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(54) EXHAUST AIR DIFFUSER AND METHOD FOR EXHAUSTING AIR

(57) The invention relates to a diffuser (10) for blowing off exhaust air, in which are arranged an underside intake connection (12) for connecting the diffuser (10) for blowing off exhaust-air to an exhaust-air duct (22) and a topside exhaust outlet (13) for blowing off the flow from the diffuser (10) for blowing off exhaust-air and to which is fitted a flow duct (14, 15), surrounding the casing structure (11), between the intake connection (12) and the exhaust outlet (13). The diffuser (10) for blowing off exhaust-air is formed as an essentially asymmetrical structure, in which the exhaust outlet (13) is arranged on a different vertical alignment relative to the intake connection (12) and that the flow duct (14, 15) is formed smooth to guide the flow from the intake connection (12) to the exhaust outlet (13), and in which sound-attenuating material (28.1, 28.2), which is fitted in connection with the flow duct (14, 15), is arranged in the casing structure (11).

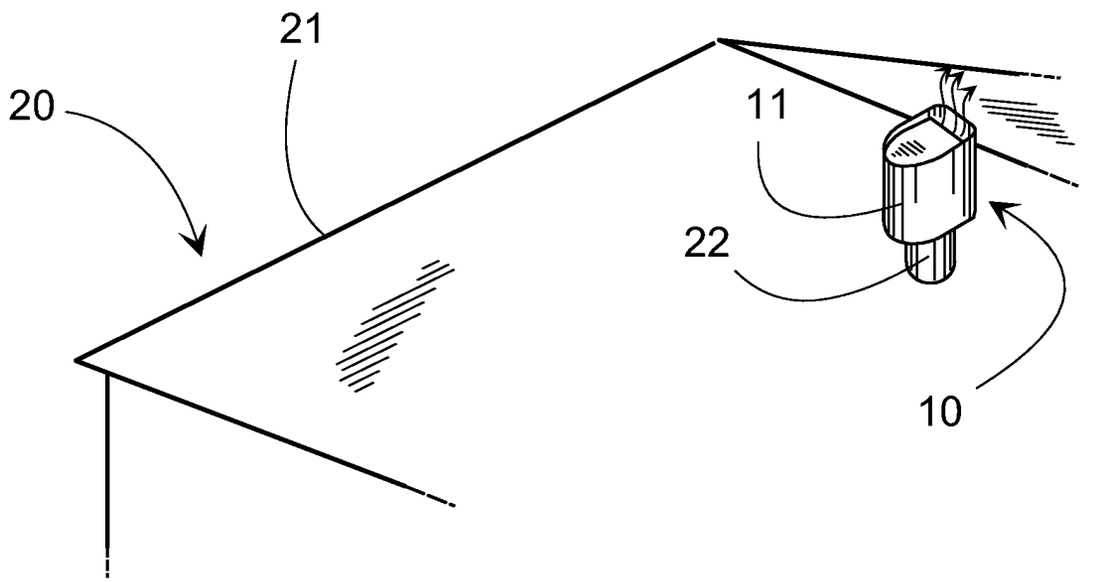

Fig. 1

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Description

[0001] The present invention relates to a diffuser for blowing off exhaust air, in which are arranged an underside intake connection for connecting the diffuser for blowing off exhaust-air to the exhaust-air duct and a topside exhaust outlet for blowing off the flow from the diffuser for blowing off exhaust-air and to which is fitted a flow duct, surrounding the casing structure, between the intake connection and the exhaust outlet. In addition, the invention also relates to a method for blowing off exhaust air.

[0002] Various symmetrical diffuser elements represent the prior art in blowing off air from the ventilation systems of buildings. Their known round or square casing structures include an underside intake connection, from which the element is connected to a ventilation exhaust-air duct, or similar. At the opposite end of the casing structure to the intake connection there is a topside exhaust outlet, from which the exhaust air brought through the duct is blown off, for example, directly into the outer air.

[0003] Examples relating to the prior art include the solutions disclosed in the JP publication 1290908 and DE patent 100 31 083 C1. In the solution disclosed in the JP publication, the operation of the diffuser is based roughly on two expansion chambers (A, B), between which the flow is throttled by a baffle element. The route of the flow through the diffuser forms a zig-zag pattern. In such a diffuser construction, however, it is obvious that the pressure drop will become quite considerable, thus weakening its operational capacity in practical implementations.

[0004] The invention in the DE publication related to effective water removal from a diffuser. In this case, symmetrical structures and also asymmetrical, highly simplified constructions are disclosed. The asymmetricality is achieved by forming a bend that diverts vertically the flow in the duct. However, the use of only a pipe bend of this kind will not achieve any kind of effective diffuser, which will instead also show the drawbacks described below that relate to exhaust-air diffusers in general.

[0005] When using known types of symmetrical casing structures, separate sound attenuator elements must be used to dampen the noise caused by blowing off air. In many cases, particularly with high levels of noise from the duct runs, the diffuser element has no attenuating effect at all on the noise level of the air being blown off. In other ways too, such symmetrical structures for blowing off exhaust air are associated with serious drawbacks, in terms of both poor functionality and of trouble-free operation.

[0006] One first such drawback is the tendency of exhaust-air diffusers to ice in sub-zero air. The humidity of the condensing indoor air, which is warmer that the outdoor temperature, causes problems in the operation of the diffuser, in the form of wetting and also icing, due precisely to known diffuser structures having water-collection and removal members that may operate poorly, or which may be even entirely lacking.

[0007] Further, a second significant drawback is the aforementioned lack of noise attenuation by the diffuser structures. Particularly the amplification of low frequencies is passed a general problem in diffusers. As is known, the effective attenuation of low frequencies would require an unreasonably large size of separate silencer element, which would correspondingly increase the manufacturing and material costs of the silencer, besides also being aesthetically detrimental on roofs.

[0008] The present invention is intended to create a diffuser for blowing off exhaust air and a method in blowing off exhaust air that are, in all respects, better and more effect than previously. The characteristic features of the diffuser for blowing off exhaust air according to the invention are stated in the accompanying Claim 1 while the characteristic features of the method are stated in Claim 10.

[0009] The diffuser for blowing off exhaust air according to the invention is surprisingly formed as an asymmetrical structure, with an integrated diffuser function for blowing off exhaust air, and an integrated attenuation function for noise arising in the exhaust air ducts and in diffuser. The attenuation is achieved with the aid of a smooth diversion of the airflow, arranged in the flow duct of the diffuser, and of an attenuation material arranged in connection with the flow duct. In an integrated diffuser of this kind, the direction of the airflow being blown off is, according to the method of the invention, diverted horizontally, when viewing the diffuser from the side, thus simultaneously achieving, among other things, effective attenuation properties and improved moisture resistance and removal. The diversion is created by means of the surprising asymmetrical flow duct construction of the internal components of the diffuser, in which the exhaust outlet has a different vertical alignment to that of the intake connection. The other characteristic features of the invention are disclosed in the accompanying Claims.

[0010] With the aid of the invention, the following advantages, among others, are gained:

- Integrating the sound attenuation in the same structure as the diffuser makes the attenuation of noise arising in ventilation more effective, so that even the low frequencies that are regarded as problematic will be better attenuated than before.
- Despite the significantly improved attenuation of low frequencies, the size of the diffuser has, nevertheless, been kept reasonable, so that its integrated attenuation properties do not increase, for example, its manufacturing costs, as happens, in the case of separate silencer elements according to the prior art.
- Moisture accumulating and condensing in the diffuser for blowing off exhaust-air is guided away bet-

ter from its interior, thus preventing it from causing icing problems, for example, or returning to the air-conditioning duct.

- The attenuation material arranged in the diffuser for blowing off exhaust-air replaces, or at least significantly reduces the need for attenuation material inside the duct runs in a building, allowing it conceivable to been replaced or cleaned much more easily than in known solutions.

[0011] Other advantages gained with the aid of the diffuser for blowing off exhaust air according to the invention and the corresponding method are itemized in the description portion.

[0012] In the following, the invention is examined, though in no way restrictively, with the aid of an example of the diffuser for blowing off exhaust air, which is shown in the accompanying figures.

Figure 1 shows one diffuser for blowing off exhaust air, according to the invention, at its point of use,

Figure 2 shows a top view of one diffuser for blowing off exhaust air, according to the invention,

Figure 3 shows a cross-section of the diffuser for blowing off exhaust air of Figure 2, and

Figure 4 shows an axonometric cross-section of the diffuser for blowing off exhaust air, according to Figures 2 and 3.

[0013] The diffuser 10 for blowing off waste or exhaust air, according to the invention, which will hereinafter be referred to by the briefer term the diffuser, is suitable for use in several different applications in the ventilation systems of buildings. The diffuser 10 can be easily connected to exhaust ducts 22 of different models and shapes. In the following, the diffuser 10 is examined, by way of example, with reference to the accompanying Figures 1 - 4, in connection with blowing off exhaust air.

[0014] Figure 1 shows the diffuser 10, according to the invention, at its point of use. An exhaust air (arrows) blow-off duct 22 has been installed in the building 20 and taken through the roof 21. The exhaust air can be blown off mechanically, impelled by a fan. In general, it can be stated that the diffuser 10 according to the invention can be used in so-called low-pressure-drop blowing off. In the case of the diffuser 10 according to the invention, the blow-off volumes can be, for example, 1 - 10 m^3/s, and even 15 m^3/s. The diffuser 10, with, according to the invention, a diffuser function and sound attenuation function integrated in the same casing structure 11, is connected to the upper end of the duct 22. As is known, very little space is allocated in the interior of the building 20 for the ventilation ducts runs and the operational elements located in connection with them, such as, for example, sound attenuator. The use of the integrated diffuser 10 according to the invention not only achieves significant space savings in buildings, but also improves the serviceability of the ventilation. In applications above roof structures 21 requiring attenuation, the diffuser 10 is also considerably lower than known solutions requiring attenuation.

[0015] Figures 2 - 4 shows one example of a diffuser 10. As can be seen from the figures, the diffuser 10 is divided in principle into two spaces 14, 15, adjacent to each other horizontally, forming an asymmetrical structure. The figures show a space 15 in the right-hand side half of the diffuser's casing structure 11, to which the airflow shown with the broken arrow is led from the exhaust duct 22, through the intake connection 12 beneath the casing structure 11. The space 15 can also be termed the attenuation chamber and in shape it corresponds at least to the lower part of the casing structure 11 as an upright segmented semi-cylinder 26.1 (U-section), which, in Figure 2, opens to the left.

[0016] On the left of the attenuation chamber 15 is a space 14, the upper part of which has an exhaust outlet 13, from which the flow, shown by a broken arrow, is led out of the diffuser 10, for example, to the outdoor air. This space can also be termed the exhaust-air passage 14, which in shape corresponds to a slightly flattened rectangular prism. The height of the passage 14 can correspond substantially to the height of the casing structure 11. The intake connection 12 and the exhaust outlet 13 have at least partly different vertical alignments. The spaces 14 and 15 together form a flow duct surrounding the casing structure 11. The flow duct 14, 15 can preferably be a single-passage structure. In the exhaust-air passage 14 there can be a support plate 31 (Figure 2), which reinforces the structure of the diffuser 10. The support plate 31 cannot, however, be regarded as having any functional effect on the operation of the diffuser 10, because it can also be omitted, if the diffuser 10 is made from thicker material.

[0017] According to the method of the invention, the direction of the airflow led from the attenuation chamber 15 of the diffuser 10 to the exhaust-air passage 14 is diverted smoothly in the asymmetrically arranged flow duct 14, 15 of the diffuser 10. The diversion takes place horizontally, when examined from the side of the diffuser 10. The diversion, and the attenuation of noise achieved with its aid are achieved by means of one or more baffles in the attenuation chamber 15, arranged in connection with the attenuation material 28.1, 28.2, one example of which is the baffle plate 17 shown.

[0018] The air baffle 17 that creates the smooth, asymmetrical flow is positioned in the casing structure 11 in such a way that its lower edge, i.e. the one on the right-hand side in Figure 4 is relative to the exhaust-air passage 14 in the opposite edge of the casing structure 11, close to the intake connection 12. From there, the air baffle 17 slopes upwards towards the exhaust-air passage 14 and guides the flow, which is led from the intake connection 12 to the diffuser 10, towards the exhaust outlet 13. When the air baffle 17 reaches the exhaust-air passage 14, it is vertically at a level slightly

above the middle of the casing structure 11. At this point, there is a bend in the air baffle 17, from which it continues upwards as a vertical wall structure 25, to nearly the top of the diffuser 10. Over this vertical part, the air baffle 17 forms a wall 25 of the upper part of the exhaust-air passage 14, with the entire length of the opposite wall being formed by the casing structure 11. The support plate 31 can be between the wall 25 and the casing structure 11.

[0019] Due to the slightly flattened shape of the casing structure 11, small flanges 24 are bent into the edges of the air-baffle 17 that rise from the attenuation chamber 15 towards the exhaust-air passage 14. The baffle 17 is attached securely to the casing structure 11 by the flanges 24 and also supports an insulation layer 28.1 that extends in the upper space 30 to the level of the cover 18.

[0020] The exhaust-air passage 14 and the attenuation chamber 15 forming the flow duct are thus connected to each other, from the intake connection 12 of the lower part of the casing structure 11, to slightly above the vertical level of the middle of the casing structure 11. The base 23 of the casing structure 11, to which the intake connection 12 is also fitted, is in the lower part of the exhaust-air passage 14. The intake connection 12 has a small collar 16.2 on the inside of the casing structure 11, which is used to prevent water that collects on the base from entering the duct 22 through the intake connection 12. On the side of the intake connection 12 opposite to the collar 16.2, there is a pressed-metal connector/flange stub 16.1, which allows the diffuser 10 to be installed in the duct 22 quickly and easily, without separate stays or support structures, for example, being required to attach it.

[0021] The lower circumference 19 of the casing structure 11 is formed of pressed support sheet-metal, with reinforcing grooves in it. The casing structure 11 can be assembled, for example from two segments, one half of which is shown in Figure 4.

[0022] The semi-cylindrical space 26 for the sound-insulating layer 28.2 is arranged in the attenuation chamber 15, partly surrounding coaxially an imaginary continuation of the intake connection 12. On its internal circumference, the space 26 is bounded, by a U-section plate 26.1, which opens to the exhaust-air passage 14, and which preferably has perforations 29.2, at least in the area corresponding to the attenuation space 15. The perforations 29.1, which also cover the entire air baffle 17, cover 20 - 40 %, preferably 25 - 35 % of the surface area of the plate 17, 26.1. In pilot-stage tests, the important observation has been made that it is precisely the use of this perforating coverage that gives the best sound attenuation of the problematic low-frequency noise too.

[0023] The outer wall 26.2 of the insulation space 26 is a blank U-section that also opens towards the exhaust-air passage 14 and is also of sheet-metal material, like the inner wall 26.1. Further, a narrow passage 27, which can be used for water-removal purposes, remains between the outer wall 26.2 that limits the insulation space 26 and the outer jacket of the casing structure 11 of the diffuser 10. The base 23 of the casing structure 11 can also slope slightly, in which case its lowest point will have an outlet (not shown) for water that may have collected inside it.

[0024] In the upper part of the attenuation chamber 15, there is a cover 18 on top of the insulation spaces 26, 30, which slopes away from the exhaust-air passage 14. The cover 18 has a visor 18.1 that protrudes for a distance over the exhaust-air passage 14. On the side opposite to the visor 18.1, the cover 18 extends at least to the water-removal passage 27, to which water raining or melting on the cover 18 can flow. The essential feature of the cover 18, is that it covers the insulation 28.1, 28.2, which is thus not only in the semi-cylindrical insulation space 26, but also in the space 30 above the baffle 17, at least as far as the cover 18. Pilot-stage tests of the diffuser 10 have shown the insulation 28.1 arranged in the space 30 to be more important than, for example, the insulation 28.2 arranged in the space 26.

[0025] The insulation material 28.1, 28.2 placed in the insulation space 26 and in the space 30 remaining between the baffle plate 17 and the cover 18 can be of a grade suitable for sound insulation. One such material is Dacron wadding. The insulation 28.1, 28.2 also functions as thermal insulation, which helps to improve the operation of the diffuser 10 in cold conditions. Yet another advantageous property of the attenuation material 28.1, 28.2 is that it does not absorb moisture.

[0026] According to yet another preferred embodiment, if the insulation material 28.1, 28.2 used is some kind of cohesive mass, or if it has, for example, a supporting mesh layer on its surface, the attenuation material itself can form the baffle surface that diverts the airflow. Thus there may be no need for a separate baffle plate 17, or an inner wall 26.1 bounding the attenuation space 26.

[0027] The sheet-metal components 11, 17, 19, 23, 26.1, 26.2 of the diffuser 10 can be, for example, FeZn sheet, which can be painted in several different colours. Further, combinations of different colours are possible in the casing structure 11, as the lower circumference 19 can be painted a different colour to the upper part, as can the halves of the cross-section of the casing structure 11. Otherwise, the diffuser 10 is a harmonious entity as architectural. The integrated attenuation function of the diffuser 10 according to the invention reduces the costs associated with the ventilation of buildings and meets environmental statutory noise-attenuation requirements. Now the diffuser 10 can also be cleaned more easily than before.

[0028] It must be understood that the above description and the related figures are only intended to illustrate the present invention. The invention is thus in no way restricted to only the embodiments disclosed above or stated in the Claims, but many different variations and adaptations of the invention, which are possible within

the scope on the inventive idea defined in the accompanying Claims, will be obvious to one versed in the art.

Claims

1. A diffuser (10) for blowing off exhaust air, in which are arranged an underside intake connection (12) for connecting the diffuser (10) for blowing off exhaust-air to an exhaust-air duct (22) and a topside exhaust outlet (13) for blowing off the flow from the diffuser (10) for blowing off exhaust-air and to which is fitted a flow duct (14, 15), surrounding the casing structure (11), between the intake connection (12) and the exhaust outlet (13), **characterized in that** the diffuser (10) for blowing off exhaust-air is formed as an essentially asymmetrical structure, in which the exhaust outlet (13) is arranged on a different vertical alignment relative to the intake connection (12) and that the flow duct (14, 15) is formed smooth to guide the flow from the intake connection (12) towards the exhaust outlet (13), and in which sound-attenuating material (28.1, 28.2), which is fitted in connection with the flow duct (14, 15), is arranged in the casing structure (11).

2. A diffuser (10) for blowing off exhaust air, according to Claim 1, **characterized in that** baffle structure, which include a slope baffle element (17) rising towards the exhaust outlet (13), are arranged in the diffuser (10) for blowing off exhaust-air, in order to guide the flow.

3. A diffuser (10) for blowing off exhaust air, according to Claim 1 or 2, **characterized in that** the baffle structures include an upright segmented cylindrical component (26.1).

4. A diffuser (10) for blowing off exhaust air, according to any of Claims 1 - 3, **characterized in that** a space (30) is arranged above the baffle element (17) for sound-attenuating material (28.1).

5. A diffuser (10) for blowing off exhaust air, according to any of Claims 1 - 4, **characterized in that** a space (26) is arranged in connection with the upright segmented cylindrical component (26.1) for sound-attenuating material (28.2), which at least partly surrounds it.

6. A diffuser (10) for blowing off exhaust air, according to any of Claims 1 - 5, **characterized in that** the sound-attenuating material (28.1, 28.2) is fitted in connection with the flow duct (14, 15) through perforations (29.1, 29.2).

7. A diffuser (10) for blowing off exhaust air, according to Claim 6, **characterized in that** the perforations (29.1, 29.2) are arranged to cover 20 - 40 %, preferably 25 - 35 % of the baffle-structure surfaces (17, 26.1).

8. A diffuser (10) for blowing off exhaust air, according to any of Claims 1 - 7, **characterized in that** a connector flange member (16.1) is fitted to the intake connection (12), in order to connect the diffuser (10) for blowing off exhaust-air to the exhaust duct (22).

9. A diffuser (10) for blowing off exhaust air, according to any of Claims 1 - 8, **characterized in that** the flow duct (14, 15) is formed as a single-passage structure.

10. A method in blowing off exhaust air from an exhaust-air duct (22), in which a diffuser (10) for blowing off exhaust-air, equipped with intake and exhaust connections (12, 13), is connected to the exhaust-air duct (22), between which intake and exhaust connections (12, 13) the exhaust air flows through the diffuser (10) for blowing off exhaust-air, and which diffuser (10) for blowing off exhaust-air is connected to the exhaust-air duct (22) in such a way that the intake connection (12) is below the exhaust outlet (13), **characterized in that** the direction of the airflow is diverted asymmetrically in the diffuser (10) for blowing off exhaust-air and attenuated with the aid of the diversion.

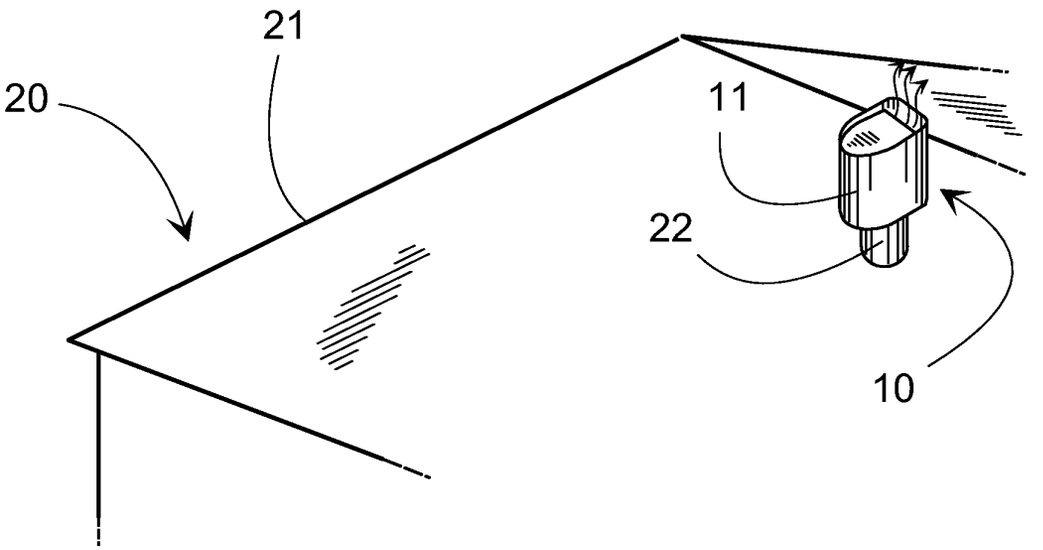

Fig. 1

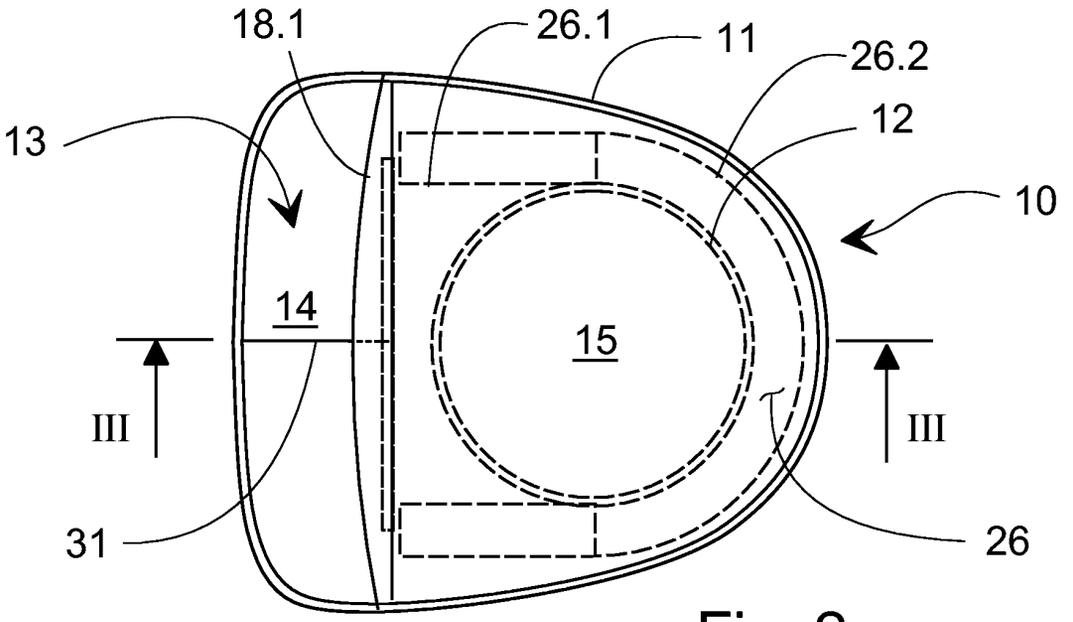
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Fig. 2

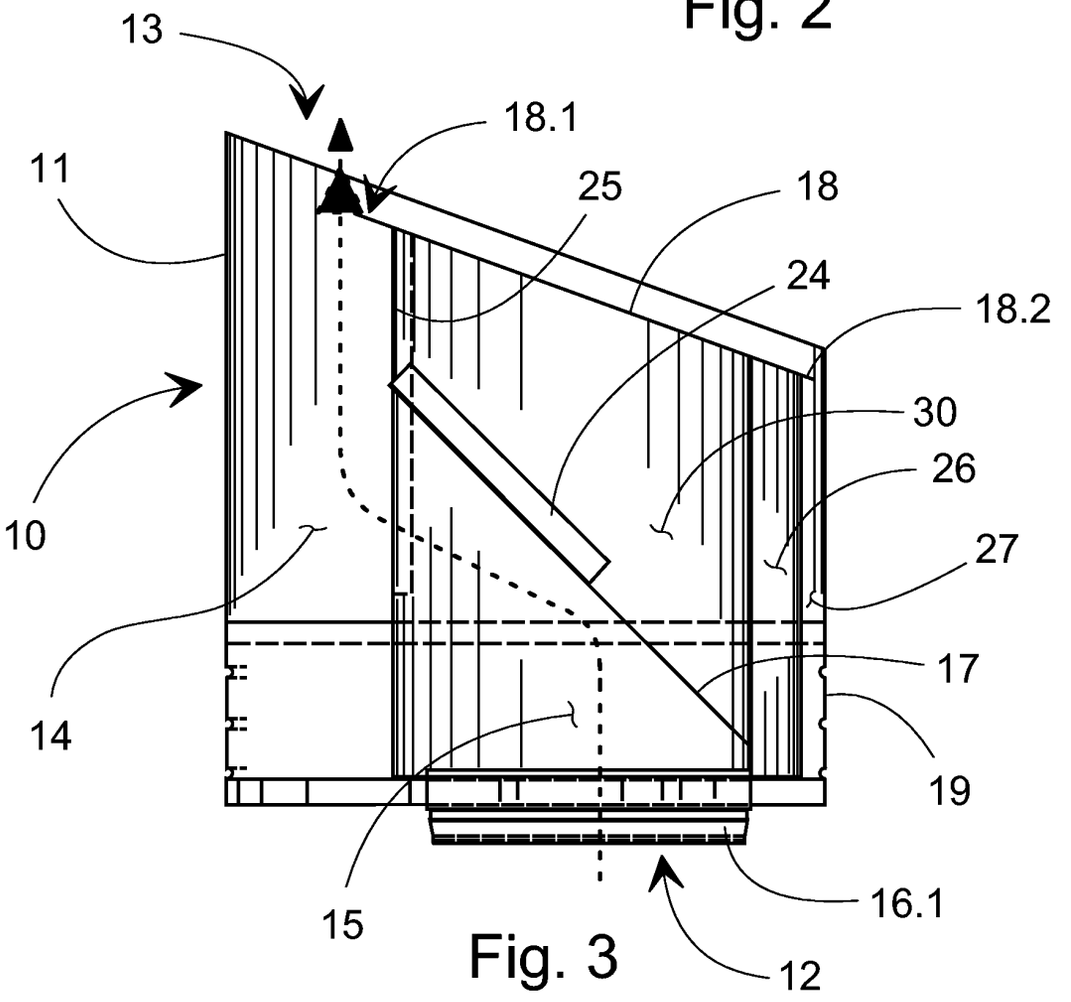
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Fig. 3

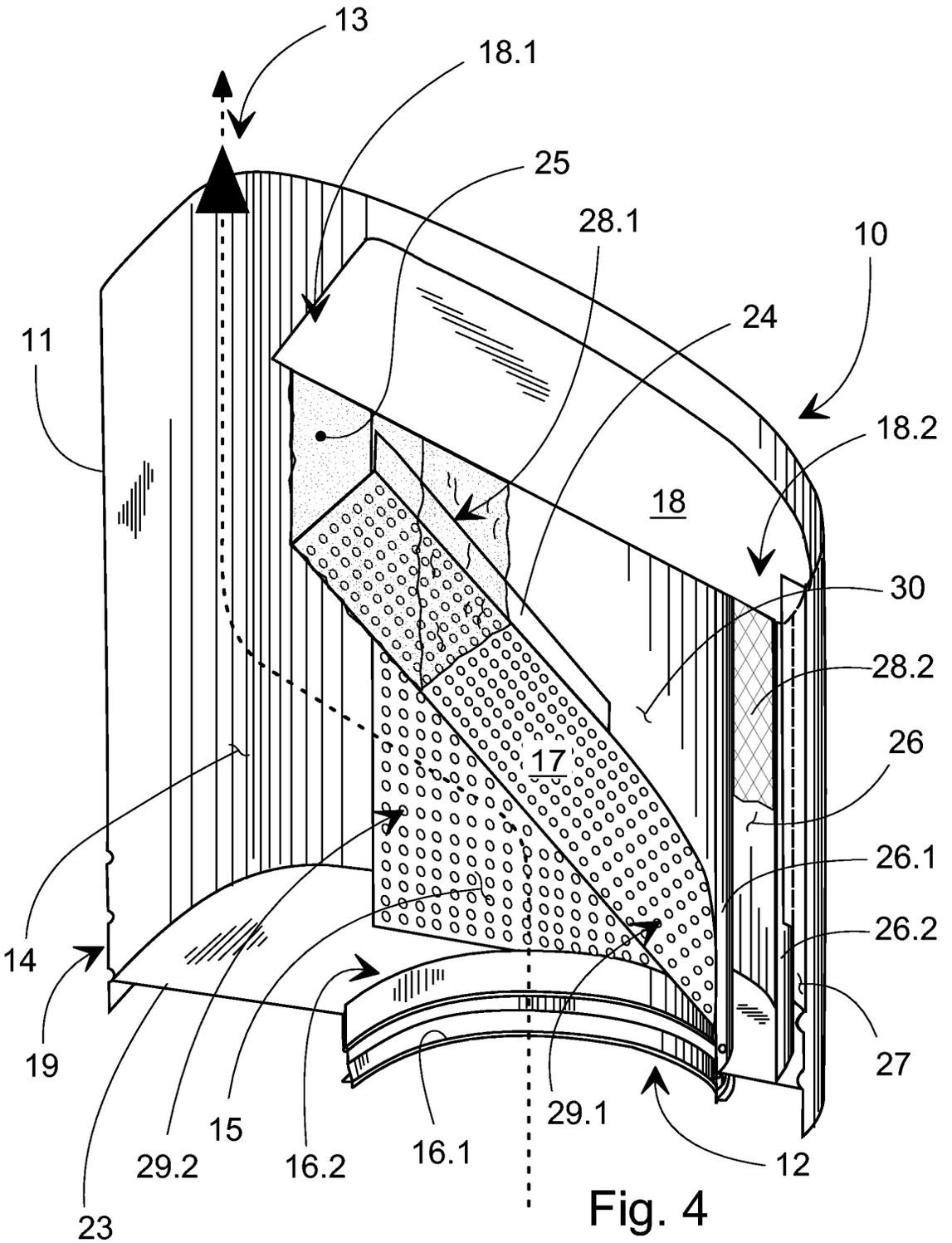
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Fig. 4

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EUROPEAN SEARCH REPORT

Application Number
EP 03 10 3793

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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
MUNICH	10 December 2003	Valenza, D

CATEGORY OF CITED DOCUMENTS

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