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(54) **EVACUATION SYSTEM**

(57) The evacuation system relates to an evacuation system (10) for evacuation of personnel from a building through an escape opening in a pitched roof (1). The evacuation system (10) comprises:

- a hatch (20) having a size and shape suitable for covering the escape opening (3), the hatch (20) is arranged to move between an open position and a closed position,
- a support frame (40) connected to the hatch (20), the support frame (40) is pivotable between a supporting position where the support frame (40) holds the hatch (20) in the open position and a folded position,
- a tunnel (50) having an inlet end (51) attached to the support frame (40) and an distal end (52), the tunnel (50) is foldable,
- a rigid ring (70) arranged along a periphery of the distal end (52) of the tunnel (50), and
- a foldable evacuation chute (80) connected to the distal end (52) of the tunnel (50).

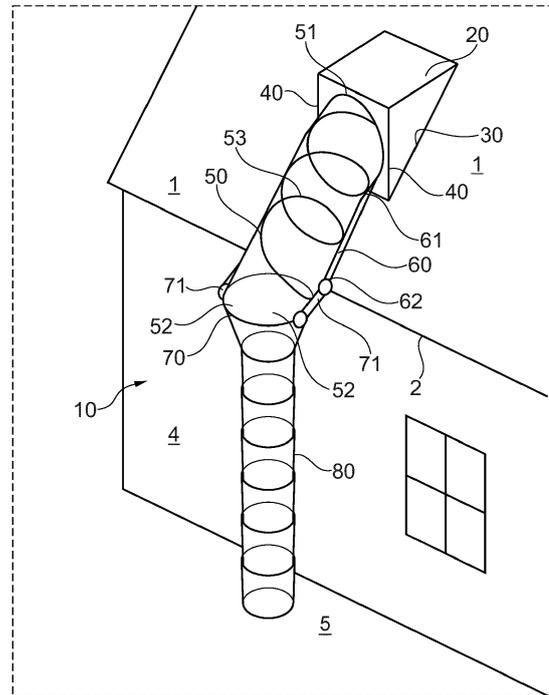


Fig. 1

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Description

Field of the invention

5 **[0001]** The invention relates to an evacuation system for evacuation of personnel from a building through an escape opening in a pitched roof.

Background of the invention

10 **[0002]** Evacuation of personnel from a building must be carried out in a fast, safe and efficient manner. Evacuation from rooms having a window on a wall can often be done via a ladder on the outside wall that can be reached from the window. There are ladders on the market that can be folded out from the wall, so that they are less noticeable and that can only be folded out from the top, in order to prevent strangers from climbing up to the window.

15 **[0003]** Evacuation from a room that do not have a window on an outer wall, is often more challenging. If there is a roof window, evacuation can be carried out through the roof window. However, climbing out on a pitched roof is not safe, so in such cases a platform and a walkway, often with handrails, then need to be installed on the roof. The walkway will often lead to a ladder on a wall, unless there are other possibilities for getting down from the roof. Most buildings with pitched roofs have an overhang or eaves, so the lower edge of the inclined roof extends out passed the walls of the building. So, the ladder will also have to extend out from the wall for personnel to be able to enter the ladder from the roof. Such an installation as described above will be expensive, quite visible, and not particularly attractive on a building such as a residential house.

20 **[0004]** An evacuation route should be arranged so that elderly and children can also manage to evacuate. Climbing a rope and reaching a ladder from a window, or even getting out of a roof window and moving on to a platform on a pitched roof, can be challenging for a child or an elderly person.

25 **[0005]** It is therefore a need for alternative solutions for evacuation from the top floor of buildings having pitched roof.

Object of the invention

30 **[0006]** An object of the invention is to provide an alternative solution for evacuating personnel from a building, especially from buildings with pitched roofs and particularly from rooms that do not have a window on an outer wall.

[0007] Another object of the invention is to provide a solution for evacuation of personnel, that is less visible on the outside of buildings than previously known solutions and/or requires installation of less structure on roofs and walls.

[0008] Yet another object of the invention is to provide a solution for evacuation via a pitched roof that is safer than the prior art solutions.

35 **[0009]** Yet another object is to provide a solution for evacuation that makes it possible and easier to evacuate the elderly and children.

Summary of the invention

40 **[0010]** *In one aspect the invention relates to an evacuation system for evacuation of personnel from a building through an escape opening in a pitched roof. The evacuation system comprises:*

- *a hatch having a size and shape suitable for covering the escape opening, the hatch is arranged to move between an open position and a closed position,*
- 45 - *a support frame, the support frame is pivotable between a supporting position where the support frame holds the hatch in the open position and a folded position,*
- *a tunnel having an inlet end attached to the support frame and a distal end, the tunnel is foldable,*
- *a rigid ring arranged along a periphery of the distal end of the tunnel, and*
- 50 - *a foldable evacuation chute connected to the distal end of the tunnel.*

[0011] Personnel evacuated from the building can be evacuated to a lower level relative to the roof, such as to the ground surrounding the building. The evacuation chute extends to the ground or to just above the ground.

[0012] The support frame can be pivotally connected to the hatch preferably at an opening side of the hatch facing the lower edge of the roof.

55 **[0013]** The support frame can be pivoted upwards towards the underside of the hatch when it is in its folded position. By folded it is in this context meant that the support frame is folded towards the hatch while it in its supporting position is protruding from the hatch.

[0014] The foldable tunnel having the attached rigid ring at the distal end and the foldable evacuation chute attached to

the rigid ring forms together an evacuation route from the escape opening along the pitched roof over the roofs lower edge and down on the ground next to the building.

[0015] The evacuation chute and the tunnel can be telescopically foldable towards the support frame.

[0016] The tunnel, the rigid ring, the escape chute and the connected bed can extend from the support frame by the help of gravity since it is intended to be arranged on a pitched roof.

[0017] The escape chute can comprise elastic rings or flexible mesh fabric sewn into the fabric of the escape chute.

[0018] The escape chute can alternatively have internal ledges for slowing down the movement of the person evacuating.

[0019] The hatch can have a depth so that when folded, the evacuation chute and the tunnel fits partly or entirely inside the hatch together with the rigid ring when the support frame is in its folded position.

[0020] The foldable tunnel having the attached rigid ring at the distal end and the foldable evacuation chute attached to the rigid ring is arranged to be folded so that it fits at least partly inside the hatch.

[0021] The tunnel can be made of fabric/cloth/canvas, preferably a flame-retardant fabric/cloth/canvas.

[0022] The rigid ring can be sewn into the fabric of the tunnel at the end of the tunnel.

[0023] An advantage of the evacuation system is that it provides safe evacuation via the pitched roof. As personnel evacuating are inside the tunnel when they transport themselves over the pitched roof, they can not fall down from the roof.

[0024] Another advantage of the evacuation system is that it does not take up much space, and it does not require large structures to be installed on the outside of buildings. When in standby, the whole evacuation system can be contained between the hatch and the ceiling and/or inside the interior of the hatch.

[0025] *The system can further comprise a roof frame, framing in said escape opening. The hatch can be hinged to the roof frame at a hinge side of the roof frame arranged to be opposite to a lower edge of the roof.*

[0026] The side of the roof frame where the hatch is hinged (the hinge side) is the side arranged to be at the highest point of the escape opening/ furthest away from the lower edge of the roof.

[0027] The advantage of having the roof frame is that it makes it easier to connect the hatch to the roof structure. If the roof structure is not suitable for connecting hinges to, then a roof frame can be put in place to frame the escape opening.

[0028] *The system can further comprise a rollable bed having a proximal end attached to the support frame and a distal end having a transverse bar/roll-up bar. The bed can be arranged to be rolled up on the roll-up bar. The roll-up bar can be pivotably connected to the rigid ring via a bracket on each side of the transvers bar. The rollable bed can be arranged to be rolled out towards the lower edge of the roof underneath the tunnel when the tunnel is extended.*

[0029] The bed could be denoted as a groundsheet, underlay or similar.

[0030] The advantage of the bed is that it helps to hold and stabilize the rigid ring at a suitable position relative to the edge of the roof. It also provides padding towards the surface of the roof for persons evacuating via the tunnel.

[0031] The bed can be inflatable, and it can be automatically inflated when rolled out.

[0032] *The hatch can have a hollow interior arranged for accommodating at least partly the support frame, the tunnel, the rollable bed, the rigid ring and the evacuation chute, when the hatch is in the closed position.*

[0033] The advantage of a hatch having a hollow interior arranged for accommodating the evacuation system, is that it does not occupy a dominant position, neither on the outside of the building nor inside the room with the escape opening.

[0034] *The hatch can comprise lift support for moving the hatch to its open position when a hatch lock mechanism, holding the hatch is in its closed position, is released.*

[0035] Lift support has the advantage that the hatch opens up automatically when the hatch lock mechanism is released. The person evacuating will not have to use force or will just have to use a little force to lift the potentially heavy hatch and the rest of the evacuation system when evacuating.

[0036] *The tunnel can comprise a spiral spring arranged for extending the tunnel from a folded position and to keep the tunnel taut when extended.*

[0037] The spiral spring can be sewn into the fabric of the tunnel. Alternatively, it can be glued or strapped to the fabric of the tunnel. The spiral spring can be a metal spiral spring or made of another suitable material such as fiberglass.

[0038] *The tunnel and the evacuation chute can be arranged to be held in a folded position close to the support frame together with the rigid ring until it is released. When released, the spiral spring is arranged to propel the tunnel, the rigid ring, the rollable bed and the evacuation chute away from the hatch.*

[0039] *The system can further comprise a ladder, pivotally connected to the roof frame at the side of the roof frame arranged to face the lower edge of the roof. The ladder is pivotable between a folded-up position wherein a bottom of the ladder is close to the hatch and an escape position wherein the bottom of the ladder is pivoted downwards towards a floor inside the building.*

[0040] The ladder can be a telescopic ladder. The ladder can be arranged above a cover that covers the escape opening from within the building similar to ceiling ladder/attic ladder that is available on the market. Only the cover will then be visible from within the building before an evacuation is started. A handle and/or lock can be in place to release and pull down the ladder.

[0041] *The ladder can be arranged to prevent the hatch from opening when in its folded up position, and can be arranged*

to release the hatch lock mechanism in when it is in its escape position.

Description of the diagrams

5 [0042]

10 Fig. 1 shows an embodiment of the evacuation system being ready for evacuation. The tunnel is extended out to the lower edge of the roof on top of the extended bed. The rigid ring that is sewn into the fabric of the tunnel and that is also pivotally connected to the distal end of the bed via the brackets prevents the tunnel from collapsing and holds the evacuation chute. The evacuation chute extends down to the ground next to the building. The evacuation chute can have internal ledges as known from prior art evacuation chutes, so that personnel will have to move through the evacuation chute along path of travel shaped as a Z.

15 Fig. 2 shows the same embodiment of the evacuation system as the on in Fig. 1. Fig. 2 shows the hatch and the roof frame in a closer view. The tunnel, the evacuation chute and the brackets are removed in order for other components to be visible. The bed is rolled up. The ladder is lowered down into the below room.

20 Fig. 3 shows the same embodiment as the preceding figures, but in this embodiment the evacuation system is packed down, as it will be when it is ready to be used in case of an emergency evacuation. The hatch is closed and covers the escape opening. The tunnel, the rigid ring and the escape chute are folded/packed into the hollow interior space of the hatch. The bed is rolled up and fitted into the hatch. The support frame 40 is folded up so that it lies more or less along the hatch. The ladder is also folded up, laying along the roof frame. A locking bracket on the ladder is preventing the hatch from being opened until the ladder is lowered.

25 Fig. 4 shows the same embodiment of the evacuation system as the previous figures. In Fig. 4 the hatch is opened, and the ladder is lowered down. The support frame is folded down together with the attached tunnel, rigid ring, escape chute and the rolled-up bed. The tunnel, the rigid ring and the escape chute is packed compactly and ready to be released.

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Reference numbers	
1	Pitched roof
2	Lower edge (of pitched roof)
35	3 Escape opening
	4 Building
	5 Ground
40	10 Evacuation system
	11 Hinge
45	20 Hatch
	21 Opening side (of hatch)
	22 Lift support (such as gas struts)
50	30 Roof frame
	31 Hinged side (of roof frame)
	32 Ladder
55	33 Locking bracket
	34 Handle (to hold onto during evacuation)

(continued)

Reference numbers	
40	Support frame
41	Legs
42	Upper transversal bar
43	Lower transversal bar
50	Tunnel
51	Inlet end (of tunnel)
52	Distal end (of tunnel)
53	Spiral spring
60	Bed
61	Proximal end (of bed)
62	Distal end (of bed)
63	Roll-up bar / Transvers bar (for rolling up the bed 60 and for pivotally connecting the distal end 62 of the bed to the brackets 71)
70	Rigid ring
71	Brackets (for connecting the rigid ring to the roll-up bar of the bed)
80	Evacuation chute

Description of preferred embodiments of the invention

[0043] In the following will embodiments of the evacuation system 10 be described in detail with reference to the figures. The evacuation system 10 is designed to provide a safe and efficient evacuation of personnel from a building 4 through an escape opening 3 in a pitched roof 1.

[0044] All the figures are sketches to show the main principles. They are not intended to be to scale or to be complete sectional drawings.

[0045] In an embodiment the evacuation system 10 comprises a hatch 20 hinged to a roof frame 30. The roof frame 30 is arranged in the escape opening 3. The hatch 20 is hinged to the roof frame 30 at an upper side similar to a top-hinged roof window, as seen in Fig. 2.

[0046] Alternatively, if the upper side of the escape opening 3 allows for it, the hatch 20 could be hinged directly to the roof structure. The need for a roof frame 30 could then be avoided.

[0047] The support frame 40 is connected to the hatch 20 on the side of the hatch 20 being opposite to the side hinged to the roof frame 30, this will be the side of the hatch 20 closest to the lower edge 2 of the pitched roof 1. The support frame 40 is pivotally connected to the hatch 20, for instance by hinges 11, so that the support frame 40 can be folded out from the underside of the hatch 20 facing the escape opening 3. The support frame 40 is arranged to support the hatch 20 in an open position when the support frame 40 is folded out from the hatch 20. In this position the legs 41 of the support frame 40 is resting on the side of the roof frame 30. When the hatch 20 is closed the support frame 40 is folded towards the underside of hatch 20. The ends of the legs 41 of the support frame 40 can slide in grooves on each side of the roof frame 30. Some sort of locking mechanism can be in place to secure the legs 41 of the roof frame when the hatch 20 is open.

[0048] The evacuation system 10 further comprises a foldable tunnel 50 made of fabric having a spiral spring 53 sewn into the fabric. This tunnel 50 has an inlet end 51 attached to the support frame 40 and a distal end 52.

[0049] At the distal end 52 of the tunnel 50 a rigid ring 70 is sewn into the fabric. The length of the tunnel 50 is customized

so that the distal end 52 reaches just over the lower edge 2 of the pitched roof 1. A foldable evacuation chute 80 is attached to the tunnel 50 and/or to the rigid ring 70. The evacuation chute 80 can be extended from its folded state so that it extends down to or to just above the ground 3.

[0050] The evacuation chute 80 can be a standard prior art foldable evacuation chute. It can have internal ledges (not visible in the figures) so that personnel can climb/slide safely down from one ledge to another. Alternatively, the evacuation chute can be narrow and made of elastic fabric so that the elastic fabric must be stretched out to let a person pass, and in this way reduces the speed of a person evacuating.

[0051] A rope can be arranged inside the tunnel 50 and inside the escape chute 80. The rope can be attached to the support frame 40 and extend all the way through the tunnel 50 and through the escape chute 80. Personnel can then hold the rope while evacuating themselves. The rope is not shown in the figures.

[0052] The evacuation system 10 is arranged to take up as little room as possible when the hatch 20 is closed, i.e., when it is in standby. The evacuation chute 80, the rigid ring 70 and the tunnel 50 can be folded and packed together so that it at least partly fits into the interior of the hatch 20 and so that it does not extend into the room where the escape opening 3 is located. Likewise, the bed 60, which is rollable onto a roll-up bar 63/ transverse bar, and the brackets 71 attached to the roll-up bar 63, are also packed close to the support frame 40 when the hatch 20 is closed. In Fig. 3 the evacuation system 10 is showed in standby with the hatch 20 closed and the rest of the system 10 compacted partly into and/or below the hatch 20.

[0053] A ladder 32 is pivotally connected to the roof frame 30 at the side of the roof frame closest to the edge 2 of the roof 1. When the escape system 10 is in standby (i.e. the hatch closed) the ladder can be folded up. The ladder 32 can be similar to a prior art attic ladder having a ceiling plate that conceals the ladder 32 and the escape opening 3 when folded up. The ladder 32 can be a telescopic ladder.

[0054] The ladder 32 can have a locking bracket 33 or similar solution for locking the hatch 20 in its closed position when the ladder 32 is folded up. The hatch 20 can be equipped with lift support 22 such as gas struts.

[0055] When personnel need to evacuate, they pull down the ladder 32. Pulling down the ladder 32 releases the hatch 20, so that the lift support 22 opens the hatch 20 to its open position. The support frame 40 having legs 41 sliding in grooves in the roof frame 30 will be folded out so that the support frame 40 prevents the hatch 20 from closing. In Fig. 4 the evacuation system 10 is showed in this configuration.

[0056] With the evacuation system 10 as seen in Fig. 4, personnel can climb up the ladder 32 to release the tunnel 50. The tunnel 50 is spring-loaded by the spiral spring 53. A release mechanism must be in place to hold the tunnel 50 back until released. Such a release mechanism can simply be one or more straps with Velcro that the evacuating personnel releases. When released, the tunnel 50 automatically extends down to the edge 2 of the roof 1 and pulls out the rolled up bed 60 that is arranged to be laid out between the roof 1 and the tunnel 50. The rigid ring 70 is held in place by the brackets 71 pivotally connected to the roll-up bar 63 of the bed 60. The evacuation chute 80 can either fall down from the rigid ring 70 by itself or it can be arranged so that personnel evacuating releases it when they are at the distal end 52 of the tunnel 50.

[0057] The bed 60, can be inflatable to provide padding against the roof, and for helping to extend itself and for helping the tunnel extending. The bed 60 must then automatically inflate when the tunnel 50 is released. A small pressure vessel with pressurized air can be connected to the bed 60 and to the release mechanism for simultaneous release.

[0058] When personnel evacuate it will be done in the following order.

1. Pull down ladder 32, so that the hatch 20 opens and the support frame 40 folds out to support the hatch 20 in its open position
2. Climb up ladder 32
3. Release the tunnel 50 so that the tunnel (with the rigid ring 70), the bed 60 and the evacuation chute 80 is extended
4. Climb into the tunnel 50 and slide or crawl down to the distal end of the tunnel 50
5. Release the evacuation chute 80 (if not already released)
6. Slide down through the evacuation chute (the evacuation chute is designed to slow down the speed of personnel so that they do not hit the ground and hurt themselves)

Claims

1. Evacuation system (10) for evacuation of personnel from a building (4) through an escape opening (3) in a pitched roof (1), the evacuation system (10) comprises:

- a hatch (20) having a size and shape suitable for covering the escape opening (3), the hatch (20) is arranged to move between an open position and a closed position,
- a support frame (40), the support frame (40) is pivotable between a supporting position where the support frame (40) holds the hatch (20) in the open position, and a folded position,
- a tunnel (50) having an inlet end (51) attached to the support frame (40) and a distal end (52), the tunnel (50) is

foldable,

- a rigid ring (70) arranged along a periphery of the distal end (52) of the tunnel (50), and
- a foldable evacuation chute (80) connected to the distal end (52) of the tunnel (50).

- 5 **2.** The evacuation system according to claim 1, wherein the system further comprises a roof frame (30), framing in said escape opening (3), the hatch (20) is hinged to the roof frame (30) at a hinge side (31) of the roof frame (30) arranged to be opposite to a lower edge (2) of the roof (1).
- 10 **3.** The evacuation system (10) according to claim 1 or 2, wherein the system (10) further comprises a rollable bed (60) having a proximal end (61) attached to the support frame (40) and a distal end (62) having a roll-up bar (63), the bed (60) is arranged to be rolled up on the roll-up bar (63), the roll-up bar (63) is pivotably connected to the rigid ring (70) via a bracket (71) on each side of the roll-up bar (63), the rollable bed (60) is arranged to be rolled out towards the lower edge (2) of the roof (1) underneath the tunnel (50) when the tunnel is extended.
- 15 **4.** The evacuation system (10) according to any of the previous claims, wherein the hatch (20) has a hollow interior, arranged for accommodating at least partly the support frame (40), the tunnel (50), the rollable bed (60), the rigid ring (70) and the evacuation chute (80), when the hatch (20) is in the closed position.
- 20 **5.** The evacuation system (10) according to any of the previous claims, wherein the hatch (20) comprises lift support (22) for moving the hatch (20) to its open position when a hatch lock mechanism, holding the hatch (20) in its closed position, is released.
- 25 **6.** The evacuation system according to any of the previous claims, wherein the tunnel (50) comprises a spiral spring (53) arranged for extending the tunnel (50) from a folded position and to keep the tunnel (50) taut when extended.
- 30 **7.** The evacuation system (10) according to any of the previous claims, wherein the tunnel (50) and the evacuation chute (80) is arranged to be held in a folded position close to the support frame (40) together with the rigid ring (70) until it is released, when released the spiral spring (53) is arranged to propel the tunnel (50), the rigid ring (70), the rollable bed (60) and the evacuation chute (80) away from the hatch (20).
- 35 **8.** The evacuation system according to any of the claims 2-7, wherein the system (10) further comprises a ladder (32), pivotally connected to the roof frame (30) at the side of the roof frame (30) arranged to face the lower edge (2) of the roof (1), the ladder (32) is pivotable between a folded up position wherein a bottom of the ladder is close to the hatch and an escape position wherein the bottom of the ladder (32) is pivoted downwards towards a floor inside the building (4).
- 40 **9.** The evacuation system according to claim 8, wherein the ladder (32) in its folded-up position is arranged to prevent the hatch (20) from opening and wherein it is arranged to release the hatch lock mechanism in its escape position.

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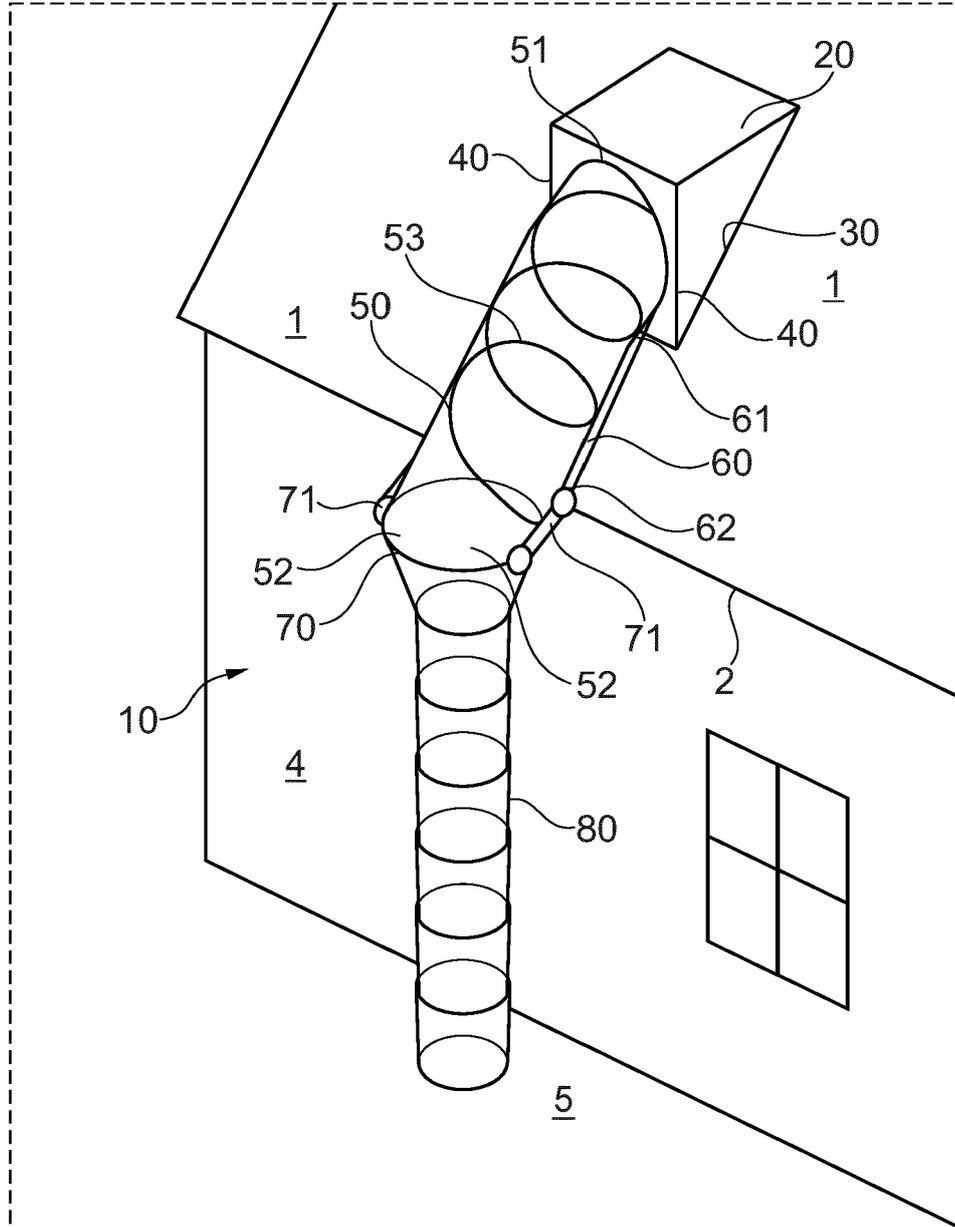


Fig. 1

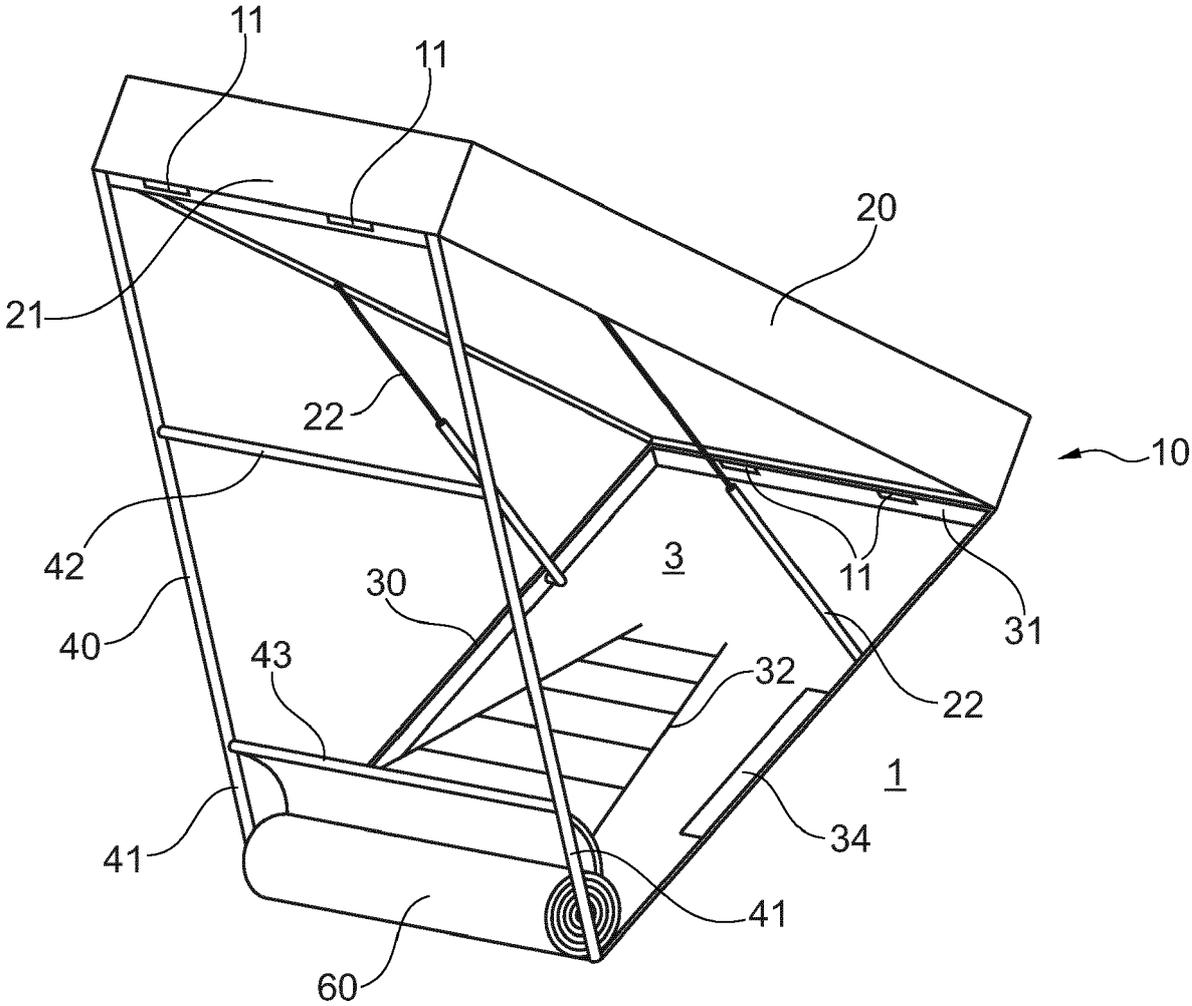


Fig. 2

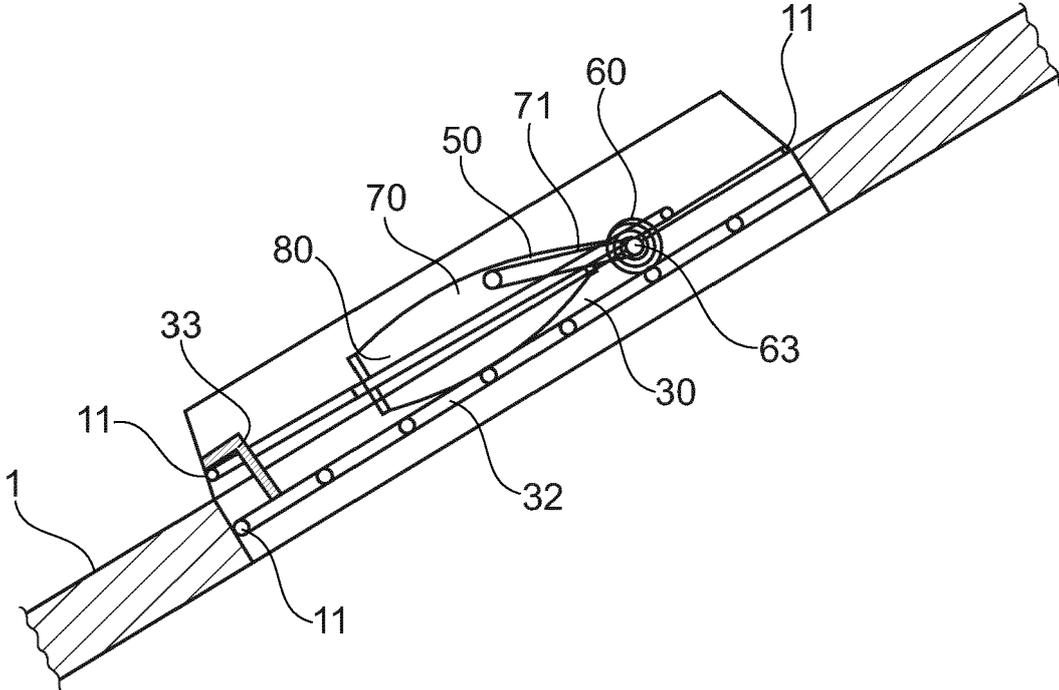


Fig. 3



EUROPEAN SEARCH REPORT

Application Number
EP 24 17 5253

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DOCUMENTS CONSIDERED TO BE RELEVANT

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The present search report has been drawn up for all claims			
Place of search The Hague		Date of completion of the search 1 October 2024	Examiner Andlauer, Dominique
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**ANNEX TO THE EUROPEAN SEARCH REPORT
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EP 24 17 5253

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