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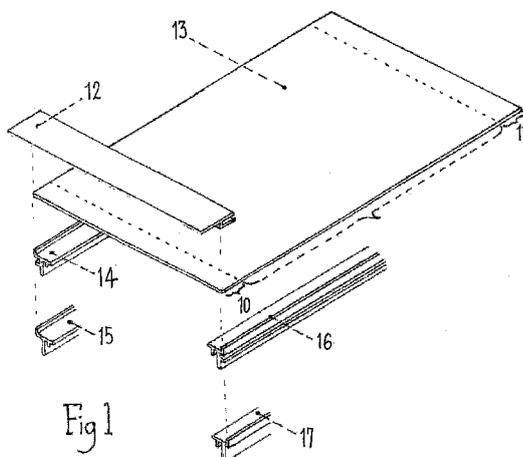
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(54) **Title:** A ROOFING SYSTEM INCLUDING PHOTOVOLTAIC MODULES



(57) **Abstract:** A method of installing a roofing system includes:- fixing a plurality of elongated channels to a supporting structure so that the channels extend parallel to one another, providing a plurality of photovoltaic modules, attaching elongated elements to two opposite edges of the modules, the elongated elements including downwardly extending flanges, and placing the photovoltaic modules in position on top of the channels so that the downwardly extending flanges of the modules fit in the channels.



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A ROOFING SYSTEM INCLUDING PHOTOVOLTAIC MODULES

Field of the Invention

The present invention relates to a roofing system that includes a plurality of photovoltaic or solar battery modules in the form of roofing tiles or slates that can be mounted onto or over a roof, façade or other structure. It also relates to the design and manufacture of these modules, the method for their mounting onto such structures, and specifically relates to methods for installing the roofing system.

Background to the invention

In recent years, considerable advances have been made in the use of PV cells and the like to convert solar energy into useful electrical energy. The market for such devices has also grown dramatically over the past decade at a rate of around 40% per year. Typically, these photovoltaic cells are manufactured using mono or polycrystalline silicon wafers, but in recent years thin film devices have also started to appear. These thin film devices are grown, typically in a vacuum, onto a substrate that is normally made of either glass or a flexible material such as stainless steel foil or high temperature plastic. The materials used for these thin film devices are typically, but not limited to: silicon (amorphous, micromorphous, polycrystalline), CIGS (Copper Indium Gallium DiSelenide) and Cadmium Telluride.

Typically, a plurality of these photovoltaic cells are encapsulated between a transparent cover sheet, (e.g. glass, plastic, etc) [unless the photovoltaic material is deposited directly on to the glass] and a transparent or opaque back sheet [which can also be of glass], to form flat, rectangular-shaped modules, sometimes referred to as laminates. The sizes of these modules vary, but they need to be sized so they can be handled by one or two people on a roof, so are typically 0.75 M by 1.25 M in size. These photovoltaic modules are usually designed with an aluminium frame around the module to provide both strength and a means of mounting them on a roof or mounting structure in a location that exposes them to the maximum amount of available sunlight. For example; framed modules are normally bolted or clamped onto support structures, such as a racking system, which in turn is bolted or screwed directly into the roof or other support structure.

Although such systems provide for the desired conversion of sunlight into electricity, they are an add-on to an existing structure and the modules used are normally not designed specifically to mount onto roof-type structures or specifically designed mounting systems. Since the use of solar electricity is increasing in use, there is a need to have the solar module become part of the structure or to be designed specifically for roof mounting, where its installation optimises the materials used, becoming quick and simple to install and preferably has functions in addition to the production of electricity. For example, such systems can act as a roofing material, replacing the existing roof tiles or slates, can replace façades or can be used anywhere a building cover needs to be used and is exposed to direct sunlight.

Building-integrated PV modules (sometimes called solar slates, solar tiles, etc) that have been developed so far are in the form of a solar roof tile or slate. In one such solar roof tile, the solar module is moulded into a plastic frame that mimics that of the surrounding tiles or slates made from terracotta, concrete or slate (real and artificial), incorporating the same mounting system. When the roof is constructed, such modules are placed onto the roof along with the ordinary roof tiles but have the ability to generate electricity. Such solar roof tiles are attractive because they are integrated into the roof structure rather than being an add-on.

Another integrated module that has been designed mimics a roof tile or slate. A common factor with these designs is that each module overlaps the other, [as in conventional tile or slate designs], with channels attached to the side of each module, which overlap to act as a single water channel. The fixing method normally incorporates a number of clips and fixings into the battens or roof structure to allow the modules to overlap each other and to fix them to the roof. In some cases a seal is required in the overlap region.

Although both these methods make for attractive integrated solutions, they are both time-consuming and expensive to install and manufacture. With the moulded designs, they are often limited in size as they actually mimic the design of the existing roof tile or slate. This restriction means that the number of electrical connections is increased, resulting in a higher cost and time for installation, whilst the

high quality of the plastic (fireproof, UV stable, etc.) makes for an expensive product. For the design that mimics the roof tile or slate overlap system, the resulting complexity of overlapping a solar module makes this a specialised installation, is time-consuming to install and is invariably expensive.

It is therefore desirable to have a system that can be fully integrated or be mounted over the roof, that is quick and simple to install, provides a waterproof barrier if required, allows the roof to breathe, can be mounted without a complex range of clips and fixings, is optimised in the amount of materials used in its manufacture and can be used with the latest thin film technology as well as the existing crystalline silicon technology.

The present invention provides for such a solar roof module and a method for its installation.

Summary of the Invention

According to a first aspect of the present invention there is provided a method of installing a roofing system which includes:-

fixing a plurality of elongated channels to a supporting structure so that the channels extend parallel to one another,

providing a plurality of photovoltaic modules,

attaching elongated elements to two opposite edges of the modules, the elongated elements including downwardly extending flanges,

placing the photovoltaic modules in position on top of the channels so that the downwardly extending flanges of the modules fit in the channels, and

providing further channels that run underneath the photovoltaic modules and are designed to carry any water away.

According to a second aspect of the present invention there is provided a roofing system which includes:-

a plurality of elongated channels that can be fixed to a supporting structure so that the channels extend parallel to one another,

a plurality of photovoltaic modules,

elongated elements that can be attached to two opposite edges of the modules, the elongated elements including downwardly extending flanges,

the arrangement being such that the photovoltaic modules can be placed in position on top of the channels so that the downwardly extending flanges of the modules fit in the channels, and

further channels that run underneath the photovoltaic modules and are designed to carry any water away.

The elongated elements having downwardly extending flanges are preferably of generally T-shape in cross-section.

The system thus includes the mounting channels and the PV modules. The mounting channels typically run from the top of the roof to the bottom of the roof and are fixed onto battens running across the roof. There are preferably 'U'-shaped slots in the mounting channels into which the 'T' sections on the bottom of the photovoltaic modules

locate, and further 'U'-shaped channels either side of this that run underneath the photovoltaic modules and are designed to carry any water away.

Each module is preferably designed with 'T' sections running down either side of the bottom of the photovoltaic module to locate into the 'U' section and provide a fixing point, whether that be by a fixing screw or location pin. On the bottom edge of each module there is preferably an extrusion (lip) that runs over the top of the module below it.

This means that the modules can be mounted level with each other, with the extrusions mounted on the bottom edges of the modules providing overlaps running down the roof, and the mounting channels providing overlaps running across the roof. This is a much simpler method than conventional designs where the actual modules are overlapped down the roof and individual extrusions mounted onto the photovoltaic modules overlap and interlock across the roof. These are then normally held in place with a range of clips and fixings, rather than the simple channels used in the present invention.

Brief Description of the Drawings

FIG. 1 is an exploded perspective view of a photovoltaic module for a roof-integrated solution,

FIG. 2 is an exploded perspective view of a photovoltaic module for an over-the roof solution,

FIG. 3 is a cross-section of a mounting channel for an over-the-roof solution with a screw-fixing method, fixed to a batten with clips,

FIG. 4 is a cross-section showing an alternative screw fixing to the batten for FIG. 3.

FIG.5 is a cross-section of a mounting channel for an over-the-roof solution with pin fixing method,

FIG.6 is an exploded view of the pin fixing method,

FIG. 7 is a cross-section of a mounting channel for a roof-integrated solution with a screw fixing method, fixed to the batten with clips,

FIG.8 is a cross-section showing an alternative screw fixing to the batten for FIG 7,

FIG. 9 is a cross-section of a mounting channel for a roof-integrated solution with a pin fixing method, fixed to the batten with clips,

FIG. 10 is a cross-section showing an alternative screw fixing to the batten for FIG 9,

FIG. 11 is a cross-sectional side view, showing an over-the-roof system with pin fixing,

FIG. 12 is a detail view of the mounting channel fixing method for the over-the-roof system,

FIG. 13 is a cross-section showing a pin location method and showing how the mounting channel is fixed to the roof,

FIG. 14 is a cross-section showing the screw fixing method for an integrated solution, with a sealing strip. It also shows the PV module located into the mounting channel held into place with a countersunk screw clamping the 'T' section,

FIG. 15 is a detail cross-section which shows a bolt fixing method for an over-the-roof system,

FIG. 16 shows a house fitted with a plurality of PV modules – not to scale,

FIG. 17 is a partly-sectioned view showing a plurality of PV modules built up onto a pitched roof,

FIG. 18 is a side view showing a pin fixing method as if looking through the mounting channel. It also shows a plurality of PV modules fixed into an existing pitched roof structure made from tiles or slate.

FIG.19 is a close-up of the pin fixing method as if looking through the mounting channel, and

FIG.20 shows how the back of a PV module is vented through the gap between the modules running down the roof and across the roof.

Description of the Preferred Embodiments

While the invention will be described in connection with specific preferred details, it is understood that it is not limited thereto. It is intended to cover all equivalents, modifications and alternatives (such as raising the module at one end for a flat roof system).

Referring now to the drawings, which are not always drawn to scale, FIG.1 is an exploded perspective view of a photovoltaic (PV) module for a roof integrated solution. The PV module has two sections 10 and 11 which are the non-active areas (no solar cells), where the front lip 12 fixes to the PV module over section 10 and where the front lip 12 covers section 11 of the PV module below it at the top of the PV module. This area may also be covered with a lead flashing, roof tile or slate. 13 is the active solar cell area. Any type of solar cell material can be used to construct the PV module. For example, PV modules containing solar cells made from mono-multi-crystalline crystalline silicon wafers, or thin film solar cells, typically, but not limited to: silicon (amorphous, micromorphous, polycrystalline), CIGS (Copper Indium Gallium DiSelenide) and Cadmium Telluride. The PV module can be of any size that can be handled on a roof; however a typical module would be 500 mm wide with a range of different lengths, so as to optimise the available roof space, with a typical maximum length of 2000 mm.

The front lip extrusion 12 is factory fitted and can be made of, but not limited to, anodised aluminium or a highly durable plastic which is fireproof and suitable for at least 25 years of exposure. The extrusions 12 are fixed to the PV modules using proven and tested silicone sealants or a two-part adhesive. The purpose of the lip is to provide a waterproof overlap to the PV module directly below it, avoiding the need to overlap the PV module itself, providing for a much simpler mounting system.

'T' sections 14, 15, 16 and 17, which are made from anodised aluminium or a suitable alternative, are factory fitted using proven and tested silicone sealants or a two-part adhesive. These 'T' sections are designed to fit into the mounting channel 'U' section as illustrated in FIGS. 3-10, providing a partial water barrier as well as a means of location and fixing. 'T' sections 14 and 16 are designed for a screw fixing method as described below and 'T' sections 15 and 17 are designed for a pin fixing method also described below.

FIG.2 is an exploded view of a photovoltaic module for an above-the-roof solution. In this case, the PV module area 18 is covered completely with solar cell material. Any type of solar cell material can be used to construct the PV module. For example, PV modules containing solar cells made from mono-multi-crystalline crystalline silicon wafers, or thin film solar cells, typically, but not limited to: silicon (amorphous, micromorphous, polycrystalline), CIGS (Copper Indium Gallium DiSelenide) and Cadmium Telluride. The 'T' sections 14, 15, 16 and 17 are as shown in FIG.1 described above.

FIGS. 3 & 4 show a cross-section of a mounting channel 19 for an over-the-roof system, using a screw fixing method. The mounting channel 19 is designed to run from the top of a pitched roof to the bottom or part thereof. Tapped fixing holes 20 are spaced a predetermined distance apart to coincide with the PV module size and spacing. The 'T' section of the PV module locates into a 'U' section and can be clamped in place. The mounting channel 19 is fixed in

place either with a fixing clamp 22 and screw 23 or directly screwed into the batten as shown in FIG. 4 with a screw 24.

FIG. 5 shows a cross-section of a mounting channel 25 for an over-the-roof system, using a pin fixing method. The mounting channel 25 is designed to run from the top of a pitched roof to the bottom or part thereof. The pin 26 runs across the mounting channel through the two 'U' sections at a predetermined distance apart to coincide with the module size. The pin 26, which is typically 3 mm in diameter, is located using circlips 27, though other methods such as split pins may also be used. The 'T' sections of the PV module are located into the 'U' sections and are locked into place, when the 'L' shaped cut out in FIG. 6 locates onto the pin 26. The mounting channel is drilled on-site through the centre section 28 at the point where it intersects a batten 29 running across the roof through a mounting block 30 into the batten 29.

FIG.6 is an exploded view of a 'T' section, such as 14, with an 'L' shaped slot 31 fixing onto pin 26 and into the 'U' channel 25.

FIGS. 7 & 8 show a cross-section of a mounting channel for an integrated roofing system, using a screw fixing method. The mounting channel is designed to run from the top of a pitched roof to the bottom or part thereof. The tapped fixing holes 32 are spaced a predetermined distance apart to coincide with the PV module size and spacing. The 'T' section of the PV module locates into the 'U' section

channel 33 and is clamped into place as illustrated in FIG. 14. The mounting channel is fixed in place with a clamp 34 attached by a screw 35 to the batten 36. As an alternative to this, FIG. 8 shows a direct screwing method using a screw 37. In this embodiment of the invention, the mounting channel for the integrated solution has two outer 'U' sections 38, 39. These 'U' sections 38, 39 run under the PV modules and are designed to carry away any excess water that spills or is blown past the central 'U' section 32 of the mounting channel.

FIGS. 9 & 10 show a cross-section of a mounting channel 40 for an integrated roofing system, using a pin fixing method. The mounting channel 40 is designed to run from the top of a pitched roof to the bottom or part thereof. A pin 41 runs across the mounting channel 40 through the outer 'U' sections 42, 43 at a predetermined distance apart to coincide with the module size. The pin, which is typically 3 mm in diameter, is located using circlips 44. The 'T' sections of the PV modules are located into the 'U' sections 42, 43 and are locked into place when the 'L' shaped cut-out in FIG. 6 locates onto the pin 41. In this embodiment of the invention, the mounting channel for the integrated solution has two outer 'U' sections 42, 43. These 'U' sections 42, 43 run under the PV modules and are designed to carry away any excess water that spills or is blown past the central 'U' section of the mounting channel. The fixing arrangements are as described above with reference to Figures 7 and 8.

FIGS. 11 & 12 show a side view of an over-the-roof mounting system, showing how the PV modules 45 (only one numbered for

clarity) and the mounting channel 46 are fixed to the roof. In this embodiment of the invention, there is an 'L'-shaped cut-out 46A, circled as if looking through the mounting channel 46 into which the pin locates. In this case, the roof is covered with a plurality of slates 47 but the same system will also apply to, for example, concrete and terracotta tiles. It is to be understood that when the PV modules are installed there will be a plurality of PV modules covering the roof. The diagrams also show how the mounting channel 46 is fixed onto the mounting block 48, which is fixed onto batten 49, which in turn is fixed onto the roof trusses 50. The mounting block 48 is fixed down with a screw 51 through the mounting channel 46. A washer 52 on the screw head and a gasket 53 at the bottom of the mounting block ensure that there are no leaks, with the gasket 53 also providing a cushion, so as not to stress the tile/slate to which it is mounted.

FIG.13 shows a cross-section of a screw fixing for an over the roof system using a fixing pin 54, a mounting block 55, a screw fixing the mounting channel 56, the PV module 57 and the 'T' piece 58 fixed to it.

FIG. 14 shows a cross section of the screw fixing method for an integrated roofing system. In this embodiment of the invention, there is a 'T' piece 59. This 'T' piece, which is fixed to the PV module as previously described, has a section 60 that acts as a first line buffer for any water that runs into the mounting channel, so that water has to run underneath and up the other side for water to reach the outer 'U' channels 61 and 62. These two 'U' sections 61 and 62 ensure that no

water can leak out, as any water would have to get past and flow over three separate barriers. The diagram also shows part of a 'T' section 63 that is used to clamp the PV module in place. The PV modules, in this embodiment of the invention, each include a strip 64 made from anodised aluminium, coated steel or a suitable high grade plastic as well as a gasket 65 running the length of the mounting channels, which are fixed in place by screws 66. The strip 64 and the gasket 65 are designed so that water cannot run into the outer 'U' channels except where the PV modules join, thereby providing most of the water barrier. The fixing arrangements are as described above with reference to Figure 7.

FIG. 15 shows an alternative simpler fixing system using a bolt 67 and a washer 68 fixing for an over-the-roof system, where no water barrier is required for section 69.

FIG. 16 is a simple drawing of a house 79 which, although not to scale, shows the PV modules 71 which are approximately 500 mm by 800 mm in size integrated into the roof of tiles 72.

FIG. 17 is a section drawing of FIG. 16. Going from left to right, it first shows a mounting channel 73 running from the top of the roof to the bottom of the roof though, if only part of the roof needs to be covered with a plurality of PV modules, then the mounting channel would only run part way up the roof. It can also be seen from this figure how the mounting channels 73 are attached by clamps 74 in

place onto the battens 75. The figure then shows a PV module 71 fitting into the mounting channel 73 and the 'U' shaped channels of the mounting channel running underneath the PV module.

The gap 76 in between the PV modules 71 and, therefore, the gap between the 'U' sections in the mounting channel, is designed with two different formats. The first is with a minimum gap so that only small debris can fall between the sections and be washed away and the second a large enough gap so that any debris that forms in the mounting channel is washed away and can be cleaned if required.

In order to integrate the PV module into the surrounding roof structure, lead flashing 77, 78 is used. This will be very similar to the method used for pitched roof windows. However, in this embodiment of the invention, the lead flashing 77 will fold into the outer two 'U' sections of the mounting channel to provide a waterproof seal running down the length of the plurality of PV modules 71. For integration with the rest of the roof structure running across the roof, the lead flashing 78 will be folded over the top of the PV 71 module at the upper end of the pitched roof and will run underneath the PV module 71 at the bottom end of the pitch roof, which is shown more clearly in FIG. 18.

The PV modules 71 are easily mounted; however, it is important, when you start mounting the plurality of PV modules, that the mounting channels are parallel with each other and run true and straight up the roof. Once the first mounting channel is fixed, the next

mounting channel is located and positioned by using dummy PV panels located into the 'U' channel at the top and the bottom of the mounting channel, which can easily be fixed into place. This process is then repeated running across the roof, ensuring that the PV modules will always align with the 'U' channels in the mounting channel. Although not shown, an electrical grounding wire can be fixed to each mounting channel and the wires connected together using a threaded bolt that will screw into the mounting channel directly. The other end of the wire is properly grounded. This will provide a convenient way to electrically ground the PV modules 71 and thereby reduce the possibility of an electrical shock. Again not shown, the plurality of PV modules 71 may be connected together in series or parallel with the wires running in the space 79 between the roofing felt 78 and the mounting channel 73. The connection may be made as each row of PV 71 modules is mounted into place, and the connecting wires will be of sufficient length to ease fitting and removal. A strip of lead flashing 80 is disposed between each module 71 and the next lower module 71 and the lowest module 80 extends over the adjacent gutter 81.

FIGS. 18 & 19 show a side view of an integrated system using the pin fixing method, integrated into an existing slate/tile pitched roof. The figures show, as if you are looking through (circled) the mounting channel, how the 'L' shaped cut-out 82 or 83 in the 'T' section drops onto the pin 84, which runs across the mounting channel 'U' sections, and then slides up the 'L' shape to lock the PV module 85 into place (this can be most clearly seen in FIG. 6). This method requires no further screws or fixing. To remove a PV module, you simply slide the

PV module back up the pin 84 to lift it out. This is much simpler than conventional systems where the PV modules or PV tiles would have to be unbolted, and would often require some of the surrounding PV modules or tiles to be removed first.

FIGS. 18 & 19 also show a front lip 86 attached to the PV module overlapping the PV module 85 directly below it, and the tiles/slate at the bottom of the mounting channel. Fig. 18 also shows in more detail how the lead flashing 87 is used to integrate the plurality of PV modules into the surrounding tile/slate roof structure. The lead flashing 87 is typically folded over a wooden block 88 that is screwed into the trusses and is located just under the last tile 89. The same format is also used at the bottom. The roof also includes battens 90 and fixing screws 91 and there is a gap 92 between adjacent modules 85.

FIG. 20 shows a venting system for a plurality of PV modules. FIG. 18 shows the gap 92 between the PV modules. This gap 92 is to first allow the PV modules 85 to be fixed into place and be removed, and also provides a ventilation system for the plurality of PV modules 85. Any hot or stagnant air 93 can freely circulate between the PV modules 85, while the 'U' sections 94 and 95 running underneath the modules 85 prevent water leaking out into the roof.

Important features of the invention:-

Photovoltaic modules made with any type of photovoltaic material with an area at the top and bottom where there are no photovoltaic cells, or

Photovoltaic modules made with any type of photovoltaic material, which are fully covered.

A front lip extrusion fixed to the front of the photovoltaic modules.

'T' sections running underneath down both sides of the photovoltaic modules.

Mounting channels comprising;

- a. Two central 'U' sections into which the 'T' sections of the photovoltaic modules are located.
- b. Two or more outer 'U' sections that run underneath the photovoltaic modules and are designed to carry water away down the channel.
- c. Flat outer section for clamping or screwing

The front lip extrusion can be designed so that it runs over the PV module directly below it or into the gutter of the pitched roof. It is designed so that the PV modules themselves do not have to overlap, with the front lip extrusion providing this function, allowing the PV modules to be mounted level with each other.

The 'T' sections attached to the modules can be used as a means of fixing the modules to the mounting rail, replacing a conventional outer frame.

The 'T' sections of the PV modules may have a flat section protruding half way down the side of each module, so that it sits on the raised section in the centre of the mounting channel.

Each 'T' section may have a section half way across that is running down, acting as a secondary water barrier.

Each 'T' section may have 'L' shaped cut-outs which locate onto the pins running across the mounting channel.

A mounting channel for an over-the-roof system may have two 'U' channels, a raised centre section and a flat outer section. The PV module 'T' section is clamped onto the raised section in the centre of the mounting channel, and screwed or clamped down onto the batten using the flat outer section.

A fixing clamp may be provided for the mounting channel, where the clamp locates onto the outer section of the mounting channel.

A mounting channel for an over-the-roof system may have two 'U' channels, with pins running across the 'U' section onto which the 'L' sections of the 'T' piece locate. The mounting channel is screwed in place through the centre of the mounting channel.

A mounting channel for an integrated roofing system may have two 'U' channels for 'T' piece location, a raised centre with a tapped hole, and at least two outer 'U' sections for water collection and a flat area for clamping or screwing.

A mounting channel for an integrated roofing system may have two 'U' sections for 'T' piece location, at least two further outer 'U' channels for water collection and a flat outer section for clamping or screwing. The 'T' piece, with an 'L' shaped cut-out, is located onto a pin that runs across the 'U' section.

There may be a mounting block for an over-the-roof system, with a gasket seal between the roof and the mounting block.

A system may be provided where the mounting channel for an integrated solution is integrated into the surrounding roof down the sides by folding lead into the outer two 'U' channels.

A system may be provided where the top row of PV modules is integrated into the surrounding roof by folding lead over the top section of each PV module, which contains no solar cells.

A ventilation system may be provided where a gap is left between the modules running down the pitched roof, so that hot and stale air is vented out from behind the modules, yet still provides a waterproof seal, with the outer 'U' section of the mounting channel collecting any water that passes through the gap.

A sealing strip and a gasket may be provided for a screw fixing mounting channel that runs the length of the mounting channel, and is screwed into place onto the centre raised section of the mounting channel.

The invention includes the use of photovoltaic (PV) modules and mounting channels that can either be fixed on top of an existing roof structure or be fully integrated into the roof.

The PV modules are factory manufactured with aluminium 'T' sections running down underneath the length of each side and, when fully integrated, may have a front overlap lip section fixed onto the front. For a fully integrated system, the mounting channels may be fixed directly onto the battens either by fixing brackets or by being screwed directly into the battens. The mounting channels may include two central 'U' sections into which the 'T' sections, fitted to the underside of the modules, are located. The channels may also have two further 'U' sections either side of the locating 'U' section, which run underneath the modules and will act as channels for any water that falls between the modules. The modules may be located into the channels with 'L' shaped cut-outs, machined into the 'T' shaped sections on the modules. These 'L' shaped sections may locate onto pins running across the 'U' section at a predetermined distance, locking the PV modules into place. This distance is designed to allow for a gap between each module so that stagnant hot air behind them is ventilated.

As an alternative to the use of 'L' shaped cut-outs, the 'T' sections can be designed with a flat section protruding down the side of each 'T' section. This section and a sealing strip gasket running down the length of the channel may then be screwed into place onto a

raised section in the centre of the 'U' channel with either a raised bolt or countersunk screw, providing for a sealed, waterproof section between the modules.

The modules may be integrated into the rest of the pitched roof using lead flashing running over the top of the PV modules at the top and bottom of the pitched roof and into the 'U' shaped channel down the side of the PV modules.

In essence, the same design may be used for a system mounted above an existing roof, but the channel will be made using a single "U" section and the modules will be designed without a front overlap section. In this case, the mounting channels will be fixed onto the battens through the existing structure using a raised mounting block. The PV module fixing methods will also be the same but without a sealing strip in the case of the screw fixing method.

Claims:-

1. A method of installing a roofing system which includes:-
fixing a plurality of elongated channels to a supporting structure so that the channels extend parallel to one another,
providing a plurality of photovoltaic modules,
attaching elongated elements to two opposite edges of the modules, the elongated elements including downwardly extending flanges,
placing the photovoltaic modules in position on top of the channels so that the downwardly extending flanges of the modules fit in the channels, and
providing further channels that run underneath the photovoltaic modules and are designed to carry any water away.

2. A method as claimed in Claim 1, in which the elongated elements having downwardly extending flanges are of generally T-shape in cross-section.

3. A method as claimed in Claim 1, in which the elongated channels run from the top of the roof to the bottom of the roof and are fixed onto battens running across the roof.

4. A method as claimed in Claim 2, which includes forming 'U'-shaped slots in the elongated channels into which the 'T' sections on the bottom of the photovoltaic modules locate.

5. A method as claimed in any one of the preceding claims, which includes providing 'T' sections running down either side of the bottom of each of the photovoltaic modules.

6. A method as claimed in any one of the preceding claims, which includes providing a protrusion on the bottom edge of each module that runs over the top of the module below it.

7. A roofing system which includes:-

a plurality of elongated channels that can be fixed to a supporting structure so that the channels extend parallel to one another,

a plurality of photovoltaic modules,

elongated elements that can be attached to two opposite edges of the modules, the elongated elements including downwardly extending flanges,

the arrangement being such that the photovoltaic modules can be placed in position on top of the channels so that the downwardly extending flanges of the modules fit in the channels, and

further channels that run underneath the photovoltaic modules and are designed to carry any water away.

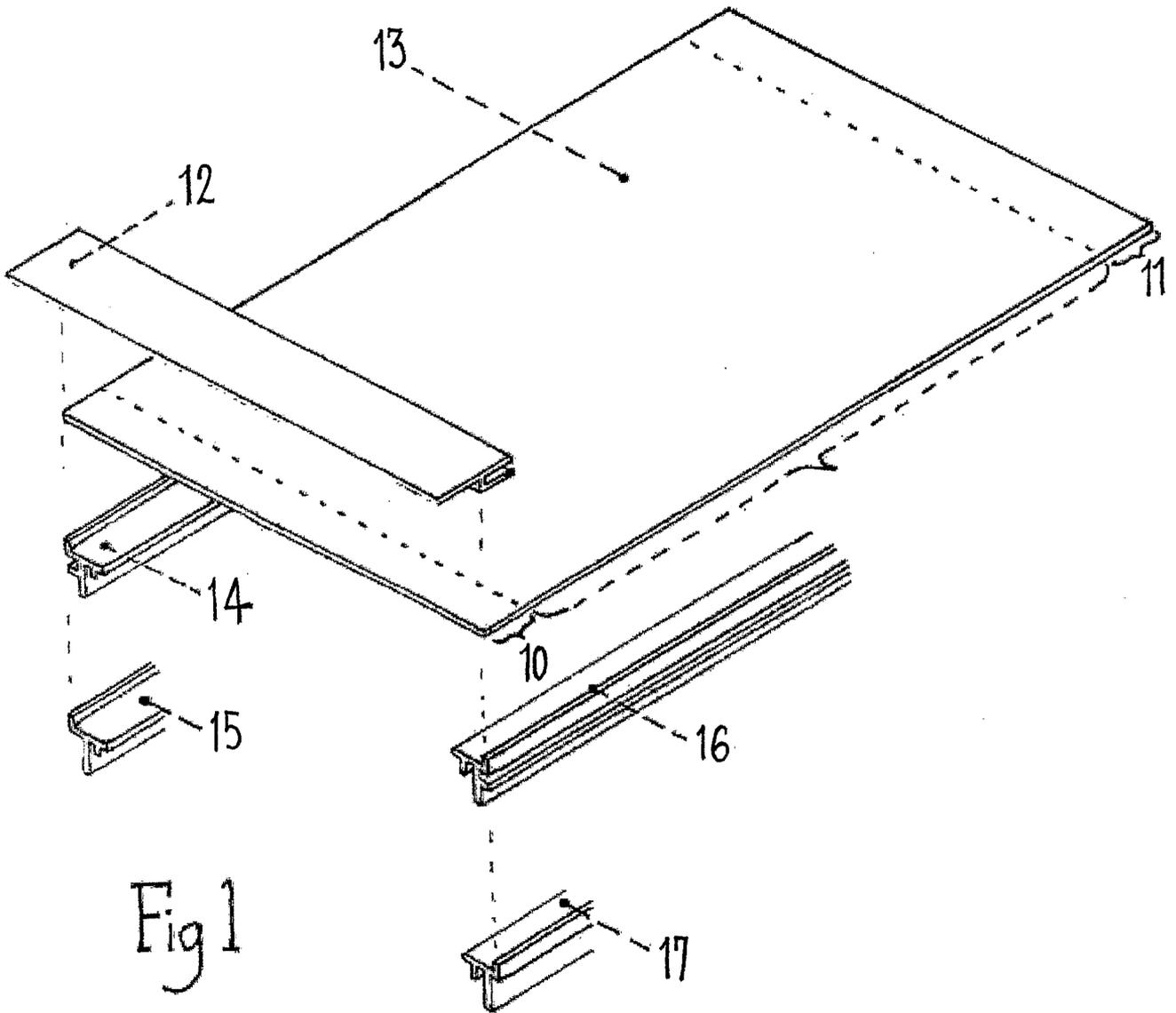
8. A roofing system as claimed in Claim 7, in which the elongated elements having downwardly extending flanges are of generally T-shape in cross-section.

9. A roofing system as claimed in Claim 7 or Claim 8, in which the channels run from the top of the roof to the bottom of the roof and are fixed onto battens running across the roof.

10. A roofing system as claimed in Claim 8, in which there are 'U'-shaped slots in the channels into which the 'T' sections on the bottom of the photovoltaic modules locate.

11. A roofing system as claimed in any one of Claims 7 to 10, in which 'T' sections run down either side of the bottom of each of the photovoltaic modules.

12. A roofing system as claimed in any one of Claims 7 to 10, in which there is a protrusion on the bottom edge of each module that runs over the top of the module below it.



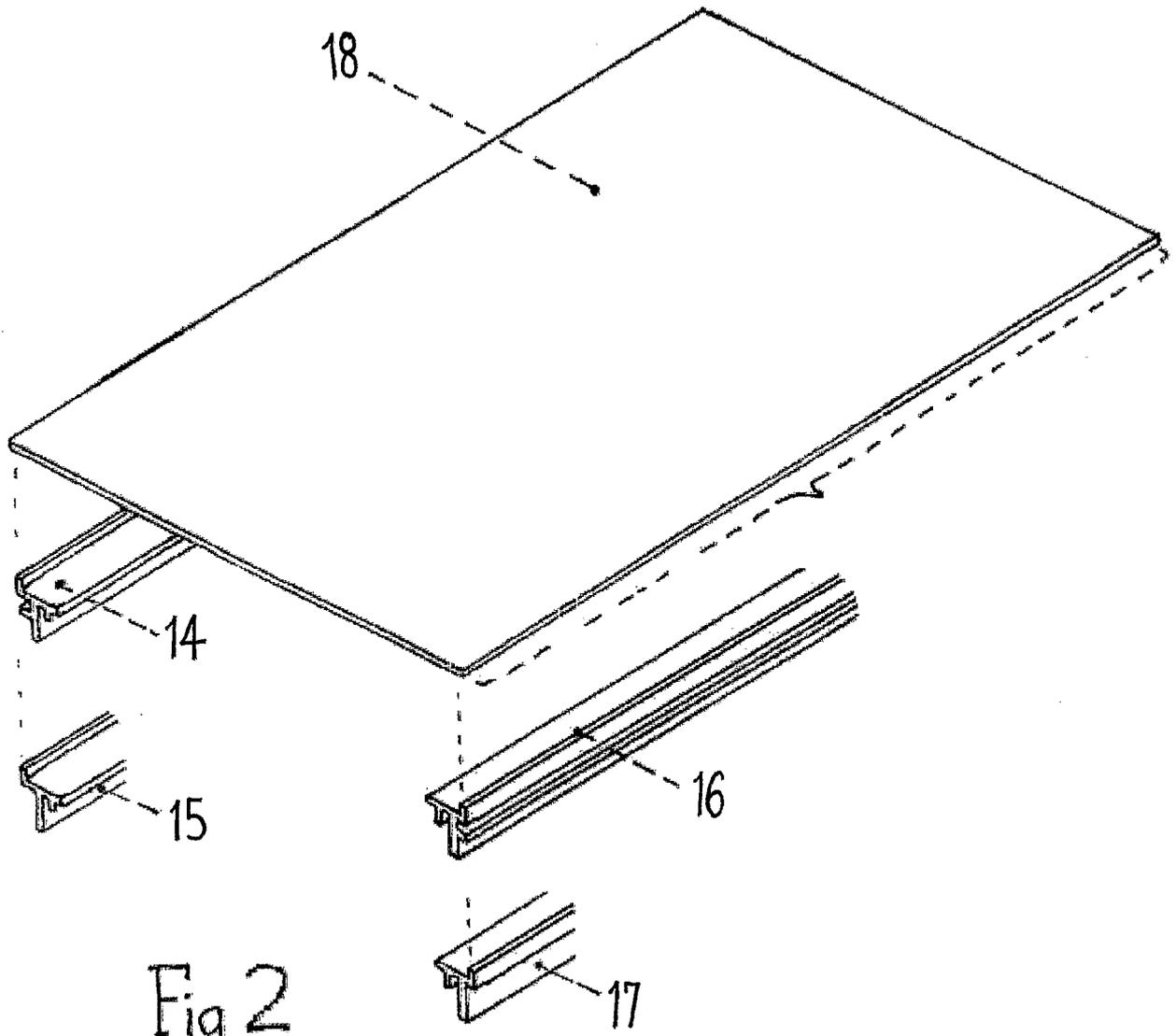


Fig 2

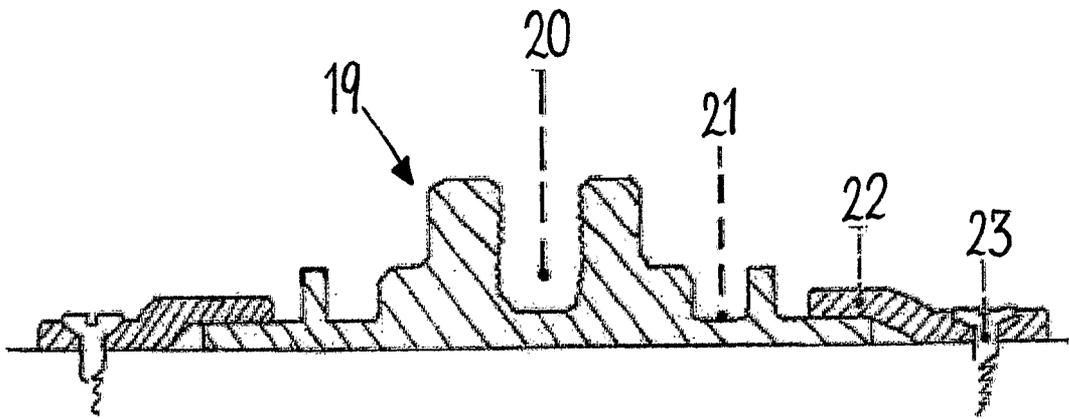


Fig 3

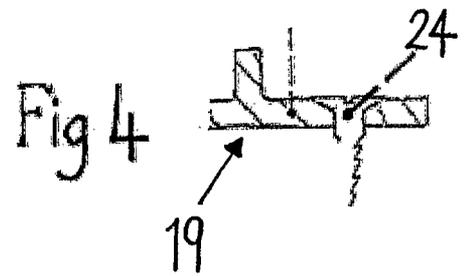
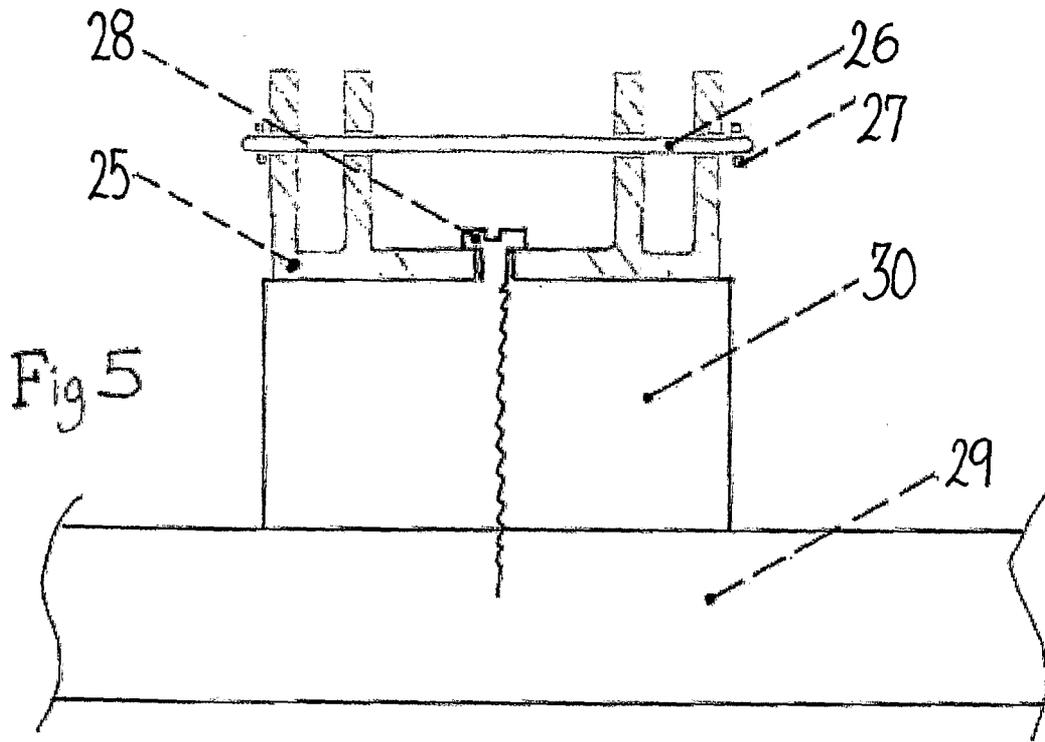


Fig 4



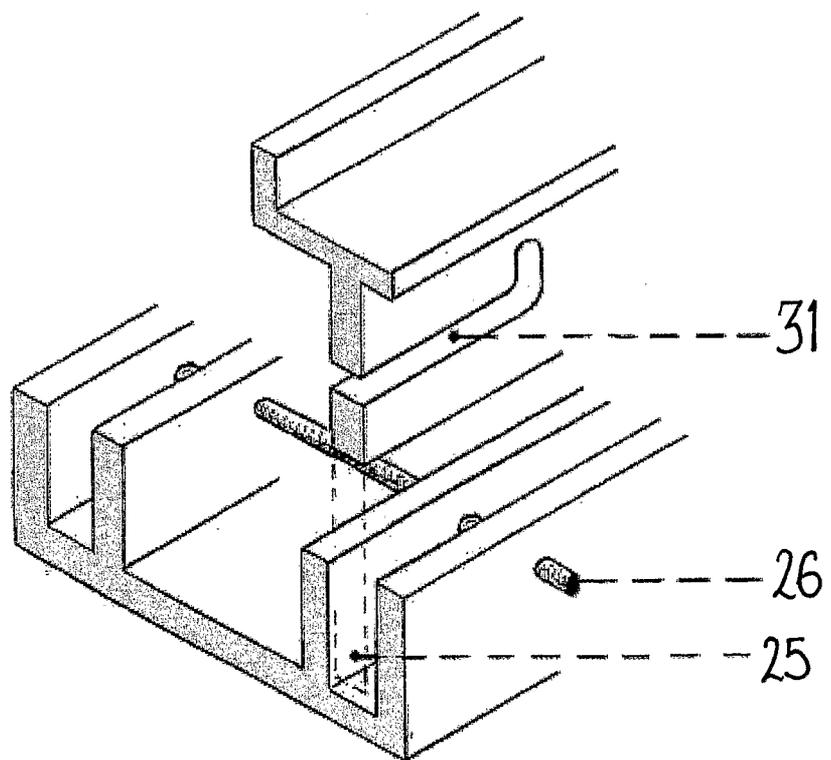
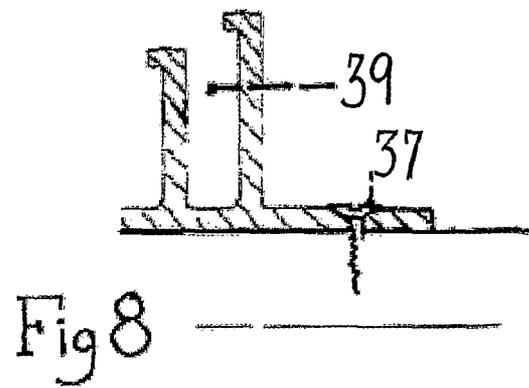
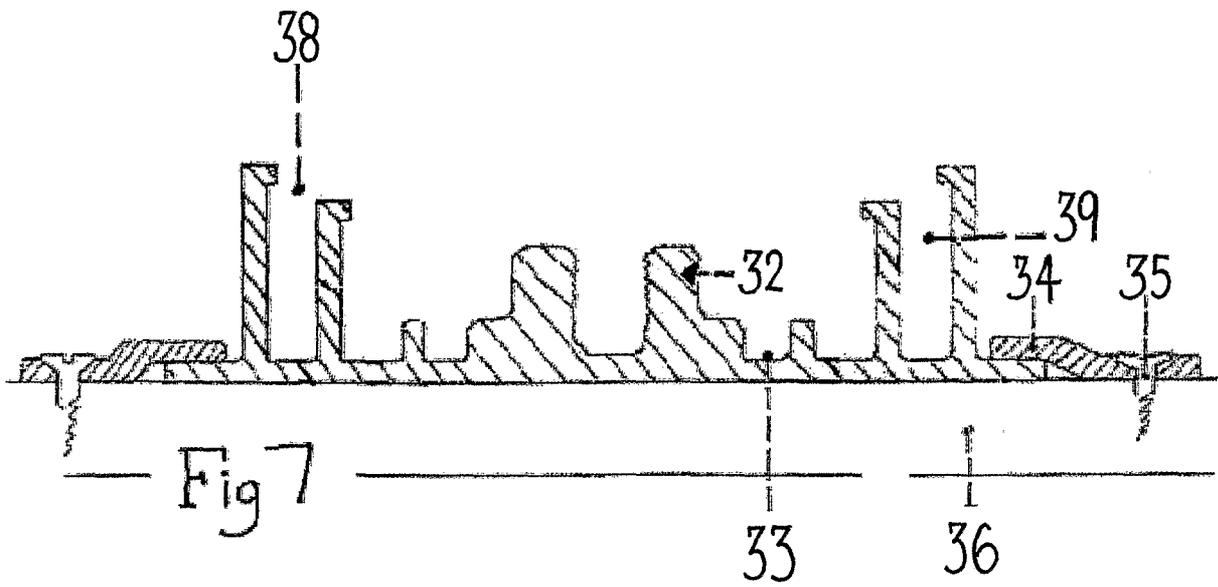
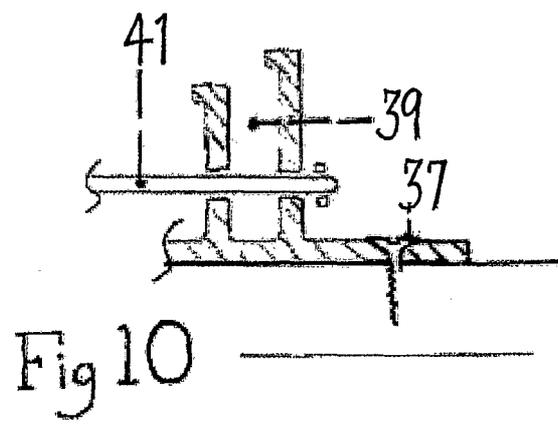
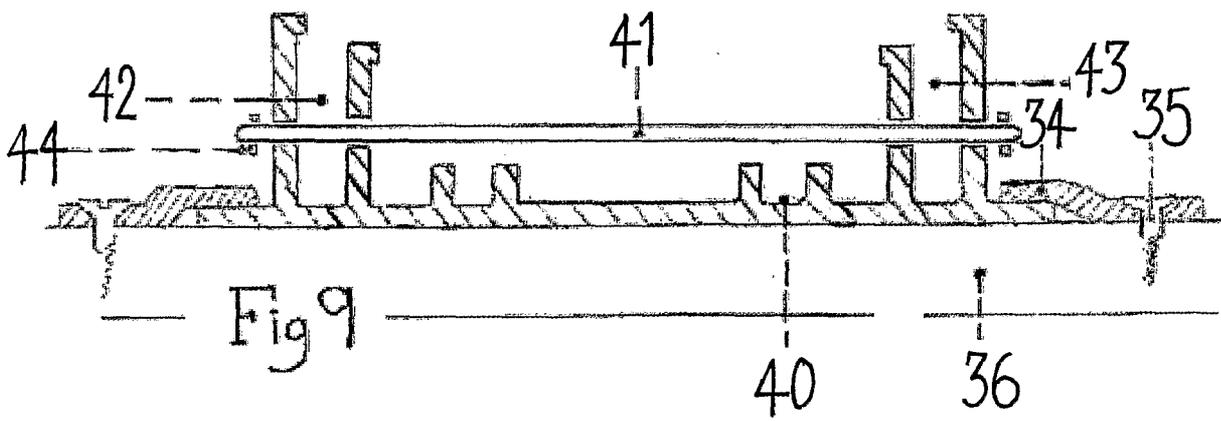
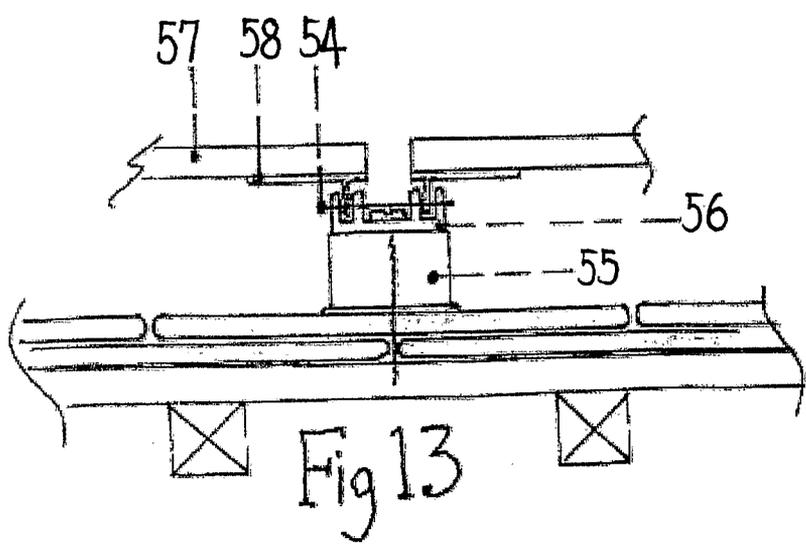
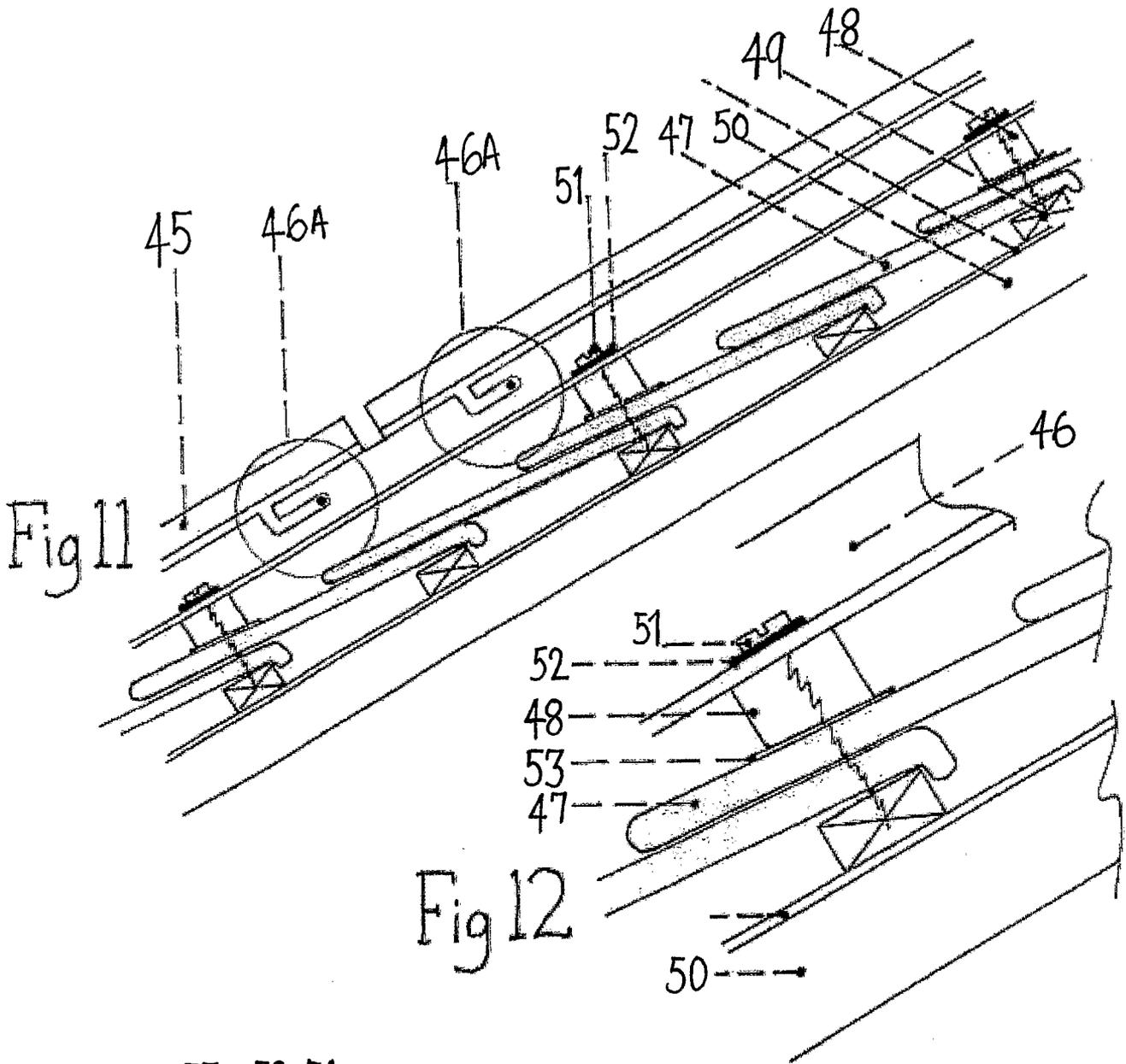
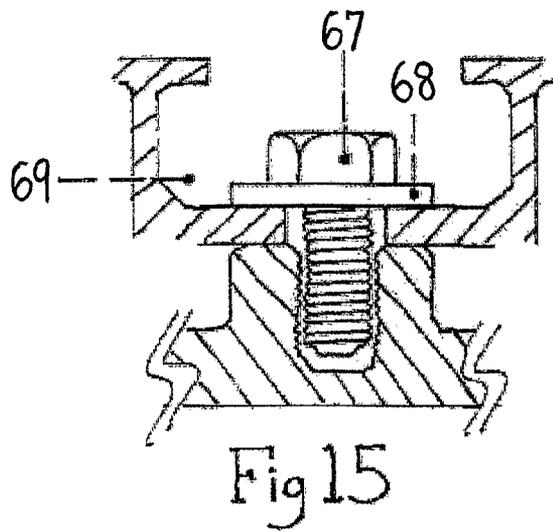
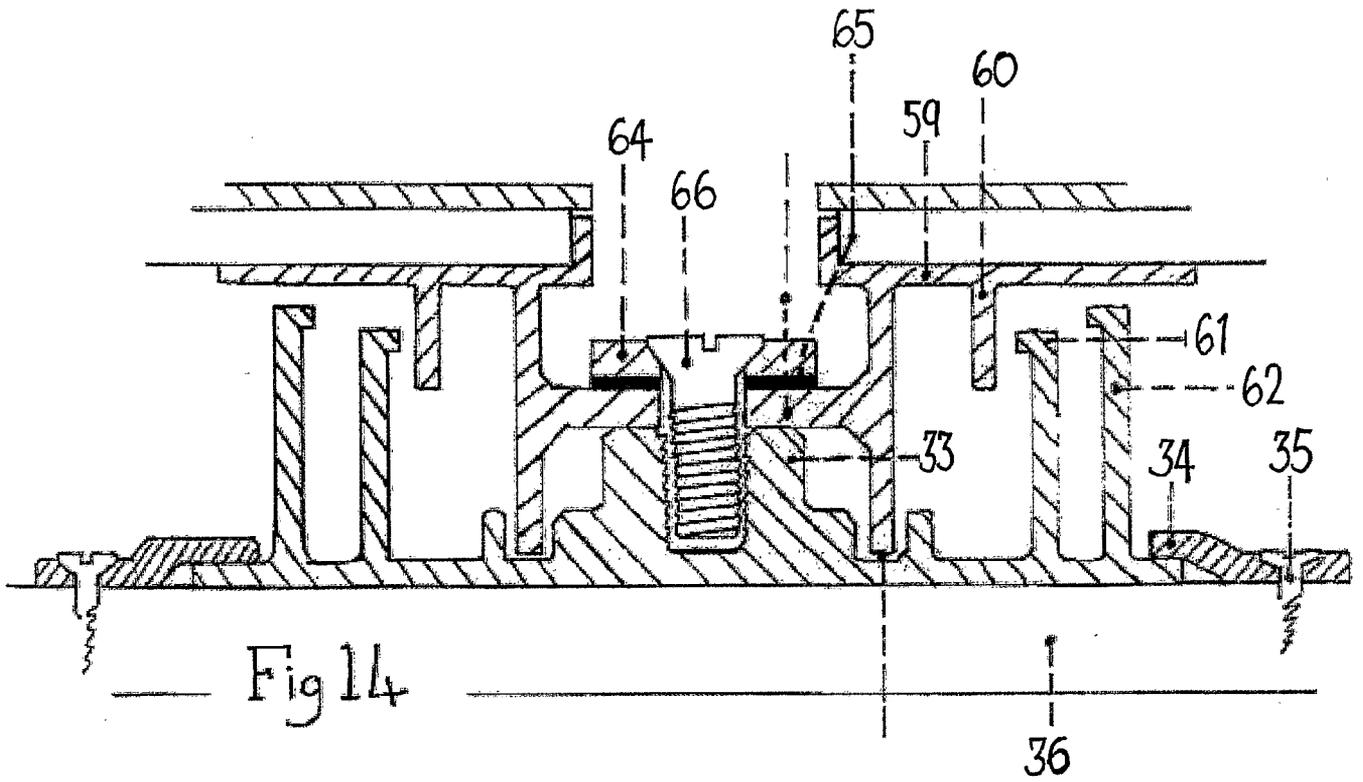


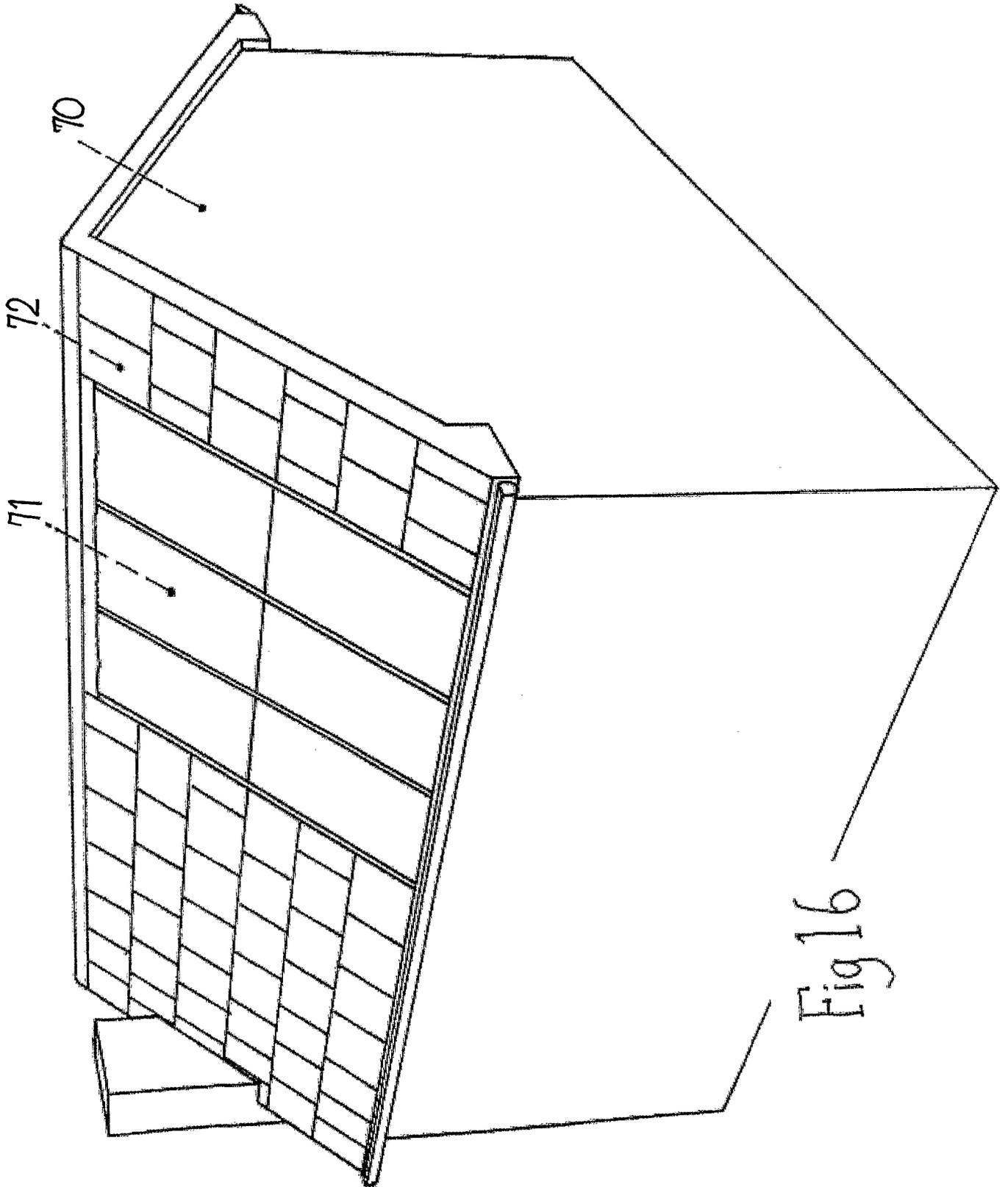
Fig 6











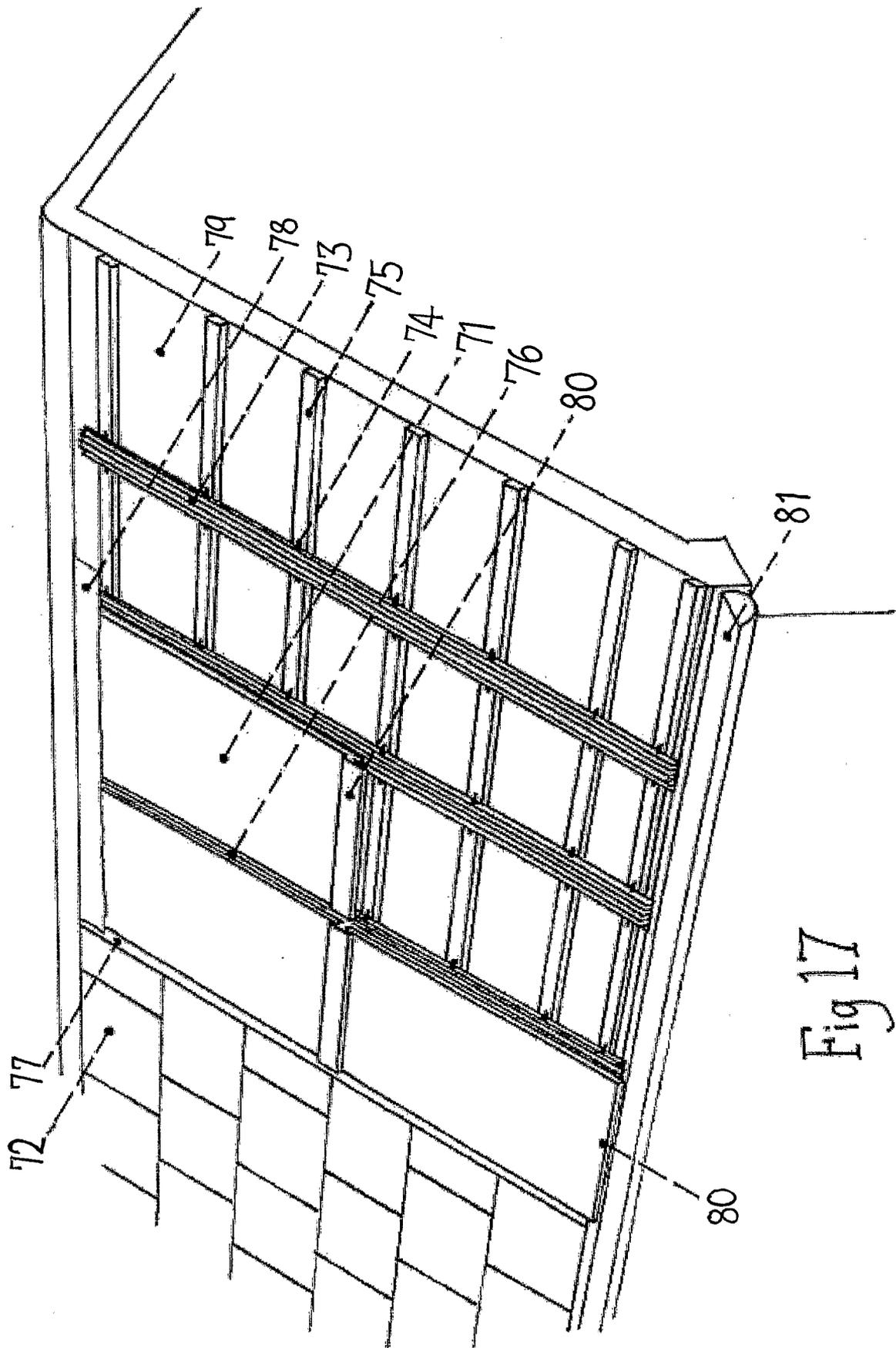


Fig 17

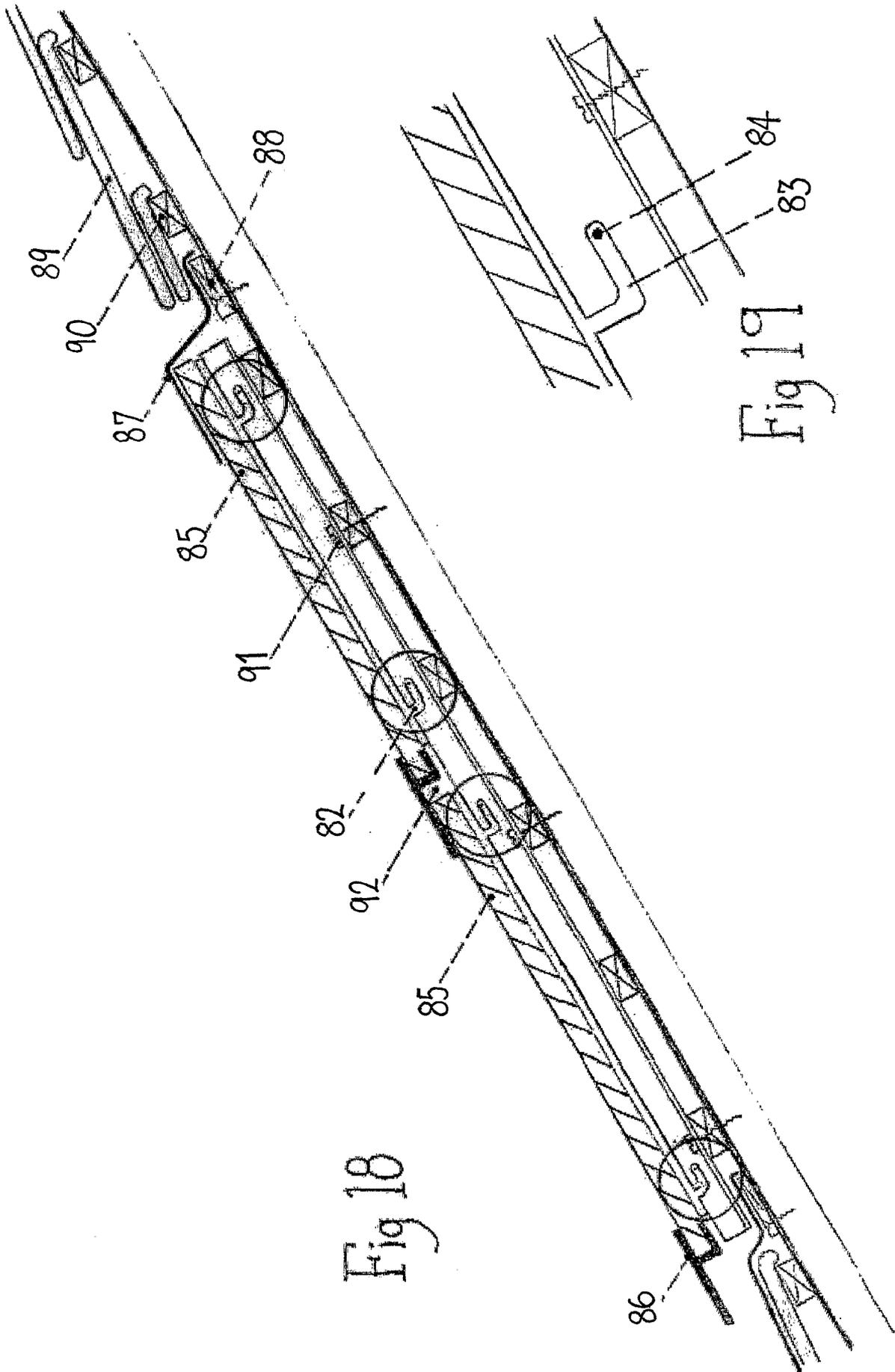


Fig 18

Fig 19

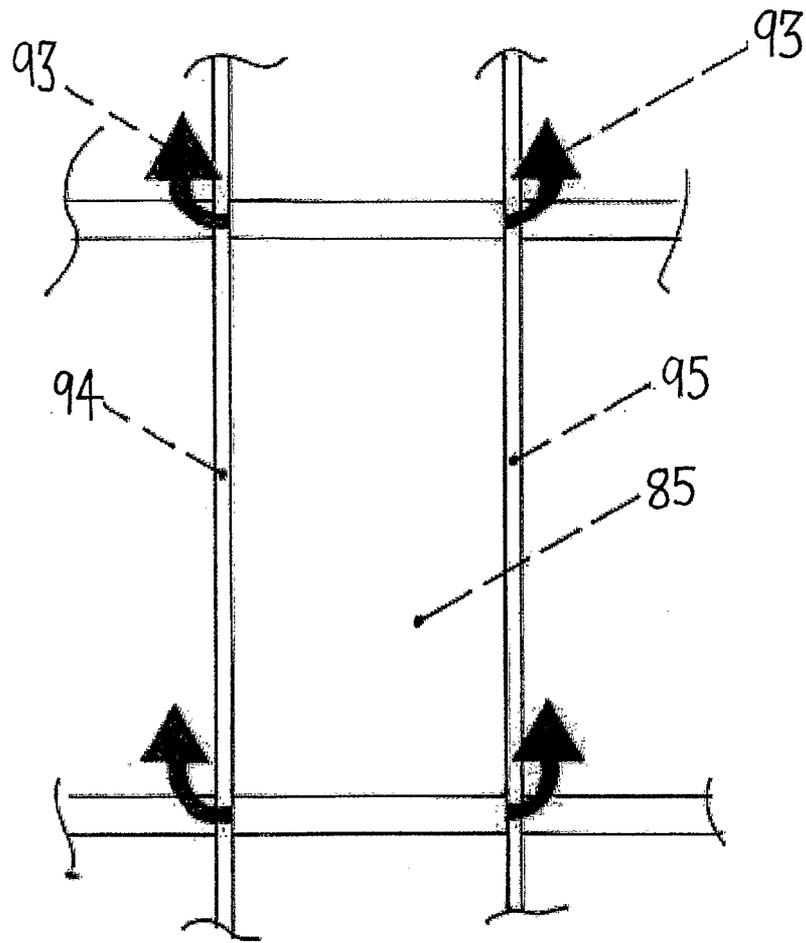


Fig 20