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(54) **Ceiling suspension system**

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## Description

**[0001]** The present invention relates to a ceiling suspension system according to the preamble of the first claim.

**[0002]** A wide variety of systems have been developed in the art, which permit expansion of a ceiling suspension grid system when subjected to heat for example in the case of fire, and which at the same aim at limiting the risk to buckling of the system. Buckling of the system is undesirable as it gives rise to heat penetration into the plenum above the ceiling suspension system. Besides this, buckling of the system often involves displacement of the ceiling panels supported by the grid, and the risk that the panels fall from the structure, following which the fire retardant properties of the ceiling seriously deteriorate.

**[0003]** From US-A-3.722.933 a ceiling suspension system is known which comprises a plurality of parallel long main runner members made of metal sheet. The main runners are interconnected by means of a plurality of cross members to form a span running from one side of a room to the opposite side. Both the main runner and the cross member are composed of a horizontal flange and a vertical web and comprise co-operating fastening means for holding the cross members in position relative to the main runners. The fastening means consist of two opposite longitudinal tabs which are bent to face each other to define a slide structure on the main runner for receiving a connector portion present on the cross member. The cross member connector portion comprises a tab element which is bent out at a 90° angle from the longitudinal axis of the cross member. Co-operating dimples on the cross member and main runner provide a positive locking friction to the tab element. When heated, the main part of the cross member is allowed to expand in longitudinal direction by collapsing of the corrugated structure which connects the tab element to the cross member's web.

**[0004]** Although the cross profiles show some heat resistance, removal of the cross members after they have been inserted into the main runners is complicated.

**[0005]** From US-A-5.347.783 a ceiling suspension system is known, which comprises a multiplicity of grid members formed of metal sheet, the grid members having the shape of an inverted T with a bulb at the top and a double thickness central web and oppositely disposed flanges at the bottom. Deformation and expansion of the grid members is controlled by weakening the metal structure of the bulb and web, in particular by (i) cutting along opposite sides of the bulb two parallel lances, and (ii) providing staggered cutouts in the two thicknesses which make up the web. Upon thermal expansion, the web cutouts and the lances co-operate to cause

(i) the bottom flange to buckle down,
(ii) the web and sides of the bulb to laterally separate and fold and
(iii) the top of the bulb to buckle up.

**[0006]** In a further known ceiling suspension system heat resistance is provided by the presence of two opposite toothed end parts on the cross profile. To provide for a removable mounting of the cross profiles the toothed ends may be folded in upward and downward direction. However, after having been folded a couple of times, there is a serious risk that the toothed ends break, thus destroying the connection between the cross profile and the main runner to which it was attached.

**[0007]** The above described systems have in common that the grid members are weakened in longitudinal direction to provide for a controlled deformation and a controlled longitudinal collapse, which have to compensate expansion in longitudinal direction following heating of the member.

**[0008]** US-A-3.290.075 to Chicago Metallic discloses an expandable, runner construction for use in suspended ceiling systems, in which the ends of two main runners may be interlocked with a transversely extending cross runner to secure the runners in an assembled relation. Thereto, opposite runner ends of the main runner comprise identical tongue members. When coupling two main runners to opposite sides of a flange of transverse runner, the tongue members of the oppositely positioned main runners extend through an opening in the transverse runner, in a side-by-side relation. Co-operating engaging means on the main runners prevent relative movement of the main runners in a separating direction along a longitudinal axis of the main runners. Each main runner comprises a web, which at its upper longitudinal edge terminates in a tubular reinforcing bead. Opposite end parts of the bead comprise an extension, which is adapted to abut the bead of the cross runner in the assembled structure, in view of preventing movement of the runner ends towards the cross runner. A slit in a lower part separating the bead and the extension permit folding of the hollow member in upward direction, i.e. in a direction pointing away from the flange. Thus a main runner is provided which is deformable upon the application of expansion forces, for example when heated. The folding at the position of the slit may also be used to permit removing of a main runner or transverse runner from the grid. However, after having been folded a couple of times, there is a serious risk that the connection between the extension and the bead breaks, which has an adverse effect on the stability of the grid. US-A-3.290.075 discloses a ceiling suspension system according to the preamble of claim 1.

**[0009]** It is the aim of the present invention to provide a ceiling suspension system, in which demounting of the cross profiles is facilitated without adversely affecting the heat resistance of the suspension system.

**[0010]** It is a further object of this invention to provide a ceiling suspension system which is capable of expanding when subjected to heat, with a reduced risk to collapsing of the system .

**[0011]** This problem is solved by the present invention with a suspension system showing the technical features of the characterizing part of the first claim.

**[0012]** Thereto, the ceiling suspension system of the present invention is **characterized in that** the first heat expansion section comprises a top face cut-out in a top face of the first protrusion above said separation in between said first protrusion and the web so as to provide an upright extending folding axis along the height direction of the cross profile at the position of the longitudinal cut-out, the first protrusion being foldable with respect to the hollow member along the upright folding axis in such a way that upon expansion of the cross member in the ceiling suspension system the first protrusion will deform by folding of the first protrusion along the upright folding axis.

**[0013]** The heat expansion section may be provided on either one or on both ends of the cross profile.

**[0014]** The separation between the first protrusion and the web, which permits deformation of the cross profile upon expansion by folding of the first protrusion with respect to the web, is preferably obtained by the presence of a longitudinal cut-out which extends in longitudinal direction of the cross profile at a position between the first protrusion and the first web, to a position where the first protrusion meets the hollow member. Thereby, the first protrusion may be made in one part with the hollow member or may be made as a separate part in the form of a nose or cap which is mounted to the hollow member. Since the first protrusion is separate from the web over at least part of the protrusions' length, the first heat expansion section may deform or be folded independently of the web.

**[0015]** The presence of the top face cut-out in the top face of the first hollow member at the position of at least part of the longitudinal cut-out ensures that the connection between

(i) the position where the longitudinal cut-out at the bottom of the hollow member meets the web and
(ii) the top face cut-out in the top of the hollow member defines an upright folding axis along which the first heat expansion section may fold or rotate upon expansion of the cross profile in longitudinal direction. Besides functioning as a heat expansion zone, the first protrusion may also be folded manually along the upright folding axis thus providing for a removable mounting of the cross profile.

**[0016]** The presence of a first protrusion formed by compressing an end portion of the first hollow member in lateral direction over at least part of its height in such a way that opposite longitudinal faces of the hollow member lay adjacent one another, at a position between the top face cut-out and a far end of the cross profile comprising the first protrusion, serves the purpose of facilitating deformation of the first protrusion upon expansion of the cross profile, by facilitating folding along the upright folding axis. As virtually no material needs to be removed, reduction of the rigidity and strength of the cross profile may be minimized. To ensure that folding of the first protrusion may take place in opposite directions about the rotation axis, the first protrusion is positioned substantially centrally of the first hollow member.

**[0017]** A connection between the first connecting member on the cross profile and the second connecting member on the main runner is established by means of

i. a first connecting member with a first protrusion which protrudes in longitudinal direction from the first upright web, and
ii. a second connecting member comprising a slit which extends in height direction of the second web and comprises a tapered upper and lower end part. The tapering shape facilitates insertion of the first connecting member of the cross profile in that the second protrusion on the cross profile may be inserted either parallel to the height direction of the slit in the main runner, or may slant somewhat and thereafter rotated so that the cross profile extends substantially vertical or in height direction of the main runner.

**[0018]** Additional preferred embodiments of the cross profile claimed in the dependent claims, relate to means for removably fixing the position of cross profiles mounted to opposite sides of a main runner, the first connecting members of the oppositely mounted cross profiles being connected to the same second connecting member on the main runner. Additional preferred embodiments claimed in the dependent claims, also relate to technical features guiding the deformation and displacement of the cross profile with respect to the main runner upon expansion.

**[0019]** The ceiling support system of the present invention also comprises technical features which allow deformation of the at least one main runner upon expansion, in particular in longitudinal direction of the main runner. This is achieved by with a ceiling suspension system comprising at least one main runner with at least one second heat expansion section, the at least one second heat expansion section comprising

- a third cut-out within the web of the main runner, the third cut-out having a height which is smaller than the height of the web and a length which is smaller than the length of the web,
- a third and fourth slit which extend from a bottom side of the third cut-out towards the flange over at least part of the distance between the third cut-out and the flange,
- a first intersection in a bottom side of the third cut-out, the first intersection having opposite sides which slant from the bottom side of the third cut-out towards each other and towards the flange, the first intersection defining in the second heat expansion section a first and a second flange portion on opposite sides of the intersection.

**[0020]** When heated, deformation upon expansion of the main runner is controlled by the co-operating third and fourth slit and first intersection, which at the position of the second heat expansion section, force the flange to fold in a direction pointing away from the hollow member with respect to the web. Thus, a main runner is provided in which the removed material portions control the deformation of the main runner upon expansion, the at least one second heat expansion section having three bending or folding lines:

1. a first bending line formed by the bottom of the third slit along which a first flange portion is folded in a direction pointing away from the hollow member
2. a second bending line formed by the bottom of the fourth slit along which the flange is folded in a direction pointing away from the hollow member in such a way that the first and second flange portion slant towards each other
3. a central folding line provided by the first intersection, along which the first and second flange portion are folded with respect to each other.

The folding of the flange in a direction pointing away from the hollow member presents the advantage that the risk to damaging the ceiling panels supported by the main runner upon expansion thereof may be minimized. Besides this also the risk to displacing the ceiling panels from the main runner upon expansion thereof may be minimized, thus improving the heat resistance and strength of the ceiling suspension system. In addition, the second heat expansion section involves the removal of a small amount of material only, the web being a virtually neutral position with regard to strength building, as a consequence of which there is a minimum risk to adversely affecting the strength of the main runner. Moreover upon expansion optimum material concentration is achieved in the hollow member, i.e. in the pressure zone.

**[0021]** An improved control of the deformation may be obtained with a third cut-out having the shape of a V.

**[0022]** An improved expansion control of the main runner is achieved with a main runner which at the position of the second heat expansion section comprises a hollow member having a third heat expansion section. The third heat expansion section comprises

- a part of the second hollow member which is locally compressed in such a way that the opposite longitudinal walls of the hollow member lay close to each other, preferably against each other,
- a third and fourth cut-out in an upper part on opposite ends of the compressed part of the second hollow member of the main runner
- a fifth cut-out at a position between the third and fourth cut-out, preferably at a central position between them.

**[0023]** The technical features of this preferred embodiment, in particular the cut-outs, control deformation of the main runner at the position of the third heat expansion section. Thereby the cut-outs control folding of the part of the hollow member at the position of the second heat expansion section along folding lines which run in height direction of the main runner. This has the consequence that the hollow member as well as the part of the second web between the hollow member and the second heat expansion section, is forced to fold along an upright axis. Thereby the folded part is displaced in a direction perpendicular to the folding axis, above the ceiling panel supported by the main runner. Thus a reduced risk to affecting the position of the ceiling panel is provided, as well as a reduced risk to falling of the panels from the support system and improved heat resistance properties of the ceiling support system.

**[0024]** To provide a symmetric expansion and folding of the third heat expansion section, the second hollow member is locally compressed at the position of the third heat expansion section in such a way that the opposite longitudinal faces of the second hollow member preferably run parallel are disposed side-by side. This embodiment also facilitates folding of the hollow member upon expansion.

**[0025]** The above described ceiling suspension system is suitable for use in various designs, for example a first design which in which the flanges have a straight end which is provided to lay against a side of the flange of the at least one main runner. The ceiling suspension system of this invention is also suitable for use with a second design which is characterised in that the flanges have a joggled end which is provided to be received on top of an upper face of the flange of the at least one main runner.

**[0026]** The present invention additionally relates to a first heat expansion system as part of the cross profile, a second heat expansion section as part of the main runner, a third heat expansion section as described above as part of the main runner.

**[0027]** The invention is further elucidated in the appending figures and description of the figures.

Figure 1 a, b, c show a possible way in which expansion of the cross profile may take place.

Figure 2a and 2b show a view to a first embodiment of the cross profile of the ceiling suspension system of the present invention having respectively a straight cut and a joggled end.

Figure 3a and 3b show a view to a second embodiment of the cross profile of the ceiling suspension system of the present invention having respectively a straight cut and a joggled end.

Figure 4 is a view to a main runner of the ceiling suspension system of this invention, the heat expansion section and end parts being taken apart.

Figure 5 is a view to a side of the main runner of the ceiling suspension system of this invention.

Figure 6 is a view to a side of a first embodiment of

the cross profile of the ceiling suspension system of this invention.

Figure 7 is a view to a side of a second embodiment of the cross profile of the ceiling suspension system of this invention.

Figure 8 is a cross section of a first embodiment of the cross profile.

Figure 9 is a cross section of a second embodiment of the cross profile.

Figure 10 shows the way in which the main runner of the ceiling suspension system of this invention is deformed upon expansion.

**[0028]** The ceiling suspension system of this invention comprises a plurality of main runners 20 which run substantially parallel to each other. In particular, the ceiling suspension system comprises a multiplicity of main runners 20 having at least one heat expansion section 5, 50. Besides these main runners, the ceiling suspension system may also comprise main runners which do not comprise the at least one heat expansion section of the present invention. Adjacent rows of main runners 20 are connected to each other by a plurality of cross profiles 10, 30 as shown in figure 2, 3. Mostly the cross profiles 10, 30 will run substantially perpendicular with respect to the main runners 20. Within the scope of the present invention the ceiling suspension system may however also comprise a plurality of cross profiles which do not contain a heat expansion section. Furthermore, in stead of running parallel, it is also possible that the main runners 20 and/or cross profiles slant with respect to each other, if it is the intention of providing a ceiling suspension system with a specific design. In the ceiling suspension system of this invention, parallel cross runners may be connected to each other in cross direction by means of one or more further cross runners, an example of which is shown in figure 6 and 7. However, for this purpose also the cross runners shown in figure 2 and 3 may be used.

**[0029]** A possible embodiment of the main runner 20 of the ceiling suspension system of this invention having a heat expansion section is shown in figure 4, 5. A view to a side of a complete cross profile 10, 30 having a heat expansion section and a cross section of such a cross profile 10, 30 is shown in figure 6-9.

**[0030]** As can be seen from fig. 4-5, the main runner 20 is virtually T-shaped and comprises an upright longitudinal web 21 with a first and second side-by-side disposed metal sheet. Along a top side of the web 21 a second hollow member 24 is provided. This second hollow member 24 comprises a longitudinal top wall 6 and first and second opposite, longitudinal side wall 8, 28 on both sides of the top wall 6. As can be seen from fig. 4, the second hollow member 24 tapers from the web 21 towards the top face 6 of the hollow member 24. This is done to increase the free space around the top of the hollow member and to facilitate positioning of the ceiling panels. The top face 6 of the hollow member will preferably be flat to provide a mounting surface, for example for receiving fastening members, hold down clips or light fixtures. Along a bottom side of the web of the main runner 20, on both sides thereof, a first and second flange 22, 23 are present, which point in a direction away from the second web 21. The flanges 22, 23 function as a support for ceiling panels which are to be positioned on a top face 29 of the flanges.

**[0031]** Besides the above described main runner, the ceiling suspension system of this invention will mostly also comprise at least one of the cross profiles 10, 30 shown in figure 2, 3, 6-9. Similarly to the main runner 20, the cross profile 10, 30 is virtually T-shaped and comprises an upright longitudinal web 11, 31 comprising a first and second side-by-side disposed metal sheet. Along a top side of the web a first hollow member 14, 34 is provided having a first and second opposite, longitudinal side wall 17, 37. As can be seen from fig. 2 and 3, the first hollow member 14, 34 tapers from the web 12, 32 towards the top face 16 of the hollow member. This tapering shape has the advantage that, similarly to the main runner, a virtually flat top face 16 is present, which constitutes a suitable surface for receiving tooling, for example fastening members, for example for lightning. Along a bottom side of the web 12, 32, on both sides thereof a first and second flange 12, 13, 32, 33 are present, which point in a direction away from the web 12, 32. The flanges 12, 13, 32, 33 function as a support for ceiling panels. Due to the tapering shape of the first hollow member 14, 34 insertion of ceiling panels via the top of the suspension system, on top of the flanges 12, 13, 32, 33 is facilitated.

**[0032]** To allow positioning ceiling panels on top of the flanges, usually the dimensions of the ceiling panels will be somewhat smaller than the distance between adjacent rows of main runners 20, between adjacent rows of cross profiles. In particular, usually the dimensions of the ceiling panels will be somewhat smaller than the spaces enclosed by the webs of the main runners and the cross profiles forming the grid of the ceiling suspension system. A central positioning of the ceiling panels within the space between adjacent main runners and cross profiles may however be achieved by the presence of one or more protrusions 1 which extend from the first web 21 of the main runner 20. The protrusions may for example take the shape of an embossing. The embossing is preferably present at a position which corresponds to an upright side face of a ceiling panel, so that they assist in the positioning of the ceiling panels within the grid. The dimensions of the embossing is not critical to the invention, as long as they are large enough to assist in the positioning of the ceiling panels. The embossing on the cross profile may have the same dimensions as or different dimension than the embossing on the main runner. To achieve central positioning, it is however preferred that the embossing extend from the main runner and cross profile over substantially the same distance.

**[0033]** The connection between at least one cross profile 10, 30 and facing main runners 20 is established by

means of at least one first 15 and at least one second connecting member 25. The connecting members may take any suitable shape known to the person skilled in the art, but preferably correspond to the preferred embodiment described below.

**[0034]** In particular, at least one first connecting member 15 is present on at least one end part of the cross profile 10, 30. The first connecting member 15 is provided to co-operate with at least one second connecting member 25 on the main runner 20. Preferably however a first connecting member is provided on both opposite ends of the cross profile 10, 30. The main runner 20 will usually comprise a multiplicity of second connecting members, provided to co-operate with the above described first connecting member. This is done to permit connection of the cross profiles at different, multiple positions. The position of the second connecting members 25 is not critical to the invention. However, mostly they will be provided at standardized, regular distances so as to provide a standard and universally applicable ceiling suspension system. As can be seen from figure 4 and 5, the main runner 1 will mostly also comprise a plurality of suspending positions 7, which function to suspend the main runner to a building construction or any other suspension ceiling. Mostly also the suspending positions 7 are spaced from each other at regular distances. The length of the main runner 1, nor the number of suspending positions 7 or the distance between adjacent suspending positions 7 are critical to the present invention.

**[0035]** The cross profiles preferably do not contain such suspending positions as they are suspended by their opposite ends to the main runners only. However, in case it is desirable to also suspend at least part of the cross profiles to the building construction, one or multiple suspending positions 64 may also be provided on the cross profiles, as is for example shown in figure 6 and 7.

**[0036]** From figure 2 and 3 it becomes apparent that the first connecting member 15 comprises a second protrusion 18 which protrudes in longitudinal direction from the first upright web 11, 31 of the cross profile 10, 30. Thereby the second protrusion 18 may be made in one part with the first web 11 or may be made as a separate part or nose which is supposed to be mounted to an end part of the web.

**[0037]** The second connecting member 25 on the main runner 20, 60 preferably comprises a first slit 25 which extends in height direction of the second web 21 of the main runner, the first slit 25 comprising a tapered upper and lower end part 26, 27, and a central part 68 having a width which is smaller than the largest width of the end parts 26, 27. In the particular example shown, the second connecting member 25 has the shape of a two-sided arrow. The tapering upper and lower end part 26, 27 may have the shape of a sharp or a blunt arrow, which may be symmetrical or asymmetrical. The tapering shape of the slit has several advantages:

i. it permits connecting one single cross profile to a second connecting member of a main runner. In that way a suspension system can be provided in which the rectangular spaces enclosed by the main runners and cross profiles are staggered with respect to each other and do not run in line.

ii. it permits inserting the first connecting member 15 in a slanting position into the slit 25 in a facilitated manner. By rotating the cross profile somewhat after it has been slantingly inserted, it may be positioned so as to run perpendicular with respect to the main runner 20, 60.

**[0038]** Insertion of the cross profile is further facilitated in case the second protrusion 18 forming part of the first connecting member 15 comprises a top and a bottom side 36, 38 in longitudinal direction of the protrusion, at least part of which taper towards an end part 44 of the second protrusion 18.

**[0039]** A removable positioning of the cross profile 10, 30 with respect to the main runner 20 may also be achieved with an alternative embodiment of the second protrusion according to which the second protrusion 18 comprises a longitudinally extending, resilient lip or tab 75 substantially centrally of the second protrusion 18, taken in height direction thereof (fig. 3a and 3b). By pushing the lip to have it extending close to or in the plane of the first protrusion, the first protrusion may be removed from the first slit when necessary. However, the lip also functions to fix the position of the cross profile with respect to the main profile and to hamper withdrawal of the cross profile in case the lip is not pushed back. If so desired, any other technical features which provide a removable positioning of the first connecting member 15 in the second connecting member 25 may be used as well. For example as shown in fig. 2a and 2b, it is also possible to shape the second protrusion 18 such that it is bent or folded once or several times along at least one axis extending in longitudinal direction of the cross profile. The bending introduces some resiliency to the protrusion 18, thus providing a removable mounting combined with a good stiffness, and relatively simple production techniques. The bending is preferably done in such a way that the convex surface of protrusions of cross profiles mounted to opposite sides of a main runner point towards each other. Thereby, the presence of lip 35 which protrudes with respect to the second protrusion, in cross direction of the cross profile 10, 30 allows to fix the position of the cross profile within the slit 25 on the main runner. Because of its resiliency, insertion of the lip into and displacement of the lip through the slit 68 is facilitated. Once displaced to such an extent that the lip is positioned on a side of the main runner 20 opposite the side on which the remainder of the cross profile 10, 30 is positioned, because of its resiliency, lip 35 will take its original shape until it abuts with its front edge 74 against the web 21 of the main runner 20. Usually the lip 35 will protrude from a far end 44 of the second protrusion 18 towards the cross profile 10, 30. Because of the resiliency,

an active compensation of any play of the first connecting member 15 within the second connecting member 25 may be achieved. Because of the resiliency also insertion of an additional first connecting member in the second connecting member is mechanically possible and facilitated. Un-coupling may be achieved by pushing the lip 35 towards the second protrusion 18. The front side 74 of the lip 35 slants with respect to the web of the main runner 20 to which it is connected, as a consequence of which the cross profile 10, 30 will tend to take a position where the front side 74 of the lip abuts against the web 21 of the main runner. The result is that play and clearance between cross profile and main runner will be reduced to a minimum, thus shortening the coupling distance between them and improving the rigidity of the ceiling suspension system.

**[0040]** The width of the slit 68 on the main runner 20 is not critical to the invention, but should be sufficient to accommodate in it at least one first connecting member 15, but preferably two first connecting members 15 mounted to opposite sides of the main runner 20. The height of the second connecting member 25 is not critical to the invention, but should be sufficient to accommodate the first connecting member 15 in height direction so that it extends perpendicular to the main runner. Preferably the sides of the slit 68 extend in height direction of the second web 21, for example perpendicular to the flanges 22, 23 of the main runner as this permits building a perpendicular, straight web.

**[0041]** The ceiling suspension system of the present invention may also comprise at least one cross profile having a web with at least one a third connecting member 65 similar to the second connecting member described above in function of the main runner 20. The presence of such a third connecting member 65 would permit positioning further cross profiles between adjacent rows of main runners and reduce the dimensions of the space enclosed by the main runners and cross profiles. The third connecting member 65 is provided to co-operate with the first connecting member 15 on the cross profile 10, 30 as disclosed above in respect of the second connecting member. The third connecting member preferably comprises a fifth slit 65 which extends in height direction of the first web 11, 31 of the cross profile and comprises a tapered upper and lower end part 66, 67. In the particular example shown, the third connecting member 65 has the shape of a two-sided arrow.

**[0042]** To improve the heat expansion properties of the cross profile 10, 30 in particular to facilitate further sliding of the second protrusion 18 within the first slit 25 on the main runner 20, the cross profile may comprise a first connecting member 15 according to the embodiment described hereafter, in stead of the above described embodiment. According to this second embodiment, the second protrusion 18 comprises a second slit 19 which extends from a bottom side 38 of the first protrusion 15 in the direction of a top side 36 of the first protrusion (figure 3a and 3b). The second slit 19 is provided to engage or receive a bottom side of the tapering lower end part 26 of the first slit 25 of the second connecting member on the main runner. The second slit 19 preferably comprises an edge 59 on the side of the slit facing the first web 11, 31 of the cross profile, which edge 59 slants towards the web 11, 31. This edge 59 is provided to guide the displacement of the cross profile with respect to the main runner. When expansion of the cross profile takes place, the slanting edge 59 permits sliding of the first protrusion 18 over the tapering lower end part 26 of the first slit 25 in such a way that the cross profile is moved towards the web 21 of main runner 20. The slanting edge functions as a guiding for the displacement of the cross profile towards the main runner. Simultaneously, the flanges 12, 13 of the cross profile are lifted and may be received on top of the flange 22, 23 of the main runner 20.

**[0043]** To hamper withdrawal of the cross profile of figure 3a and b from the main runner 20 once inserted and to limit translation in height direction, the second protrusion 18 comprises on its top side 36 a further protrusion 58 which protrudes from the top side of the second protrusion 18. The side of the further protrusion 58 facing the web 11, 31 will usually slant towards the web to facilitate lifting removal of the cross profile from the main runner. Anyhow, translation of the cross profile 10, 30 towards the main runner 20, 60 will be limited to the point where the far end of the flange 12, 32 of the cross profile 10, 30 meets the web of the main runner 20, 60 to which it is connected. With a mounted ceiling suspension system, the second protrusion 18 of the first connecting member 15 is provided to extend throughout the slit 25 of the second connecting member and to take a position on a side of the second web 21 of the main runner, opposite the side on which the remainder of the cross profile is located. A second cross profile may be mounted in the same second connecting member to the opposite side of the main runner 20.

**[0044]** Depending on the envisaged design of the ceiling suspension system, the flanges 12, 13 of the cross profile may either have a straight end 9 (see fig. 2a, 3a) to rest against the side of flange of the main runner 20, 60 or may have a joggled end 2 as shown in figure 2b and 3b, the joggled end resting upon the flange 22, 23 of the main runner. It will be clear from the above given description that the embodiments of the cross profile described above may be produced with a flange having either a straight or joggled end part, but also with one end of the flange having a straight end and the opposite end having a joggled end.

**[0045]** To provide a ceiling suspension system with an improved heat stability, the cross profile 10, 30 comprises at least one first heat expansion section 40. The presence of the heat expansion section 40 permits deformation of the cross profile upon expansion at a minimum risk to adversely affecting the connection between the cross profile and main runner and a minimum risk to displacing ceiling panels supported by it. The first heat expansion section 40 is provided on at least one end part of the

hollow member 14, but may also be provided on both opposite end parts.

**[0046]** The first heat expansion section 40 comprises a first protrusion 41 which protrudes in longitudinal direction from a or both end parts 39 of the first hollow member 14, 34. The first protrusion may be made in one part with the hollow member or may be made as a separate part or nose mounted to the hollow member. The first protrusion 41 may have any shape considered suitable by the person skilled in the art. However, the first protrusion is preferably constructed and connected to the first hollow member 14, 34 in such a way that deformation is permitted upon expansion of the cross profile, in particular by folding of the protrusion along the connection between the protrusion and the hollow member 14, 34. In particular deformation of the first heat expansion section 40 is to take place by folding of the protrusion along an upright axis 45 extending along the connection between the first protrusion 41 and the hollow member 14, 34. Thus, deformation of the cross profile in longitudinal direction is permitted upon expansion while it remains connected to the main runner 20, 60. Also, with the folding of the first protrusion with respect to the remainder of the cross profile as described above, there is a minimum risk to falling of the ceiling panels from the suspension grid, thus improving the stability of the suspension system.

**[0047]** According to a further preferred embodiment of this invention, deformation of the first protrusion is facilitated with a minimum risk to adversely affecting the strength of the cross profile or breaking of the first protrusion from the cross profile, in case the first heat expansion section 40 comprises a longitudinal cut-out 42, which extends in longitudinal direction of the cross profile 10, 30, at a position between the first protrusion 41 and the first web 11, 31. The longitudinal cut-out 42 may have any shape considered suitable by the person skilled in the art. The longitudinal cut-out may for example take the shape of a longitudinal slit, which extends from an end part of the first protrusion in the direction of the centre of the cross profile. However, the longitudinal cut-out may take any other suitable shape and may for example be wedge shaped. The dimensions of the longitudinal cut-out 42 are not critical to the invention and will be selected by the person skilled in the art taking account of the intended use, the envisaged mechanical strength and loading properties, the nature of the materials and the weight of the ceiling panels and the suspension system. Usually however, the longitudinal cut-out 42 will extend from the end part of the first protrusion to at least the position where the first protrusion 41 is connected to the first hollow member 14. The longitudinal cut-out may however have a longer length.

**[0048]** A maximum translation of the cross profile with respect to the main runner to which it is attached is however provided in case the length of the longitudinal cut-out 42 is at equal to the width of the flange 22, 23 of the main runner. Usually both flanges 22, 23 will have the same width. It is however possible that opposite flanges 22, 23 have a different width. In that case the length of the longitudinal cut-out 42 may be adapted accordingly. The dimensions of the second protrusion 18 and the position of the slit 18 and protrusion 58 thereon, may be adapted by the person skilled in the art to permit the above-described translation of the cross profile with respect to the main runner upon deformation of the cross profile. Production of the cross profile 10, 30 of the ceiling suspension system of this invention is simplified in case the top face cut-out 42 is positioned somewhat below the folding line occurring between the hollow member 34 and the web 31.

**[0049]** Folding of the first protrusion 41 with respect to the hollow member 14, 34 is facilitated, the folding line may be shortened and the risk that the folding line extends into the web may be minimized by means of a first heat expansion section 40 which also comprises a top face cut-out 43 in a top face 16 of the first hollow member 14, 34 at the position of the longitudinal cut-out 42. It is however preferred to have the top face cut-out at the position where the longitudinal cut-out 42 ends and meets the web 11, 31. To facilitate folding along the connection, the first protrusion 41 is formed by compressing an end portion of the first hollow member (14, 34) in lateral direction over at least part of its height, preferably over its full height. Thereby it is preferred to compress the first hollow member 14, 34 in such a way that opposite longitudinal faces 17, 37 of the hollow member lay close, preferably along or adjacent one another and extend parallel to each other. Preferably the first protrusion consists of a part of the hollow member 14, 34 which compressed over its entire length between the top face cut-out 43 and a far end 44 of the cross profile. The first protrusion 41 may be positioned either substantially centrally of the first hollow member 14, 34 or may be shifted to the position of one of the longitudinal faces of the hollow member. The central positioning is preferred as this facilitates folding and permits that folding takes place to both opposite sides of the hollow member 14, 34.

**[0050]** The above described technical features define a kind of upright rotation axis which allows for a folding of the protrusion in a plane more or less parallel to the suspended ceiling, or a direction more or less parallel with the flanges of the cross profile. As the folding takes place over a double layer of material of the hollow member, more material is provided in the folding zone as a consequence of which the folding edge increases and the risk to breaking of the material at the position of the folding line is minimised.

**[0051]** A further improvement of the stability and heat resistance of the ceiling suspension system of this invention is achieved with a ceiling suspension system comprising at least one main runner 20 with at least one second heat expansion section 50. The at least one main runner 20 may however comprise two or more heat expansion sections 50, depending on the envisaged heat resistance properties of the ceiling suspension system. The heat expansion section 50 may take any position in

the web of the main runner, the most suitable position being determinable by the person skilled in the art, when taking into account the envisaged mechanical strength of the suspension system.

**[0052]** The second heat expansion section 50 comprises a third cut-out 46 within the web 21 of the main runner 20. The third cut-out will usually have a height which is smaller than the height of the web 21, in such a way that it is limited to the web, preferably to part of the height of the web, and does not extend into the hollow member 24. This is done to minimise the risk to adversely affecting the strength of the main runner. For the same reason the length of the second heat expansion section will be smaller than the length of the web.

**[0053]** The second heat expansion section 50 further comprises a third and fourth slit 47, 48 which are open towards a lower part or a bottom side of the third cut-out and which extend from the third cut-out 46 towards the flange 22, 23 of the main runner 20 over at least part of the distance between the third cut-out and the flange. Or in other words the third and fourth slit 47, 48 extend in height direction of the main runner 20. Thereby the third and fourth slit 47, 48 may extend substantially vertical or they may slant somewhat with respect to the height axis of the main runner 20. The third and fourth slit 47, 48 may have any shape known to the person skilled in the art, as long as they are open towards the third cut-out 46. The third and fourth slit 47, 48 may have a longitudinal shape, however it is preferred that the opposite sides slant towards each other as this facilitates displacing of the opposite sides from each other upon expansion and deformation of the main runner. The third and fourth slit 47, 48 may for example be substantially U or V-shaped. The upper edge of the third cut-out 46 will usually extend in longitudinal direction of the main runner 20, but may have any shape considered suitable by the person skilled in the art in view of maximizing expansion possibilities at minimum risk to decreasing the mechanical strength and heat resistance of the main runner. It may for example be a straight line or have the shape of an inverted v or any other suitable shape.

**[0054]** The second heat expansion section 50 further comprises a first intersection 49 in a bottom side 53 of the third cut-out 46, the first intersection having opposite sides 51, 52 which slant from the bottom side of the third cut-out 46 towards a position between the flanges 22, 23 and the third cut-out. The first intersection may for example be substantially U-shaped with upright or slanting edges. Preferably however, the first intersection 49 is substantially V-shaped. When symmetric, the upright symmetry line of the first intersection 49 may slant with respect to the height axis of the main runner 20, but preferably extends along this height axis. The first intersection 49 may take any position along the bottom side of the third cut-out, but is preferably positioned substantially centrally of the third cut-out 46.

**[0055]** With the above described preferred embodiment of this invention a main runner is provided in which material removal needed to provide a heat expansion section is concentrated as much as possible in the web, the web being a rather neutral part in view of the strength of the main runner. Or in other words material removal is done in the part having the smallest contribution to the strength of the main runner. Thus a main runner may be obtained the strength of which is hardly affected by the cut-out, optimum material saving in the pressure zone - the hollow member 21 - being guaranteed.

**[0056]** The presence of (i) the first intersection 49 the sides of which slant towards each other, and (ii) third and fourth slit 47, 48 guides and controls deformation of the main runner upon expansion. Thereby deformation is controlled in such away that at the position of the second heat expansion section, the flanges 22, 23 positioned below the ceiling panels are folded in downward direction, whereas the hollow member and the part of the web above the ceiling panels is folded in horizontal direction. In particular, a first part of the flanges 22, 23 located between a first upright edge of the third cut-out and the first intersection 49 gets folded in such a way that a first flange part 76 on a first side of intersection 49 extends downwardly from the first upright edge 72 towards the first intersection 49. Similarly the opposite second part of the flanges 77 located between the second upright edge 73 of the third cut-out opposite the first upright edge, and the first intersection 49 gets folded in such a way that the second flange part extends downwardly from the second upright edge towards the second intersection. In that way basically, the flanges 22, 23 are deformed to take a substantially V-shaped position. Thereby the opposite sides 51, 52 of the substantially V-shaped first intersection 49 are displaced towards each other, displacement being permitted until the opposite sides 51, 52 of the first intersection 49 lay against each other. Simultaneously, the upper part of the third and fourth slit 47, 48, i.e. the position where the third and fourth slit meet the bottom edge of the third cut-out 46, is opened and the opposite sides of the third and fourth slit are displaced from each other to preferably take the shape of a V-shaped slit.

**[0057]** In essence expansion of the main runner 20 at the position of the second heat expansion section 50 is controlled by the cut-outs 46, 47, 48, 49. With a central positioning of the intersection 49, and a positioning of the slits 47, 48 at the opposite bottom edges of the cut-out 46, expansion may be controlled to proceed in height direction of the main runner.

**[0058]** Preferably, the main runner 20 additionally comprises at least one third heat expansion section 5 in the second hollow member 24, to provide for an over-all expansion possibility in longitudinal direction of the main runner and improve the mechanical strength and heat resistance of the ceiling support system. The main runner 20 may comprise a single or a multiplicity of such third heat expansion sections 5. The dimensions of the third heat expansion section 5 will usually be adapted to the dimensions of the second heat expansion section to en-

sure that deformation of the second and third heat expansion section involve virtually the same change of length of the main runner. The position of the third heat expansion section 5 may be shifted towards one of the sides of the second heat expansion section 50, but is preferably positioned substantially centrally with respect to the second heat expansion section 50 as in that position it contributes to and facilitates deformation of the second heat expansion section 50. By providing a separate heat expansion section in the hollow member 24 and in the web 21, the hollow member and web are permitted to expand independently of each other, due to which the strength and heat resistance properties of the ceiling suspension system may be improved.

**[0059]** The third heat expansion section 5 comprises a part of the second hollow member 24 which is locally compressed in such a way that the opposite longitudinal walls 8, 28 of the hollow member lay close to each other, preferably against each other to facilitate folding upon expansion. To facilitate deformation at the position of the third heat expansion section 5, a third and fourth cut-out 3, 4 is provided in an upper part 6 on opposite ends of the compressed part of the second hollow member 24 of the main runner, preferably along the compression axis 60, 62 at the position where the hollow member 24 transfers into the compressed part. Furthermore, a fifth cut-out 29 is provided at a position between the third and fourth cut-out 3, 4. The fifth cut-out 29 may take any position with respect to the third and fourth cut-out 3, 4 but is preferably positioned substantially centrally between them to provide for a symmetric folding of the hollow member 24. The local compression of the hollow member, the presence of the third and fourth cut-out 3, 4 and the fifth cut-out 29 guide deformation of the main runner upon expansion in the sense that folding of the hollow member and an upper part of the web present between the second heat expansion section 50 and the hollow member 24 takes place along an upright folding axis 61 which extends in height direction of the main runner 20. The upright folding axis extends along a line between a position substantially centrally of the fifth cut-out 29 towards a position of the first intersection 49, where the opposite sides 51 and 52 of the intersection or a line drawn there through, meet each other. Thereby the second hollow member 24 is folded in such a way that opposite sides of the hollow member protrude in the same direction from the hollow member as is shown in figure 10. In other words, the above described technical features control deformation of the hollow member upon expansion to take place in longitudinal direction of the main runner 20. By properly selecting the dimensions of the second heat expansion section 50 in height direction of the main runner, expansion of the hollow member 24 at the position of the third heat expansion section 5 may be controlled in such a way that folding or deformation of the hollow member and the part of the web between the second heat expansion section 50 and the hollow member 24 takes place at a position above the ceiling panel supported by the main runner. Thus a ceiling support system is provided in which there is a minimum risk to affecting the position of the ceiling panels supported by it, as well as the risk to falling of the panels from the support system, thus improving the heat resistance properties of the ceiling support system. Preferably also the dimensions and material thickness at the position of the second and third heat expansion section 5, 50 are selected such that the deformation occurring upon heating of the main runner take place simultaneously and to a similar extent, to achieve uniform compensation of the expansion in height direction of the main runner. In that way the risk to the occurrence of dimensional differences in longitudinal direction at the position of the hollow member 24 and the web 21 may be minimized.

**[0060]** Deformation at the position of the third heat expansion section 5 is further facilitated in case the top edge of the top face cut-out 46 comprises two edges 70, 71 which slant towards each other at a position corresponding to the position of the fifth cut-out 29. This may for example be achieved by having a top edge made of two parts which slant to each other from the upright sides 72, 73 of the top face cut-out 46 towards the position corresponding to the position of the fifth cut-out 29. This may also be achieved by providing a cut out 69 having the shape of an inverted V in the top edge of the top face cut-out 46. Thereby, the distance d between the fifth cut-out and the second heat expansion section will be taken as small as possible but sufficiently large to obtain the optimum compromise between facilitated folding and sufficiently high mechanical strength and rigidity of the web.

**[0061]** The above described technical features result in a main runner 20 in which the force needed to deform the hollow member 24 at the position of the third heat expansion section 5 is of the same order of magnitude as the force needed to obtain deformation of the web and flanges at the position of the second heat expansion section 50. The result is a ceiling suspension system with an improved heat stability, where the risk to unwanted occurrence of slits or gaps upon heating and expansion may be minimized. The presence of slits or gaps should be avoided as much as possible as they provide room for fire passage from the space below the suspended ceiling into the plenum above the suspended ceiling.

**[0062]** Deformation of the ceiling suspension system of the present invention upon expansion mainly takes place as shown in figure 10 in respect of the main runner and in figure 1 a-c in respect of the cross profile. As can be seen from figure 10, when expanded the web 21 and flanges 22, 23 are folded in downward direction, whereby the third slit 47 opens and guides the displacement of the part of the web between the third slit 47 and the first intersection in downward direction. Simultaneously the fourth slit 48 opens and guides the displacement of the part of the web between the fourth slit 48 and the first intersection in downward direction. Thereby the web and flanges are folded along a folding line which extends through the point where the opposite sides 51, 52 of the

intersection 49 meet each other, and the opposite sides 51, 52 towards each other.

**[0063]** Expansion of the hollow member 24 of the main runner 20 proceeds mainly in a direction parallel to the flanges as shown in figure 10, i.e. along a height axis of the main runner 20 and is limited to the hollow member and the part of the web between the hollow member and the third cut-out 46 in the web. Thereby opposite sides of the hollow member are folded to form a V-shaped expanded section, which may extend on either one side of the main runner. This has the advantage that the hollow member upon expansion may fold above the surface of any ceiling panel supported by it, without damaging the ceiling panels and at minimum risk that the ceiling panels fall from the ceiling suspension system. Moreover, the position of the ceiling panels on top of the flanges is secured due to the presence of the embossings.

**[0064]** The number and position of the heat expansion sections will usually be determined by the person skilled in the art taking into account the envisaged heat and fire resistance properties of the ceiling suspension system. Often the ceiling suspension system will be built in such a way that expansion of 1 mm per m of length of the profiles is allowed per 100°C of temperature increase.

**[0065]** Deformation of the cross profile 10, 30 upon expansion is illustrated in figure 1. Figure 1a shows the cross profile in a non-expanded state. In figure 1b, the protrusion 41 of the first heat expansion section 40 is folded along the compression line 45 of the hollow member 14, 34, to extend under an angle with respect to or along the longitudinal side face of the main runner to which the cross profile is attached.

**[0066]** Upon heating of the cross profile 10, 30 deformation takes place in the first heat expansion section 40 to compensate for the expansion caused by the heating. In particular, an end part of the cross profile 10, 30 may fold along the upright folding axis 45 towards either one of the sides of the hollow member 14, 34 to allow for a displacement of the cross profile with respect to the main runner 20, the web 24 of the main runner guiding the folding or deformation of the first protrusion. The connection between (i) the position where the longitudinal cut-out 42 at the bottom of the hollow member 14 meets the web 11 (2) and the top of the hollow member thus forms an upright folding axis 45 which provides the possibility

i. to have the cross profile deformed when expanding;

ii. to fold the first protrusion 41 of the first heat expansion section at a first end of the cross profile along an upright folding axis, so that the main runner may be canted towards the cross profile. In that way the first connecting member of the cross profile mounted to the opposite side of the main runner may be disconnected and access to the plenum above the ceiling suspension system is provided, without the need to remove the cross profile. When access is no longer needed, the opposite cross profile may be re-attached and the first protrusion may be folded back to its original position. In that way a suspension system is provided with removably mounted cross profiles, removal and repositioning of the cross profiles hardly having any adverse effect to the strength of the ceiling suspension system;

iii. of removably mounting cross profiles by having the protrusions at both opposite ends of the cross profile folded with respect to the web when removing them, and folded back to lay again in line with the web when re-attached to the main runner.

**[0067]** The removable mounting of cross profiles is particularly important with modern suspended ceilings, where in the event of constructing often in a first stage the ceiling is mounted to the building construction and lightning, electricity supply, air conditioning, etc. are provided only later on. In such cases it is an advantage that cross profiles are displaceable with respect to the main runner or even removably mountable to the ceiling suspension system, to allow them being removed when mounting electricity supply etc. in the plenum above the suspended ceiling and to put the cross profiles back in place when the mounting is finished. Thereby it is important that damage caused to the cross profiles is reduced to a minimum and that their strength is affected to the smallest extent only. Thus, with the present invention a ceiling suspension system with a cross profile is provided in which the heat expansion section has the additional function of providing a removable mounting of the cross profiles.

**[0068]** The present invention may relate to a ceiling suspension system comprising

- a multiplicity of the above described cross profiles having a first heat expansion section and
- at least one cross profile having no heat expansion section and
- exclusively main runners having no or a different heat expansion section.

**[0069]** The present invention may also relate to a ceiling suspension system comprising

- a multiplicity of the above described main runners having a second and third heat expansion section and
- at least one main runner having no heat expansion section and
- exclusively cross profiles having no or a different heat expansion section.

## Claims

1. A ceiling suspension system comprising a plurality of main runners (20), adjacent main runners (20) of said plurality of main runners being connected by

means of at least one cross profile (10, 30) through a a co-operating first connecting member (15) on the cross profile and second connecting member (25) on the main runner, the at least one cross profile comprising an upright longitudinally extending first web (11, 31) having at its lower end on each side a flange (12, 13, 32, 33), the flanges pointing in opposite direction from the first web, the first web (11, 31) having at its upper end a first hollow member (14, 34), at least one main runner (20) comprising an upright longitudinally extending second web (21) having at its lower end on each side a flange (22, 23), the flanges pointing in opposite direction from the second web, the second web (21) having at its upper end a second hollow member (24), the flanges (12, 13, 22, 23, 32, 33) being provided to support at least one ceiling panel, the cross profile comprising at least one first heat expansion section (40), said first heat expansion section (40) being provided on at least one end part (39) of the first hollow member (14, 34), the first heat expansion section (40) comprising

- a first protrusion (41) which protrudes in longitudinal direction at the height of the first hollow member (14, 34) from said end part (39) of the first hollow member and which is separated from the first web (11, 31) in the height direction of the cross profile by a separation running along the longitudinal direction of the cross profile and in between said first protrusion and the first web,
- the ceiling suspension system being **characterised in that** the first heat expansion section comprises a top face cut-out (43) in a top face (16) of the first protrusion above said separation in between said first protrusion and the first web, so as to provide an upright extending folding axis (45) along the height direction of the cross profile at the position of the top face cut-out, the first protrusion (41) being foldable with respect to the hollow member (14, 34) along the upright folding axis (45) in such a way that upon expansion of the cross member in the ceiling suspension system the first protrusion will deform by folding of the first protrusion along the upright folding axis.

**2.** A ceiling suspension system as claimed in claim 1, **characterised in that** the first protrusion (41) is separate from the web in the height direction of the cross profile (10, 30) by means of a longitudinal cut-out (42) which extends in longitudinal direction of the cross profile at a position between the first protrusion (41) and the first web (11, 31), to at least a position where the first protrusion is connected to the first hollow member (14, 34).

**3.** A ceiling suspension system as claimed in claim 1 or 2, **characterised in that** the first protrusion (41) is formed by compressing an end portion of the first hollow member (14, 34) in lateral direction over at least part of its height in such a way that opposite longitudinal faces (17, 37) of the hollow member lay side by side at a position between the top face cut-out (43) and a far end (44) of the cross profile comprising the first protrusion.

**4.** A ceiling suspension system as claimed in any one of claims 1-3, **characterised in that** the first protrusion (41) is positioned substantially centrally with respect to the first hollow member (14, 34).

**5.** A ceiling suspension system as claimed in any one of claims 1-4, **characterised in that** the first connecting member (15) on the cross profile (10, 30) comprises a second protrusion (18) which protrudes in longitudinal direction from the first upright web (11, 31) and **in that** the second connecting member (25) on the main runner (20) comprises a first slit which extends in height direction of the second web (21) and comprises a tapered upper and lower end part (26, 27), the second protrusion being provided to be inserted in the first slit in view of connecting the at least one cross profile (10, 30) to the at least one main runner (20) in such a way that the at least one cross profile extends from a first longitudinal side of the main runner and an end part of the first connecting member (15) extends from a second longitudinal side of the main runner opposite the first longitudinal side.

**6.** A ceiling suspension system as claimed in claim 5, **characterised in that** the tapered upper and lower end part (26, 27) of the first slit are connected to each other through a central slit (68) which extends in height direction of the main runner (20).

**7.** A ceiling suspension system as claimed in claim 6, **characterised in that** the central slit (68) has the shape of a two sided arrow with a central slit of reduced width.

**8.** A ceiling suspension system as claimed in any one of claims 5-7, **characterised in that** the second protrusion (18) has a top and a bottom side (36, 38) which extend in longitudinal direction of the protrusion, at least part of the top and bottom side tapering towards an end part (44) of the cross profile and the second protrusion.

**9.** A ceiling suspension system as claimed in any one of claims 5-8, **characterised in that** preferably substantially centrally of the second protrusion (18) taken in height direction thereof, a longitudinally extending resilient lip (35) is provided, the lip being provided to extend through the first slit and to abut against a side of the main runner (20) opposite the side from

with the remainder of the cross profile (10, 30) extends, in view of removably fixing the position of the cross profile with respect to the main runner.

**10.** A ceiling suspension system as claimed in any one of claims 5-9, **characterised in that** the second protrusion (18) is folded in longitudinal direction of the cross profile in such a way that a central part (57) of the second protrusion (18) protrudes from the remainder of the second protrusion in cross direction of the cross profile, with the aim of fixing the position of the first connecting members of cross profiles mounted to opposite sides of the main runner through the same second connecting member (25).

**11.** A ceiling suspension system as claimed in any one of claims 5-10, **characterised in that** a bottom side (38) of the second protrusion (18) slants from the flange (12, 13) in the direction of the tapering end part (44).

**12.** A ceiling suspension system as claimed in claim 5, **characterised in that** the second protrusion (18) comprises a second slit (19) which extends from a bottom side (38) of the second protrusion (18) in the direction of a top side (36) of the second protrusion, the second slit (19) being provided to receive the tapered lower end part (26) of the second connecting member (25).

**13.** A ceiling suspension system as claimed in claim 5 or 12, **characterised in that** the second protrusion (18) comprises a third protrusion (58) which extends from a top side (36) of the first protrusion (18) in height direction thereof, the third protrusion being provided to abut against a side of the main runner (20) opposite the side on which the remainder of the cross profile is positioned.

**14.** A ceiling suspension system as claimed in claim 12 or 13, **characterised in that** the second slit (19) comprises an edge (59) on the side of the slit facing the web (11, 31) of the cross profile, the edge (59) slanting towards the web (11, 31) and being provided to guide the displacement of the cross profile with respect to the main runner.

**15.** A ceiling suspension system as claimed in any one of claims 5-14, **characterised in that** the second protrusion (18) is made as a separate part which is mounted to the first longitudinal web (11, 31) of the cross profile (10, 30).

**16.** A ceiling suspension system as claimed in any one of claims 1-15, **characterised in that** the ceiling suspension system comprises at least one main runner (20) with at least one second heat expansion section (50), the at least one second heat expansion section (50) comprising

- a third cut-out (46) within the second web (21), the third cut-out (46) having a height which is smaller than the height of the web (21) and a length which is smaller than the length of the second web (21) taken in longitudinal direction thereof,
- a third and fourth slit (47, 48) which extend from the third cut-out (46) towards the flange (22, 23) over at least part of the distance between the third cut-out and the flange,
- a first intersection (49) in a bottom side (53) of the third cut-out, the first intersection having opposite sides (51, 52) which slant from the bottom side of the third cut-out towards each other and towards the flange (22, 23).

**17.** A ceiling suspension system as claimed in claim 16, **characterised in that** the first intersection (49) is substantially V-shaped.

**18.** A ceiling suspension system as claimed in claim 16 or 17, **characterised in that** the main runner (20) comprises at least one third heat expansion section (5), the third heat expansion section comprising a part of the second hollow member (24) which is locally compressed in such a way that the opposite longitudinal walls (8, 28) of the second hollow member run parallel to each other, the third heat expansion section (5) further comprising a third and fourth cut-out (3, 4) in an upper part (6) of the hollow member (24) on opposite ends of the compressed part of the second hollow member (24) and a fifth cut-out (29) at a position between the third and fourth cut-out.

**19.** A ceiling suspension system as claimed in claim 18, **characterised in that** the third heat expansion section (5) is provided at the position of the second heat expansion section (50) and has a length in longitudinal direction of the main runner which is smaller than or equal to the length of the second heat expansion section (50).

**20.** A ceiling suspension system as claimed in claim 18 or 19, **characterised in that** the third and fourth cut-out (3, 4) are provided in a top face (6) of the second hollow member.

**21.** A ceiling suspension system as claimed in any one of claims 18-20, **characterised in that** the second hollow member (24) is compressed at the position of the third heat expansion section (5) in such a way that the opposite longitudinal faces (8, 28) of the second hollow member are disposed side-by side.

**22.** A ceiling suspension system as claimed in any one of claims 1-21, **characterised in that** the second

web (21) of at least one main runner (20) comprises at least one embossing (1), to fix the position of the at least one ceiling panel with respect to the suspension system.

**23.** A ceiling suspension system as claimed in any one of claims 1-22, **characterised in that** each of the flanges of the at least one cross profile (10) comprises at least one end part, adjacent end parts having a straight edge (9) which is provided to lay against a side (54, 56) of the flange (22, 23) of the at least one main runner (20).

**24.** A ceiling suspension system as claimed in any one of claims 1-22, **characterised in that** each of the flanges of the at least one cross profile (30) comprises at least one end part, adjacent end parts having a joggled end (2) which is provided to be received on top of an upper face (75) of the corresponding flange (22, 23) of the at least one main runner (20).

**Patentansprüche**

**1.** Deckenabhängesystem, umfassend eine Vielzahl von Hauptschienen (20), wobei benachbarte Hauptschienen (20) der Vielzahl von Hauptschienen mittels mindestens einem Querprofil (10, 30) über ein zusammenwirkendes erstes Verbindungsglied (15) an dem Querprofil und ein zweites Verbindungsglied (25) an der Hauptschiene verbunden sind, wobei das mindestens eine Querprofil einen senkrechten, sich in Längsrichtung erstreckenden ersten Steg (11, 31) umfasst, der an seinem unteren Ende auf jeder Seite einen Flansch (12, 13, 32, 33) aufweist, wobei die Flansche von dem ersten Steg weg in entgegengesetzte Richtungen weisen, wobei der erste Steg (11, 31) an dessen oberem Ende ein erstes Hohlglied (14, 34) aufweist, wobei mindestens eine Hauptschiene (20) einen senkrechten, sich in Längsrichtung erstreckenden zweiten Steg (21) umfasst, der an dessen unterem Ende auf jeder Seite einen Flansch (22, 23) aufweist, wobei die Flansche von dem zweiten Steg weg in entgegengesetzte Richtungen weisen, wobei der zweite Steg (21) an dessen oberem Ende ein zweites Hohlglied (24) aufweist, wobei die Flansche (12, 13, 22, 23, 32, 33) vorgesehen sind, um mindestens eine Deckenplatte zu tragen, wobei das Querprofil mindestens einen ersten Wärmeausdehnungsabschnitt (40) umfasst, wobei der Wärmeausdehnungsabschnitt (40) an mindestens einem Endteil (39) des ersten Hohlglieds (14, 34) vorgesehen ist, wobei der erste Wärmeausdehnungsabschnitt (40) umfasst:

- einen ersten Vorsprung (41), der in Längsrichtung auf der Höhe des ersten Hohlglieds (14, 34) von dem Endteil (39) des ersten Hohlglieds vorsteht und von dem ersten Steg (11, 31) in der Höhenrichtung des Querprofils durch eine Abteilung, welche die Längsrichtung des Querprofils entlang und zwischen dem ersten Vorsprung und dem ersten Steg verläuft, getrennt ist,
- wobei das Deckenabhängesystem **dadurch gekennzeichnet ist, dass** der erste Wärmeausdehnungsabschnitt einen oberseitigen Ausschnitt (43) in einer oberen Fläche (16) des ersten Vorsprungs oberhalb der Abteilung zwischen dem ersten Vorsprung und dem ersten Steg umfasst, um eine sich senkrecht erstreckende Klappachse (45) entlang der Höhenrichtung des Querprofils an der Position des oberseitigen Ausschnitts vorzusehen, wobei der erste Vorsprung (41) in Bezug auf das Hohlglied (14, 34) entlang der senkrechten Klappachse (45) klappbar ist, derart, dass sich bei Ausdehnung des Querglieds in dem Deckenabhängesystem der erste Vorsprung durch Klappen des ersten Vorsprungs entlang der senkrechten Klappachse verformt.

**2.** Deckenabhängesystem nach Anspruch 1, **dadurch gekennzeichnet, dass** der erste Vorsprung (41) von dem Steg in der Höhenrichtung des Querprofils (10, 30) mittels eines Längsausschnitts (42) getrennt ist, welcher sich in Längsrichtung des Querprofils an einer Position zwischen dem ersten Vorsprung (41) und dem ersten Steg (11, 31) zu mindestens einer Position hin erstreckt, wo der erste Vorsprung mit dem ersten Hohlglied (14, 34) verbunden ist.

**3.** Deckenabhängesystem nach Anspruch 1 oder 2, **dadurch gekennzeichnet, dass** der erste Vorsprung (41) durch Zusammendrücken eines Endabschnitts des ersten Hohlglieds (14, 34) in seitlicher Richtung über mindestens einen Teil seiner Höhe gebildet wird, derart, dass entgegengesetzte Längsseiten (17, 37) des Hohlglieds an einer Position zwischen dem oberseitigen Ausschnitt (43) und einem fernen Ende (44) des Querprofils, welches den ersten Vorsprung umfasst, Seite an Seite angeordnet sind.

**4.** Deckenabhängesystem nach einem beliebigen der Ansprüche 1-3, **dadurch gekennzeichnet, dass** der erste Vorsprung (41) im Wesentlichen mittig in Bezug auf das erste Hohlglied (14, 34) angeordnet ist.

**5.** Deckenabhängesystem nach einem beliebigen der Ansprüche 1-4, **dadurch gekennzeichnet, dass** das erste Verbindungsglied (15) an dem Querprofil (10, 30) einen zweiten Vorsprung (18) umfasst, der in Längsrichtung von dem ersten senkrechten Steg (11, 31) vorsteht, und dass das zweite Verbindungsglied (25) an der Hauptschiene (20) einen ersten

Schlitz umfasst, der sich in Höhenrichtung des zweiten Stegs (21) erstreckt und einen konisch zulaufenden oberen und unteren Endteil (26, 27) umfasst, wobei der zweite Vorsprung vorgesehen ist, in den ersten Schlitz eingeführt zu werden, um das mindestens eine Querprofil (10, 30) mit der mindestens einen Hauptschiene (20) zu verbinden, derart, dass sich das mindestens eine Querprofil von einer ersten Längsseite der Hauptschiene erstreckt und sich ein Endteil des ersten Verbindungsglieds (15) von einer zweiten Längsseite der Hauptschiene, welche der ersten Längsseite entgegengesetzt ist, erstreckt.

**6.** Deckenabhängesystem nach Anspruch 5, **dadurch gekennzeichnet, dass** der konisch zulaufende obere Endteil (26) und der konisch zulaufende untere Endteil (27) des ersten Schlitzes durch einen mittleren Schlitz (68) miteinander verbunden sind, welcher sich in der Höhenrichtung der Hauptschiene (20) erstreckt.

**7.** Deckenabhängesystem nach Anspruch 6, **dadurch gekennzeichnet, dass** der mittlere Schlitz (68) die Form eines Doppelpfeils mit einem mittleren Schlitz von reduzierter Breite aufweist.

**8.** Deckenabhängesystem nach einem beliebigen der Ansprüche 5-7, **dadurch gekennzeichnet, dass** der zweite Vorsprung (18) eine obere und eine untere Seite (36, 38) aufweist, welche sich in Längsrichtung des Vorsprungs erstrecken, wobei mindestens ein Teil der oberen und der unteren Seite zu einem Endteil (44) des Querprofils und dem zweiten Vorsprung hin konisch zulaufen.

**9.** Deckenabhängesystem nach einem beliebigen der Ansprüche 5-8, **dadurch gekennzeichnet, dass** vorzugsweise im Wesentlichen in der Mitte des zweiten Vorsprungs (18) in einer Höhenrichtung davon eine sich in Längsrichtung erstreckende elastische Lippe (35) vorgesehen ist, wobei die Lippe vorgesehen ist, um sich durch den ersten Schlitz zu erstrekken und an einer Seite der Hauptschiene (20) anzuliegen, die jener Seite entgegengesetzt ist, von welcher sich der Rest des Querprofils (10, 30) erstreckt, um die Position des Querprofils in Bezug auf die Hauptschiene lösbar zu befestigen.

**10.** Deckenabhängesystem nach einem beliebigen der Ansprüche 5-9, **dadurch gekennzeichnet, dass** der zweite Vorsprung (18) in Längsrichtung des Querprofils auf eine Weise geklappt wird, dass ein mittlerer Teil (57) des zweiten Vorsprungs (18) von dem Rest des zweiten Vorsprungs in der Querrichtung des Querprofils vorsteht, mit dem Ziel, die Position der ersten Verbindungsglieder von Querprofilen, die an entgegengesetzten Seiten der Hauptschiene angebracht sind, durch dasselbe zweite Verbindungsglied (25) zu befestigen.

**11.** Deckenabhängesystem nach einem beliebigen der Ansprüche 5-10, **dadurch gekennzeichnet, dass** eine untere Seite (38) des zweiten Vorsprungs (18) von dem Flansch (12, 13) in Richtung des konisch zulaufenden Endteils (44) abgeschrägt ist.

**12.** Deckenabhängesystem nach Anspruch 5, **dadurch gekennzeichnet, dass** der zweite Vorsprung (18) einen zweiten Schlitz (19) umfasst, der sich von einer unteren Seite (38) des zweiten Vorsprungs (18) in Richtung einer oberen Seite (36) des zweiten Vorsprungs erstreckt, wobei der zweite Schlitz (19) vorgesehen ist, um den konisch zulaufenden unteren Endteil (26) des zweiten Verbindungsglieds (25) aufzunehmen.

**13.** Deckenabhängesystem nach Anspruch 5 oder 12, **dadurch gekennzeichnet, dass** der zweite Vorsprung (18) einen dritten Vorsprung (58) umfasst, der sich von einer oberen Seite (36) des ersten Vorsprungs (18) in einer Höhenrichtung davon erstreckt, wobei der dritte Vorsprung vorgesehen ist, um an einer Seite der Hauptschiene (20) anzuliegen, die jener Seite entgegengesetzt ist, auf welcher der Rest des Querprofils angeordnet ist.

**14.** Deckenabhängesystem nach Anspruch 12 oder 13, **dadurch gekennzeichnet, dass** der zweite Schlitz (19) eine Kante (59) auf der Seite des Schlitzes, welche dem Steg (11, 31) des Querprofils zugewandt ist, umfasst, wobei die Kante (59) zu dem Steg (11, 31) hin abgeschrägt ist und vorgesehen ist, um die Verlagerung des Querprofils in Bezug auf die Hauptschiene zu führen.

**15.** Deckenabhängesystem nach einem beliebigen der Ansprüche 5-14, **dadurch gekennzeichnet, dass** der zweite Vorsprung (18) als getrennter Teil hergestellt ist, der an dem ersten Längssteg (11, 31) des Querprofils (10, 30) angebracht ist.

**16.** Deckenabhängesystem nach einem beliebigen der Ansprüche 1-15, **dadurch gekennzeichnet, dass** das Deckenabhängesystem mindestens eine Hauptschiene (20) mit mindestens einem zweiten Wärmeausdehnungsabschnitt (50) umfasst, wobei der mindestens eine zweite Wärmeausdehnungsabschnitt (50) umfasst:

- einen dritten Ausschnitt (46) innerhalb des zweiten Stegs (21), wobei der dritte Ausschnitt (46) eine Höhe, die kleiner als die Höhe des Stegs (21) ist, und eine Länge, die kleiner als die Länge des zweiten Stegs (21) in einer Längsrichtung davon ist, aufweist,
- einen dritten und einen vierten Schlitz (47, 48),

die sich über mindestens einen Teil des Abstands zwischen dem dritten Ausschnitt und dem Flansch von dem dritten Ausschnitt (46) zu dem Flansch (22, 23) hin erstrecken,
- eine erste Kreuzungsstelle (49) in einer unteren Seite (53) des dritten Ausschnitts, wobei die erste Kreuzungsstelle entgegengesetzte Seiten (51, 52) aufweist, die von der unteren Seite des dritten Ausschnitts zu einander und zu dem Flansch (22, 23) hin abgeschrägt sind.

**17.** Deckenabhängesystem nach Anspruch 16, **dadurch gekennzeichnet, dass** die erste Kreuzungsstelle (49) im Wesentlichen V-förmig ist.

**18.** Deckenabhängesystem nach Anspruch 16 oder 17, **dadurch gekennzeichnet, dass** die Hauptschiene (20) mindestens einen dritten Wärmeausdehnungsabschnitt (5) umfasst, wobei der dritte Wärmeausdehnungsabschnitt einen Teil des zweiten Hohlglieds (24) umfasst, der lokal derart zusammengedrückt ist, dass die entgegengesetzten Längswände (8, 28) des zweiten Hohlglieds parallel zueinander verlaufen, wobei der dritte Wärmeausdehnungsabschnitt (5) ferner einen dritten und einen vierten Ausschnitt (3, 4) in einem oberen Teil (6) des Hohlglieds (24) an entgegengesetzten Enden des zusammengedrückten Teils des zweiten Hohlglieds (24) und einen fünften Ausschnitt (29) an einer Position zwischen dem dritten und dem vierten Ausschnitt umfasst.

**19.** Deckenabhängesystem nach Anspruch 18, **dadurch gekennzeichnet, dass** der dritte Wärmeausdehnungsabschnitt (5) an der Position des zweiten Wärmeausdehnungsabschnitts (50) vorgesehen ist und eine Länge in Längsrichtung der Hauptschiene aufweist, die kleiner gleich der Länge des zweiten Wärmeausdehnungsabschnitts (50) ist.

**20.** Deckenabhängesystem nach Anspruch 18 oder 19, **dadurch gekennzeichnet, dass** der dritte und der vierte Ausschnitt (3, 4) in einer oberen Fläche (6) des zweiten Hohlglieds vorgesehen sind.

**21.** Deckenabhängesystem nach einem beliebigen der Ansprüche 18-20, **dadurch gekennzeichnet, dass** das zweite Hohlglied (24) an der Position des dritten Wärmeausdehnungsabschnitts (5) auf eine Weise zusammengedrückt ist, dass die entgegengesetzten Längsflächen (8, 28) des zweiten Hohlglieds Seite an Seite angeordnet sind.

**22.** Deckenabhängesystem nach einem beliebigen der Ansprüche 1-21, **dadurch gekennzeichnet, dass** der zweite Steg (21) von mindestens einer Hauptsclliene (20) mindestens eine Prägung (1) umfasst, um die Position der mindestens einen Deckenplatte in Bezug auf das Abhängesystem zu befestigen.

**23.** Deckenabhängesystem nach einem beliebigen der Ansprüche 1-22, **dadurch gekennzeichnet, dass** jeder der Flansche des mindestens einen Querprofils (10) mindestens einen Endteil umfasst, wobei benachbarte Endteile eine gerade Kante (9) aufweisen, die vorgesehen ist, um an einer Seite (54, 56) des Flansches (22, 23) der mindestens einen Hauptschiene (20) anzuliegen.

**24.** Deckenabhängesystem nach einem der Ansprüche 1-22, **dadurch gekennzeichnet, dass** jeder der Flansche des mindestens einen Querprofils (30) mindestens einen Endteil umfasst, wobei benachbarte Endteile ein verzahntes Ende (2) aufweisen, welches vorgesehen ist, um oben auf einer oberen Fläche (75) des entsprechenden Flansches (22, 23) der mindestens einen Hauptschiene (20) aufgenommen zu werden.

**Revendications**

**1.** Système de suspension de plafond comprenant une pluralité de rails principaux (20), des rails principaux (20) adjacents de ladite pluralité de rails principaux étant reliés au moyen d'au moins un profilé transversal (10, 30) par l'intermédiaire d'un premier élément de connexion (15) sur le profilé transversal et d'un deuxième élément de connexion (25) sur le rail principal, ledit au moins un profilé transversal comprenant une première âme verticale (11, 31) s'étendant longitudinalement ayant à son extrémité inférieure une aile (12, 13, 32, 33) de chaque côté, les ailes pointant en sens opposé à partir de la première âme, la première âme (11, 31) ayant à son extrémité supérieure un premier élément creux (14, 34), au moins un rail principal (20) comprenant une deuxième âme verticale (21) s'étendant longitudinalement ayant à son extrémité inférieure une aile (22, 23) de chaque côté, les ailes pointant en sens opposé à partir de la deuxième âme, la deuxième âme (21) ayant à son extrémité supérieure un deuxième élément creux (24), les ailes (12, 13, 22, 23, 32, 33) étant prévues pour supporter au moins un panneau de plafond, le profilé transversal comprenant au moins une première section de dilatation thermique (40), ladite première section de dilatation thermique (40) étant prévue sur au moins une partie terminale (39) du premier élément creux (14, 34), la première section de dilatation thermique (40) comprenant :

- une première protubérance (41) qui fait saillie en direction longitudinale à la hauteur du premier élément creux (14, 34) de ladite partie terminale (39) du premier élément creux et qui est séparée de la première âme (11, 31) dans le

sens de la hauteur du profilé transversal par une séparation courant le long de la direction longitudinale du profilé transversal et entre ladite première protubérance et la première âme,
- le système de suspension de plafond étant **caractérisé en ce que** la première section de dilatation thermique comprend une découpe (43) dans une face supérieure (16) de la première protubérance au-dessus de ladite séparation entre ladite première protubérance et la première âme de manière à fournir un axe de pliage (45) s'étendant verticalement le long du sens de la hauteur du profilé transversal au niveau de la position de la découpe dans la face supérieure, la première protubérance (41) pouvant être pliée par rapport à l'élément creux (14, 34) le long de l'axe de pliage verticale (45) de telle manière que, lors de la dilatation de l'élément transversal dans le système de suspension de plafond, la première protubérance se déforme en pliant la première protubérance le long de l'axe de pliage vertical.

**2.** Système de suspension de plafond tel que revendiqué dans la revendication 1, **caractérisé en ce que** la première protubérance (41) est séparée de l'âme dans le sens de la hauteur du profilé transversal (10, 30) au moyen d'une découpe longitudinale (42) qui s'étend dans la direction longitudinale du profilé transversal d'une position entre la première protubérance (41) et la première âme (11, 31), jusqu'à au moins une position où la première protubérance est reliée au premier élément creux (14, 34).

**3.** Système de suspension de plafond tel que revendiqué dans la revendication 1 ou 2, **caractérisé en ce que** la première protubérance (41) est formée en comprimant une partie terminale du premier élément creux (14, 34) en direction latérale sur au moins une partie de sa hauteur de telle manière que des faces longitudinales opposées (17, 37) de l'élément creux reposent côte à côte dans une position entre la découpe dans la face supérieure (43) et une extrémité (44) du profilé transversal comprenant la première protubérance.

**4.** Système de suspension de plafond tel que revendiqué dans l'une quelconque des revendications 1 à 3, **caractérisé en ce que** la première protubérance (41) est positionnée de manière sensiblement centrée par rapport au premier élément creux (14, 34).

**5.** Système de suspension de plafond tel que revendiqué dans l'une quelconque des revendications 1 à 4, **caractérisé en ce que** le premier élément de connexion (15) sur le profilé transversal (10, 30) comprend une deuxième protubérance (18) qui fait saillie dans la direction longitudinale à partir de la première âme verticale (11, 31) et **en ce que** le deuxième élément de connexion (25) sur le rail principal (20) comprend une première fente qui s'étend dans le sens de la hauteur de la deuxième âme (21) et comprend une partie terminale supérieure et inférieure effilée (26, 27), la deuxième protubérance étant prévue pour être insérée dans la première fente en vue de connecter ledit au moins un profilé transversal (10, 30) audit au moins un rail principal (20) de telle manière que ledit au moins un profilé transversal s'étende à partir d'un premier côté longitudinal du rail principal et qu'une partie terminale du premier élément de connexion (15) s'étende à partir d'un deuxième côté longitudinal du rail principal opposé au premier côté longitudinal.

**6.** Système de suspension de plafond tel que revendiqué dans la revendication 5, **caractérisé en ce que** la partie terminale supérieure et inférieure effilée (26, 27) de la première fente sont connectées l'une à l'autre par l'intermédiaire d'une fente centrale (68) qui s'étend dans le sens de la hauteur du rail principal (20).

**7.** Système de suspension de plafond tel que revendiqué dans la revendication 6, **caractérisé en ce que** la fente principale (68) a la forme d'une flèche à deux pointes avec une fente centrale de largeur réduite.

**8.** Système de suspension de plafond tel que revendiqué dans l'une quelconque des revendications 5 à 7, **caractérisé en ce que** la deuxième protubérance (18) a une côté supérieur et un côté inférieur (36, 38) qui s'étendent dans la direction longitudinale de la protubérance, au moins une partie du côté inférieur et du côté supérieur s'effilant en direction d'une partie terminale (44) du profilé transversal et de la deuxième protubérance.

**9.** Système de suspension de plafond tel que revendiqué dans l'une quelconque des revendications 5 à 8, **caractérisé en ce qu'**une lèvre élastique (35) s'étendant longitudinalement est prévue, de préférence, pratiquement au centre de la deuxième protubérance (18) prise dans le sens de sa hauteur, la lèvre étant prévue pour s'étendre à travers la première fente et pour buter contre un côté du rail principal (20) opposé au côté à partir duquel le reste du profilé transversal (10, 30) s'étend, en vue de fixer de manière amovible la position du profilé transversal par rapport au rail principal.

**10.** Système de suspension de plafond tel que revendiqué dans l'une quelconque des revendications 5 à 9, **caractérisé en ce que** la deuxième protubérance (18) est pliée dans la direction longitudinale du profilé transversal de telle manière qu'une partie centrale (57) de la deuxième protubérance (18) fasse saillie

du reste de la deuxième protubérance dans la direction transversale du profilé transversal, dans le but de fixer la position des premiers éléments de connexion des profilés transversaux montés sur des côtés opposés du rail principal à travers le même deuxième élément de connexion (25).

**11.** Système de suspension de plafond tel que revendiqué dans l'une quelconque des revendications 5 à 10, **caractérisé en ce que** un côté inférieur (38) de la deuxième protubérance (18) s'incline à partir de l'aile (12, 13) dans la direction de la partie terminale effilée (44).

**12.** Système de suspension de plafond tel que revendiqué dans la revendication 5, **caractérisé en ce que** la deuxième protubérance (18) comprend une deuxième fente (19) qui s'étend à partir d'un côté inférieur (38) de la deuxième protubérance (18) en direction d'un côté supérieur (36) de la deuxième protubérance, la deuxième fente (19) étant prévue pour recevoir la partie terminale inférieure effilée (26) du deuxième élément de connexion (25).

**13.** Système de suspension de plafond tel que revendiqué dans la revendication 5 ou 12, **caractérisé en ce que** la deuxième protubérance (18) comprend une troisième protubérance (58) qui s'étend à partir du côté supérieur (36) de la première protubérance (18) dans le sens de sa hauteur, la troisième protubérance étant prévue pour buter contre un côté du rail principal (20) opposé au côté sur lequel le reste du profilé transversal est positionné.

**14.** Système de suspension de plafond tel que revendiqué dans la revendication 12 ou 13, **caractérisé en ce que** la deuxième fente (19) comprend un bord (59) sur le côté de la fente faisant face à l'âme (11, 31) du profilé transversal, le bord (59) s'inclinant vers l'âme (11, 31) et étant prévu pour guider le déplacement du profilé transversal par rapport au rail principal.

**15.** Système de suspension de plafond tel que revendiqué dans l'une quelconque des revendications 5 à 14, **caractérisé en ce que** la deuxième protubérance (18) est réalisée comme une partie séparée qui est montée sur la première âme longitudinale (11, 31) du profilé transversal (10, 30).

**16.** Système de suspension de plafond tel que revendiqué dans l'une quelconque des revendications 5 à 15, **caractérisé en ce que** le système de suspension de plafond comprend au moins un rail principal (20) avec au moins une deuxième section de dilatation thermique (50), ladite au moins une deuxième section de dilatation thermique (50) comprenant :

- une troisième découpe (46) dans la deuxième âme (21), la troisième découpe (46) ayant une hauteur qui est plus petite que la hauteur de l'âme (21) et une longueur qui est plus petite que la longueur de la deuxième âme (21) prise dans la direction longitudinale de celle-ci,
- une troisième et une quatrième fente (47, 48) qui s'étendent à partir de la troisième découpe (46) vers l'aile (22, 23) sur au moins une partie de la distance entre la troisième découpe et l'aile,
- une première intersection (49) dans un côté inférieur (53) de la troisième découpe, la première intersection ayant des côtés opposés (51, 52) qui s'inclinent à partir du côté supérieur de la troisième découpe l'un vers l'autre et vers l'aile (22, 23).

**17.** Système de suspension de plafond tel que revendiqué dans la revendication 16, **caractérisé en ce que** la première intersection (49) est essentiellement en forme de V.

**18.** Système de suspension de plafond tel que revendiqué dans la revendication 16 ou 17, **caractérisé en ce que** le rail principal (20) comprend au moins une troisième section de dilatation thermique (5), la troisième section de dilatation thermique comprenant une partie du deuxième élément creux (24) qui est localement comprimé de telle manière que les parois longitudinales opposées (8, 28) du deuxième élément creux courent parallèlement entre elles, la troisième section de dilatation thermique (5) comprenant en outre une troisième et une quatrième découpe (3, 4) dans une partie supérieure (6) de l'élément creux (24) sur des extrémités opposées de la partie comprimée du deuxième élément creux (24) et une cinquième découpe (29) dans une position entre la troisième et la quatrième découpe.

**19.** Système de suspension de plafond tel que revendiqué dans la revendication 18, **caractérisé en ce que** la troisième section de dilatation thermique (5) est prévue dans la position de la deuxième section de dilatation thermique (50) et a une longueur dans la direction longitudinale du rail principal qui est inférieure ou égale à la longueur de la deuxième section de dilatation thermique (50).

**20.** Système de suspension de plafond tel que revendiqué dans la revendication 18 ou 19, **caractérisé en ce que** la troisième et la quatrième découpe (3, 4) sont prévues dans une face supérieure (6) du deuxième élément creux.

**21.** Système de suspension de plafond tel que revendiqué dans l'une quelconque des revendications 18 à 20, **caractérisé en ce que** le deuxième élément

creux (24) est comprimé au niveau de la position de la troisième section de dilatation thermique (5) de telle manière que les faces longitudinales opposées (8, 28) du deuxième élément creux soient disposées côte à côte.

**22.** Système de suspension de plafond tel que revendiqué dans l'une quelconque des revendications 1 à 21, **caractérisé en ce que** la deuxième âme (21) d'au moins un rail principal (20) comprend au moins un bosselage (1) pour fixer la position dudit au moins un panneau de plafond par rapport au système de suspension.

**23.** Système de suspension de plafond tel que revendiqué dans l'une quelconque des revendications 1 à 22, **caractérisé en ce que** chacune des ailes dudit au moins un profilé transversal (10) comprend au moins une partie terminale, des parties terminales adjacentes ayant un bord droit (9) qui est prévu pour reposer contre un côté (54, 56) de l'aile (22, 23) dudit au moins un rail principal (20).

**24.** Système de suspension de plafond tel que revendiqué dans l'une quelconque des revendications 1 à 22, **caractérisé en ce que** chacune des ailes dudit au moins un profilé transversal (30) comprend au moins une partie terminale, des parties terminales adjacentes ayant une extrémité en saillie (2) qui est prévue pour être reçue au-dessus d'une face supérieure (75) de l'aile correspondante (22, 23) dudit au moins un rail principal (20).

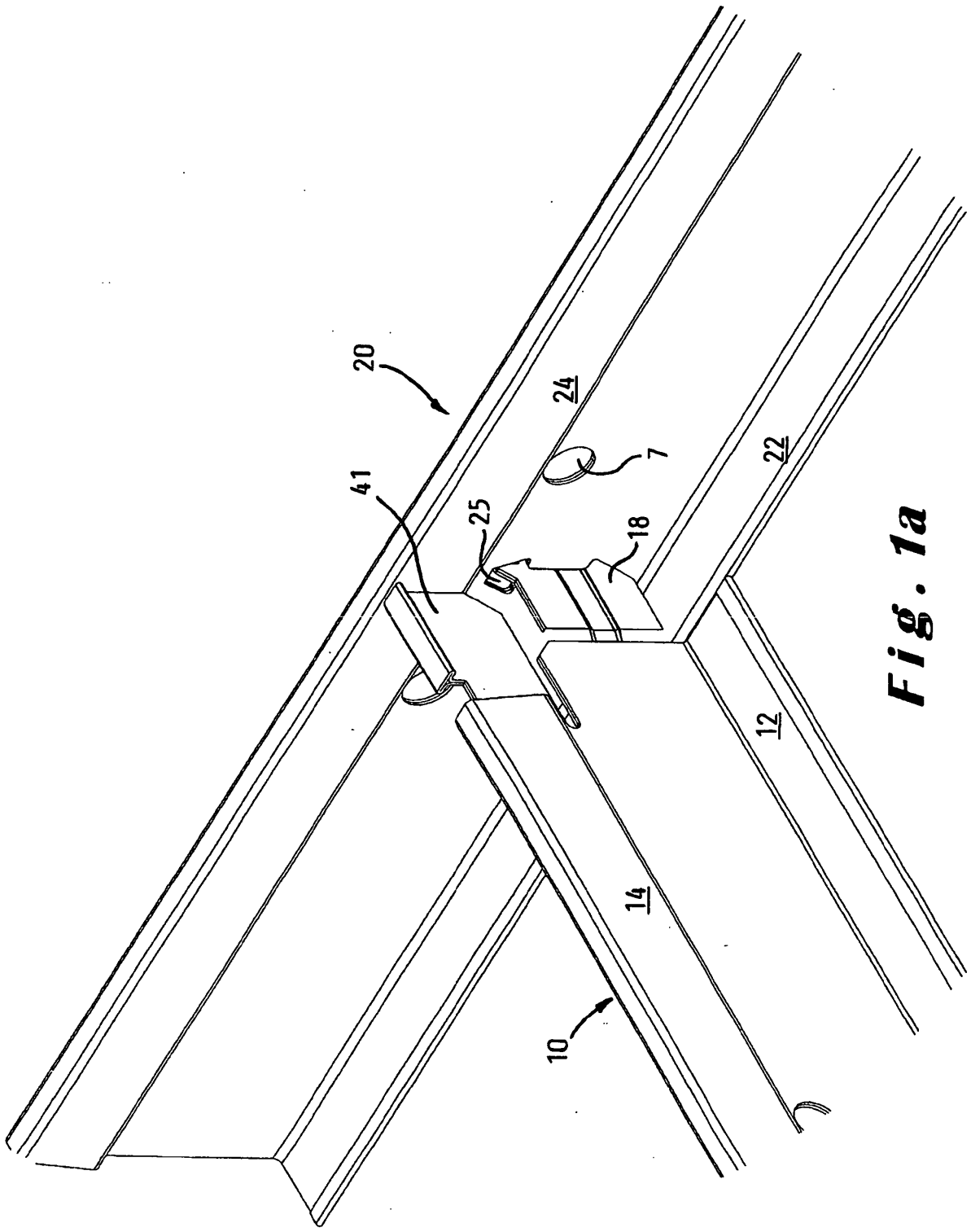



Fig. 1a

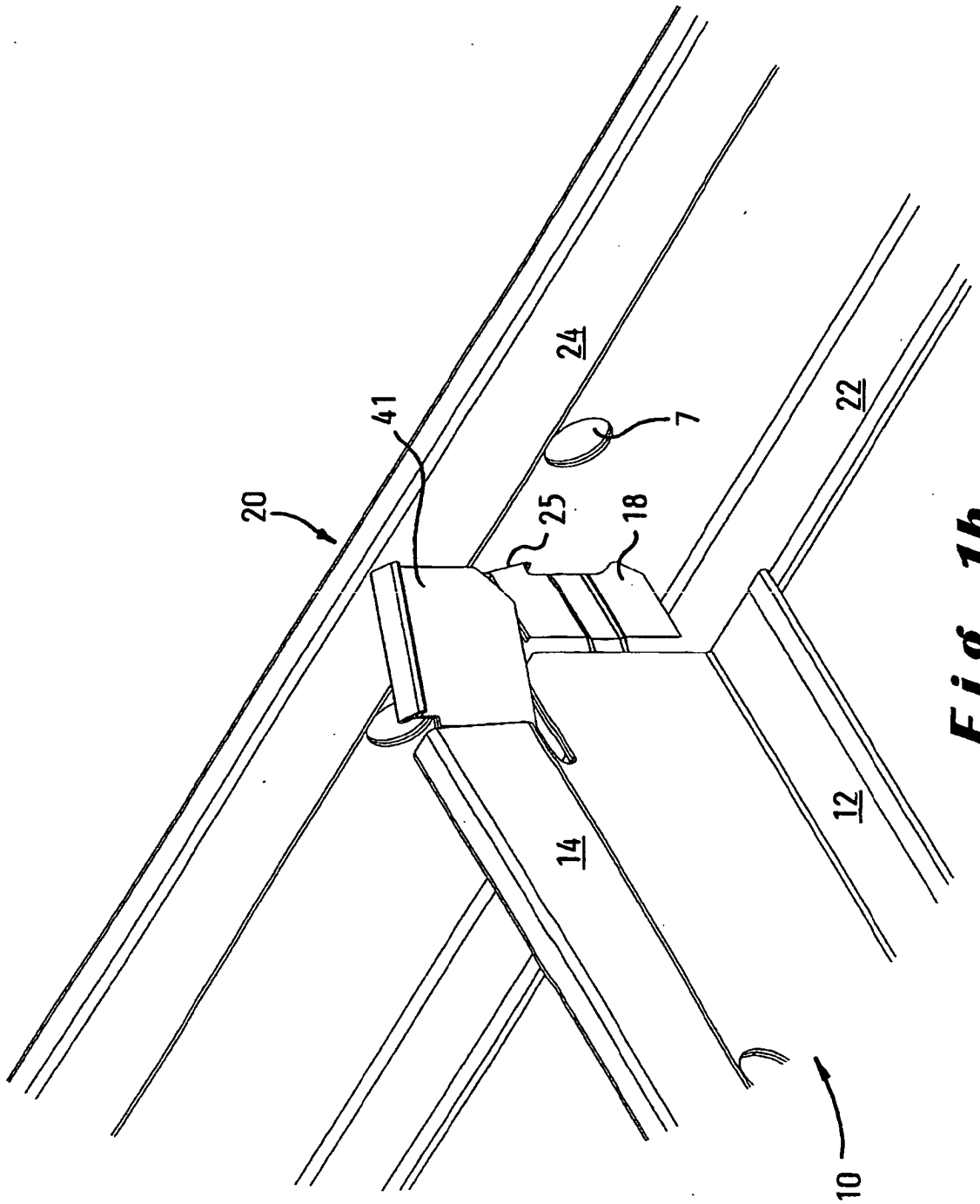



Fig. 1b

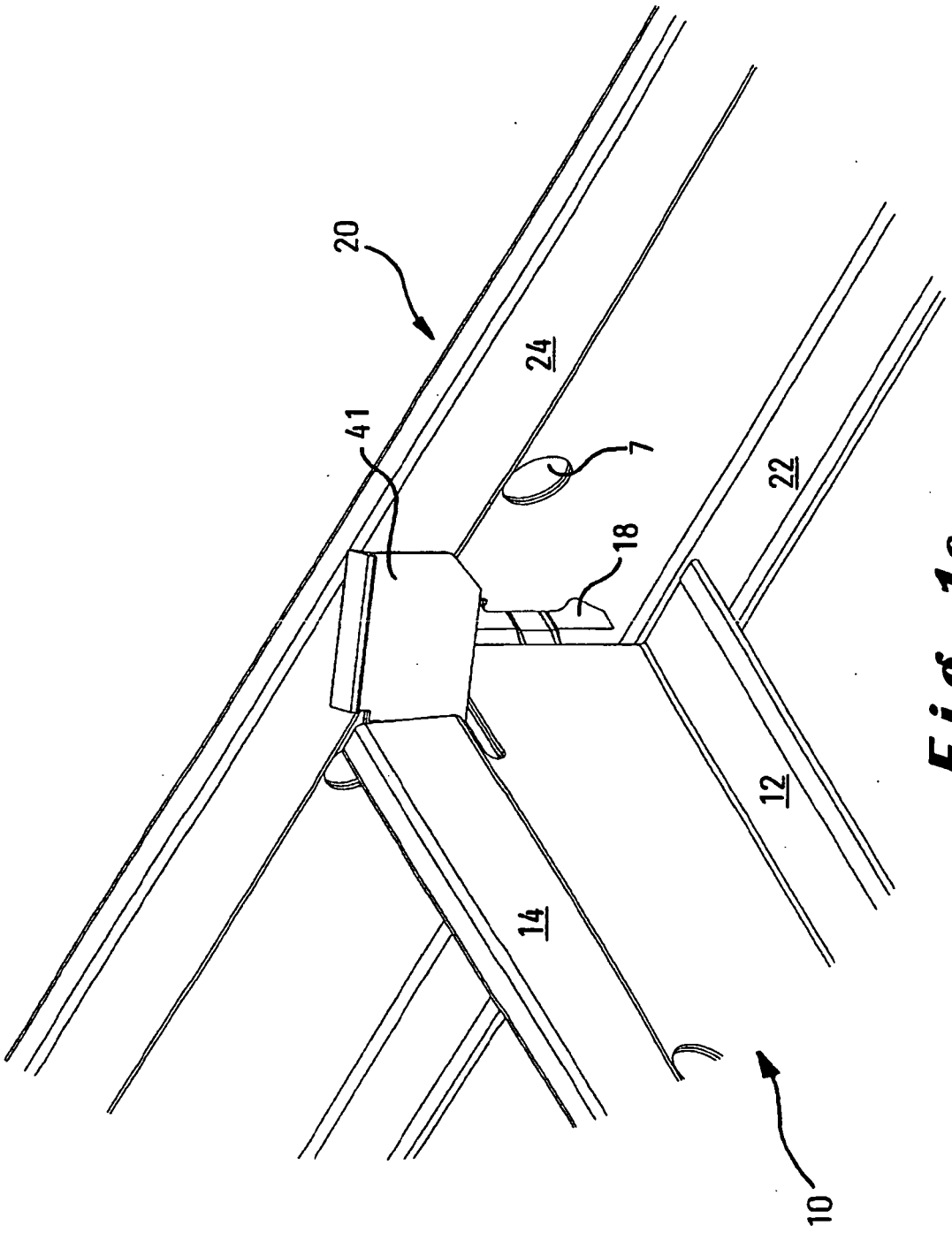



Fig. 1c

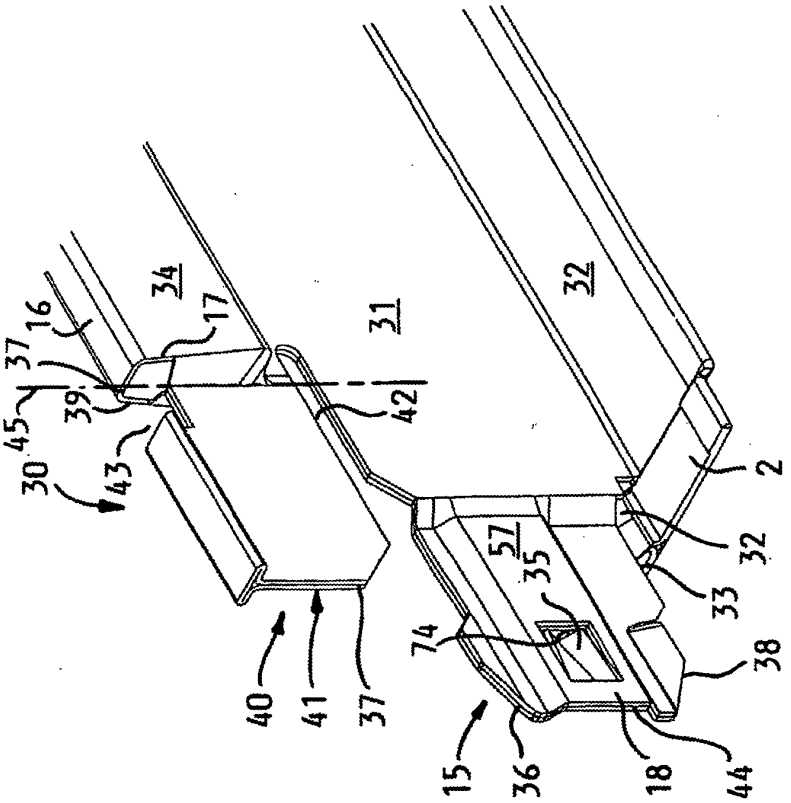

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Fig. 2b

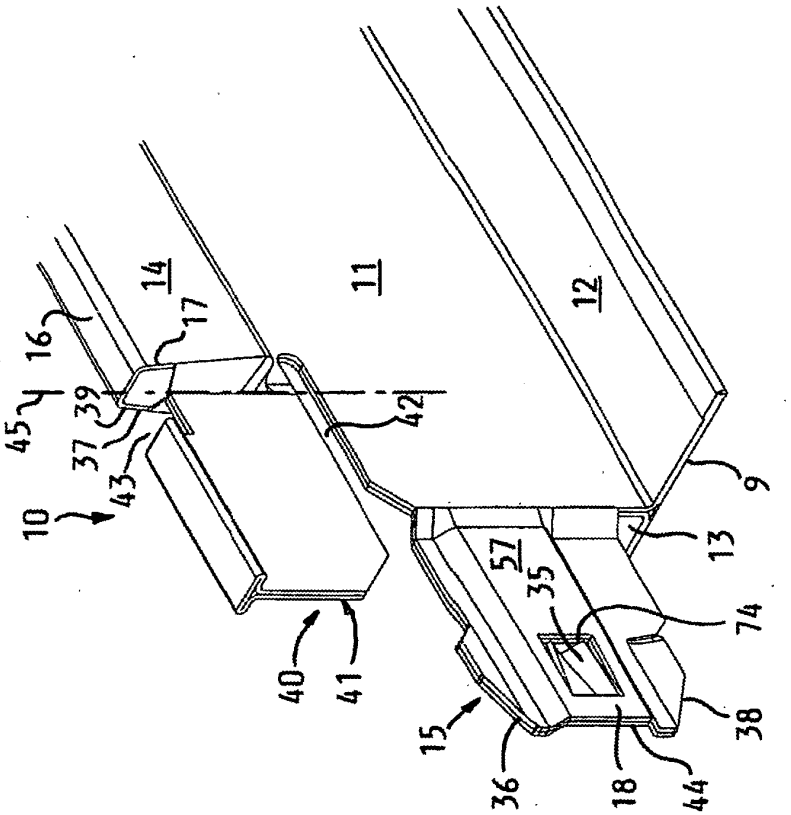

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Fig. 2a

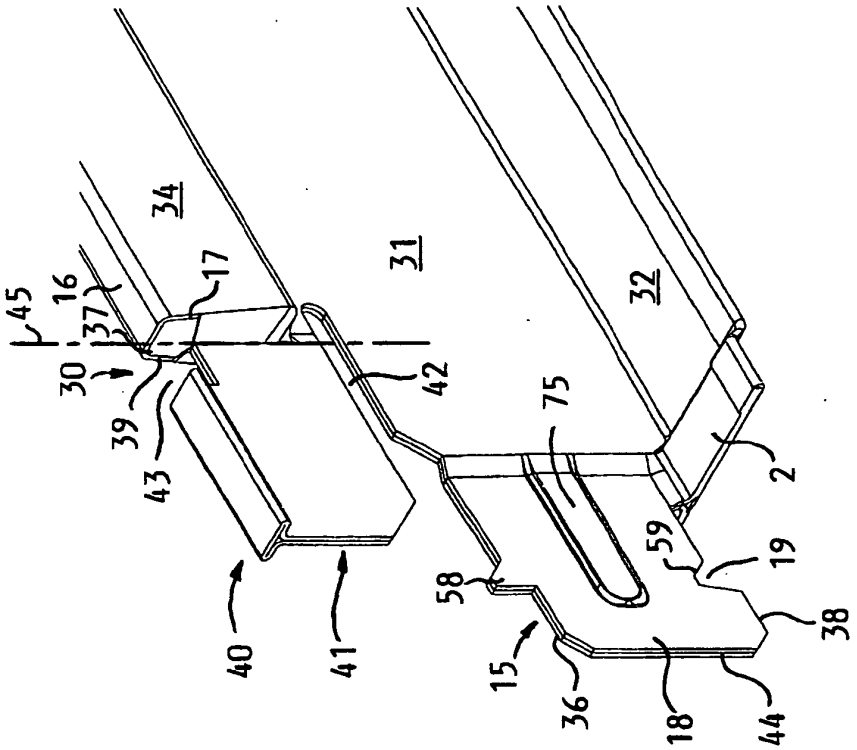

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Fig. 3b

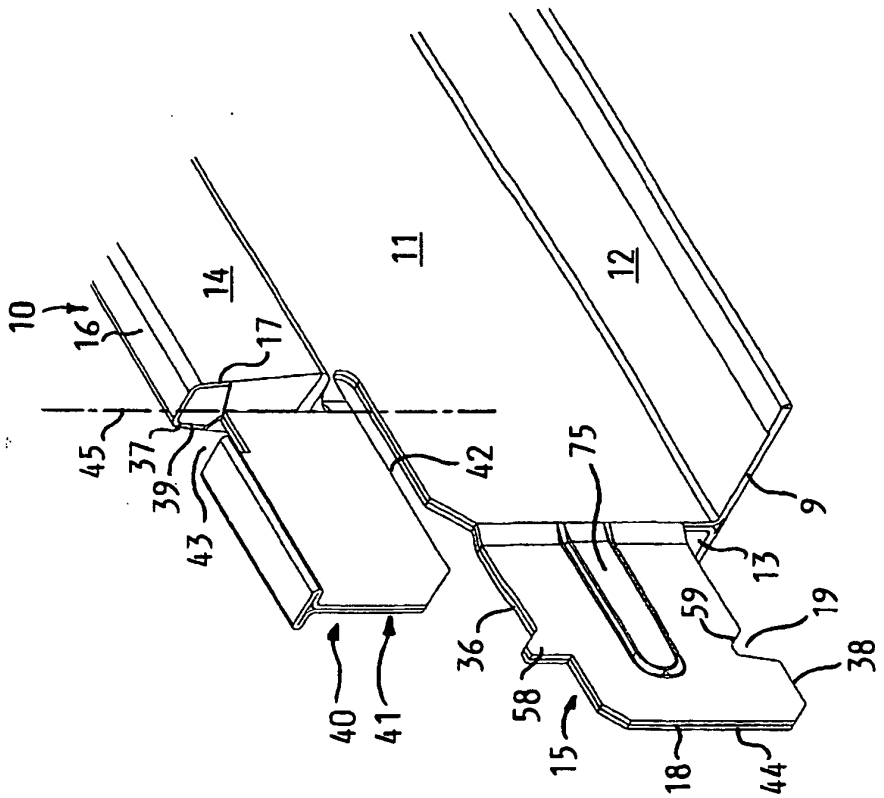

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Fig. 3a

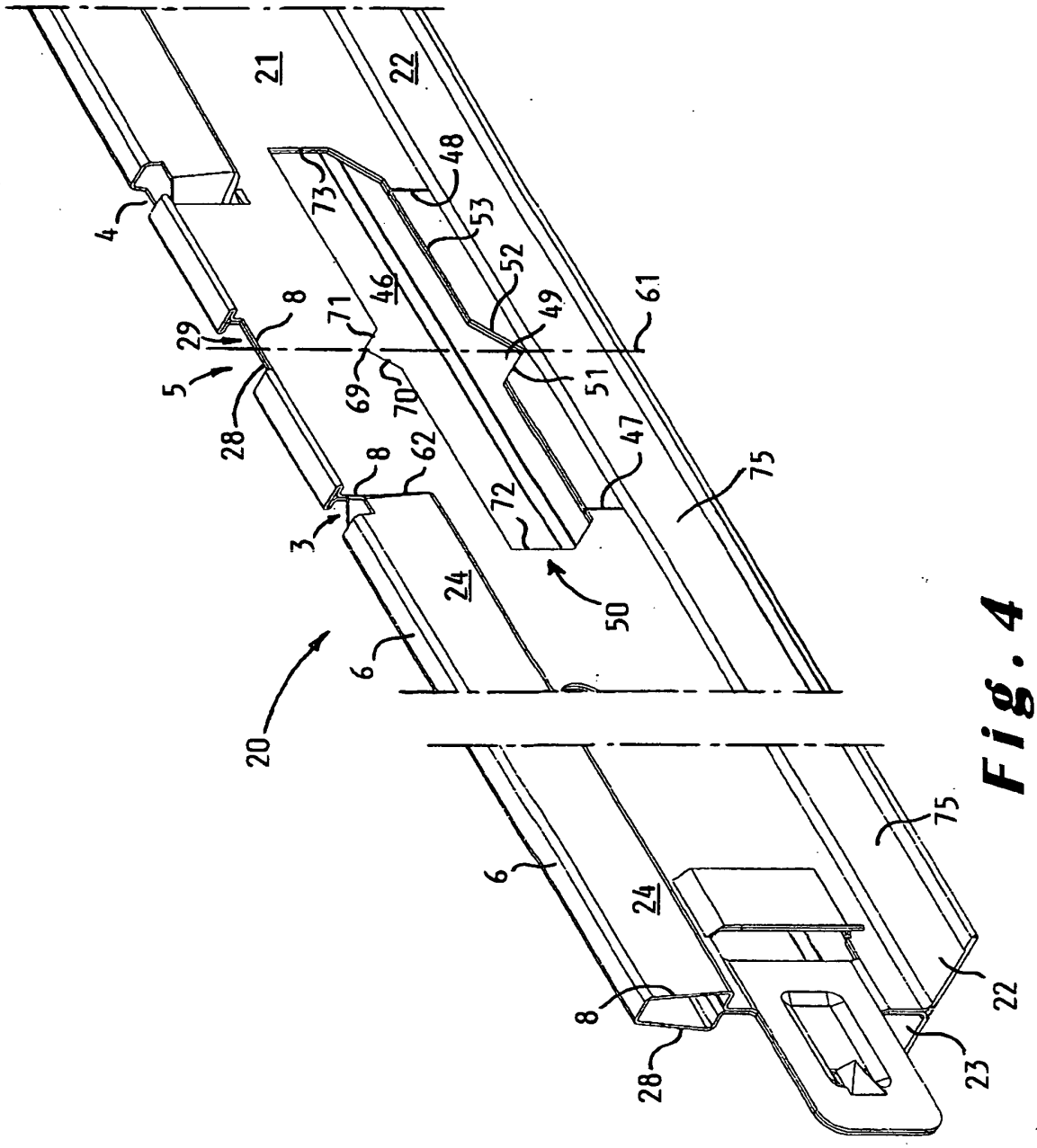

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Fig. 4

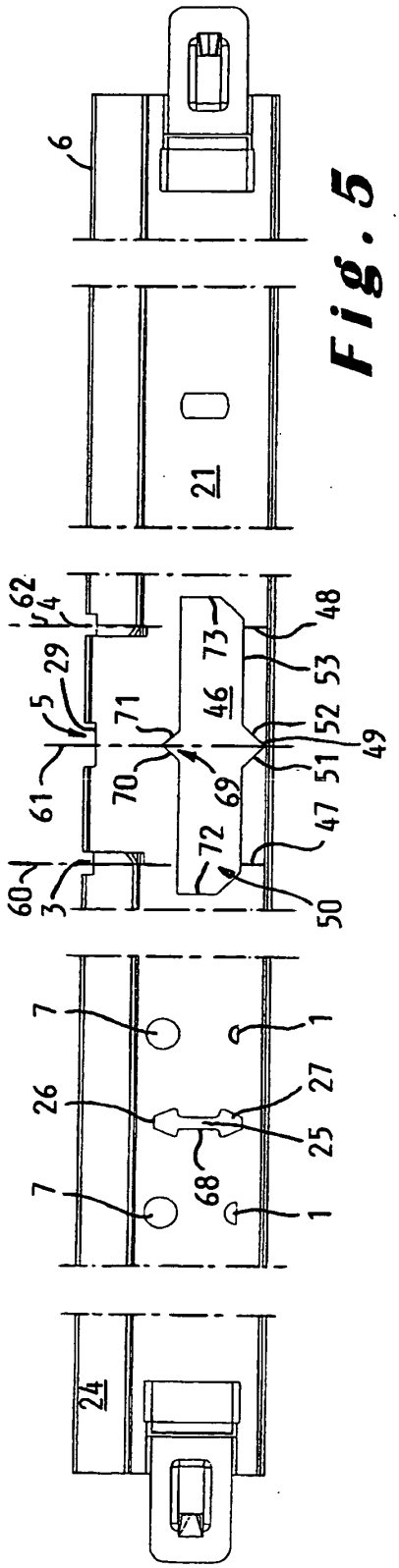



Fig. 5

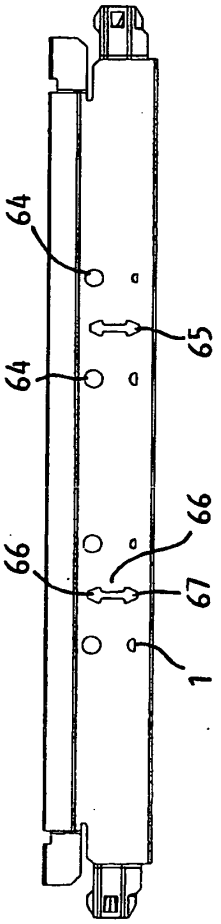



Fig. 6

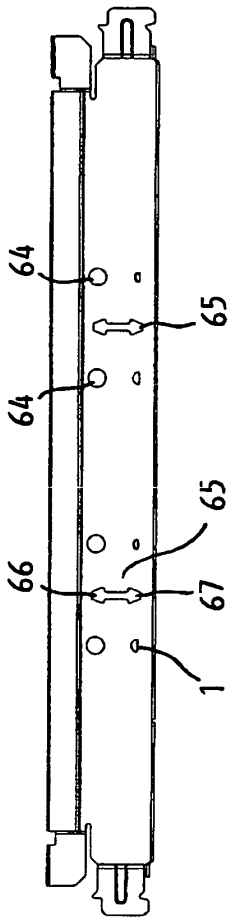



Fig. 7



Fig. 8

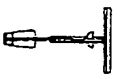


Fig. 9

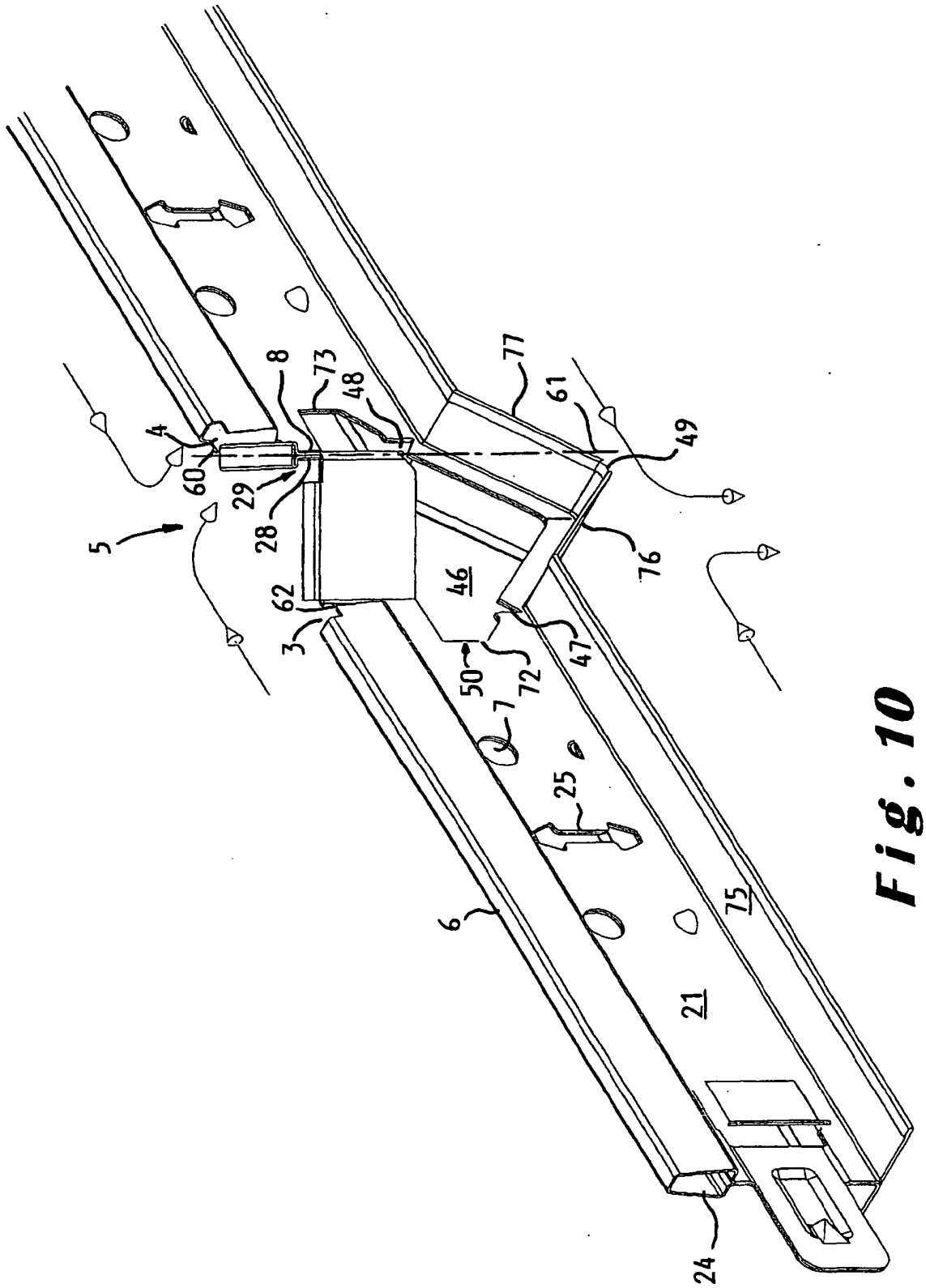



Fig. 10

## REFERENCES CITED IN THE DESCRIPTION

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### Patent documents cited in the description


- US 3722933 A **[0003]**
- US 5347783 A **[0005]**
- US 3290075 A **[0008]**