(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) **EP 2 982 909 A1**

(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
10.02.2016 Bulletin 2016/06

(51) Int Cl.:
F24F 7/02 *(2006.01)*

(21) Application number: **15275180.6**

(22) Date of filing: **03.08.2015**

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

(30) Priority: **08.08.2014 GB 201414119**

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(54) A COWL FOR A VENTILATION SYSTEM

(57) A cowl for a ventilation system comprising at least two separate flow paths, an outlet flow path defined by a first conduit and an inlet flow path defined by a second conduit that extends around the first conduit of the outlet flow path, the first and second conduits extending in the direction of a common axis, the inlet and outlet flow paths each having a first end adapted to open to atmosphere and each having a second end adapted to be connected to the ventilation system, wherein the inlet flow path includes a mouth portion at its first end, the mouth portion substantially facing a direction perpendicular to the common axis to provide an opening into the inlet flow path and including at least one louver, the louver configured to present to incoming air a radially outward upwardly inclined section and a radially inward downwardly inclined section.

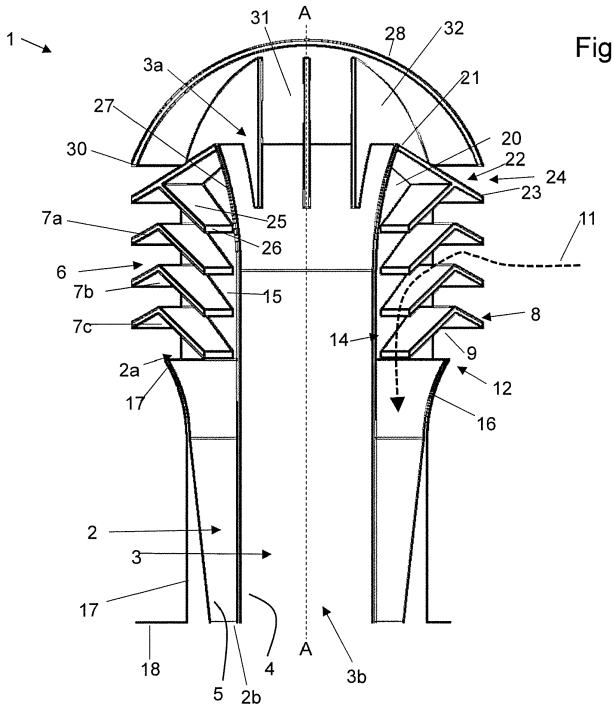

Fig. 1a

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Description

[0001] This invention relates to a cowl for a ventilation system and, in particular, it relates to a cowl for a passive ventilation system. The invention also relates to a ventilation system, such as a passive ventilation system, including said cowl.

[0002] As buildings are becoming better insulated and more airtight, the need for adequate ventilation, to maintain a healthy indoor environment, is growing in importance. Ventilation systems comprise an outflow duct and an inflow duct to exhaust stale air to atmosphere and draw in fresh air. Electrically powered fans may be used to move the air through the ventilation system. Some ventilation systems include heat recovery and thus include a heat exchanger. The heat exchanger comprises a region where the inflow duct and outflow duct are separated by a number of heat exchanger plates or a thin membrane that allows heat transfer therethrough. Thus, the warm outgoing air is used to heat the cooler incoming air. These systems have been shown to be able to recover up to 90% of the energy of the outgoing air. These systems can therefore provide ventilation without a significant effect on heating requirement. However, if we take account of the electricity used by the fans, the overall saving in energy usage may be very small and they are cumbersome to install.

[0003] Passive ventilation systems are known that utilise the buoyancy of warmer air to drive the ventilation of buildings; the so called "passive stack effect". However, these systems have drawbacks as the movement of air through the ventilation system can be slow or stop and reverse depending on the relative conditions inside and outside the building. This makes passive ventilation systems ineffective in certain conditions. A cowl provides the interface between the ventilation system and the atmosphere and is typically located on the roof of the building. The cowl may provide an exhaust for air from the building as well as an inlet for air from atmosphere. It has been found that the design of the cowl can have a significant effect on the performance of a passive ventilation system (and on active, powered ventilation systems). How the cowl accepts air into the ventilation system, how the cowl exhausts air and how the inlet and exhaust flows interact are all critical factors for efficient cowl design.

[0004] According to a first aspect of the invention, we provide a cowl for a ventilation system comprising at least two separate flow paths; an outlet flow path defined by a first conduit and an inlet flow path defined by a second conduit that extends around the first conduit of the outlet flow path, the first and second conduits extending in the direction of a common axis, the inlet and outlet flow paths each having a first end adapted to open to atmosphere and each having a second end adapted to be connected to the ventilation system, wherein
the inlet flow path includes a mouth portion at its first end, the mouth portion substantially facing a direction perpendicular to the common axis to provide an opening into the inlet flow path and including at least one louver, the louver configured to present to incoming air a radially outward upwardly inclined section and a radially inward downwardly inclined section.

[0005] This arrangement is advantageous as the louvers have been found to provide efficient rain ingress protection without hindering flow and, in fact, may improve flow.

[0006] The inclined sections may be continuous with one another.

[0007] The mouth portion may extend above a terminal end of the second conduit and a guide section may be arranged to extend out of the second conduit and define the mouth portion with the terminal end of the second conduit. Thus, the mouth may be defined by the terminal ends of the second conduit and a terminal end of the guide section that extends out of the second conduit. The mouth portion may provide a laterally facing aperture to receive atmospheric air which is turned downward into the inlet flow path. The louver or louvers may be spaced from guide section. Thus, a channel inward of the louvers and common to each of them may be defined that carries atmospheric air entering the cowl into the second conduit. At least the downwardly inclined section(s) may be located directly above the terminal end of the second conduit.

[0008] The first conduit may form the guide section. Thus, an outer wall of the first conduit and the second conduit may define the inlet flow path. The guide section (or outer wall of the first conduit) may present a substantially smooth surface facing the mouth portion for guiding air between the mouth portion and the first end of the second conduit. This arrangement has been found to be advantageous in which the air-diverting louvers open into a channel that is defined by a smooth surface, the smooth surface extending into the second conduit. The smooth surface may have dimples or a texture, which may disrupt any boundary layer formed thereover. The smooth surface may be free from protuberances that substantially alter the bulk direction of air flow in the channel. The guide section may be annular and arranged substantially vertically. The guide section may include a concave portion opposite the mouth portion. This may advantageously receive air from the louvers with low pressure drop.

[0009] The mouth portion may include a plurality of louvers arranged in a stacked configuration.

[0010] Adjacent louvers may define a flow path through the mouth portion into the inlet flow path that extends upwardly and then downwardly.

[0011] The or each inclined section (upward or downward) of each louver may be substantially linear in cross-section. The louvers may have a substantially V-shaped cross-section. The louvers may be substantially curved and arranged such that a first part of the curve defines the upwardly inclined section and a second part of the curve defines the downwardly inclined section. The downwardly inclined section may be wider than the upwardly inclined section. The louvers may advantageously

prevent substantial rain ingress.

[0012] The terminal end of the second conduit may be flared radially outwardly. The radial outer edge of the louvers, or at least the lowermost louver, may extend radially beyond a terminal edge of the flared portion. In particular, the upwardly inclined section may extend radially beyond the terminal edge of the flared portion. The downwardly inclined section may extend radially inwardly of the terminal edge of the flared portion. This arrangement has been found to be advantageous for guiding air into the flared inlet flow path while cooperating with the air direction imparted by the louvers.

[0013] The radius of the second conduit decreases from its first end to its second end. Thus, the second conduit may continue to narrow beyond the flared part.

[0014] The inlet flow path, at least at the mouth portion, may include at least two sectorial fins extending in a radial direction configured to divide the mouth portion into at least two sectors facing in different radial directions. The fins have been found to assist in efficient operation of the cowl in varying wind directions. The cowl may include at least three, four, five, six, seven, eight or more fins. The combination of substantially vertically oriented fins with the louvers that extend in a horizontal plane has been found to be a surprising combination for promoting air flow through the cowl

[0015] The sectorial fins may extend from the guide portion or outer wall of the first conduit. The fins may terminate at the terminal end of the second conduit. Thus, the second conduit may not be defined into annular sectors.

[0016] A separator flange may extend radially outwardly at a terminal end of the first conduit, the separator flange defining an upper wall of the mouth portion and a lower wall of an opening to the outlet flow path. The separator flange may extend from the terminal end of the first conduit. The terminal end of the first conduit may be configured to flare outwardly.

[0017] The separator flange may extend radially outwardly and downwardly. The separator flange may include a guide surface that extends radially inwardly from a lower surface thereof, the guide surface being complimentary to an upper-most louver of the mouth portion. Thus, the guide surface acts as a louver in defining a flow path with the uppermost louver in the mouth portion. Separating the inlet and outlet flows by way of the separator flange in combination with the complimentary lower surface of the flange is advantageous.

[0018] The guide surface may be provided by a guide flange, the guide flange including a free end opposite its connection to the separator flange. Thus, the free end of the guide flange is spaced from the guide portion/first conduit. Alternatively, the separator flange may be wedge shaped and may taper from the terminal end of the first conduit. As the guide flange does not contact the first conduit it defines an annular void.

[0019] The guide surface may extend from a mid-point between distal and proximal ends of the separator flange. Thus, the portion of the separator flange between the mid-point and its distal end and the guide surface define a bi-directionally inclined surface complimentary to the uppermost louver which forms a louver flow path through the mouth portion into the inlet flow path, the louver flow path arranged to extend upwardly and then downwardly to incoming air. This is advantageous as the separator flange, which divides flows between the first and inlet flow paths, acts to efficiently guide air into the inlet flow path along with the louver(s).

[0020] A cap may extend over and be spaced from the first end of the outlet flow path. The outlet flow path may include an opening at its first end, the opening facing upwardly.

[0021] A rim of the cap may extend, at least in part but preferably substantially wholly, below a terminal end of the first conduit. The cap may be domed, hemispherical, conical, or pyramidal or of a truncated form thereof. A dome, such as a substantially hemispherical dome, has been found to be particularly advantageous.

[0022] Optionally, the inner surface of the cap opposite the opening of the first conduit is concave. Thus there is no indentation in the concave cap opposite opening. The rim of the cap may have a diameter greater than first end of the first conduit.

[0023] A rim of the cap and a separator flange may define an opening from a void within the cap, the first conduit opening into said void, wherein the separator flange extends radially outwardly at a terminal end of the first conduit. The opening may be annular.

[0024] The cap may include at least two sectorial fins extending in a radial direction configured to divide an opening into the cap into at least two sectors facing in different radial directions. The sectorial fins may be radially spaced from the common axis to define an open central void in the cap directly above the first end of the first conduit. Thus, flow entering one sector can therefore enter the central void and leave by any other sectorial channel defined by the fins, possibly carrying with it air from the outlet flow path.

[0025] The inlet flow path may be annular and extend around the outlet flow path, the first and second conduits arranged substantially coaxially along the common axis. The first end of the outlet flow path may face in the direction of the common axis.

[0026] The cowl of the first aspect may comprise a passive ventilation system cowl.

[0027] According to a second aspect of the invention we provide a cowl for a ventilation system comprising at least two separate flow paths, an outlet flow path defined by a first conduit and an inlet flow path defined by a second conduit that extends around the first conduit of the outlet flow path, the first and second conduits extending in the direction of a common axis, the inlet and outlet flow paths each having a first end open to atmosphere and each having a second end adapted to be connected to the ventilation system, wherein

a separator flange extends radially outwardly at a termi-

nal end of the first conduit to separate atmospheric air flow, the separator flange having a lower surface configured to guide laterally flowing atmospheric air downwardly into the inlet flow path, and an upper surface configured to guide laterally flowing atmospheric air upward and over the open end of the outlet flow path.

[0028] The arrangement and shape of the separator flange relative to the rest of the cowl has been found to be particularly important to efficiently manage the incoming and outgoing flows.

[0029] The inlet flow path may include a mouth portion at its first end, the mouth portion substantially facing a direction perpendicular to the common axis to provide an opening into the inlet flow path and including at least one louver, the louver comprising a radially outer upwardly inclined section and a radially inward downwardly inclined section, the inclined sections and the lower surface of the separator flange defines an upper wall of the mouth portion.

[0030] The inclined sections may be continuous with one another.

[0031] The upper surface of the separation flange may extend radially outwardly and downwardly from the terminal end.

[0032] The lower surface may include a guide flange extending therefrom, the guide flange extending from the separation flange downwardly and towards the common axis. The guide surface may extend from a mid-point between distal and proximal ends of the separator flange.

[0033] The guide flange may comprise a first end where it connects to the separator flange and an opposed free end. Thus, the free end of the guide flange may be spaced from the guide portion/first conduit.

[0034] The separator flange may be wedge shaped and may taper from the terminal end of the first conduit. Thus, the separator flange may comprise an annular wedge.

[0035] A cap may extend over and be spaced from the first end of the outlet flow path. The first conduit may include an opening at its first end, the opening facing upwardly.

[0036] A rim of the cap and the upper surface of the separator flange may define an opening from a void within the cap to atmosphere, the first conduit opening into said void. The opening may be annular. A rim of the cap may extend, at least in part, below a terminal end of the first conduit from which the separator flange extends. The cap may have a diameter substantially equal to the outer edge of the louvers.

[0037] The cap may include at least two sectorial fins extending in a radial direction between the upper surface and the cap and configured to divide an opening into the cap into at least two sectors facing in different radial directions. The sectorial fins may be radially spaced from the common axis to define an open central void in the cap directly above the first end of the first conduit.

[0038] According to a third aspect of the invention, we provide a cowl for a ventilation system comprising at least two separate flow paths, an outlet flow path defined by a first conduit and an inlet flow path defined by a second conduit that extends around the first conduit of the outlet flow path, the first and second conduits extending in the direction of a common axis, the inlet and outlet flow paths each having a first end open to atmosphere and each having a second end adapted to be connected to the ventilation system, wherein

the cowl includes a cap, the cap extending over and spaced from the open end of the first conduit and having a rim arranged lower than the open end.

[0039] The positioning of the dome over the open end of the exhaust flow path such that the open end opens into an internal volume defined by the dome and its rim has been found to be advantageous in terms of efficient air flow and rain ingress protection.

[0040] The cap may be domed and the apex of the dome may be arranged substantially opposite the open end of the first conduit. The outlet flow path may include an opening at its first end, the opening facing upwardly.

[0041] A separator flange may extend radially outwardly and downwardly at a terminal end of the first conduit.

[0042] The rim of the cap and an upper surface of the separator flange may define an annular opening from a void within the cap to atmosphere, the first conduit opening into said void.

[0043] The cap may include at least two sectorial fins extending in a radial direction between the separator flange and the cap and configured to partially divide an opening into the cap into at least two sectors facing in different radial directions.

[0044] The sectorial fins may be radially spaced from the common axis to define an open central void in the cap directly above the first end of the first conduit.

[0045] According to a fourth aspect of the invention we provide a cowl for a ventilation system comprising at least two separate flow paths, an outlet flow path defined by a first conduit and an inlet flow path defined by a second conduit that extends around the first conduit of the outlet flow path, the first and second conduits extending in the direction of a common axis, the inlet and outlet flow paths each having a first end open to atmosphere and each having a second end adapted to be connected to the ventilation system, wherein

the cowl includes a cap, the cap extending over and spaced from the open end of the first conduit and wherein the cap includes a plurality of radially extending sectorial fins arranged to channel air towards a central axis.

[0046] The sectorial fins extending into the cap have been found to advantageously control air flow through the cap, which may assist in drawing air from the outlet flow path. Thus, the sectorial fins extend in a radial direction and are configured to partially divide an opening into the cap into a plurality of sectors facing in different radial directions. The sectorial fins may be radially spaced from the common axis to define an open central void in the cap directly above the first end of the first conduit.

[0047] According to a fifth aspect of the invention, we provide a cowl for a ventilation system comprising at least two separate flow paths; an outlet flow path defined by a first conduit and an inlet flow path defined by a second conduit that extends around the first conduit of the outlet flow path, the first and second conduits extending in the direction of a common axis, the inlet and outlet flow paths each having a first end adapted to open to atmosphere and each having a second end adapted to be connected to the ventilation system, wherein
the inlet flow path includes a mouth portion at its first end, the mouth portion substantially facing a direction perpendicular to the common axis to provide an opening into the inlet flow path, the mouth portion defined between the first end of the inlet flow path and a terminal end of a guide portion that extends out of the inlet flow path, the guide portion having a necked portion opposite the mouth portion.

[0048] Optionally, the guide portion comprises a first section adjacent the first end of the inlet flow path, a second section adjacent its terminal end and the necked portion extends between the first and section sections and radially inwardly thereof. The guide portion may comprise the first conduit.

[0049] According to a sixth aspect of the invention, we provide a passive ventilation system for a building including an inlet conduit for delivering atmospheric air into the building and an outlet conduit for exhausting air from the building to atmosphere, the system further including the cowl of the first, second, third, fourth or fifth aspects, wherein the outlet conduit is connected to the second end of the outlet flow path of the cowl and the inlet conduit is connected to the second end of the inlet flow path of the cowl.

[0050] It will be appreciated that the optional features of any one of the first to fourth aspects can be applied to any of the other aspects.

[0051] There now follows, by way of example only, a detailed description of embodiments of the invention with reference to the following figures, in which:

Figures 1 a and 1 b show a cross-sectional view and perspective view of a first embodiment of a cowl;

Figure 2 shows a cross section through a louver shown in Figures 1 a and 1 b;

Figures 3a and 3b show a second embodiment of the cowl;

Figure 4 shows a cross-sectional view of a third embodiment of a cowl;

Figure 5 shows a cross-sectional view of a fourth embodiment of a cowl;

Figures 6a and 6b show a cross-sectional view of a fifth embodiment of a cowl;

Figure 7 shows a cross-sectional view of a sixth embodiment of a cowl;

Figure 8 shows a cross-sectional view of a seventh embodiment of a cowl;

Figure 9 shows a cross-sectional view of a eighth embodiment of a cowl; and

Figure 10 shows a ventilation system including a cowl.

[0052] Figures 1 and 2 shows a cowl 1 for a ventilation system and, in this embodiment, a passive ventilation system. As the movement of air through a passive ventilation system is unpowered, the design of the cowl and how it receives air from and exhausts air to atmosphere is important. Further, the cowl 1 comprises an integral unit for two separate flow paths; an inlet flow path 2 for receiving atmospheric air into the ventilation system and an outlet flow path 3 for exhausting air from the ventilation system to atmosphere. Figure 10 shows a schematic diagram of a ventilation system 100 in a building 101. The cowl 1 is mounted to the roof of the building 101 but could be mounted elsewhere provided it is in the flow of atmospheric air. A conduit 102 connects to the inlet flow path of the cowl 1 and a conduit 103 connects to the outlet flow path. The conduits 102 and 103 terminate at vents 104 and 105 to provide a connection to the building's interior. The ventilation system may also include a heat exchanger to provide heat recovery. The heat exchanger may exchange heat between the air in the inlet and outlet conduits. It will be appreciated that Figure 10 shows a schematic, example layout of a ventilation system and other layouts and designs are possible. For example, the ventilation system may supply fresh air to a communal area of each floor and extract air from each compartmentalised room (bedroom, living room, bathroom etc.) separately. Further, the ventilation system may introduce inlet at the bottom of each room and remove air at the top of each room.

[0053] Turning to Figures 1 and 2, the outlet flow path 3 is defined by a first conduit 4 and the inlet flow path 2 is defined by a second conduit 5 that extends around the first conduit 4 of the outlet flow path 3. The inlet flow path 2 is annular and is defined by the space between the first and second conduits 4, 5. In other embodiments, the inlet flow path may extend only partially around the outlet flow path. Further, a separate tube or member may define the inner wall of the inlet flow path 2 rather than the first conduit. The first and second conduits 4, 5 extend in the direction of a common axis A and are coaxial. The inlet flow path 2 and the outlet flow path 3 each have a first end 2a, 3a adapted to open to atmosphere and each have a second end 2b, 3b adapted to be connected to the remainder of the ventilation system 90.

[0054] The inlet flow path 2 includes a mouth portion 6 at its first end 2a. The mouth portion 6 substantially

faces in a lateral direction, perpendicular to the common axis A, and provides an opening into the inlet flow path 2. It will be appreciated that the cowl 1 is configured to be mounted with the common axis A substantially vertical such that the mouth portion 6 collects laterally flowing atmospheric air. The mouth portion 6 includes at least one louver. In this embodiment, three louvers 7a, 7b and 7c are mounted in the mouth portion 6 vertically spaced from one another in a stacked configuration. The louvers 7a-c each comprise an upwardly inclined section 8 and a downwardly inclined section 9. In this embodiment the inclined sections are continuous with one another, although in other embodiments they may be separated by a distance, such as a radial distance.

[0055] The louvers 7a-c may comprise an annulus arranged in the mouth portion 6 or may be formed of a plurality of sectorial sections arranged to form a ring. The upwardly inclined section 8 of the louvers 7a-c is arranged radially outwardly of the downwardly inclined section 9. Thus, the upwardly inclined section 8 provides rain ingress protection and the downwardly inclined section 9 guides air downwards into the second conduit 5. The shape of the louvers 7a-c is particularly important to ensure sufficient rain ingress protection, low resistance to the flow of air into the ventilation system and efficient guiding of the air downwards into the inlet flow path 2.

[0056] Figure 2 shows a cross-section through one of the louvers 7. The upwardly and downwardly inclined sections 8 and 9 are substantially linear and meet at an apex 10 in a central region of the louver. The upwardly inclined section 8 has a width, x, less than the width, y, of the downwardly inclined section 8. The width y may be at least 50% greater than the width y. This has been found to provide a sufficient width, x, to substantially prevent rain ingress while not significantly interfering with the incoming air flow to cause a substantial pressure drop when the air meets the transition between the upwardly inclined section 8 and the downwardly inclined section 9. This is further aided by the angle of the upwardly and downwardly inclined sections 8, 9 to the horizontal (assuming the common axis A is mounted vertically). In particular, the section 8 has a lower inclination to the horizontal than section 9. In particular, the upwardly inclined section 8 has an inclination between 1° and 15° and preferably between 3° and 10°. In this embodiment, the inclination is substantially 5°. The downwardly inclined section 9 has an inclination between 20° and 60° and preferably between 25° and 45°. In this embodiment, the inclination is substantially 35°. The thickness of the louvers is substantially constant over the sections 8 and 9, although other configurations are possible.

[0057] The stacked louvers 7a-c define a plurality of louver flow paths 11 into the inlet flow path. In particular, the upper surface of a lower louver and the lower surface of an adjacent upper louver define a path through the mouth portion 6. The flow path, by virtue of the upwardly inclined sections 8 extends upwardly and towards the common axis A and then, by virtue of the downwardly inclined sections 9, extends downwardly and towards the common axis A. Accordingly, atmospheric air flowing laterally towards the mouth portion 6 will be diverted slightly upwards and then downwards by the louvers.

[0058] The mouth portion 6 extends above a terminal end 12 of the second conduit 5 and a guide section 14 is arranged to extend out of the second conduit 4 and define the mouth portion 6 with the terminal end 12 of the second conduit 5. In this embodiment, the first conduit 4 comprises the guide section 14. The louvers 7 are radially spaced from first conduit 4 which defines a channel 15 inward of the louvers and common to each of the louver flow paths 11, the channel arranged to carry air into the second conduit 5. The guide section 14 or outer wall of the first conduit 4 is substantially smooth opposite the louvers 7a-c and extends vertically. It has been found that a smooth wall inwardly of the louvers provides for an efficient flow into the second conduit 5.

[0059] The second conduit 5 flares at its terminal end 12 and thus includes a funnel portion 16. The funnel portion terminates at an annular lip 17. The lip 17 has a radius and the louvers are positioned such that the lip is radially aligned with the apex 10. The louvers 7a-c project radially outwardly beyond the lip 17 and, in particular, the upwardly inclined section project radially beyond the lip 17. Thus, the downwardly inclined section 9 is aligned with the funnel portion 16. This is advantageous as the lowermost louver 7c is provided with inclined surface complimentary to its downwardly inclined section 9 with which to co-act to direct air into the inlet flow path 2.

[0060] Downstream of the funnel portion 16, the inlet flow path 2 may have a decreasing cross-section area. This is provided by the second conduit 5 having a radius decreasing relative to radius of the first conduit 4. The second conduit 5 and the cowl 1 itself is supported by a mount tube 17, which is affixed to the second conduit 5 at the funnel portion 16. The mount tube 17 may include a base 18 for securement to the roof of the building or the like or the base 18 may comprise part of the roof. The mount tube 17 may be disconnectable from the remainder of the cowl 1 so an appropriately shaped base 18/mount tube 17 can be selected to mount the cowl 1 to the particular roof line.

[0061] The first conduit 4 has a substantially constant diameter up to a flared portion 20 at the first end 3a. The flared portion 20 has a terminal end 21 comprising the uppermost part of the first conduit 4.

[0062] A separator flange 22 extends radially outwardly and downwardly at the terminal end 21 of the first conduit 4. The separator flange 22 forms a member that divides laterally flowing atmospheric air between flowing into the mouth portion 6 or over the first end 3a of the outlet flow path 3. The separator flange 22 defines an upper wall of the mouth portion 6 opposite the lip 17. The separator flange 22 also defines a lower wall 23 of an opening 24 for the outlet flow path 3.

[0063] The annular separator flange 22 includes a guide surface 25 that extends radially inwardly and down-

wardly from a central region, spaced from the ends, of the lower surface thereof. Thus, the downwardly and outwardly extending separator flange 22 in combination with the downwardly and inwardly extending guide surface 25 is complimentary to an upper-most louver 7a. In particular, the lower surface of the separator flange has a bi-directionally inclined form similar to the louvers. Accordingly, the lower surface of the separator flange is configured to form a louver flow path (similar to the inter louver flow paths described above) with the uppermost louver 7a. The guide surface 25 is defined by a guide flange, the guide flange similar in form to the downwardly extending section 9 of the louvers 7. The guide flange has a free end 26 opposite its connection to the separator flange 22 and spaced from the first conduit 4. The separator flange 22, first conduit 4 and guide flange thus define an annular void 27.

[0064] The first end 3a of the outlet flow path opens in a vertical direction, facing upward. The terminal end 21 is covered by a cap 28, which extends over and is axially spaced from the first end of the inlet flow path 3. The cap 28 is domed and, in this embodiment, substantially hemispherical. The apex of the dome is centred on the common axis A. The cap 28 includes a rim 30 which is substantially circular. The rim 30 has a diameter such that it is, substantially, in axial alignment with the outermost parts of the louvers. The rim 30 has a diameter greater than the diameter of the terminal end 21. The cap 28 is arranged over the first conduit 4 such that the rim 30 extends axially lower than the terminal end 21 of the first conduit 4. In this embodiment, the whole of the rim 30 is below the terminal end 21. The rim 30 and the lower wall 23 thus define the annular opening 24. The cap 28 thus defines a void 31 above the first conduit 4 into which air entering the opening 24 is received. The inner surface of the cap 28 is concave such that there is no reduction in the headspace above the first conduit 4 by virtue of an indentation or the like extending from the cap.

[0065] The annular opening 24 receives atmospheric air and also provides an outlet for exhaust from the outlet flow path 3. The shape of the separator flange and the position of the rim 30 thus requires atmospheric air entering the opening to travel upwards into the void 31. Air leaving the void 31 is guided by the cap 28 and separator flange 22 downwardly and outwardly through the opening. The position of the rim 30 relative to the terminal end 21 assists in rain ingress protection as well as improving air flow for extraction of air from the outlet path. This is further aided by the downward and outward inclination of the separator flange. This arrangement of the rim, terminal end and inclination of the separator flange has been found to be particularly advantageous for rain ingress protection without substantially hindering air flow and, in fact, advantageously providing efficient extraction of air from the outlet path. Further, contrary to conventional thinking, it has been found that providing a concave headspace above the open end of the first conduit 4 can allow air flowing through the void 31 to draw exhaust air from the outlet flow path 3.

[0066] The cowl 1 further includes sectorial fins 32. In this example, eight fins are provided at equally angularly spaced locations around the cowl 1. It will be appreciated that other numbers of fins may be provided. The sectorial fins 32 extend radially and axially and divide the opening 24 and mouth portion 6 into a plurality of annular sectors (eight). These annular sectors face in different radial directions. The dividing of the mouth portion 6 and opening 24 into sectors may aid the directional performance of the cowl. Thus, atmospheric air received on one side of the cowl 1 is guided towards the centre of the cowl, and into the channel 15 and void 31 rather than flowing around the mouth portion 6 or opening 24.

[0067] In this example the fins 32 are common to the mouth portion 6 and void 31, although different arrangements of fins may be provided in each of the aforementioned sections. In the mouth portion 6, the axial extent of the fins comprises them extending from the terminal end 17 of the second conduit 5 to the separator flange 22. The radial extent of the fins comprises from the guide portion 14 to the outermost point of the louvers 7a-c. The mouth portion 6 is thus divided into a plurality of sectorial sections extending around the cowl 1. The sectorial sections open into the common second conduit 5 which is free from fins.

[0068] In the void 31, the sectorial fins 32 extend from the opening 24, partially towards the common axis A. Thus, the void 31 has a central region above the first end 3a free from fins 32. This arrangement of the fins and central region has been found to be advantageous in terms of efficient flow and extraction from the outlet flow path 3. The fins 32, in this embodiment, extend into the flared portion 20 and terminate at a distance from the axis A substantially equal to the radius of the first conduit 4.

[0069] Figures 3a and 3b show a second embodiment and the same reference numerals have been used for like parts. The arrangement of the cowl 1 is substantially similar to Figure 1 and therefore only the differences will be described. In this embodiment, the cowl 1 has nine louvers 7 rather than three. Thus, the mouth portion 6 is wider in a vertical direction. The base 18 has a short neck 33 and meets with the second conduit 5 at its flared portion 16. The wider mouth portion 6 may allow the cowl to receive a greater quantity of air into the inlet flow path 2. The separator flange 22 extends radially outwardly and downwardly at the terminal end 21 of the first conduit 4. The separator flange 22 forms a member that divides laterally flowing atmospheric air between flowing into the mouth portion 6 or over the first end 3a of the outlet flow path 3. The separator flange in this embodiment comprises an annular wedge that tapers in a radial direction from its connection to the terminal end 21 of the first conduit 4. The separator flange 22 presents a guide surface 25 that extends radially inwardly and downwardly. Further, an upper surface of the flange 22 guides air up into the void 31.

[0070] Figure 4 shows a third embodiment which is similar to the embodiment of Figure 1 except it shows a cowl 1 having two louvers 7. The louvers 7, similar to the other embodiments, include a radially outer section 8 that is upwardly inclined towards the axis A and a radially inner section 9 that is downwardly inclined towards the axis A. The sections 8, 9 are continuous with one another. The louvers 7 comprise an annular ring with a curved cross section. The guide surface 25, which extends from the separator flange 22 is also curved and is spaced from but complimentary to the uppermost louver 7.

[0071] Figure 5 shows a fourth embodiment having three louvers 7 which have a curved cross section similar to the third embodiment. Further the separator flange 22 comprises a wedge similar to the second embodiment. The remainder of the cowl 1 is similar to the first embodiment.

[0072] Figures 6a and 6b show a fifth embodiment. In this embodiment the cowl 1 has a substantially square cross section. Thus, the first conduit 4 has a square profile and is surrounded by a second conduit 5, also having a square profile. The louvers 7, of which there are four in this embodiment, are arranged in a ring but with a square perimeter. The cap 28 is of a truncated square based pyramidal shape. In this embodiment four fins 32 are provided that each extend in a direction from the central axis A to one of the corners of the cowl 1.

[0073] Figure 7 shows a sixth embodiment which includes a modification to the separator flange 22. The separator flange 22 includes a guide surface 25 on its lower surface that is complimentary to the radially outer section 8 of the uppermost louver 7. The guide surface of this embodiment does not include a downwardly inclined section such as that provided by the guide flange in previous embodiments. Instead, the separator flange 22 is mounted adjacent to the flared portion 20 such that incoming air over the surface 25 is guided downwards into the inlet flow path 2 by the flared portion 20. Further, the separator flange 22 is supported by sectorial fins 32 rather than depending from the terminal end 21.

[0074] Figure 8 shows a schematic diagram illustrating louvers 7 of different sizes in the mouth portion 6. The lowermost louver 7e is narrower in a radial direction than the uppermost louver 7a.

[0075] Figure 9 shows a further embodiment 90. In form it is substantially similar to the embodiment of Figure 1. However, its aspect ratio of axial height to diameter is lower. It has been found that advantageous performance can be achieved with a cowl that does not project particularly high from the roof line if its diameter is sufficiently large. Thus, the cowl of figure 9 has an aspect ratio of less than 1.2 and, in this example, substantially 1. The advantageous design features discussed above have surprisingly been found to be effective in cowls having a height less than 1000mm or 900mm above the roof line and a diameter of 600 to 900mm and substantially 700-800mm. The guide portion is concave in cross section in that it includes a necked portion 91 that curves radially inwardly, opposite the mouth portion. Thus, the first conduit includes a first section 92 adjacent the first end of the second conduit and a second section 93 at the terminal end of the first conduit, and the necked portion extends radially inwardly of both the first and second sections.

Claims

1. A cowl for a ventilation system comprising at least two separate flow paths; an outlet flow path defined by a first conduit and an inlet flow path defined by a second conduit that extends around the first conduit of the outlet flow path, the first and second conduits extending in the direction of a common axis, the inlet and outlet flow paths each having a first end adapted to open to atmosphere and each having a second end adapted to be connected to the ventilation system, wherein
the inlet flow path includes a mouth portion at its first end, the mouth portion substantially facing a direction perpendicular to the common axis to provide an opening into the inlet flow path and including at least one louver, the louver configured to present to incoming air a radially outward upwardly inclined section and a radially inward downwardly inclined section.

2. A cowl according to claim 1, wherein the mouth extends above a terminal end of the second conduit and a guide section is arranged to extend out of the second conduit and define the mouth portion with the terminal end of the second conduit.

3. A cowl according to claim 2, wherein the first conduit forms the guide section.

4. A cowl according to claim 2 or claim 3, wherein the guide section presents a substantially smooth surface facing the mouth portion for guiding air between the mouth portion and the first end of the second conduit.

5. A cowl according to any preceding claim, wherein the mouth portion includes a plurality of louvers arranged in a stacked configuration and, optionally, the adjacent louvers define a flow path through the mouth portion into the inlet flow path that extends upwardly and then downwardly.

6. A cowl according to claim 2, wherein the terminal end of the second conduit is flared radially outwardly.

7. A cowl according to any preceding claim, in which the inlet flow path, at least at the mouth portion, includes at least two sectorial fins extending in a radial direction configured to divide the mouth portion into

at least two sectors facing in different radial directions and, optionally, the sectorial fins extend from the guide portion.

8. A cowl according to any preceding claim, in which a separator flange extends radially outwardly at a terminal end of the first conduit, the separator flange defining an upper wall of the mouth portion and a lower wall of an opening to the outlet flow path.

9. A cowl according to claim 8, in which separator flange extends radially outwardly and downwardly.

10. A cowl according to claim 8 or claim 9, in which the separator flange includes a guide surface that extends radially inwardly from a lower surface thereof, the guide surface being complimentary to an uppermost louver of the mouth portion.

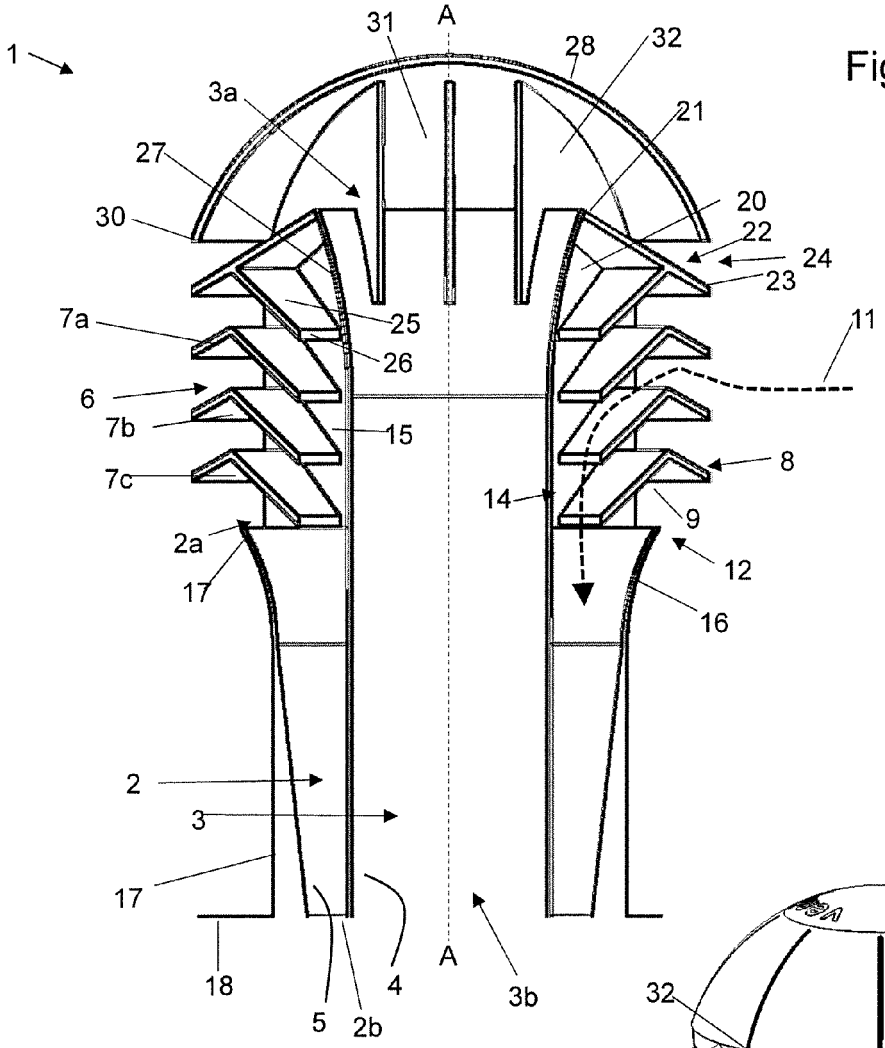
11. A cowl according to any preceding claim, in which a cap extends over and is spaced from the first end of the outlet flow path and, optionally, a rim of the cap extends, at least in part, below a terminal end of the first conduit.

12. A cowl according to claim 11, in which a rim of the cap and a separator flange defines an opening from a void within the cap, the first conduit opening into said void, wherein the separator flange extends radially outwardly at a terminal end of the first conduit.

13. A cowl according to claim 11 or claim 12, in which the cap includes at least two sectorial fins extending in a radial direction configured to divide an opening into the cap into at least two sectors facing in different radial directions and, optionally, the sectorial fins are radially spaced from the common axis to define an open central void in the cap directly above the first end of the first conduit.

14. A cowl according to any preceding claim, wherein the inlet flow path is annular and extends around the outlet flow path, the first and second conduits arranged substantially coaxially along the common axis and, optionally, the first end of the outlet flow path faces in the direction of the common axis.

15. A passive ventilation system for a building including an inlet conduit for delivering atmospheric air into the building and an outlet conduit for exhausting air from the building to atmosphere, the system further including the cowl of any one of claims 1 to 24, wherein the outlet conduit is connected to the second end of the outlet flow path and the inlet conduit is connected to the second end of the inlet flow path.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7b
15
8
7c
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9
2a
12
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16
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18
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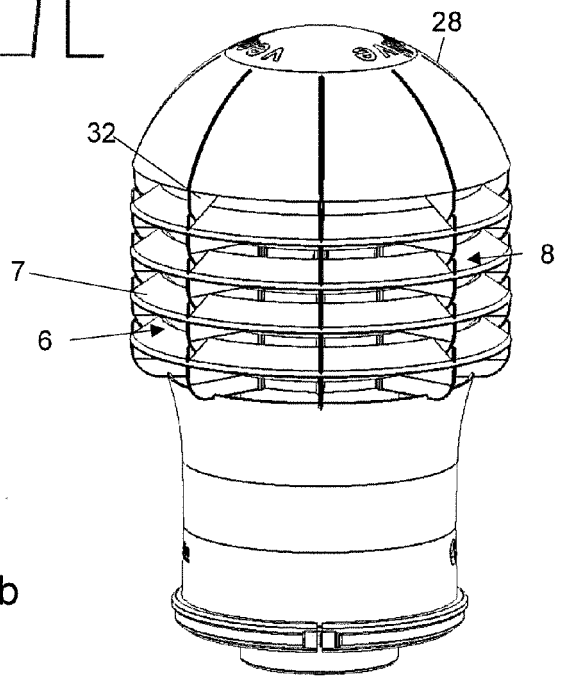
2b
4
A
3b

Fig. 1a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7
6

Fig. 1b

Fig. 2

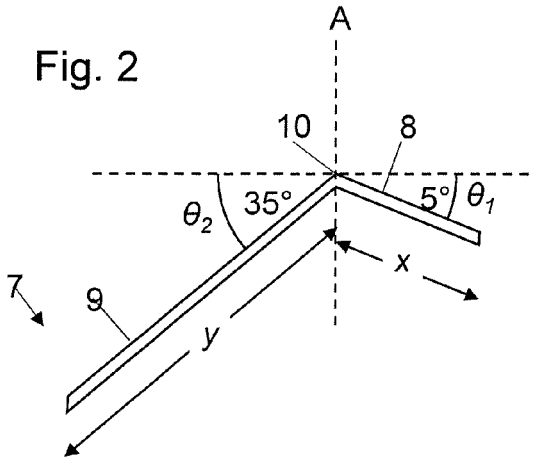


Fig. 3a

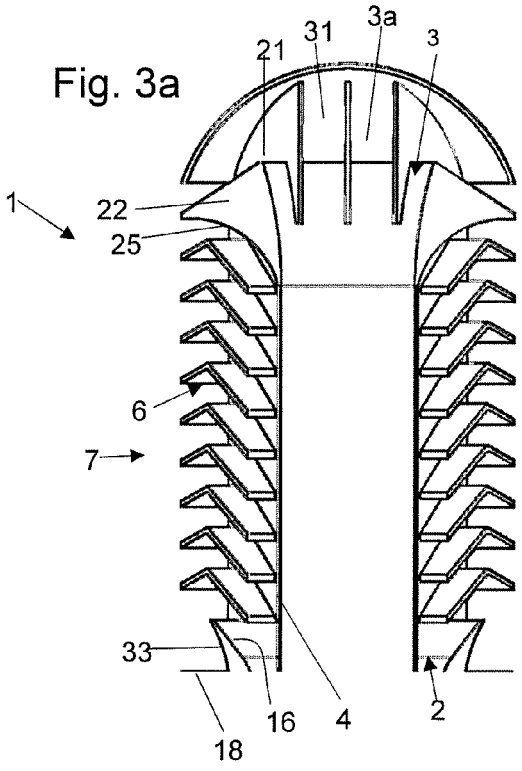


Fig. 3b

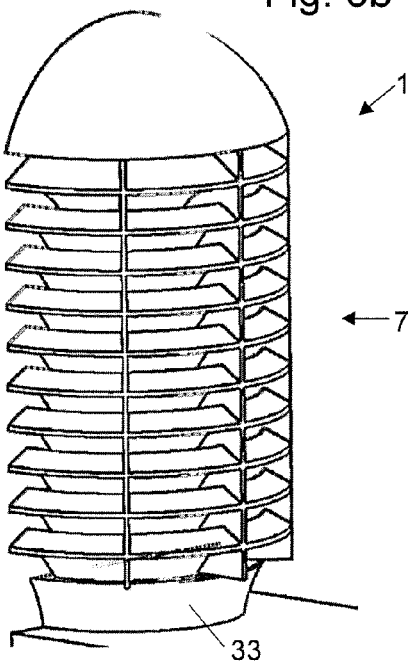


Fig. 4

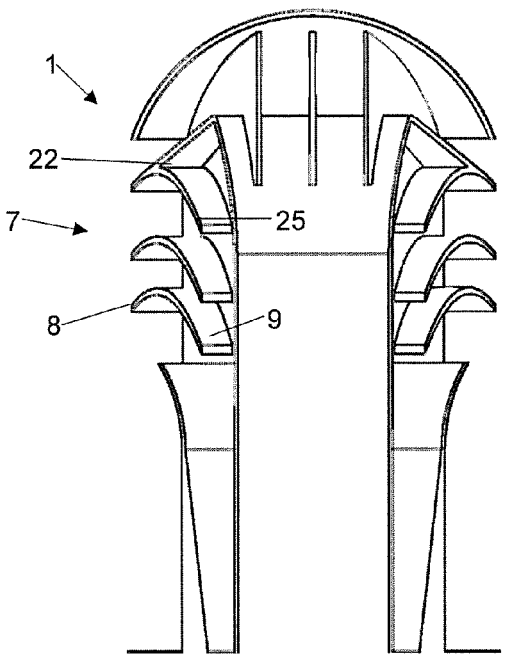


Fig. 5

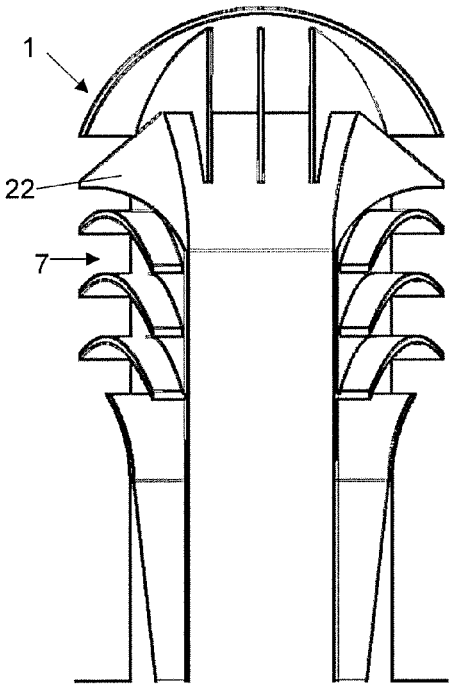


Fig. 6a

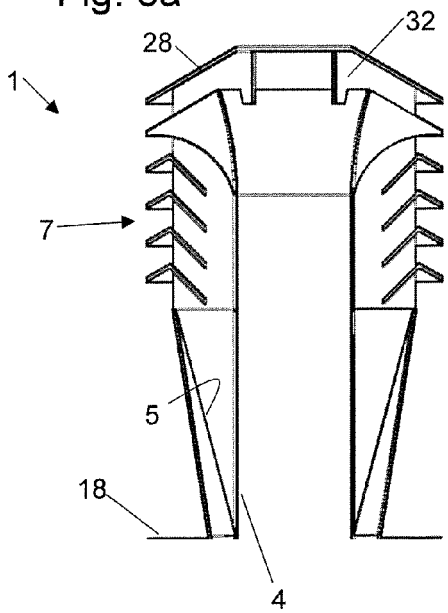


Fig. 6b

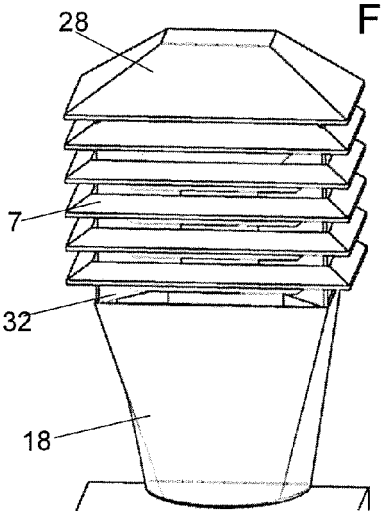


Fig. 7

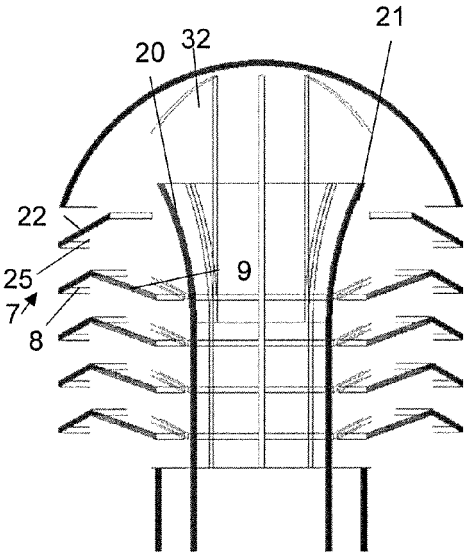


Fig. 8

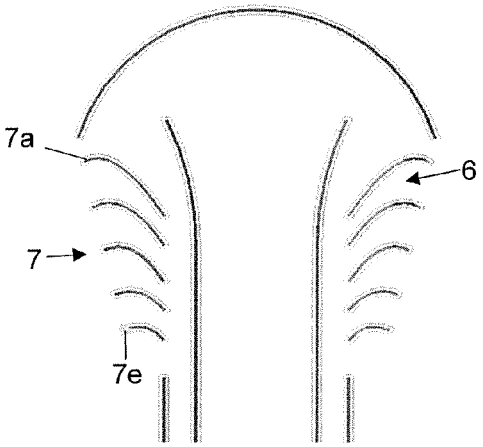


Fig. 9

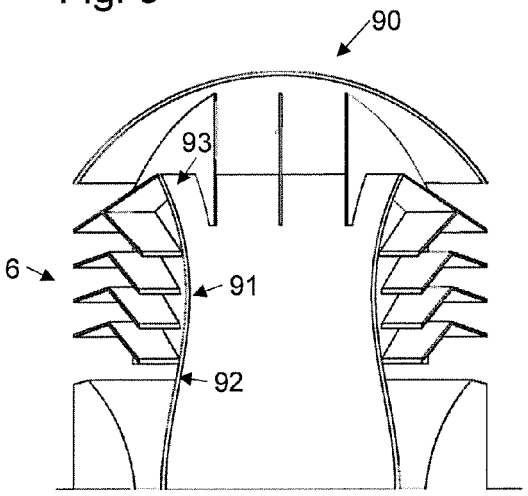
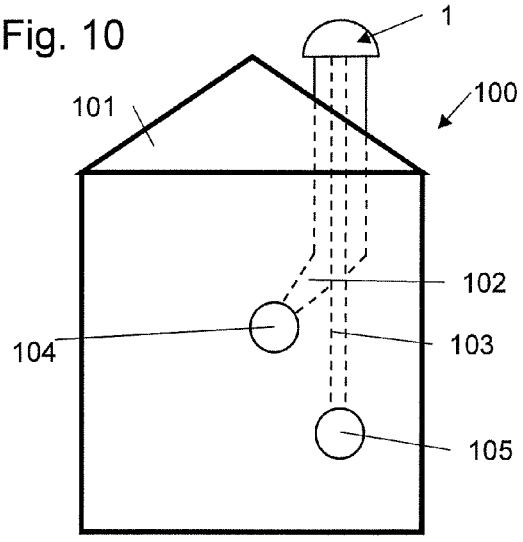


Fig. 10



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EUROPEAN SEARCH REPORT

Application Number
EP 15 27 5180

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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	US 297 707 A (CONRAD MÜLLER) 29 April 1884 (1884-04-29) * page 1, line 20 - page 1, line 102; figures 1-3 *	1-15	
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F24F
F23L

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	16 December 2015	Anconetani, Mirco

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