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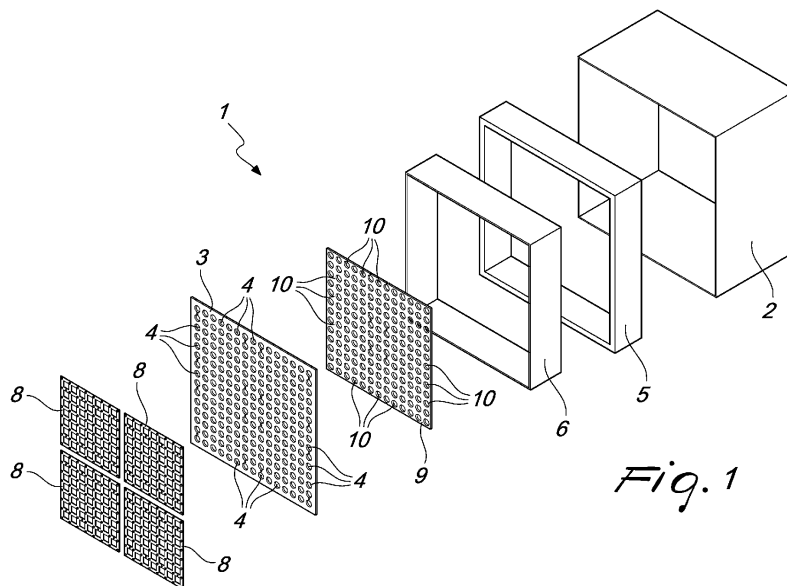
(54) **APPARATUS FOR THE TREATMENT OF ENVIRONMENTAL PARAMETERS**

(57) An apparatus (1) for the treatment of environmental parameters, which comprises:

- a box-like body (2) designed to be placed in an environment;
- at least one panel (3) which is rigidly coupled to the box-like body (2) and is substantially parallel to a fixing surface (S) of the environment; said panel (3) is provided

with a plurality of holes (4) of predefined breadth which are distributed according to a predefined pattern;

- at least one lighting assembly (8) which is associated with the panel (3) and is substantially parallel thereto and is oriented to emit the light beam toward the environment, i.e., with the respective light sources arranged opposite the fixing surface (S).



Description

[0001] The present invention relates to an apparatus for the treatment of environmental parameters.

[0002] The specific conditions that a person perceives in an environment are linked to parameters that said person assesses according to subjective criteria: in particular, these are parameters that each person can detect subjectively on the basis of their own senses.

[0003] The use of sound conditioning of some environments is known in order to minimize (dampen, attenuate) noise interference (so-called background noise) or to improve sound quality (as occurs for example in recording studios and TV studios).

[0004] Acoustic conditioning of an environment allows to change significantly the feelings experienced by the people who are in it: specific acoustic conditions may be suitable for conventions and professional meetings, others may be better suited to leisure or entertainment environments.

[0005] A same environment can therefore be reconfigured by means of sound-conditioning apparatuses of the known type depending on the activity that is expected to be performed, optimizing its acoustic output for it.

[0006] Other environmental conditioning parameters are related to the type of lighting and lighting technology criteria used to design it, as well as to the design of the environments and furnishings.

[0007] Unfortunately, these are distinct and often mutually conflicting aspects, which therefore challenge architects, designers and decorators who have to mutually integrate components and technologies that are scarcely compatible (or even not compatible at all).

[0008] The aim of the present invention is to solve the problems described above, providing an apparatus for the treatment of environmental parameters suitable to be completely integrated in the architectural elements of the environment.

[0009] Within this aim, an object of the invention is to provide an apparatus for the treatment of environmental parameters that is suitable for the acoustic conditioning of the environment.

[0010] Another object of the invention is to provide an apparatus for the treatment of environmental parameters that is suitable for the lighting the environment.

[0011] Another object of the invention is to provide an apparatus for the treatment of environmental parameters that is suitable for changing the environmental parameters also in an active manner.

[0012] Another object of the invention is to provide an apparatus for the treatment of environmental parameters that is suitable to allow subsequent reconfigurations of the environment.

[0013] A further object of the present invention is to provide an apparatus for the treatment of environmental parameters that has low costs, is relatively easy to provide in practice and is of assured application.

[0014] This aim and these and other objects which will

become better apparent hereinafter are achieved by an apparatus for the treatment of environmental parameters, characterized in that it comprises:

- a box-like body designed to be placed in an environment;
- at least one panel which is rigidly coupled to said box-like body and is substantially parallel to a fixing surface of the environment, said panel being provided with a plurality of holes of predefined breadth which are distributed according to a predefined pattern;
- at least one lighting assembly which is associated with said panel and is substantially parallel thereto and is oriented to emit a light beam toward the environment, i.e., with respective light sources arranged opposite the fixing surface.

[0015] Further characteristics and advantages of the invention will become better apparent from the description of a preferred but not exclusive embodiment of the apparatus for the treatment of environmental parameters, illustrated by way of non-limiting example in the accompanying drawings, wherein:

Figure 1 is a schematic exploded perspective view of a possible embodiment of an apparatus for the treatment of environmental parameters according to the invention;

Figure 2 is a schematic rear perspective view of the apparatus of Figure 1;

Figure 3 is a schematic partially hidden perspective view of the image of Figure 2;

Figure 4 is a schematic front perspective view of the apparatus of Figure 1;

Figure 5 is a schematic partially hidden perspective view of the image of Figure 4;

Figure 6 is a schematic front view of the apparatus of Figure 1;

Figure 7 is a schematic front view of the apparatus of Figure 1 during the adjustment of the frequencies subjected to attenuation;

Figure 8 is a schematic perspective view of a surface of an environment covered by apparatuses according to the invention.

[0016] With reference to the figures, an apparatus for the treatment of environmental parameters is generally designated by the reference numeral 1.

[0017] It should be noted, ahead of the specific description of the present invention, that in the background art the treatment of only the acoustic parameters of an environment involves an analysis of the volume and shape of the environment, the identification of its intended use, the finding of information related to the current situation (checking, for example, whether the environment is already furnished and in operation), the acquisition of acoustic information on the environment (for ex-

ample, by acquiring the reverberation time, STI). This information will affect the project along with other intervention parameters (such as the planned budget for it and its time requirements).

[0018] The impossibility to integrate the components by means of which the treatment of the acoustic parameters will be provided with the architectural and design requirements (which impose the adoption of a specific lighting technology design, certain furniture and/or the presence of other technical systems, such as ventilation and/or air treatment systems) creates very strict constraints for the general designer (who can therefore be at odds with the architect or designer or decorator who are working on the same environment at the same time).

[0019] Known techniques for the acoustic treatment of an environment are therefore often in sharp contrast with the lighting technology-oriented design of the environments: the apparatus 1 according to the invention allows the two fields of intervention to be combined, simultaneously performing both functions.

[0020] The apparatus 1 according to the invention comprises a box-like body 2 designed to be placed in an environment: in particular, the apparatus may be of a freestanding type (i.e., suitable for forming a wall or partition) or may be associated with a surface S of an environment.

[0021] The surface S might be a wall or the ceiling, although the possibility of fixing the apparatus 1 to furniture components, doors or other dividing elements designed to partition the environments and, in general, to any surface present within the environment to be worked on is not excluded.

[0022] The apparatus 1 according to the invention also comprises at least one associated panel 3 which is rigidly coupled to the box-like body and is substantially parallel to the fixing surface S. The panel 3 is conveniently provided with a plurality of holes 4 of predefined breadth, which are distributed according to a predefined pattern.

[0023] Optionally, there are respective frames 5, 6, interposed between the panel 3 and the box-like body 2 in order to ensure optimum positioning of the panel 3, taking advantage of the mechanical properties of the frames 5, 6 (or of those of the respective components that provide the mutual coupling) to prevent, for example, vibrations from being able to be transferred from the panel 3 to the box-like body 2 (and therefore to the surface S of the environment) and/or vice versa.

[0024] However, the possibility to render the panel 3 directly integral with the box-like body 2 in order to minimize the necessary components, is not excluded.

[0025] The joining of the panel 3 (and/or frames 5 and 6) to the box-like body 2 can be provided in a rigid, elastic manner or with the interposition of dampers (for example, layers of polymeric foams and the like).

[0026] In practice, the assembly of the box-like body 2, any frames 5, 6 and the panel 3 constitutes a Helmholtz resonator; it is, in other words, a particular acoustic resonant cavity conceived by Hermann von Helmholtz in

1860 for the study of sound and its perception. By oscillating the air contained in a resonator, stationary waves are generated inside it in resonance with the natural frequency of the cavity, which therefore behaves as a selective amplifier of sound in a narrow range of frequencies.

[0027] The dimensions and shape of the box-like body 2, of the frames 5, 6, of the panel 3 and the breadth and number of holes 4 are not fixed but are chosen as a function of each specific application: these dimensional geometrical parameters vary according to the dimensions and shape of the environment (as well as the allowable space occupations for the apparatus 1) and the resonance frequency at which one wishes the resonator to operate.

[0028] It is specified that a membrane 7 may be installed along the front edge of the box-like body 2 and may be affected by a plurality of distributed through receptacles and/or compact (having no perforations of any kind). Merely way of example, the membrane 7 may be made of fabric, mesh in sheet form or materials with equivalent characteristics.

[0029] The apparatus 1 according to the invention advantageously comprises at least one lighting assembly 8 which can face or be integrated with respect to the panel 3 and substantially parallel thereto.

[0030] The lighting assembly is oriented to emit the light beam toward the environment, i.e., with the respective light sources arranged opposite the fixing surface S.

[0031] It is specified that the apparatus 1 can also conveniently comprise means for adjusting the breadth of the holes 4: by virtue of the adjustment of said breadth, it will be possible to adjust the acoustic frequency ranges attenuated by the apparatus 1 by modifying the resonance frequency (as described previously in relation to the Helmholtz resonator).

[0032] The means for adjusting the breadth of the holes 4 are to be considered optional components of the apparatus 1, which is fully operational even in simpler versions in which the possibility to adjust the breadth of the holes 4 is not provided.

[0033] It should be noted that the means for adjusting the breadth of the holes 4 may advantageously comprise a plate 9 provided with a predefined number of openings that have dimensions and a distribution that correspond to those of the holes 4 present on the panel 3.

[0034] The plate 9 is movable along a face of the panel 3, modifying, according to its position, the breadth of the passages constituted by each hole 4 partially covered by the plate 9 and therefore allowing an easy adjustment of the resonance frequency (which corresponds to the frequency for which the apparatus 1 will provide the best acoustic attenuation).

[0035] The movement of the plate 9 on the panel 3 may be manual (an operator may "calibrate" the apparatus 1 from the outside by moving the plate 9), or automatic, by virtue of respective actuators.

[0036] With particular reference to an embodiment of

unquestionable interest in practice and in application, the at least one lighting assembly 8 may conveniently comprise a plurality of side-by-side LEDs 11 distributed along respective linear portions.

[0037] In accordance with what is shown by way of non-limiting example in the accompanying figures, the at least one lighting assembly 8 with LEDs 11 may favorably comprise a plurality of LEDs 11 which are distributed according to a matrix 12 which comprises a plurality of mutually intersecting linear portions.

[0038] In practice, each lighting assembly 8 of the type just described is affected by a plurality of through windows 13 defined between bands 14 for supporting the linear portions along which the LEDs 11 are arranged.

[0039] As an alternative, it is also possible to arrange the LEDs 11 directly on the panel 3 (at its portions not affected by the holes 4): this embodiment is particularly interesting, since it allows to minimize the components, allowing therefore also a reduction in the overall thickness of the apparatus 1, which is a particularly interesting solution for some specific applications.

[0040] In particular, it is noted that the lighting assemblies 8 may preferably be at least two (the accompanying figures show, by way of non-limiting example, an embodiment that uses four separate lighting assemblies 8), which will mutually be arranged side by side and substantially parallel.

[0041] All the lighting assemblies 8 that are present face the panel 3 and their set has an overall contour, the shape and dimensions of which are proximate to those of the corresponding panel 3.

[0042] It is also noted that the apparatus 1 may usefully comprise at least one control and management unit (not shown in the accompanying figures), functionally associated with at least one sensor (not shown in the accompanying figures), which is chosen between acoustic sensors and optical sensors. In any case, the use of thermal sensors as well (in order to detect abnormal thermal conditions) or motion sensors (in order to detect a seismic event, for example) is not excluded.

[0043] The control and management unit may be validly connected to respective means for the adjustment and control of the light beam emitted by the lighting assembly 8, so as to control (and adjust) in feedback the parameters of the emitted light beam as a function of the signals detected by the at least one sensor.

[0044] In practice, therefore, it is possible to change the intensity and color of the light beam emitted by the at least one lighting assembly 8 as a function of the parameters detected by the at least one sensor: for example, in the presence of sunlight coming from outside the environment it is possible to reduce the intensity of the emitted beam or select a specific color temperature thereof, or it is possible to change the intensity of the emitted beam and also its color upon specific detected acoustic signals.

[0045] In the event of a fire (detected by the thermal sensors) or a seismic event (detected by the motion sen-

sors), the apparatus 1 may be commanded to send safety information to the people present (for example, in order to identify escape routes or to broadcast pre-recorded acoustic messages).

[0046] It should be noted that the apparatus 1 according to the invention may also comprise at least one element for the actuation of the means for adjusting the breadth of the holes 4: said at least one actuation element is controlled by the at least one control and management unit for feedback control of the breadth of holes 4 as a function of the signals detected by the at least one sensor.

[0047] In practice, therefore, if the sensors detect a particular intensification of (unwanted) interference signals in the acoustic field, the control and management unit may command the actuator to adjust the breadth of the holes 4, setting the resonance frequency precisely to the frequency of said unwanted signals, so as to dissipate them, avoiding their reverberation and reflection.

[0048] With particular reference to an embodiment of unquestionable interest in practice and in application, the apparatus 1 can be active and advantageously comprises at least one acoustic generator (not shown in the accompanying figures) of the type suitable, optionally in combination with other components, to emit sound waves and associated with a respective control computer.

[0049] From a constructive standpoint, it is specified that the alternative embodiment proposed in the accompanying figures by way of non-limiting example provides that the at least one lighting assembly 8 is advantageously arranged proximate to the fixing surface S, the at least one panel 3 is advantageously adjacent to the face that is directed toward the outside environment of the at least one lighting assembly 8, the means for adjusting the breadth of the holes 4 (in particular the plate 9 provided with the openings 10) are positively contiguous to at least one of the faces of the panel 3.

[0050] As shown in Figure 8, the set of multiple apparatuses can give the surface S the role of a variable passive acoustic treatment system.

[0051] Any presence of at least one acoustic generator in the apparatuses 1 installed on a surface S will give said surface the role of a variable active acoustic treatment system.

[0052] In its simplest version, the apparatus 1 may comprise only the panel 3 and the at least one assembly 8 within the box-like body 2: the resonance frequency of the apparatus is not adjustable and depends (in addition to the dimensions of the box-like body 2) on the number, breadth and distribution of the holes 4 on the panel 3. In this case each apparatus 1 performs an attenuation of the noise (unwanted acoustic waves) having a frequency close to the resonance frequency (or falling within a fixed predefined frequency range).

[0053] By virtue of the adoption of the means for adjusting the breadth of the holes 4 (for example, by virtue of the presence of the plate 9) it is possible to vary the resonance frequency by changing the breadth of the holes 4 (by moving the plate 9 and partially occluding the

holes 4). In this case, each apparatus 1 performs at all times an attenuation of noise (unwanted acoustic waves) having a frequency close to the resonance frequency (or falling within a fixed predefined frequency range), but said frequency may be adjusted by modifying the breadth of the holes 4.

[0054] The movements of the plate 9 cause, as its position in space (along the X, Y, and Z coordinates) varies, a variation in the performance of the resonator in terms of absorption at the various frequencies. It is therefore noted that the plate 9 may, in particular embodiments, move also in a direction of approach/spacing with respect to the panel 3, thus affecting the frequencies of the acoustic signals that are absorbed by the apparatus 1.

[0055] The required breadth of the displacement of the plate 9 can be defined empirically, or by following preset position indications according to the desired type of absorption (for example, 100 Hz - 200 Hz - 500 Hz or other frequencies), or also, more simply, in relation to the intended use of the environment at a given time (for example, full auditorium - medium capacity auditorium - half-empty auditorium).

[0056] Logically, when referring to an auditorium or a recording studio, it is necessary to point out that it is not possible to use a single apparatus 1 in order to achieve the desired result, making it necessary to pair/combine a plurality of apparatuses 1: in this case, in fact, the acoustic correction intervention cannot be entrusted to a single apparatus 1, but multiple apparatuses 1 are required in order to discretize the entire installation surface S.

[0057] The set of devices 1, in turn, can be calibrated (adjusted, tuned) in a static configuration (i.e., in which it is not possible to adjust the breadth of the holes 4), in a variable configuration (by adjusting the breadth of the holes 4 empirically or according to preset manual or mechanical indications as mentioned above) or even in a mixed configuration (i.e., in which some apparatuses 1 are in a static configuration and others are in a variable configuration).

[0058] The apparatuses 1 can be installed on the surface S in a regular manner with a space that is predefined by them (a gap) and can vary depending on the design.

[0059] This predefined space is an element that, in similar arrangements, affects the acoustic response of the surface S and is an element that can be controlled at the design stage in terms of final acoustic performance. The apparatuses 1 may also be arranged differently in the spaces: in a column, distributed unevenly, or even according to specific geometric configurations (even substantially imaginary ones), always taking care that the set of apparatuses 1 produces the desired effect from an acoustic point of view.

[0060] Moreover, the apparatuses 1 may also have any shape, as well as any dimensions, depending on the specific installation requirements.

[0061] If one wishes to use apparatuses 1 of the active type, it is a matter of adding the acoustic generator so

that the apparatus can react "actively" (and automatically) to external information, adapting its performance status to the specific requirement.

[0062] Control of the acoustic functions of the set of apparatuses 1 can be assigned to dedicated software capable of managing a stream of preset data toward said set, while processing data that arrive both from each of the installed apparatuses 1 and from the host environment (the software acts on the control and management unit and/or on an external computer associated with it). This means that the geometric changes of the apparatuses 1 (in terms of changes in the breadth of the holes 4 or in terms of the acoustic waves produced by the acoustic generator) can be commanded via the software and can comply with specific encodings or can be defined (and commanded) as a result of the processing of the data by said software.

[0063] The first "active" function of the set of apparatuses 1 is therefore expressed as the adaptability to different acoustic scenarios determined by the intended use of the environment or by the momentary state thereof (for example, presenting a different response upon a full or half-full auditorium).

[0064] The second "active" function, which is added to the previous one, consists in using the panel 3 (and possibly also the plate 9) of the individual apparatuses 1 to emit sound upon commands of the acoustic generator.

[0065] In its most interesting form, in fact, the acoustic generator merely induces vibrations of the panel 3 and/or plate 9 which determine the generation of acoustic waves that can be propagated in the environment (in practice, the panel 3 and/or the plate 9 act as speakers, which are driven by using operating software).

[0066] The set of apparatuses 1, thus conceived, in this case has an active acoustic configuration. In summary: the use of artificial intelligence in conjunction with the ability to emit sound shifts the set from the family of PASSIVE configurations to the ACTIVE one.

[0067] It is worth specifying that a system of apparatuses 1 in active acoustic configuration does not necessarily have to provide the variability function of the system in acoustic terms. The variability of the acoustic performance (rarely required, also because it is extremely expensive) is an available option, which allows accurate tuning of the environments, even in real time, but is not a necessary condition to define an active configuration system. It is therefore specified that the apparatuses 1 in the active acoustic configuration may also not include the means for adjusting the breadth of the holes 4.

[0068] The set of apparatuses 1 according to the invention also allows to provide that the lighting is an integrated element and not a "foreign object" to each apparatus 1; the acoustic phenomenon and the light phenomenon in each apparatus 1 mutually interact, generating innovative semiotic and functional connotations.

[0069] For this reason, the apparatus 1 comprises the at least one lighting assembly 8 which can be applied on the matrix 12 and proximate to the panel 3.

[0070] In any case, whether the lighting assemblies 8 are applied in adhesion to the panel 3 or spaced from it, the effect that this operation can have on the proper functioning of the resonator must be taken into account. In both cases (adhesion or spacing) the lighting assembly 8 must be "transparent" to sound and must not compromise the action capabilities of the panel 3 (in particular the lighting assemblies 8 must not in any way occlude the holes 4, and for this reason the matrix 12 is provided with the through windows 13).

[0071] The apparatus 1 can be provided with the additional membrane 7, which can be customized with acoustically compatible fabrics, so as to conceal the internal geometric shapes of the apparatus 1 and meet aesthetic design requirements.

[0072] The lighting assemblies 8 can be controlled by the above-mentioned control computer, thus fulfilling their task of furnishing and lighting.

[0073] According to the invention it is possible to entrust lighting control to the central intelligence of the management software of the system. The reason for this choice will become apparent in the following application examples: its result is a new generation system with semiotic and synesthetic capabilities that do not exist in known products.

[0074] When designing a restaurant (for example), the architect can decide whether to use all the information about the apparatus 1 according to the invention (and the related instruments), and proceed with the design of the environment including the acoustic part (vertical approach). This is one of the manners. Another hypothesis is that the architect uses only part of the information of the system (for example, finishes, modularity, dimensions, spatial layout, light control), confident that the design of the acoustic treatment will not subsequently entail any changes to his own design (superficial approach).

[0075] In practice, in both cases, the architect can simply use the apparatus 1 according to the invention as a furnishing element without worrying about obtaining a good acoustic climate of the environment.

[0076] The architect can be assisted by a competent technician who performs the required measurements to obtain the data that allow a check of the actual quantity (and specific acoustic characteristics) of apparatuses 1 required.

[0077] However, the possibility of using software applications that allow the architect to automatically perform a reliable acoustic investigation and determine the number of apparatuses 1 required, is not excluded. In the case of "simple" interventions, or on a small budget, this superficial approach can be very useful.

[0078] The number of apparatuses 1 to be arranged in the environment and their geometric shape are the only information useful to the architect in order to be able to proceed with executive design. The conditions of intervention may require the use of apparatuses 1 in a specific configuration (passive static or passive variable or even active). While the choice of the suitable configuration

(whether passive static or passive variable) is a strictly acoustic matter (as regards the passive static and variable configurations, this is in fact a manner of acoustic performance of the apparatus 1), the same cannot be said when entering the field of active configuration: in this case, the set of apparatuses 1 no longer represents only a "passive" acoustic treatment element, but can interact with the host environment and determine actions and reactions (imagine, for example, that the apparatuses 1 perform the task of broadcasting ambient music or generate sounds with the function of "masking" noise).

[0079] The apparatuses 1 can produce/control the sound: this production can be the result of a simple data transmission to the system (for example, background music), or it can be derived from a real-time acoustic climate analysis with consequent processing and response (for example, masking). By virtue of the presence of the lighting assemblies 8, however, the apparatus 1 turns into a complex instrument for acoustic control and communication, since this component can be correlated with the acoustic phenomenon.

[0080] Imagine that the restaurant is open: a crowded room in which one can experience (as in any restaurant or crowded environment) what is known in acoustics as the "Lombard effect". The background noise, due to chatter and anthropic noises, rises constantly until it reaches a maximum peak, after which it descends abruptly and then resumes its tendency to rise, and so on all the time. This effect may be more or less noticeable, depending indeed on the quality of the acoustic climate of the room: the better the acoustic treatment, the lower the maximum noise peak.

[0081] By means of the set of apparatuses 1 it is possible to "level" the background noise with music or with a gentle musical background. The volume of the musical background may follow a wave-like pattern similar to the diagram of the Lombard effect, but it can do so in such a manner as to anticipate the natural noise peak of the room, so as to allow an anticipated abrupt drop of the background noise in order to return to the baseline sound level, with the result of inducing people instinctively to lower their voice level.

[0082] The considerable innovation that resides in the apparatuses 1 according to the invention is that the light that they emanate can be a soft light that fits in well with the elegant environment designed by the architect.

[0083] It is even possible to choose a lighting with an intensity and a color temperature that are suitable and paired with the context of the evening.

[0084] What is extremely important, however, is that the light emitted by each apparatus 1 according to the invention is not fixed; it can undergo constant variations (for example, it can evoke the northern lights).

[0085] As the sound intensity of the musical background (background music) and anthropogenic noises (background noises) rises, the color of the emitted light beam may conveniently shift slowly toward red up to the artificial maximum peak of the musical background

(background music) produced by the intelligence of the apparatus 1: once this condition has been passed, the lighting quickly returns to its initial color, thus demonstrating that the apparatus 1 allows a conditioning of the environmental parameters that also induces virtuous behaviors among the people present in the environment in which they are installed.

[0086] The example of the restaurant is only one of the many fields of application in which the semiotic and synesthetic value of the system of apparatuses 1 according to the invention can improve the experiential path of the users and the quality of the work of the operators.

[0087] A further, rather extreme hypothesis of application can also be analyzed in which the semiotic value (but not the synesthetic value) fades into the background, but in which the apparatuses 1 according to the invention continue to be in fact the only viable route to obtain the desired results from the different operators who are working in the same environment.

[0088] Following the current trend, whereby radio is becoming visual radio, classic radio broadcasting studios have shown their limitations and solutions have been sought to meet the needs of the technicians. On the one hand, the video technician, with his lighting needs; and on the other, the audio technician with his sound acquisition needs; furthermore, the Artistic Director and the Communications Manager must also be included along these roles. The experiments conducted so far, in which, for example, LED screens have been placed in front of walls provided with acoustic treatment means, have shown a reduction in the quality of acoustic acquisitions (sound recordings), forcing technicians to work on filters or in postproduction. Once again, it results a conflicting cohabitation of the sound element and the light element.

[0089] The apparatus 1 according to the invention meets the "stage" requirements with a single product: thanks to the use of apparatuses 1 according to the invention, the function of luminous "backdrop" does not have to be provided at the expense of acoustic performance, which instead remains preponderant and even with the possibility of variations depending on stage setups. At the same time, the apparatuses 1 according to the invention are configured as customizable design elements, in contrast with the cold character of traditional LED screens.

[0090] Even with just a small stretch of the imagination, it is intuitive to identify the considerable difference between a set of apparatuses 1 (continuously reconfigurable and fully integrated into the design of the installation environment) and an LED screen.

[0091] The apparatus 1 according to the invention is at the same time:

- a luminaire which can simply illuminate, or which reacts to external stimuli, by means of a system of dedicated sensors and software, by releasing a series of visual information items (signals, colors, ambi-
ances),

- a sound-absorbing element (passive acoustics), which absorbs sound energy in the frequency range that needs to be controlled in that particular context,
- a sound source (active acoustics) which can play music or sound signals performing, in addition to the classic tasks of acoustic treatment and lighting, the more complex tasks of a semiotic and synesthetic nature.

[0092] The apparatus 1 according to the invention (either as a single element or as part of systems constituted by a specific number of functionally associated apparatuses 1) can find assured and valid application in hotels, reception areas, restaurants, airports, stations, public spaces, waiting rooms, radio or television studios or recording studios, lobbies facing the stalls of a theater (foyer), conference rooms, auditoriums, listening rooms, thermal and wellness environments (spas), home theaters, music therapy environments, motivational booths, and the like.

[0093] Advantageously, the present invention solves the problems described above by providing an apparatus 1 for the treatment of environmental parameters that is suitable to be fully integrated into the architectural elements of the environment.

[0094] Conveniently, the apparatus 1 according to the invention is suitable for the sound conditioning of the environment.

[0095] Advantageously, the apparatus 1 according to the invention is suitable for lighting the environment.

[0096] Usefully, the apparatus 1 according to the invention is suitable to modify the environmental parameters of the environment also in an active manner.

[0097] Favorably, the apparatus 1 according to the invention is suitable to allowing subsequent reconfigurations of the environment.

[0098] Validly, the apparatus 1 according to the invention is relatively easy to provide in practice and substantially low in cost: these characteristics make the apparatus 1 according to the invention an innovation of assured application.

[0099] The invention thus conceived is susceptible of numerous modifications and variations, all of which are within the scope of the appended claims; all the details may furthermore be replaced with other technically equivalent elements.

[0100] In the exemplary embodiments shown, individual characteristics, given in relation to specific examples, may actually be interchanged with other different characteristics that exist in other exemplary embodiments.

[0101] In practice, the materials used, as well as the dimensions, may be any according to the requirements and the state of the art.

[0102] The disclosures in Italian Patent Application No. 102021000031421 from which this application claims priority are incorporated herein by reference.

[0103] Where technical features mentioned in any claim are followed by reference signs, those reference

signs have been included for the sole purpose of increasing the intelligibility of the claims and accordingly such reference signs do not have any limiting effect on the interpretation of each element identified by way of example by such reference signs.

Claims

1. An apparatus for the treatment of environmental parameters, **characterized in that** it comprises:
 - a box-like body (2) designed to be placed in an environment;
 - at least one panel (3) which is rigidly coupled to said box-like body (2) and is substantially parallel to a fixing surface (S) of the environment, said panel (3) being provided with a plurality of holes (4) of predefined breadth which are distributed according to a predefined pattern;
 - at least one lighting assembly (8) which is associated with said panel (3) and is substantially parallel thereto and is oriented to emit a light beam toward the environment, i.e., with respective light sources arranged opposite the fixing surface (S).
2. The apparatus according to claim 1, **characterized in that** it comprises means for adjusting the breadth of said holes (4), which corresponds to the adjustment of the intervals of the acoustic frequencies attenuated by said apparatus (1).
3. The apparatus according to claim 1, **characterized in that** said means for adjusting the breadth of said holes (4) comprise a plate (9) provided with a predefined number of openings (10) the dimensions and distribution of which correspond to those of the holes (4) that are present on said panel (3), said plate (9) being movable along one face of said panel (3).
4. The apparatus according to one or more of the preceding claims, **characterized in that** said at least one lighting assembly (8) comprises a plurality of LEDs (11) arranged side by side and distributed along respective linear portions.
5. The apparatus according to claim 4, **characterized in that** said at least one lighting assembly (8) comprises a plurality of LEDs (11) which are distributed according to a matrix (12) which comprises a plurality of mutually intersecting linear portions (14).
6. The apparatus according to one or more of the preceding claims, **characterized in that** said lighting assemblies (8) are at least two, are arranged mutually side by side and substantially parallel and face said panel (3), the set of all of said side-by-side and

contiguous lighting assemblies (8) having an overall contour the shape and dimensions of which are proximate to those of said panel (3).

7. The apparatus according to one or more of the preceding claims, **characterized in that** it comprises at least one control and management unit which is functionally associated with at least one sensor, chosen between acoustic sensors and optical sensors, and is connected to respective means for the adjustment and control of the light beam emitted by said lighting assembly (8), for the feedback control of the parameters of the emitted light beam as a function of the signals detected by the at least one sensor.
8. The apparatus according to claims 2 and 7, **characterized in that** it comprises at least one element for the actuation of said means for adjusting the breadth of said holes (4) which is controlled by said at least one control and management unit, for the feedback control of the breadth of said holes (4) as a function of the signals detected by the at least one sensor, with consequent adjustment of the attenuation frequencies of specific acoustic signals.
9. The apparatus according to one or more of the preceding claims, **characterized in that** it comprises at least one acoustic generator of the type adapted, optionally in combination with other components, to emit sound waves, said acoustic generator being associated with a respective control computer.
10. The apparatus according to one or more of the preceding claims, **characterized in that** said at least one lighting assembly (8) is arranged proximate to said fixing surface (S) of said environment, said at least one panel (3) is adjacent to the face that is directed toward the outside environment of said at least one assembly (8), and said means for adjusting the breadth of said holes (4) of said at least one panel (3) are contiguous to at least one of the faces of said panel (3).

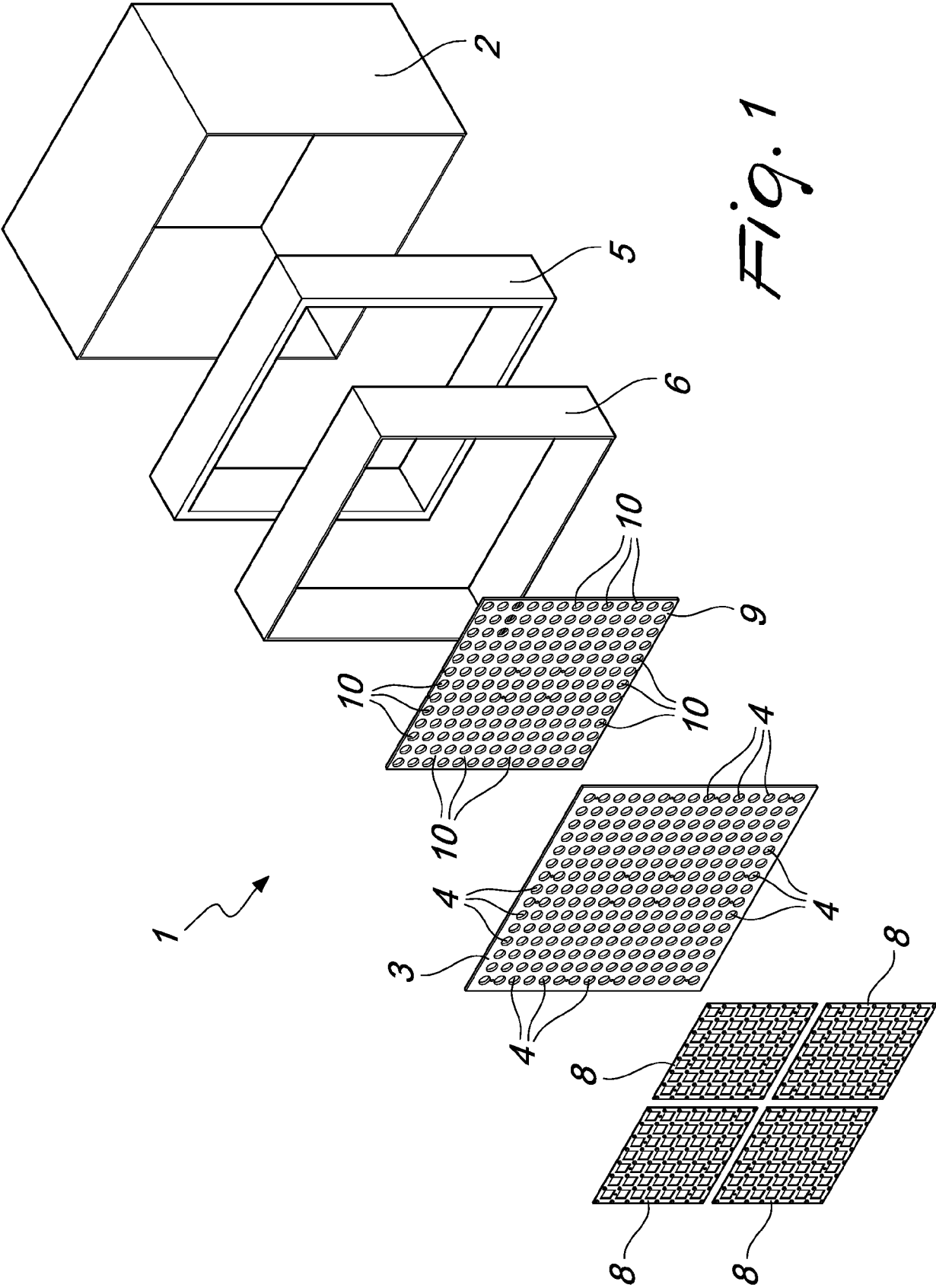


Fig. 1

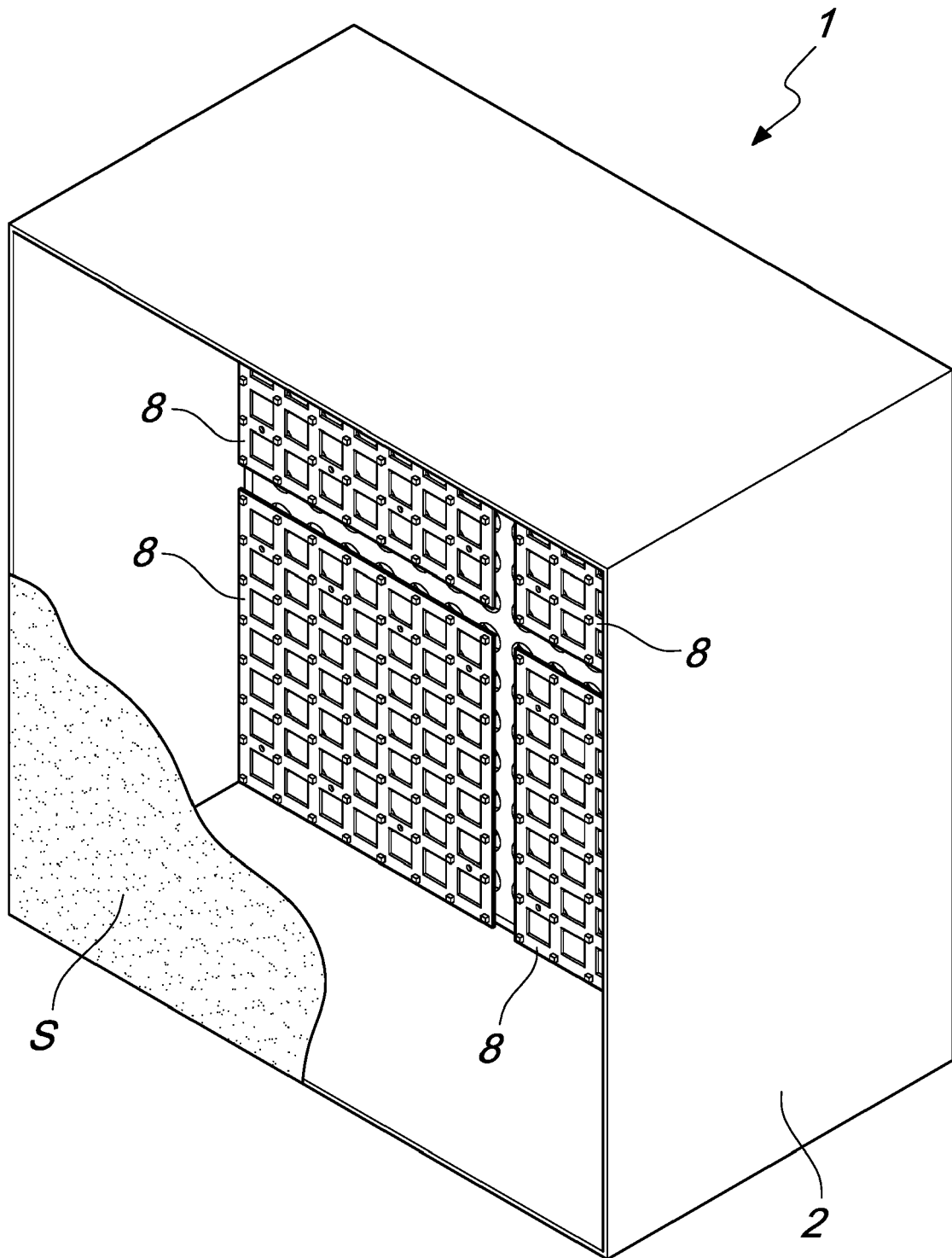


Fig. 2

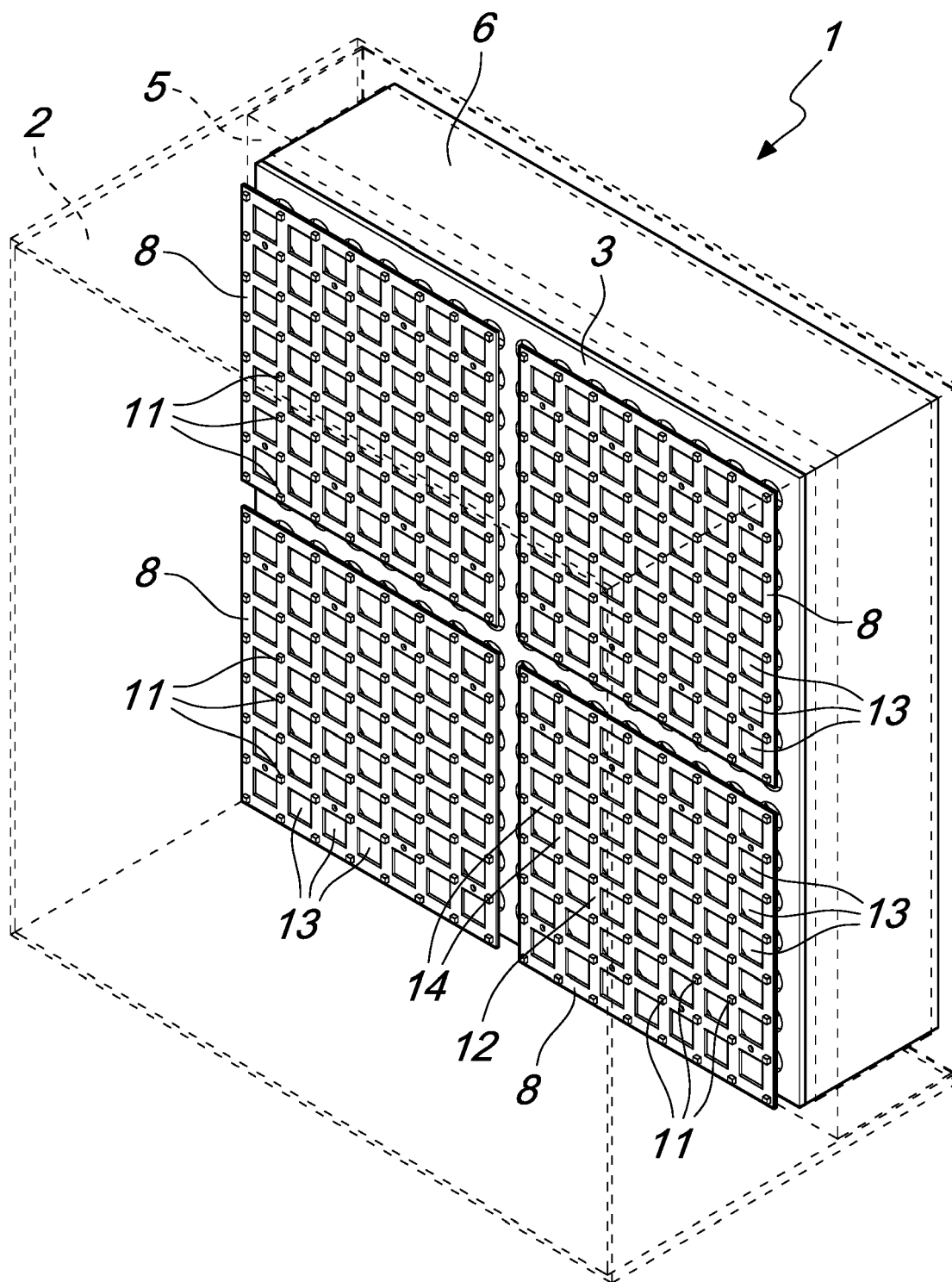


Fig. 3

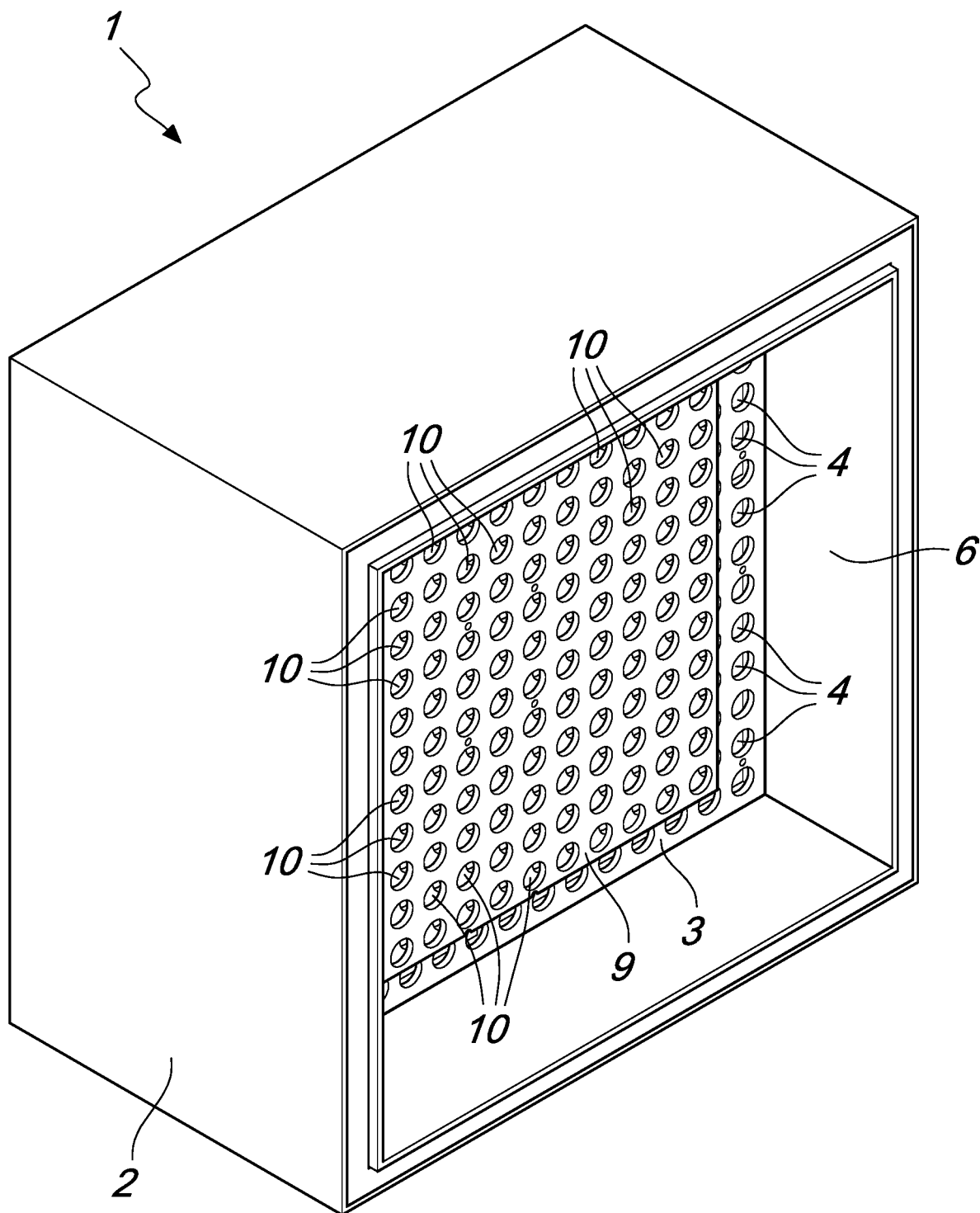


Fig. 4

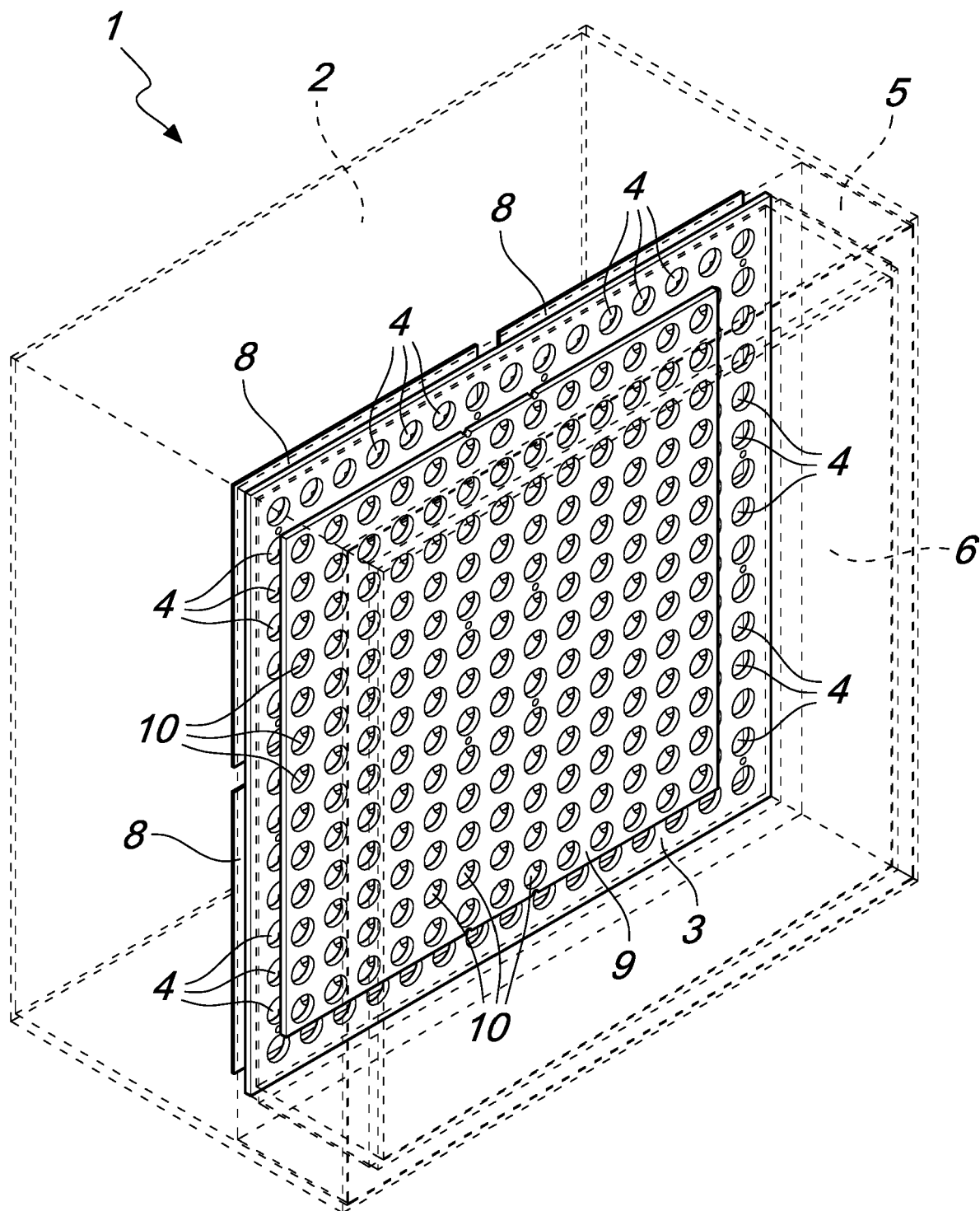


Fig. 5

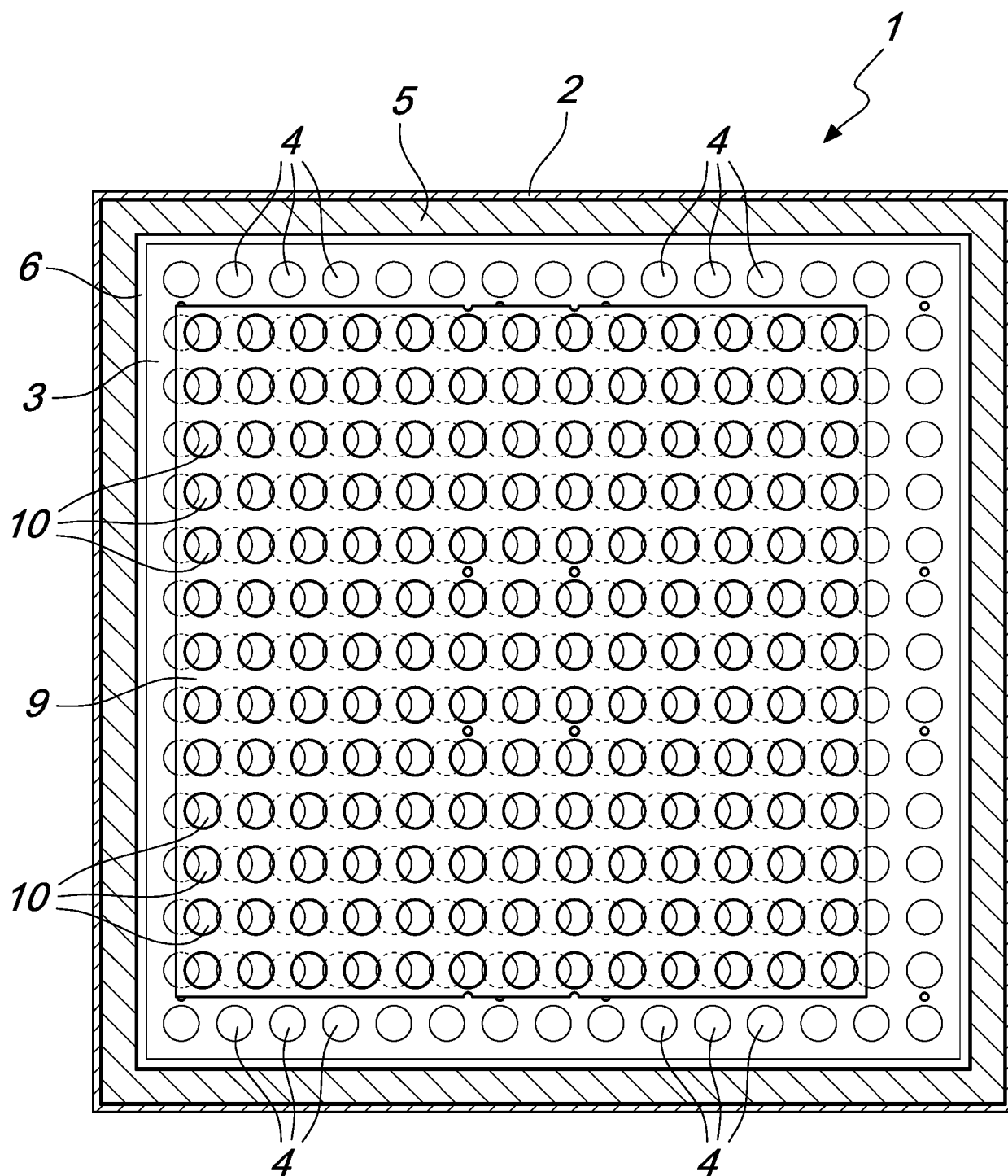


Fig. 6

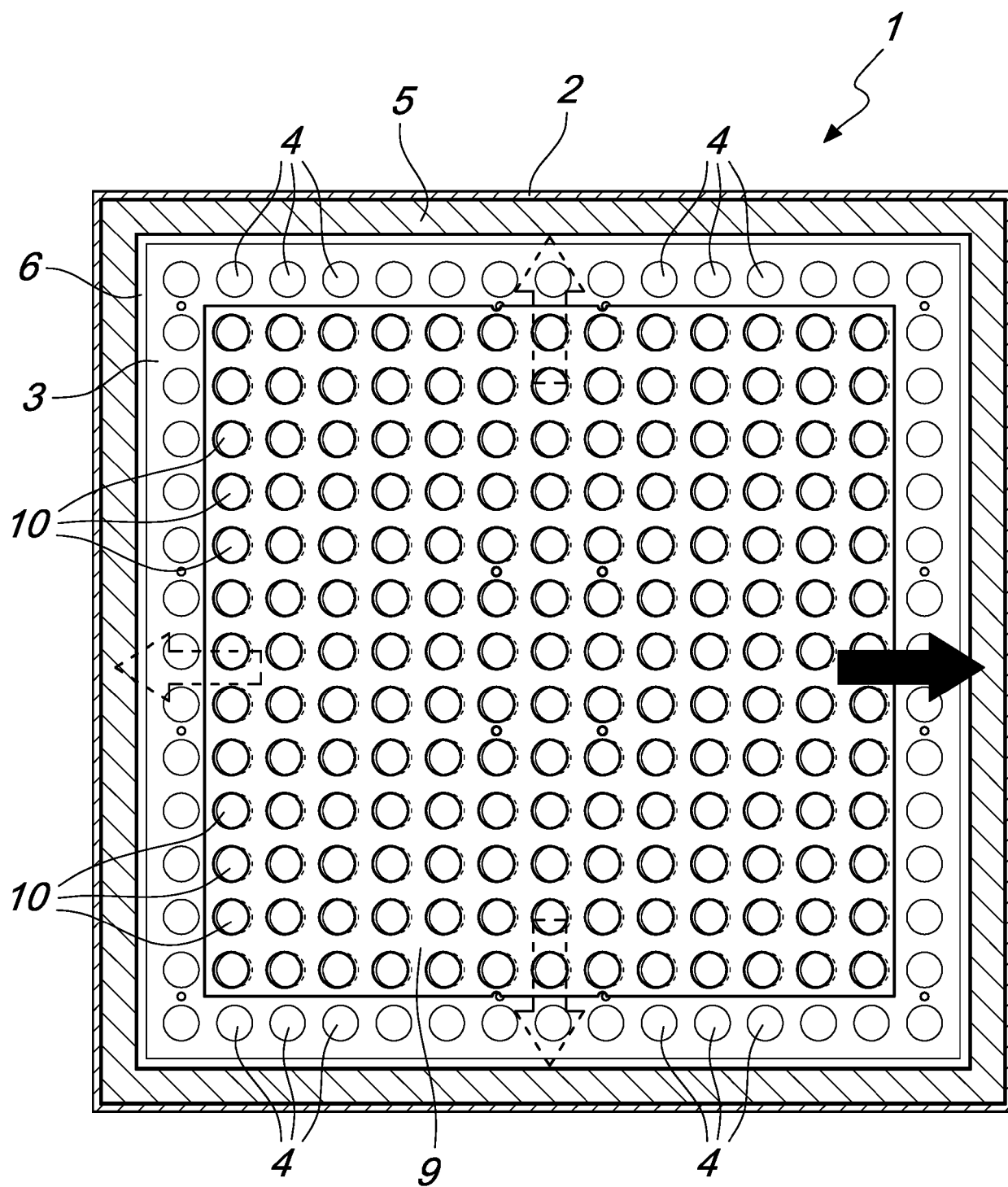


Fig. 7

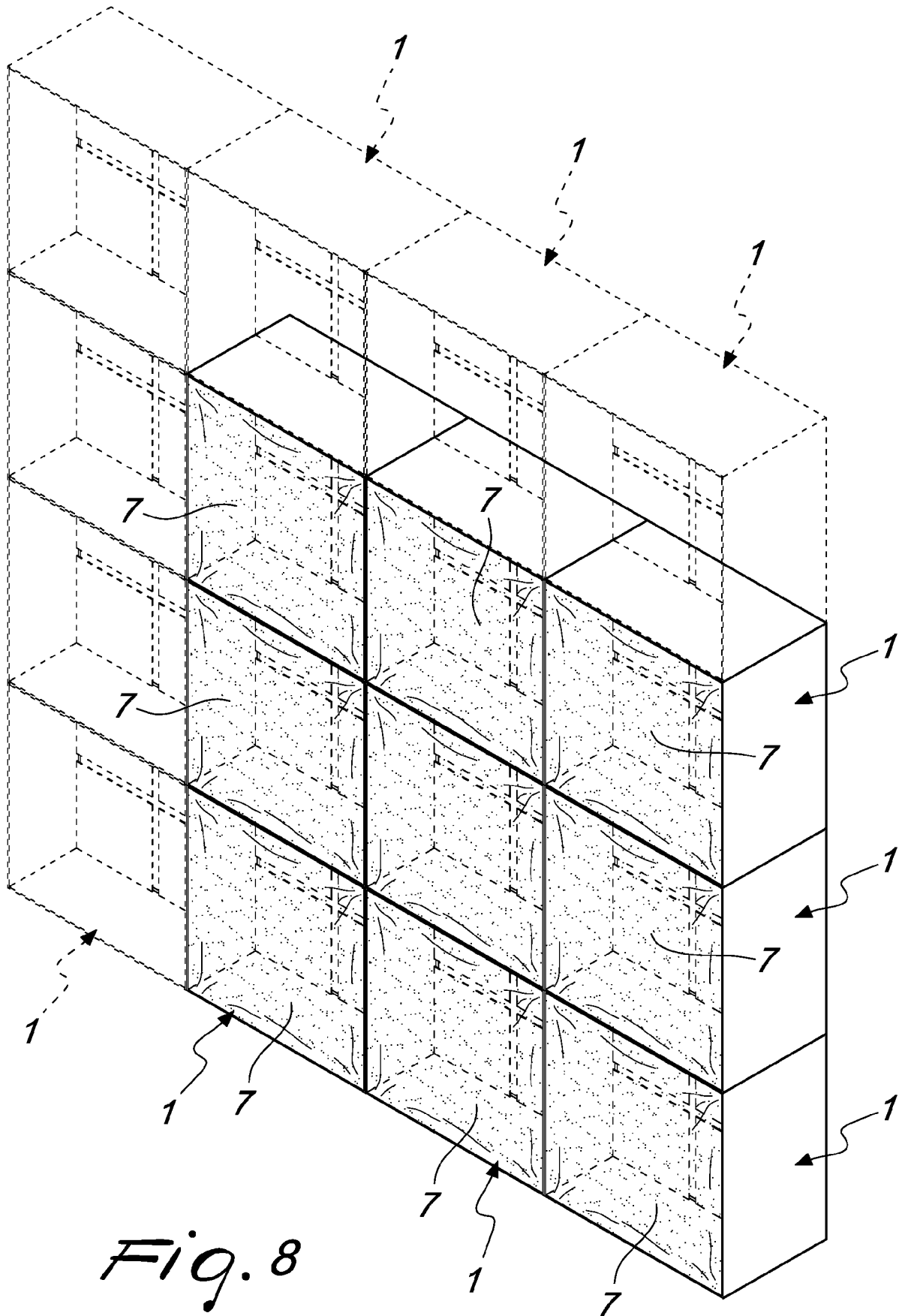


Fig. 8



EUROPEAN SEARCH REPORT

Application Number

EP 22 21 0165

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DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	US 2013/148357 A1 (JOHNSTON RAYMOND P [US] ET AL) 13 June 2013 (2013-06-13)	1, 2, 4-7	INV. F21V33/00
Y	* paragraph [0012] - paragraph [0020] *	3, 9, 10	F21V15/01
A	* figures 1-3 *	8	F21S8/00 G10K11/172
X	US 2014/299408 A1 (SWINKELS STEFAN HENRICUS [NL] ET AL) 9 October 2014 (2014-10-09)	1, 4-7	ADD. F21Y115/10 F21Y105/16 F21V23/04
	* paragraph [0001] *		
	* paragraph [0013] *		
	* paragraph [0051] *		
	* paragraph [0078] - paragraph [0079] *		
	* figures 1b, 7, 8 *		
X	EP 2 573 461 A1 (KONINKL PHILIPS ELECTRONICS NV [NL]) 27 March 2013 (2013-03-27)	1, 4-7	
	* paragraph [0010] *		
	* paragraph [0028] *		
	* paragraph [0080] - paragraph [0115] *		
	* figures 1-4 *		
X	US 2015/109765 A1 (SEPKHANOV RUSLAN AKHMEDOVICH [NL] ET AL) 23 April 2015 (2015-04-23)	1, 4-7	E04B G10K
	* paragraph [0045] - paragraph [0050] *		
	* figures 1, 2 *		
Y	US 2016/372100 A1 (MASON JONATHAN DAVID [NL] ET AL) 22 December 2016 (2016-12-22)	3, 10	
A	* paragraph [0010] *	1	
	* paragraph [0020] *		
	* paragraph [0061] - paragraph [0063] *		
	* figures 3a, 3b *		
Y	GB 2 078 922 A (MILLER HERMAN INC) 13 January 1982 (1982-01-13)	9	
	* the whole document *		
	----- -/--		
The present search report has been drawn up for all claims			
Place of search The Hague		Date of completion of the search 10 May 2023	Examiner Soto Salvador, Jesús
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	



EUROPEAN SEARCH REPORT

Application Number

EP 22 21 0165

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	GB 2 565 033 A (KP ACOUSTICS LTD [GB]) 6 February 2019 (2019-02-06) * the whole document * -----	8	
			TECHNICAL FIELDS SEARCHED (IPC)
The present search report has been drawn up for all claims			
Place of search		Date of completion of the search	Examiner
The Hague		10 May 2023	Soto Salvador, Jesús
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			
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EPO FORM 1503 03.82 (P04C01)

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

EP 22 21 0165

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

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30

35

40

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55

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2013148357 A1	13-06-2013	EP 2788975 A1	15-10-2014
		JP 2015507816 A	12-03-2015
		KR 20140107380 A	04-09-2014
		US 2013148357 A1	13-06-2013
		WO 2013085935 A1	13-06-2013
US 2014299408 A1	09-10-2014	CN 103890288 A	25-06-2014
		EP 2744950 A1	25-06-2014
		JP 6173326 B2	02-08-2017
		JP 2015504528 A	12-02-2015
		US 2014299408 A1	09-10-2014
		WO 2013057610 A1	25-04-2013
EP 2573461 A1	27-03-2013	EP 2573461 A1	27-03-2013
		WO 2013042064 A1	28-03-2013
US 2015109765 A1	23-04-2015	CN 104220807 A	17-12-2014
		EP 2836762 A1	18-02-2015
		JP 6165233 B2	19-07-2017
		JP 2015518098 A	25-06-2015
		RU 2014145316 A	10-06-2016
		US 2015109765 A1	23-04-2015
		WO 2013153491 A1	17-10-2013
US 2016372100 A1	22-12-2016	CN 105340002 A	17-02-2016
		EP 3017443 A1	11-05-2016
		US 2016372100 A1	22-12-2016
		WO 2015000874 A1	08-01-2015
GB 2078922 A	13-01-1982	DE 3023891 A1	21-01-1982
		FR 2485162 A1	24-12-1981
		GB 2078922 A	13-01-1982
GB 2565033 A	06-02-2019	NONE	

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- IT 102021000031421 [0102]