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(54) A suspended ceiling and a method for providing a profile for a suspended ceiling

(57) The present invention relates to a suspended ceiling comprising a grid (10) and at least one ceiling tile (5), the grid (10) being formed of one or more profiles (2,3) and being adapted to support said at least one ceiling tile (5), wherein each profile (2,3) is adapted to be supported at at least two suspension points. Said at least one profile (2,3) of said one or more profiles comprises in an unloaded condition at least one upwardly curved portion, such that, in a loaded condition of said at least one profile (2,3), said at least one profile (2,3) extends such that a deflection of said at least one profile (2,3) is less than a predetermined value. The invention further relates to methods for providing a profile for a suspended ceiling.

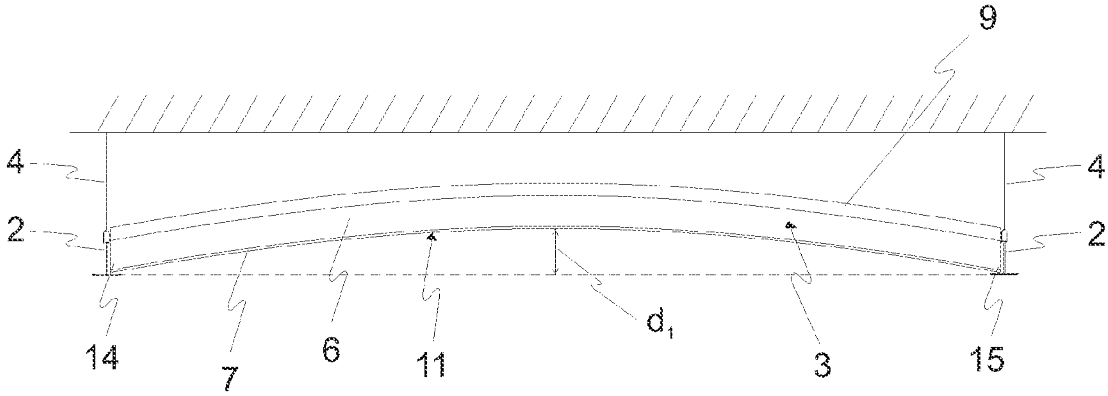

Fig 4b

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Description

Field of the invention

[0001] The present invention relates a suspended ceiling comprising a grid and at least one ceiling tile. The grid is formed of one or more profiles and is adapted to support said at least one ceiling tile, wherein each profile is adapted to be supported at at least two suspension points. The present invention also relates to a method for providing a profile for a suspended ceiling.

Technical background

[0002] Suspended ceilings can be installed in many different types of buildings for various reasons, for example 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 suspended ceiling usually comprises a plurality of ceiling tiles and a supporting structure in form of a grid. The grid comprises profiles which support the ceiling tiles. The grid often comprises main profiles which are suspended to the ceiling structure of the building and transverse or cross profiles which are supported by the main profiles. The profiles usually have an inverted T-shape. The ceiling tiles may have sound-absorbing and/or sound-insulation properties in order to improve the acoustic environment of the room. In order to obtain a relatively lightweight ceiling with satisfactory sound absorption, the tiles, for instance, may be made of a compressed fibre material such as mineral wool and especially glass wool.

[0004] In addition to ceiling tiles, the profiles may also support various equipments such as lightning devices, ventilation equipments, inspection openings, detectors, cable trays, loudspeakers, signs, sprinklers etc.

[0005] Consequently, the profiles are subjected to a load resulting from the weight of ceiling tiles or other equipment supported by the profile. A load on a profile causes deflection. The deflection is proportional to the load and strongly depends on the span between the points where the profile is supported. The deflection is also undesirable due to aesthetic reasons.

[0006] The deflection is measured as the maximum distance between the profile and an imaginary straight line between adjacent suspension points when the profile is in its loaded condition.

[0007] Various standards for suspended ceilings, for example EN 13964 include requirements on the maximum deflection allowed. EN 13964 allows a deflection (for instance measured in mm) not exceeding the distance the profile between the adjacent suspension points (for instance measured in mm) divided by 500 (for EN 13964 class 1), or for certain premises divided by 300 (EN 13964 class 2). However, the maximum deflection must be less or equal to 4,0 mm according to EN 13964 class 1.

[0008] One solution suggested in order to minimise the deflection of a loaded profile is to increase the bearing capacity of the profile. The profile may be strengthen in different ways, for example by increasing the material thickness of the profile, by adding stiffening grooves to the profile, or by adding a reinforcement bulb to a web of the profile. Another solution provided in the prior art in order to increase the torsional rigidity of the profile is to fold the profile such that the web has a layered structure and join different portions of the web of the profile by gluing, wedging or riveting. Examples of such solutions are found in WO 2009/087378 and in EP 2 099 983.

[0009] However, adding extra material or performing additional steps in the manufacturing process of the profile increases the cost for manufacturing each profile.

Summary of the invention

[0010] It is an object of the present invention to provide an improvement over the above described techniques and prior art.

[0011] A further object is to provide a suspended ceiling including a profile which withstands deflection better compared to the prior art solutions.

[0012] At least some of these and other objects and advantages that will be apparent from the description have been achieved by a suspended ceiling comprising a grid and at least one ceiling tile, the grid being formed of one or more profiles and being adapted to support said at least one ceiling tile, wherein each profile is adapted to be supported at at least two suspension points. At least one profile of said one or more profiles comprises in an unloaded condition at least one upwardly curved portion, such that, in a loaded condition of said at least one profile, said at least one profile extends such that a deflection of said at least one profile is less than a predetermined value.

[0013] The predetermined value may be a maximum allowed value according to any of existing or future standards.

[0014] Preferably, the deflection of said at least one profile in the loaded condition is less than a distance between two adjacent suspension points of said at least one profile divided by a factor of 300.

[0015] Preferably, the deflection of said at least one profile in the loaded condition is less than the distance between two adjacent suspension points of said at least one profile divided by a factor of 500.

[0016] By an unloaded condition is meant a condition wherein the profile is unaffected by the force of gravity resulting from the own weight of the profile and from any additional load in a vertical direction.

[0017] By a loaded condition is meant a condition wherein the profile is affected by the force of gravity resulting from the own weight of the profile and from any additional load in a vertical direction. The additional load may be both a uniformly distributed load and/or a point load.

[0018] By suspension points are meant a point wherein the profile is suspended, for example suspended by another profile, suspended by a suspension means, for example a hanger, or directly to the ceiling structure of the building by means of a fastening means.

[0019] By providing the profile with at least one curved portion extending between adjacent suspension points, the profile forms in its unloaded condition an upwardly curved line in the vertical direction, i.e. as seen in a plane perpendicular to the extension of the suspended ceiling. When a load is applied to the profile but also by the own weight of the profile, the profile is deformed by the load such that it extends more or less along a straight line, or is deflected such that the deflection is less than the distance between two adjacent suspension points of said at least one profile divided by a factor of 300. In some situations, if the load is light-weight compared to the rigidity of the profile, the profile may even remain slightly upwardly curved in the loaded direction. However, the requirement that the deflection is, for example, less than the distance between two adjacent suspension points of the profile divided by a factor of 300 is still fulfilled.

[0020] Consequently, it is possible to calculate the curvature required in the unloaded condition such that the profile, in the loaded condition, extends such that the deflection is less than a predetermined value, for example the distance between two suspension points divided by a factor of 300. The curvature in the unloaded condition of the profile is calculated such that the deflection of the profile in the loaded condition of the profile is less than a maximum allowed value, for example the deflection is less than the distance between two suspension points divided by a factor of 300.

[0021] By providing a profile with an upwardly curved portion between two suspension points in its unloaded condition, the profile can carry an increased load. For example, in the unloaded condition of the profile, the maximum distance in a vertical direction between an upwardly curved portion extending between two suspension points and an imaginary straight line extending between the suspension points is equal to the distance between the suspension points divided by 300. Thereby, the curved profile can carry a load being doubled compared to a conventionally straight profile until the maximum allowed deflection is reached according to various standards such as EN 13964, ASTM C635, BS 8290 part 2, DIN 18 168 and SS 81 51 13. By curving the profile even more, the curved profile can carry a load being more than doubled, still fulfilling the deflection requirement.

[0022] Consequently, the load that the profile can carry before reaching the maximum deflection allowed according to standards, for example EN 13964, is increased when using a profile having a curved portion compared to a conventional straight profile. A profile having an upwardly curved portion may therefore carry a larger load in form of more ceiling tiles, heavier ceiling tiles, more additional equipment etc, before an undesired deflection is obtained. As an example, by calculating the deflection which would occur if the profile would not be curved for a certain load, the profile may be curved such that the maximum distance in mm in the vertical direction between the curved portion in its unloaded condition and an imaginary straight line corresponds to the previous deflection. The profile may be even more curved in order to carry a larger load and still fulfil the deflection requirement.

[0023] Further, it is possible to decrease the material thickness of the profile if the profile comprises at least one upwardly curved portion. Thereby, the cost of the profile can be decreased since the consumption of material for each profile is reduced. A conventional profile which is not curved having a decreased material thickness would result in a deflection exceeding the allowed deflection for a certain load. If the same profile is provided with at least one curved portion, the deflection would be below the allowed deflection if the same load is applied. If a certain dimension is required for a profile in order to avoid a too large deflection when a load is applied, it is possible to diminish the dimension if a profile having at least one curved portion is used instead.

[0024] By reducing the deflection of profiles forming a suspended ceiling, a more aesthetically pleasing ceiling may be formed.

[0025] A grid for supporting a suspended ceiling usually comprises main profiles which are suspended to the ceiling structure and transverse profiles being suspended by the main profiles. The ends of the transverse profile may be suspended by the main profiles such that the transverse profile is extending between at least two main profiles. If the profile having at least one upwardly curved portion is a transverse profile, the profile in its unloaded condition comprises an upwardly curved portion between the two adjacent suspension points. If the upwardly curved profile is a main profile, the main profile is curved such that it in its unloaded condition comprises at least one curved portion in the vertical direction between two adjacent suspension points.

[0026] Furthermore, the grid supporting the suspended ceiling may comprise both conventional profiles and a profile or profiles having at least one upwardly curved portion. The profile having an upwardly curved portion may be both a main profile and a transverse profile. Alternatively, both types of profiles may comprise upwardly curved portions.

[0027] Said at least one profile may be plastically and/or elastically deformed in its unloaded condition. The upwardly curved portion may be formed in alternative ways. The upwardly curved portion may be formed by plastically deforming the profile such that at least one curved portion is formed. Thereby, the profile is plastically deformed in its unloaded condition. Plastically deformation may be performed by a roll forming operation. Alternatively, the curved portion may be formed by elastically deforming the profile such that at least one curved portion is formed. Thereby, the profile is elastically deformed in its unloaded condition. Elastically deforming may be achieved by introducing an internal state of stress into the profile. As a further alternative, a combination is also possible. The curved portion may be formed by both plastically and elastically deformed such that at least one curved portion is formed. The profile may thus be both elastically and plastically deformed in its unloaded condition.

[0028] Said at least one profile may be pre-stressed in its unloaded condition. The at least one upwardly curved portion may be formed by pre-stressing the profile. By pre-stressing the profile, the profile is elastically deformed such that at least one curved portion is formed. By pre-stressing the profile, an advantageous stress distribution is obtained. Tensile stress is formed at the upper parts of the profile due to the pre-stressing condition. The tensile stress improves the stability of the profile and reduces the risk of lateral-torsional buckling.

[0029] An internal state of stress may also be introduced into the profile by fixing a profile having at least one curved portion directly to the ceiling structure of the building. As alternative to being directly fixed to the ceiling structure, a spacing member may be arranged between the profile and the ceiling structure. The profile is fixed to the ceiling such that the profile extends along a straight line, preferably parallel to the ceiling. As a consequence of the curved profile being forced into a straight extension, an internal state of stress is introduced into the profile and the profile is thereby pre-stressed. Thus, the profile may carry an increased load without reaching a critical deflection. Alternatively, if the load remains the same as for a conventional profile, the material thickness of the profile may be reduced without reaching maximum allowed deflection.

[0030] Said at least one curved portion may be concavely curved in an upward direction in the unloaded condition of the profile as viewed from a side of the profile adapted to face the interior of a room when mounted in suspended ceiling. The curved portion is upwardly curved in a plane perpendicular to the plane of the suspended ceiling. When a load is applied to such a profile, the profile will deflect downwards such that it forms an essentially straight line, or deflects to a degree less than the allowed deflection defined in standards such as EN 13964.

[0031] Said at least one profile in its loaded condition may be elastically deformed by means of load applied and own weight such that in a loaded condition of said at least one profile, said at least one profile extends such that the deflection of said at least one profile is less than the predetermined value. For instance, the predetermined value may be the distance between two adjacent suspension points of said at least one profile divided by a factor of 300. In the loaded condition of the profile, the curved portion of the profile is deflected due the load applied and the own weight of the profile.

[0032] Said at least one profile may have a curvature in the same direction along its entire longitudinal extension in its unloaded condition. Thereby, a single upwardly curved portion is formed. The curved portion may be extending between two adjacent suspension points of the profile.

[0033] Said at least one profile may comprise a plurality of upwardly curved portions with respective curvature in the same direction along a longitudinal direction of the profile and transition portions between said upwardly curved portions in its unloaded condition. The profile may be supported at more than two suspension points. The curved portions may have a uniform radius.

[0034] A radius of curvature of a first curved portion may be different from a radius of curvature of a second of curved portion.

[0035] Said at least one profile may be a main profile adapted to be suspended to a ceiling structure or adapted to be suspended by another profile. The profile may be suspended to the ceiling structure by means of hangers. Alternatively, at its ends, the profile may be suspended by profiles attached to two opposite walls.

[0036] Said at least one profile may be a transverse profile adapted to be suspended by another profile. Such a transverse profile is normally only suspended at each end. As an example, the end portions of an transverse profile is resting on a first and a second main profile, respectively, and the transverse portion has a curved portion extending between the first and second main profiles by which the transverse profile is supported in its unloaded condition.

[0037] Said at least one profile may be fixed directly to a ceiling structure of a building. The profile may be in abutment with the ceiling. By fixing the profile having at least one curved portion directly to the ceiling structure, an internal state of stress may be introduced into the profile as previously described.

[0038] Said at least one profile may comprise a web and a flange. The flange may be adapted to support said at least one tile. For example, an edge portion of the ceiling tile may rest on the flange. Alternatively, the ceiling tile may be provided with a groove in which the flange is inserted such that the profile supports the ceiling tile.

[0039] Said at least one profile may further comprise a capping enclosing at least a portion of the flange. The capping may be used in order to pre-stress the profile such that at least one curved portion is formed. Further, the capping improves the visual appearance of the grid as seen from inside the room and hides parts of the profile.

[0040] Said at least one profile may be an inverted T-profile. The inverted T-profile includes a web extending in a vertical direction and a flange extending in a horizontal direction as seen in cross-section.

[0041] According to a second aspect of the invention, the present invention is realised by a method for providing a profile for a suspended ceiling, comprising providing a profile, and forming at least one upwardly curved portion of the profile by plastically deforming at least one portion of the profile, such that the profile in a loaded condition when forming part of suspended ceiling extends such that a deflection of said at least one profile is less than a predetermined value.

[0042] Preferably, the deflection of said at least one profile in the loaded condition is less than a distance between two adjacent suspension points of said at least one profile divided by a factor of 300.

[0043] Preferably, the deflection of said at least one profile in the loaded condition is less than the distance between two adjacent suspension points of said at least one profile divided by a factor of 500.

[0044] Such a profile having at least one upwardly curved portion extends in the loaded condition such that the deflection is less than a predetermined value determined according to a standard for suspended ceilings. Such an upwardly curved profile can carry a larger load without resulting in a deflection exceeding the allowed value according to various standards such as EN 13964. Alternatively, the material thickness of the profile can be reduced while deflection is maintained to an acceptable level. Thereby, material consumption of the profile may be reduced.

[0045] Consequently, it is possible to calculate the curvature required in the unloaded condition such that the profile, in the loaded condition, extends such that the deflection is less, for example, than the distance between two suspension points divided by a factor of 300. The curvature in the unloaded condition of the profile is calculated such that the deflection of the profile in the loaded condition of the profile is less than a maximum allowed value, for example the deflection is less than the distance between two suspension points divided by a factor of 300.

[0046] According to an alternative solution to the second aspect of the invention relating to the same problem, the present invention is realised by a method for providing a profile for a suspended ceiling, comprising providing a profile having a web and a flange, pre-stressing the profile by attaching a capping to the flange, wherein the length of the capping is less than the length of the profile.

[0047] The profile is pre-stressed by attaching the capping to the flange such that at least one upwardly curved portion is formed. By pre-stressing the profile, the profile is elastically deformed. The profile may form a part of a grid for a suspended ceiling.

[0048] Such a pre-stressed profile can carry a larger load without resulting in a deflection exceeding the allowed value according to various standards such as EN 13964. Alternatively, the material thickness of the profile can be reduced while deflection is maintained to an acceptable level. Thereby, material consumption of the profile may be reduced. Further, by pre-stressing the profile, an advantageous stress distribution is obtained. Tensile stress is formed at the upper parts of the profile, which improves the stability of the profile and reduces the risk of lateral-torsional buckling.

[0049] A combination of the two methods is also possible. In such case, the profile is both plastically and elastically deformed.

[0050] The step of providing a profile may comprise roll forming at least one sheet blank into a profile having a web and a flange, wherein after the profile has been provided, at least one upwardly curved portion is formed by a second roll forming step.

[0051] The method may further comprise providing a capping and attaching the capping to the flange. The capping may be attached to the flange after the profile has been provided with at least one curved portion. Alternatively, the capping may already be attached to the flange before the profile is provided with at least one curved portion.

[0052] The step of attaching the capping to the flange may comprise folding the capping over at least a portion of the flange.

[0053] The step of attaching the capping to the flange may comprise folding, gluing, welding and/or riveting the capping to the flange.

[0054] According to a third aspect of the invention, the present invention is realised by a profile for forming part of a grid for suspended ceiling. The profile is adapted to be supported at at least two suspension points. The profile comprises in an unloaded condition at least one upwardly curved portion, such that, in a loaded condition of said profile, said profile extends such that a deflection of said profile is less than a predetermined value.

[0055] Preferably, the deflection of said at least one profile in the loaded condition is less than a distance between two adjacent suspension points of said at least one profile divided by a factor of 300.

[0056] Preferably, the deflection of said at least one profile in the loaded condition is less than the distance between two adjacent suspension points of said at least one profile divided by a factor of 500.

Brief description of the drawings

[0057] 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.

Fig. 1 schematically discloses a suspended ceiling.

Fig. 2a discloses an inverted T-profile.

Fig. 2b discloses the inverted T-profile in fig. 2a in cross-section.

Fig. 3 discloses the deflection of a suspended profile in a loaded condition.

Fig. 4a discloses a curved transverse profile in an unloaded condition.

Fig. 4b discloses the transverse profile in fig. 4a when being suspended.

Fig. 4c discloses the transverse profile in fig. 4b in a loaded condition.

Fig. 5a discloses a curved main profile in an unloaded condition.

Fig. 5b discloses the main profile in fig. 5a when being suspended.

Fig. 5c discloses the main profile in fig. 5b in a loaded condition.

Fig. 6a discloses a curved main profile in an unloaded condition.

Fig. 6b discloses the main profile in fig. 6a when being suspended.

Fig. 6c discloses the main profile in fig. 6b in a loaded condition.

Fig. 7a discloses a main profile having three curved portions in an unloaded condition.

Fig. 7b discloses the main profile in fig. 7a when being suspended at three suspension points.

Fig. 7c discloses the main profile in fig. 7b in a loaded condition.

Fig. 8a discloses a main profile having a plurality of curved portions in an unloaded condition.

Fig. 8b discloses the main profile in fig. 8a when being suspended.

Fig. 8c discloses the main profile in fig. 8b in a loaded condition.

Fig. 9a discloses a main profile having a plurality of curved portions in an unloaded condition.

Fig. 9b discloses the main profile in fig. 9a when being suspended.

Fig. 9c discloses the main profile in fig. 9b in a loaded condition.

Fig. 10a discloses a curved main profile in an unloaded condition.

Fig. 10b discloses the main profile in fig. 10a when being suspended to the ceiling structure.

Fig. 10c discloses the main profile in fig. 10b in a loaded condition.

Fig. 11 schematically discloses a roll forming process for forming a curved portion of a profile.

Detailed description

[0058] Fig. 1, to which now is referred, shows schematically a suspended ceiling 1. The suspended ceiling 1 is attached to the ceiling structure of the building. The suspended ceiling 1 comprises a grid 10 and a plurality of ceiling tiles 5. The grid 10 comprises one or more profiles 2, 3. In the shown embodiment, the grid 10 comprises profiles of two types; main profiles 2 extending in a first direction and transverse profile 3 extending in a direction perpendicular to the first direction. The main profiles 2 are suspended to the ceiling structure by means of suspension means 4, for example hangers. In some embodiments (not shown), the main profiles may be suspended by profiles attached to two opposite walls along the walls. The transverse profiles 3 are suspended by the main profiles 2. Consequently, the main profiles 2 support both the ceiling tiles 5 forming the ceiling and the transverse profiles 3, and any additional load. Such additional load may be various equipments such as lightning devices, ventilation equipments, inspection openings, detectors, cable trays, loudspeakers, signs, sprinklers etc. By load is meant both load resulting from the own weight of the profile and applied load in form of ceiling tiles, other profiles, additional load as described above etc.

[0059] The ceiling tiles 5 may be made of man-made mineral fibre, such as a compressed mineral fibre material. More specifically, the mineral fibre material may be mineral wool, especially glass wool. In addition to the mineral fibre material, the ceiling tiles 5 comprise a binder. The ceiling tiles 5 may further comprise at least one surface layer.

[0060] A profile 2, 3 will now be described in more detail with reference to figs. 2a-b. The profile 2, 3 in figs. 2a-b may be both a main profile and a transverse profile. The profile 2, 3 is in the shown embodiment an inverted T-profile, having an inverted T-shaped cross-section as shown in fig. 2b. The profile 2, 3 has an elongated extension. The profile 2, 3 comprises a web 6, a flange 7 and a capping 8. The web 6 is extending in vertical direction. The web 6 comprises a bulb 9. The flange 7 is extending in the horizontal direction. The flange 7 is adapted to support ceiling tiles 5. An edge portion of the ceiling tile 5 may rest on the flange 7. Alternatively, the ceiling tile 5 is provided with a groove in which the flange 7 is inserted such that the profile 2, 3 supports the ceiling tile 5. The capping 8 is attached to the flange 7. The capping 8 is extending along the flange 7. The capping 8 is folded over at least a portion of the flange 7. The capping 8 is covering at least a surface of the flange 7 facing the room when being suspended. Thereby, the underside of the flange 7 is not visible from the room, only the capping 8. The capping 8 may be attached to the flange 7 by means of folding, gluing, welding and/or riveting the capping to the flange, or a combination thereof.

[0061] The profile 2, 3 may be produced in a roll forming operation in which two sheets of metal is folded into a profile 2, 3.

[0062] A load on a profile 2, 3 will cause deflection of the profile, which is shown in fig. 3. The deflection f is proportional to the load and strongly depends on the distance L between the points where the profile is supported. Load includes the own weight of the profile 2, 3, ceiling tiles 5 supported by the profile 2, 3, other profiles supported by the profile, additional loads such as lightning devices, ventilation equipments, inspection openings, detectors, cable trays, loudspeakers, signs, sprinklers etc. The total load deforms the profile 2, 3 such that deflection of the profile 2, 3 occurs. Fig. 3 shows a conventional profile in a loaded condition. In its unloaded condition, the conventional profile is extending along a straight line. In its loaded condition, the profile becomes slightly curved as shown in fig. 3. The deflection f is measured as a maximum distance f between the profile and an imaginary straight line extending between the suspension points of the profile.

[0063] The decisive factor has been that the deflection, for example measured in mm, should be less than a predetermined value, for example less than the distance L between the suspension points, for example measured in mm, divided by a factor of 300, i.e. maximum allowed deflection is f=L/300. However, according to EN13964 class 1, the maximum deflection allowed is 4 mm.

[0064] Figs. 4a-4c shows a profile 3 according to a first embodiment of the invention. The profile 3 in figs. 4a-c is a transverse profile 3 adapted to be supported by main profiles 2 at its ends.

[0065] In fig. 4a, the profile 3 is in its unloaded condition. The profile 3 is plastically and/or elastically deformed such that it is slightly curved in its unloaded condition. The profile 3 thereby has one upwardly curved portion 11 extending along its longitudinal extension. The curved portion 11 is extending between the suspension points 14, 15. The profile 3 has a curvature in the same direction along its entire longitudinal extension. In this embodiment, the profile 3 has a constant curvature along its longitudinal extension. However, in other embodiments, the profile may have a varying curvature along its longitudinal extension. The profile 3 is upwardly curved in a vertical direction, i.e. in a plane perpendicular to the plane of the suspended ceiling 1 when mounted. The profile 3 is concavely curved in an upward direction as viewed from a side of the profile adapted to face the interior of a room when mounted in a suspended ceiling.

[0066] In its unloaded condition, as shown in fig. 4a, the profile 3 is curved such that the maximum distance between an imaginary straight line between the end points of the profile and the curved portion of the profile 3 is do.

[0067] Fig. 4b shows the transverse profile 3 in fig. 4a when being suspended in a suspended ceiling 1. The profile 3 is suspended by main profiles 2. Each end of the profile 3 rests on a main profile 2. The load of the own weight of the profile 3 may reduce the curvature of profile 3 and make the profile 3 slightly more straight. The curvature of the profile 3 may be reduced by the own load of the profile 3 such that the maximum distance d_1 between an imaginary straight line between the suspension points and the profile 3 is less than d_0.

[0068] Fig. 4c shows the transverse profile 3 in a loaded condition when forming part of a grid 10 for suspended ceiling 1. In the loaded condition, the load deforms the profile 3 such that the profile assumes an essentially linear extension. The load includes the own weight of the profile 3 and external load applied, such as weight of ceiling tiles 5. The load deflects the profile 3 such that the curvature becomes straightened or deflected. By essentially linear extension is meant that the maximum deflection f is less than a predetermined value, for example the distance L measured in mm between the two adjacent suspension points 14, 15 of the profile 3 divided by a factor of 300.This implies that the profile 3 in its loaded condition may be straight, or may be slightly curved or deflected, as long as the deflection does not exceed the predetermined value, for example the distance L between two adjacent suspension points 14, 15 of the profile 3 divided by a factor of 300. As long as the maximum deflection is not exceeded, the profile 3 may be both slightly convexly curved or slightly concavely curved in its loaded condition. Deflection around L/400 is possible to for the human eye to detect. By keeping the deflection below L/500, the human eye will not detect the deflection.

[0069] As an example, the distance between the suspension points for the transverse profile 3 in fig. 4c may be 1200 mm. The maximum allowed deflection is then 1200/300=4 mm. As an example, the transverse profile 3 may be curved such that in its unloaded condition, the maximum distance do between the profile 3 and an imaginary straight line extending between the ends of the profile 3 is 4 mm. Thereby, the transverse profile 3 may carry a load being doubled compared to a conventional straight profile without increasing the deflection in its loaded condition. Alternatively, it is possible to make the profile 3 weaker while maintaining the same deflection in its loaded condition. However, by curving the profile even more by increasing the distance do between the profile 3 and an imaginary straight line extending between the ends of the profile 3, the profile can carry a load being more than doubled still fulfilling the deflection requirement.

[0070] Figs. 5a-c discloses a profile 2 according to a second embodiment of the invention. In figs. 5a-c, the profile is a main profile 2 being suspended to the ceiling structure at two suspension points 16, 17 by means of suspension means 4. Alternatively, the main profile 2 may be supported by profiles (not shown), for example profiles attached to two opposite walls.

[0071] In fig. 5a, the profile 2 is in its unloaded condition before being suspended to the ceiling. The profile 2 is plastically and/or elastically deformed such that it is slightly curved in its unloaded condition. The profile 2 thereby has one upwardly curved portion 21 extending along its longitudinal extension. When suspended, the curved portion 21 will be extending between two suspension points 16, 17. The profile 2 has a curvature in the same direction along its entire longitudinal extension. In this embodiment, the profile 2 has a constant curvature along its longitudinal extension. However, in other embodiments, the profile may have a varying curvature along its longitudinal extension. The profile 2 is upwardly curved in a vertical direction, i.e. in plane perpendicular to the plane of the suspended ceiling 1. The profile 2 is concavely curved in an upward direction as viewed from a side of the profile adapted to face the interior of a room when mounted in a suspended ceiling.

[0072] In its unloaded condition, as shown in fig. 5a, the profile 2 is curved such that the maximum distance between an imaginary straight line extending between end points of the profile 2 and the curved portion of the profile 2 is do.

[0073] Fig. 5b shows the main profile 2 in fig. 5a when being suspended to the ceiling structure by suspension means 4. The profile 2 is suspended at its respectively ends 16, 17. The profile 2 is upwardly curved. However, the load of the own weight of the profile 3 may reduce the curvature of profile 2 to some extent and make the profile 2 more straight. The curvature of the profile 2 may be reduced by the own load of the profile 2 such that the maximum distance d_1 between an imaginary straight line between the suspension points and the profile 2 is less than d_0.

[0074] Fig. 5c shows the main profile 2 in a loaded condition when forming part of a grid 10 for a suspended ceiling 1. In the loaded condition, the load deforms the profile 2 such that the profile 2 assumes an essentially linear extension or deflected extension. The load includes the own weight of the profile 2 and external load applied, such as weight of ceiling tiles 5 and of transverse profiles 3 suspended by the main profile 2. The load deflects the profile 2 such that the curvature is straightened or deflected downwards. By essentially linear extension is meant that the maximum deflection is equal or is less than a predetermined value, for example the distance L measured in mm between the two adjacent suspension points 16, 17 of the profile 2 divided by a factor of 300.This implies that the profile 2 in its loaded condition may be straight, or may be slightly curved, as long as the deflection f does not exceed the predetermined value, for example the distance L measured two adjacent suspension points of said at least one profile divided by a factor of 300. As long as the maximum deflection is not exceeded, the profile 2 may be both slightly convexly curved or slightly concavely curved in its loaded condition.

[0075] As an example, the distance between the suspension points 16, 17 for the main profile 2 in fig. 4c may be 1200 mm. The maximum allowed deflection is then 1200/300=4 mm. The main profile 2 may be curved such that in its unloaded condition, the maximum distance d between the profile 2 and an imaginary straight line extending between the ends of the profile 2 is 4 mm. Thereby, the main profile 2 may carry a load being doubled compared to a conventional straight profile without increasing the deflection in its loaded condition. Alternatively, it is possible to make the profile 2 weaker while maintaining the same deflection in its loaded condition. However, by curving the profile 2 even more by increasing the distance do between the profile 2 and an imaginary straight line extending between the ends of the profile 2, the profile can carry a load being more than doubled still fulfilling the deflection requirement.

[0076] Figs. 6a-c discloses a profile 2 according to a third embodiment of the invention. In figs. 6a-c, the profile is a main profile 2 being suspended to the ceiling structure at three suspension points 16, 17, 18 by means of suspension means 4, for example hangers. Alternatively, the main profile 2 may be supported by profiles attached to two opposite walls at its ends (not shown).

[0077] In fig. 6a, the profile 2 is in its unloaded condition before being suspended to the ceiling. The profile 2 is plastically and/or elastically deformed such that it is slightly curved in its unloaded condition. The profile 2 thereby has one upwardly curved portion 21 extending along its longitudinal extension. When suspended, the curved portion 21 will be extending between three suspension points 16, 17, 18. The profile 2 has a curvature in the same direction along its entire longitudinal extension. In this embodiment, the profile 2 has a constant curvature along its longitudinal extension. However, in other embodiments, the profile may have a varying curvature along its longitudinal extension. The profile 2 is upwardly curved in a vertical direction, i.e. in plane perpendicular to the plane of the suspended ceiling 1 when mounted. The profile 2 is concavely curved in an upward direction as viewed from a side of the profile adapted to face the interior of a room when mounted in a suspended ceiling.

[0078] In its unloaded condition, as shown in fig. 6a, the profile 2 is curved such that the maximum distance between an imaginary straight line extending between end points of the profile 2 and the curved portion of the profile 2 is do.

[0079] Fig. 6b shows the main profile 2 in fig. 6a when being suspended to the ceiling structure by suspension means 4. The profile 2 is suspended at its respectively ends. The profile 2 is upwardly curved. However, the load of the own weight of the profile 2 may reduce the curvature of profile 2 to some extent and make the profile 2 more straight. The curvature of the profile 2 may be reduced by the own load of the profile 2 such that the maximum distance d_1 between an imaginary straight line between the suspension points and the profile 2 is less than d_0.

[0080] When being suspended to the ceiling structure but still not carrying any additional load, as shown in fig. 6b, the profile 2 may not be supported at the second suspension point 17, due to the curvature of the profile 2.

[0081] Fig. 6c shows the main profile 2 in a loaded condition when forming part of a grid 10 for a suspended ceiling 1. In the loaded condition, the load deforms the profile 2 such that the profile 2 assumes an essentially linear extension or deflected extension. The load includes the own weight of the profile 2 and external load applied, such as weight of ceiling tiles 5 and of transverse profiles 3 suspended by the main profile 2. The load deflects the profile 2 such that the curvature is straightened or deflected downwards. By essentially linear extension is meant that the maximum deflection f is less than a predetermined value, for example the distance L measured in mm between the two adjacent suspension points 16, 17 of the profile 2 divided by a factor of 300.This implies that the profile 2 in its loaded condition may be straight, or may be slightly curved, as long as the deflection f does not exceed the predetermined value, for example the distance L measured two adjacent suspension points of said at least one profile divided by a factor of 300. As long as the maximum deflection f is not exceeded, the profile 2 may be both slightly convexly curved or slightly concavely curved in its loaded condition.

[0082] As an example, the distance between the suspension points 16, 17 for the main profile 2 in fig. 4c may be 1200 mm. The maximum allowed deflection is then 1200/300=4 mm. The main profile 2 may be curved such that in its unloaded condition, the maximum distance d between the profile 2 and an imaginary straight line extending between the ends of the profile 2 is 4 mm. Thereby, the main profile 2 may carry a load being more than doubled compared to a conventional straight profile without increasing the deflection in its loaded condition. Alternatively, it is possible to make the profile 2 weaker while maintaining the same deflection in its loaded condition.

[0083] Figs. 7a-c discloses a profile 2 according to a fourth embodiment of the present invention. The profile 2 in figs. 7a-c is a main profile 2.

[0084] In its unloaded condition before being suspended to the ceiling, as shown in fig. 7a, the main profile 2 includes two upwardly curved end portions 21, 22 and a downwardly curved transition portion 23 extending between said end portions. The curved end portions 21, 22 are concavely curved in an upward direction in the vertical plane as viewed from a side of the profile adapted to face the interior of a room when mounted in a suspended ceiling. The transition portion 23 is convexly curved in an upward direction in the vertical plane as viewed from a side of the profile adapted to face the interior of a room when mounted in a suspended ceiling. The profile 2 is adapted to be suspended to the ceiling structure at three suspension points 16, 17, 18 by means of suspension means 4, for example hangers. The two upwardly curved end portions have a curvature in the same direction. The downwardly curved transition portion has a curvature in the opposite direction as the end portions. The radius of curvature of the two curved end portions may be equal. Alternatively, the radius of curvature may differ. The radius of curvature of the transition portion may differ from the radius of curvature of the two curved end portions. The profile 2 is elastically and/or plastically deformed such that the two curved portions 21, 22 are formed.

[0085] In its unloaded condition, as shown in fig. 7a, the profile 2 comprises three curved portions 21, 22, 23. The first curved end portion 21 is extending between the first suspension point 16 and a point adjacent the second suspension point 17. The second curved end portion 22 is extending between the third suspension point 18 and a point adjacent the second suspension point 17. The second suspension point is arranged at a point of the transition portion 23 wherein the tangent is horizontal. The transition portion 23 is extending between the first and second curved end portions 21, 22.

[0086] The maximum distance between an imaginary line extending between the ends of the profile and the profile is do.

[0087] Fig. 7b shows the main profile 2 in fig. 7a when being suspended to the ceiling structure by suspension means 4. The profile 2 is suspended to the ceiling structure at three suspension points 16, 17, 18. The three suspension points 16, 17, 18 are arranged at an equal distance from each other.

[0088] When being suspended, the load of the own weight of the profile 2 may reduce the curvature of profile 2 to some extent and make the profile 2 slightly more straight. The maximum distance d_1 between an imaginary line extending between the ends of the profile and the profile is less than do.

[0089] Fig. 7c shows the main profile 2 in a loaded condition when forming part of a grid 10 for a suspended ceiling 1. In the loaded condition, the load deforms the profile 2 such that the profile 2 assumes an essentially linear extension. The load includes the own weight of the profile 2 and external load applied, such as weight of ceiling tiles 5 and of transverse profiles 3 suspended by the main profile 2. The load deflects the profile 2 such that the two curved portions 21, 22 become straightened. By essentially linear extension is meant that the maximum deflection f is less than a predetermined value, for example the distance L measured in mm between two adjacent suspension points of the profile divided by a factor of 300.This implies that the profile 2 in its loaded condition may be straight, or may have slightly curved portions, as long as the deflection f does not exceed the predetermined value, for example the distance L measured in mm between two adjacent suspension points of said at least one profile divided by a factor of 300. As long as the maximum deflection f is not exceeded, the profile 2 may have both slightly convexly curved portions or slightly concavely curved portions in its loaded condition.

[0090] Figs. 8a-c discloses a profile 2 according to a fifth embodiment of the present invention. The profile in figs. 8a-c is a main profile 2 including five curved portions 31, 32, 33, 34, 35.

[0091] In the unloaded condition before being mounted to a suspended ceiling, as shown in fig. 8a, the main profile 2 includes three upwardly curved portions 31, 32, 33 and two downwardly curved transition portions 34, 35. The upwardly curved portions 31, 32, 33 are concavely curved in an upward direction in the vertical plane as viewed from a side of the profile adapted to face the interior of a room when mounted in a suspended ceiling. The downwardly curved transition portions 34, 35 have a curvature in the opposite direction as the upwardly curved portions 31, 32, 33. The profile 2 is adapted to be suspended to the ceiling structure at four suspension points 16, 17, 18, 19 by means of suspension means 4 for example hangers. The profile 2 is elastically and/or plastically deformed such that three curved portions 31, 32, 33 are formed.

[0092] The distance α between two adjacent suspension points 16, 17, 18, 19 is equal for all suspension points. The three upwardly curved portions have a curvature in the same direction in the longitudinal direction. However, the three upwardly curved portions have different radius of curvature. For the first and third curved portions 31, 33, the maximum distance between the profile and an imaginary straight line extending between the suspension points is d_{0a}. For the second curved portion

32, the maximum distance between the profile and an imaginary straight line extending between the suspension points is d_{0b}, which is less than d_{0a}. Thereby, the radius of curvature of the second curved portion is smaller than the radius of curvature of the first and third curved portion.

[0093] Fig. 8b shows the main profile 2 in fig. 8a when being suspended to the ceiling structure by suspension means 4. The profile 2 is suspended to the ceiling structure at four suspension points 16, 17, 18, 19. The four suspension points 16, 17, 18, 19 divide the profile 2 into three sections. The four suspension points 16, 17, 18, 19 are arranged at an equal distance α from each other. The first suspension point 16 is arranged at the first end of the profile 2. The second suspension point 17 is arranged at a first transition portion 34 extending between the first and second upwardly curved portions. The third suspension point is arranged at a second transition 35 portion extending between the second and third upwardly curved portions. The fourth suspension point 19 is arranged at the second end of the profile 2.

[0094] When being suspended, the profile 2 comprises three upwardly curved portions 31, 32, 33. However, the load of the own weight of the profile 2 may reduce the curvature of profile to some extent and make the profile slightly more straight, i.e. the maximum distance between the profile and an imaginary straight line extending between the suspension points is less than d_{0a} and d_{0b}, respectively. In the shown embodiment, for the first and third curved portions 31, 33, the maximum distance between the profile and an imaginary straight line extending between the suspension points is d_{1a}. For the second curved portion 32, the maximum distance between the profile and an imaginary straight line extending between the suspension points is d_{1b}, which is less than d_{1a}.

[0095] Fig. 8c shows the main profile 2 in a loaded condition when forming part of a grid 10 for a suspended ceiling 1. In the loaded condition, the load deforms the profile 2 such that the profile 2 assumes an essentially linear extension. The load includes the own weight of the profile 2 and external load applied, such as weight of ceiling tiles 5 and of transverse profiles 3 suspended by the main profile 2. The load deflects the profile 2 such that the three curved portions 21, 22, 23 become straightened or deflected. By essentially linear extension is meant that the maximum deflection f is less than a predetermined value, for example the distance L measured in mm between two adjacent suspension points of the profile 2 divided by a factor of 300.This implies that the profile 2 in its loaded condition may be straight, or may have slightly curved portions, as long as the deflection f does not exceed the predetermined value, for example the distance L measured in mm between two adjacent suspension points of said at least one profile divided by a factor of 300. As long as the maximum deflection f is not exceeded, the profile 2 may have both slightly convexly curved portions or slightly concavely curved portions in its loaded condition. In fig. 8c, the deflection f_b of the second portion 32 is less than the deflection f_a of the first and third portion 31, 33.

[0096] Figs. 9a-c discloses a profile 2 according to a sixth embodiment of the present invention. The profile in figs. 9a-c is a main profile 2 including five curved portions 31, 32, 33, 34, 35.

[0097] In the unloaded condition of the profile before being mounted to a suspended ceiling, as shown in fig. 9a, the main profile 2 includes three upwardly curved portions 31, 32, 33 and two downwardly curved transition portions 34, 35. The upwardly curved portions 31, 32, 33 are concavely curved in an upward direction in the vertical plane as viewed from a side of the profile adapted to face the interior of a room when mounted in a suspended ceiling. The profile 2 is adapted to be suspended to the ceiling structure at four suspension points 16, 17, 18, 19 by means of suspension means 4, for example hangers. The profile 2 is elastically and/or plastically deformed such that three curved portions 21, 22, 23 are formed.

[0098] The embodiment shown in figs. 9a-c differs from the embodiment shown in figs. 8a-c in that the distance between adjacent suspension points 16, 17, 18, 19 differs. The distance between the first and second suspension point 16, 17 is α_1. The distance between the third and fourth suspension point 18, 19 is α_1. However, the distance between the second and third suspension point 17, 18 is α_2 which is larger than α_1.

[0099] Before being suspended, as shown in fig. 9a, for the first and third curved portions 31, 33, the maximum distance between the profile and an imaginary straight line extending between the suspension points is d_{0a}. For the second curved portion 32, the maximum distance between the profile and an imaginary straight line extending between the suspension points is d_{0b}, which is larger than d_{0a}. However, a ratio defined as the deflection d_{0a}, d_{0b} divided by the length α_1, α_2 between respective suspension points is the same for the first, second and third upwardly curved portions 31,32, 33.

[0100] Fig. 9b shows the main profile 2 in fig. 9a when being suspended to the ceiling structure by suspension means 4. The profile 2 is suspended to the ceiling structure at four suspension points 16, 17, 18, 19. The second suspension point 17 is arranged at a first transition portion extending between the first and second upwardly curved portions. The third suspension point is arranged at a second transition portion extending between the second and third upwardly curved portions. The fourth suspension point 19 is arranged at the second end of the profile 2.

[0101] When being suspended, the profile 2 comprises three upwardly curved portions 31, 32, 33. However, the load of the own weight of the profile 2 may reduce the curvature of profile to some extent and make the profile slightly more straight, i.e. the maximum distance d_{1a}, d_{1b} between the profile and an imaginary straight line extending between the suspension points is less than d_{0a}, d_{0b}, respectively. In the shown embodiment, for the first and third curved portions 31, 33, the maximum distance between the profile and an imaginary straight line extending between the suspension points is d_{1a}. For the second curved portion 32, the maximum distance between the profile and an imaginary straight line extending between the suspension points is d_{1b}, which is larger than d_{1a}. However, a ratio defined as the deflection d_{0a}, d_{0b} divided by the length α_1, α_2 between respective suspension points is the same for the first, second and third upwardly curved portions 31,32, 33.

[0102] Fig. 9c shows the main profile 2 in a loaded condition when forming part of a grid 10 for a suspended ceiling 1. In the loaded condition, the load deforms the profile 2 such that the profile 2 assumes an essentially linear extension. The load includes the own weight of the profile 2 and external load applied, such as weight of ceiling tiles 5 and of transverse profiles 3 supported by the main profile 2. The load deflects the profile 2 such that the three curved portions 21, 22, 23 become straightened or deflected. By essentially linear extension is meant that the maximum deflection f is less than a predetermined value, for example the distance L measured in mm between two adjacent suspension points of the profile 2 divided by a factor of 300.This implies that the profile 2 in its loaded condition may be straight, or may have slightly curved portions, as long as the deflection does not exceed the predetermined value, for example the distance L measured in mm between two adjacent suspension points of said at least one profile divided by a factor of 300. As long as the maximum deflection f is not exceeded, the profile 2 may have both slightly convexly curved portions or slightly concavely curved portions in its loaded condition. In fig. 9c, the deflection f_b of the second portion 32 is larger than the deflection f_a of the first and third portion 31, 33. However, a ration defined as the deflection f_a, f_b divided by the length α_1, α_2 between respective suspension points is the same for the first, second and third upwardly curved portions 31, 32, 33.

[0103] It is contemplated that in further embodiments, the profile 2, 3 may have a plurality of curved portions. The portions may be concavely curved in an upward direction in the vertical plane. When being suspended to a ceiling structure and forming part of a suspended ceiling 1, the profile 2, 3 have an essentially linear extension. With essentially linear extension is meant that the maximum deflection is less than a predetermined value, for example the distance L measured in mm between two adjacent suspension points of the profile divided by a factor of 300. This implies that the profile 2, 3 in its loaded condition may be straight, or may have slightly curved portions. As long as the maximum deflection is not exceeded, the profile 2, 3 may have either slightly convexly curved portions or slightly concavely curved portions in its loaded condition.

[0104] To sum up, by providing the profile 2, 3 with at least one upwardly curved portion in its unloaded position, it is possible to control the deflection of the profile 2, 3. It is thus possible to adapt the curvature of the curved portions and the overall shape of the profile 2, 3 in the vertical direction to the loads that is to be applied to the profile 2, 3 such that the deflection f of the profile 2, 3 in its loaded condition is less than a predetermined value, for example the distance L measured in mm between two adjacent suspension points of said at least one profile divided by a factor of 300. Load applied to the profile 2, 3 may be increased, or the material thickness of the profile 2, 3 may be reduced, while maintaining an acceptable deflection.

[0105] In another embodiment, which is shown in fig. 10a-c, is the profile 2 fixed directly to the ceiling structure of the building. The profile may be a main profile or a transverse profile. In its unloaded condition, when not affected by the gravity resulting from the own weight of the profile 2 or any additional load in the vertical direction, the profile 2 is upwardly curved, as shown in fig. 10a. The profile2 is plastically and/or elastically deformed such that it is slightly curved in its unloaded condition. The profile 2 thereby has one upwardly curved portion 11 extending along its longitudinal extension. The curved portion 11 is extending between the suspension or fastening points 14, 15. The profile 2 has a curvature in the same direction along its entire longitudinal extension. In this embodiment, the profile 2 has a constant curvature along its longitudinal extension. However, in other embodiments, the profile may have a varying curvature along its longitudinal extension. The profile 2 is upwardly curved in a vertical direction, i.e. in a plane perpendicular to the plane of the suspended ceiling 1 when mounted. The profile 2 is concavely curved in an upward direction as viewed from a side of the profile adapted to face the interior of a room when mounted in a suspended ceiling. The maximum distance between an imaginary line extending between the ends of the profile and the profile is do.

[0106] When the profile 2 is suspended and fixed to the ceiling structure, as shown in fig. 10b, the profile 2 will be forced to become straightened. The profile 2 when suspended will have an essential linear extension, preferably parallel to the ceiling structure. The profile 2 may directly abut the ceiling structure, or may be arranged at distance from the ceiling structure. When the profile 2 is arranged at distance from the ceiling structure, a spacer may be arranged between the profile 2 and the ceiling structure.

[0107] As a consequence of the curved profile 2 being forced into a straight extension, an internal state of stress is introduced into the profile 2 and the profile is thereby pre-stressed. Introducing an internal state of stress is advantageous for the load carrying capacity of the profile 2. Thus, the profile 2 may carry an increased load without reaching a critical deflection. Alternatively, if the load remains the same as for a conventional profile, the material thickness of the profile may be reduced without reaching maximum allowed deflection.

[0108] Fig. 10c shows the main profile 2 in a loaded condition when forming part of a grid 10 for a suspended ceiling 1. In the loaded condition, the load deforms the profile 2 such that the profile 2 assumes an essentially linear extension or deflected extension. The load includes the own weight of the profile 2 and external load applied, such as weight of ceiling tiles 5 and of transverse profiles 3 suspended by the main profile 2. The load deflects the profile 2 such that the curvature is straightened or deflected downwards. By essentially linear extension is meant that the maximum deflection f is less than a predetermined value, for example the distance L measured in mm between the two adjacent suspension points 16, 17 of the profile 2 divided by a factor of 300.This implies that the profile 2 in its loaded condition may be straight, or may be slightly curved, as long as the deflection f does not exceed the predetermined value, for example the distance L measured two adjacent suspension points of said at least one profile divided by a factor of 300. As long as the maximum deflection f is not exceeded, the profile 2 may be both slightly convexly curved or slightly concavely curved in its loaded condition.

[0109] It is to be understood that the profiles 2, 3 described above with reference to figs. 4a-c, 5a-c, 6a-c, 7a-c, 8a-c, 9a-c, and 10a-c all are adapted to form part of a grid 10 for a suspended ceiling 1 as described above in connection with fig. 1. Further, it is to be understood that transverse profiles 3 comprising at least one curved portion may be combined with conventional profiles as well as main profiles 2 comprising at least one curved portion, and the opposite.

[0110] The curved portion or portions of the profile may be achieved by curving the profile, for example in a roll forming operation, or by pre-stressing the profile.

[0111] A method of providing the profile 2, 3 with curved portions in connection to a roll forming operation will now be disclosed with reference to fig. 11. In the roll forming operation, the profile 2, 3 is formed from a sheet blank. The sheet blank is made of metal, for example steel or aluminium. The sheet blank is fed between successive pairs of rolls that progressively bend, fold and form the sheet blank until the desired shape and cross section of the profile 2, 3 is obtained. The sheet blank is folded such that a profile 2, 3 having a web 6 and flange 7 is formed. In the preferred embodiment, the profile 2, 3 is shaped into an inverted T-profile.

[0112] Further, in the roll forming operation, pressure is applied to the profile 2, 3 such that a curved portion is formed, which is shown in fig. 11. For example, the profile 2, 3 is fed between a pressure roll 31 and a pair of opposite rolls 32, 33, wherein the pressure roll 31 applies pressure on the profile 2, 3 such that a curved portion is formed. The profile 2, 3 is thereby plastically deformed. By varying the pressure applied to the profile 2, 3, it is possible to vary the curvature formed. A uniform pressure may be applied, such that a uniform curvature is obtained. In this case, a profile 2, 3 according to the embodiments shown in figs. 4a-c, 5a-c, 6a-c and 10a-c are obtained. Alternatively, a non-uniform pressure may be applied on the profile 2, 3. Thereby, it is possible to form a profile 2, 3 having a non-uniform curvature and different radius of curvature. For example, a profile 2, 3 according to the embodiments which are shown in figs. 7a-c, 8a-c and 9a-c may be formed by applying pressure to a first portion of the profile 2, 3 in a first direction, then applying pressure to a second portion of the profile 2, 3 in a direction opposite to the first direction, and then applying pressure to a third portion of the profile 2, 3 in the first direction. After a desired shape of the profile 2, 3 is obtained, the profile is cut into a desired length. The profile 2, 3 may also be provided with a capping 8, before or after the curved portion is formed.

[0113] It contemplated that the profile 2, 3 may be formed in a separate step from the operation for forming curved portions, and that the profile 2, 3 may be formed in a different operation than by roll forming, for example by extruding.

[0114] An alternative solution to the above described method, also having the object to provide a profile 2, 3 with at least one curved portion, is to pre-stress the profile. By pre-stressing the profile 2, 3, the profile 2, 3 elastically deformed. The profile 2, 3 is elastically deformed such that a curved portion is formed.

[0115] The profile 2, 3 may be pre-stressed by means of a capping 8 attached to the flange 7 of the profile 2, 3. The profile 2, 3 having a web 6 and a flange 7 is formed in any conventional way, such as by roll forming as described above. A capping 8 is adapted to enclose at least a portion of the flange 7, especially a side of the flange 7 adapted to face the room when the profile 2, 3 is suspended to the ceiling structure of the room. The capping 8 is provided in form of an elongated sheet or strip of metal which is folded around the flange 7 of the profile 2, 3. The capping 8 is attached to the flange 7 by means of folding, gluing, welding and/or riveting the capping to the flange. A combination of the alternatives mentioned is also possible.

[0116] In order to pre-stress the profile 2, 3, the length of the capping 8 in the longitudinal direction is less than the length of the profile 2, 3 onto which the capping 8 is to be attached. The ends of the profile 2, 3 and the capping 8 are aligned such that the capping 8 is to be extending along the entire length of the profile 2, 3. A first end of the capping 8 is attached to a first end of the profile 2, 3, and a second end of the capping 8 is attached to a second end of the profile 2, 3. The rest of the capping 8 is then adhered to the flange 7 of the profile 2, 3. Thereby, the profile 2, 3 is pre-stressed such that a curved portion is formed. A profile 2, 3 according to the embodiments disclosed in figs. 4a-c, 5a-c, 6a-c and 10a-c is obtained. The profile 2, 3 will have a uniform curvature.

[0117] It is to be understood that the curvature of the curved portions in the figures is highly exaggerated in order to make the curvature visible. For example, for a profile being suspended between two suspension points arranged at distance of 1200 mm from each other, the maximum distance d between the curved portion an imaginary straight line could be for example in the range of 2-4 mm.

[0118] It is contemplated 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, it is to be contemplated that a transverse profile also may be provided with more than one curved portion, although not shown in the drawings.

[0119] In the above described embodiments, the profile has been an inverted T-profile. However, a person skilled in the art contemplates that the invention also may be applied to a profile of any other shape, for example, a L-shaped profile, a I-shaped profile, a Z-shaped profile etc. Further, in the shown embodiments, the profiles are provided with a bulb. However, it is contemplated that the invention also may be applied to a profile without any bulb.

[0120] It is also to be understood that the main profile instead of being suspended by hangers or directly to the ceiling structure may be suspended by another profile, for example profiles attached to two opposite walls, and be provided with curved portion/portions in the manner described above.

[0121] In the shown embodiments, the profile is shown as slightly curved when it is suspended but not carrying any additional load in addition to the own weight of the profile, as shown in figs. 4b, 5b, 6b, 7b, 8b, and 9b. However, the own weight of the profile may result in that the profile has an essentially linear extension when being suspended. In the loaded condition, the additional load may result in a deflection not exceeding the length of the profile L divided by 300.

Claims

1. A suspended ceiling (1) comprising a grid (10) and at least one ceiling tile (5), the grid (10) being formed of one or more profiles (2, 3) and being adapted to support said at least one ceiling tile (5), wherein each profile (2, 3) is adapted to be supported at at least two suspension points,
characterised in that at least one profile (2, 3) of said one or more profiles comprises in an unloaded condition at least one upwardly curved portion, such that, in a loaded condition of said at least one profile (2, 3), said at least one profile (2, 3) extends such that a deflection of said at least one profile is less than a predetermined value.

2. A suspended ceiling (1) according to claim 1, wherein, in a loaded condition of said at least one profile (2, 3), said at least one profile (2, 3) extends such that the deflection (f) of said at least one profile (2, 3) is less than a distance (L) between two adjacent suspension points of said at least one profile (2, 3) divided by a factor of 300, preferably less than a distance (L) between two adjacent suspension points of said at least one profile (2, 3) divided by a factor of 500.

3. A suspended ceiling (1) according to claim 1 or 2, wherein said at least one profile (2, 3) is plastically and/or elastically deformed in its unloaded condition.

4. A suspended ceiling (1) according to any one of claims 1-3, wherein said at least one profile (2, 3) is pre-stressed in its unloaded condition.

5. A suspended ceiling (1) according to any one of claims 1-4, wherein said at least one curved portion is concavely curved in an upward direction in the unloaded condition of the profile (2, 3) as viewed from a side of the profile adapted to face the interior of a room when mounted in a suspended ceiling..

6. A suspended ceiling (1) according to any one of claims 1-5, wherein said at least profile (2, 3) in its loaded condition is elastically deformed by means of load applied and own weight such that in the loaded condition of said at least one profile (2, 3), said at least one profile (2, 3) extends such that the deflection (f) of said at least one profile (2, 3) is less than the predetermined value.

7. A suspended ceiling (1) according to any one of claims 1-6, wherein said at least one profile (2, 3) has a curvature in the same direction along its entire longitudinal extension in its unloaded condition.

8. A suspended ceiling (1) according to any one of claims 1-6, wherein said at least one profile (2, 3) comprises a plurality of upwardly curved portions with respective curvature in the same direction along a longitudinal direction of the profile and transition portions between said upwardly curved portions in its unloaded condition.

9. A suspended ceiling (1) according to claim 8, wherein a radius of curvature of a first curved portion is different from a radius of curvature of a second of curved portion.

10. A suspended ceiling (1) according to any one of claim 1-9,
wherein said at least one profile is a main profile (2) adapted to be suspended to a ceiling structure or adapted to be suspended by another profile.

11. A suspended ceiling (1) according to any one of claims 1-9,
wherein said at least one profile is a transverse profile (3) adapted to be suspended by another profile (2).

12. A suspended ceiling (1) according to any one of claims 1-9,

wherein said at least one profile (2) is fixed directly to a ceiling structure of a building.

13. Method for providing a profile (2, 3) for a suspended ceiling (1), comprising
providing a profile (2, 3), and
forming at least one upwardly curved portion of the profile (2, 3) by plastically deforming at least one portion of the profile (2, 3), such that the profile (2, 3) in a loaded condition when forming part of suspended ceiling (1) extends such that a deflection (f) of said at least one profile (2, 3) is less than a predetermined value.

14. Method for providing a profile (2, 3) for a suspended ceiling (1), comprising
providing a profile (2, 3) having a web (6) and a flange (7), and
pre-stressing the profile (2, 3) by attaching a capping (8) to the flange (7), wherein the length of the capping (8) is less than the length of the profile (2, 3).

15. Method according to claim 13, wherein the step of providing a profile (2, 3) comprises roll forming at least one sheet blank into a profile (2, 3) having a web (6) and a flange (7), wherein after the profile (2, 3) has been provided, at least one upwardly curved portion is formed by a second roll forming step.

16. Method according to claims 13 or 15, further comprises providing a capping (8) and attaching the capping (8) to the flange (7).

17. Method according to claims 14 or 16, wherein the step of attaching the capping (8) to the flange (7) comprises folding the capping (8) over at least a portion of the flange (7).

18. Method according to any one of claims 14, 16 or 17, wherein the step of attaching the capping (8) to the flange (7) comprises folding, gluing, welding and/or riveting the capping (8) to the flange (7).

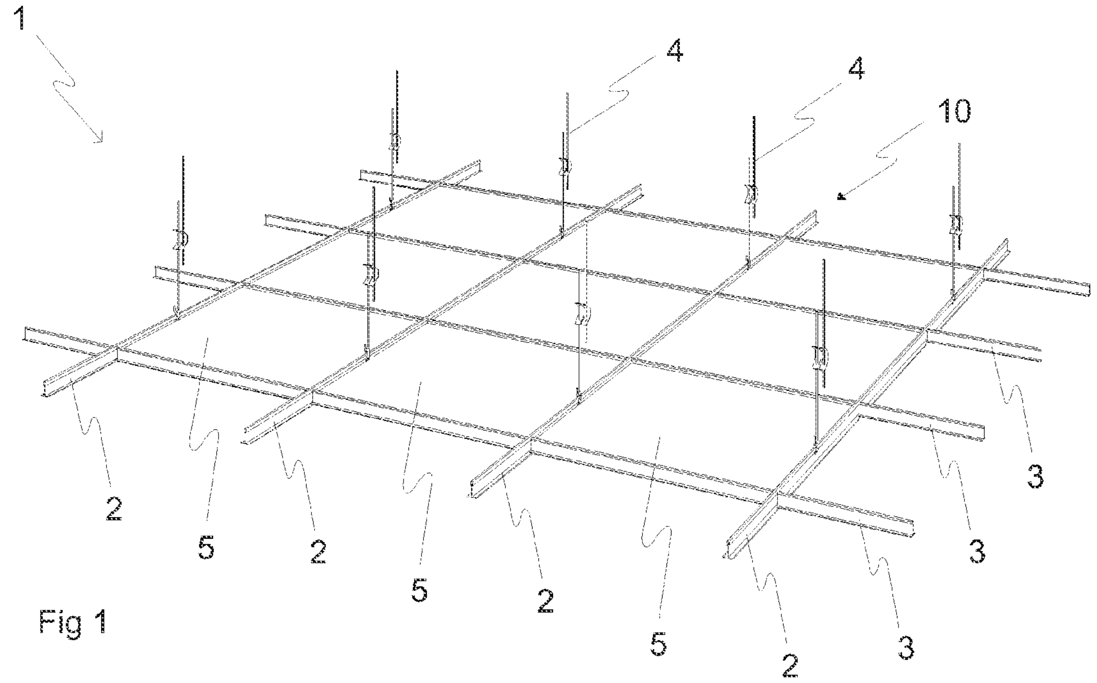

Fig 1

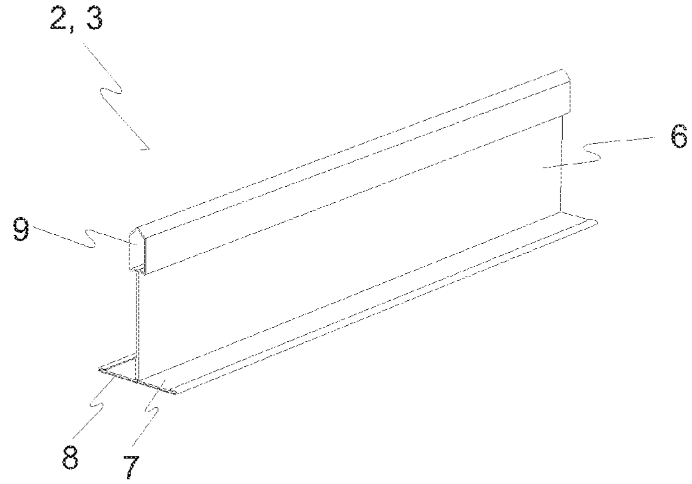

Fig 2a

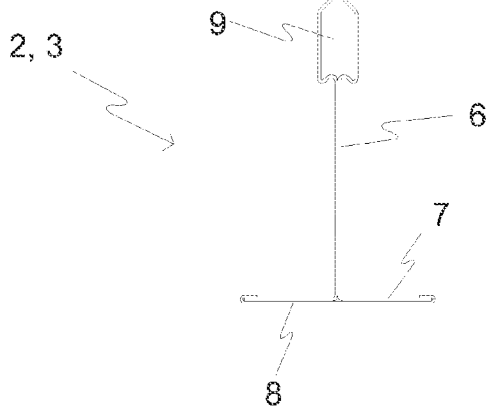

Fig 2b

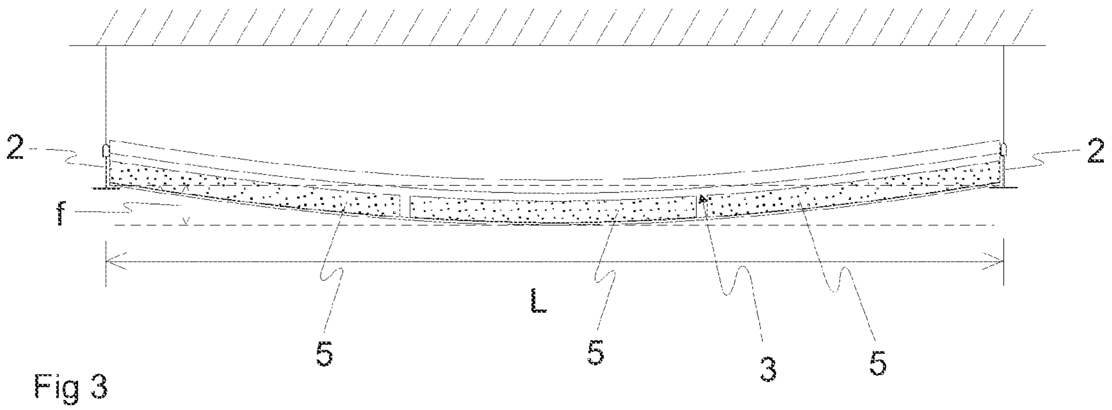

Fig 3

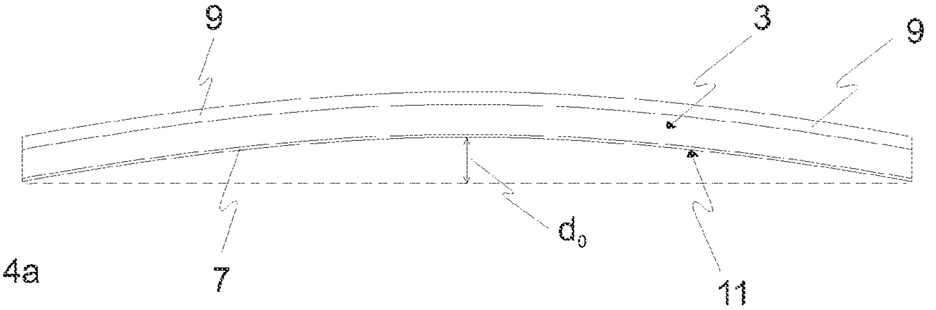

Fig 4a

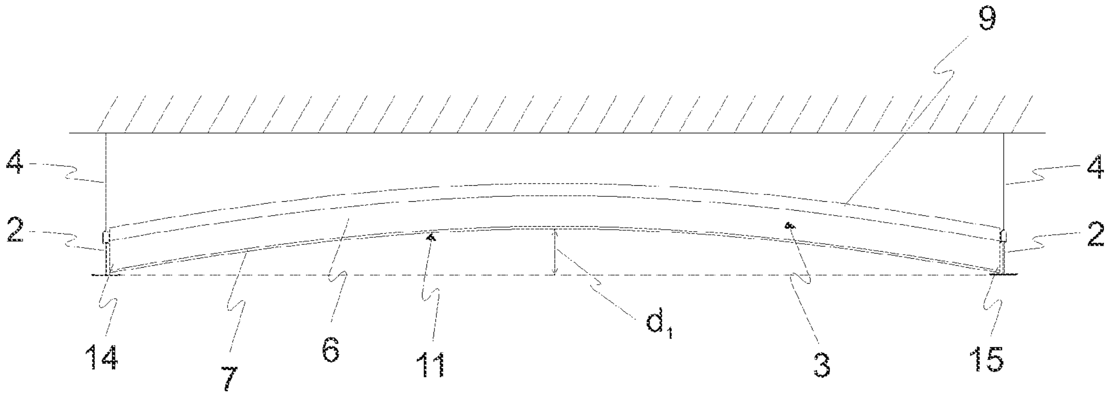

Fig 4b

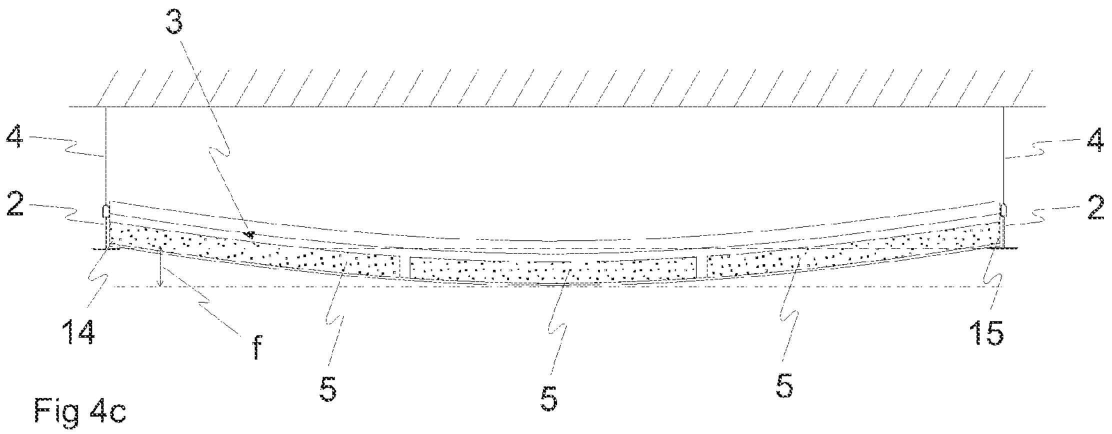

Fig 4c

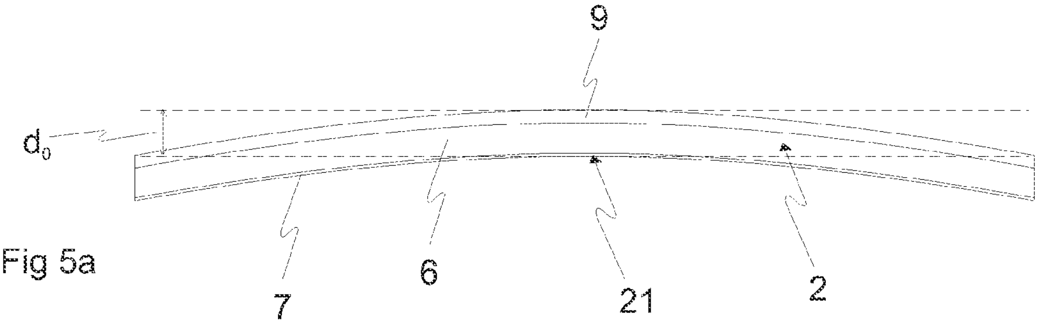

Fig 5a

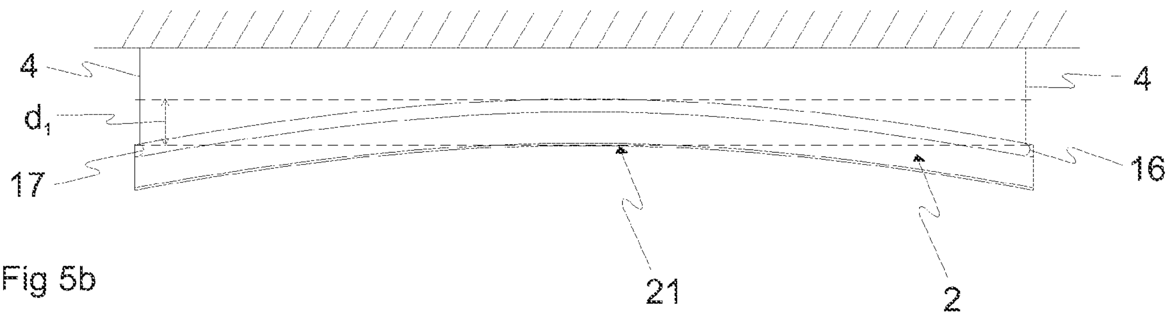

Fig 5b

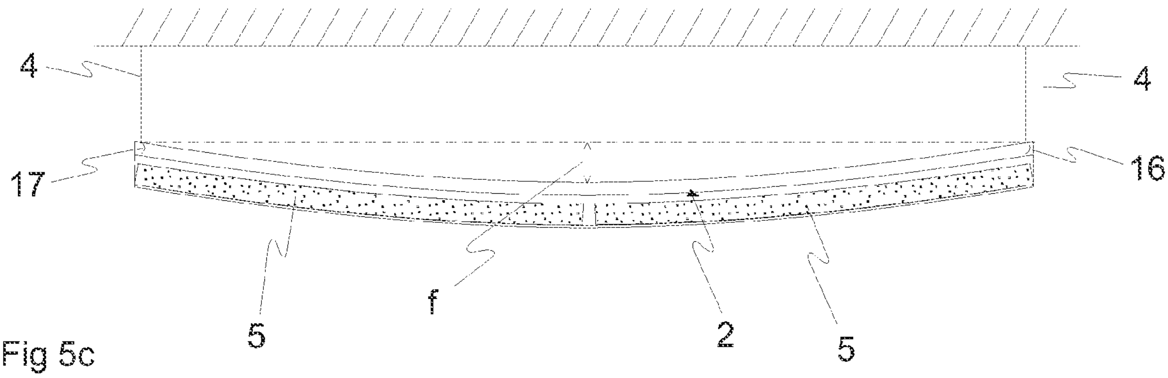

Fig 5c

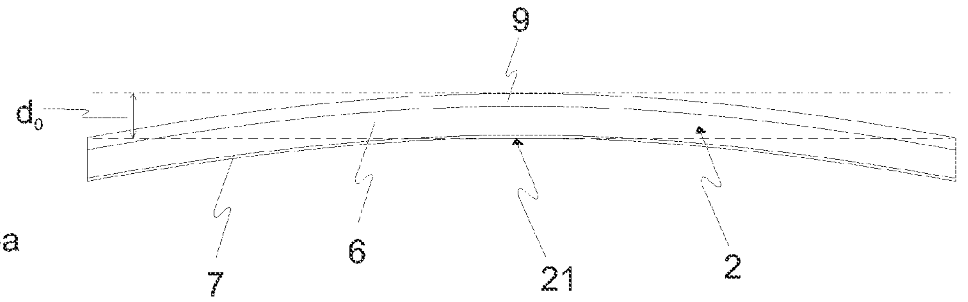

Fig 6a

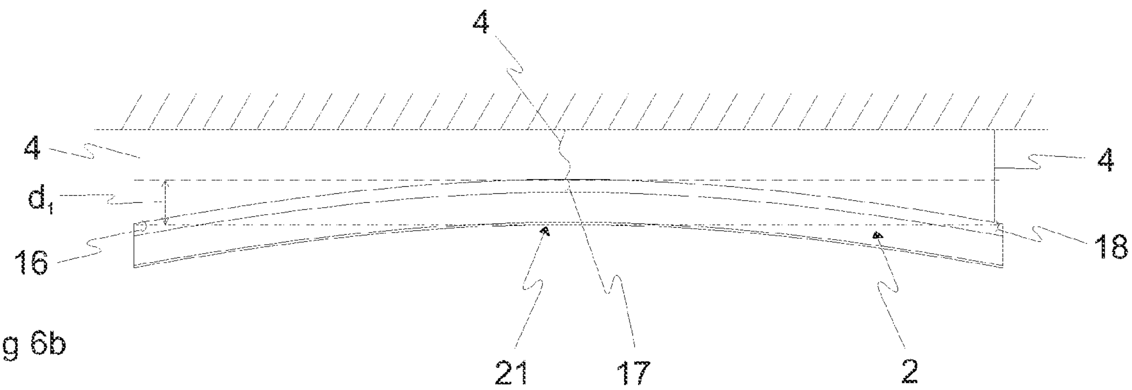

Fig 6b

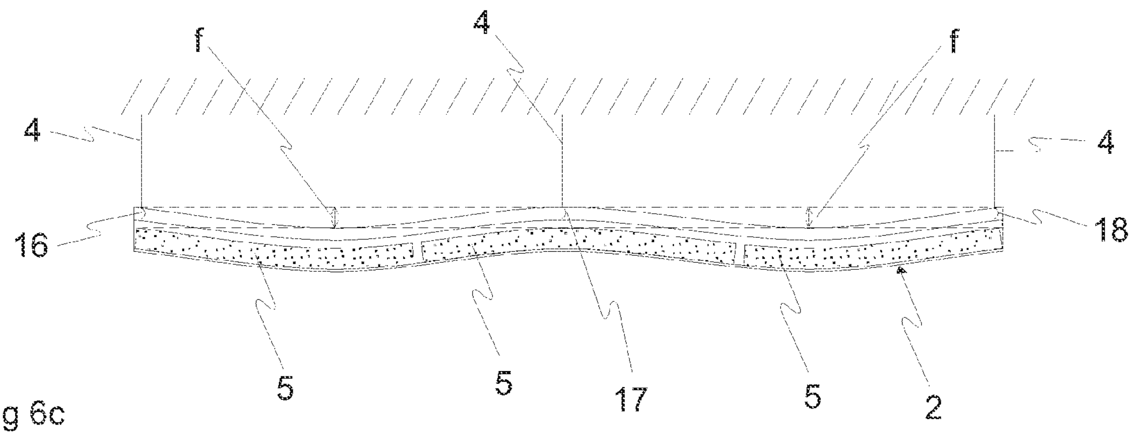

Fig 6c

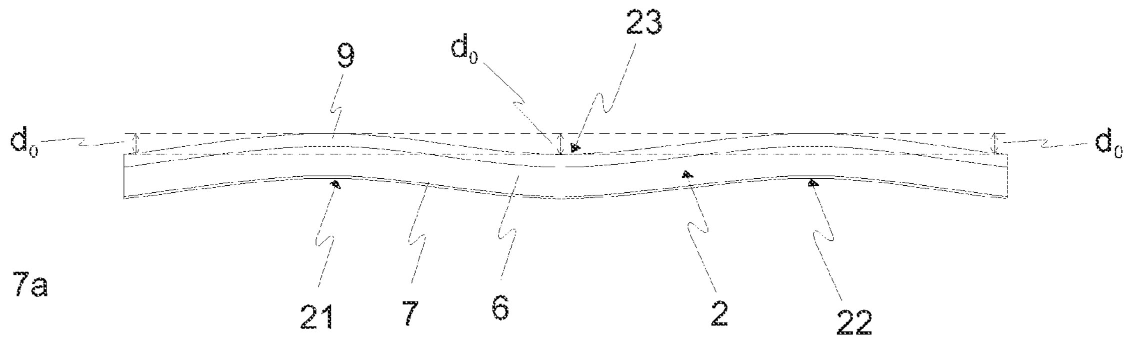

Fig 7a

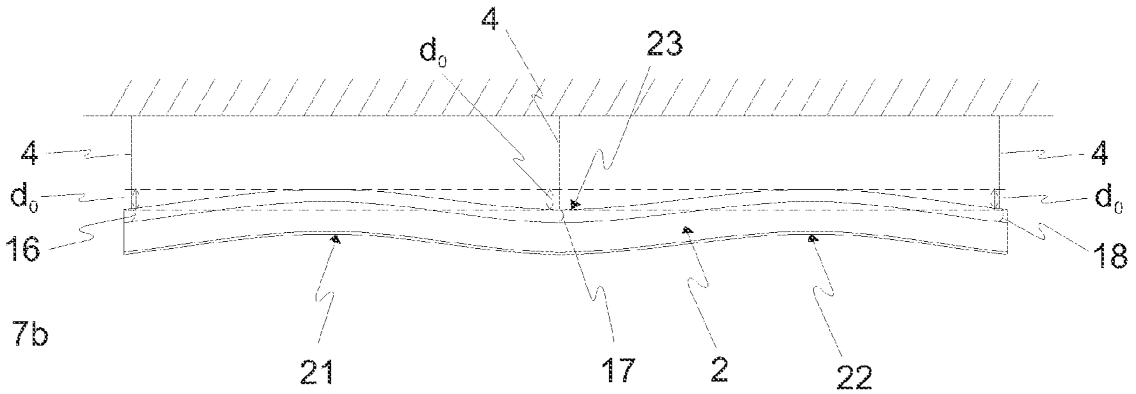

Fig 7b

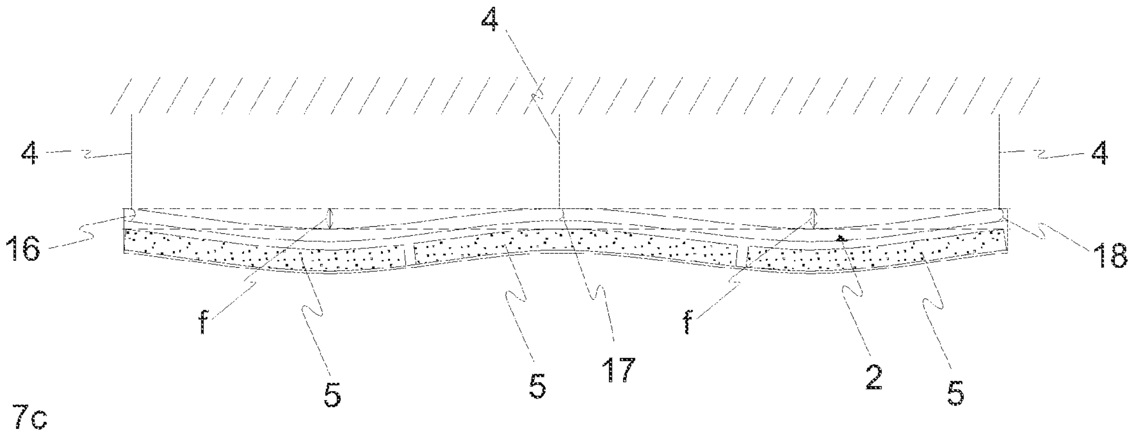

Fig 7c

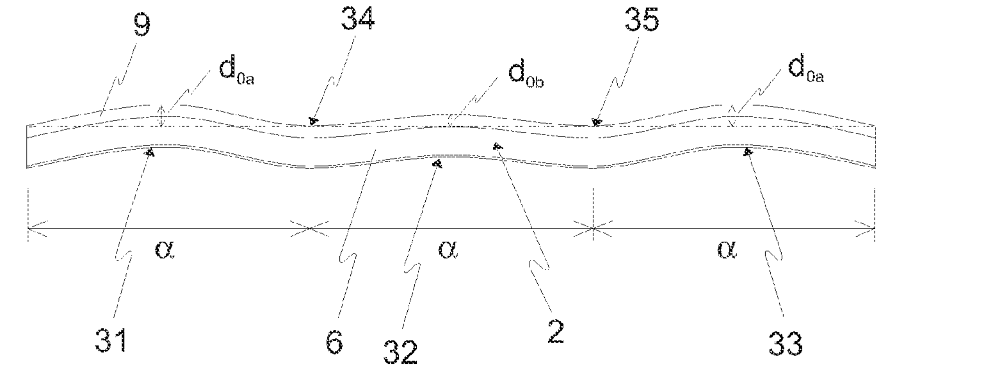

Fig 8a

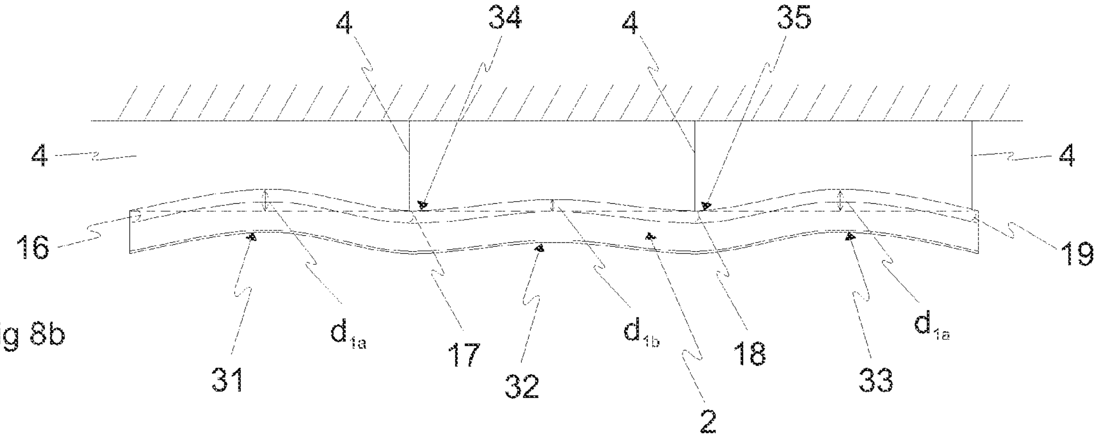

Fig 8b

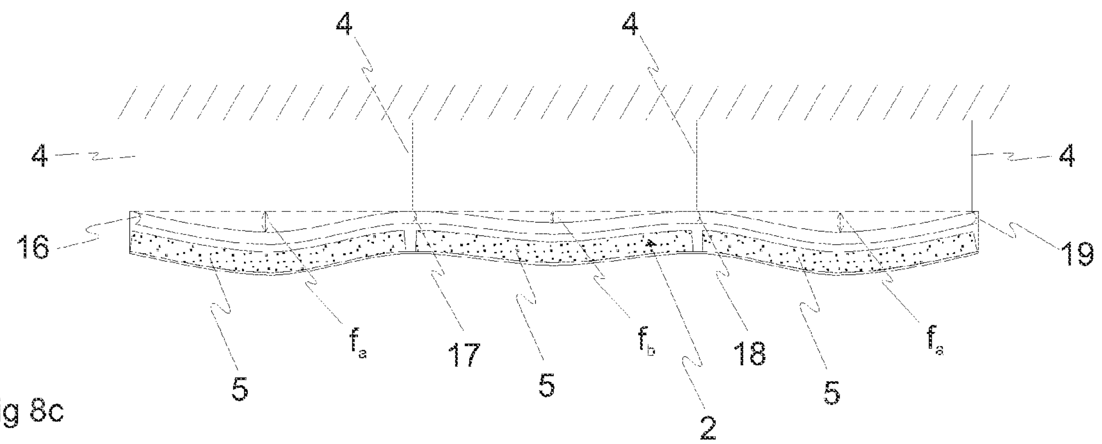

Fig 8c

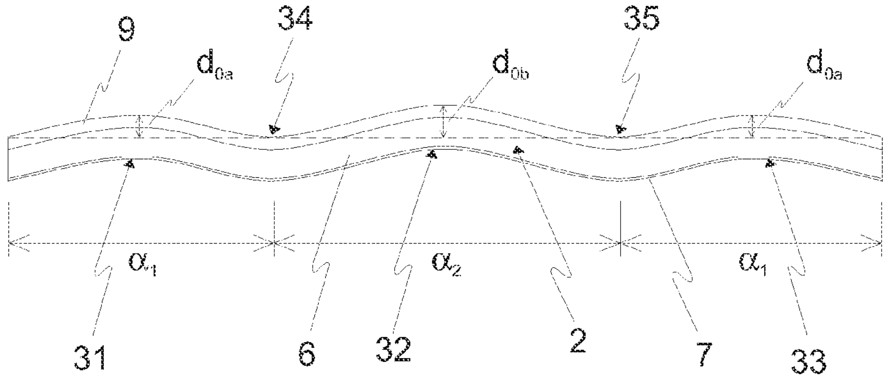

Fig 9a

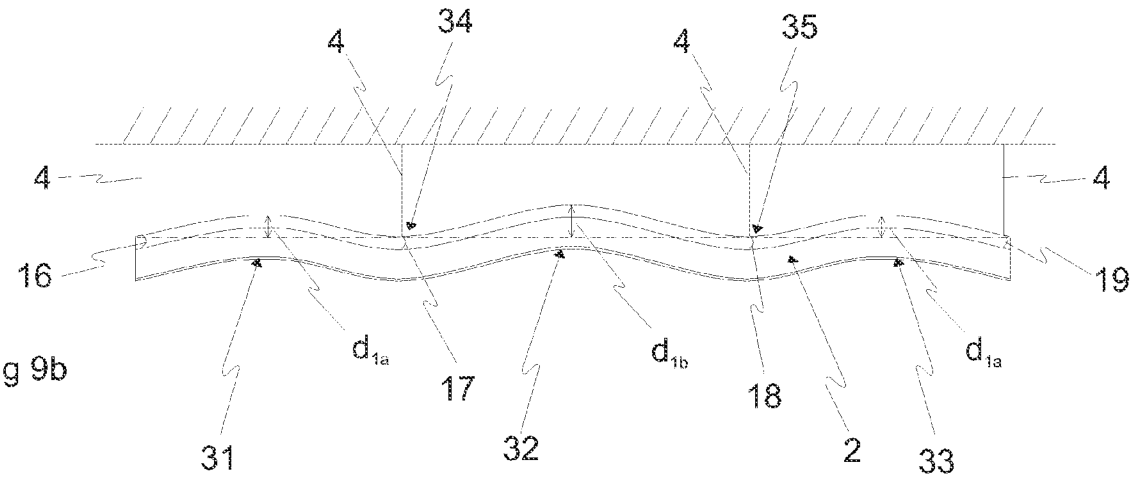

Fig 9b

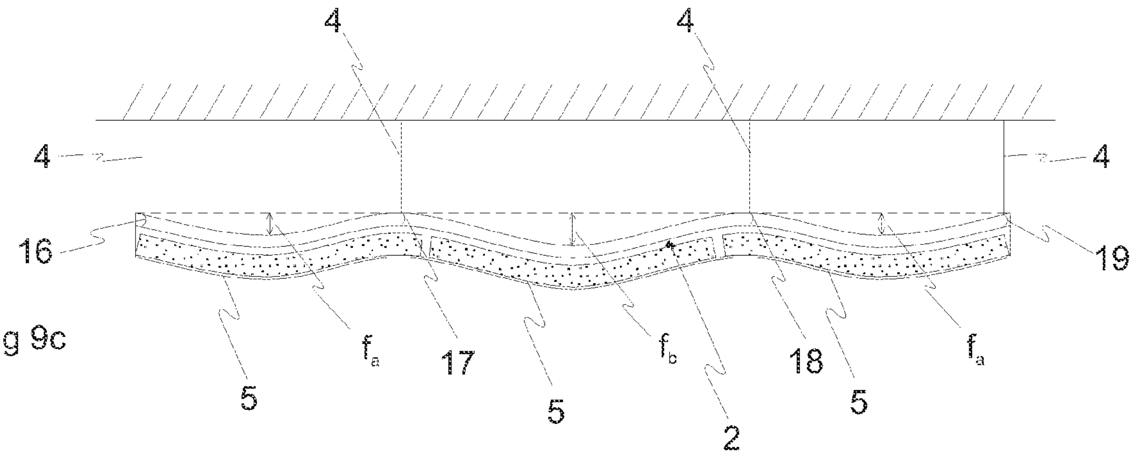

Fig 9c

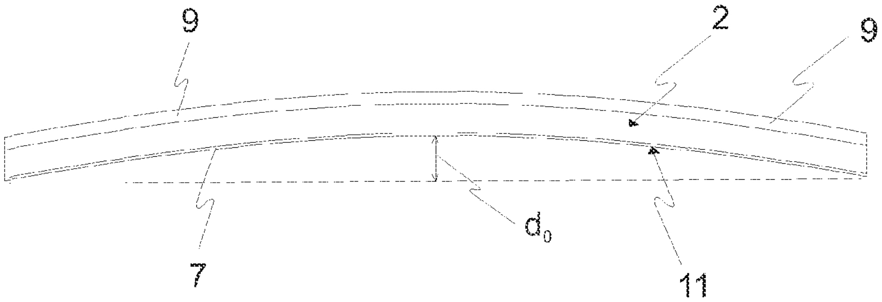

Fig 10a

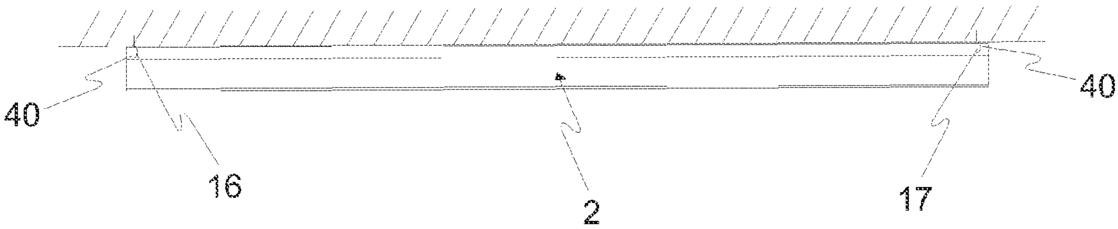

Fig 10b

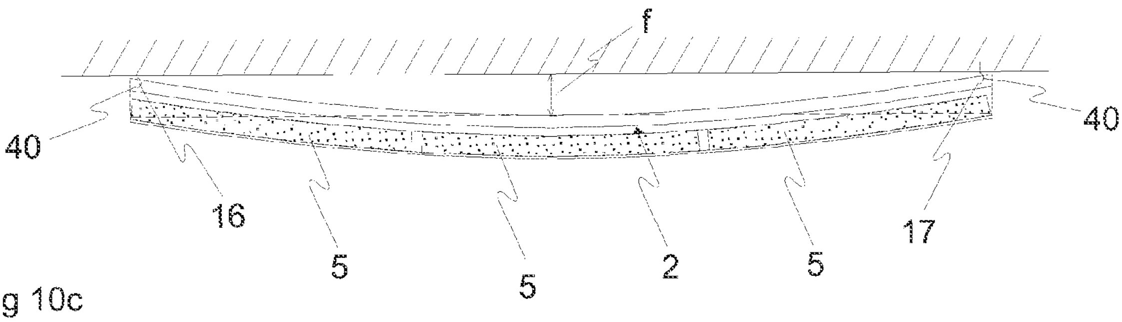

Fig 10c

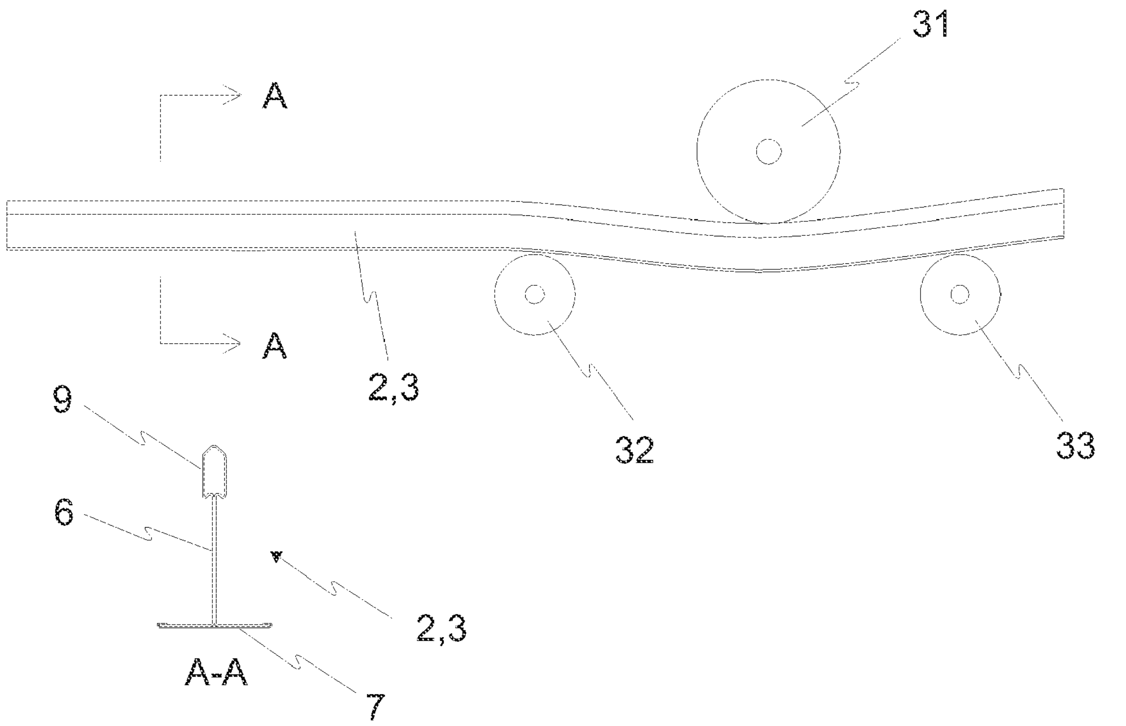

Fig 11

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EUROPEAN SEARCH REPORT

Application Number
EP 11 17 9024

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
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Y,D	US 2008/155935 A1 (RAHEEL MUHAMMAD M [US] ET AL) 3 July 2008 (2008-07-03) * abstract * * paragraph [0008] - paragraph [0016] * * figures 1,2 * -----	1-7,10, 12	TECHNICAL FIELDS SEARCHED (IPC)
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The present search report has been drawn up for all claims

1

Place of search	Date of completion of the search	Examiner
Munich	26 January 2012	Beucher, Stefan

CATEGORY OF CITED DOCUMENTS

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