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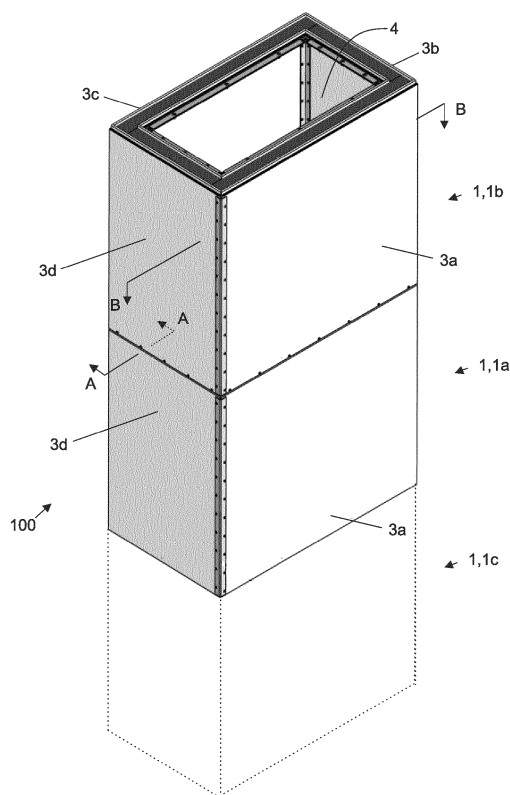
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(54) **A TUBULAR SMOKE SHAFT SECTION AND A SMOKE SHAFT**

(57) The invention relates to a tubular smoke shaft section (1) comprising, when in an upright position, plurality of vertical walls (3a,3b,3c,3d) in connection with each other and arranged to border a hollow upwards and downwards open smoke guiding channel (4), wherein each said wall (3a,3b,3c,3d) has a sandwich structure and comprises a first face sheet (31) forming an inner face of the wall (3a,3b,3c,3d) and a second face sheet (32) forming an outer face of the wall (3a,3b,3c,3d), and an insulation layer (33) between said first face sheet (31) and said second face sheet (32), the tubular smoke shaft section (1) having an upper end (E1) and a lower end (E2), in particular shaped to form counterparts for each other for enabling piling of tubular smoke shaft sections (1) on top of each other. The tubular smoke shaft section (1) comprises fixing members (11,12,13) comprising one or more first horizontal plate portions (11a,13a) extending horizontally inside the smoke guiding channel (4) at the upper end (E1) of the smoke shaft section (1), and one or more second horizontal plate portions (11b,12a,13b) extending horizontally inside the smoke guiding channel (4) at the lower end (E2) of the smoke shaft section (1), wherein said first and second horizontal plate portions (11a,12;13a,13b) are positioned such that they overlap vertically. The invention also relates to a smoke shaft comprising plurality of tubular smoke shaft sections (1).

Fig. 1



Description

Field of the invention

[0001] The invention relates to a smoke shafts in particular for guiding smoke and/or other gaseous substances such as ventilation air in case of fire.

Background of the invention

[0002] Smoke shafts (also referred to as smoke ducts) are used in buildings for removing smoke, heat and combustion products from one or more fire compartments of the building, such as floors of the building, to the outside of the building. Smoke shafts can also be used to take replacement air into the building. Smoke, heat and combustion products may be produced in case of fire, for example, and become hazardous for the people inside the building. If smoke, heat and combustion products are not removed by smoke shafts, these might be guided to a stairway and disable it from serving as an escape route. The same smoke shaft may serve a single fire compartment or plurality of different fire compartments. In multi-storey buildings, the smoke shafts may, for example, provide a duct from lower parts of the building through intermediate floors and further up through the roof possibly having openings leading to different floors for thus being able to remove smoke, heat and combustion products from different floors. The upper end of the smoke shaft has an opening, which may be covered with a hatch. The hatch may comprise a window e.g. so that the smoke shaft can provide light into the building. This is advantageous particularly if the smoke shaft lower end opens into a room right below the roof.

[0003] In prior art, one way to fabricate and install a smoke shaft has been to build it from tubular sections by piling them on top of each other. Such tubular sections are known which have sandwich walls having insulation layer between face sheets. One way to fix such tubular sections to each other has been to screw them together by horizontal screws. However, a problem has been that the screws may form a harmful heat bridge in the structure. A challenge has been to ensure engagement between vertically consecutive smoke shaft sections such that the seam between them has good tightness throughout the lifetime of the smoke shaft. It is particularly important that the structure is not prone to lose its tightness due to thermal expansion or shrinkage in case of fire. Another challenge has been that the fabrication method requires often on-site piling of the smoke shaft sections, whereby engagement between the vertically consecutive smoke shaft sections can not be freely secured.

Brief description of the invention

[0004] The object of the invention is to introduce a new solution for a smoke shaft, which is improved in terms of firmness and tightness of the engagement between ver-

tically consecutive smoke shaft sections in different conditions while being well suitable to be fabricated on site.

[0005] An object is particularly to introduce a solution by which one or more of the above-mentioned drawbacks of prior art and/or drawbacks discussed or implied elsewhere in the description can be solved.

[0006] It is brought forward a new tubular smoke shaft section comprising, in particular when in an upright position, plurality of vertical walls in connection with each other and arranged to border a hollow upwards and downwards open smoke guiding channel, wherein each said wall has a sandwich structure and comprises a first face sheet forming an inner face of the wall and a second face sheet forming an outer face of the wall, and an insulation layer between said first face sheet and said second face sheet, the tubular smoke shaft section having an upper end and a lower end, said ends in particular being shaped to form counterparts for each other for enabling piling of tubular smoke shaft sections on top of each other. The tubular smoke shaft section comprises fixing members comprising one or more first horizontal plate portions extending horizontally inside the smoke guiding channel or inside the vertical projection of the smoke guiding channel at the upper end of the smoke shaft section, and one or more second horizontal plate portions extending horizontally inside the smoke guiding channel or inside the vertical projection of the smoke guiding channel at the lower end of the smoke shaft section, wherein said first and second horizontal plate portions are positioned such that they overlap vertically.

[0007] With this kind of solution one or more of the above-mentioned objects can be facilitated. Thereby, it is enabled positioning the first horizontal fixing plate portion opposite to a second horizontal fixing plate portion of a second smoke shaft section on top of said first tubular smoke shaft section, and for enabling positioning the second horizontal fixing plate portion opposite to a first horizontal fixing plate portion of a third smoke shaft section below said first tubular smoke shaft section, for thereby facilitating fixing of them together. This is advantageous, because thus the inner parts of the tubular consecutive sections can be fixed together simply and firmly by reaching from above. Thus, a firm and tight structure is achieved, which can be easily fabricated by piling.

[0008] Preferable further details of the tubular smoke shaft section are introduced in the following, which further details can be combined with the tubular smoke shaft section individually or in any combination.

[0009] In a preferred embodiment, the fixing members are attached on the first face sheets of one or more of said walls.

[0010] In a preferred embodiment, adjacent walls have been connected to each other by mitre joints.

[0011] In a preferred embodiment, the first and second face sheets of each said wall are vertical and parallel.

[0012] In a preferred embodiment, said fixing members comprise attached on at least one wall, in particular on the first face sheet thereof,

a first elongated horizontal bar comprising a first horizontal plate portion extending horizontally, in particular inside the smoke guiding channel or inside the vertical projection of the smoke guiding channel, at the upper end of the smoke shaft section, and a second elongated horizontal bar comprising a second horizontal plate portion extending horizontally, in particular inside the smoke guiding channel or inside the vertical projection of the smoke guiding channel, at the lower end of the smoke shaft section, the first and second horizontal bars being such positioned that the first and second horizontal plate portions overlap vertically.

[0013] In a preferred embodiment, said fixing members comprise an elongated vertical bar extending vertically inside the smoke guiding channel, or at least partially inside the smoke guiding channel, in at least one corner of adjacent two walls, in particular attached on said adjacent two walls, in particular on the first face sheets thereof, the elongated vertical bar comprising:

a first horizontal plate portion at the upper end of the elongated vertical bar, which first horizontal plate portion extends horizontally, in particular inside the smoke guiding channel or inside the vertical projection of the smoke guiding channel, and a second horizontal plate portion at the lower end of the elongated vertical bar, which second horizontal plate portion extends horizontally, in particular inside the smoke guiding channel or inside the vertical projection of the smoke guiding channel, and the first and second horizontal plate portions of the elongated vertical bar are positioned to overlap vertically.

[0014] In a preferred embodiment, the overlapping first and second horizontal plate portions, in particular of the elongated vertical bar and/or the horizontal bars comprise coinciding fixing holes, in particular for an elongated fixing member such as a fixing bolt member. The fixing holes preferably extend through the first and second horizontal plate portions in vertical direction.

[0015] In a preferred embodiment, a counterpart member for an elongated fixing member has been inserted in one hole of coinciding holes of the overlapping first and second horizontal plate portions in particular of the elongated vertical bar and/or the horizontal bars, said hole being a hole of a first horizontal plate portion. Preferably, said counterpart member is locked or lockable unrotatable relative to the hole. Preferably, said counterpart member is a nut member, preferably a rivet nut with internal threads, the elongated fixing member being a bolt member with external threads.

[0016] In a preferred embodiment, each said horizontal bar and/or each said vertical bar comprises, preferably being an angle bar, a first plate branch and a second plate branch, which are at right angle relative to each

other. A plate branch of each said horizontal bar preferably forms one of the aforementioned horizontal plate portions.

[0017] In a preferred embodiment, said vertical bar comprises at the vertical and lower end thereof a horizontal plate portion.

[0018] In a preferred embodiment, only said first branch of said branches of each said horizontal bar is fixed against the first face sheet, the second branch extending horizontally inside the smoke guiding channel, or inside the vertical projection of the smoke guiding channel, forming the horizontal plate portion of the fixing member in question.

[0019] In a preferred embodiment, the first branch of said vertical bar is attached on a first face sheet of one of two adjacent walls, and the second branch of said vertical bar is attached on a first face sheet of the other of two adjacent walls.

[0020] In a preferred embodiment, the upper end of the wall is provided with a first form locking shape and the lower end of the wall with a second form locking shape, the first and second form locking shapes being counterparts for each other. Preferably, the first form locking shape comprises a male form locking shape and the second form locking shape a female form locking shape forming a counterpart for the male form locking member, or vice versa.

[0021] In a preferred embodiment, the lower edge of the second sheet has been bent to form a downwardly open groove, particularly the second sheet being bent inwards, upwards, inwards and downwards (inwards meaning towards the wall central plane), and the upper edge of the second sheet is arranged to fit into the groove, preferably bent inwards, upwards inwards and downwards. This could also be vice versa. This structure provides that two smoke shaft sections piled on top of each other can be simply locked, working from the outside, vertically immovably together by aid of an elongated fixing member extending through the edges of the smoke shaft sections. Thus, in addition to the fixing by aid of the fixing members inside the smoke guiding channel, also second sheets of the smoke shaft walls are well secured together, which provides very firm and tight engagement between vertically consecutive smoke shaft sections in different conditions yet being well suitable to be fabricated on site.

[0022] In a preferred embodiment, the lower edge of the second sheet has been bent to form a downwardly open groove, particularly the second sheet being bent inwards, upwards, inwards and downwards (inwards meaning towards the wall center plane), and the upper edge of the second sheet is arranged to fit into the groove, preferably bent inwards, upwards inwards and downwards.

[0023] In a preferred embodiment, the insulation layer is a mineral wool layer, in particular which comprises or is made of mineral wool.

[0024] In a preferred embodiment, said first face sheet

and/or said second face sheet is a metal sheet, in particular a sheet which comprises or is made of metal.

[0025] In a preferred embodiment, the tubular smoke shaft section is a rectangular tube.

[0026] In a preferred embodiment, the face sheets are not in contact with each other nor connected by a metal member. This is advantageous, because otherwise a heat bridge would be formed between the face sheets.

[0027] In a preferred embodiment, the overlapping first and second horizontal plate portions extend inside the vertical projection of the smoke guiding channel.

[0028] In a preferred embodiment, one or both of the overlapping first and second horizontal plate portions extend inside the smoke guiding channel.

[0029] In a preferred embodiment, each said first horizontal plate portion has a horizontal planar face facing upwards, and each said second horizontal plate portion has a horizontal planar face facing downwards.

[0030] It is also brought forward a new smoke shaft wherein the smoke shaft comprises plurality of tubular smoke shaft sections as described anywhere above and/or in any of the claims of the application, which smoke shaft sections are piled on top of each other in alignment such that their smoke guiding channels together form a continuous vertically oriented smoke guiding channel, consecutive smoke shaft sections being fixed together with said fixing members.

[0031] With this kind of solution one or more of the above-mentioned objects can be facilitated.

[0032] Preferable further details of the smoke shaft have been introduced above as well as will be introduced in the following, which further details can be combined with the smoke shaft individually or in any combination.

[0033] In a preferred embodiment, the smoke shaft extends through one or more openings formed in a floor structure and/or through one or more openings formed in a roof structure of a building.

[0034] In a preferred embodiment, the smoke shaft comprises a first smoke shaft section and a second smoke shaft section on top of the first smoke shaft section, the first horizontal fixing plate portions of the first smoke shaft section being positioned vertically opposite to the second horizontal fixing plate portions of the second smoke shaft section and/or a third smoke shaft section below the first smoke shaft section, the second horizontal fixing plate portions of the first smoke shaft section being positioned vertically opposite to the first horizontal fixing plate portions of the third smoke shaft section.

[0035] In a preferred embodiment, the first and second smoke shaft section piled on top of each other are locked vertically immovably together by aid of an elongated fixing member, such as bolt or screw or rivet extending through the lower edge of the second sheet of a second smoke shaft section and the upper edge of the second sheet of the first smoke shaft section located below said second smoke shaft section and/or the first and third smoke shaft section piled on top of each other are locked

vertically immovably together by aid of an elongated fixing member, such as bolt or screw or rivet extending through the lower edge of the second sheet of the first smoke shaft section and the upper edge of the second sheet of the third smoke shaft section located below said first smoke shaft section.

[0036] In a preferred embodiment, vertically oppositely positioned first and second horizontal fixing plate portions of the first and second smoke shaft section and/or vertically oppositely positioned first and second horizontal fixing plate portions of the first and third smoke shaft section are fixed together, in particular with an elongated fixing member extending through coinciding holes of said vertically oppositely positioned first and second horizontal fixing plate portions.

[0037] In a preferred embodiment, the upper end thereof is at least partially outside of the building wherein the smoke shaft is installed.

[0038] In a preferred embodiment, the upper end thereof is provided with an openable hatch covering in an openable manner the smoke guiding channel.

[0039] In a preferred embodiment, one or more of the smoke shaft sections, except at least the lowermost, rests at least partially carried by the smoke shaft section below it.

[0040] It is also brought forward a new smoke shaft arrangement comprising a smoke shaft as defined anywhere above or in any of the claims of the application.

Brief description of the drawings

[0041] In the following, the present invention will be described in more detail by way of example and with reference to the attached drawings, in which

FIG. 1 partially a smoke shaft according to an embodiment as well as an embodiment of a tubular smoke shaft section 1 according to an embodiment.

FIG. 2 illustrates a cross sectional view of consecutive smoke shaft sections of Figure 1.
A-A of the upper end of a wall of a tubular smoke shaft section of Figure 1.

FIG. 3 illustrates an enlarged view of a detail of Figure 2.

FIG. 4 illustrates an enlarged view of a detail of Figure 3.

FIG. 5 illustrates the cross section A-A of Figure 1.

FIG. 6 illustrates the cross section B-B of Figure 1.

FIG. 7 illustrates an enlarged view of a detail of Figure 6.

FIG. 8 illustrates preferred further details of the

smoke shaft of Figure 1 and an arrangement comprising the smoke shaft.

Detailed description

[0042] Figure 1 illustrates partially a smoke shaft 100 according to an embodiment as well as an embodiment of a tubular smoke shaft section 1 according to an embodiment. The Figure illustrates in particular two tubular smoke shaft section 1 piled on top of each other, but preferably the smoke shaft 100 comprises more of them piled on top of each other.

[0043] The tubular smoke shaft section 1 is illustrated in Figure 1 and described hereinafter as it is when in upright position.

[0044] The tubular smoke shaft section 1 comprises plurality of walls 3a,3b,3c,3d, which are vertical when the tubular smoke shaft section 1 is in an upright position. Said vertical walls 3a,3b,3c,3d, in particular four walls, are in connection with each other and arranged to border a hollow, upwards and downwards open, smoke guiding channel 4.

[0045] Each said wall 3a,3b,3c,3d has a sandwich structure and comprises a first face sheet 31 forming an inner face of the wall 3a,3b,3c,3d and a second face sheet 32 forming an outer face of the wall 3a,3b,3c,3d, and an insulation layer 33 between said first face sheet 31 and said second face sheet 32. Each said face sheet 31,32 is preferably rectangular or at least substantially rectangular in shape.

[0046] The tubular smoke shaft section 1 has an upper end E1 and a lower end E2 shaped to form counterparts for each other for enabling piling of tubular smoke shaft sections 1 on top of each other.

[0047] The tubular smoke shaft section 1 comprises fixing members 11,12,13 comprising first horizontal plate portions 11a,13a extending horizontally inside the smoke guiding channel 4 at the upper end E1 of the smoke shaft section 1, and second horizontal plate portions 12a,13b extending horizontally inside the smoke guiding channel 4 at the lower end E2 of the smoke shaft section 1, wherein said first and second horizontal plate portions 11a,12a;13a,13b are positioned such that they overlap vertically. Thereby, it is enabled positioning the first horizontal fixing plate portion 11a,13a opposite to a second horizontal fixing plate portion 12a,13b of a second smoke shaft section 1, 1b on top of said first tubular smoke shaft section 1, 1a, and for enabling positioning the second horizontal fixing plate portion opposite to a first horizontal fixing plate portion of a third smoke shaft section 1, 1c below said first tubular smoke shaft section 1, 1a, for thereby facilitating fixing of them together. The plate portions being horizontal provides that they can be placed vertically opposite each other and simply fixed immovably to each other. The horizontal plate portions 11a,12a,13a extending horizontally inside the smoke guiding channel 4, or at least inside the vertical projection of the smoke guiding channel 4, provides that horizontal

plate portions 11a,12a,13a of consecutive smoke shaft sections can be reached from above and fixed simply to each other.

[0048] Each said first horizontal plate portion 11a,13a has in particular a horizontal planar face facing upwards, and each said second horizontal plate portion 12a,13b has in particular a horizontal planar face facing downwards. Thus, the horizontal plate portions of consecutive smoke shaft sections are simple to arrange to overlap and to fix on each other. For instance, vertically oriented fixing holes are easy to provide on them to extend through the planar faces.

[0049] The fixing members 11,12,13 can comprise horizontal or vertical fixing members also referred to as elongated horizontal bars and elongated vertical bars. The advantage of a horizontal fixing member 11,12 is that it is simple to design to have vast horizontal plate portion which thereby simply provides a vast fixing area. The advantage of a vertical fixing member 13 is that it can be simply designed to have both the first and second horizontal plate portions 13a,13b comprised in the same fixing member 13. In the preferred embodiments illustrated in Figures the smoke shaft section 1 comprises both kinds of fixing members 11,12,13, which is preferable since this provides a very reliable engagement. However, this is not necessary, because it would be also possible to utilize only horizontal fixing members 11,12 or only vertical fixing members 13, if maximal firmness of the fixing is not necessary.

[0050] In the preferred embodiments, the fixing members 11,12,13 comprise attached on each wall 3a,3b,3c,3d, and more specifically on the first face sheet 31 thereof:

a first elongated horizontal bar 11 comprising a first horizontal plate portion 11a, which first elongated horizontal bar 11 extends horizontally inside the smoke guiding channel 4 at the upper end E1 of the smoke shaft section 1, and

a second elongated horizontal bar 12 comprising a second horizontal plate portion 12a, which second elongated horizontal bar 12 extending horizontally inside the smoke guiding channel 4 at the lower end E2 of the smoke shaft section 1.

[0051] The first and second horizontal bars 11,12 are such positioned that the first and second horizontal plate portions 11a,12a overlap vertically.

[0052] The overlapping first and second horizontal plate portions 11a,12;13a,13b, of the horizontal bars 11,12 comprise coinciding fixing holes 11a1,12a1;13a1,13b1 for an elongated fixing member 14 such as a fixing bolt member 14 as illustrated.

[0053] A counterpart member 15 for an elongated fixing member 14 has been inserted in one hole 11a1 of coinciding holes 11a1,12a1 of the overlapping first and second horizontal plate portions 11a,12a; of the horizontal bars 11,12, said hole 13a1 being a hole of a first hor-

horizontal plate portion 11a said counterpart member 15 being locked or lockable unrotatable relative to the hole 11a1. Thus, the elongated fixing member 14 is simply fixable by working from above, which is advantageous for the installation process where the smoke shaft 100 is to be fabricated by piling. Thus, the fitter person can reach into the channel 4 from above so as to fix the uppermost smoke shaft section to the one below it. Said counterpart member 15 is preferably a rivet member, preferably a rivet nut with internal threads, the elongated fixing member 14 being a bolt member with external threads. A rivet member is advantageous because it provides a firm and well holding fixing to the plate portion and hole where it is inserted.

[0054] In the preferred embodiments, the fixing members 11-13 comprise an elongated vertical bar 13 extending vertically inside the smoke guiding channel 4 in at least one, however preferably in each, corner of adjacent two walls 3a,3b;3b,3c;3c,3d;3d,3a, in particular attached on said adjacent two walls 3a,3b;3b,3c;3c,3d;3d,3a, in particular on the first face sheets 31 thereof. The elongated vertical bar 13 comprises

[0055] a first horizontal plate portion 13a at the upper end of the elongated vertical bar 13, which first horizontal plate portion 13a extends horizontally inside the smoke guiding channel 4, and

a second horizontal plate portion 13b at the upper end of the elongated vertical bar 13, which second horizontal plate portion 13b extends horizontally inside the smoke guiding channel 4.

[0056] The first and second horizontal plate portions 13a,13b of the elongated vertical bar 13 are positioned to overlap vertically.

[0057] The overlapping first and second horizontal plate portions 13a,13b of the elongated vertical bar 13 comprise coinciding fixing holes 13a1,13b for an elongated fixing member 14 such as a fixing bolt member 14 as illustrated.

[0058] A counterpart member 15 for an elongated fixing member 14 has been inserted in one hole 11a1; 13a1 of coinciding holes 11a1,12a1;13a1,13b of the overlapping first and second horizontal plate portions 11a,12;13a,13b in particular of the elongated vertical bar 13 and/or the horizontal bars 11,12, said hole 11a1; 13a1 being a hole of a first horizontal plate portion 11a,12a,13a, said counterpart member 15 being locked or lockable unrotatable relative to the hole 11a1; 13a1. Thus, the elongated fixing member 14 is simply fixable by working from above. Thus, the fitter person can reach into the channel 4 from above so as to fix the uppermost smoke shaft section to the one below it. Said counterpart member 15 is preferably a nut member, preferably a rivet nut with internal threads, the elongated fixing member 14 being a bolt member with external threads. A rivet nut is advantageous because it provides simply a firm and well holding fixing to the plate portion and to the hole where it is inserted, which is also simply usable in difficult position of the fitter when reaching inside the smoke guid-

ing channel 4.

[0059] Each said wall 3a,3b,3c,3d having a sandwich structure is preferably such that the insulation layer 33 is a mineral wool layer, in particular which comprises or is made of mineral wool. Said first face sheet 31 and/or said second face sheet 32 is a metal sheet, in particular a sheet which comprises or is made of metal. Each said wall 3a,3b,3c,3d having a sandwich structure is preferably such the face sheets 31,32 thereof are vertical and parallel to each other. Each said wall 3a,3b,3c,3d is preferably moreover such that the face sheets 31,32 are not in contact with each other. Preferably, the face sheets 31,32 are not connected by a metal member. This is advantageous, because otherwise a heat bridge would be formed between the face sheets.

[0060] Generally, the tubular smoke shaft section 1 is preferably such that it has four of said walls 3a-3d which are at right angle relative to each other such that the tubular smoke shaft section 1 is a rectangular tube. The second face sheets 32 of all the walls 3a-3d can be of same one-piece structure. Thus, tightness of the overall structure is improved.

[0061] Each said wall 3a,3b,3c,3d having a sandwich structure is preferably such that the upper end of the wall is provided with a first form locking shape and the lower end of the wall with a second form locking shape the first and second form locking shapes being counterparts for each other. Figure 5 illustrates a cross section of the upper end of a wall 3a,3b,3c,3d as well as a cross section of the lower end of a wall 3a,3b,3c,3d. In this Figure the upper and lower ends are of different smoke shaft sections 1, but these smoke shaft sections 1 are similar, so they have similar lower and upper ends.

[0062] The form locking shapes facilitate tightness of the seam between piled smoke shaft sections 1 as well as accurate and firm positioning of them relative to each other. The structure is also relatively rigid. Also, the piling steps are quick and easy to perform.

[0063] In the illustrated embodiment, the first form locking shape of the upper end of the wall comprises a male form locking shape and the second form locking shape of the lower end of the wall comprises a female form locking shape forming a counterpart for the male form locking member. This could alternatively be vice versa.

[0064] The structure is more specifically such that the lower edge 41 of the first sheet 31 has been bent to form a downwardly open groove 42, particularly the second sheet 32 being bent inwards, upwards, inwards and downwards (inwards meaning towards the wall central plane), and the upper edge 43 of the first sheet 31 is arranged to fit into the groove 42, preferably bent inwards, upwards inwards and downwards.

[0065] The lower edge 51 of the second sheet 32 has been bent to form a downwardly open groove 52, particularly the second sheet 32 being bent inwards, upwards, inwards and downwards (inwards meaning towards the wall central plane), and the upper edge 53 of the second sheet 32 is arranged to fit into the groove 52, preferably

bent inwards, upwards inwards and downwards.

[0066] The edges 41,43 and 51,53 shaped as described provides the aforementioned advantages of shape locking efficiently, and in such a manner that the face sheets 31,32 are able to carry vertical loads. Also, the consecutive smoke shaft sections 1 piled on top of each other are thus easy to lock vertically immovably together by aid of an elongated fixing member 60, such as bolt or screw or rivet extending through the lower edge 51 of the second sheet 32 of a first smoke shaft section 1 and the upper edge 53 of the second sheet 32 of a second smoke shaft section 1 located below said first smoke shaft section 1. Thus, the fixing need not extend deep into the wall structure whereby it does not constitute a harmful heat bridge. Sealing substance 54 can be provided in the seam between the walls. A sealing member 34 can be provided between insulation layers of walls that are on top of each other. The sealing member 34 is preferably an elastic band comprising intumescent material. Thus, it can expand in high temperatures and thereby compensate for any existing or emerging spaces or voids inside or around the insulation layers 33 of the walls.

[0067] Each said horizontal bar 11,12 preferably comprises a first plate branch b1 and a second branch b2, which are at right angle relative to each other. Said horizontal bar 11,12 forms the horizontal plate portion 11a,12a. Each said horizontal bar 11,12 is preferably an angle bar. Only said first branch b1 of said branches b1,b2 of each said horizontal bar 11,12 is fixed against the first face sheet 31, the second branch b2 extending horizontally inside the smoke guiding channel 4 forming the horizontal plate portion 11a,12a of the fixing member 11,12 in question.

[0068] Each said vertical bar 13 preferably comprises a first plate branch b1 and a second branch b2, which are at right angle relative to each other. Said vertical bar 13 comprises at the vertical and lower end thereof a horizontal plate portion 11a,12a. Each said vertical bar 13 is preferably an angle bar. The first branch b1 of said vertical bar 13 is attached on a first face sheet 31 of one of two adjacent walls 3a,3b;3b,3c;3c,3d;3d,3a, and the second branch b2 of said vertical bar 13 is attached on a first face sheets 31 of the other of two adjacent walls 3a,3b;3b,3c;3c,3d;3d,3a. Thus, they also strengthen the corner structure of the smoke shaft section 1.

[0069] The adjacent walls 3d,3a; 3a,3b;3b,3c;3c,3d have been preferably connected to each other by mitre joints M, as illustrated for example in Figures 6 and 7. In this case, the vertical fixing members 13 facilitate also tightness of the mitre joint M. Sealing substance can be provided in the seam between the seam and the vertical bar 13.

[0070] Figure 8 illustrates an arrangement comprising an embodiment of a smoke shaft 100 wherein the smoke shaft comprises plurality of tubular smoke shaft sections 1 as described referring to Figures 1-7 and piled on top of each other in alignment such that their smoke guiding

channels 4 together form a continuous vertically oriented smoke guiding channel. The consecutive smoke shaft sections 1 are fixed together with said fixing members 11,12,13.

5 **[0071]** One or more of the smoke shaft section 1, except at least the lowermost, rests at least partially carried by the smoke shaft section 1 below it.

10 **[0072]** The smoke shaft 100 comprises a first smoke shaft section 1,1a and second smoke shaft section 1,1b on top of the first smoke shaft section 1,1a section, the first horizontal fixing plate portions 11a,13a of the first smoke shaft section 1,1a being positioned vertically opposite to the second horizontal fixing plate portions 12a,13b of the second smoke shaft section 1,1b. This has been illustrated particularly in Figures 3-5. This has been illustrated particularly in Figures 3-5. The first smoke shaft section is marked in Figure 1 with additional reference 1a and the third smoke shaft section with reference 1c.

20 **[0073]** The smoke shaft 100 comprises a third smoke shaft section 1,1c below the first smoke shaft section 1,1a section, the second horizontal fixing plate portions 12a,13b of the first smoke shaft section 1,1a being positioned vertically opposite to the first horizontal fixing plate portions 11a,13a of the third smoke shaft section 1,1c. This has been illustrated particularly in Figures 3-5. The first smoke shaft section is marked in Figure 1 with additional reference 1a and the second smoke shaft section with reference 1b.

30 **[0074]** Vertically oppositely positioned first and second horizontal fixing plate portions 11a,12a;13a,13b of the first and second smoke shaft section 1a,1b and/or vertically oppositely positioned first and second horizontal fixing plate portions 11a,12a;13a,13b of the first and third smoke shaft section 1a,1c are fixed together, in particular with an elongated fixing member 14 extending through coinciding holes 11a1,12a1;13a1,13b1 of said vertically oppositely positioned first and second horizontal fixing plate portions 11a,12a;13a,13b.

40 **[0075]** As illustrated in Figure 5, the first and second smoke shaft section 1a,1b piled on top of each other are preferably locked vertically immovably together by aid of an elongated fixing member 60, such as bolt or screw or rivet extending through the lower edge of the second sheet 32 of a second smoke shaft section 1b and the upper edge of the second sheet 32 of the first smoke shaft section 1a located below said second smoke shaft section 1b and/or the first and third smoke shaft section 1a,1c piled on top of each other are locked vertically immovably together by aid of an elongated fixing member 60, such as bolt or screw or rivet extending through the lower edge of the second sheet 32 of the first smoke shaft section 1a and the upper edge of the second sheet 32 of the third smoke shaft section 1c located below said first smoke shaft section 1a.

55 **[0076]** In the arrangement, the smoke shaft 100 extends through an opening 2 formed in a floor structure 101 and an opening 2 formed in a roof structure 102.

Thereby it extends through the fire compartment that is between said structures 101 and 102. Generally, the smoke shaft can extend through any number of structures 101 and/or 102, whereby it could extend through one or more fire compartments. The smoke shaft 100 could for example extend through openings 2 formed in more than one floors 101. An insulation arrangement 5 is provided around the smoke shaft 100 at the point of each opening 2. The upper end of the smoke shaft 100 is at least partially outside of the building wherein the smoke shaft is installed. The upper end thereof is preferably provided with an openable hatch 35 covering in an openable manner an opening leading to the smoke guiding channel 4 of the smoke shaft 100.

[0077] One or more smoke shaft sections 1 of the smoke shaft 100 preferably comprises one or more smoke inlets 36 leading into the smoke channel 4 of the smoke shaft section 1 in question, as illustrated in Figure 12. The smoke inlets 36 preferably comprise an openable hatch covering them.

[0078] Generally, the dimensions of the tubular smoke shaft section 1 can be freely chosen. However, the dimensions are preferably such that x is at most 1250 mm and y is at most 1000 mm, where x is horizontal width of the smoke guiding channel 4 and y is horizontal depth of the smoke guiding channel 4. Thickness of each said insulation layer is preferably more than 50 mm, preferably more than 80 mm. Preferably, the insulation layer 33 of each wall 3a-3d fills more than 80 % of the space between the face sheets 31,32 of the wall.

[0079] Generally preferably, the fixing members 11,12,13 are attached on the first face sheets 31 of one or more of said walls 3a,3b,3c,3d. Hereby, they can be simply included in the structure without forming heat bridges.

[0080] Generally, said first horizontal plate portions 11a,13a of a smoke shaft section 1 are higher than the second horizontal plate portions 11a,13a. Preferably, the upper faces of said first horizontal plate portions 11a,13a of a smoke shaft section 1 are below the upper edges 43 of the first sheets 31 of the smoke shaft section 1 and the lower faces of said second horizontal plate portions 12,13b of a smoke shaft section 1 are preferably above the lower edges 41 of the first sheets 31 of the smoke shaft section 1.

[0081] Generally, the smoke shaft is for guiding smoke and/or other gaseous substances such as ventilation air in case of fire. It is primarily for this use, and not for serving as a chimney of a fireplace, whereby it is not connected to a fire place.

[0082] In the illustrated embodiments both of the overlapping first and second horizontal plate portions 11a,12a;13a,13b extend inside the smoke guiding channel 4, whereby a rigid structure which is well operable from above is achieved. However, it is not necessary that they both are inside the smoke guiding channel 4 since alternatively for example only one of them could be inside the smoke guiding channel 4, in which case the other

would extend above or below the smoke guiding channel 4 of the section in question. Generally most preferably, however, the overlapping first and second horizontal plate portions 11a,12a;13a,13b extend inside the vertical projection of the smoke guiding channel 4 of the tubular smoke shaft section in question.

[0083] It is to be understood that the above description and the accompanying Figures are only intended to teach the best way known to the inventors to make and use the invention. It will be apparent to a person skilled in the art that the inventive concept can be implemented in various ways. The above-described embodiments of the invention may thus be modified or varied, without departing from the invention, as appreciated by those skilled in the art in light of the above teachings. It is therefore to be understood that the invention and its embodiments are not limited to the examples described above but may vary within the scope of the claims.

Claims

1. A tubular smoke shaft section (1) comprising plurality of vertical walls (3a,3b,3c,3d) in connection with each other and arranged to border a hollow upwards and downwards open smoke guiding channel (4), wherein each said wall (3a,3b,3c,3d) has a sandwich structure and comprises a first face sheet (31) forming an inner face of the wall (3a,3b,3c,3d) and a second face sheet (32) forming an outer face of the wall (3a,3b,3c,3d), and an insulation layer (33) between said first face sheet (31) and said second face sheet (32), the tubular smoke shaft section (1) having an upper end (E1) and a lower end (E2), in particular shaped to form counterparts for each other for enabling piling of tubular smoke shaft sections (1) on top of each other, **characterized in that** the tubular smoke shaft section (1) comprises fixing members (11,12,13) comprising one or more first horizontal plate portions (11a,13a) extending horizontally inside the smoke guiding channel (4) or inside the vertical projection of the smoke guiding channel (4) at the upper end (E1) of the smoke shaft section (1), and one or more second horizontal plate portions (12a,13b) extending horizontally inside the smoke guiding channel (4) or inside the vertical projection of the smoke guiding channel (4) at the lower end (E2) of the smoke shaft section (1), wherein said first and second horizontal plate portions (11a,12a;13a,13b) are positioned such that they overlap vertically.
2. A tubular smoke shaft section (1) according to any of the preceding claims, wherein the fixing members (11,12,13) are attached on the first face sheets (31) of one or more of said walls (3a,3b,3c,3d).
3. A tubular smoke shaft section (1) according to any

of the preceding claims, wherein said fixing members (11-13) comprise attached on at least one wall (3a,3b,3c,3d), in particular on the first face sheet (31) thereof:

a first elongated horizontal bar (11) comprising a first horizontal plate portion (11a) extending horizontally, in particular inside the smoke guiding channel (4) or inside the vertical projection of the smoke guiding channel (4), at the upper end (E1) of the smoke shaft section (1), and a second elongated horizontal bar (12) comprising a second horizontal plate portion (12a) extending horizontally, in particular inside the smoke guiding channel (4) or inside the vertical projection of the smoke guiding channel (4), at the lower end (E2) of the smoke shaft section (1), wherein the first and second horizontal bars (11,12) are such positioned that the first and second horizontal plate portions (11a,12a) overlap vertically.

4. A tubular smoke shaft section (1) according to any of the preceding claims, wherein said fixing members (11-13) comprise an elongated vertical bar (13) extending vertically at least partially inside the smoke guiding channel (4) in at least one corner of adjacent two walls (3a,3b;3b,3c;3c,3d;3d,3a), in particular attached on said adjacent two walls (3a,3b;3b,3c;3c,3d;3d,3a), in particular on the first face sheets (31) thereof, the elongated vertical bar (13) comprising:

a first horizontal plate portion (13a) at the upper end of the elongated vertical bar (13), which first horizontal plate portion (13a) extends horizontally, in particular inside the smoke guiding channel (4) or inside the vertical projection of the smoke guiding channel (4), and a second horizontal plate portion (13b) at the lower end of the elongated vertical bar (13), which second horizontal plate portion (13b) extends horizontally, in particular inside the smoke guiding channel (4) or inside the vertical projection of the smoke guiding channel (4), wherein the first and second horizontal plate portions (13a,13b) of the elongated vertical bar (13) are positioned to overlap vertically.

5. A tubular smoke shaft section (1) according to any of the preceding claims, wherein the overlapping first and second horizontal plate portions (11a,12a;13a,13b), in particular of the elongated vertical bar (13) and/or of the horizontal bars (11,12), comprise coinciding fixing holes (11a1,12a1;13a1,13b1), in particular for an elongated fixing member (14), such as a fixing bolt member.

6. A tubular smoke shaft section (1) according to any of the preceding claims, wherein a counterpart member (15) for an elongated fixing member (14) has been inserted in one hole (11a1; 13a1) of coinciding holes (11a1,12a1;13a1,13b1) of the overlapping first and second horizontal plate portions (11a,12;13a,13b) in particular of the elongated vertical bar (13) and/or the horizontal bars (11,12), said hole (11a1; 13a1) being a hole of a first horizontal plate portion (11a,12a,13a), wherein said counterpart member (15) is preferably locked or lockable unrotatable relative to the hole (11a1; 13a1), said counterpart member (15) preferably being a nut member, most preferably a rivet nut with internal threads, the elongated fixing member (14) preferably being a bolt member with external threads.

7. A tubular smoke shaft section (1) according to any of the preceding claims, wherein each said horizontal bar (11,12) and/or each said vertical bar (13) comprises a first plate branch (b1) and a second plate branch (b2), which are at right angle relative to each other.

8. A tubular smoke shaft section (1) according to any of the preceding claims, wherein each said vertical bar (13) comprises at the vertical and lower end thereof a horizontal plate portion (13a,13b).

9. A tubular smoke shaft section (1) according to any of the preceding claims, wherein only said first branch (b1) of said branches (b1,b2) of each said horizontal bar (11,12) is fixed against the first face sheet (31), the second branch (b2) extending horizontally, in particular inside the smoke guiding channel (4) or inside the vertical projection of the smoke guiding channel (4), forming the horizontal plate portion (11a,12a) of the fixing member (11,12) in question.

10. A tubular smoke shaft section (1) according to any of the preceding claims, wherein the first branch (b1) of said vertical bar (13) is attached on a first face sheet (31) of one of two adjacent walls (3a,3b;3b,3c;3c,3d;3d,3a), and the second branch (b2) of said vertical bar (13) is attached on a first face sheet (31) of the other of two adjacent walls (3a,3b;3b,3c;3c,3d;3d,3a).

11. A tubular smoke shaft section (1) according to any of the preceding claims, wherein the lower edge (51) of the second sheet (32) has been bent to form a downwardly open groove (52), and the upper edge (53) of the second sheet (32) is arranged to fit into the groove (52), or vice versa.

12. A smoke shaft (100) wherein the smoke shaft (100) comprises plurality of tubular smoke shaft sections

(1) as defined in any of the preceding claims, piled on top of each other in alignment such that their smoke guiding channels (4) together form a continuous vertically oriented smoke guiding channel, consecutive smoke shaft sections (1) being fixed together with said fixing members (11,12,13). 5

13. A smoke shaft (100) according to any of the preceding claims, wherein the smoke shaft (100) comprises a first smoke shaft section (1,1a) and a second smoke shaft section (1,1b) on top of the first smoke shaft section (1,1a), the first horizontal fixing plate portions (11a,13a) of the first smoke shaft section (1,1a) being positioned vertically opposite to the second horizontal fixing plate portions (12a,13b) of the second smoke shaft section (1,1b) and/or a third smoke shaft section (1,1c) below the first smoke shaft section (1,1a) section, the second horizontal fixing plate portions (12a,13b) of the first smoke shaft section (1,1a) being positioned vertically opposite to the first horizontal fixing plate portions (11a,13a) of the third smoke shaft section (1,1c). 10 15 20

14. A smoke shaft (100) according to the preceding claim, wherein the first and second smoke shaft section (1a,1b) piled on top of each other are locked vertically immovably together by aid of an elongated fixing member (60), such as bolt or screw or rivet extending through the lower edge of the second sheet (32) of a second smoke shaft section (1b) and the upper edge of the second sheet (32) of the first smoke shaft section (1a) located below said second smoke shaft section (1b) and/or the first and third smoke shaft section (1a,1c) piled on top of each other are locked vertically immovably together by aid of an elongated fixing member (60), such as bolt or screw or rivet extending through the lower edge of the second sheet (32) of the first smoke shaft section (1a) and the upper edge of the second sheet (32) of the third smoke shaft section (1c) located below said first smoke shaft section (1a). 25 30 35 40

15. A smoke shaft (100) according to any of the preceding claims, wherein vertically oppositely positioned first and second horizontal fixing plate portions (11a,12a;13a,13b) of the first and second smoke shaft section (1a,1b) and/or vertically oppositely positioned first and second horizontal fixing plate portions (11a,12a;13a,13b) of the first and third smoke shaft section (1a,1c) are fixed together, in particular with an elongated fixing member (14) extending through coinciding holes (11a1,12a1;13a1,13b1) of said vertically oppositely positioned first and second horizontal fixing plate portions (11a,12a; 13a,13b). 45 50 55

Fig. 1

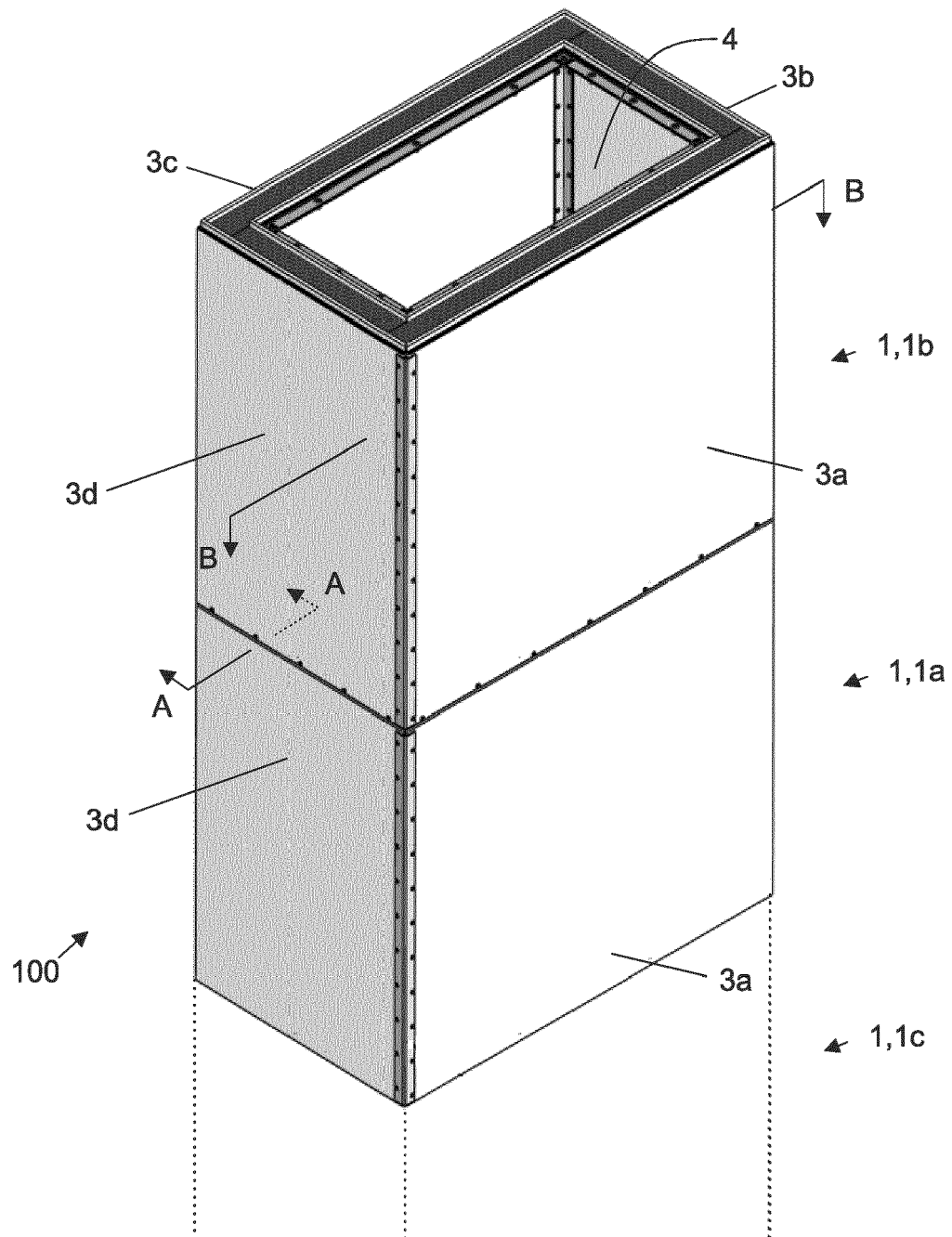


Fig. 2

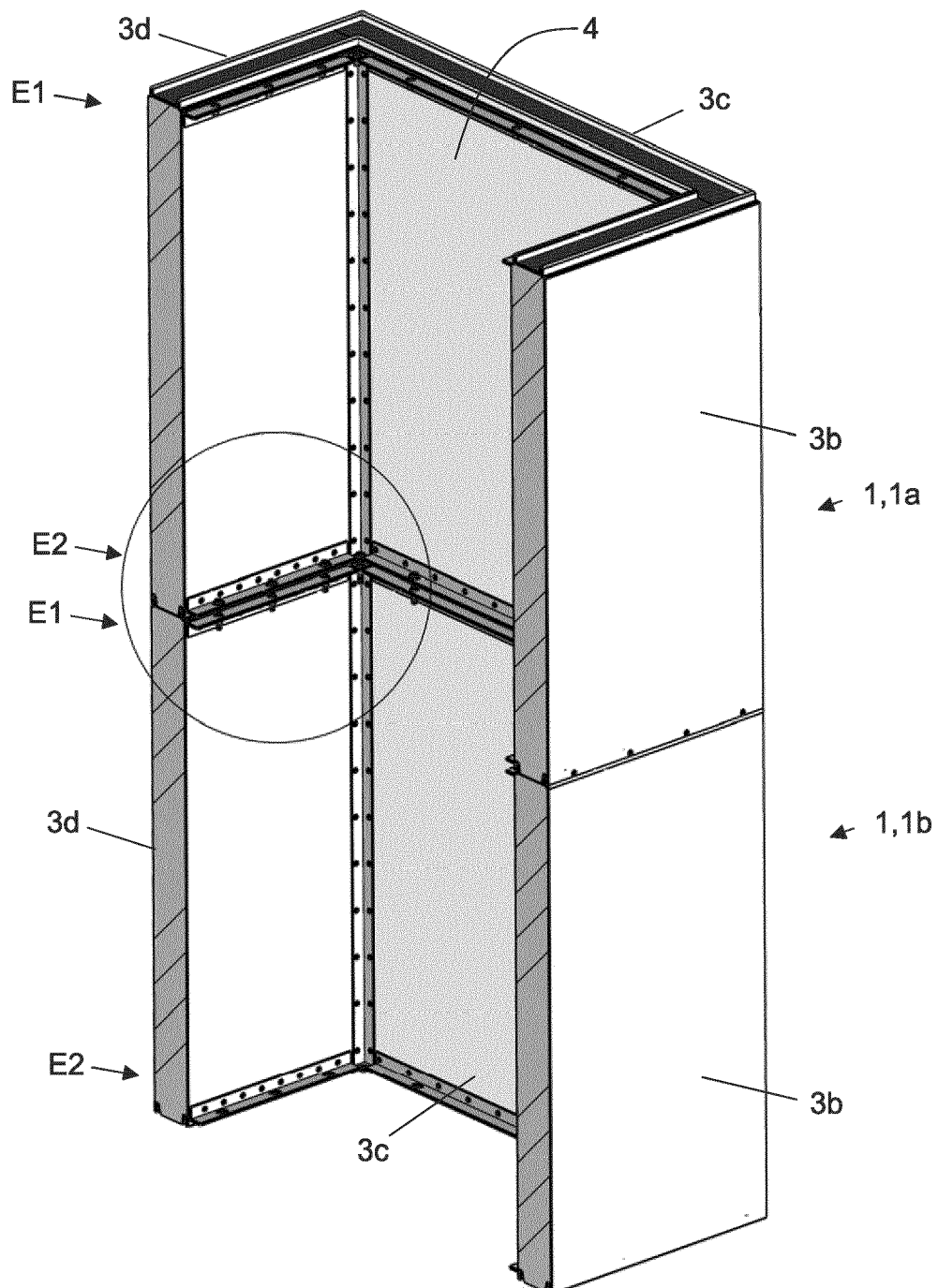


Fig. 3

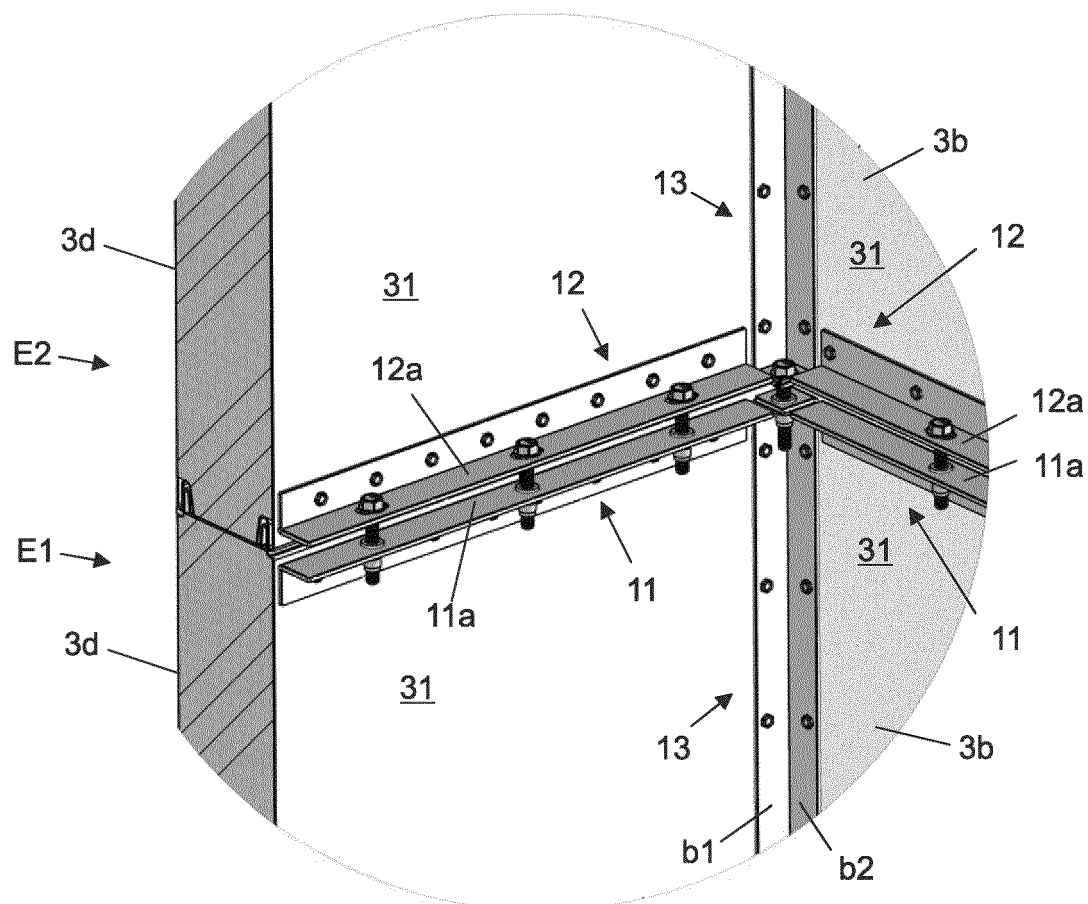


Fig. 4

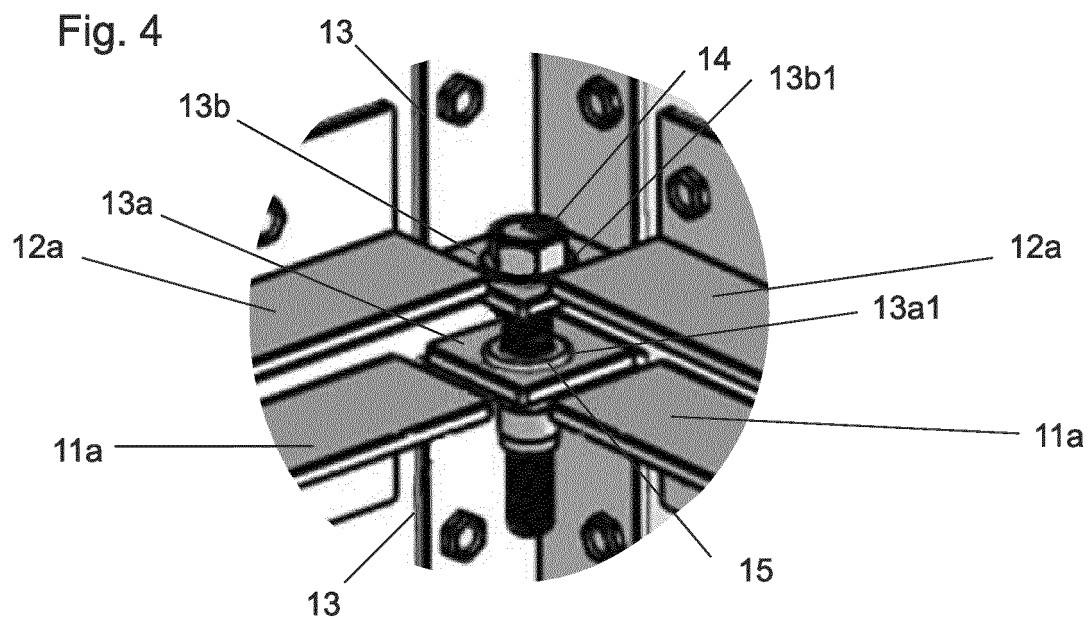


Fig. 5

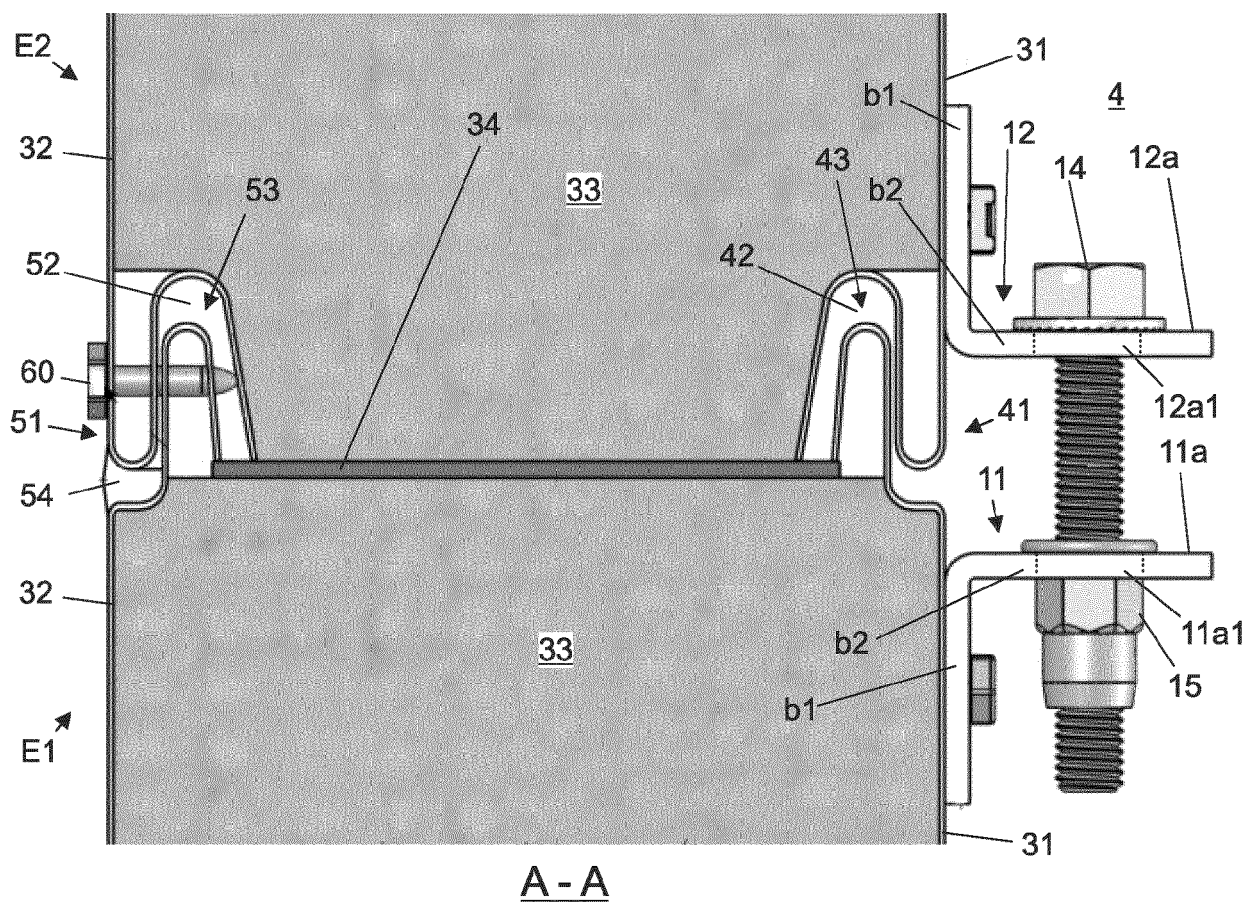


Fig. 6

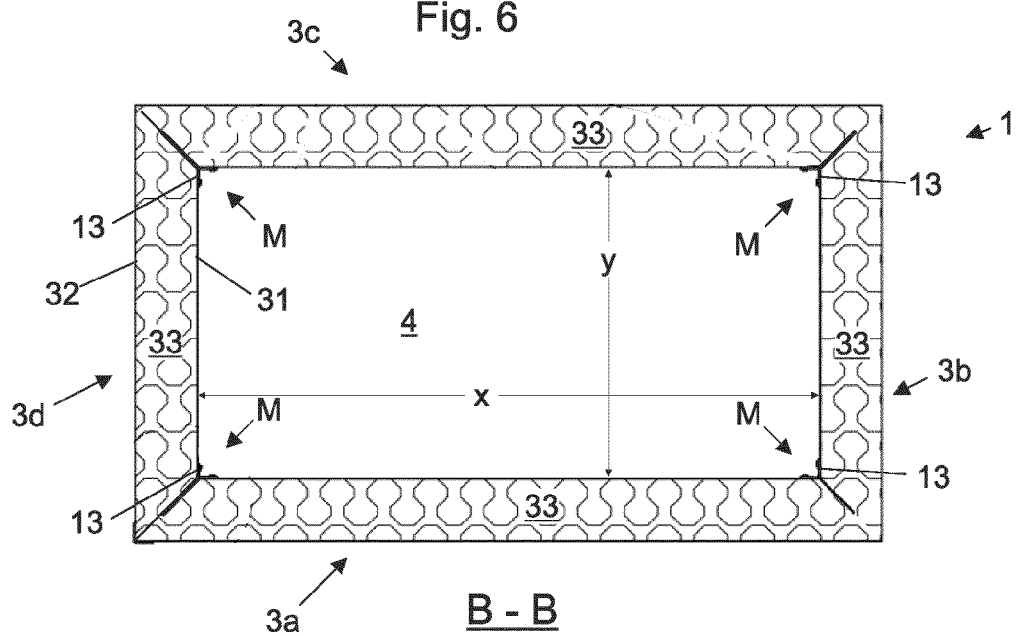


Fig. 7

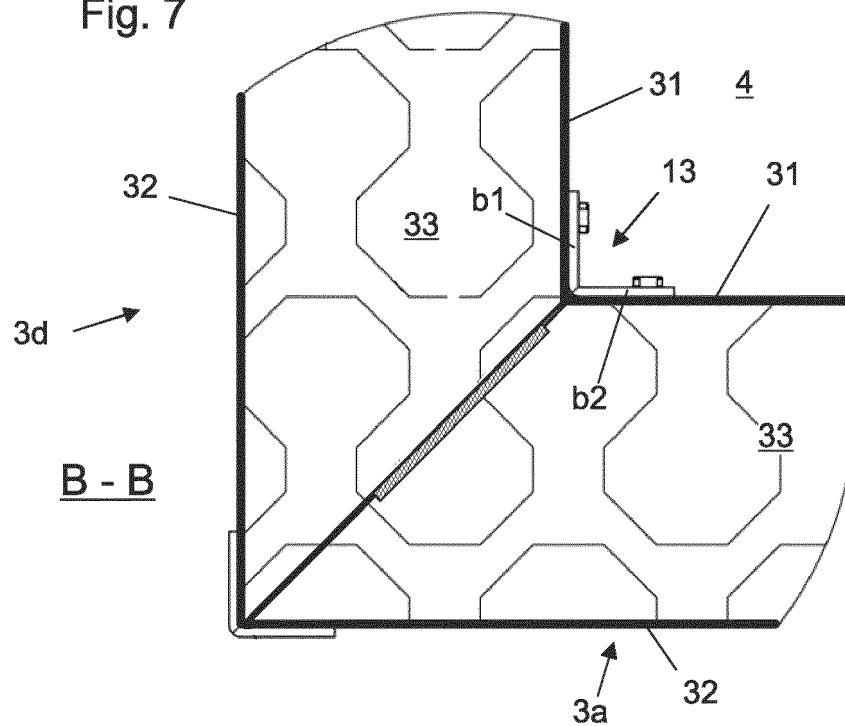
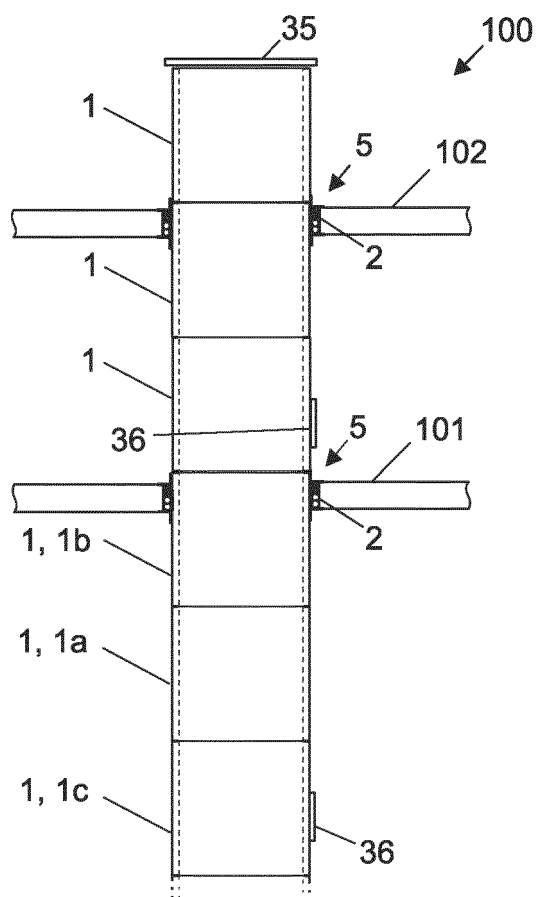


Fig. 8





EUROPEAN SEARCH REPORT

Application Number

EP 23 16 9104

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A	DE 28 41 651 A1 (MABAG LUFT & KLIMATECHNIK) 3 April 1980 (1980-04-03) * figure 1 * -----	1-15	INV. E04F17/04 E04F19/00 E04F17/02
			TECHNICAL FIELDS SEARCHED (IPC)
			E04F
The present search report has been drawn up for all claims			

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EPO FORM 1503 03:82 (P04C01)

Place of search Munich	Date of completion of the search 19 September 2023	Examiner Topcuoglu, Sadik Cem
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EP 23 16 9104

5 This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
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19-09-2023

10	Patent document cited in search report	Publication date	Patent family member(s)	Publication date
	DE 2841651	A1	03-04-1980	NONE
15	-----			
20				
25				
30				
35				
40				
45				
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