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Description

[0001] The present invention relates to an air supply valve for ventilating closed buildings according to the preamble of claim 1.

[0002] A generic air supply valve is known, for example, from DE 20 2007 004 497 U1. Air supply valves of this type are used in particular in order to be able to supply animal stables with sufficient fresh air from the outside. A window ventilator having a valve flap is known from GB 2 194 328 A, which flap is pivotable back and forth between an open and a closed position. The air supply valve disclosed in said document, however, has no special features in order to avoid icing of the valve flap.

[0003] Very cold outside temperatures pose the problem of the air supply valves freezing and no longer being able to freely move. Ice forms in particular in the joint region between the lateral edges of the valve flap and the frame, and on the interior-side rear wall of the valve flap. The formation of ice is linked to the fact that, under normal conditions, a slight negative pressure in relation to the outside air prevails inside the building due to extraction of the internal air. Due to the negative pressure, a residual amount of outside air still flows through the joints into the interior of the building despite the joints on the air supply valve being sealed, since an air supply valve cannot be produced so as to be completely pressure-tight. The ice builds up from the condensation water which condenses out of the warm stable air when the warm stable air meets the cold outside air that flows into the building through the air supply valve. The formation of ice on the air supply valve cannot be avoided to the desired extent by means of the air baffles known from the prior art, which baffles are attached to the frame.

[0004] The problem addressed by the invention is that of reducing the tendency of air supply valves to ice at very cold outside temperatures.

[0005] The problem is solved for a generic air supply valve by the characterising features of claim 1.

[0006] Due to the laws of physics, ice formation on the interior side of the air supply valve in the inflow region of the air supply valve cannot be completely prevented. The joints between the sides of the valve flap and the surrounding frame cannot be designed so as to be hermetically sealed either, and therefore cold air always penetrates through the joints into the interior of the building. However, it is possible to at least partially displace the encounter of cold and warm air in the region of the joints, in particular of the lower transverse joint, between the valve flap and the frame surrounding said valve flap into regions in which ice formation no longer impairs the mobility of the valve flap. In the region of the transverse joint or of the transverse gap along the lower transverse profile, the cold air exiting the transverse gap into the interior of the building can immediately sink downwards when entering the interior of the building due to the specific higher density of said cold

air. This creates a downwards air flow that induces the warm air present in the interior of the building as a warm air flow and pulls the warm air down.

[0007] Due to the amount of overhang of the valve flap over the adjacent surface of the lower transverse profile, the flowing induced warm air does not mix with the cold air in the region of the exit opening of the joint, but rather only in a region therebelow. The outflow region of the cold air from the transverse joint is kept free of and shielded from warm air by means of the overhang of the valve flap. As a result, ice does not build up in this region on the inner wall of the building and the inwardly facing surface of the frame, but rather only significantly therebelow, or the ice crystals which form from the humidity contained in the warm air fall from the intermixing air currents directly onto the floor without accumulating on an inner wall.

[0008] The overhang of the valve flap in the closed position and in an open position of up to 30% of the valve flap is sufficient, since, based on experience, the valve flap is opened no further than up to 30% of the possible opening width at very cold outside temperatures. The amount of overhang should be selected such that an outflow of cold air from the mouth opening is set that is as turbulence-free as possible and that the cold air, by means of the amount of overhang, has space in order to be able to bring the flow direction downwards without thereby immediately mixing with flowing warm air. A very small amount of overhang of, for example, merely 1 mm or 2 mm is not sufficient. Advantageously, the amount of overhang should be greater than the width of the mouth opening.

[0009] In this way, no ice forms within the gap between the underside of the valve flap and the adjacent surface of the lower transverse profile, including the surfaces, immediately adjacent to the mouth opening, of the adjacent surfaces of the valve flap and of the lower transverse profile of the frame of the valve flap. Previously, ice built up in particular in said region as well as at the mouth of the gap on the interior side of the air supply valve. Due to the overhang of the valve flap in this region, the valve flap no longer freezes up so quickly despite the cold air flowing out of the gap from the outside. The condensation of moisture due to cold air entering into the interior from the transverse gap occurs only beneath the mouth opening of the gap at a point at which the function of the valve flap is no longer disturbed by ice formation. Since the pivot pin of the valve flap is also arranged in the lower half of the valve flap, the valve flap remains free to move for longer, even when the outside air is very cold.

[0010] The valve flap has, in the lower part thereof, a thickened portion in relation to the material thickness of the valve flap in the upper part thereof, by means of which thickened portion the gap between the underside of the valve flap and the lower transverse profile of the frame is elongated. By designing the lower part of the valve flap to be thickened, the valve flap in said region has improved insulation, such that the valve flap in said region is therefore also less prone to icing on its room-side back side. The terms "lower" and "upper" part are intended to describe the spatial

arrangement of the thickened portion relative to a thinner wall thickness of the valve flap, without meaning an exact equal split of the valve flap over its height. The thickened portion can thus also extend as needed as far as into the region of the upper half of the valve flap, or the thickened portion already ends within the lower half of the valve flap. The material thickness can change linearly or non-linearly from bottom to top. Due to the partial thickened portion of the valve flap, it is easier to produce an amount of overhang in the lower room-side region of the rear wall of the valve flap that adjoins the lower transverse profile. Due to the thickened portion of the valve flap, the flow channel through which the cold air flows along the gap is also elongated. The elongated flow channel produces a calmer laminar flow of the cold air flowing through the gap, which cold air then exits the gap at the mouth opening with less turbulence, is less likely to mix with the warm air even in this region, and flows off downwards more uniformly after exiting the gap.

[0011] According to one embodiment of the invention, the underside of the valve flap and the adjacent face of the lower transverse profile of the frame have matching circular arc contours which extend in a circular arc shape. Since a gap designed as a joint between the valve flap and the frame profiles forms a weak point in the insulation of the air supply valve, the amount of gap between the underside of the valve flap and the lower transverse profile can be kept small due to the circular arc contour of the frame profile and the underside of the valve flap being adapted to one another, in particular if the valve flap has a thickened portion in the lower part thereof.

[0012] According to one embodiment of the invention, the valve flap is made of a plastics material comprising closed pores. Such a material is, for example, polyurethane foam or expanded polystyrene. When having corresponding finishing and/or a corresponding support structure, said materials have sufficient strength, but in particular very good thermal insulation properties. It is also easy to produce spatial shapes having uneven surfaces from such materials. Due to the many airtight pores in the material, it is difficult for heat to transfer from the inside to the outside.

[0013] According to one embodiment of the invention, the valve flap has a curvature pointing towards the upper end thereof in the direction of the building interior. Due to the curvature of the valve flap, it is possible that, in the upper region thereof, the valve flap protrudes further inwards into the interior of the building than would be the case when using a straight shape of the valve flap. This curved shape makes it possible for the cold air flowing into the building interior to flow deeper into the building and thus away from the air supply valve. As a result, the moisture contained in the warm air no longer condenses directly in the region of the air supply valve, but instead further away inside the building. The moisture condensing there can no longer build up as ice on the surfaces of the air supply valve.

[0014] The curvature of the shape of the valve flap results in particular in an offset in depth of the cold air flowing into the interior of the building through the lateral gaps between the side edges of the

valve flap and the lateral frame profiles and the sealing faces. The inwardly-curved shape of the valve flap results in a mouth opening for the inflowing cold air, which opening is displaced further inwards the higher up the cold air flows in at the valve flap. Due to the offset in depth, the cold air flowing in over the height of the lateral gap does not accumulate downwardly, but rather the cold air flowing into the interior at a higher point can sink down without being brought into direct contact with cold air flowing in deeper, which flows into the interior closer to the frame due to the offset in depth which results from the curvature. Since the mouth openings are spaced further inwards from the frame due to the curvature of the valve flap, in particular in the upper regions of the valve flap, the moisture contained in the warm air mixing with said cold air can no longer easily deposit and accumulate on the interior-side surface of the air supply flap, which also reduces ice formation.

[0015] The inwardly-curved shape of the valve flap also makes it easier for dew and condensation water that accumulates in the upper half on the valve flap to drip directly onto the floor without running into the lower region of the valve flap, since there is a spatial offset in the horizontal direction between the upper and lower halves of the valve flap and dripping water no longer necessarily drips onto the lower region of the valve flap.

[0016] According to one embodiment of the invention, at least one seal is arranged in the space between the underside of the valve flap and the adjacent face of the lower transverse profile of the frame. The seal may optionally be associated with the frame profile or the valve flap. By means of one or more seals, the heat insulation in the region of the joint is improved.

[0017] According to one embodiment of the invention, a drip edge is formed on the back side and/or the underside of the valve flap. Due to the drip edge, condensation water and/or dew can drip off the back side of the valve flap; in this way, the water is removed from the air supply valve. The drip edge preferably extends over the full width of the valve flap. Due to a drip edge in the upper region of the valve flap, the condensation water and/or dew cannot reach into the lower region of the valve flap at all and, as ice, cannot impair the function of the air supply valve in said lower region. Due to a drip edge on the underside of the valve flap, condensation water and/or dew is kept away from the joint between the underside of the valve flap and the frame profile.

[0018] According to one embodiment of the invention, the valve flap, in the edge regions thereof lateral to the sealing faces of the lateral frame parts, comprises a projection which projects from the remaining outward-facing outer surface of the valve flap and/or from the remaining inward-facing inner surface of the valve flap and extends along the sealing faces. Due to the projection, the joint or the gap between the lateral edges of the valve flap and the sealing faces becomes longer. Thereby, the same calming effect occurs in the cold air flowing through the gap as has already been described above for elongating the gap between the underside of the valve flap and the lower transverse profile of the frame. The region in which the cold outside air meets the warm moisture-laden room air is

further displaced into the interior of the building in the flow direction behind the mouth opening of the gap such that the ice forming in the mixing region does not build up on the inside of the frame. Since the projection is formed only in the lateral edge regions, the air passage opening and the flow opening are only slightly reduced in the particular cross section thereof if the openings are arranged on the outside, such that the air flow rate is hardly impaired by the projections.

[0019] It is advantageous to provide a projection on the side edges of the valve flap on the interior side of the air supply valve, since the mixing of the cold air flow with the warm air flow improves as a result, such that less ice forms on the interior side of the air supply valve. The outflow of the cold air flow from the gap into the interior of the building is facilitated by an interior-side projection.

[0020] According to one embodiment of the invention, the surface of the valve flap has a hydrophobic coating. Due to the hydrophobic coating, condensation water and/or dew additionally beads off the surface and does not adhere thereon, such that it likewise cannot contribute to icing.

[0021] According to one embodiment of the invention, the sealing faces and/or projections on the interior side of the valve flap are adjustable in their spatial position. Due to the adjustability, the sealing faces and/or the projections can always be adjusted in different pivoting positions of the valve flap such that the front edges of the sealing faces and the projections that face towards the interior of the room form a common mouth edge in the region of the mouth opening of the gap.

[0022] It is expressly pointed out that the features of the dependent claims, in their entirety or in part, can be combined with one another in any way with the features of the invention according to the main claim, provided that there are no compelling technical reasons to the contrary.

[0023] Further modifications and embodiments of the invention can be derived from the following description of the invention and the drawings.

[0024] The invention will now be described in greater detail with reference to an embodiment. In the drawings:

Fig. 1 shows a cross-sectional view through an air supply valve;

Fig. 2 shows an enlarged view of the zone II in Fig. 1; and

Fig. 3 shows a sectional view from a view from above along the line III-III in Fig. 1.

[0025] The accompanying Fig. 1 shows a longitudinal sectional view through an air supply valve 2. The air supply valve 2 consists of a frame 4 which delimits an air passage opening 6. A valve flap 10 which can be pivoted about a pivot pin 8 is arranged in the frame 4. In the open position of the valve flap 10 shown in solid lines, an air flow L can flow through the flow opening 18 between the upper end of the valve flap 10 and the stop surface for stopping the valve flap 10 at the upper transverse

profile 14. In the closed position 12 shown in dashed lines, the flow opening 18 is closed by the valve flap 10.

[0026] Sealing faces 20 are arranged on the lateral frame parts, which sealing faces are formed such that they also cover the lateral gap between the side edges of the valve flap 10 and the lateral frame in the open position of the valve flap 10 and close said gap against the passage of cold air therethrough. Due to the sealing faces 20, an air flow L can only flow upwards through the flow opening 18 into the interior of the building, with the exception of small air flows through the gaps. The tendency for ice to form in the lateral region of the valve flap 10 is thereby significantly reduced.

[0027] The frame 4 has a lower transverse profile 16 which adjoins the underside 22 of the valve flap 10. The underside 22 of the valve flap 10 has a circular arc shape which corresponds to the shape of the adjacent faces 24 which are formed in the lower transverse profile 16. The gap between the underside 22 of the valve flap 10 and the adjacent face 24 of the lower transverse profile 16 is elongated in this manner.

[0028] In addition, the gap does not extend in a horizontal direction and a straight plane, but rather in a curved manner, in particular curved in the shape of a circular arc, as a result of which heat losses via this gap are additionally reduced.

[0029] In order to reduce air flows through the gap, one or more seals 26 may be arranged therein. The seals can also be provided on the remaining sides of the valve flap 10 in order to seal and to close or at least reduce possible air gaps between the frame 4 and the valve flap 10.

[0030] Dew and condensation water which accumulates at the upper end on the back side of the valve flap 10 can first run off downwards on the back side of the valve flap 10. Where the dew and condensation water appears on a drip edge 28, the dew and condensation water drips from the valve flap 10. Since the back side of the valve flap protrudes over the inwardly-facing surface of the frame 4, the dew and condensation water can drip freely downwards and no longer adheres to the frame 4. The dripping effect is additionally assisted by the inwardly-extending curvature 30 in the form of the valve flap 10. The valve flap 10 has a thickened portion 32 in the lower half thereof. Due to the thickened portion 32, the gap elongates between the underside 22 of the valve flap 10 and the lower transverse profile 16. Due to the thickened portion 32, the material of the valve flap 10 in the lower half can have a lower heat transfer coefficient than in the upper half. Due to the better thermal insulation as a result of the thickened portion 32, the tendency for ice to form in the lower half of the valve flap 10 on the inner surface on the room side is reduced. Since the pivot pin 8 and the air gap to the lower transverse profile 16 are located there, a reduced tendency for icing results for the air supply valve 2 in this region, such that the air supply valve 2 remains free of ice at least on the inside, depending on the temperatures, such that the valve is also still freely operable at very low outside

temperatures, even after a longer opening time.

[0031] In the lateral edge region of the valve flap 10, a projection 34 is formed which protrudes outwards over the remaining surface of the valve flap 10. The projection 34 extends along the sealing face 20. The projection can be made a different width and thickness over the height of the valve flap 10. Alternatively or in addition, the projection can also be formed so as to protrude inwards over the adjacent face of the valve flap.

[0032] The region in which the gap 36 opens between the underside of the valve flap 10 and the lower transverse profile 16 on the interior side of the air supply valve 2 is illustrated in an enlarged view in Fig. 2. In this drawing, it can be seen that the cold air flow 38 exits the gap 36 in the region of the mouth opening 42. Due to the higher specific density of the cold air, the cold air flow 38 sinks immediately after exiting the gap 36, the radius of curvature of the flow arc being dependent on the temperature difference between the inside and outside air. The colder the outside air, the narrower the arc of curvature. The sinking cold air induces a warm air flow 40 from the warmer interior air which contains moisture. As indicated by the flow arrows in Fig. 2, the cold air flow 38 mixes with the warm air flow 40 below the mouth opening 42. Only in the mixing region can moisture then crystallise out of the air as ice and accumulate on the adjacent wall. However, according to the invention, this takes place only at a distance from the mouth opening 42 and from the movable parts of the air supply valve 2.

[0033] The cold air flow 38 flowing out of the gap 36 is upwardly shielded in the outflow region against flowing warm air by the valve flap 10 which projects by the amount 44. As a result, the cold air flow 38 mixes with the warm air flow 40 only after the flow direction of the cold air flow 38 has changed downwards and the cold air has moved downwards away from the valve flap 10 and the mouth opening 36.

[0034] Fig. 3 shows a sectional view along the line III-III in Fig. 1. The valve flap 10 is in a partially open pivot position in the drawing shown. In Fig. 3, the valve flap 10, in contrast to the drawing in Fig. 1, only has one projection 34 on the back side thereof facing the interior of the building. The cold air flow 38 enters the interior in a straight direction from the longitudinal gap 36 between the lateral sealing face 20 and the projection 34. There, the cold air flow induces warm air flows 40a, 40b which progressively mix with the cold air flow 38, ice crystallising at a correspondingly low temperature of the cold air stream 38. By means of the projection 34, the warm air flow 40b can assume a flow direction which corresponds in approximate mirror symmetry to the flow direction of the warm air flow 40a. As a result, the warm air stream 40a cannot deflect the cold air stream 38 onto the back side of the valve flap 10, where ice would then accumulate, but instead the cold air stream 38, supported by the warm air stream 40b, keeps its flow direction directed into the interior of the building approximately the same and only sinks downwards due to the cold, but hardly changes the flow

direction in the lateral direction. The projection 34 formed laterally on the rear wall of the valve flap 10 creates a flow shade in which the warm air flow 40b can align itself in the flow direction of the cold air flow 38. In this way, the projection 34 contributes to less ice accumulating on the interior side of the valve flap 10. It is advantageous if the sealing faces 20 and/or projections 34 on the interior side of the valve flap 10 are designed to be adjustable in their spatial position. In this way, even at different pivoting positions of the valve flap 10, which are indicated by arrows pointing in the opposite direction, said faces and/or projections can form a smooth mouth opening 42 of the gap 36, as is shown in Fig. 3, without producing an offset in length between the front edges of the sealing faces 20 and the projections 34.

[0035] The above-described embodiment is only illustrative of the invention. It is not difficult for a person skilled in the art to adapt the embodiment of the invention to a specific application in a manner which he considers suitable, by modifying the design.

P A T E N T K R A V

1. Lufttilførselsventil (2) til ventilation af lukkede bygninger med en ramme (4), som omgrænser en luftgennemførelsesåbning (6), og med en ventilklap (10), der er forbundet med rammen (4), og der kan drejes omkring en horisontal drejeakse (8) mellem en åben- og en lukkestilling (12), hvor ventilklassen (10) i lukkestillingen (12) med sin øvre ende ligger lukkende an mod øvre tværprofil (14), og i åbenstillingen med sin øvre ende frigiver en gennemstrømningsåbning (18) og siderammedelene har tætningsflader (20) ved hjælp af hvilke tætningsflader (20) spalten mellem siderammen (4) og sidekanterne af ventilklassen (10) er afdækket i åbenstillingen, k e n d e t e g n e t ved, at kantområdet på den indvendige rum side i den nedre del af bagvæggen af ventilklassen (10) i lukkestillingen (12) og i en åbenstilling på op til 30 % af ventilklassen (10) rager et mål (44) ud over overfladen af den nedre tværprofil (16), og ventilklassen (10) har en fortykkelse (32) i sin nedre del i forhold til materialetykkelsen af den øvre del af ventilklassen (10), igennem hvilken fortykkelse (32) spalten mellem undersiden (22) af ventilklassen (10) og de nedre tværprofil (16) af rammen (4) er forlænget.

2. Lufttilførselsventil (2) ifølge krav 1, k e n d e t e g n e t ved, at undersiden (22) af ventilklassen (10) og den tilstødende flade (24) af den nedre tværprofil (16) af rammen (4) har cirkelbueformet forløbende cirkelbuekonturer, som passer til hinanden.

3. Lufttilførselsventil (2) ifølge krav 1 eller 2, k e n d e t e g n e t ved, at ventilklassen (10) er fremstillet af et plastikmateriale, der har lukkede porer.

4. Lufttilførselsventil (2) ifølge et af de foregående krav, k e n d e t e g n e t ved, at ventilklassen (10) har en krumning (30), som peger mod dens øvre ende i retning af det indvendige rum af bygningen.

5. Lufttilførselsventil (2) ifølge et af de foregående krav, k e n d e t e g n e t ved, at der i mellemrummet mellem undersiden (22) af ventilklassen (10) og den tilstødende flade (24) af den nedre tværprofil (16) af rammen (4) mindst er anbragt én tætning (26).

6. Lufttilførselsventil (2) ifølge et af foregående krav, k e n d e t e g n e t ved, at der er dannet en drypkant (28) på bagsiden og/eller undersiden (22) af ventilklassen (10).

7. Lufttilførselsventil (2) ifølge et af foregående krav, k e n d e t e g n e t ved, at ventilklassen (10) i sine sidekantsområder har et fremspring (34), som udstrækker sig til tætningsfladerne (20) af siderammedelene af en af de øvrige yderflader, der vender udad, af ventilklassen (10), og/eller et fremspring, som udstrækker sig fra en af de øvrige inderflader, der vender indad, af ventilklassen (10) og langs tætningsfladerne (20).

8. Lufttilførselsventil (2) ifølge krav 7, k e n d e t e g n e t ved, at tætningsfladerne (20) og/eller fremspringene (34) på den indvendige rum side af ventilklassen (10) kan indstilles i deres rumlige position.

9. Lufttilførselsventil (2) ifølge et af foregående krav, k e n d e t e g n e t ved, at overfladen af ventilklassen (10) har en hydrofobisk belægning.

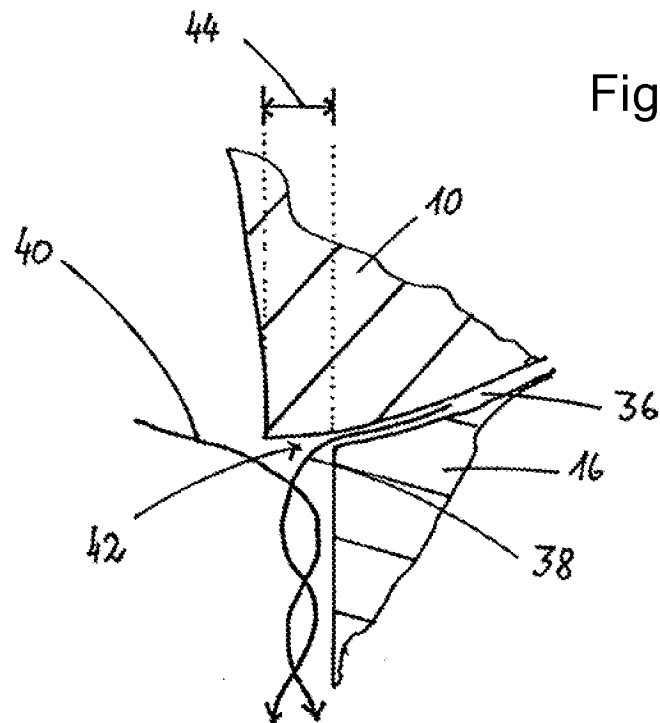


Fig. 2

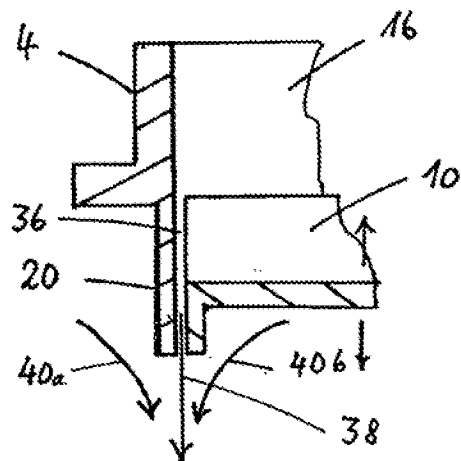


Fig. 3