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(54) **A suspended ceiling system and a method for mounting a suspended ceiling**

(57) The present invention relates to a suspended ceiling system (1) comprising a grid of profiles (3) comprising at least one runner (12) each being provided with a plurality of fixing points (30), the grid of profiles (3) being suspended in a ceiling structure (11) by means of pressure resistant suspension members (13) in order to sustain upwardly directed loads; a ceiling panel (10, 10a, 10b) provided with at least one attachment point (52); and one connection member (20) for each attachment point (52); wherein each connection member (20) is connected to a selected one of said fixing points; and wherein each of the connection members (20) comprises a lock arranged to releasably connect to one of the at least one attachment points (52) of said ceiling panel (10, 10a, 10b) in response to the attachment point (52) being pushed in an upward direction towards the lock; whereby the ceiling panel (10, 10a, 10b) is suspended by said at least one runner (12).

The present invention further relates to a method for mounting such a suspended ceiling.

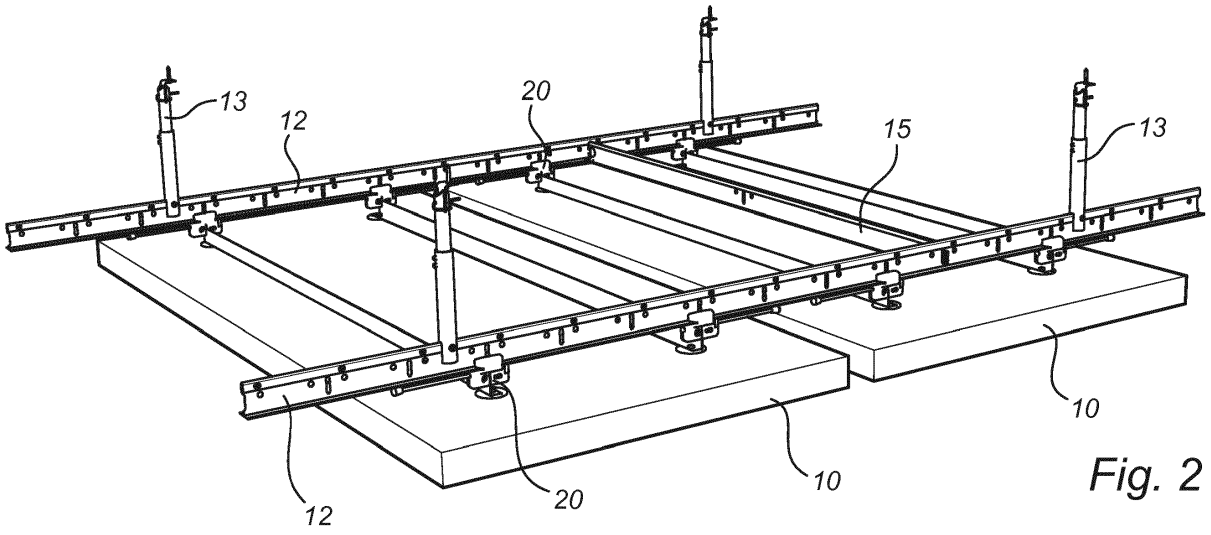

Fig. 2

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Description

Field of the invention

[0001] The present invention relates to a suspended ceiling system for suspending at least one ceiling panel. The invention also relates to a method for mounting a suspended ceiling comprising at least one ceiling panel.

Technical background

[0002] Ceilings being suspended from a ceiling structure, which henceforward is referred to as suspended ceilings, can be installed in many different types of buildings for various reasons. Examples of reasons are to absorb sound, to reflect light, to lower the ceiling height or to conceal installations such as cable arrangements, ventilation equipment, lighting installations and other devices arranged in the space between the suspended ceiling and the ceiling structure of a building.

[0003] A common type of suspension is to use a grid of profiles for suspending a plurality of ceiling panels. The grid of profiles is suspended from a ceiling structure. The profiles are arranged to support and thus uphold the ceiling. The profiles can for example be formed by T-beams with flanges facing away from the ceiling structure, wherein the ceiling panels are placed so that the flanges support the edges of the ceiling panels. The ceiling panels are thus embedded in the grid of profiles.

[0004] As an alternative to suspension of ceiling panels by means of a grid of profiles, free-hanging units of ceiling panels forming ceiling islands are one way of creating acceptable acoustic environments. The ceiling panels may have sound-absorbing properties. An advantage with free-hanging ceiling panels are that they often are regarded as more esthetically appealing due to their exposed edges and floating impression, when compared to ceiling panels being embedded in a grid of profiles.

[0005] Free-hanging ceiling panels can be installed in large, noisy environments such as open-plan areas, restaurants, shopping centers etc., close to working areas or other locations where acoustical treatment is needed in order to achieve suitable conditions for communication, concentration or recovery.

[0006] Free-hanging units can also be used as a complement to an overall suspended ceiling in order to improve the acoustic environment with a reduction of the sound level and a diminishing of sound as distance increases.

[0007] Free-hanging ceiling panels may be mounted by means of suspension members connecting the ceiling panels to a ceiling structure. This mounting causes the free-hanging ceiling panels to be sensitive to air flows which may set the ceiling panels in motion.

[0008] The ceiling panels may be arranged according to various designs depending on the application. In order to achieve a particular ceiling arrangement by means of free-hanging tiles suspended by suspension members, a precise and accurate mounting process is required. Each ceiling panel, typically being suspended by four suspension members, needs to be aligned with adjacent ceiling panels in order to achieve the desired design. This is particular important for design in which it is easy for the human eye to spot deviations, which makes the ceiling appear defective and/or incorrectly mounted. An example of such a sensitive design is ceiling panels being arrange adjacent to each other and distanced with an even distance. Even a tiny deviation from this distance makes the ceiling panels appear slanted in relation to each other. An esthetically appealing configuration is to let the distance be equal to the thickness of the ceiling panel. Thus, the distance may be quite small which makes a deviation even more easy to spot. Small distances between the ceiling panels are also desirable in order to increase the acoustic performance, i.e. the sound absorption capacity, of the ceiling. In this case, a high cover ratio of the ceiling panels are desired which is achieved by having a small distance between the ceiling panels.

[0009] Consequently, when designing a suspended ceiling system, one have to choose between embedded ceiling panels providing an easier alignment and a more stable system, and free-hanging ceiling panels providing a more appealing esthetical appearance and higher design freedom.

[0010] Thus, there is a need for an improved way of mounting ceiling panels.

Summary of the invention

[0011] It is an object of the present invention to provide an improvement over the above described techniques and prior art.

[0012] A particular object is to simplify the mounting of ceiling panels to be mounted in a free-hanging manner, i.e. such that the ceiling panels are not placed in a structure of profiles.

[0013] A further object is to provide means for simple and efficient mounting the ceiling panels in an improved manner.

[0014] According to a first aspect of the invention, at least some of these and other objects are achieved by a suspended ceiling system comprising:

a grid of profiles comprising at least one runner each being provided with a plurality of fixing points, the grid of profiles being suspended in a ceiling structure by means of pressure resistant suspension members in order to sustain upwardly directed loads,
a ceiling panel provided, at a rear surface, with at least one attachment point, and
one connection member for each attachment point, wherein each connection member is connected to a selected one of the fixing points, and
wherein each of the connection members comprises a lock arranged to releasably connect to one of the

at least one attachment points of the ceiling panel in response to the attachment point being pushed in an upward direction towards the lock,
whereby the ceiling panel is suspended by the at least one runner.

[0015] An advantage of the invention is that it provides a suspended ceiling system being a very flexible solution which provides great freedom in designing the system while still providing a simple and efficient mounting process. One underlying problem leading up to the invention is the need for a precise positioning of the ceiling panels in a suspended ceiling system. This is particular true for ceiling panels being arranged freely, meaning that they are not embedded in a supporting structure. Ceiling panels may for example be arranged adjacent to each other and distanced by a small and fixed gap. In order for the ceiling panel arrangement to be construed by a spectator as aligned and not skew, it is important that the ceiling panels are precisely positioned in relation to each other. This is particularly true for structures where the gap is small in which case the human eye easily detects a slight departure from the gap distance due to that the ceiling panels are not perfectly aligned.

[0016] The system of the present invention provides a system which simplifies the process of precisely arrangement of the ceiling panels. The suspended ceiling system is divided into a fixed foundation part being the grid of profiles with runners, and thereto connectable ceiling panels. The grid of profiles may firstly be arranged and attached to a ceiling structure. The arrangement of the grid of profiles may be performed separately to the attachment to the ceiling structure. Thus, the steps do not need to be performed simultaneously which simplifies the alignment of the runners. When the grid of profiles is attached to the ceiling structure, the ceiling panels may be connected to the runners.

[0017] The system of the present invention provides the esthetic value provided by free-hanging ceiling panels while still providing the mechanical stability provided by ceiling panels embedded in a grid of profiles.

[0018] Since the suspension members sustains upwardly directed loads, the suspension members connected to a runner will counteract the resulting upwardly directed force when a ceiling panel is pushed against the lock of a connection member connected to that runner. A person mounting the ceiling panels may thereby attach the ceiling panel to the runners without the need for access to the runners as would be the case if the ceiling panels were to be attached by screws or similar.

[0019] Moreover, the arrangement of the ceiling panels may be changed without changing the position of the foundation part and its connection to the ceiling structure. In order to reposition a ceiling panel, further connection members may be attached to the runners at suitable positions and/or the existing connection members may be repositioned.

[0020] Another advantage of the invention is that the number of connection points to the ceiling structure is reduced, when compared to when ceiling panels are directly and individually connected to the ceiling structure. The advantage is gained by that the ceiling panels are connected to the runners which in turn are connected to the ceiling structure.

[0021] By the inventive construction of the ceiling system, a flexible ceiling system is provided for both the person designing and the person mounting the ceiling system.

[0022] The grid of profiles may comprise a plurality of runners. The ceiling panel may then be provided with a plurality of attachment points, and the connection members may be connected to selected fixing points on at least two different runners. By that the ceiling panel is connected to a plurality of runners, the stability of the mounted ceiling panels is increased.

[0023] The runners may extend in parallel such that the fixing points are aligned. The fact that the fixing points are aligned simplifies the alignment of ceiling panels, in particular when distanced with a fixed gap.

[0024] The lock of each connection member may be arranged to provide a pivotal connection so as to allow a pivotal movement of the ceiling panel when connected to the runner. This in combination with that a ceiling panel is arranged to be connected to at least two runners provides the possibility to let the ceiling panel hang vertically when connected to only one runner. Thus, the space between other ceiling panels of the system and the ceiling structure may be accessed by lowering one ceiling panel to a hanging position in similar to a hinged ceiling hatch.

[0025] The fixing points may be evenly distributed in the longitudinal direction of the at least one runner. The distance between each fixing point may be a standard distance.

[0026] The ceiling panel may be provided with one or more attachment profiles. Each attachment point may in that case be formed by a hole in an attachment profile.

[0027] Each attachment profile may be fixated at one or more anchoring points of the ceiling panel by a fixing member for each anchoring point. A reinforcing element may be provided in the ceiling panel at each anchoring point for receiving the fixing member. An advantage gained with using reinforcing elements is that they enhance the fixation between the attachment profile and the ceiling panel when compared to fixation by a screw or rivet through the attachment profile and further directly into the material of the ceiling panel.

[0028] Each attachment profile may be elongated and arranged to be located, when the ceiling panel is connected to the at least one runners, transversal to the extension of the at least one runners. The attachment profile may be fixated to the ceiling panel at two or more anchoring points. By using two or more anchoring points, the resistance against shearing forces in the attachment of the attachment profile to the ceiling panel is increased. This is a particular advantage if the ceiling panel is arranged to hang vertically from a runner, in which position

the attachment will be exposed to shear forces.

[0029] Each attachment profile may comprise a flange extending vertically when the ceiling panel is connected to the at least one runner. Each hole formed in each attachment profile may be provided in the flange associated thereto.

[0030] The lock of each connection member may comprise a spring-loaded pin. The pin may be provided with an inclined profile for self-locking when an attachment point of the ceiling panel is pushed in an upward direction against the lock. Thus, the ceiling panel may be connected by only pushing the one or more attachment points against corresponding locks without the need for also accessing the connection member.

[0031] The flange may be provided with a guide notch at each hole. The guide notch may be formed to engage with a profile of the lock. In particular, the guide notch may be formed to engage with a peripheral profile of a locking portion of the pin, which locking portion extends across a slit in the locked position. The flange is intended to be arranged in the slit. The guide notch has the advantage that when a person standing below the ceiling panel is to connect the attachment point of the ceiling panel, being a hole, to the connection member, the guide notch facilitates in that the person can recognize when the flange comprising the hole is in the right position for pushing the ceiling panel, and thus attachment point, towards the lock, without seeing the elements to be connected.

[0032] Each connection member may comprise two mutually joinable parts. The parts may in an assembled state be arranged to straddle a runner section comprising the selected fixing point.

[0033] Each runner may be formed by a T-beam. Each runner may be arranged such that the flanges of the T-beam face away from the ceiling structure. The fixing points may be provided in the web of the T-beam.

[0034] The ceiling panel may comprise a plurality of attachable points. Each attachable point may be used as attachment point for attaching the ceiling panel to the grid of profiles. The at least one attachment points may thus be chosen among the attachable points. A ceiling panel may thus comprise more attachable points than attachment points, the latter being used for the attachment. Different attachment points may be chosen for different attachments of the same ceiling panel.

[0035] According to a second aspect of the invention, at least some of the above and other objects are achieved by a method for mounting a suspended ceiling, the method comprising:

providing a grid of profiles comprising at least one runner, each runner being provided with a plurality of fixing points,

suspending the grid of profiles in a ceiling structure by means of pressure resistant suspension members such that the grid of profiles sustains upwardly directed loads,

providing a ceiling panel being provided, at a rear surface, with at least one attachment point,

connecting one connection member for each attachment point to a selected one of the fixing points, the connection member comprising a lock,

pushing each of the attachment points towards the corresponding lock in an upward direction, each lock being arranged to releasably connect to the attachment point of the ceiling panel in response thereto,

whereby the ceiling panel is suspended by the at least one runner.

[0036] The grid of profiles may comprise a plurality of runners. The ceiling panel may be provided with a plurality of attachment points. In such an embodiment, the connection members may be connected to selected fixing points on at least two different runners.

[0037] The method according to the second aspect of the present invention incorporates all the advantages of the suspended ceiling system, which previously has been discussed. Thereby, the previous discussion is applicable also for the inventive method.

Brief description of the drawings

[0038] The present invention will by way of example be described in more detail with reference to the appended schematic drawings, which show embodiments of the present invention.

Figure 1 illustrates a suspended ceiling system comprising a plurality of ceiling panels, according to one embodiment

Figure 2 is a top view of a part of a suspended ceiling system, according to one embodiment.

Figure 3 illustrates a part of a grid of profiles in a suspended ceiling system according to one embodiment.

Figure 4 is a side view of a profile of a grid of profile according to one embodiment, and further includes an enlarged view of one of the connection members arranged on the grid of profile.

Figure 5 illustrates a one embodiment of a pair of attachment profiles provided on a ceiling panel.

Figures 6a-6c illustrates one embodiment of reinforcing elements arranged on a ceiling panel.

Figures 7a-7b illustrate another embodiment of reinforcing elements arranged on a ceiling panel.

Figures 8a-8c illustrate details of a connection member according to one embodiment.

Figure 9 illustrate a ceiling panel in a lowered position.

Figure 10 shows a flow chart for a method for mounting a suspended ceiling.

Figures 11 and 12 illustrate different embodiments of ceiling panel configurations according to embodiments of the present invention.

Detailed description of preferred embodiments

[0039] One embodiment of a suspended ceiling system 1 according to the present invention will now be disclosed in general with reference to figures 1 and 2. Thereafter, embodiments of different components of the suspended ceiling system 1 will be disclosed in detail with reference to figures 3-8c.

[0040] A suspended ceiling system 1 according to one embodiment of the invention is illustrated in figure 1. The suspended ceiling system 1 comprises a plurality of ceiling panels 10 being suspended by runners 12 forming a grid of profiles. The grid of profiles is suspended in a ceiling structure 11 by means of suspension members 13. The suspension members 13 are attached to the ceiling structure 11 by means of screws or corresponding fastening means.

[0041] The ceiling panels 10 may be made of compressed mineral fibers, such as mineral wool or glass wool. These are known materials for use in ceiling panels 10.

[0042] A part of the suspended ceiling system 1 is shown in the top view of figure 2. The ceiling structure 11 is omitted in this view.

[0043] The ceiling panels 10 are connected to the runners 12 by means of connection members 20. Each connection member 20 comprises a lock which is arranged to releasably connect to the ceiling panel 10 in response to the ceiling panel 10 being pushed in an upward direction against the lock. A detailed embodiment of the lock will be disclosed later.

[0044] The suspension members 13 are pressure resistant in order to sustain upwardly directed loads, meaning that the suspension members 13 counteracts an upwardly directed force applied to the runners 12. As the skilled person realizes, various configurations of the pressure resistant member 13 may achieve the pressure resistance feature. In this embodiment, the pressure resistance feature is achieved by a profile of a rigid material.

[0045] Since the suspension members 13 sustains upwardly directed loads, the suspension members 13 connected to a runner 12 will counteract the resulting upwardly directed force when a ceiling panel 10 is pushed against the lock of a connection member 20 connected to that runner 12. A person mounting the ceiling panels 10 may thereby attach the ceiling panel 10 to the runners 12 without the need for access to the runners 12 as would be the case if the ceiling panels 10 were to be attached by screws or similar.

[0046] Each runner 12 is formed by a T-beam being arranged with its flanges facing away from the ceiling structure 11. Each T-beam is made of a rigid material such as steel or aluminum.

[0047] By that the ceiling panels 10 are connected to the runners 12 which in turn is connected to the ceiling structure 11, the number of connection points to the ceiling structure 11 is reduced. As can be seen in figure 2, two ceiling panels 10 are each connected to the runners 12 by four connection members 20. The runners 12 are connected to the ceiling structure 11 by only four suspension members 13. By using this suspended ceiling structure instead of suspending each ceiling panel 10 separately to the ceiling structure 11, the number of required connections to the ceiling structure 11 is reduced, in this case by half.

[0048] One underlying problem leading up to the invention is the need for a precise positioning of the ceiling panels 10 in a suspended ceiling system. This is particular true for ceiling panels 10 being arranged freely, meaning that they are not embedded in a supporting structure. As can be seen in figures 1 and 2, the ceiling panels 10 are arranged adjacent to each other and distanced by a small and fixed gap. In order for the ceiling panel arrangement to be construed by a spectator as aligned and not skew, it is important that the ceiling panels 10 are precisely positioned in relation to each other. This is particularly true for structures where the gap is small in which case the human eye easily detects a slight departure from the gap distance by that the ceiling panels 10 are not perfectly aligned.

[0049] By the present invention, the suspended ceiling system 1 is divided into a fixed foundation part being the grid of profiles with runners 12 and thereto connectable ceiling panels 10. Thus, the arrangement of the ceiling panels 10 may be changed without changing the position of the foundation part and its connection to the ceiling structure. In order to reposition a ceiling panel 10, further connection members 20 may be attached to the runners 12 at suitable positions and/or the existing connection members 20 may be repositioned.

[0050] The different components of the suspended ceiling system will now be disclosed in more detail with reference to figures 3-8c.

[0051] One embodiment of a grid of profiles 3 forming the foundation part of the suspended ceiling system 1 is illustrated in figure 3. Two runners 12 are arranged to extend in parallel with a mutual distance W. It is appreciated that a grid of profiles according to the invention may comprise further runners 12. However, in order to facilitate the understanding of the invention, a grid of profiles 3 in a simple configuration is illustrated.

[0052] A cross bar 15 is arranged to extend between the runners 12 transverse to the extension of the runners 12. The cross bar 15 has in this embodiment the same profile as the runner 12.

[0053] The cross bar 15 increases the stability of the grid of profiles 3. In particular, the cross bar 15 fixates the runners 12 in relation to each other in order to counteract that the runners 12 become non-aligned by movement of one runner relative the other runner.

[0054] Each runner 12 is provided with a plurality of fixing points 30. Each fixing point 30 is formed by a through-hole in the profile of the runner 12, in this case through the web of the T-profile forming each runner 12. The purpose of the fixing points 30 is to define points to which the ceiling panel 10 may be attached. The cross

bar 15 may also be provided with fixing points 30 in order to increase the number of possible connection points. The cross bar 15 sustains upwardly directed loads in that it is securely attached to the runner 12. Thus, the cross bar 15 may provide the same function as the runner 12.

[0055] The runners 12 are arranged such that the set of fixing points 30 of each runner 12 are aligned. This means that each fixing point 30 of one runner 12 is aligned with each fixing point 30 on the other runner 12. Aligned fixing points 30 simplifies the alignment of ceiling panels 10, in particular when distanced with a fixed gap.

[0056] In a grid of profiles comprising further runners, it is not necessary that the fixing points of all runners of the grid of profiles are aligned with each other. The advantage of simplifying the positioning of ceiling panels 10 is also achieved by that only the fixing points of the runners 12 to which these ceiling panels 10 are to be connected are aligned. However, an alignment of all fixing points of the system is advantageous in that the system is not limited with respect to which runner 12 each ceiling panel 10 is to be connected to. The ceiling system 1 is thereby flexible in that ceiling panels 10 may be rearranged to connect to other combinations of runners 12.

[0057] The fixing points 30 are evenly distributed in the longitudinal direction of each runner 12. The distance d between each fixing point 30 is preferably fixed for all runners 12 in the grid of profiles 3. The distance d may be a standard distance, such as 100, 125 or 150 mm; or 4, 5 or 6 inches.

[0058] When the grid of profiles 3 is attached to the ceiling structure, one or more connection members 20 are connected to the runners 12, as illustrated in figure 4. Each connection member 20 is connected to a selected fixing point 30. Fixing points 30 are selected based on the intended position of a ceiling panel to be attached and the arrangement of the ceiling panel's 10 attachment points.

[0059] This embodiment discloses a connection member 20 being releasably connectable to a runner 12, which provides the advantage of the possibility to rearrange the connection member 20 if needed. However, in other embodiments, the connection member can be permanently attached to the runner. It is also possible that the runner 12 comprises a plurality of connection members which are permanently attached to a plurality of fixing points, amongst which the suitable fixing points are selected and the connection members thereto are used for connecting the intended ceiling panel.

[0060] Details of the connection member 20 are illustrated in a close-up view in figure 4. The connection member 20 comprises a casing 40 for housing a lock. The lock is arranged to releasably connect to attachment points of a ceiling panel. In this embodiment, the lock comprises a pin 41. One end portion of the pin 41 is formed as a hook and arranged in the casing 40. The hook ends with a locking portion 46 having an inclined profile 42. The pin 41 is movable between a locking position, in which the locking portion 46 and inclined profile 42 extends across a slit 44 of the casing 40, and an unlocking position, in which the locking portion 46 does not extend across the slit 44. In figure 4, the pin 41 is arranged in the locking position. In order to achieve a self-locking feature of the lock, a spring 43 is arranged for resiliently arranging the pin 41 such that the pin 41 is biased towards its locking position. Thus, the pin 41 is spring-loaded.

[0061] The connection member 20 including the lock 40 according to this embodiment is arranged to engage with an attachment point which now will be exemplified with reference to figure 5. The ceiling panel 10 is here seen from its rear side, i.e. the side facing the ceiling structure 11 in figure 1 when the ceiling panel 10 is connected to the runners 12.

[0062] The ceiling panel 10 is provided with a pair of attachment profiles 50a, 50b. In this embodiment, each attachment profile 50a, 50b are formed an as L-profile.

[0063] The attachment points are formed by holes 52 in a flange of each attachment profile 50a, 50b. The holes 52 are arranged to receive the pin 41 when a flange portion comprising one of the holes 52 is inserted into the slot 44 of the connection member 20. When the flange portion is inserted, the spring-loaded pin 41 is easily pushed aside and out of the slit 44 due to the inclined profile 42. Since the pin 41 is spring-loaded, the locking portion 46, comprising the inclined profile 42, of the pin 41 returns to the locking portion and engages with the flange through the hole 52. Thus, the lock connects to this hole 52, being the attachment point, in response to the hole 52 being pushed towards the lock.

[0064] The connection may be released by pushing the pin 41 into its unlocked position in which the locking portion 46 of the pin's hook is disengaged from the hole 52. In that position, the flange may be withdrawn from the slit 44 of the connection member 20.

[0065] In order to facilitate the alignment of the hole 52 and the locking portion 46 of the pin 41 which is to engaged with the hole 52, each attachment profile 50a, 50b may be provided with a guide notch 53 at each hole 52. The guide notch 53 is formed to engage with the peripheral profile of the locking portion 46 of the pin 41, which locking portion 46 extends across the slit 44 in the locked position. If a person standing below the ceiling panel 10 is to connect the attachment point of the ceiling panel 10, being the hole 52, to the connection member 20, the guide notch 53 facilitates in that the person can recognize when the flange comprising the hole 52 is in the right position for pushing the ceiling panel, and thus attachment point, towards the lock, without seeing the elements to be connected. When running the flange through the slit 44 while applying a small pressure upwards, the ceiling panel 10 will move slightly upwards when the pin 41 engages with the guide notch 53. In this engaged position, further pressure upwards is applied in order to connect the ceiling panel 10 to the lock of the connection member 20.

[0066] The attachment profiles 50a, 50b are spaced with a distance D. The distance D is a multiple of the

distance d of the space between each fixing point 30 of the runner 12, as illustrated in figure 3. Thus, the ceiling panel 10 is easily connected to the grid of profiles by selecting suitable fixing points, attaching connection members 20 to the selected fixing points and connecting attachment profiles of the ceiling panel 10 to these connection members 20. Thus, the system provides for a simple attachment procedure which does not require any modifications, such as measuring, positioning and drilling mounting holes in the runners 12 for connection of the attachment profiles 50a, 50b.

[0067] The attachment profiles 50a, 50b are attached to anchoring points 51 of the ceiling panel 10. In this embodiment, each of the attachment profiles 50a, 50b are attached to two anchoring points 51. Different embodiments of how the attachment profiles 50a, 50b, or other types of attachment profiles, may be attached to the anchoring points will now be disclosed with reference to figures 6a-7b.

[0068] Figure 6a illustrates a ceiling panel 60 comprising four anchoring points 61 for attaching attachment profiles. At each anchoring point 61 a reinforcing element 62 is provided. The reinforcing element 62 is illustrated in a view from the side in figure 6b. The reinforcing element 62 is shaped as a screw and comprises threads 63 and a threaded recess 64 for receiving a screw. Alternatively, the recess 64 may be arranged for receiving a rivet.

[0069] One reinforcing element 62 is screwed into the material of the ceiling panel 60 at each of the anchoring points 61. An attachment profile is attached by providing a screw or a rivet 65 through the attachment profile and further through the recess 64 of the reinforcing element 62, as exemplified in figure 6c. In this figure, the attachment profile 50b of figure 5 is attached to the ceiling panel 60. The reinforcing element 62 may in this embodiment be made of a rigid material such as steel or aluminum.

[0070] Figures 7a and 7b illustrate a reinforcing element 72 in a ceiling panel 70 according to another embodiment. The reinforcing element 72 is formed by a folded rigid plate. The plate is made of e.g. steel or sheet metal. The plates are located at anchoring points 71 of the ceiling panel 70.

[0071] The plate is provided with a hole 74 in its upper portion 75.. A lower portion 73 of the folded plate is arranged to penetrate the material of the ceiling panel 70 for attaching the reinforcing element 72 to the ceiling panel 70. A stabile surface for attachment of the attachment profile to the anchoring point 71 is thus provided.

[0072] For further reinforcement and stability, a screw (not shown) may, after the reinforcement element 72 has been arranged in the ceiling panel 70, be provided through the hole 74 and further through the lower portion 73 of the reinforcing element 72. By this fixation, the material of the ceiling panel 70 located between the upper portion 75 and the lower portion 73 of the reinforcing element 72 is compressed thus providing an increased stability for the attachment of the attachment profile. The attachment profile may be attached by means of a screw or rivet provided through the upper portion 75 of the reinforcement element 72. The screw or rivet for attaching the attachment provide may be provided such that it engages with the lower portion 73 in order to increase its fixation to the reinforcement element 72 and to the ceiling panel 70.

[0073] An advantage gained with using reinforcing elements 62, 72 is that they enhance the fixation between the attachment profile and the ceiling panel 60, 70, when compared to fixation by a screw or rivet through the attachment profile and further directly into the material of the ceiling panel 60, 70.

[0074] The connection member 20 of figure 4 will now be disclosed in greater detail with reference to figures 8a-8c. The connection member 20 comprises, as previously disclosed, a pin 41, a locking portion 46 having an inclined profile 42, and a spring 43. One end of the pin 41, comprising the locking portion 46, is formed as a hook.

[0075] The casing 40 of the connection member 20 comprises a first part 40a and a second part 40b. The first part 40a and the second part 40b are mutually joinable and form the casing 40 in the joint state, as illustrated in figure 8c. In this embodiment, the first part 40a and the second part 40b are identical in their construction. The manufacturing of the parts is thereby facilitated by that only one design instead of two different designs of the parts needs to be manufactured.

[0076] The first part 40a of the casing 40 comprises a protrusion 45 around which the pin's 41 hook is arranged.

[0077] Each of the first part 40a and second part 40b of the casing 40 is provided with a slot which together forms the slot 44 in the joint state.

[0078] The first part 40a of the casing 40 is provided with a first slit 80a and the second part 40b of the casing 40 is provided with a second slit 80b. The purpose of each of the first slit 80a and the second slit 80b is to receive a flange of the runner 12 to which the connection member 20 is to be connected. This embodiment of connection member 20 is arranged to straddle a runner shaped as a T-beam. Each of the first slit 80a and the second slit 80b is arranged to receive one of the flanges of the T-beam.

[0079] The first part 40a and the second part 40b are provided with pairs of screw holes 81 a, 81 b and 82a, 82b. The screw holes are arranged such that they are mutually aligned, within each pair, in the joint state. Thus, the first part 40a and the second part 40b is attachable to each other by providing a screw 83 through one or both of the pairs of screw holes 81 a, 81 b and 82a, 82b.

[0080] The first part 40a is provided with a first protrusion 84a and the second part 40b is provided with a second protrusion 84b. The purpose of each of the first protrusion 84a and the second protrusion 84b is to extend through the selected fixing point, being a through-hole, of the runner at which the connection member 20 is arranged. The connection member 20 is thus precisely positioned along the runner. It is noted that it is not neces-

sary that the connection member 20 comprises two protrusions in order to achieve this feature. One protrusion member suffices in order to gain the advantage of precise positioning.

[0081] Figure 9 illustrates the suspended ceiling system 1 of figure 2 wherein the ceiling panel 10a is arranged in a lowered position. By the arrangement of the connection member 20, where the lock comprises a pin to be inserted into a hole of an attachment profile of the ceiling panel, the connection member 20 is arranged to provide a pivotal connection so as to allow a pivotal movement of the ceiling panel 10a when connected to the runner 12. Thus, when the ceiling panel 10a is connected to both runners 12 by all four connection members 20, the locks of the connection members 20 of one runner 12 may be unlocked so as to release the attachment profiles 50a, 50b from this runner 12. The ceiling panel 10a may thus be pivoted to its position in figure 9. In this position, access is provided to the space between the ceiling panel 10b, and other fully attached ceiling panels of the ceiling system, and the ceiling structure arranged above. This access is useful for example when inspecting ventilation systems located in this space or when it is desired to access the grid of profiles or connection members attached thereto.

[0082] In view of the feature of pivotal movement of the ceiling panel 10a, the pin of the connection member's 20 lock is advantageously formed with a round cross-section in order to facilitate the pivotal movement when the ceiling panel 10a has round holes as attachment points.

[0083] As illustrated in figure 9, the ceiling panel 10a need not be entirely removed from the runners 12, which makes the process of accessing the above space, and subsequent reconnecting the ceiling panel 10b, easier.

[0084] The lowered position of the ceiling panel 10a is also advantageous when mounting the ceiling panel 10a. The ceiling panel 10a may be connected one runner 12 first and lowered in order to assure that the connection has been performed correctly. Thereafter, the ceiling panel 10a may be raised by pivoting it to a horizontal position and connected to other runner 12. Connection members 20 may be connected to the other runner 12 first when the ceiling panel 10a is raised to the horizontal position where it is apparent to which fixing points 30 the connection members 20 shall connect. Thus, time spent on figuring out which fixing points 30 is to be selected may be reduced.

[0085] In embodiments providing the feature of lowering of the ceiling panel 10a to a hanging and vertical position, it is preferred that the attachment profiles 50a, 50b, which extends transversal to the extension of the runners 12, are each attached to two or more anchoring points of the ceiling panel 10b. By two or more anchoring points, the fixation between each of the attachment profiles 50a, 50b and the ceiling panel 10a is increased. This is a particular advantage when the ceiling panel 10b is arranged to hang in a vertical position in which the fixation of the attachment profiles 50a, 50b to the ceiling panel 10b is exposed to shear forces.

[0086] Figure 10 shows a flow chart of a method of mounting a suspended ceiling, which have also been disclosed above throughout the detailed description.

[0087] A grid of profiles is provided 1001. The grid of profiles comprises at least one runner. The grid of profiles are suspended 1002 in a ceiling structure by means of pressure resistant suspension members such that the grid of profiles sustains upwardly directed loads. A ceiling panel is provided 1003. The ceiling panel is provided with at least one attachment point. One connection member for each attachment point of the ceiling panel is connected 1004 to a selected fixing point of a runner of the grid of profiles. The connection member comprises a lock being arranged to releasably connect to an attachment point. Each attachment point is pushed 1005 towards the corresponding lock in an upward direction. Consequently, the ceiling panel is suspended by the at least one runner.

[0088] The grid of profiles, forming the foundation part of the system, and the possibility of selecting fixing points among a plurality of fixing points, opens for working with any shape of ceiling panels independent of the configuration of the grid of profiles. In other words, different sets of ceiling panels, having different shapes, may be attached to the same grid of profiles without the need for changes in the mounting to the ceiling structure. This is an advantage in view of free-hanging ceiling panels, where the exchange of ceiling panels typically requires a remounting of suspension members to the ceiling structure. The invention is also advantageous over embedded ceiling panels in that the configuration of the grid of profiles defines the shape of the ceiling panel to be embedded therein. For a ceiling panel with different shape, remounting and reconstruction of the grid of profiles is required.

[0089] Figures 11 and 12 illustrate different embodiments of the present invention where ceiling panels having different shapes within the same ceiling are provided. The figures are transparent views from below or from above the ceiling.

[0090] A grid of profiles comprising pairs of runners 12 is illustrated in figure 11. The runners 12 of each pair is distanced by the distance W. Adjacent pairs of runners 12 are distanced with a smaller distance. Differently shaped ceiling panels 110 are attached to the runners 12. As previously disclosed, the runners 12 comprises fixing points, and connection members are connected to selected fixing points 30 for attachment of the ceiling panels 110.

[0091] Note that, in order to facilitate the understanding of the figures, only selected fixing points 30 to which the ceiling panels 110 are or are to be connected is illustrated in figures 11 and 12.

[0092] For details of the mounting process, including the connection of connection members to the selected fixing points 30, reference is made to the above disclo-

sures in connection to previous figures.

[0093] The ceiling panels 110 have different shapes and are distanced by a small gap. By the alignment the fixing points of the runners 12, it is possible to design a ceiling panel pattern with different shapes without making the mounting process, and in particular the precise alignment of the ceiling panels, more complex when compared to mounting of identically shaped ceiling panels.

[0094] Figure 12 illustrates ceiling panels 120 with different rounded shapes. In this embodiment, the grid of profiles comprises a plurality of equally spaced runners 12 forming a grid. The grid comprises runners 12 extending in both a longitudinal direction and in a transversal direction. The runners 12 extending in the transversal direction, or in the longitudinal direction, could alternatively be previously disclosed cross bars 15 which may comprise fixing points.

[0095] The ceiling panels 120 are attached to selected fixing points 30 by means of connection members. As for figure 11, only selected fixing points 30 are illustrated in this figure.

[0096] It is appreciated from figures 11 and 12 that differently shaped ceiling panels may be arranged to a single grid of profiles. By knowing the configuration of a grid of profiles on beforehand, any shape of ceiling panel may be designed and configured to enable mounting to the grid of profiles in question. Different fixing points within the same grid of profiles may be selected for different ceiling panels. Rearrangable connection members provides the possibility to easily reselect fixing points and rearrange connection members thereto for replacing one ceiling panel with another.

[0097] It is noted that the overall ceiling system includes a number of variable parameters, such as distance W between runners 12 in a pair of runners, the distance between adjacent pairs of runners, positioning of fixing points 30, positioning of attachment points and attachable points on the ceiling panels 10, and design of ceiling panel 10. When designing the suspended ceiling system with regards to a desired arrangement of the ceiling panels 10, these parameters are of course taken into account in relation to each other. That is, different parameters may be varied in different ways in relation to each other in order to achieve a specific result, such as aligned ceiling panels. These considerations are taken during the design process of the ceiling panel arrangement. The suspended ceiling system according to the present invention provides a very flexible solution which provides great freedom in designing the system while still providing a simple and efficient mounting process. One can create a great variety of design by changing different parameters of the system.

[0098] It is appreciated that there are numerous modifications of the embodiments described herein, which are still within the scope of the invention as defined by the appended claims. For example, various forms of lock configurations and corresponding attachment points of the ceiling panel are possible within the scope of the present invention. The skilled person has the knowledge and ability to achieve such alternative solutions and their execution. Various forms of connection members, achieving the feature of releasably connecting to one of the at least one attachment points of the ceiling panel in response to the attachment point being pushed in an upward direction towards the lock, are also possible within the scope of the present invention, such as various forms of known snap locks.

[0099] It is further appreciated that the ceiling panel may be suspended such that the ceiling panel is angled in relation to the ceiling structure of the ceiling.

[0100] Other configurations of ceiling panels are possible. For example, the ceiling panels need not be arranged adjacent to each other. The ceiling panels may for example be arranged on different distance from the ceiling structure, i.e. on different heights.

Claims

1. A suspended ceiling system comprising:

a grid of profiles (3) comprising at least one runner (12) each being provided with a plurality of fixing points (30), said grid of profiles (3) being suspended in a ceiling structure (11) by means of pressure resistant suspension members (13) in order to sustain upwardly directed loads,
a ceiling panel (10, 10a, 10b, 60, 70, 110, 120) provided, at a rear surface, with at least one attachment point (52), and
one connection member (20) for each attachment point (52),
wherein each connection member (20) is connected to a selected one of said fixing points (30), and
wherein each of the connection members (20) comprises a lock arranged to releasably connect to one of the at least one attachment points (52) of said ceiling panel (10, 10a, 10b, 60, 70, 110, 120) in response to the attachment point (52) being pushed in an upward direction towards the lock,
whereby the ceiling panel (10, 10a, 10b, 60, 70, 110, 120) is suspended by said at least one runner (12).

2. The suspended ceiling system according to claim 1, wherein
the grid of profiles (3) comprises a plurality of runners (12),
the ceiling panel (10, 10a, 10b, 60, 70, 110, 120) is provided with a plurality of attachment points (52), and wherein
the connection members (20) are connected to selected fixing points on at least two different runners (12).

3. The suspended ceiling system according to claim 2, wherein the runners (12) extend in parallel such that the fixing points (30) are aligned.

4. The suspended ceiling system according to claim 2 or 3, wherein the lock of each connection member (20) is arranged to provide a pivotal connection so as to allow a pivotal movement of the ceiling panel (10, 10a, 10b, 60, 70, 110, 120) when connected to the runner (12).

5. The suspended ceiling system according to any one of claims 1-4, wherein the fixing points (30) are evenly distributed in the longitudinal direction of said at least one runner (12).

6. The suspended ceiling system according to any one of claims 1-5, wherein the ceiling panel (10, 10a, 10b, 60, 70, 110, 120) is provided with one or more attachment profiles (50a, 50b), each attachment point being formed by a hole (52) in an attachment profile (50a, 50b).

7. The suspended ceiling system according to claim 6, wherein each attachment profile (50a, 50b) is fixated at one or more anchoring points (51, 61, 71) of the ceiling panel (10, 10a, 10b, 60, 70, 110, 120) by a fixing member (65) for each anchoring point (51, 61, 71), and
wherein a reinforcing element (62, 72) is provided in the ceiling panel (10, 10a, 10b, 60, 70, 110, 120) at each anchoring point (51, 61, 71) for receiving the fixing member (65).

8. The suspended ceiling system according to claim 6 or 7,
wherein each attachment profile (50a, 50b) is elongated and arranged to be located, when the ceiling panel is connected to the at least one runner (12), transversal to the extension of the at least one runners, and
wherein each attachment profile (50a, 50b) is fixated to the ceiling panel (10, 10a, 10b, 60, 70, 110, 120) at two or more anchoring points (51, 61, 71) of the ceiling panel (10, 10a, 10b, 60, 70, 110, 120).

9. The suspended ceiling system according to any one of claims 6-8, wherein each attachment profile (50a, 50b) comprises a flange extending vertically when the ceiling panel (10, 10a, 10b, 60, 70, 110, 120) is connected to the at least one runner (12), and wherein each hole (52) formed in each attachment profile (50a, 50b) is provided in the flange associated thereto.

10. The suspended ceiling system according any one of claims 6-9, wherein the lock of each connection member (20) comprises a spring-loaded pin (41) provided with an inclined profile (42) for self-locking when an attachment point (52) of the ceiling panel (10, 10a, 10b, 60, 70, 110, 120) is pushed in an upward direction against the lock.

11. The suspended ceiling system according to claims 9 and 10, wherein the flange is provided with a guide notch (53) at each hole (52), the guide notch (53) being formed to engage with a profile of the lock.

12. The suspended ceiling system according to any of the preceding claims, wherein each connection member (20) comprises two mutually joinable parts (40a, 40b), wherein said parts (40a, 40b) in an assembled state are arranged to straddle a runner section comprising the selected fixing point.

13. The suspended ceiling system according to any of the preceding claims, wherein each runner (12) is formed by a T-beam, the flanges of the T-beam facing away from the ceiling structure (11), wherein the fixing points (30) are provided in the web of the T-beam.

14. The suspended ceiling system according to any of the preceding claims, wherein the ceiling panel (10, 10a, 10b, 60, 70, 110, 120) comprises a plurality of attachable points among which the at least one attachment points (52) are chosen.

15. A method for mounting a suspended ceiling, said method comprising:

providing (1001) a grid of profiles comprising at least one runner, each runner being provided with a plurality of fixing points,
suspending (1002) said grid of profiles in a ceiling structure by means of pressure resistant suspension members such that the grid of profiles sustains upwardly directed loads,
providing (1003) a ceiling panel being provided, at a rear surface, with at least one attachment point,
connecting (1004) one connection member for each attachment point to a selected one of said fixing points, said connection member comprising a lock,
pushing (1005) each of the attachment points towards the corresponding lock in an upward direction, each lock being arranged to releasably connect to the attachment point of said ceiling panel in response thereto,
whereby the ceiling panel is suspended by said at least one runner.

16. The method according to claim 14, wherein
the grid of profiles comprises a plurality of runners, the ceiling panel being provided with a plurality of

attachment points, and wherein
the connection members are connected to selected fixing points on at least two different runners.

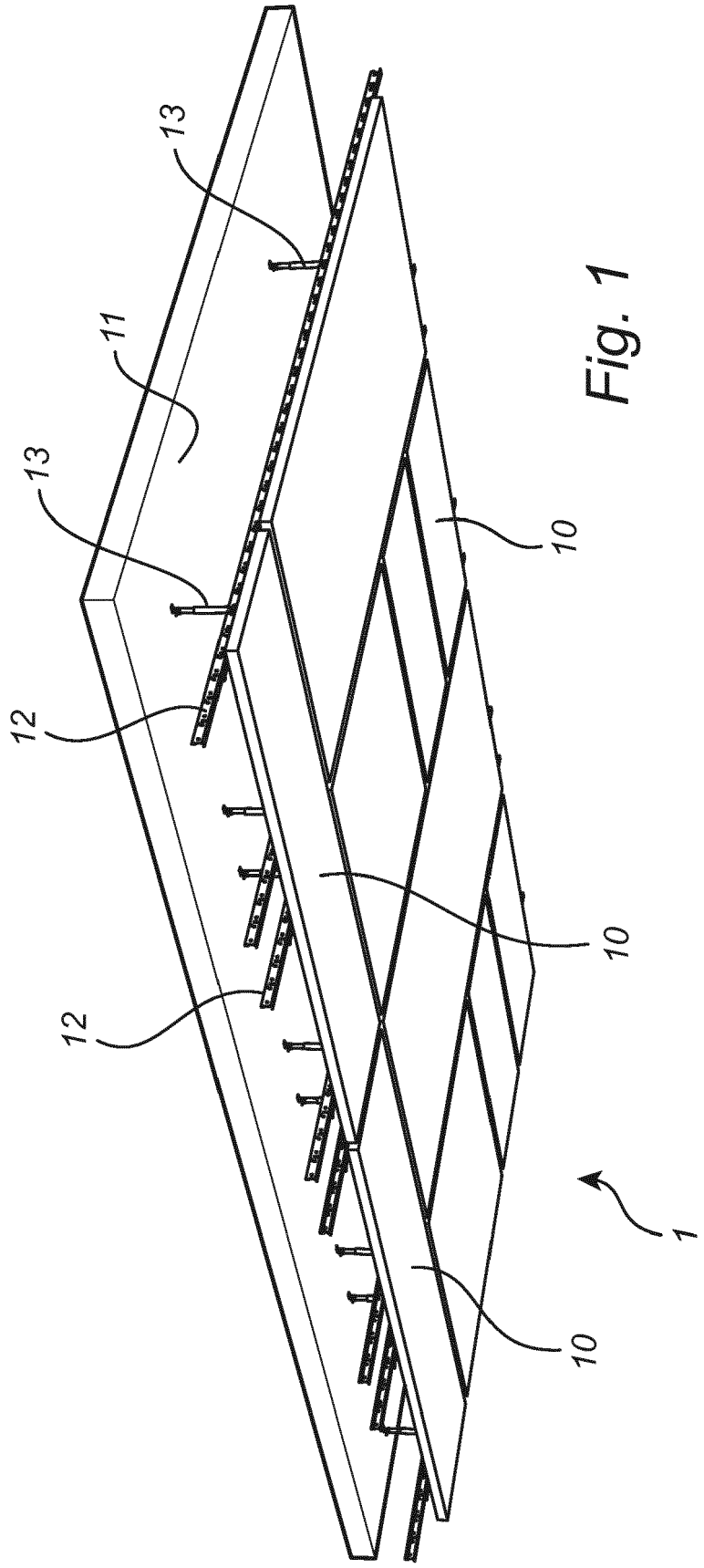

Fig. 1

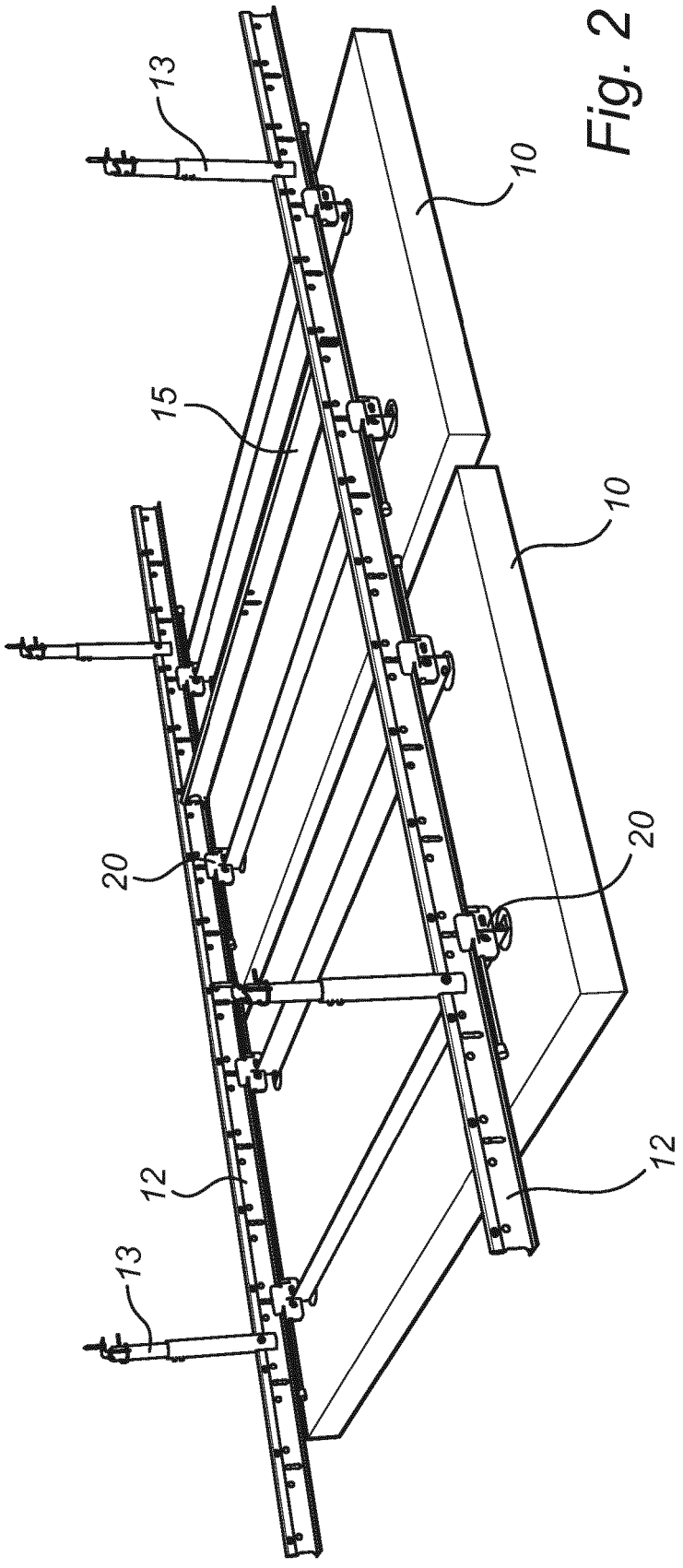

Fig. 2

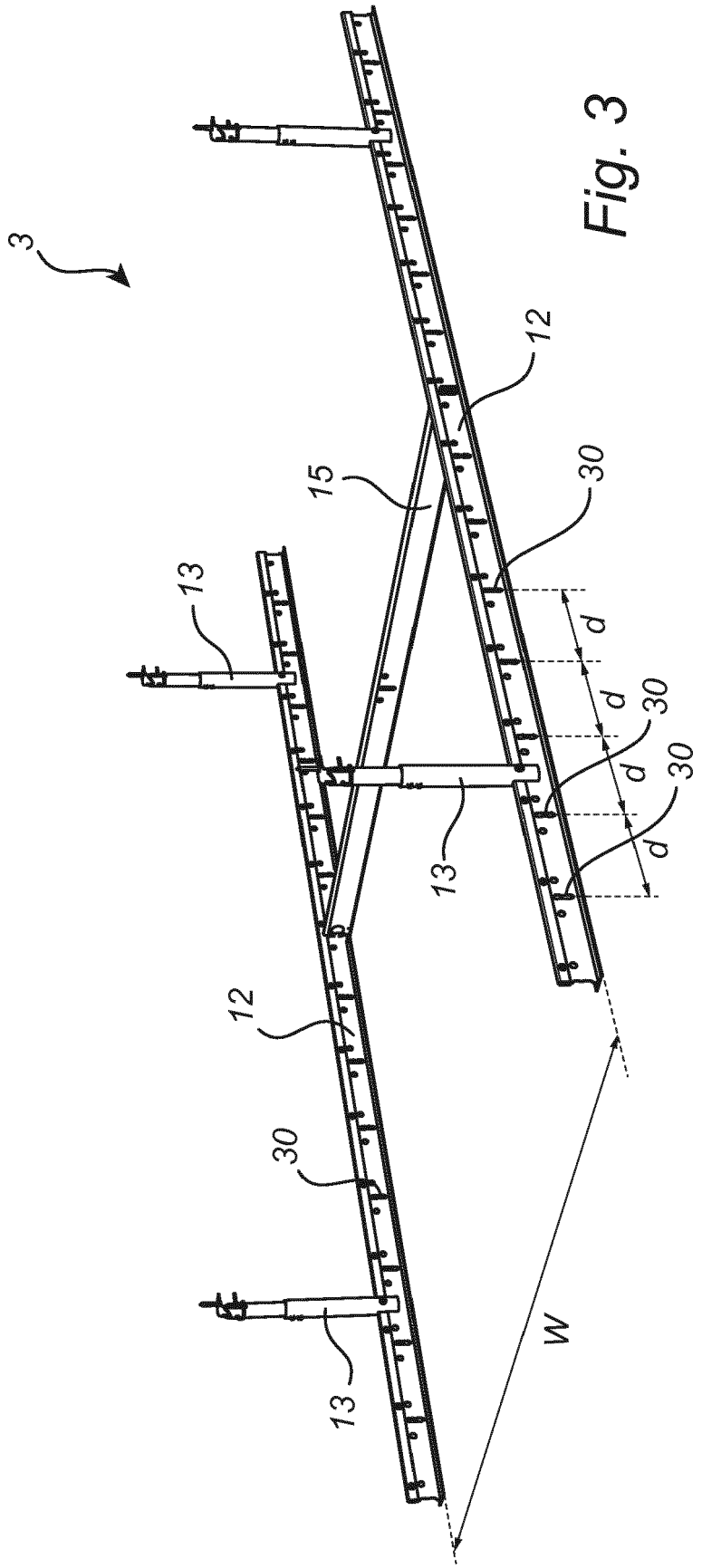

Fig. 3

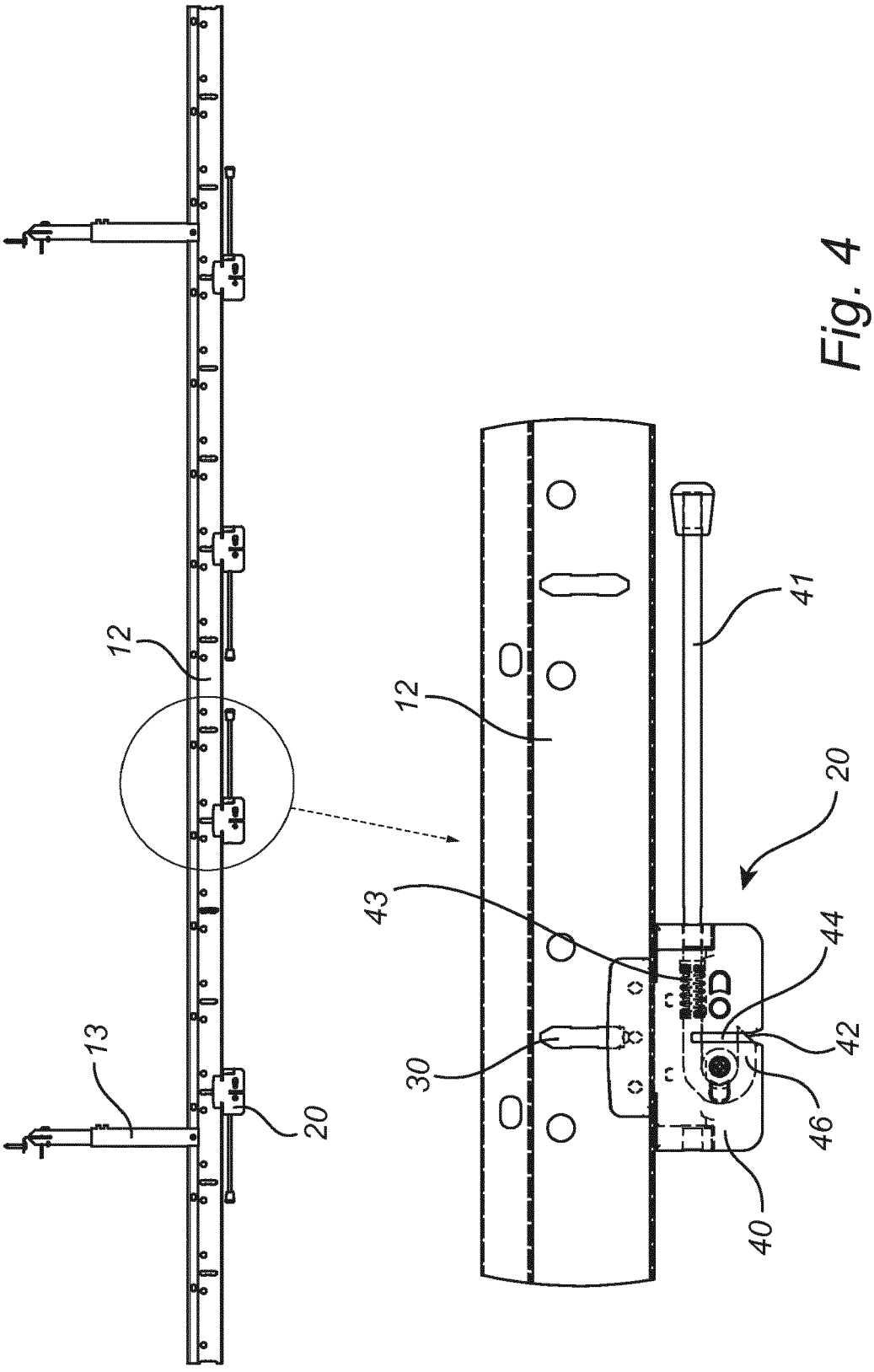

Fig. 4

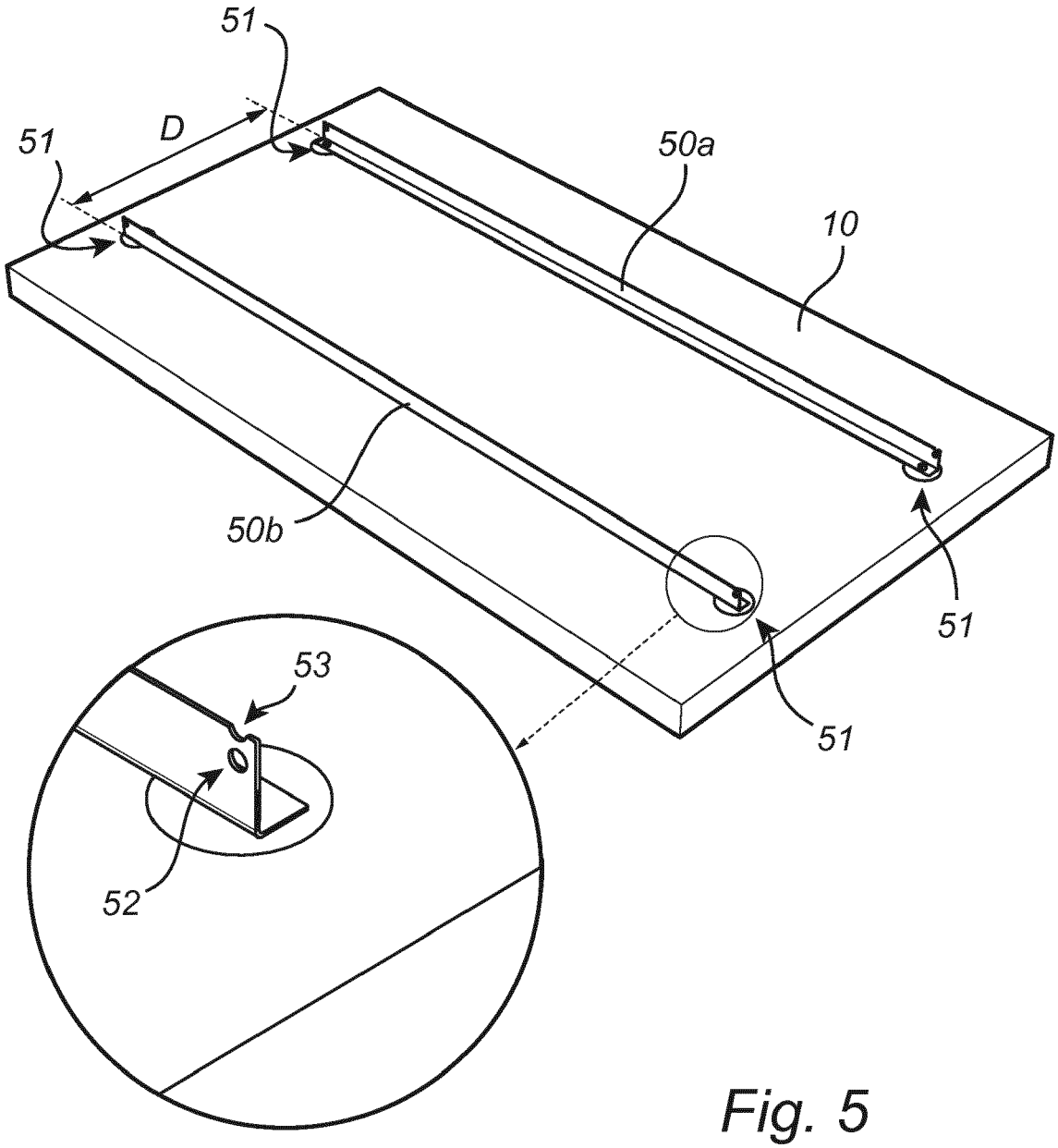

Fig. 5

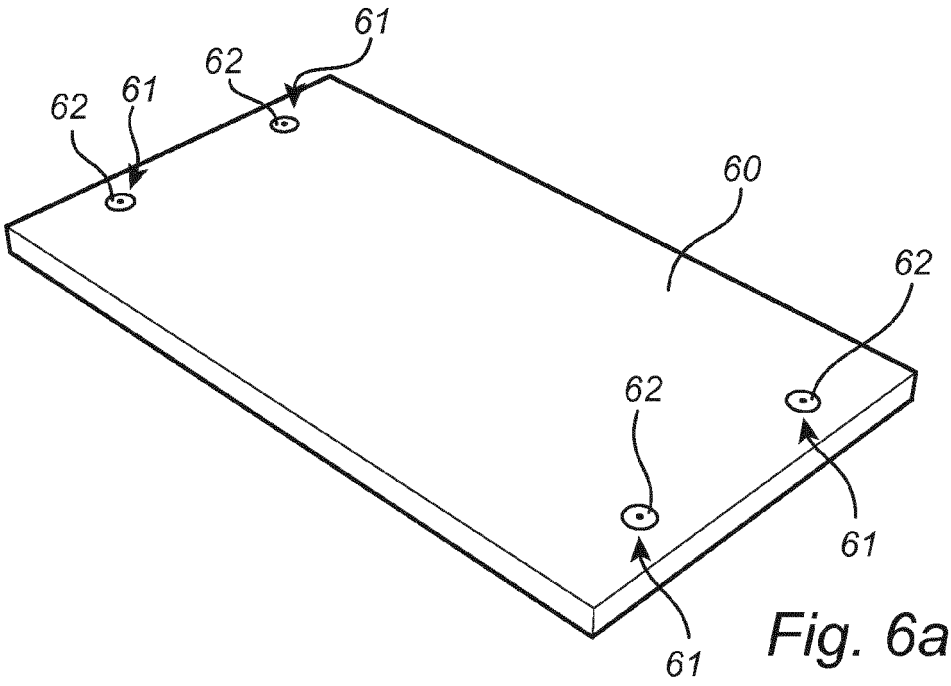

Fig. 6a

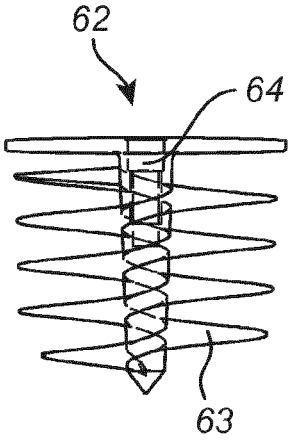

Fig. 6b

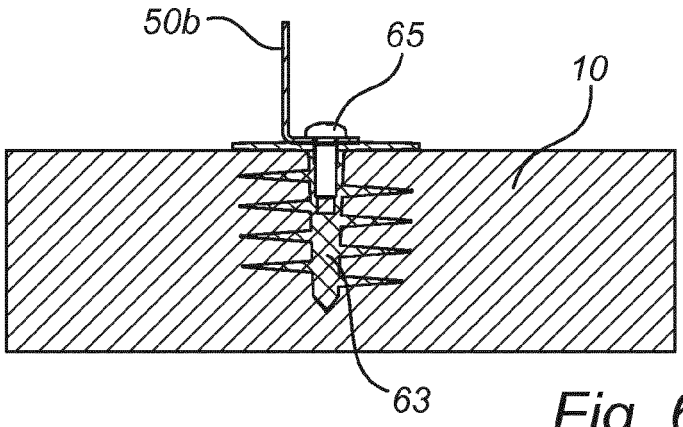

Fig. 6c

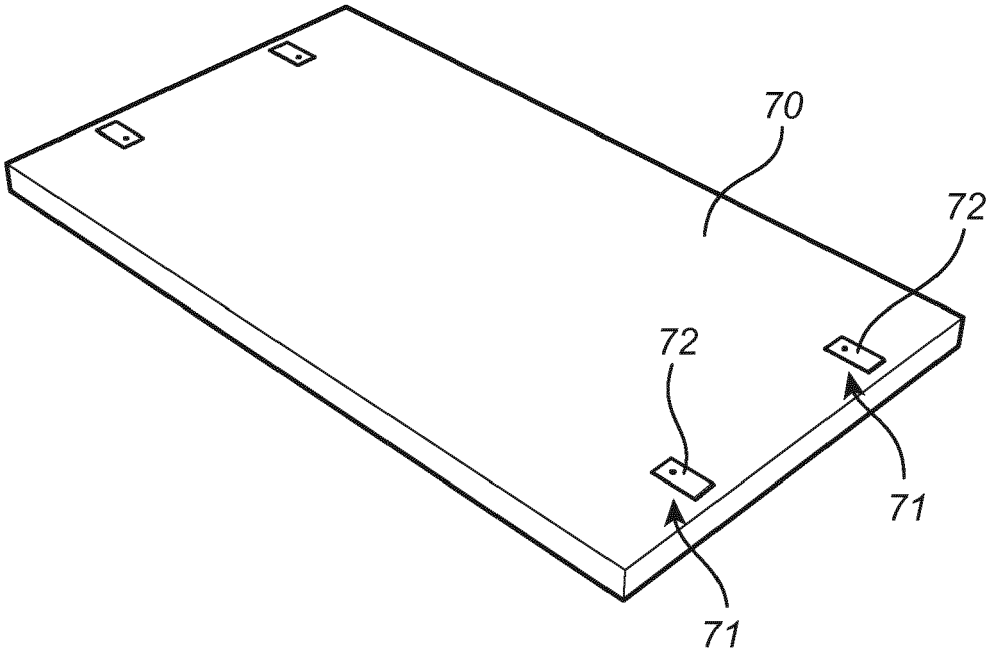

Fig. 7a

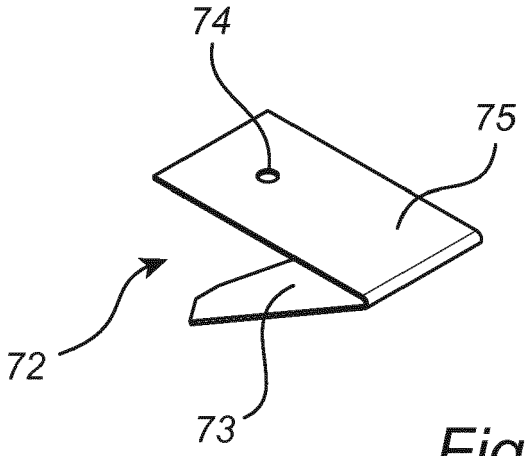

Fig. 7b

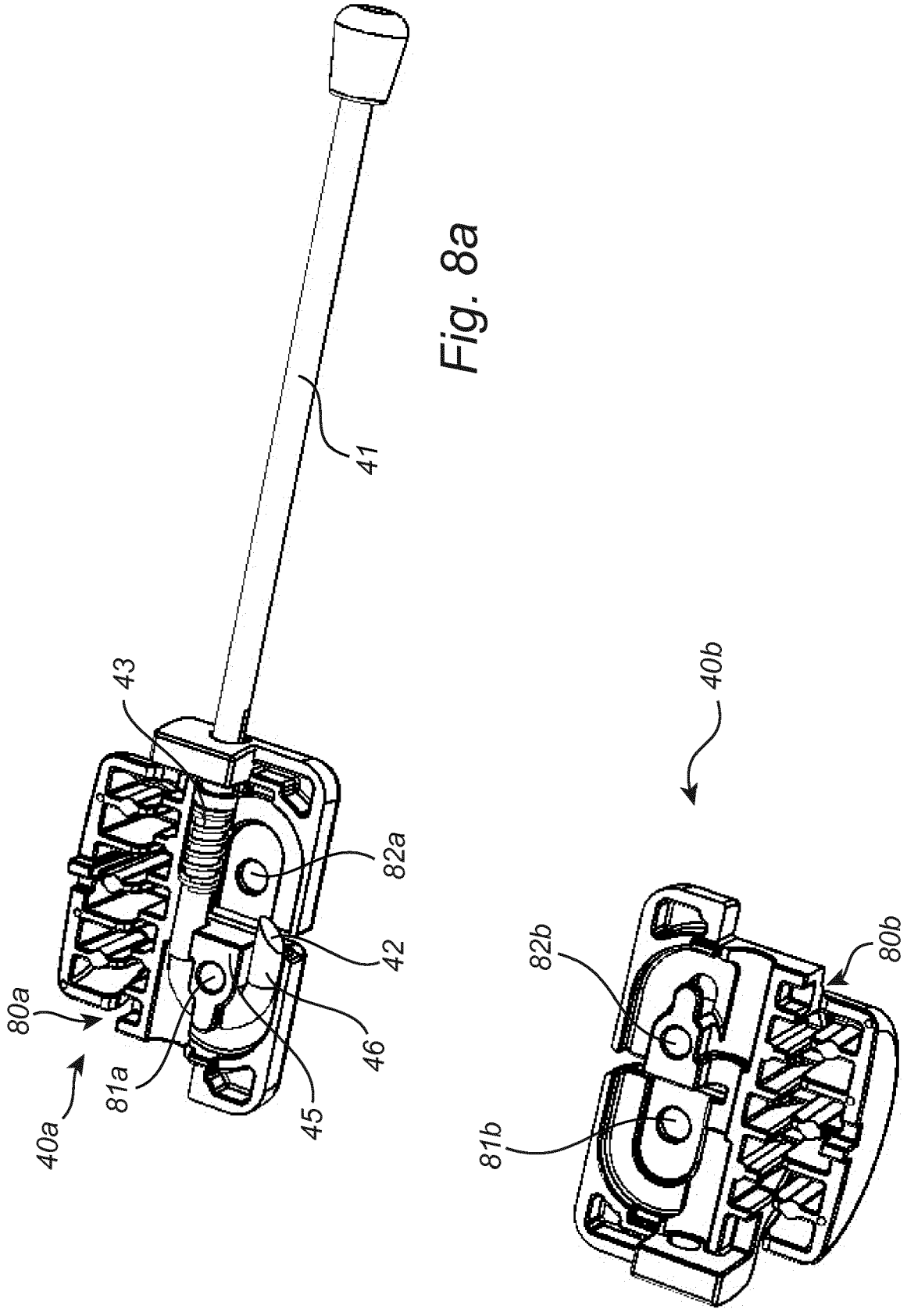

Fig. 8a

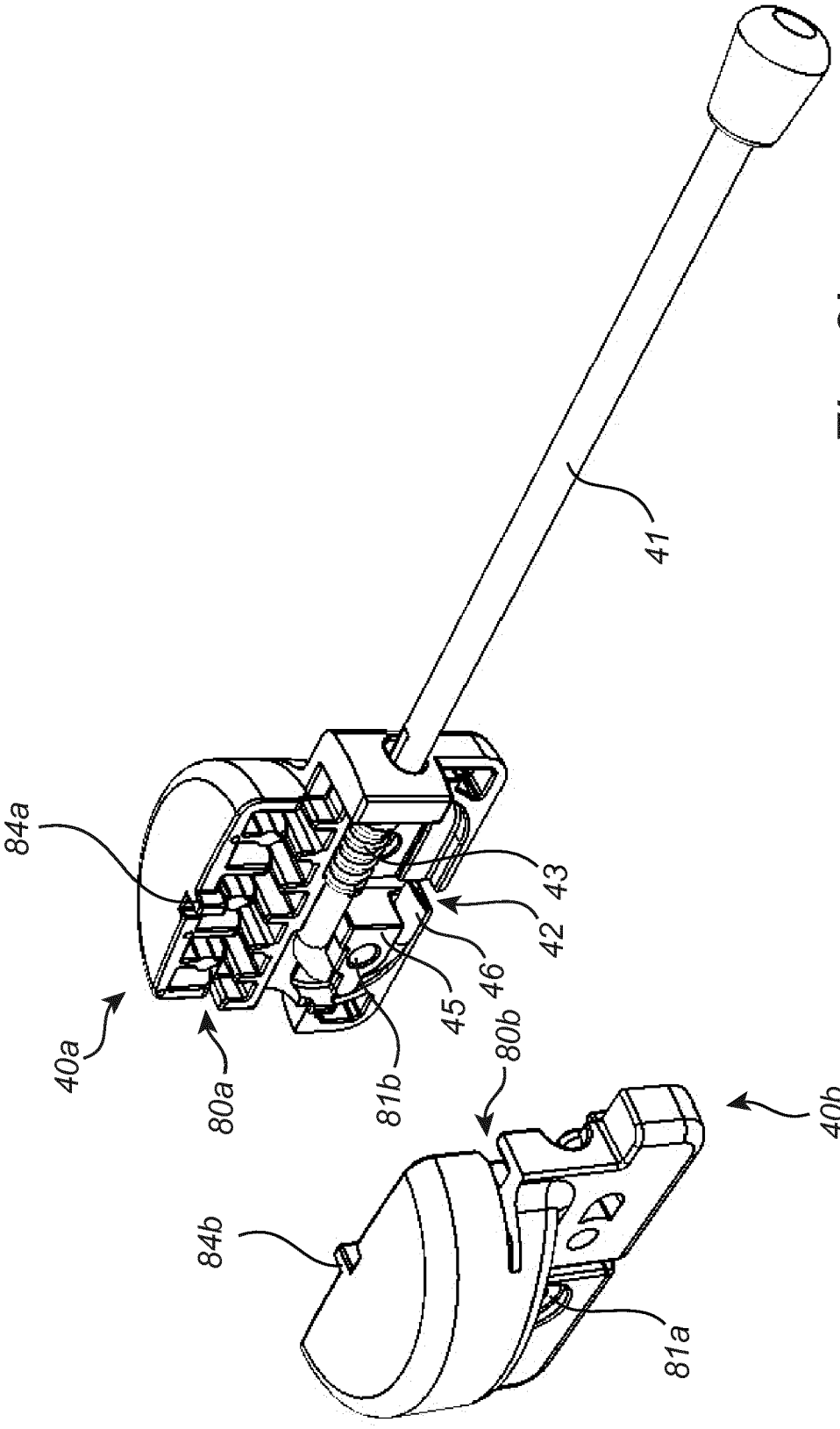

Fig. 8b

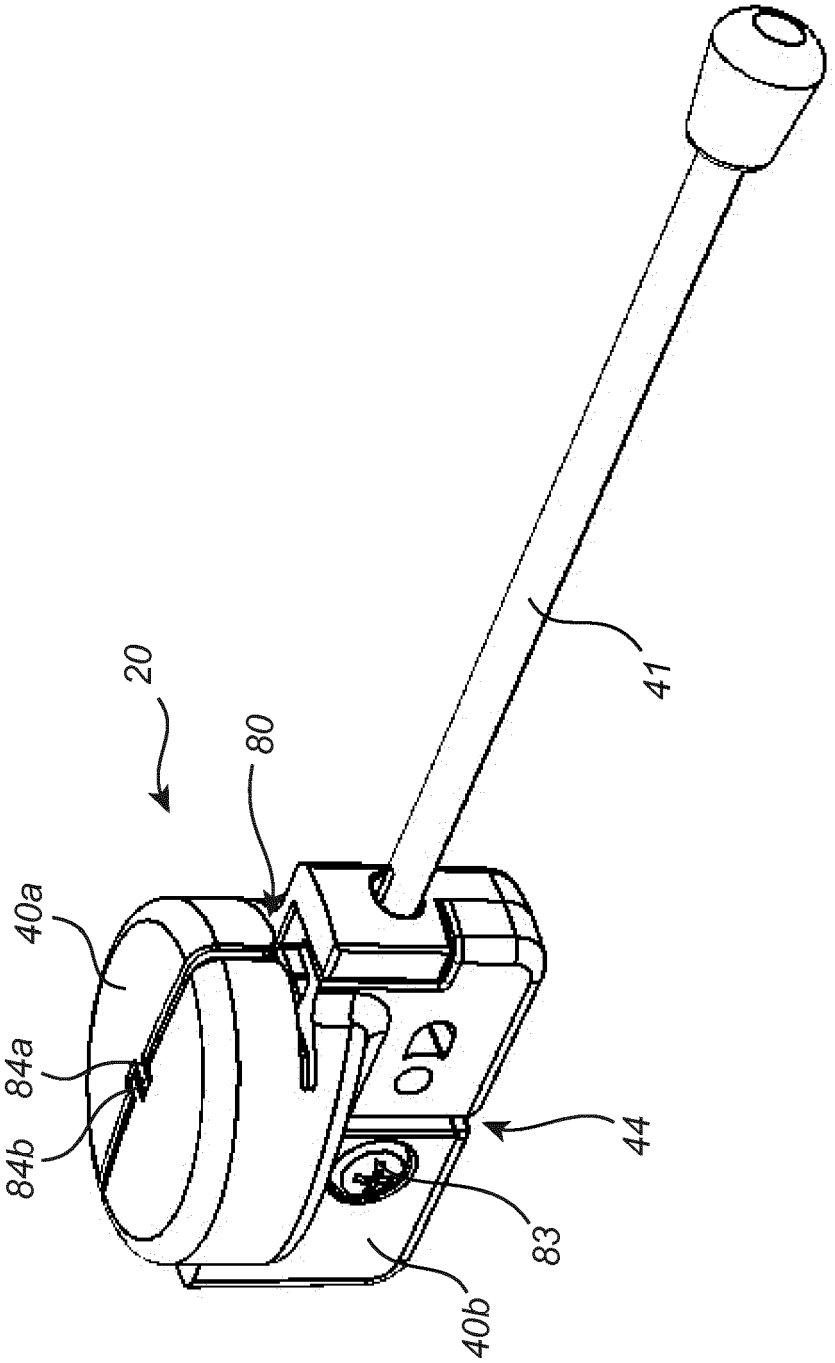

Fig. 8c

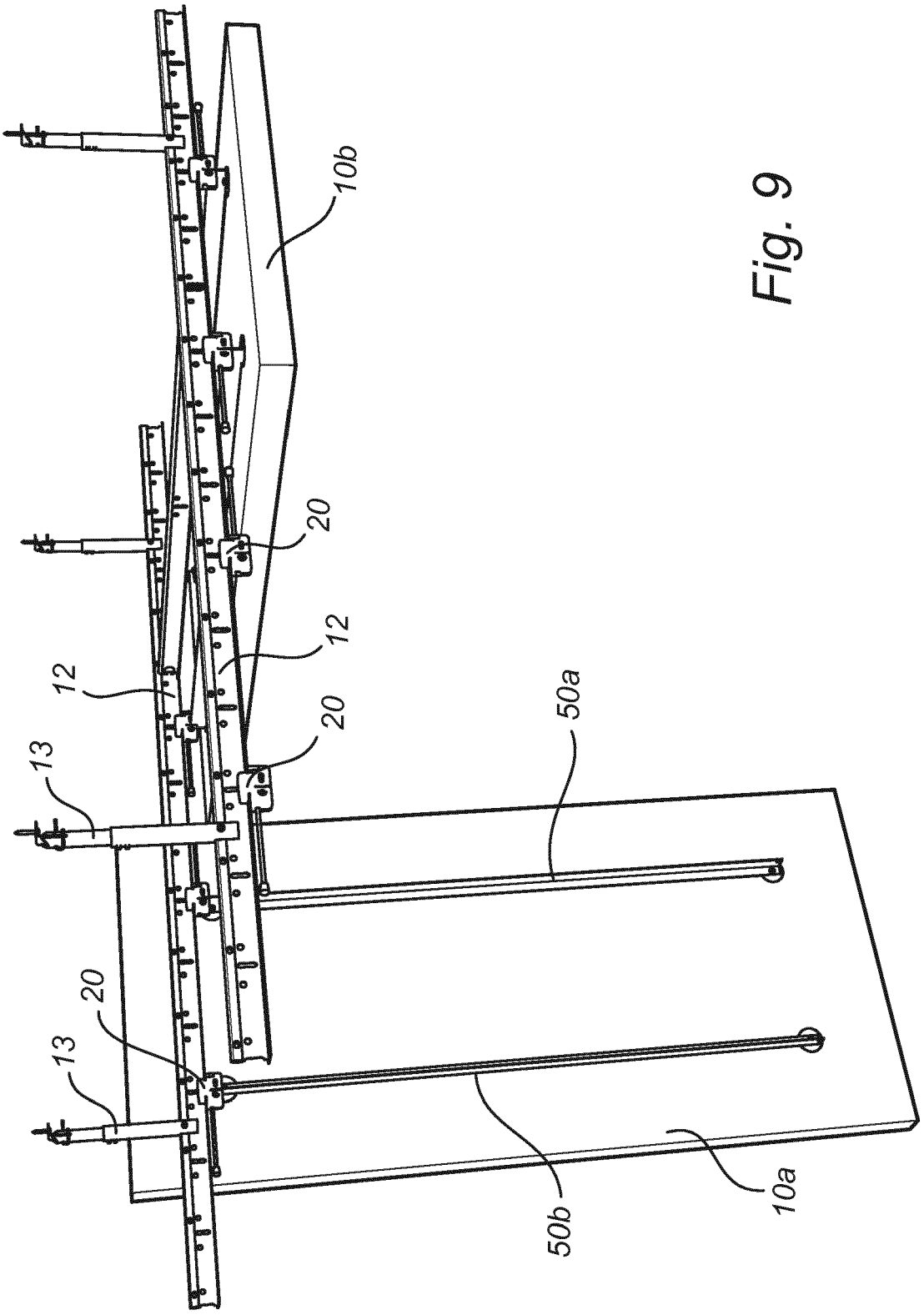

Fig. 9

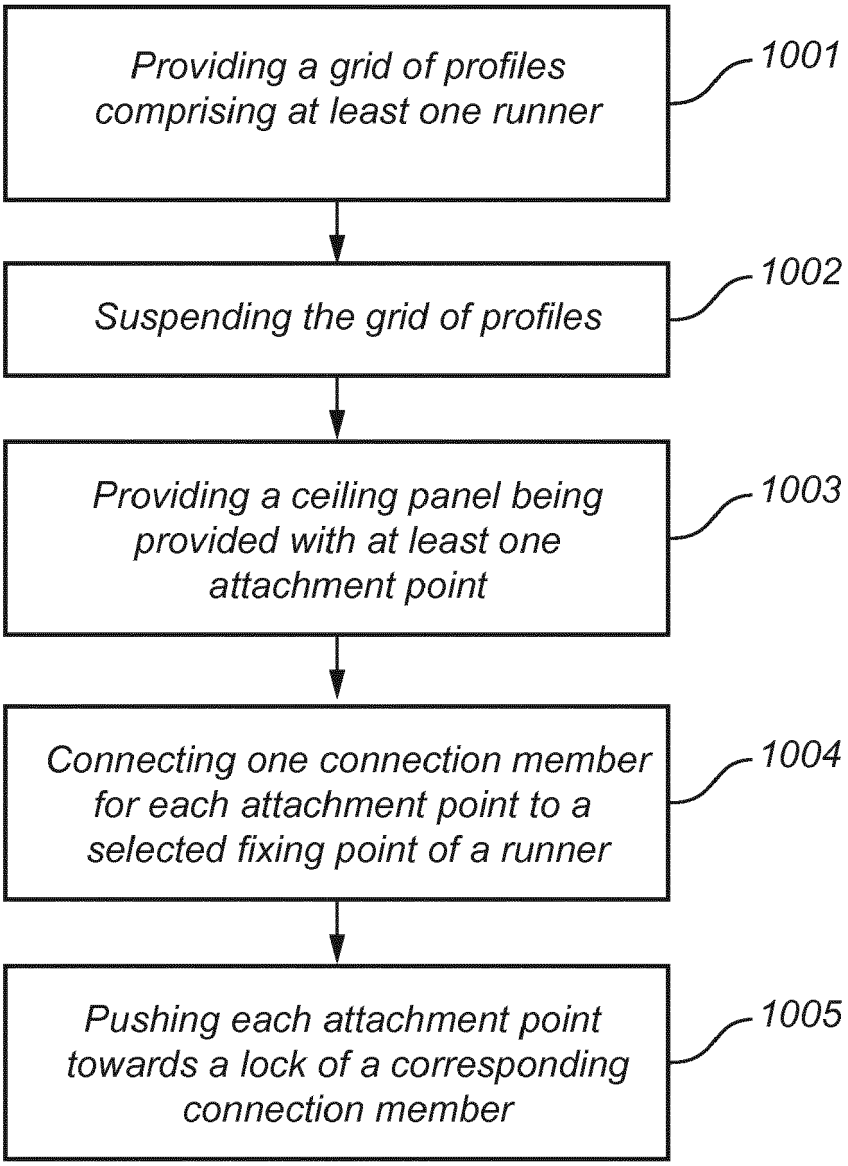
Providing a grid of profiles comprising at least one runner
1001
Suspending the grid of profiles
1002
Providing a ceiling panel being provided with at least one attachment point
1003
Connecting one connection member for each attachment point to a selected fixing point of a runner
1004
Pushing each attachment point towards a lock of a corresponding connection member
1005

Fig. 10

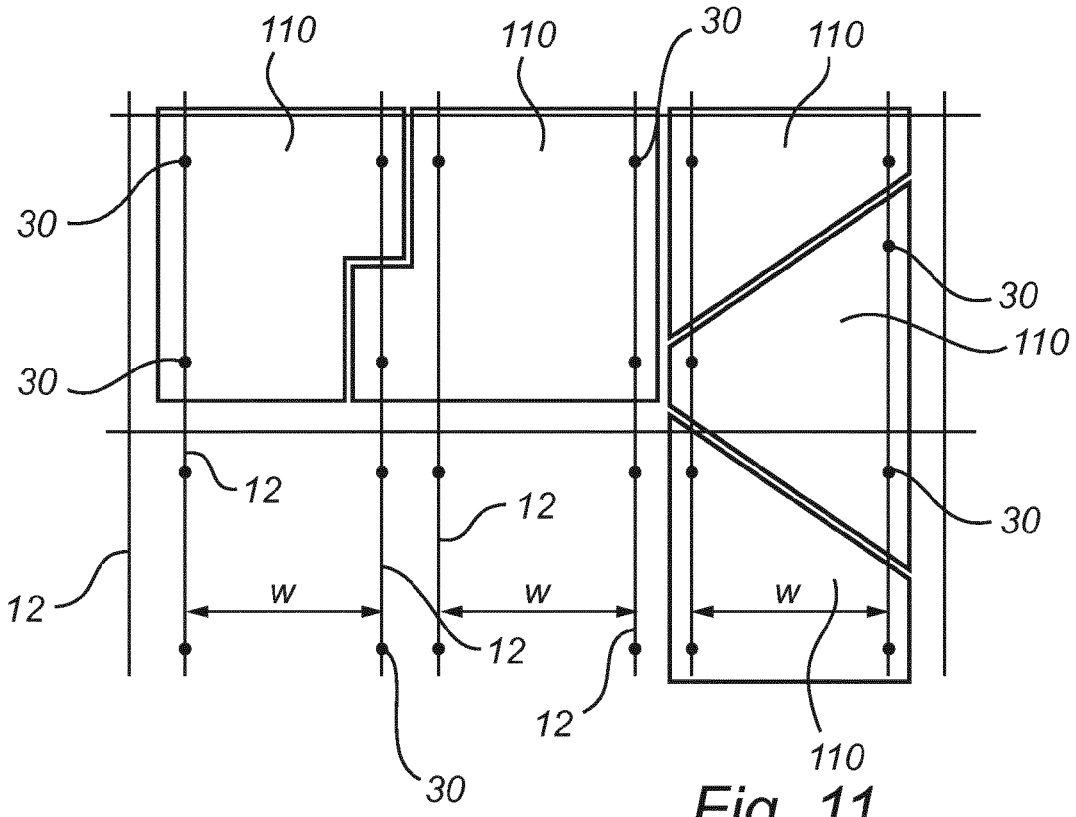
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Fig. 11

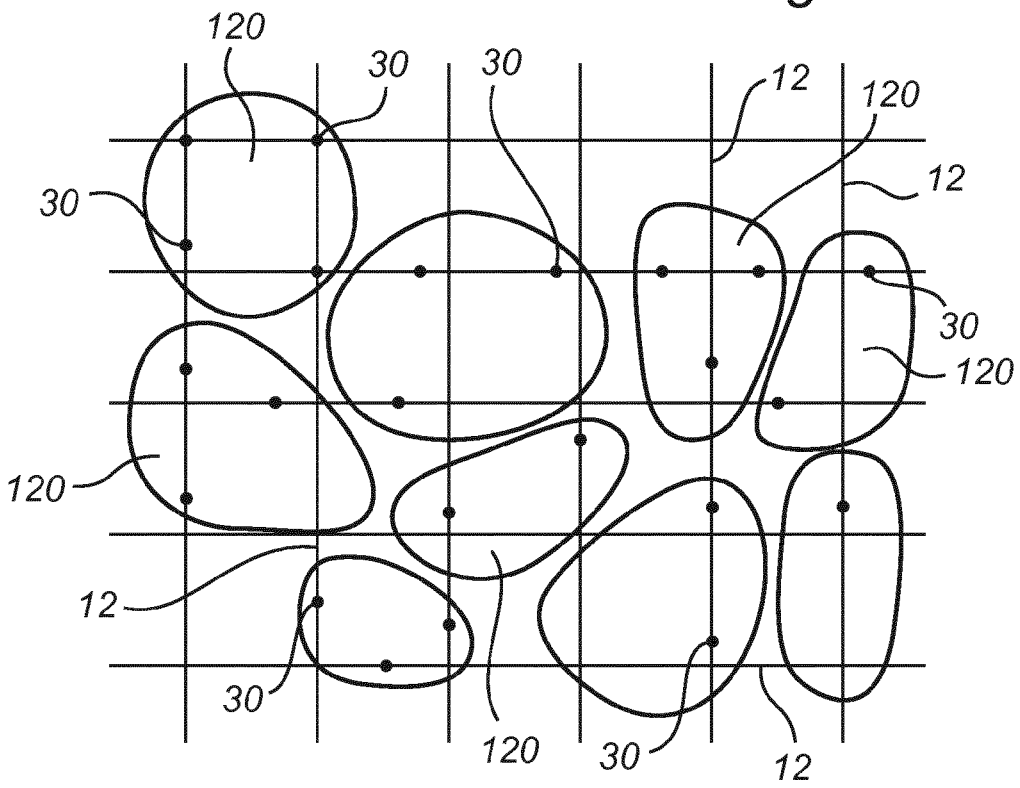
120
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Fig. 12

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EUROPEAN SEARCH REPORT

Application Number
EP 14 15 3164

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Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	26 June 2014	Bauer, Josef

CATEGORY OF CITED DOCUMENTS

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ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 14 15 3164

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For more details about this annex : see Official Journal of the European Patent Office, No. 12/82