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(54) **A SOUND INSULATION HOUSING**

(57) The invention relates to a sound insulation housing. In particular, it relates to sound insulating housing for a heat pump. The sound insulation housing comprises

at least one air inlet and at least one air outlet. Further, the invention relates to an assembly comprising a sound insulation housing and a heat pump.

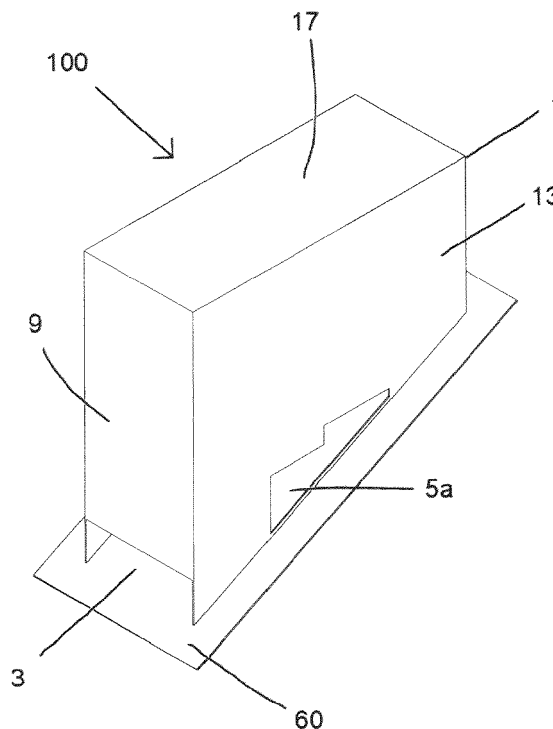


Fig. 2A

Description

[0001] The invention relates to a sound insulation housing. In particular, it relates to sound insulating housing for a heat pump. Air conditioners are a familiar example of heat pumps, but the term "heat pump" is more general and applies to many heating, ventilating, and air conditioning (HVAC) devices used for space heating/cooling and/or heating/cooling water.

[0002] Further, the invention relates to an assembly comprising a sound insulation housing and a heat pump.

[0003] Such a sound insulation housing and/or assembly are for example known from DE 10 2019 105 934. This known housing has a cuboid shape, wherein in the housing a central space for a heat exchanger device is provided. Further, the known housing defines a predetermined air inflow path by using an air inlet in the housing, an air inlet channel inside the housing and an air inlet compartment near the air intake side of the centrally arranged heat exchanger device. The predetermined air inflow path redirects air flow at least twice. The predetermined out flow path is spaced apart from the outflow path. The outflow path uses in a similar manner as the air inflow path an air outlet in the housing, an air outlet channel inside the housing and an air outlet compartment near the air discharge side of the heat exchanger device.

[0004] The known sound insulation housing is relatively voluminous, i.e. in relation to its height, the length and width dimensions of the housing are relatively large. Furthermore, mounting the heat exchanger device on the bottom of the sound-insulating housing limits its applicability or at least in such a manner that compensatory measures are required for a wider application.

[0005] It is an object of the present invention to provide a relatively compact sound insulation housing and/or to provide a sound insulation housing with a relatively wide applicability.

[0006] This object or at least a part thereof is achieved with a sound insulation housing according to claim 1.

[0007] The sound insulation housing for a heat pump comprises at least one air inlet and at least one air outlet. Further, the sound insulation housing defines an interior heat pump space in which a heat pump can be installed. Below the heat pump space the sound insulation housing is provided with the at least one air outlet and/or the at least one air inlet.

[0008] The sound insulation housing can be provided with relatively small length and width dimensions, whereas its height can be used in a relatively efficient manner by providing the at least one air outlet and/or the at least one air inlet below the heat pump space for providing a relatively compact sound insulation housing. In addition, the volume within the sound insulation housing below the heat pump space can additionally be used to increase the design freedom of the sound insulation housing, because a support surface for the sound insulation housing does no longer require to be planar. The shape of the support surface can be taken care of or compensated by

the volume below the heat pump space without affecting the dimensions of the heat pump space. Hence, the applicability of the sound insulation housing can be increased such that the housing has a relatively wide applicability. In addition, the interior volume of the sound insulation housing below the heat pump space may be used to improve sound insulation, i.e. reduce the noise levels produced by the heat pump to the surroundings. In addition, it is advantageous to arrange the air inlet and air outlet relatively close to the bottom of the housing from an aesthetic perspective, because at this position the inlet and outlet are less noticeable, in particular if the sound insulation housing is installed on a relatively high-lying object such as a roof of a building.

[0009] In one aspect, the heat pump space may have a bottom side defining a virtual plane which divides the sound insulation housing in a lower housing section and an upper housing section, wherein the lower housing section is configured for installation on a non-flat roof, for example a pitched roof or an arched roof or a domed roof. Normally, a housing construction as known from DE 10 2019 105 934 is used in combination with an additional construction for installation on a non-flat surface, for example a roof, wherein the additional construction provides a planar support surface for the bottom portion of the known housing. Such an additional construction is no longer required, because the dimensions of the lower housing section providing the air inlet and air outlet below the heat pump space are adaptable and/or configured to be installed on a non-flat roof. After installation the bottom side of the heat pump space may extend in a substantially horizontal plane. A horizontal installation surface for the heat pump is usually prescribed or at least recommended by the heat pump manufacturer to ensure that the heat pump installed in the sound insulation housing has the correct orientation for optimal use with maximum maintenance intervals.

[0010] The sound insulation housing may have at least one side or side section having a first height and an opposite side or opposite side section having a second height, wherein the first height is larger than the second height. The height to be measured extends in a vertical direction. The height of the side or side section is measured between an edge with the bottom side of the sound insulation housing and an edge with the top side of the sound insulation housing. The height of a side to be measured is normally substantially constant, but it is also possible that for a side or sides having a varying height to use an average height. For example, the heights of the two vertical extending corners/edges may be used to calculate an average height of a side or sides. The wording side section is used to cover for example a sound insulation housing without (vertical extending) corners, for example a largely cylindrical sound insulation housing, wherein the height of two diametrically opposed side sections is measured to obtain the first height and second height. If a block-like sound insulating housing is used on a non-planar roof, for example a pitched roof, then

the heights of the two parallel longitudinal sides is constant, because the longitudinal sides extending in the direction of the slope of the roof have identical dimensions, wherein the heights of the two sides extending transverse to the longitudinal sides are different, i.e. one transverse side has a first height and an opposite transverse side has a second height, wherein the first height is larger than the second height.

[0011] In a further aspect, a first air channel is provided between the air inlet and the heat pump space and a second air channel is provided between the air outlet and the heat pump space, wherein in the interior of the sound insulation housing the first air channel and the second air channel are separated from each other. In the first air channel and/or the second air channel parallel arranged noise reducing plate-like elements may be provided. The interior volume of the sound insulation housing may be used to provide separate air channels for fresh air and exhaust air and the noise reducing plate-like elements in at least one these air channels further improve sound insulation, i.e. reduce the noise levels produced by the heat pump to the surroundings. In addition, it is possible by arranging the air outlet and the air inlet below the heat pump space to deflect the air flows in each air channel at least twice. Normally, it is not possible to provide a compact sound insulation housing in combination with parallel arranged noise reducing plate-like elements, because of the dimensions of these elements, i.e. the smallest dimension of these noise reducing plate-like elements is the thickness which is at least 2 or 3 cm. However, by arranging these parallel arranged noise reducing plate-like elements in the volume below the heat pump space, it becomes possible to use these parallel arranged noise reducing plate-like elements to reduce the noise/sound of the heat pump in a sound insulation housing having relatively compact dimensions. The noise reducing plate-like elements may be provided in the first air channel and/or in the second air channel. At least a portion of the first air channel may extend between at least two parallel arranged noise reducing plate-like elements. In the second air channel at least two parallel arranged noise reducing plate-like elements may be provided. Providing the parallel arranged noise reducing plate-like elements close to the air outlet and air inlet, i.e. in the lower housing section, provides maximum sound insulation such that the sound produced by the heat pump can be reduced drastically. In this manner, the volume of the sound insulation housing below the heat pump space is used in an efficient manner.

[0012] The invention also relates to an assembly comprising a sound insulation housing as disclosed herein and a heat pump installed in the interior heat pump space of the sound insulation housing. The assembly is particularly suitable to be installed on a roof of a building, wherein the roof may be a pitched roof or an arched roof or a domed roof. However, the assembly may also be installed on a planar support surface or other sloped support surfaces, such that the assembly has a relatively

wide applicability.

[0013] The sound insulating housing and the assembly will be explained in more detail below with reference to the appended figures showing an exemplary embodiment, in which:

Figures 1A-D show schematic cross section views of an assembly embodiment and a sound insulating housing embodiment;

Figures 2A-F show perspective views of the assembly embodiment shown in figures 1A-D.

[0014] In the following description identical or corresponding parts have identical or corresponding reference numerals. Each feature disclosed with reference to a specific figure can also be combined with another feature disclosed in this disclosure, unless it is evident for a person skilled in the art that these features are incompatible.

[0015] The figures show an assembly 100 comprising a heat pump 50 and a sound insulation housing 1. The sound insulation housing 1 comprises one air inlet 3 and two air outlets 5a, 5b. The sound insulation housing 1 defines an interior heat pump space in which the heat pump 50 is installed or can be installed. Below the heat pump space, wherein the space below the heat pump space is indicated in figure 1B with a dotted line and arrows X, the sound insulation housing 1 is provided with the air outlets 5a, 5b and the air inlet 3. In the sound insulation housing 1 the air inlet 3 and each air outlet 5a, 5b are provided in different sides 9, 13, 15 of the sound insulation housing. In particular, the different sides 9, 13, 15 of the sound insulation housing are adjacent sides 9, 13, 15 of the sound insulation housing 1. The two air outlets 5a, 5b are provided in opposite sides 13, 15 of the sound insulation housing 1. Providing the air inlet 3 and the two air outlets 5a, 5b in the sides 9, 13, 15 of the sound insulation housing 1 as shown in the figures provides excellent results for reducing the noise or sound made by the heat pump 50 and/or the air inflow 70 (figs 2C, 2F) and the air outflow 80 (figs. 1D, 2C, 2F) without affecting the inflow or outflow capacity of the sound insulation housing 1.

[0016] The heat pump space has a bottom side defining a virtual plane, indicated in figures 1B, D with dotted lines which divides the sound insulation housing 1 in a lower housing section 1b and an upper housing section 1a (fig. 1D), wherein the lower housing section 1b is configured or can be configured for installation on a non-flat roof, i.e. a pitched roof 60. The sound insulation housing 1 shown in the figures is an one-piece housing body or an integral unit, i.e. the upper housing section 1a and lower housing section cannot be separated from each other without destruction. The one-piece housing body 1 is preferably substantially made of one material.

[0017] The sound insulation housing 1 may comprise an interior support (not shown in the schematic figures) for supporting the heat pump in the heat pump space and/or for supporting air channels with noise reducing

elements which will be discussed in more detail below. Such an interior support may be connected (not shown) to one or a number of the inner sides of the housing 1 such that the housing 1 carries or supports the interior support.

[0018] The sound insulation housing 1 has a largely block-like or cuboid-like shape and its shape resembles a chimney. The sound insulation housing 1 has six sides, two nearly identical longitudinal sides 13, 15, two sides extending transversal to the longitudinal sides 13, 15, hereafter transversal sides 9, 11, a top side 17 and an open bottom side 19. The transversal sides 9, 11 are not identical. As is clearly shown in figure 1C, the transverse side 9 has a first height H1 and an opposite transverse side 11 has a second height H2, wherein the first height H1 is larger than the second height H2. As shown in figure 1B, the lower housing section 1b has a side section having a first height H1' and an opposite side section having a second height H2', wherein the first height H1' is larger than the second height H2'. As shown in figure 1D, the longitudinal sides 13, 15 have the same height measured from the roof 60.

[0019] As is clearly shown in figures 2C, 2F, the sound insulation housing 1 is provided with a first air channel which is identifiable by the air inflow arrow 70 between the air inlet 3 and the heat pump space. In the lower housing section 1b, see fig. 1B, two noise reducing plate-like elements 21a, 21b are provided in a first portion 20 of the first air channel. The two noise reducing plate-like elements 21a, 21b are arranged parallel to each other, such that the first portion 20 of the first air channel extends between these two noise reducing plate-like elements 21a, 21b. A second portion 22 of the first air channel in the upper housing section 1a is provided by an internal structure (not shown in detail) of the insulation housing 1, wherein the second portion 22 of the first air channel extends between the first portion 20 and the heat pump space, i.e. towards to air intake of the heat pump 50 installed in the heat pump space. In the second portion 22 of the first air channel in the upper housing section 1a no noise reducing plate-like elements are provided. It is possible to provide the inner sides of the sound insulation housing 1 with noise reducing materials (not shown). It is also possible that the air intake of the heat pump 50 has a different position, such as in a side of the heat pump 50 facing the transversal side 9. The heat pump 50 is shown schematically in the figures and in the figures the heat pump 50 is enclosed in an optional sound absorbing layer 51.

[0020] As is clearly shown in figures 1D, 2C, 2F, the sound insulation housing 1 is provided with a second air channel which is identifiable by the air outflow arrow 80 between the heat pump space and the air outlets 5a, 5b. In the lower housing section 1b, see fig. 1B, three noise reducing plate-like elements 23a, 23b, 23c are provided in the first air channel, wherein noise reducing element 21b is also used in the second air channel. The noise reducing plate-like elements 21b, 23a, 23b, 23c are ar-

ranged parallel to each other at a horizontal distance from each other, such that air outflow 80 extends between the between noise reducing plate-like elements 21b, 23a, 23b, 23c. The second air channel is provided in the upper housing section 1a by an internal structure 53 of the insulation housing 1. This internal structure 53 provides an exhaust air chamber in the upper housing section 1a. It is also possible to provide a similar structure (not shown) in the first air channel to provide a supply air chamber (not shown) in front of the air intake of the heat pump 50. This internal structure 53 has a shape for deflecting exhaust air from the heat pump 50 downwards into the lower housing section 1b provided with the noise reducing plate-like elements 21b, 23a, 23b, 23c. In the lower housing section 1b the exhaust air is again deflected towards the air outlets 5a, 5b. In the internal structure 53 no noise reducing plate-like elements are provided. At least a portion of the noise reducing plate-like elements have different heights, i.e. the elements 21b, 23a, 23b, 23c provided in the second air channel. These different heights are a result of the dimensions of the lower housing section 1b, i.e. the height of the lower housing section 1b decreases seen in a longitudinal direction (parallel to the longitudinal sides 13, 15) of the insulation housing 1. The reduced height of the elements 21b, 23a, 23b, 23c is compensated to maximize the sound insulation effect of the elements by reducing the distance between parallel arranged noise reducing plate-like elements 21b, 23a, 23b, 23c if the height of a subsequent reducing plate-like element is smaller. As can be seen in figure 1B, the horizontal distance d1 between the elements 21b, 23a is larger than the horizontal distance d2 between the elements 23a, 23b, because element 23b has a smaller height than element 23a.

[0021] In the interior of the sound insulation housing 1, the first air channel and the second air channel are separated from each other, such that the air inflow 70 is isolated from the air outflow 80 to prevent mixing of these flows from and to the heat pump 50.

[0022] The sound insulation housing 1 may have an installation section housing part (not shown) close to the heat pump space. For example, the installation section housing part may be provided in the top side 17 of the sound insulation housing 1. The installation section housing part can be opened and closed for installing and/or inspecting a heat pump 50 in the sound insulation housing 1.

[0023] Instead of the configuration of the air inlet 3 and the air outlets 5a, 5b shown in the figures, other configurations of the air inlet and the air outlets are possible in the sound insulation housing. For example, air outlet 5b can also be used as air inlet, such that the sound insulation housing only has one air outlet 5a. In that configuration, air inlet 3 may be omitted. Further, it is also possible that the air inlet and the air outlet are positioned in the same side of the sound insulation housing.

[0024] In a non-shown embodiment of the sound insulation housing, the lower housing section (indicated with

1b in the figure 1D) and the upper housing section (indicated with 1a in the figure 1D) may be separate sections which are connected to each other during installation of the assembly for providing the sound insulation housing. In such an embodiment, the lower housing section and the upper housing section may be detachably connected to each other. Such an alternative embodiment provides easy access for an operator for inspection and/or maintenance of the heat pump 50.

[0025] The assembly 100 comprises a sound insulation housing 1 as specified in this disclosure and a heat pump 50 installed in the interior heat pump space of the sound insulation housing. The assembly can be installed on a roof of a building, wherein the roof may be a pitched roof or an arched roof or a domed roof.

Claims

1. A sound insulation housing comprising at least one air inlet, at least one air outlet, and defining an interior heat pump space in which a heat pump can be installed, **characterised in that** below the heat pump space the sound insulation housing is provided with the at least one air outlet and/or the at least one air inlet.
2. The sound insulation housing according to claim 1, wherein the heat pump space has a bottom side defining a virtual plane which divides the sound insulation housing in a lower housing section and an upper housing section, wherein the lower housing section is configured for installation on a non-flat roof, for example a pitched roof or an arched roof or a domed roof, preferably after installation on the non-flat roof, the lower housing section is configured to provide a bottom side of the heat pump space extending in a substantially horizontal plane.
3. The sound insulation housing according to any preceding claim, wherein the sound insulation housing is an one-piece housing body.
4. The sound insulation housing according to claim 2, wherein the lower housing section and the upper housing section are separate sections which are connected to each other for providing the sound insulation housing, preferably the lower housing section and the upper housing section are detachably connected to each other.
5. The sound insulation housing according to any preceding claim, wherein the sound insulation housing comprises an interior support for supporting a heat pump in the heat pump space.
6. The sound insulation housing according to any preceding claim, wherein the sound insulation housing has at least one side or side section having a first height and an opposite side or opposite side section having a second height, wherein the first height is larger than the second height.
7. The sound insulation housing according to claim 2 and 6, wherein the lower housing section has at least one side or side section having a first height and an opposite side or opposite side section having a second height, wherein the first height is larger than the second height.
8. The sound insulation housing according to any preceding claim, wherein in the sound insulation housing the at least one air inlet and the at least one air outlet are provided in different sides of the sound insulation housing, preferably the different sides of the sound insulation housing are adjacent sides of the sound insulation housing, and/or the sound insulation housing has two air outlets which are provided in opposite sides of the sound insulation housing.
9. The sound insulation housing according to any preceding claim, wherein between the air inlet and the heat pump space a first air channel is provided and between the air outlet and the heat pump space a second air channel is provided, wherein in the interior of the sound insulation housing the first air channel and the second air channel are separated from each other, wherein in the first air channel and/or the second air channel parallel arranged noise reducing plate-like elements are provided.
10. The sound insulation housing according to claim 2 and 9, wherein the noise reducing plate-like elements are provided in the lower housing section.
11. The sound insulation housing according claim 9 or 10, wherein at least a portion of the noise reducing plate-like elements have different heights.
12. The sound insulation housing according claim 11, wherein the distance between parallel arranged noise reducing plate-like elements is reduced if the height of a subsequent noise reducing plate-like element is smaller.
13. The sound insulation housing according to any preceding claim 9-12, wherein the noise reducing plate-like elements are provided in the first air channel and in the second air channel, wherein at least a portion of the first air channel extends between at least two parallel arranged noise reducing plate-like elements, and/or in the second air channel at least two parallel arranged noise reducing plate-like elements are provided.

14. The sound insulation housing according to any preceding claim, wherein the sound insulation housing has an installation section housing part close to the heat pump space for installing and/or inspecting a heat pump, wherein the installation section housing part can be opened and closed. 5

15. An assembly comprising a sound insulation housing according to any preceding claim and a heat pump installed in the interior heat pump space of the sound insulation housing, preferably the assembly is installed on a roof of a building, preferably the roof is a pitched roof or an arched roof or a domed roof. 10

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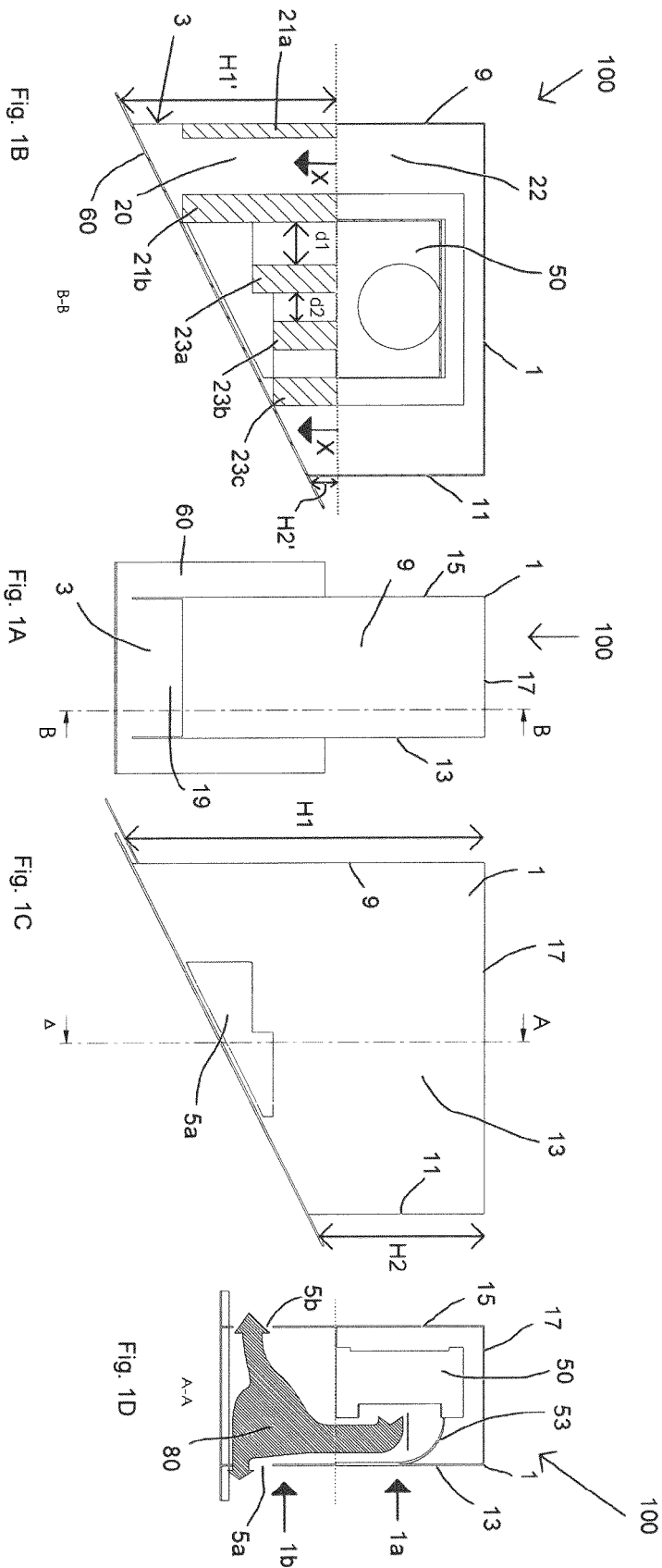


Fig. 2A

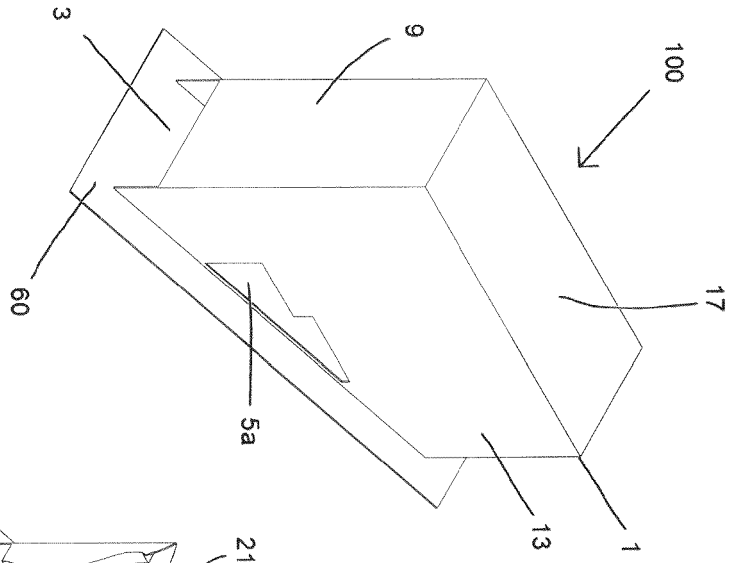


Fig. 2B

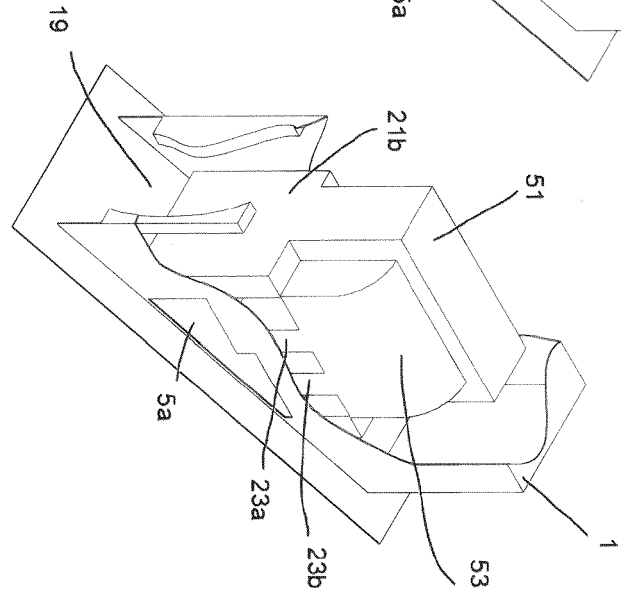
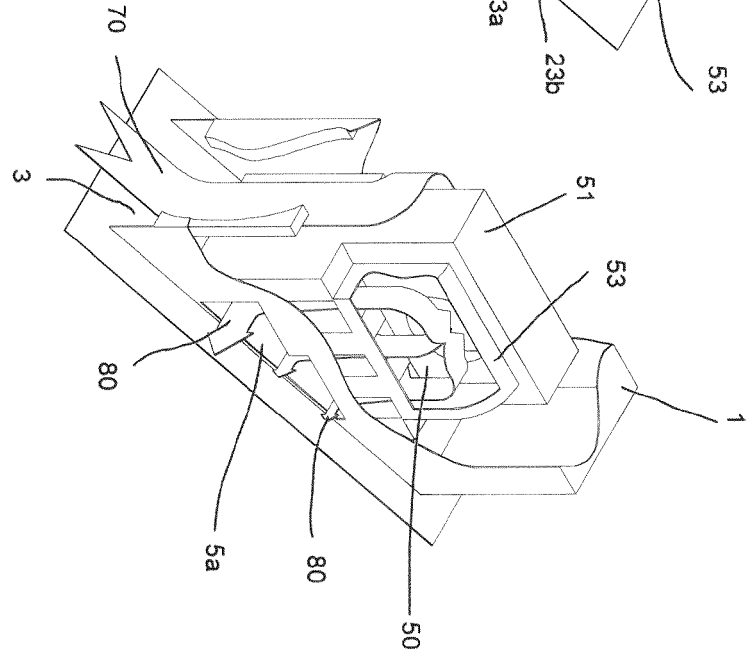
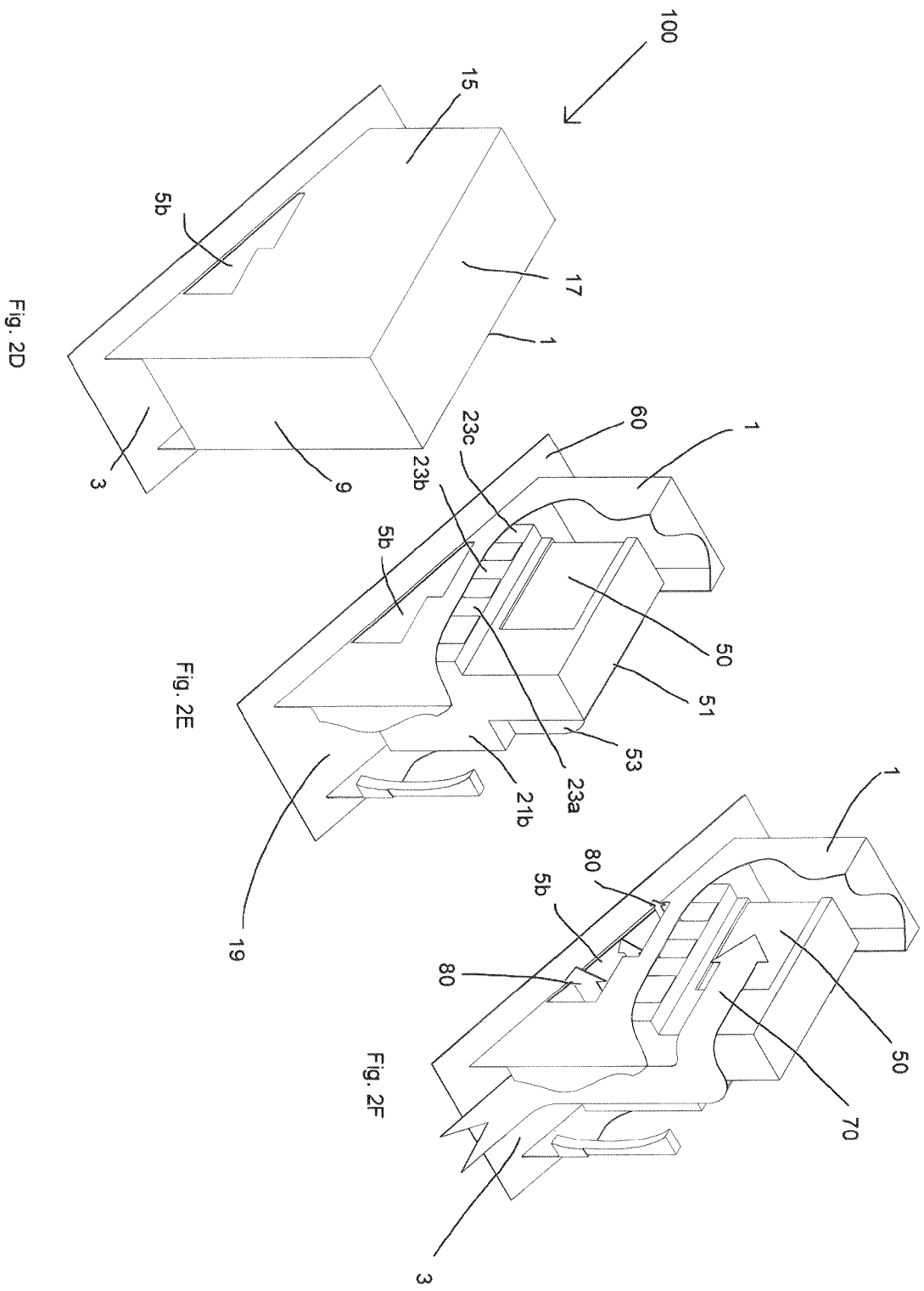


Fig. 2C







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Place of search The Hague		Date of completion of the search 1 June 2022	Examiner de Graaf, Jan Douwe
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**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

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