the biomass heating system is a pellet stove.

[0011] It should be noted that, in different embodiments, the biomass heating system 2 and the sound-absorbing device 3 of the assembly 1 can be connected to each other, or they can be separate bodies without mechanical connections to each other, to be positioned in an appropriate way during operation for a correct noise reduction.

[0012] The biomass heating system 2 comprises in a known manner a casing 21 and a combustion chamber inside the casing 21, not illustrated. The casing 21 of the biomass heating system 2 has at least one front wall 21a and a rear wall 21b, opposite the front wall 21a. The front wall 21a is a wall generally intended to be turned towards the centre of a room of a building, while the rear wall 21b

is intended to be turned towards a wall of the room proximal to the heating system 2. As more detailed below, one or more elements of connection to utilities of a building, if provided, are usually arranged at the rear wall 21b of the heating system 2.

[0013] Furthermore, the biomass heating system 2 comprises a noise source 24a, 24b, for example one or more fans 24a, 24b inside the casing 21. As known to the person skilled in the art, the fan is configured to diffuse heat generated inside the combustion chamber outside the biomass heating system 2.

[0014] More in detail, the rear wall 21b has a plurality of rear openings 23, configured to allow aeration of the biomass heating system 2. The rear openings 23 are spaced from the noise source 24a, 24b in an exit direction, which substantially represents the direction followed by the air to exit the casing 21.

[0015] The heating system 2 may comprise multiple noise sources 24a, 24b, e.g. multiple fans, and various rear openings 23 specific to the distinct noise sources 24a, 24b. Instead, the front wall 21a is usually a continuous wall, devoid of openings.

[0016] In the preferred embodiment, shown in figures 2-4, where in figure 2 the sound-absorbing devices 3 have been omitted, a noise source 24a, 24b is given by a first fan 24a, placed in a compartment of the casing 21 delimited at least on one side by the rear wall 21b. It can be observed that, while it might appear from the figures that the compartment substantially occupies the entire casing 21, it is provided that the casing 21 also contains various other inner components or compartments known to the persons skilled in the art and omitted for sake of simplicity.

[0017] In this embodiment, the rear openings 23 comprise a plurality of slots 23a distributed on the rear wall 21b and shaped to put the compartment of the casing in fluid communication with the outside. The first fan 24a and the slots 23a are therefore dedicated to delivering the heat of the heating system 2 in the room where the heating system 2 is located. The slots 23a, however, also represent a passage for unwanted noise of the first fan 24a.

[0018] Still in the preferred embodiment, the heating system 2 is provided for connection with one or more ventilation ducts of the building, configured to convey hot air to other rooms of the building. These ventilation ducts can be arranged at least in part inside said proximal wall of the room.

[0019] In particular, in this embodiment the rear openings 23 comprise at least one mouth 23b, preferably a plurality of mouths 23b, each configured for connection with at least one ventilation duct external to the casing 21. Furthermore, the noise source 24a, 24b comprises at least one second fan 24b, preferably a plurality of second fans 24b, each housed in a respective fan shell in fluid communication with a respective mouth 23b. The fan shell, at least on an exhaust side of the second fan 24b, is sealed with respect to the compartment of the

casing 21 including the first fan 24a.

[0020] In the illustrated embodiment, two mouths 23b are provided for connection to respective ventilation ducts, in addition to a further mouth 25 that does not communicate with noise sources 24a, 24b, and can be dedicated for example to electrical wirings.

[0021] It is worth pointing out that the same heating system 2 can be installed in different rooms of different buildings, where ventilation ducts are not always present or necessary to adequately heat all the desired environments. Therefore, one or more mouths 23b could be opened without any connection to ventilation ducts, resulting in unwanted noise output.

[0022] In other embodiments, mouths 23b and second fans 24b may not be provided, but only a first fan 24a and the slots 23a, or yet no first fan 24a, but only second fans 24b, which may be in any number.

[0023] The sound-absorbing device 3 has an inner wall 33, configured to be turned towards the noise source 24a, 24b in such a way as to be hit by its noise, and an outer wall 34, opposite the inner wall 33. It is worth noting that the inner wall 33 has a sound-absorbing function, which will be described in detail below. Furthermore, the outer wall 34 is impervious, with a sound-insulating function.

[0024] Preferably, the sound-absorbing device 3 is arranged transversely to the exit direction, at least for a main portion thereof, preferably perpendicularly to the exit direction. Hence, the sound-absorbing device 3 can be placed substantially vertically, and/or substantially in parallel to the rear wall 21b. Thanks to this arrangement, the sound-absorbing device can be hit frontally, as well as by the air flow, also by the sound waves, and therefore its damping effect is maximum.

[0025] In the presence of multiple rear openings 23 and noise sources 24a, 24b, it is possible to provide a single sound-absorbing device 3, or a sound-absorbing device 3 for each opening 23.

[0026] For each sound-absorbing device 3, it is possible that it is arranged externally to the casing 21, with the inner wall 33 of the device 3 facing the rear wall 21b of the casing 21. For example, a sound-absorbing device 3 may be external to the casing 21 and placed in front of one or more of the slots 23a and at least one of the mouths 23b. Preferably, distinct sound-absorbing devices 3, for example three in number, are in front of the assembly of the slots 23a and distinct mouths 23b.

[0027] Individual devices 3 for the mouths 23b are preferable, so that they can be used only where required, and in particular only in a number equal to the mouths 23b which in the application of interest are not connected to ventilation ducts.

[0028] Alternatively, as shown in figure 6, one or more of the sound-absorbing devices 3 can be placed inside the casing 21, but in any case, transverse to the exit direction, with the inner wall 33 turned towards the noise source 24a, 24b and the outer wall 34 facing the rear wall 21b of the casing 21, in particular at one or more rear

openings 21b.

[0029] This can be applied for example in the case of a sound-absorbing device 3 placed in the same compartment as the first fan 23a, between the fan 23a and the rear wall 21b. The air flow moved by the first fan 23a can thus reach the slots 23a and the outside of the casing 21 bypassing the sound-absorbing device 3, while the sound waves are damped.

[0030] In still other embodiments, one or more sound-absorbing devices 3 can act at least in part as a rear wall 21b of the casing 21, i.e. they can be integrated therein.

[0031] For example, as shown in figure 5, the rear wall 21b may comprise a plurality of sound-absorbing devices 3 and a plurality of rear openings 23a, 23b. The rear openings 23a, 23b and the sound-absorbing devices 3 in this case can be arranged alternately with each other in strips. For example, the rear openings 23a, 23b may be formed in the rear wall 21b between pairs of adjacent sound-absorbing devices 3, and vice versa. Therefore, the air can exit the casing passing in openings 23a, 23b between pairs of sound-absorbing devices 3, while these attenuate the noise that hits them, letting pass only that portion of noise that propagates directly towards the openings 23a, 23b.

[0032] This embodiment example can be applied both for the compartment of the first fan 24a, so that the devices 3 are interspersed between the slots 23a, and for the mouths 23b, only partially obstructing the mouths 23b.

[0033] Some embodiment examples are now described, to illustrate various possible positionings and conformations that one or more of the sound-absorbing devices 3 can assume with respect to the casing 21.

[0034] In some embodiments, shown at least in figures 7a - 7e, the device 3 is concave.

[0035] In other embodiments, shown at least in figures 7f - 7h, the device 3 is flat.

[0036] Preferably, the device 3 has two ends 32, connected to each other by the inner wall 33 and by the outer wall 34.

[0037] Furthermore, in the embodiments in which the device 3 is concave, the device 3 may have a central portion 30a and a pair of arms 30b, which connect the central portion 30a to respective ends 32. In some embodiments, in which the device 3 is concave, shown in figures 7b, 7d and 7e, the central portion 30a and the arms 30b are joined by edges. In the embodiments of figure 7a and 7c, where the device 3 is curved, the central portion 30a and the arms 30b are in any case identifiable as portions of the curved shapes of the inner wall 33 and of the outer wall 34.

[0038] In one embodiment, the sound-absorbing device 3 has a U-shape, for example in figures 7b and 7d, or a crescent, half-moon shape, for example in figures 7a and 7c.

[0039] In one embodiment, the inner wall 33 defines a concavity. This concavity is configured for positioning at least one portion of the biomass heating system 2 be-

tween the two ends 32, as schematically shown in figures 7a-7e.

[0040] In the embodiment of figure 7h, the system comprises a flat device 3.

[0041] In the embodiments shown in figures 7g and 7h, the system comprises a plurality of devices 3. In detail, in the embodiment of figure 7g, the sound-absorbing devices 3 are arranged consecutively, so that the inner wall 33 of the devices 3 is turned towards the biomass heating system 2 or towards the outer wall 34 of another device. In the embodiment shown in figure 7h, the system comprises a plurality of devices 3, which can be positioned independently of each other, so that they are turned towards the biomass heating system 2.

[0042] In an alternative embodiment, shown in figure 7i, the devices 3 with a flat shape are spaced apart with respect to the biomass heating system 2. It is worth noting that the devices 3 of the embodiments shown in figures 7g and 7h can also be spaced from the biomass heating system 2.

[0043] In a further embodiment, shown in figure 7l, the system comprises two devices 3. Preferably, each device 3 has an end 32 connected to the casing 21 of the biomass heating system 2.

[0044] Optionally, the sound-absorbing device 3 has a through channel, not visible in the figures, between the inner wall 33 and the outer wall 34. Inside the through channel, a tube 50, a cable or a device for controlling the biomass heating system 2 can be inserted. Preferably, the tube 50, the cable or the control device have a connection end with which they are connected to the biomass heating system 2.

[0045] In all the mentioned embodiments, the device 3 comprises a gap 35, comprised between the inner wall 33 and the outer wall 34. In detail, the gap 35 has a gap depth 36 between the inner wall 33 and the outer wall 34.

[0046] In a first embodiment, the gap depth 36 is constant between the two ends 32. In other words, the central portion 30a and the arms 30b, in the embodiments in which they are provided, have the same gap depth 36. In this embodiment, shown for example in figure 7a, the gap depth is comprised between 10 and 40 mm.

[0047] In a second embodiment, the gap depth 36 is variable between the two ends 32 between a minimum depth 36a and a maximum depth 36b, to dissipate the noises coming from the source.

[0048] For example, as shown in figures 7b and 7d, the minimum depth 36a can be identified at the central portion 30a, while the maximum depth 36b can be identified at arms 30b. In particular, in the embodiments of figures 7b and 7d, the minimum gap depth 36a may be constant along the central portion 30a. Further, in the embodiments of figures 7b and 7d, the maximum gap depth 36b may be constant along the arms 30b.

[0049] In a further embodiment, shown in figure 7c, the minimum gap depth 36a can be identified at the ends 32. Furthermore, the maximum depth 36b can be identified at the central portion 30a. In this embodiment, the max-

imum depth can be detected at a centre of symmetry C of the central portion 30a.

[0050] Preferably, in such an embodiment, the gap depth 36 progressively decreases from the centre C of the central portion 30a up to the ends 32.

[0051] In the embodiments shown in figures 7f-7i, the gap depth 36 is substantially constant between the two ends 32.

[0052] In a further embodiment, shown in figures 8d and 8e, the inner wall 33 has ridges 33a and depressions 33b.

[0053] In one embodiment, not shown in the figures, the ridges 33a and the depressions 33b may be irregular. In other words, the gap depth 36 at each ridge 33a is variable, i.e. the ridges 33a have gap depth 36 different from one another. Further, a distance L between two consecutive ridges 33a is variable.

[0054] Instead, in the embodiments shown in figures 8d and 8e, the ridges 33a and the depressions 33b have the same gap depth 36 and the same distance L between two consecutive ridges 33a. Preferably, the distance L is comprised between 5 mm and 5 cm. In the embodiment 8d, the ridges 33a and depressions are corrugated. In the embodiment 8e, the ridges 33a and the depressions 33b have a plurality of edges and segments.

[0055] In the embodiments of figure 8d and 8e, the rear wall 34 is smooth, i.e. it has no ridges and depressions. In this embodiment, the thickness of gap 36 has a minimum gap depth 36a at the depressions 33b of the inner wall 33 and a maximum gap depth 36b at the ridges 33a.

[0056] In a further embodiment, not shown in the figures, the rear wall 34 of the device 3 may also have ridges and depressions. In this case, the gap depth 36 may be constant despite the ridges and depressions.

[0057] As already previously anticipated, the inner wall 33 has a sound-absorbing function. In fact, a first noise damping mechanism is due to the vibration of the inner wall 33. The frequency range that is damped by this first mechanism depends, for example, on a material of the inner wall 33 and a thickness of the inner wall 33.

[0058] It should be noted that the inner wall 33 has a plurality of through openings 38 configured to be turned towards the noise source 24a, 24b.

[0059] A second noise damping mechanism is given by the acoustic resonance of the through openings 38 on the wall 33 with the gap 35. In fact, the openings and the gap 35 form an acoustic resonator that guarantees sound dissipation in a specific range of frequencies, preferably in one or more frequency bands in the range between 500 and 3000 Hz. In detail, this range varies with the variation of parameters such as a thickness of the inner wall 33, the gap depth, a dimension and a shape of the through openings 38.

[0060] In a preferred embodiment, as through openings 38 the inner wall 33 has pores, not shown in the figures. The porosity of the inner wall is for example less than 5%, preferably less than 1%. These pores have a diameter comprised between 0.01 and 3 mm, preferably

between 0.1 and 1 mm. It should be noted that the pores also contribute to damping sounds, in particular with regard to the second damping mechanism. In particular, the parameters affecting damping comprise the porosity of the inner wall 33, a dimension and a shape of the pores.

[0061] Alternatively, the through openings 38 may be slots, or have other shapes.

[0062] In the case where the inner wall 33 has ridges 33a and depressions 33b, it is possible to increase the amplitude of a frequency range of the noises that are damped by the sound-absorbing device 3, improving the damping of noises to the outside. In fact, it is possible to obtain local variations of the frequency that is damped at the inner wall 33.

[0063] In an embodiment in which the inner wall 33 is flat, the device 3 is configured to dampen 5 dB noises with a frequency comprised between 500 and 1000 Hz.

[0064] In another embodiment example in which the inner wall 33 has ridges 33a and depressions 33b, the device 3 is configured to dampen 4 dB noises with a frequency comprised between 300 and 1500 Hz.

[0065] In one embodiment, the gap 35 of the device 3 is empty, as shown in figure 8b.

[0066] In an alternative embodiment, the gap 35 of the device 3c is filled at least in part with a sound-absorbing material 4, as shown in figure 8c. For example, the sound-absorbing material 4 may totally fill the gap 35 or leave some areas empty.

[0067] Preferably, such sound-absorbing material 4 is, for example, polyester, polyurethane or rock wool.

[0068] It should be noted that the gap 35 defines an inner volume 37 of the device 3. In one embodiment, the device 3 comprises, inside the gap 35, at least one dividing element 5, configured to divide the inner volume 37 into several gap portions. In one embodiment, this dividing element 5 has a height equal to a vertical height H of the sound-absorbing device 3. Preferably, the dividing element 5 forms a mesh, not shown in the figures, composed of mesh elements of different shapes, for example square or hexagonal.

[0069] In a further embodiment, the device 3 comprises a plurality of dividing elements 5, configured to divide the inner volume 37 into a plurality of gap portions. The dividing elements 5 can be distributed in various ways within the gap. Each dividing element 5 may have a height equal to the vertical height H of the sound-absorbing device 3, or even a lower height.

[0070] Advantageously, the dividing element 5 further contributes to damping the noises coming from the source. In addition, the dividing element 5 also performs a structural function, improving the mechanical properties of the sound-absorbing device 3.

[0071] In a further embodiment, not shown in the figures, at least one of the gap portions created by at least one dividing element 5 is filled with sound-absorbing material 4.

[0072] In one embodiment, shown in figure 7e, the two ends 32 of the sound-absorbing device 3 are connected

to the casing 21 of the biomass heating system 2. Preferably, the two ends 32 are connected with a respective sealing element 6, for example gasket elements. Preferably, each sealing element 6 extends along the vertical height H of the sound-absorbing device 3, as shown in figure 1.

[0073] In this way, the noises coming from the noise source 24a, 24b are channelled between the casing 21 and the inner wall 33, since the sealing elements 6 prevent their exit at the ends 32. The noises are channelled towards an upper opening S, between the inner wall 33 and the casing 21, which still allows the aeration thereof. This improves noise dissipation. When the sound waves are channelled towards the upper opening S, they travel a longer path before escaping into the external environment and, during this path, they are more damped by the inner wall 33 thanks to the first and second damping mechanisms, described above.

[0074] It should be noted that the same effect can be obtained by using for example the embodiment of figure 7c, in which a portion of the inner wall 33 is fixed to the casing 21. In this way, the noises are channelled between the casing 21 and the inner wall 33, towards the upper opening S.

[0075] In detail, the inner wall 33 is spaced from the casing 21 of the biomass heating system 2 by a distance comprised between 5 and 100 mm, preferably between 10 and 30 mm. In particular, as shown in figure 7d, the inner wall is spaced from the casing 21 both at the arms 30b and at the central portion 30a. In the embodiment shown in 7c, the inner wall 33 is spaced from the casing at the central portion 30a.

[0076] The inner wall 33 can be made of metal, plastic or glass, for example. Furthermore, the inner wall 33 can be made with a combination of such materials or of other materials deemed suitable by the person skilled in the art. In particular, the materials are chosen from those that withstand temperatures comprised between 90 and 200 °C, preferably between 120 and 150 °C.

[0077] Still preferably, the inner wall 33 and/or the outer wall 34 may have a thickness comprised between 0.1 and 20 mm.

[0078] As shown in the attached figures, the sound-absorbing device 3 can be built according to different embodiments.

[0079] In general, the embodiments illustrated in figures 7a-7e, in which the device 3 is concave, allow to at least partially surround the casing 21. Preferably, the inner wall 33 of each sound-absorbing device 3 is facing on at least three walls of the casing 21: the rear wall 21b and at least one pair of side walls 21c, which connect the front wall 21a with the rear wall 21b.

[0080] In one embodiment, the rear wall 21b, the at least one pair of side walls 21c and preferably the front wall 21a are joined by edges. In a further embodiment, the rear wall 21b, the at least one pair of side walls 21c and preferably the front wall 21a identify distinct portions of the same arched wall that defines the casing 21.

[0081] The inner wall 33 of the sound-absorbing device 3 is turned towards the rear wall 21b of the casing 21.

[0082] It is worth noting that, in the embodiment of figure 7h, in which the devices 3 have a flat shape, the sound-absorbing devices 3 can be turned towards the at least one pair of side walls 21c. Even in this embodiment, the devices 3 allow to at least partially surround the casing 21.

[0083] Preferably, in the embodiments shown in figures 7f, 7g, 7i and 7l, the inner wall 33 of each sound-absorbing device 3 is facing only on the rear wall 21b of the casing 21. Furthermore, in the embodiment of figure 7l, each device 3 is connected to the rear wall 21b at a respective end 32.

[0084] In an alternative embodiment, as also anticipated with reference to figure 5, the casing 21 of the biomass heating system 2 always has at least one front wall 21a and a rear wall 21b, opposite the front wall 21a. However, the inner wall 33 of the device 3 acts at least in part as the rear wall 21b of the biomass heating system 2. In other words, in this embodiment, the device 3 is an integral part of the casing 21.

[0085] In the alternative embodiments shown in figures 7f - 7h, for at least one device 3, the inner wall 33 of the device 3 acts as the rear wall 21b of the biomass heating system 2. In other words, even in such embodiments, at least one device 3 is an integral part of the casing 21.

[0086] In such embodiments, the noise coming from the noise source 24a, 24b is damped by the inner wall 33 as soon as it escapes from the casing 21. In fact, the noise is channelled inside the gap 35. In this embodiment, the noise sound waves are more damped within the gap 35 through the second damping mechanism. It should also be noted that the noise 35 is confined within the gap 35 since the outer wall 34 is impervious.

Claims

1. Assembly (1) of biomass heating system (2) and sound-absorbing device (3), comprising:

- a biomass heating system (2), comprising:

- a casing (21) having at least one front wall (21a) and a rear wall (21b), opposite the front wall (21a), and
- a noise source (24a, 24b) inside the casing (21),

- at least one sound-absorbing device (3), which has:

- an inner wall (33) configured to be turned towards the noise source (24a, 24b),
- an outer wall (34) opposite the inner wall (33),
- a gap (35), comprised between the inner

wall (33) and the outer wall (34),

wherein the inner wall (33) has a plurality of through openings (38) configured to be turned towards the noise source (24a, 24b), and the outer wall (34) is impervious,

characterized in that:

- the rear wall (21b) has a plurality of rear openings (23a, 23b) configured to allow aeration of the biomass heating system (2), the rear openings (23a, 23b) being spaced from the noise source (24a, 24b) in an exit direction, and
- the sound-absorbing device (3) is arranged transversely to the exit direction.

2. Assembly (1) according to claim 1, wherein:

- the sound-absorbing device (3) is external to the casing (21) with the inner wall (33) facing the rear wall (21b), or
- the sound-absorbing device (3) acts at least in part as a rear wall (21b) of the casing (21), or
- the sound-absorbing device (3) is placed inside the casing (21), with the inner wall (33) turned towards the noise source (24a, 24b) and the outer wall (34) facing the rear wall (21b) of the casing (21).

3. Assembly (1) according to claim 1 or 2, wherein the rear openings (23a, 23b) comprise a plurality of slots (23a) distributed on the rear wall (21b), and the noise source (24a, 24b) comprises a first fan (24a) placed in a compartment of the casing (21) delimited by the rear wall (21b).

4. Assembly (1) according to any one of claims 1 to 3, wherein:

- the rear openings (23a, 23b) comprise at least one mouth (23b) configured for connection with at least one ventilation duct external to the casing (21), and
- the noise source (24a, 24b) comprises at least one second fan (24b), housed in a fan shell in fluid communication with said mouth (23b).

5. Assembly (1) according to claim 4, wherein at least one sound-absorbing device (3) is placed outside the casing (21) or is integrated in a portion of the rear wall (21b) at said mouth.

6. Assembly (1) according to claim 4 or 5, wherein the rear openings (23a, 23b) comprise a plurality of mouths, the assembly (1) comprising a plurality of sound-absorbing devices (3) distinct from each other for distinct mouths.

7. Assembly (1) according to any one of claims 1 to 6, wherein the rear wall (21b) of the casing (21) comprises a plurality of sound-absorbing devices (3), and wherein the rear openings (23a, 23b) are formed in the rear wall (21b) between pairs of adjacent sound-absorbing devices (3).

8. Assembly (1) according to any one of claims 1 to 7, wherein the device (3) has two ends (32), the inner wall (33) connecting the two ends (32) and defining a concavity configured for positioning at least one portion of the biomass heating system (2) between the two ends (32).

9. Assembly (1) according to any one of claims 1 to 8, wherein the gap (35) has a gap depth (36) between the inner wall (33) and the outer wall (34), the gap depth (36) being constant along a width of the sound-absorbing device (3).

10. Assembly (1) according to any one of claims 1 to 9, wherein the gap (35) has a gap depth (36) between the inner wall (33) and the outer wall (34), the gap depth (36) being variable between a minimum depth (36a) and a maximum depth (36b) along a width of the sound-absorbing device (3), for dissipating noises with different frequencies coming from the noise source (24a, 24b).

11. Assembly (1) according to any one of claims 1 to 10, wherein the gap (35) of the device (3) is filled at least in part with a sound-absorbing material (4).

12. Assembly (1) according to any one of claims 1 to 11, wherein the gap (35) defines an inner volume (37) of the sound-absorbing device (3), the sound-absorbing device (3) comprising, at the gap (35), at least one dividing element (5), configured to divide the inner volume (37) into several gap portions.

13. Assembly (1) according to any one of claims 1 to 12, wherein the device (3) has two ends (32), the two ends (32) being connected to the casing (21) of the biomass heating system (2), preferably with a respective sealing element (6).

14. Assembly (1) according to any one of claims 1 to 13, wherein the inner wall (33) is spaced from the casing (21) of the biomass heating system (2) by a distance comprised between 5 and 100 mm, preferably between 10 and 30 mm.

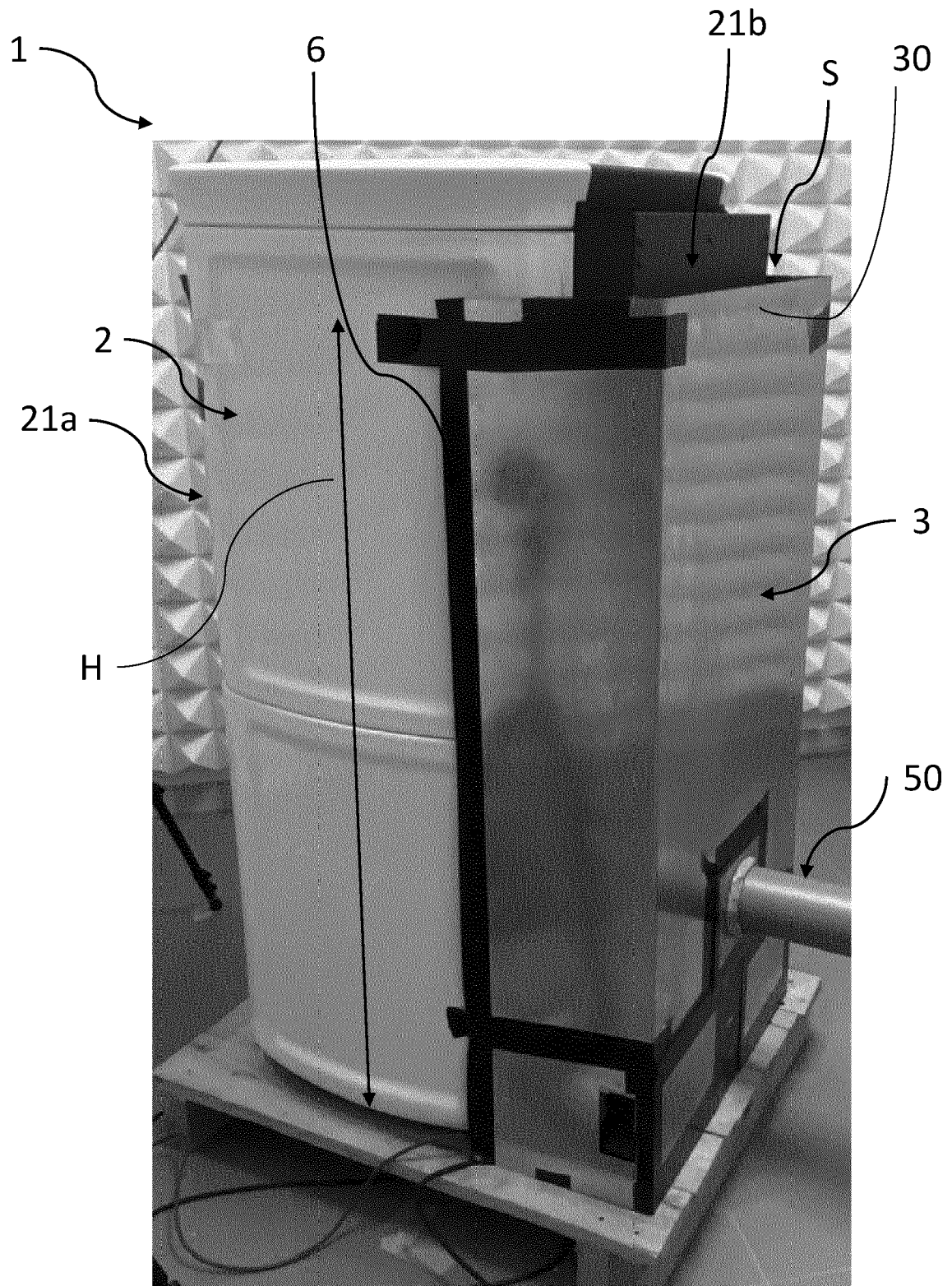


Fig. 1

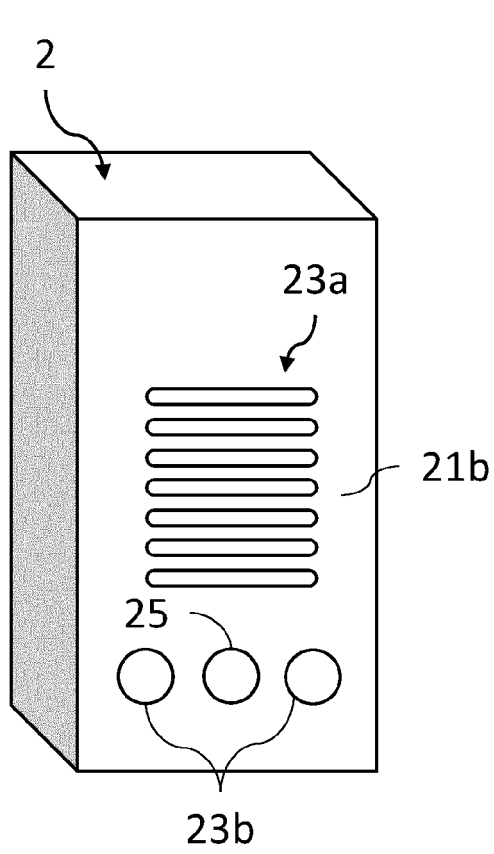


Fig. 2

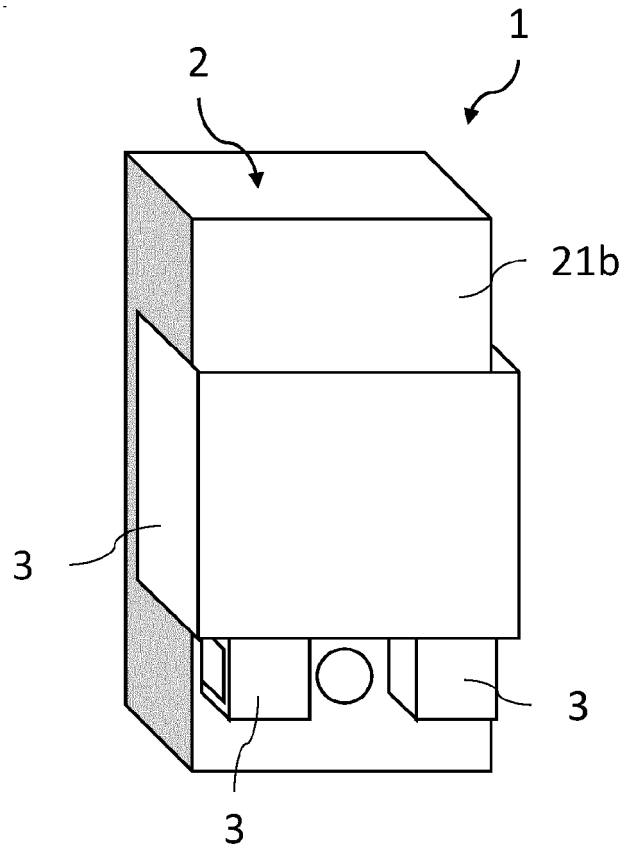


Fig. 3

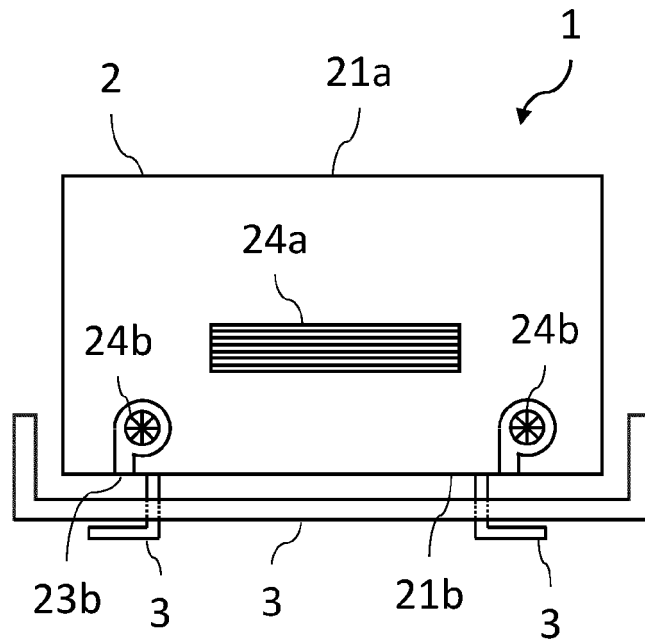


Fig. 4

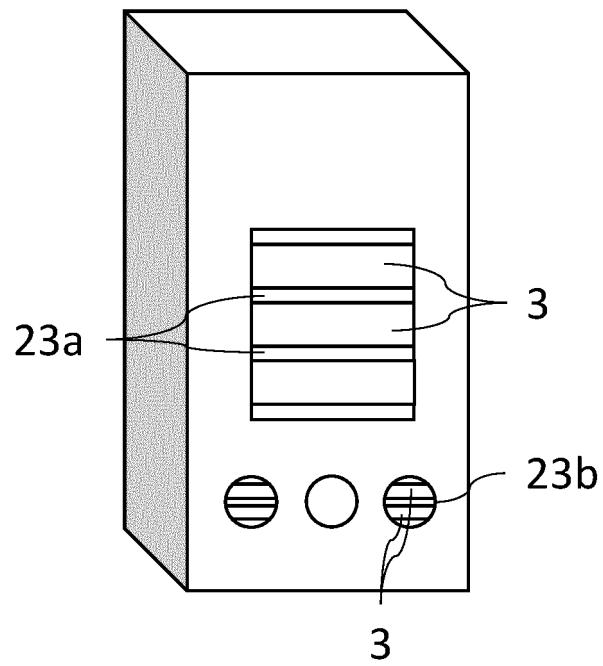


Fig. 5

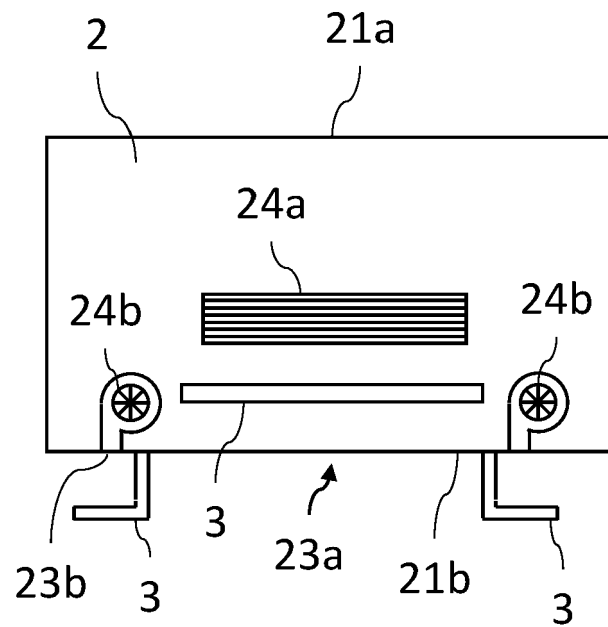


Fig. 6

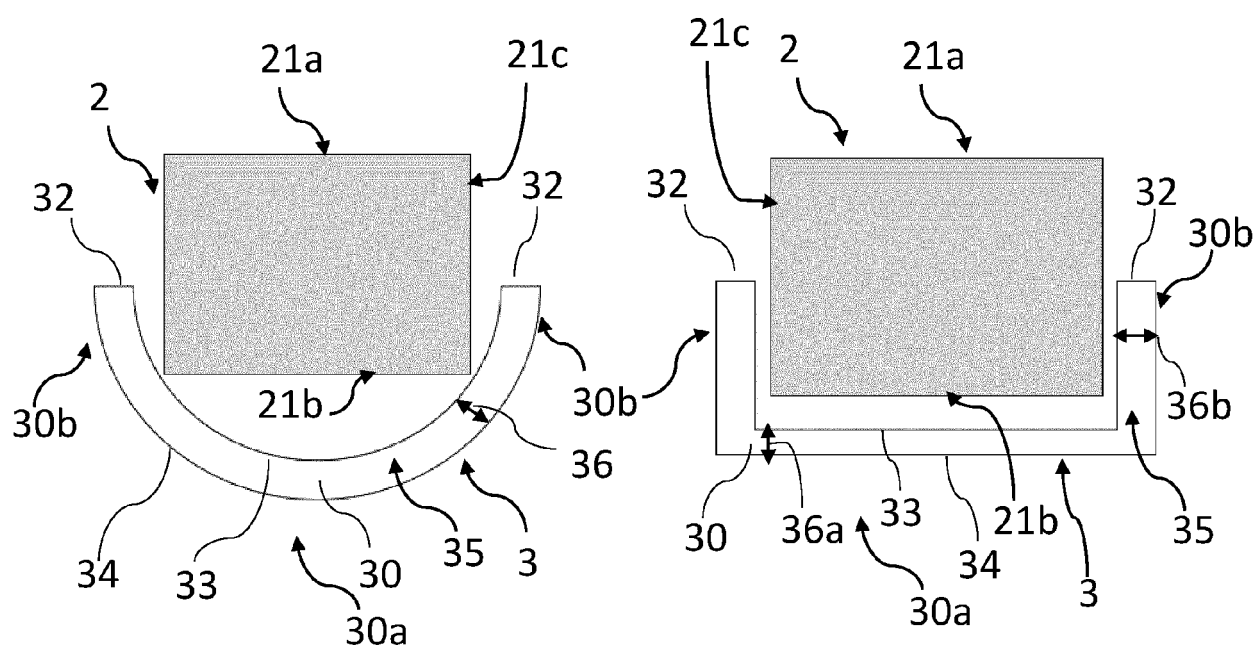


Fig. 7a

Fig. 7b

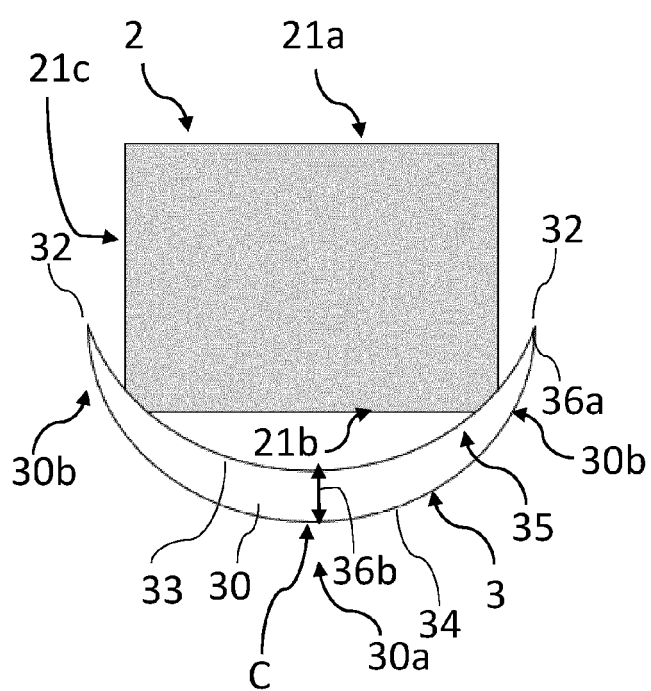


Fig. 7c

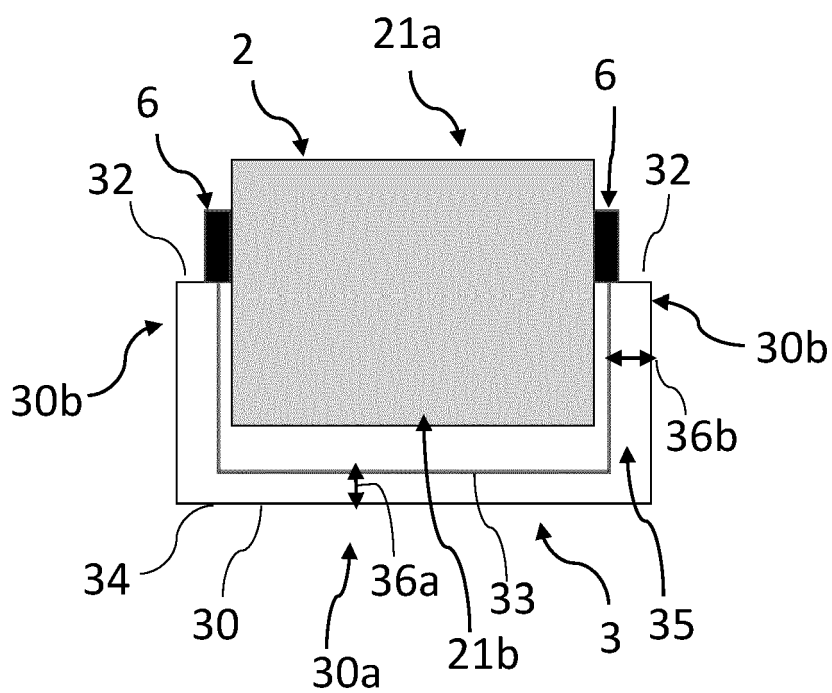


Fig. 7d

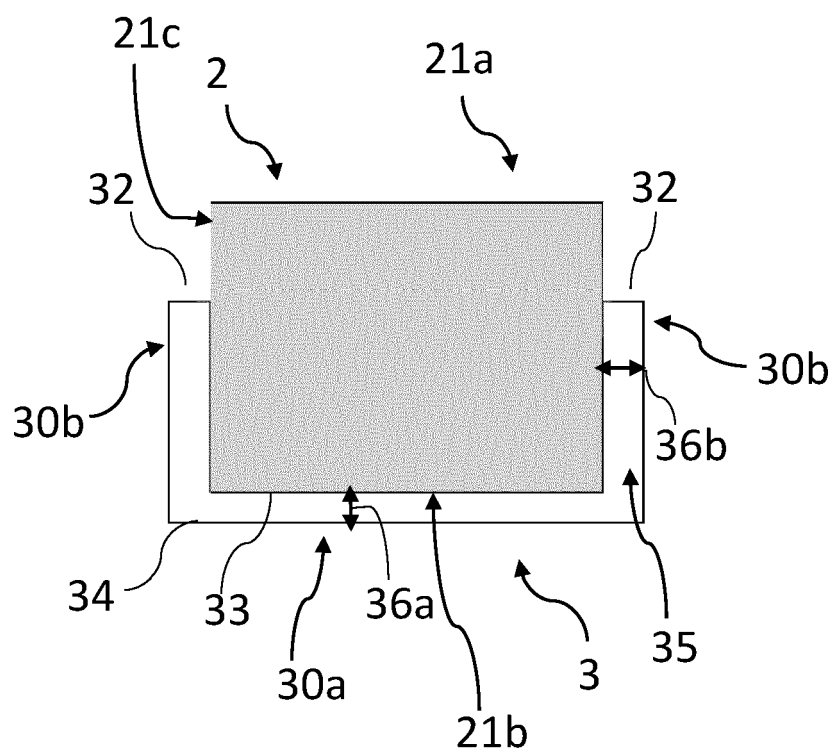


Fig. 7e

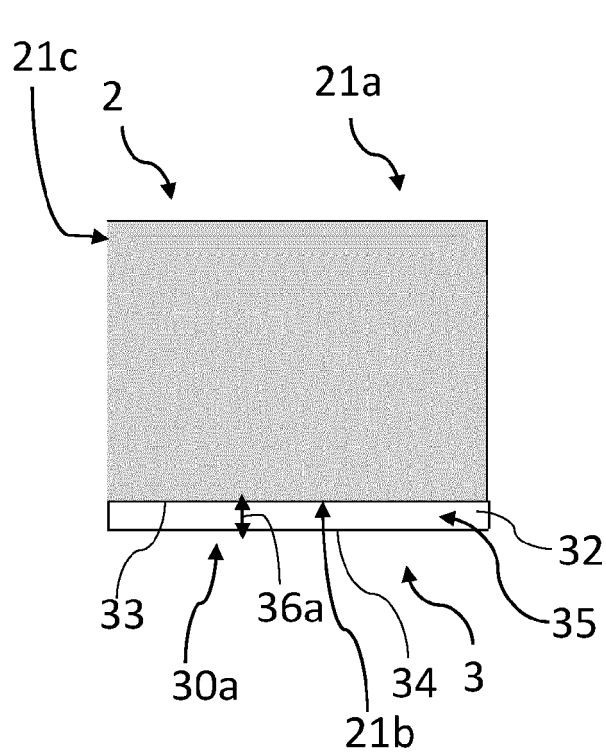


Fig. 7f

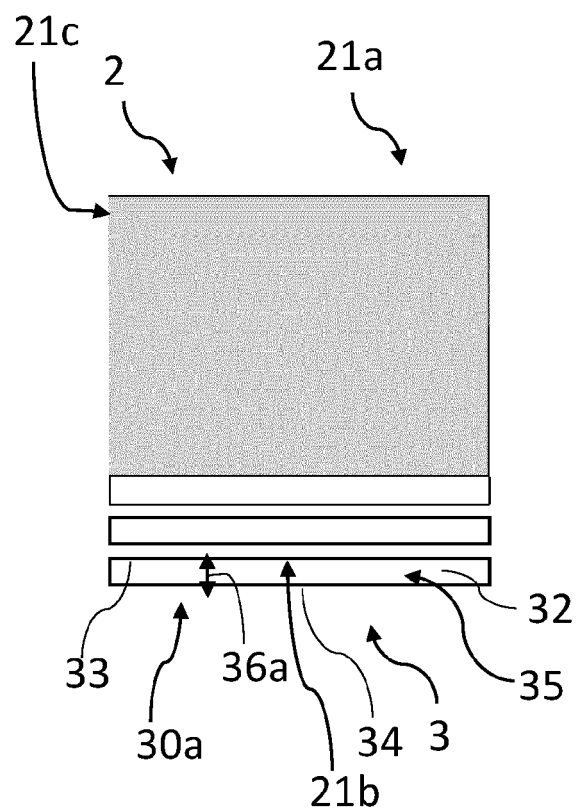


Fig. 7g

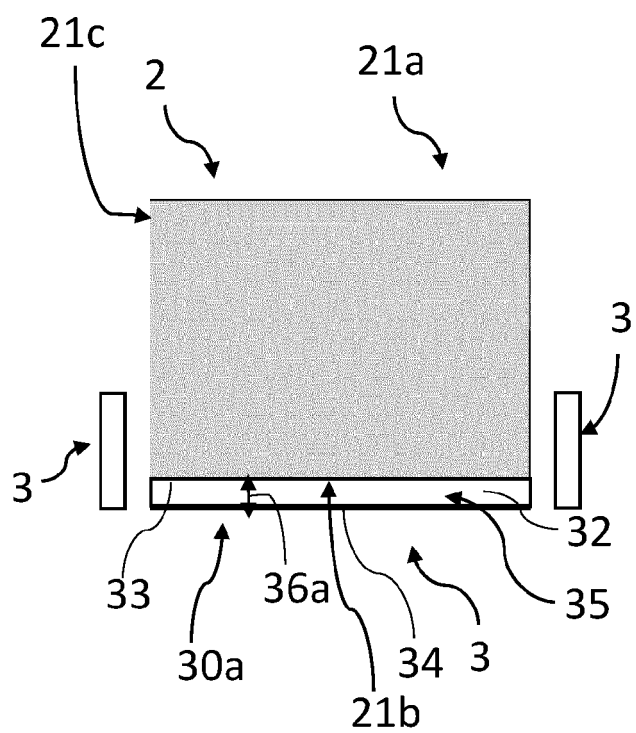


Fig. 7h

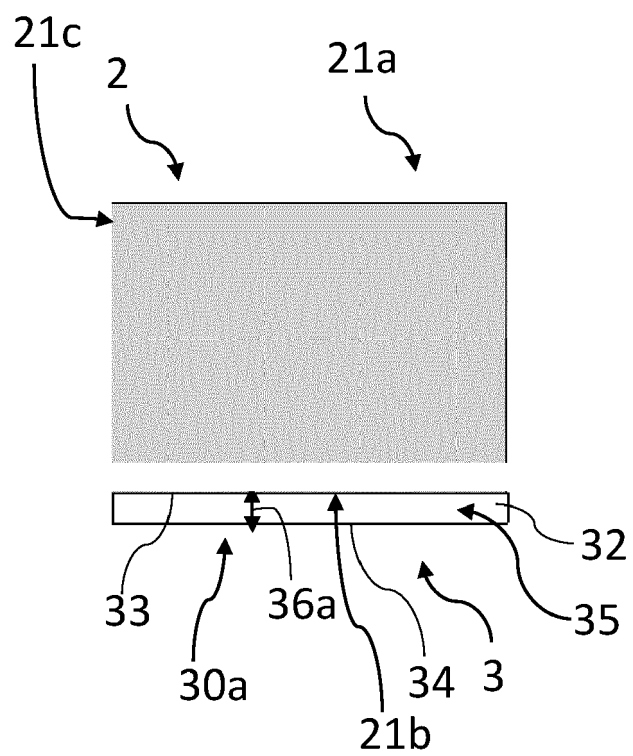


Fig. 7i

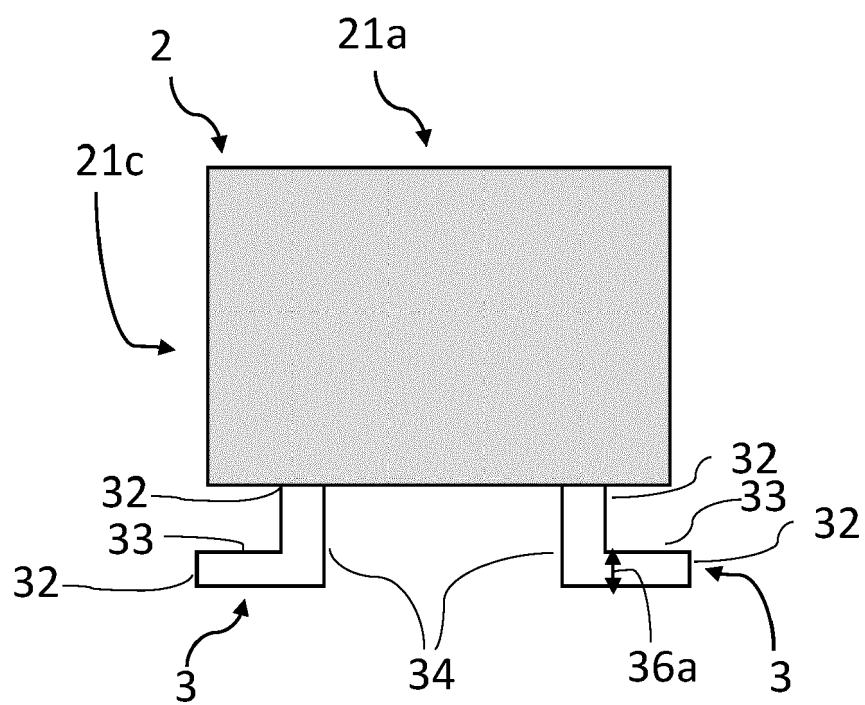


Fig. 7l

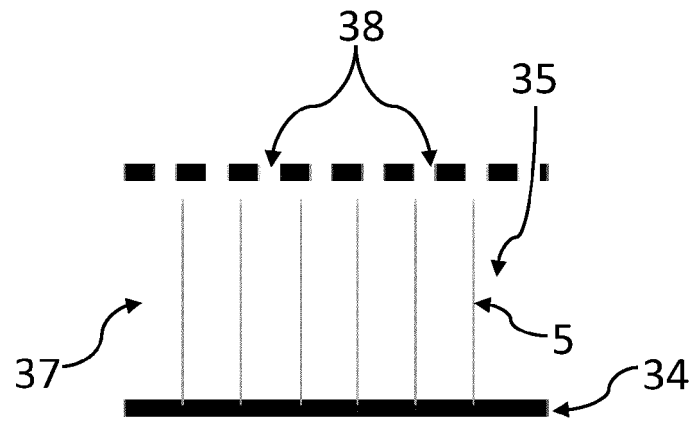


Fig. 8a

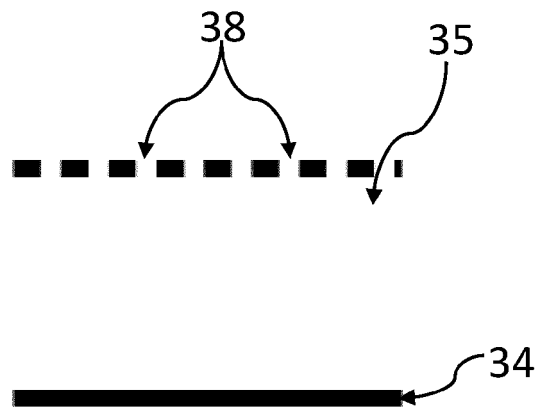


Fig. 8b

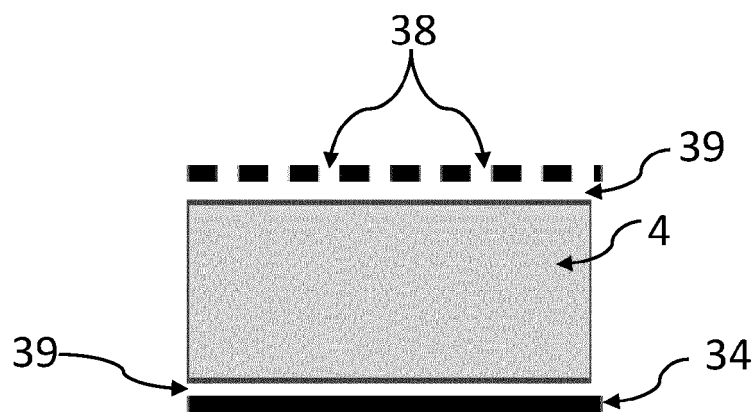


Fig. 8c

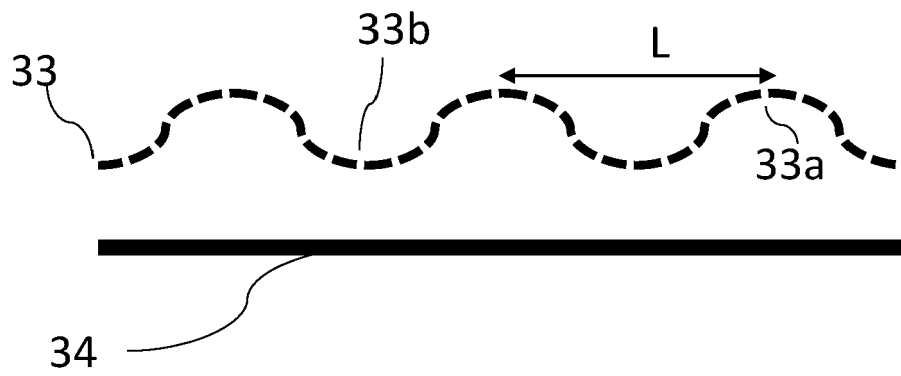


Fig. 8d

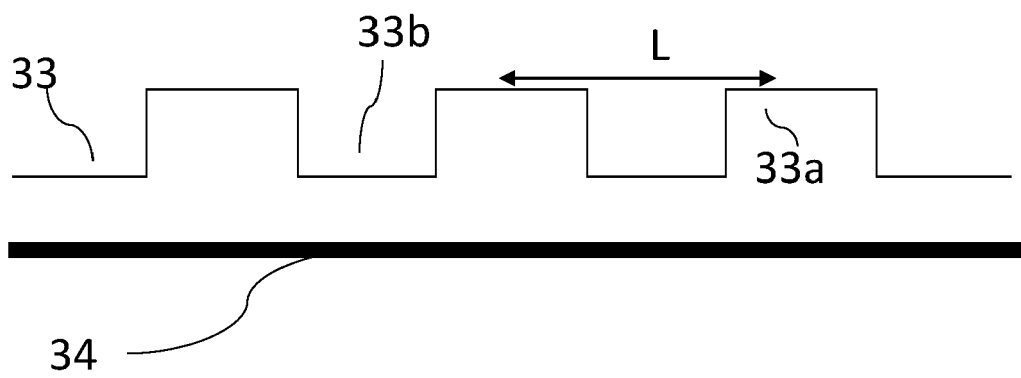


Fig. 8e



EUROPEAN SEARCH REPORT

Application Number

EP 24 15 6098

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A	US 4 862 993 A (RIEGER HEINZ H [CA]) 5 September 1989 (1989-09-05) * column 1, lines 28-35; figures 1-5 * -----	1-14	INV. F24B13/00 F24B1/195 E04B1/86
A	CN 108 361 740 A (ZHEJIANG ZHONGLI TOOL MFT CO LTD) 3 August 2018 (2018-08-03) * figure 1 * -----	1-14	F24B1/181 F24B1/185 F24B7/00
Y	US 2017/061949 A1 (AYRES COLIN [AU]) 2 March 2017 (2017-03-02) * paragraph [0003]; figure 1 * -----	1-14	
Y	JP 7 157974 B1 (PIXIE DUST TECH INC) 21 October 2022 (2022-10-21) * figures 2,3 * -----	10,12	
Y	JP S49 69714 U (UNKNOWN) 18 June 1974 (1974-06-18) * figure 4 * -----	8	
Y	SE 406 122 B (IMPULS INNOVATION AB [SE]) 22 January 1979 (1979-01-22) * figures 1-3 * -----	7	TECHNICAL FIELDS SEARCHED (IPC)
A	WO 2006/101403 A1 (DEAMP AS [NO]; VIGRAN TOR ERIK [NO]; PETTERSEN ODD [NO]) 28 September 2006 (2006-09-28) * figure 3 * -----	1-11	F24B G01K F23B E04B E01F F01N F24C
Y	EP 1 505 348 A2 (GRUPPO PIAZZETTA SPA [IT]) 9 February 2005 (2005-02-09) * figure 1 * -----	1-14	
X	EP 3 158 268 B1 (INVICTA GROUP [FR]) 6 May 2020 (2020-05-06) * paragraph [0057] * ----- - / - -	1	
The present search report has been drawn up for all claims			
Place of search		Date of completion of the search	Examiner
The Hague		6 June 2024	Adant, Vincent
CATEGORY OF CITED DOCUMENTS			
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EUROPEAN SEARCH REPORT

Application Number

EP 24 15 6098

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A	US 2019/212011 A1 (MCCORMICK COLIN [US] ET AL) 11 July 2019 (2019-07-11) * claim 1; figures *	1-14	
A	US 5 983 888 A (ANSELMINO JEFFERY JOHN [US] ET AL) 16 November 1999 (1999-11-16) * column 4, lines 54-57; figure 3 *	1-14	
The present search report has been drawn up for all claims			TECHNICAL FIELDS SEARCHED (IPC)
Place of search The Hague			Date of completion of the search 6 June 2024
Examiner Adant, Vincent			
CATEGORY OF CITED DOCUMENTS			
X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document			
T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO.

EP 24 15 6098

5

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
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06-06-2024

10

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20

25

30

35

40

45

50

55

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 4862993 A	05-09-1989	CA 1277604 C US 4862993 A	11-12-1990 05-09-1989
CN 108361740 A	03-08-2018	NONE	
US 2017061949 A1	02-03-2017	AU 2015252769 A1 US 2017061949 A1 WO 2015164929 A1	22-12-2016 02-03-2017 05-11-2015
JP 7157974 B1	21-10-2022	CN 116134195 A EP 4213144 A1 JP 7157974 B1 JP 7197876 B1 JP 2023024421 A JP 2023027207 A JP WO2023013323 A1 US 2023260496 A1	16-05-2023 19-07-2023 21-10-2022 28-12-2022 16-02-2023 01-03-2023 09-02-2023 17-08-2023
JP S4969714 U	18-06-1974	JP S4969714 U JP S5215930 Y2	18-06-1974 11-04-1977
SE 406122 B	22-01-1979	NONE	
WO 2006101403 A1	28-09-2006	CA 2602301 A1 DK 1861554 T3 EP 1861554 A1 ES 2609411 T3 JP 2008534820 A KR 20070112398 A NO 322685 B1 PL 1861554 T3 US 2008264720 A1 WO 2006101403 A1	28-09-2006 06-02-2017 05-12-2007 20-04-2017 28-08-2008 23-11-2007 27-11-2006 28-04-2017 30-10-2008 28-09-2006
EP 1505348 A2	09-02-2005	NONE	
EP 3158268 B1	06-05-2020	EP 3158268 A1 ES 2803237 T3 FR 3038034 A1 WO 2016207390 A1	26-04-2017 25-01-2021 30-12-2016 29-12-2016
US 2019212011 A1	11-07-2019	CA 3029354 A1 US 2019212011 A1	09-07-2019 11-07-2019
US 5983888 A	16-11-1999	NONE	

EPO FORM P0459

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