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(54) COVER ELEMENT FOR AN INLET OPENING OF AN EXTRACTION DEVICE

(57) The present invention concerns a cover element (26) for an inlet opening (24) of an extraction device (14). The cover element (26) comprises at least two passage openings for a passage of air, particularly of cooking fumes, preferably for a passage in an at least approximately vertical top-down direction. The passage openings are of an elongated shape, which are included in the cover element (26) spaced apart and which extend substantially parallel to one another. The section of the cover element (26) between the elongated passage openings comprises or is shaped as a bar (68, 70, 70'), which preferably extends over a substantial portion of the longitudinal extension of the cover element (26).

According to the invention, the bar (68, 70, 70') comprises at least one section and/or at least one surface with aerodynamic qualities and particularly has a bottom side or bottom area with reduced thickness compared to its top side or top area in the installation position of the cover element (26).

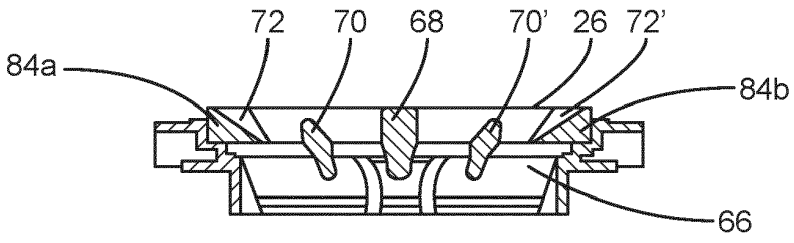

FIG. 11

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Description

[0001] The present invention relates to a cover element for an inlet opening of an extraction device according to the preamble of claim 1. The present invention further relates to an extraction device or a combination appliance according to claim 16.

[0002] During the performance of cooking activities under use of a cooking hob, kitchen vapours are generated, which are distributed over the cooking area. In order to avoid these kitchen vapours to be spread throughout the entire kitchen space, an arrangement of an extraction device is common. Said extraction device is operated in parallel to the cooking hob, thereby sucking in those kitchen vapours in order to filter out particles and tiny droplets from the vapours and/or to blow the vapours to the outside of the building. Such an extraction device may be arranged above the cooking area as a range hood or, alternatively, it may be embodied as a downdraft extraction device. Such kind of downdraft extraction device is usually arranged below a kitchen worktop or a cooktop of the related cooking hob and it comprises at least one fan for sucking air from the cooking area through an opening or recess arranged in the worktop. In order to suck the kitchen vapours through the worktop or cooktop, an inlet opening is provided therein, which is known to be covered by a cover element, which in some cases is formed as a cover grid.

[0003] It is an object of the present invention to provide a cover element for an inlet opening, which contributes to improving the extraction performance of the extraction device. According to a further object, an extraction device or a combination appliance including a cooking hob and an extraction device shall be provided, which extraction device shall be operated with improved extraction performance.

[0004] The object is achieved for a cover element for an inlet opening of an extraction device according to the preamble of claim 1 by the characterizing features of this claim.

[0005] A cover element for an inlet opening of an extraction device comprises at least two passage openings for a passage of air, particularly for a passage of cooking fumes. Preferably, said passage is arranged to be in an at least approximately vertical top-down direction. The passage openings may be designed as elongated passage openings or holes, specifically formed as slits, which are included in the cover element spaced apart from one another and, moreover, extending substantially parallel to one another. The orientation of the passage openings is favourably in a longitudinal direction of the cover element, which is preferably rectangular or oval-shaped. The section of the cover element between the elongated passage openings comprises a bar or is shaped as a bar, which preferably extends over a substantial portion of the longitudinal extension of the cover element. The cover element is preferably formed as a grid. Additionally, or alternatively, the cover element is preferably designed symmetrically along its longitudinal axis, insofar providing a handsome appearance to the user. According to the present invention, the bar comprises at least one section and/or at least one surface with aerodynamic qualities. "Aerodynamic qualities" in relation to the present invention may mean that a laminar airflow is ensured and/or turbulences in the airflow are minimized or avoided. Moreover, the bar particularly has a bottom side or bottom area with reduced thickness compared to its top side or top area, wherein bottom side or are and top side or area are determined, when the cover element is in its installation position. According to an even more particular embodiment, the bar is at least partially wing-shaped, specifically similar to a wing of a plane. Advantageously, the cover element comprises more than one passage openings, i. e. at least two or a plurality of passage openings. Consequently, at least three passage openings may be included in the cover element. The extraction device according to the present invention is particularly a downdraft extraction device for the extraction of cooking fumes generated during a cooking process on a cooking hob. Due to the fact that the cover element comprises at least two passage openings formed as slits for a passage of air, which are included in the cover element spaced apart and extending substantially parallel to one another, wherein the section of the cover element between the slits comprises or is shaped as a bar, which comprises at least one section and/or at least one surface with aerodynamic qualities, a cover element for an inlet opening is provided, which contributes to improving the extraction performance of the extraction device. More specifically, with such a bar design a laminar airflow is supported, because with said aerodynamic structuring air turbulences are avoided.

[0006] According to one particular embodiment, the cover element covers an inlet opening of a combination appliance, which comprising a cooking hob in addition to the extraction device. Said combination appliance may be configured to be arranged in a cut-out of a worktop. The worktop receiving the combination appliance is particularly a kitchen worktop, in which the combination appliance is integrated and operated.

[0007] More specifically, the bottom side or bottom area of the bar comprises rounded edges or a round cross-section. This further increases the aerodynamic properties of the bar and, consequently, of the entire cover element, by further reducing turbulences. An even more advanced level of improvement by even further minimizing turbulences may be received by additionally providing rounded edges or a round cross-section at the top side or top area of the bar. According to an alternative solution, however, the top side of the bar particularly comprises a flat area. In an even more specific embodiment, the top side is completely flat. Such flat top surface specifically provides for an increased aesthetical appearance. Moreover, sharp edges at the flat top surfaces may fulfil the user's highest demands on design requirements. On the other hand, a provision of at least slightly rounded edges

may particularly be favourable with respect to keeping the danger of cutting damages for the user of the extraction device at a low level, which is specifically relevant, when the cover element, what is preferred, is a metallic part.

[0008] In some implementations, the cover element comprises a first bar and a second bar, so that related at least first, second and third passage openings may be provided, which in pairs enclose the first and second bars. This structure favourably increases the magnitude of air passage compared to only one or two passage openings. Even more, in addition to that or as an alternative, an uneven number of bars, i.e. at least three bars, may be included in the cover element. Said first and second bars and/or said uneven number of bars are aligned at least approximately in parallel with one another.

[0009] In particular, the cover element comprises a central bar, specifically enclosed by two passage openings, which central bar is preferably located on a centreline of the cover element. In addition, at least one laterally or eccentrically located bar is included, wherein the central bar particularly has an increased thickness compared to the at least one laterally or eccentrically located bar, which increased thickness may improve mechanical stability of the cover element. More specifically, at least two laterally or eccentrically located bars are provided, which particularly are positioned adjacent to the central bar by flanking the central bar, specifically midway between them. In that, a cover element with three bars and related four passage openings with sufficient passage surface for the sucked air is provided.

[0010] One specific solution for the cooking hob according to the present invention provides that at least a section of the bar, preferably the whole bar, or at least a section of at least one of the plurality of bars, in particular at least a section of the central bar or the whole central bar, has an axis-symmetrical cross-section. Such bar design advantageously provides a basis for a particularly high performance of the extraction device resulting from a laminar airflow.

[0011] According to an embodiment, the cover element comprises at least one laterally or eccentrically located bar having at least one lateral surface, specifically a first lateral surface, which is inclined by an angle α towards the vertical. Said angle α is in particular adapted to and inclined with the angle of airflow. Having the first lateral surface at least approximated the airflow direction, turbulences in the airflow are minimized and operating performance of the extraction device is increased. Additionally, or alternatively, the at least one laterally or eccentrically located bar may have a second lateral surface, opposite the first lateral surface with respect to a central axis of the at least one laterally or eccentrically located bar, which second lateral surface is inclined by an angle β towards the vertical. The first and second lateral surfaces of the bar may include an angle, notably an angle β-α, therein forming a V-shaped cross-section. An even more advanced structure of the cover element provides for a first laterally or eccentrically located bar and a second laterally or eccentrically located bar, which both are preferably inclined from their top sides to their bottom sides towards a centreline of the cover element, and favourably are related to each other in mirrored symmetry in relation to a central axis of the cover element.

[0012] According to a particularly specific embodiment, angle α is selected to be in the range between 0 degrees and 20 degrees, preferably in the range between 4 degrees and 15 degrees, more preferably in the range between 6 degrees and 10 degrees, most preferably 8 degrees. Moreover, angle β is selected to be in the range between 6 degrees and 30 degrees, preferably in the range between 10 degrees and 26 degrees, more preferably in the range between 14 degrees and 22 degrees, most preferably 18 degrees.

[0013] In some implementations, the cover element comprises a central bar having a first lateral surface and a second lateral surface, opposite the first lateral surface with respect to a central axis of the central bar, which first and second lateral surfaces are vertically oriented, so that the central bar particularly has a rectangular or a procedural oval shaped cross-section. Alternatively, being a preferred embodiment, the first and second lateral surfaces of the central bar are inclined by an angle γ towards the vertical, particularly inclined in different directions. Preferably, the first and second lateral surfaces of the central bar include an angle 2 times γ, specifically forming an at least approximately V-shaped cross-section, more specifically with rounded bottom section. Angle γ may be selected to be in the range between 2 degrees and 20 degrees, preferably in the range between 4 degrees and 15 degrees, more preferably in the range between 6 degrees and 10 degrees, most preferably 8 degrees.

[0014] According to embodiments, the bar or at least one of the plurality of bars has an increased height compared to at least one other section of the cover element, in particular compared to a border or a frame of the cover element. Such design contributes to a reduction of an incorrect positioning of the cover element into the inlet opening. In that, a poka-yoke design is assigned to the cover element, so that a reduced performance of the extraction device as a consequence of an incorrect positioning of the cover element is prevented.

[0015] A particularly preferred solution of the present invention is characterized in that, in the installation position of the cover element, a top side of a laterally or eccentrically located bar is arranged at a lower level compared to at least one of: a top side of entire cover element, a border or a frame of the cover element, and a central bar, which central bar is preferably located on a centreline of the cover element.

[0016] In some implementations, at least a section of the bottom side of at least one bar follows a contour. According to a preferred embodiment, at least a section of the bottom side of the entire cover element follows a contour. Said contour is in particular designed in adap-

tation to a curved and/or radially shaped casing element of the extraction device. More particularly, said casing element is a part of an air channel and/or a part of a fan housing. With such adaptation, more specifically when the remaining parts of the bottom side of the bar or of the entire cover element is designed differently, another or a further contribution to a reduction of an incorrect positioning of the cover element into the inlet opening is reached.

[0017] According to a specific embodiment, at least one interior surface of a border or a frame of the cover element is inclined by an angle δ towards the vertical. More specifically, the inclination of the at least one interior surface is oriented towards the centreline of the cover element in airflow direction. According to a particularly specific embodiment, the internal surfaces of all frame parts are inclined by an angle towards the vertical, wherein the angles of the individual frame part surfaces may differ from each other. However, the two opposite frame parts forming the longer sides of a rectangular frame may be specified by interior surfaces with inclination angles being the same according to amount. Said inclined inner surface or surfaces may form guiding plate(s) for the airflow, particularly in addition to the inclined bar or bars, hence guiding the airflow in a preferred direction, which contributes to minimized or avoided turbulences.

[0018] One particularly specific embodiment of the present invention provides for at least one bar, which is adjustable in its inclination. The inclination is preferably performable within a predefined angle range. The modification of the inclination level is particularly executable by a manual operation or automatically using a driving mechanism. With such a provision of inclination adjustability, an adaptation to actual cooking and/or cooking fumes extraction conditions is possible, therein receiving an optimization of performance level of the extraction device.

[0019] One specific solution according to the present invention is characterized in that the adjusted value of the inclination angle depends at least on the height of a selected cooking utensil, from which the cooking fumes originate, and/or on the selected airflow speed. In particular, a larger angle is selected for a higher airflow speed. For example, an angle of 8 degrees is selected, when the airflow is driven with a high speed, while an angle of 6 degrees may be selected for a medium airflow speed. Moreover, an automatic modification of the inclination level may be based on any measured properties or parameters, like pot height, airflow speed, etc.. To this end, respective sensor means may be included in the extraction device and/or parameters may be received from a control unit of the extraction device.

[0020] The object is achieved for an extraction device or a combination appliance including a cooking hob and an extraction device by the features of claim 16.

[0021] According to a further aspect, an extraction device or a combination appliance including a cooking hob and an extraction device is provided, wherein the extraction device comprises the cover element according to any one of the embodiments as herein disclosed.

[0022] Novel and inventive features of the present invention are set forth in the appended claims.

[0023] The present invention will be described in further detail with reference to the drawings, in which

Fig. 1 is a perspective view of a general setup of a combination appliance comprising a cooking hob and a downdraft extraction device installed in a kitchen cabinet, wherein the combination appliance is structured according to a first example;

Fig. 2 is a cross-sectional perspective view of the disassembled combination appliance of Fig. 1 with a frontal surface cut away;

Fig. 3 is a top perspective view of a second example of a combination appliance;

Fig. 4 is a bottom perspective view of the combination appliance according to Fig. 3;

Fig. 5 is a front view of the combination appliance according to Figs. 3 and 4;

Fig. 6 is a top perspective view of the isolated extraction device of the combination appliance according to Figs. 3 to 5;

Fig. 7 is a cross-sectional view of the combination appliance according to Fig. 5 along the line VII-VII;

Fig. 8 is a top view of a suction opening of the downdraft extraction device, isolated from a cooktop of the cooking hob as indicated with dotted line by VIII in Fig. 3, illustrating a cover grid included in an air channel;

Fig. 9 is a cross-sectional view of the cover grid and the air channel according to Fig. 8 along the line IX - IX and indicated with dotted line by IX in Fig. 7;

Fig. 10 is a top perspective view of the cover grid and the air channel according to Fig. 8;

Fig. 11 is a cross-sectional view of the cover grid and the air channel according to Fig. 8 along the line XI - XI;

Fig. 12 is a top perspective view of the cover grid isolated from the air channel;

Fig. 13 is a bottom perspective view of the cover grid of Fig. 12;

Fig. 14 is a schematic illustration of a part of the cover grid following Fig. 11, with details related to a central bar and one of the two lateral bars;

Fig. 15 is a perspective view of a design alternative of the cover grid according to Figs. 10 to 14; and

Fig. 16 is a front view of the cover grid according to Fig. 15.

[0024] In all figures the same or equivalent part are marked with the same reference numbers.

[0025] Fig. 1 illustrates a general setup of a combination appliance 10 comprising a cooking hob 12 and a downdraft extraction device 14 installed in a kitchen cabinet 16. The combination appliance 10 illustrated in Figs. 1 and 2 presents a structure of a combination appliance 10 according to a first example. In general, and as shown in Fig. 1, the combination appliance 10 is implemented in a cut-out of a kitchen countertop 18 forming a top cover plate of the kitchen cabinet 16. The downdraft extraction device 14 is configured to take away cooking vapours occurring during cooking processes, in particular when cooking with uncovered cookware. The cooking hob 12 comprises cooking regions 20a, 20b arranged on a left half and a right half of a cooktop 22 of the cooking hob 12, which left and right halves are separated from each other by an inlet opening, more specifically a suction opening 24, for an intake of the cooking vapours, the suction opening 24 being arranged alongside a cooktop centreline. The suction opening 24 is covered by a cover element formed as a cover grid 26 for preventing items, e. g. cookware, to fall into the suction opening 24.

[0026] A housing 28 of the extraction device 14 is shown in Fig. 1 in transparent illustration. Said housing 28 provides a closed outer shell or channel segment for a flow of the sucked-in cooking vapours on their way from the suction opening 24 to an exhaust opening 30 in a base area 32 of the kitchen cabinet 16. Said exhaust opening 30 is also covered, namely by an outlet grille 34.

[0027] The flow of the sucked-in cooking vapours through the extraction device 14 is driven by the operation of an extraction fan 36 arranged inside of the housing 28. Said extraction fan 36 comprises a bottom-sided intake opening 38 for sucking the cooking vapours from the interior space of the housing 28.

[0028] A rear-sided fan outlet is arranged for a horizontal exit of the air blown out backwards from the extraction fan housing 42. The fan outlet is connected to a first end of an air duct 44 designed as a rectangular tube and forms a second channel arranged downstream the above-mentioned first channel. Directly at the passage from the fan outlet to the air duct 44, an air duct bending by 90 degrees is implemented, which redirects the air flow from horizontal to vertical downwards. The air duct 44 may be guided alongside a rear side of the kitchen cabinet 16 and may be bent again by 90 degrees close to a rear lower edge of the kitchen cabinet 16 in order to direct the airflow towards exhaust opening 30 in the base area 32 of the kitchen cabinet 16. Accordingly, the second end of the air duct 44 is connected to the exhaust opening 30. The embodiment illustrated in Fig. 1 shows a solution of the air duct 44 with an inclined section of its downwardly directed portion, directed slightly to the right. Naturally, a solution with said portion arranged in an exact vertical direction is considerable as well.

[0029] The course of the cooking vapours from the cooking area through the extraction device 14 to a re-entry into ambient air is illustrated in Fig. 1 by dotted arrows 46^1 to 46^5. On their way through the extraction device 14, the cooking vapours pass through a filter assembly 48, which is arranged downstream directly behind the suction opening 24 for providing a purification of the conveyed air. Said filter assembly 48 includes a filter carrier 50 supporting a filter element (not shown) that is usually configured for filtering out grease particles and droplets.

[0030] The structure of the combination appliance 10 illustrated by Fig. 1 includes an extraction device 14 operated in a recirculation mode, i. e. the air conveyed through the extraction device 14, filtered by the filter assembly 48 and leaving the extraction device 14 at its exhaust opening 30, re-enters the kitchen area, from where it can be aspirated again through the suction opening 24. The re-entry into the ambient air of the kitchen area is at the exhaust opening 30 arranged in a plinth panel (not shown) of the base area 32 of the kitchen cabinet 16. Alternatively to the air outlet at the exhaust opening 30 in the plinth panel, the air outlet zone may be positioned in the area below the kitchen cabinet 16, so that the exhausted air can be distributed in the base area beneath the kitchen cabinet 16 and from there it may particularly enter the ambient air of the kitchen area by at least one specific passage opening arranged in the plinth panel.

[0031] The cross-sectional view of Fig. 2 further shows two power boards 54, one for the left cooking region 20a and one for the right cooking region 20b, the power boards 54 providing cooking zones in the left and right cooking regions 20a, 20b with electrical power. In the present embodiment, the cooking hob 12 is an induction cooking hob and the cooking zones are defined by induction coils (not shown) that are arranged below the cooktop 22 of the cooking hob 12. Attached to the bottom side of the power board 54 assigned to the right cooking region 20b, a further circuit board is arranged forming a control electronics 56 for the combination appliance 10.

[0032] The embodiment illustrated in Figs. 3 to 7 is a structure of a combination appliance 10 according to a second example. In contrast to the first example, the combination appliance 10 according to second example provides a modular setup for a combination appliance 10 with a general downdraft extraction device 14, which can be combined with different models of cooking hobs 12.

[0033] The combination appliance embodiment according to Figs. 3 to 7 further differs from the setup of the

combination appliance 10 according to Figs. 1 and 2 in that all parts or modules of the cooking hob 12, except the two power board modules 54, are aggregated in a hob assembly part 12', which is dimensioned such that this hob assembly 12' will entirely find place in a cut-out area provided by a kitchen installer in a standard kitchen countertop 18, whereas said non-accommodated power board modules 54 are attached to an outer surface of the housing 28 of the extraction device 14, as will be described more in detail further down below.

[0034] Figs. 3 to 5 show the combination appliance 10 according to the second example from various angles. As can be specifically seen in Fig. 6, which is an illustration from a similar view as that one of Fig. 3, but which is a presentation of the isolated extraction device 14, i. e. without the hob assembly 12' on the top side of the extraction device 14, core part of the extraction device 14 is the housing 28 having a standardized dimensioning. This housing part 28 is configured to receive nearly all the extraction device components except, on the one hand, the components accommodated in the cooking hob 12, which are the suction opening 24 including its cover grid 26 and an initial section of the suction duct, and, on the other hand, a fan control module 58, which is also attached to an outer surface of the housing 28 of the extraction device 14, as will be described more in detail further down below, as well.

[0035] As illustrated in Figs. 3 to 6, the housing 28 of the general extraction device 14 is formed as a plastic box or plastic container of prism-shaped nature. Two opposing side walls of the housing 28, which are first 28a and second 28b side walls, are inclined from the vertical axis. The other two opposing and essentially trapezoid third 28c and fourth 28d side walls are vertically oriented in installation alignment. With this configuration, the four side walls 28a, 28b, 28c, 28d form a box, more precisely a container, which is tapered towards its bottom wall 28e. Said box or container is open at the top, but sealed by a bottom wall 60 of the housing 62 of the cooking hob 12 after completed assembling of the combination appliance 10.

[0036] The perspective bottom view according to Fig. 4 shows a bottom side of a fluid collector 64 arranged in a section of the bottom wall 28e, which may be formed like a shell open to the top, i. e. to the interior of the extraction device housing 28. The fluid collector 64 may be configured to be pulled down from the bottom wall 28e of the housing 28 for emptying it. Preferably, said pulling down is only possible after a lateral movement of the fluid collector 64 and/or by unlocking a locking mechanism. Other embodiments, not shown in the figures, may include another opening in the bottom wall 28e of the extraction device housing 28 arranged in another section of the bottom wall 28e, which another opening may serve as a service opening for providing service activities. Said another opening allows access to the interior of the extraction device housing 28 and is closable by a closing lid, preferably by a sealed closing lid, in this respect preventing passage of fluid not collected in the fluid collector 64 and/or passage of conveyed air.

[0037] Fig. 6 grants an inside from the top into the arrangement of components inside of the extraction device housing 28. As is visible, the construction of the assembled extraction device 14 is nearly axially symmetrical. An air transportation system including a fan 36 for air conveyance is positioned along a central axis of the extraction device housing 28. The fan 36 is arranged in a vertical orientation, i. e. a rotation axis of a fan wheel (not shown) is horizontally aligned. The fan 36 comprises two intake openings 38, 38' arranged at opposing sides of a fan housing 42, which construction enables a symmetric intake of air from both halves of the interior of the extraction device housing 28. As can be also seen in Fig. 6, a filter assembly 48, which is axially symmetrical similarly to the fan 36 and accommodated in a filter housing 50, with two flat filter elements positioned at opposing sides of the filter carrier 50, is included for a filtration of the conveyed air and for a separation of particles and/or droplets, e. g. grease, odour and/or vapour particles and/or droplets. Said filter assembly 48 and filter carrier 50 are arranged side-by side with the fan 36. The cooking vapours aspirated through the suction opening 24 enter the filter assembly 48 from the top side, and are deflected by about 90 degrees from vertical to horizontal direction fairly equally to both sides and through the filter elements. After passing the filter elements another deflection by about 90 degrees, but in approximately horizontal direction, takes place, so that the conveyed air is forwarded to the two intake openings 38, 38' for its transportation via the fan housing 42 to exhaust opening 30 positioned at the fourth side wall 28d, which is a rear wall in installation orientation of the combination appliance 10. Although the filter assembly 48 only takes up space of a smaller extension in depth direction of the cooking hob 12, the suction opening 24 extends nearly over the entire cooking hob depth, which means that a portion of the suction opening 24 is arranged above the fan housing 42, however, the cooking vapours aspirated through that portion are immediately guided towards the filter assembly 48, i. e. initially nearly in parallel to the surface of the cooktop 22. Moreover, the filter assembly 48 may be positioned above the previously described fluid collector 64, so that condensed droplets may directly drop down into the fluid collector 64.

[0038] Figs. 3 to 7 further illustrate, that both the power board modules 54 and the fan control module 58 are attached to the outer surfaces of housing walls, quasi in a backpack manner. According to the present embodiment, the two power board modules, i. e. first and second power board modules 54, are attached to the first and second side walls 28a, 28b, which are lateral walls of the extraction device housing 28 in installation orientation of the combination appliance 10, and which are said side walls inclined from the vertical. Further, the fan control module 58 is attached to the third side wall 28c, which is a front wall of the extraction device housing 28 in instal-

lation orientation. The fan control module 58 is positioned at an opposing side in relation to the exhaust outlet 30, which is arranged in the fourth side wall 28d, which is the rear wall in the present embodiment.

[0039] As previously mentioned, the suction opening 24 of the extraction device 14 is covered by a cover grid 26. The cover grid 26 of the second example of the combination appliance 10 is illustrated particularly in Figs. 8 to 11, isolated from the cooktop 22 of the cooking hob 12, but together with an air channel 66 forming an initial section of the air duct system of the extraction device 14. As can be seen in Fig. 7, a top surface of said air channel 66 is attached to the bottom surface of a cut-out of the cooktop 22 forming a hole provided for the suction opening 24. The cover grid 26 rests within the air channel 66 on a related support area and is kept in position by gravity. Hence, a user of the combination appliance 10 can easily remove the cover grid 26 from the air channel 66, in particular for cleaning activities, and insert it again in reverse order.

[0040] The cover grid 26 comprises a rectangular frame 84 having outer dimension configured to be inserted in the cut-out of the cooktop 22 and the allocated location area on the top side of the air channel 66 in circumferentially nearly gap-free manner. The frame 84 is designed in a way that its upper surface is flush with the upper surface of the cooktop 22, as illustrated in Fig. 7. Said frame 84 borders a central bar 68 and two lateral bars 70, 70', which bars 68, 70, 70' are in an arrangement parallel to each other and parallel to the longer ones of the frame parts 84a, 84b. Moreover, said longer frame parts 84a, 84b and the three bars 68, 70, 70' are in an at least approximately equidistant positioning, so that the spaces between these elements 68, 70, 70', 84a, 84b are of equal width. The lateral bars 70, 70' take the central bar 68 in their middle, wherein the central bar 68 coincides with the central axis of the cover grid 26. More specifically, the cover grid 26 is of an axisymmetric design.

[0041] As can be best seen in Figs. 10 to 13, the upper surface of the central bar 68 is flush with the upper surface of the frame 84, which upper bar surface is flat for design reasons. However, the lateral edges of the upper surface may be slightly rounded in order to avoid cutting damages, when the user is handling the cover grid 26, e. g. for cleaning activities. In contrast to the central bar 68, the upper surfaces of the lateral bars 70, 70' are located on a lower level compared to the upper surfaces of the frame 84 and the central bar 68. Said upper surfaces of the lateral bars 70, 70' may also be of a flat design, however, as illustrated in Fig. 11, these upper surfaces are rounded, what is favourable with respect to a limitation of turbulences in the air sucked through the cover grid 26. Even further, the present inventors have found that such turbulences can be completely avoided in the area around the lateral bars 70, 70' by designing them with a wing-shaped cross-section (cf. Fig. 11). Such a design particularly comprehends a rounded bottom area, which shaping is carried over for the bottom area of the central bar 68 for aerodynamic reasons.

[0042] Fig. 11 further illustrates that the lateral bars 70, 70' are inclined towards the vertical, particularly in a mirrored way. Consequently, the related lateral bar surfaces 80, 82 are inclined, too, but particularly with different inclination angles, as will be explained in more detail further down below with reference to Fig. 14. The inclination angles are selected by adapting to the direction of airflow, which direction is determined by usual operating conditions of the extraction device 14, what is particularly influenced by typical airflow speed and the dimensions of a standard cookware defining the source of the cooking fumes. By such adaptation, i. e. airflow direction being congruent with inclination angle, turbulences can be further decreased and the extraction device 14 is operated with best performance.

[0043] In a similar manner, also the longer frame parts 84a, 84b are provided with inclined lateral frame surfaces 72, 72' in order to also align with the airflow direction. As shown in Fig. 11 the inclination angle of the lateral frame surfaces 72, 72' towards the vertical is larger than second lateral bar surfaces 82 (only one is shown in Fig. 14) facing said lateral frame surfaces 72, 72'. That way, funnel-shaped passage openings (in cross-section) are defined by the inclined lateral frame surfaces 72, 72' and the related second lateral bar surfaces 82.

[0044] According to Figs. 8, 10 and 12, the cover grid 26 includes a rear section, which is characterized by an elongated (lengthwise) inclined rear surface 74. This rear section has no passage opening, but the areas between the longer frame parts 84a, 84b and the bars 68, 70, 70' are closed. This structure is selected as a consequence of this rear section overlapping a related section of the housing 42 of fan 36 (cf. Fig. 7). The cover grid 26 is extended towards the rear to this extent by overlapping the eccentrically positioned fan 36 for design reasons, in order to constitute a symmetric view on the cooktop 22 with the included suction opening 24 covered by the cover grid 26.

[0045] Moreover, the cover grid 26 is also designed by providing a poka-yoke design, i.e., the cover grid 26 is arrangeable in the suction opening 24 in only one way. To this end, the bottom side is constructed by adapting to the specific contours of air channel 66 and the fan housing 42. More specifically, the bottom sides of the bars 68, 70, 70' include curved contours 78 of, which follow the outer contour of the fan housing 42. Since there is a different shaping provided at the opposite ends of the bottom sides of the bars 68, 70, 70', a rotated placement of the cover grid 26 is prevented. Moreover, also a risk of an upside-down positioning is limited, namely in that the bottom sides of the bars 68, 70, 70' are designed by protruding from the level, which is defined by the bottom side of the frame 84. That way, the user is called attention to such a wrong upside-down positioning, when the protruding bottom sides of the bars 68, 70, 70' are visible after putting the cover grid 26 into position.

[0046] Finally, the cover grid 26 includes three bumpers 76 for a gentle and even arrangement in the suction opening 24, thereby holding the cover grid 26 in a centred position. Said bumpers 76 are arranged on the bottom sides of the longer frame parts 84a, 84b, split by 2 to 1 as is visible particularly in Fig. 13. In the resting position of the cover grid 26 within the air channel 66, the three bumpers 76 engage with correlated holes or recesses (not shown) included in the related support area.

[0047] By Fig. 14 a schematic illustration of a part of the cover grid 26 including the left hand lateral bar 70 and the central bar 68 is shown. This illustration only serves the purpose of providing details related to the inclination of the lateral bar surfaces 80, 80', 82, 82'. This figure shows the left hand longer frame part 84a, the central bar 68 and the left hand one 70 of the two lateral bars 70, 70'. The illustrated club-shaped design of the bars 68, 70 is generally feasible and would also provide a highly aerodynamic solution, however, as previously mentioned, the factual designs of the bars 68, 70, 70' as particularly illustrated by Fig. 11 have been selected for the above-mentioned aerodynamic and design reasons. According to Fig. 14, the central bar 68 is in a vertical arrangement with inclined lateral bar surfaces 80', 82', wherein the inclination is defined by an angle γ, which is equal according to amount at both left hand lateral bar surface 82' and right hand lateral bar surface 80'. With respect to the illustrated lateral bar 70, its left hand lateral bar surface 82 is inclined by angle β towards the vertical and its right hand lateral bar surface 80 is inclined towards the vertical by an angle α.

[0048] With respect to angle α, best performance has been determined, by means of simulation, by selecting an angle α in the range between 6 degrees and 10 degrees, most preferably around 8 degrees, but the extraction device 14 is sufficiently operable with α being selected within the interval 0 to 20 degrees. Further, with respect to angle β, best performance has been determined, by selecting the angle β in the range between 14 degrees and 22 degrees, most preferably around 18 degrees, but the extraction device 14 is sufficiently operable with β being selected within the interval 6 to 30 degrees. Finally, with respect to angle γ, best performance has been determined, by selecting the angle γ in the range between 6 degrees and 10 degrees, most preferably around 8 degrees, but the extraction device 14 is sufficiently operable with γ being selected within the interval 2 to 20 degrees.

[0049] As previously indicated, the inclination angles are selected by adapting to the direction of airflow, particularly influenced by typical airflow speed. In addition to the mentioned minimization of turbulences, the adaptation of the inclination angles can support an increased capture of cooking vapours. The higher the airflow, the larger the inclination angles α and β related to lateral bars 70 may be adjusted. For example, a standard position for a normal air speed may result in an angle β of 16 degrees, while an angle β of 25 degrees may be taken for a high air speed position. In the rising phase from normal to high air speed all intermediate positions between these two particular inclination angles may be taken by the lateral bars 70. The modification of the inclination angles α and β may be provided by a motorised adjustment. Preferably, however, the modification of the inclination angles α and β is generated automatically, i. e. adjusted according to the fan motor speed selected by the user of the combination appliance 10 or by a program controlled adjustment. In this case, the material of the cover grid 26 may have a specific flexibility that allows the automatic adjustment of the inclination angle of the lateral bars 70.

[0050] By Figs. 15 and 16 a cover grid 26 modified as compared with the previously described cover grid design according to Figs. 10 to 16 is shown. While most of the parts and sections of the cover grid 26 according to this design alternative are unmodified, e. g. frame 84, inclined rear surface 74, lateral bars 70 and bumpers 76, the central bar 68 has an increased height, i. e. an increased extension in downward direction, designed similar to a keel of a boat. With such increased extension of the central bar 68, a better separation of the air portion penetrating the gaps around the left-hand lateral bar 70 from the air portion penetrating the gaps around the right-hand lateral bar 70 is obtained. This measure results in an even further reduction of turbulences of the airflow in the area of the air channel 66 and, as a consequence, a further noise reduction is achieved for the operation of the combination appliance 10.

[0051] Even though not explicitly illustrated, the combination appliance 10 according to the first example shown in Figs. 1 and 2 is also configured to include the afore-described concept according to the present invention, with adaptations to the modified general setup.

[0052] It is further noted that the particular cover grids 26 according to either Figs. 10 to 14 or according to Figs. 15 and 16 not only can be used in combination appliances 10 configured for an operation with recirculation of air, but also combination appliances 10 configured for an operation in an exhaust mode exhaustion mode may be equipped with such kind of cover grids 26.

[0053] Although illustrative embodiments of the present invention have been described herein with reference to the accompanying drawings, it is to be understood that the present invention is not limited to these precise embodiments, and that various other changes and modifications may be affected therein by one skilled in the art without departing from the scope or spirit of the invention. All such changes and modifications are intended to be included within the scope of the invention as defined by the appended claims.

[0054] Moreover, features which are described in the context of separate aspects and embodiments of the invention may be used together and/or be interchangeable. Similarly, features described in the context of a single embodiment may also be provided separately or in any suitable sub-combination.

List of reference numerals

[0055]

10	combination appliance
12	cooking hob
12'	hob assembly
14	downdraft extraction device
16	kitchen cabinet
18	kitchen countertop
20a,20b	cooking regions
22	cooktop
24	suction opening
26	cover grid
28	extraction device housing
28a	first side wall
28b	second side wall
28c	third side wall
28d	fourth side wall
28e	bottom wall
30	exhaust opening
32	base area
34	outlet grille
36	extraction fan
38,38'	intake openings
42	fan housing
44	air duct
$46^{1 \text{ to } 5}$	arrows indicating air flow
48	filter assembly
50	filter carrier
54	power boards
56	control electronics
58	fan control module
60	hob bottom wall
62	hob housing
64	fluid collector
66	air channel
68	central bar
70,70'	lateral bars
72,72'	inclined lateral frame surfaces
74	inclined rear surface
76	bumpers
78	curved contour
80,80'	first lateral bar surfaces
82,82'	second lateral bar surfaces
84	frame
84a,84b	longer frame parts
α, β, γ	inclination angles

Claims

1. A cover element (26) for an inlet opening (24) of an extraction device (14), particularly a downdraft extraction device (14) for the extraction of cooking fumes generated during a cooking process on a cooking hob (12), more particularly a cover element (26) for an inlet opening (24) of a combination appliance (10) comprising a cooking hob (12) and an extraction device (14), the cover element (26) comprising at least two passage openings for a passage of air, particularly of cooking fumes, preferably for a passage in an at least approximately vertical top-down direction, wherein the passage openings are of an elongated shape, preferably formed as slits, which are included in the cover element (26) spaced apart and extending substantially parallel to one another, more preferably in a longitudinal direction of the preferably rectangular or oval-shaped cover element (26), wherein the section of the cover element (26) between the elongated passage openings comprises or is shaped as a bar (68, 70, 70'), which preferably extends over a substantial portion of the longitudinal extension of the cover element (26), the cover element (26) preferably being formed as a grid and/or being designed symmetrically along its longitudinal axis, **characterized in that**
the bar (68, 70, 70')

- comprising at least one section and/or at least one surface (80, 80', 82, 82') with aerodynamic qualities,
- particularly having a bottom side or bottom area with reduced thickness compared to its top side or top area in the installation position of the cover element (26),
- more particularly being at least partially wing-shaped.

2. The cover element (26) according to claim 1, wherein the bottom side or bottom area of the bar (68, 70, 70') comprises rounded edges or a round cross-section, and wherein the top side of the bar (68, 70, 70') particularly comprises a flat area, the top side more particularly being completely flat.

3. The cover element (26) according to claim 1 or 2, wherein the cover element (26) comprises

- a first bar (68, 70, 70') and a second bar (68, 70, 70'),
and/or
- an uneven number of bars (68, 70, 70'), which first and second bars (68, 70, 70') and/or uneven number of bars (68, 70, 70') are aligned at least approximately in parallel with one another.

4. The cover element (26) according to claim 3, wherein the cover element (26) comprises a central bar (68), which is preferably located on a centreline of the cover element (26), and at least one laterally or eccentrically located bar (70, 70'), wherein particularly the central bar (68) has an increased thickness compared to the at least one laterally or eccentrically located bar (70, 70').

5. The cover element (26) according to any one of the preceding claims, wherein at least a section of the bar (68, 70, 70') or of at least one of the plurality of bars (68, 70, 70') has an axis-symmetrical cross-section.

6. The cover element (26) according to any one of the preceding claims, wherein the cover element (26) comprises at least one laterally or eccentrically located bar (70, 70') having

- at least one lateral surface, preferably a first lateral surface (80), which is inclined by an angle α towards the vertical,
- and preferably a second lateral surface (82), opposite the first lateral surface (80) with respect to a central axis of the at least one laterally or eccentrically located bar (70, 70'), which second lateral surface (82) is inclined by an angle β towards the vertical,

wherein more preferably the first (80) and second (82) lateral surfaces of the at least one laterally or eccentrically located bar (70, 70') include an angle, particularly forming a V-shaped cross-section.

7. The cover element (26) according to claim 6, wherein

- angle α is selected to be in the range between 0 degrees and 20 degrees, preferably in the range between 4 degrees and 15 degrees, more preferably in the range between 6 degrees and 10 degrees, most preferably 8 degrees,
- angle β is selected to be in the range between 6 degrees and 30 degrees, preferably in the range between 10 degrees and 26 degrees, more preferably in the range between 14 degrees and 22 degrees, most preferably 18 degrees.

8. The cover element (26) according to any one of the preceding claims, wherein the cover element (26) comprises a central bar (68) having a first lateral surface (80') and a second lateral surface (82'), opposite the first lateral surface (80') with respect to a central axis of the central bar (68), which first (80') and second (82') lateral surfaces

- are vertically oriented
or
- are inclined by an angle γ towards the vertical, wherein preferably the first (80') and second (82') lateral surfaces of the central bar (68) include an angle 2 times γ, particularly forming a V-shaped cross-section.

9. The cover element (26) according to claim 8, wherein angle γ is selected to be in the range between 0 degrees and 20 degrees, preferably in the range between 4 degrees and 15 degrees, more preferably in the range between 6 degrees and 10 degrees, most preferably 8 degrees.

10. The cover element (26) according to any one of the preceding claims, wherein the bar (68, 70, 70') or at least one of the plurality of bars (68, 70, 70') has an increased height compared to at least one other section of the cover element, in particular compared to a border or a frame (84) of the cover element (26).

11. The cover element (26) according to any one of the preceding claims, wherein in the installation position of the cover element (26) a top side of a laterally or eccentrically located bar (70, 70') is arranged at a lower level compared to

- a top side of the entire cover element (26), and/or
- a border or a frame (84) of the cover element (26), and/or
- a central bar (68), which is preferably located on a centreline of the cover element (26).

12. The cover element (26) according to any one of the preceding claims, wherein at least a section of the bottom side of at least one bar (68, 70, 70'), preferably at least a section of the bottom side of the entire cover element (68, 70, 70'), follows a contour (78), in particular in adaptation to a curved and/or radially shaped casing element (66) of the extraction device (26).

13. The cover element (26) according to any one of the preceding claims, wherein an interior surface (72, 72') of a border or a frame (84) of the cover element (26) is inclined by an angle δ towards the vertical.

14. The cover element (26) according to any one of the preceding claims, wherein at least one bar (68, 70, 70') is adjustable in its inclination, preferably within a predefined angle range, in particular by means of a manual operation or automatically using a driving mechanism.

15. The cover element (26) according to claim 14, wherein the adjusted value of the inclination angle depends at least on

- the height of a selected cooking utensil, from which the cooking fumes originate,
and/or
- the selected airflow speed, wherein particularly a larger angle is selected for a higher airflow speed.

16. An extraction device (14) or a combination appliance

(10) including a cooking hob (12) and an extraction device (14), the extraction device (14) comprising the cover element (26) according to any one of the preceding claims.

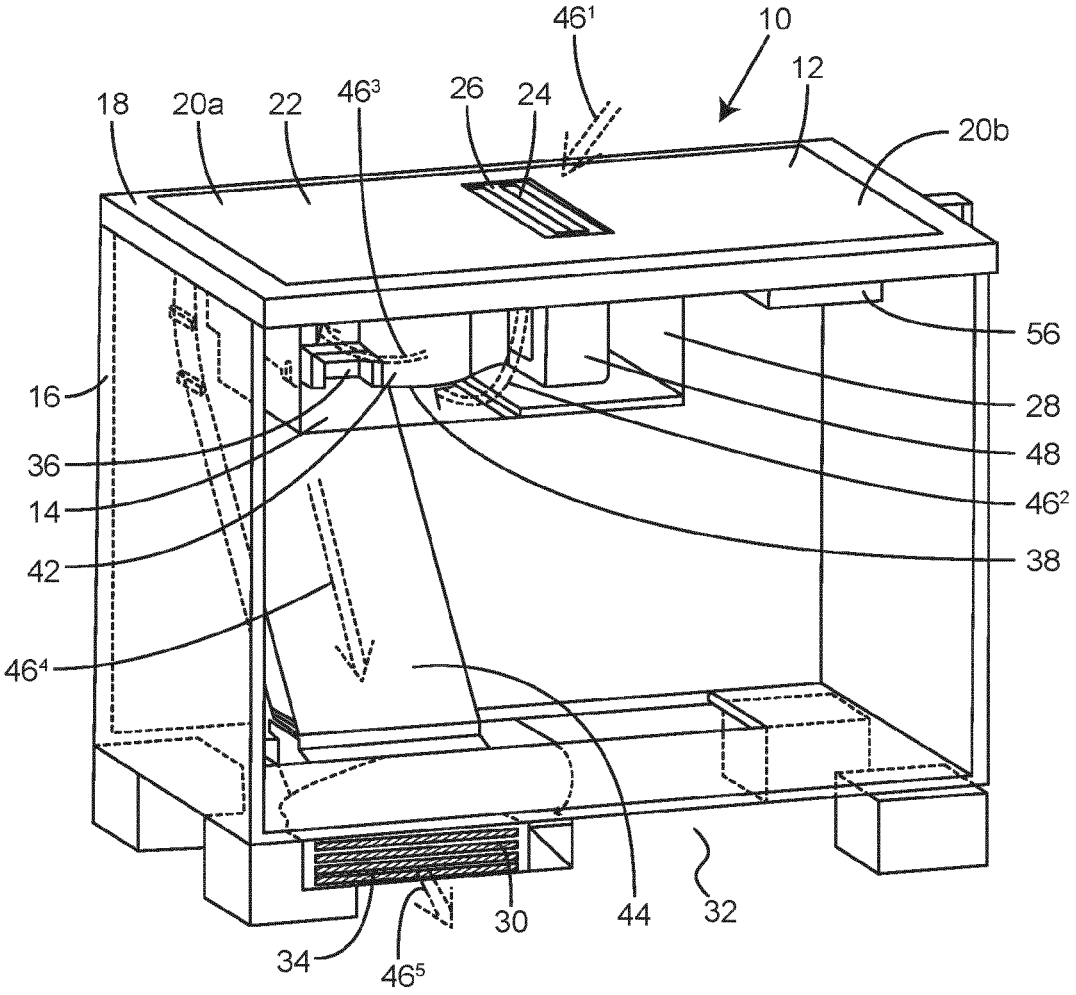
46¹
10
12
18
20a
22
46³
26
24
20b
56
16
28
36
48
14
46²
42
38
46⁴
30
44
32
34
46⁵

FIG. 1

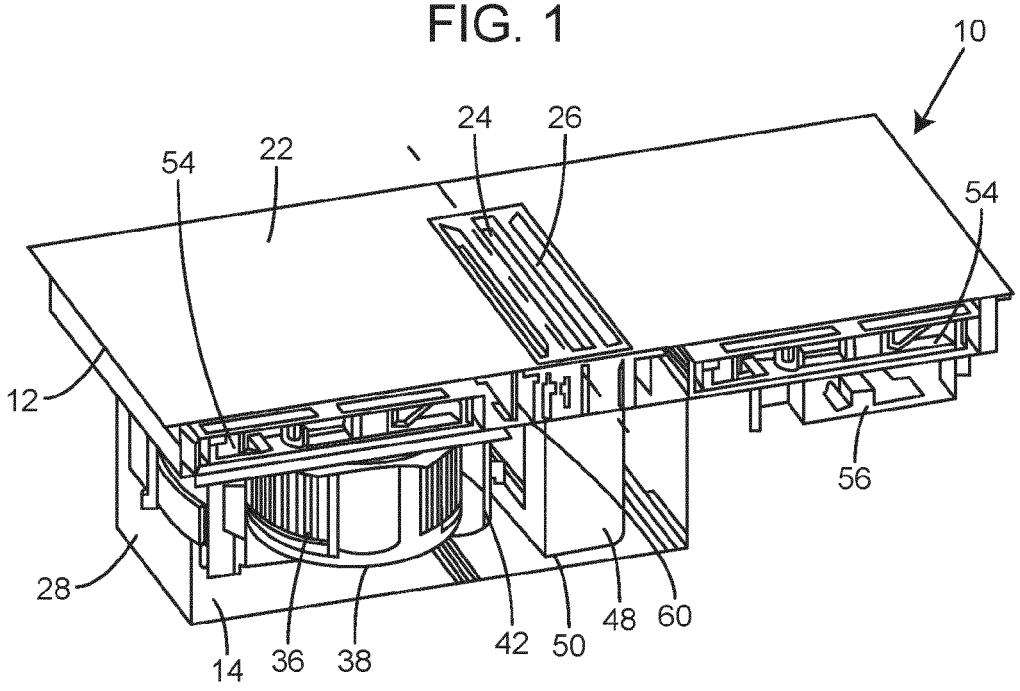
10
24
26
54
22
54
12
56
28
14
36
38
42
50
48
60

FIG. 2

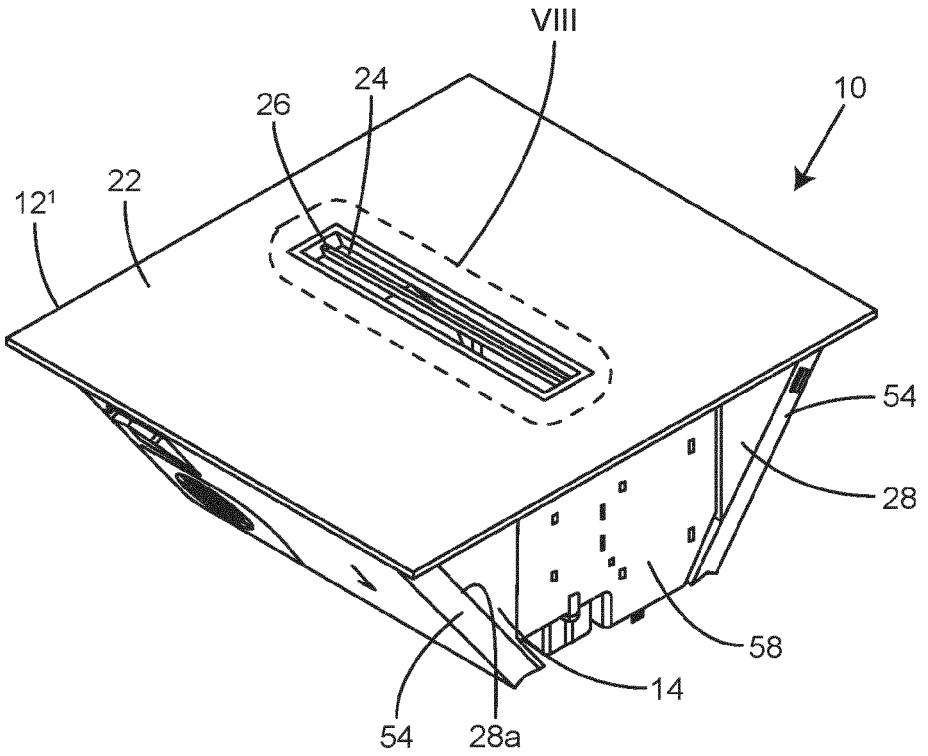
VIII
24
26
10
12¹
22
54
28
58
14
54
28a

FIG. 3

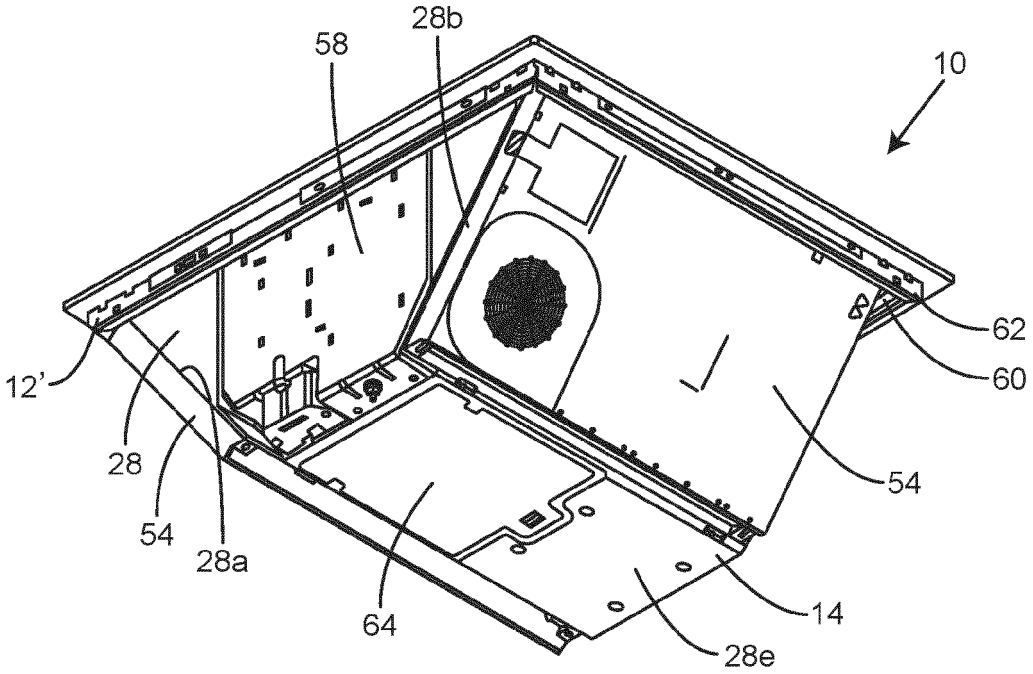
28b
58
10
62
60
12'
28
54
54
28a
64
14
28e

FIG. 4

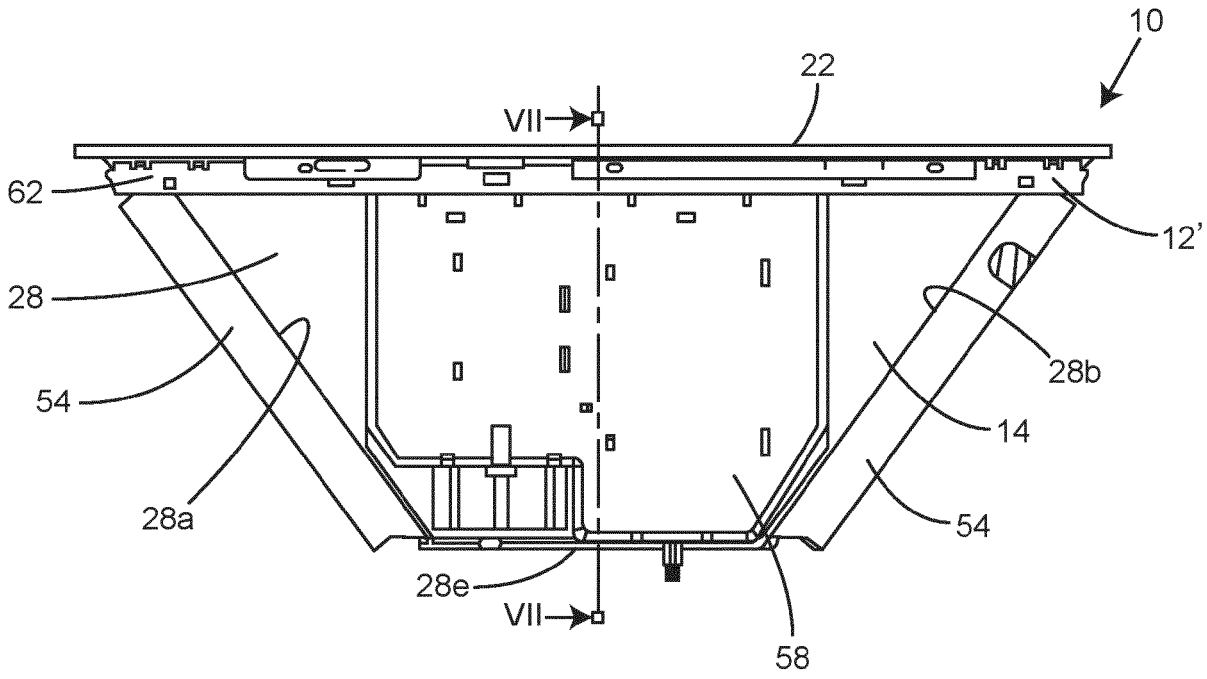
10
22
VII
62
12'
28
28b
54
14
28a
54
28e
VII
58

FIG. 5

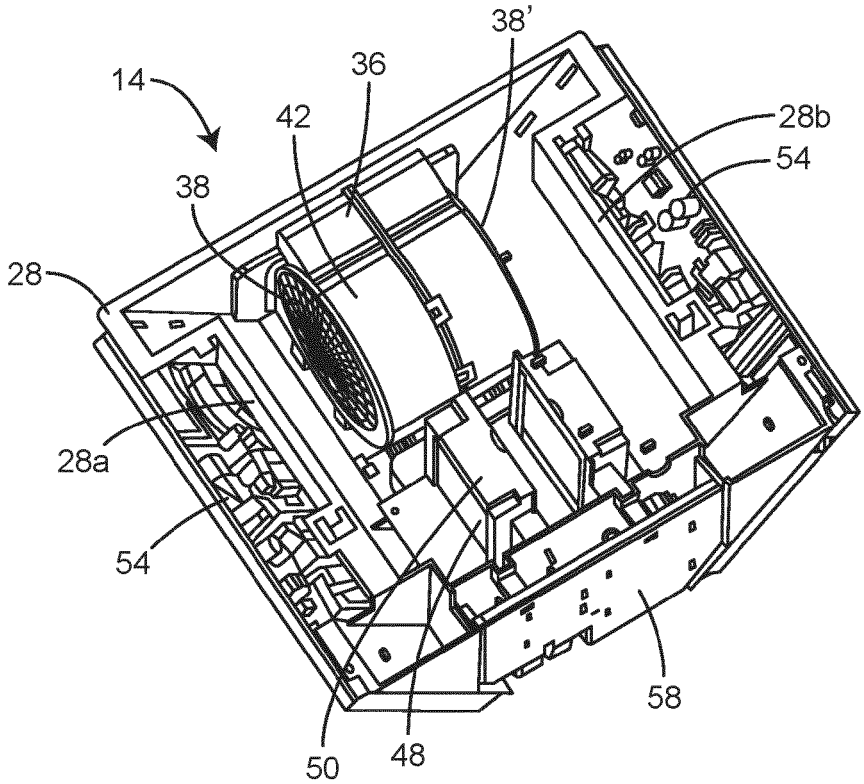
38'
14
36
42
28b
54
38
28
28a
54
58
50
48

FIG. 6

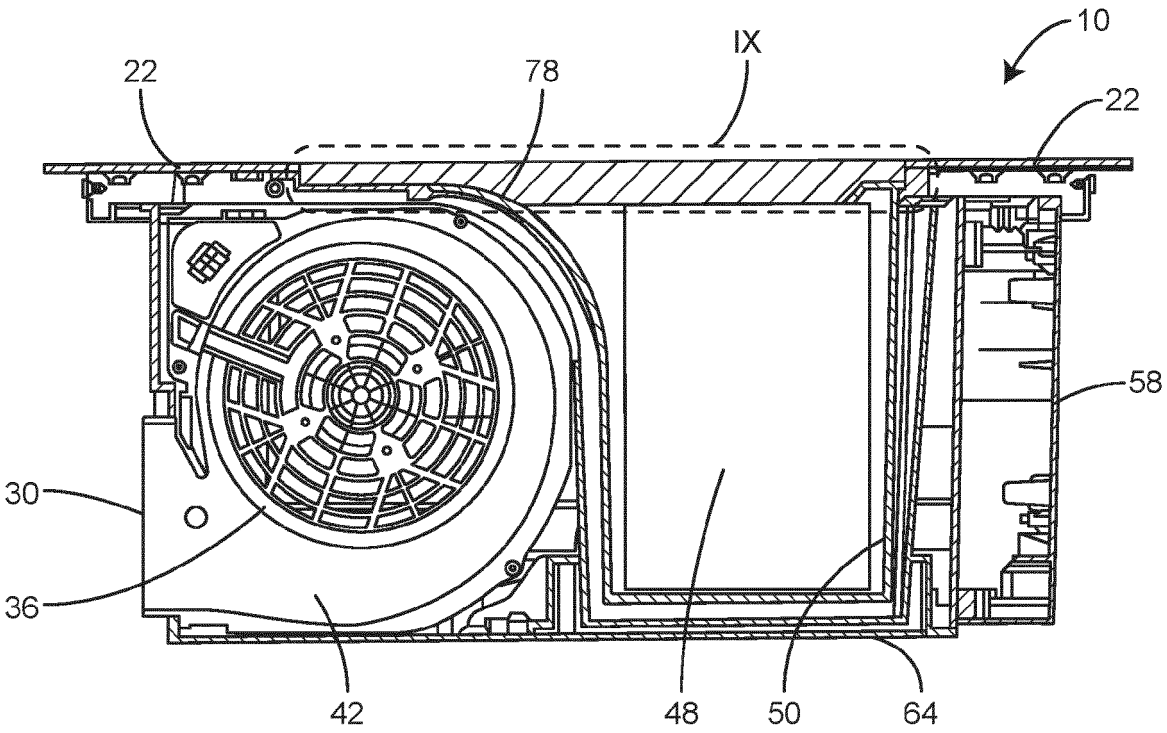
10
IX
22
78
22
58
30
36
42
48
50
64

FIG. 7

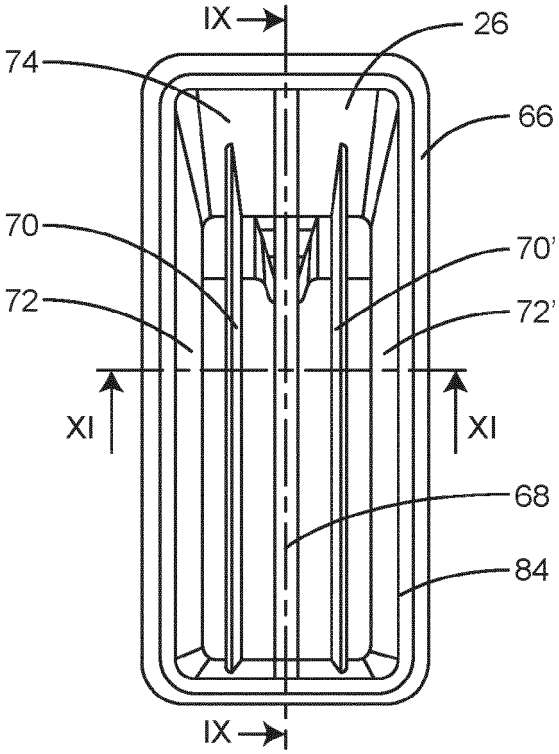
IX
26
74
66
70
70'
72
72'
XI
XI
68
84
IX

FIG. 8

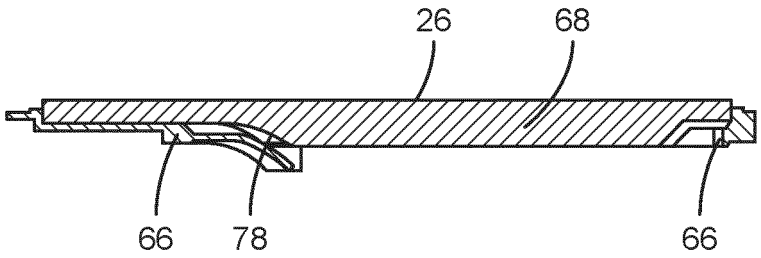

FIG. 9

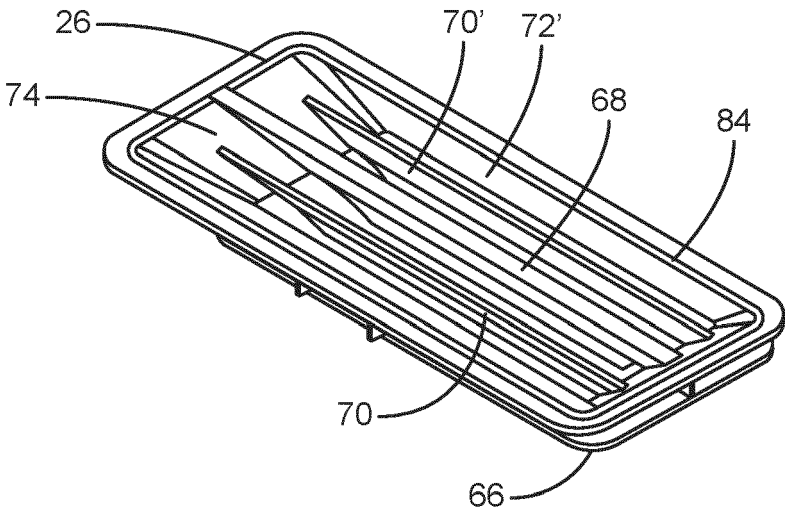

FIG. 10

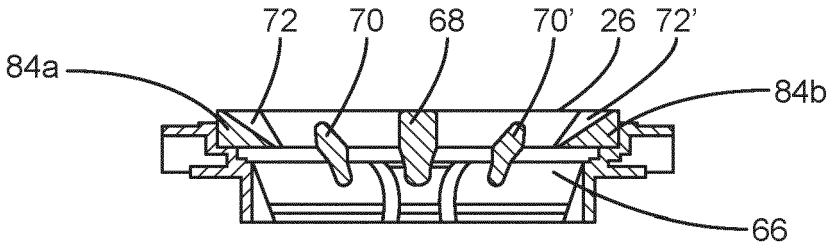

FIG. 11

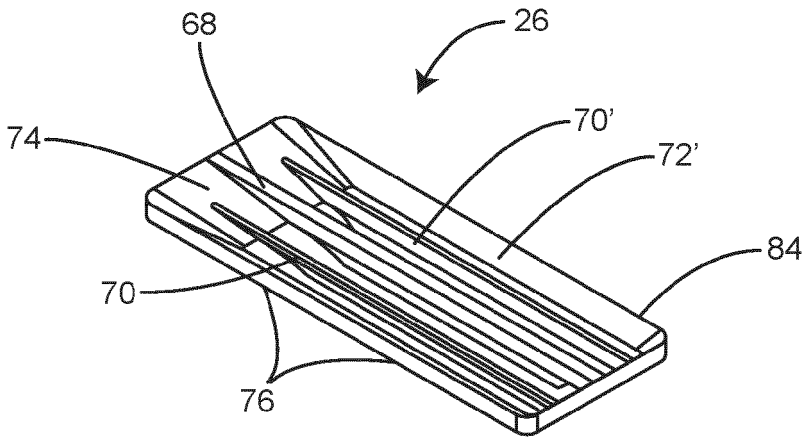

FIG. 12

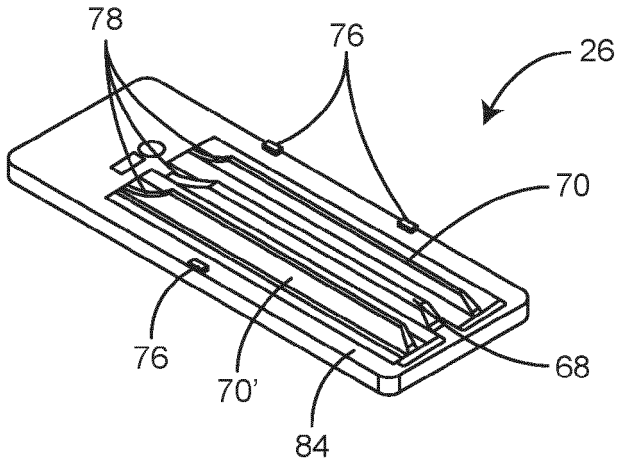

FIG. 13

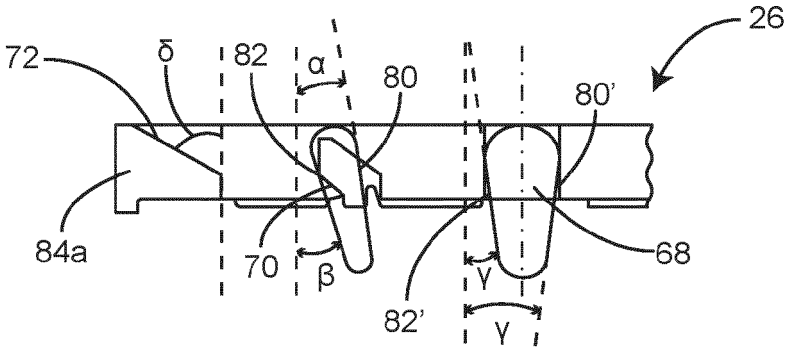

FIG. 14

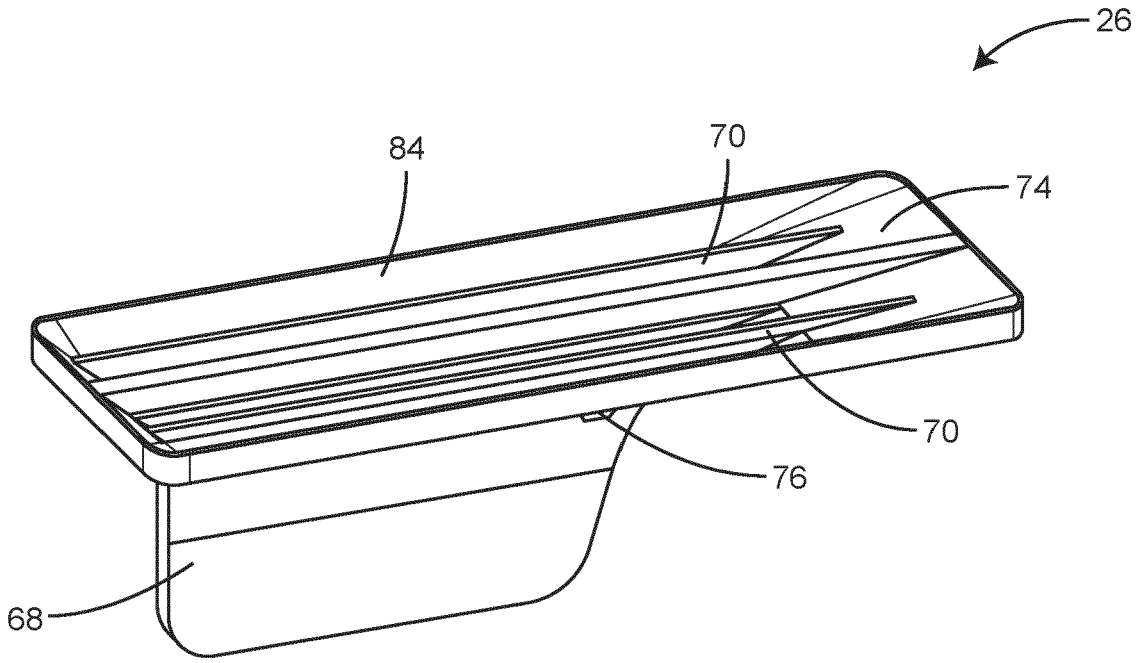

FIG. 15

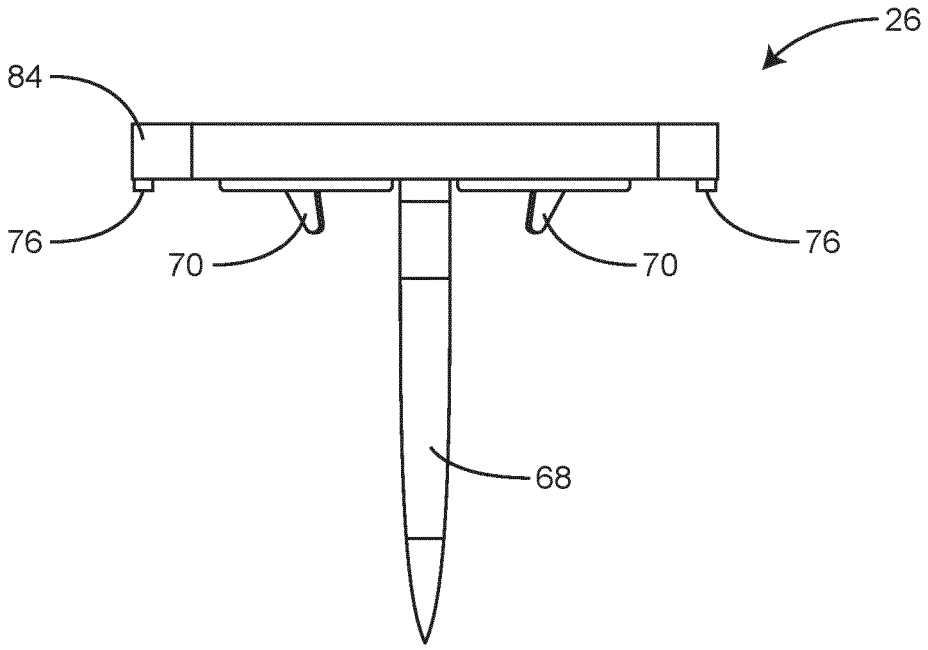

FIG. 16

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EUROPEAN SEARCH REPORT

Application Number
EP 23 17 6975

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Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
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X	EP 3 457 033 A1 (BERBEL ABLUFTTECHNIK GMBH [DE]) 20 March 2019 (2019-03-20) * paragraph [0077]; claim 22; figures 1-5 *	1-8,12, 13,16	
X	WO 2021/009173 A1 (INTELL PROPERTIES B V [NL]) 21 January 2021 (2021-01-21) * figures 1-3 *	1,5, 8-10,12, 13,16	
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X	EP 3 401 606 A1 (NABER HOLDING GMBH & CO KG [DE]) 14 November 2018 (2018-11-14) * figure 1 *	1	

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	1 November 2023	Fest, Gilles

CATEGORY OF CITED DOCUMENTS

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