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(71) Applicant: **Saint-Gobain Acoustical Products International B.V.**
3846 BJ Harderwijk (NL)

(72) Inventor: **HEESBEEN, Jan-Dirk Pieter**
3828 AE, HOOGLAND (NL)

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(74) Representative: **Riemens, Roelof Harm**
Exter Polak & Charlouis B.V.
P.O. Box 3241
2280 GE Rijswijk (NL)

(54) **Ceiling frame for holding ceiling panels having a cross runner with a locally impressed nose section.**

(57) A ceiling frame for holding ceiling panels, comprising a plurality of main runners, at least one cross runner 2 having a longitudinal direction and coupling means 7 for coupling the main runners with each other, in which the cross runner 2 comprises an upright longitudinally extending web 3 having flanges 4 extending in opposite sideways directions at its lower end for supporting edges of ceiling panels upon, and having a longitudinally extending hollow profile 6 at its upper end for providing strength. The cross runner 2 further comprises a heat expansion nose section 10 provided on at least one of its free end parts, in which the heat expansion nose section 10 forms an integral part of the cross runner 2 in that it comprises a free end part 11 of the hollow profile 6

which is separate from at least a lower part of the web 3 by a cut 12 which is at least partially 12a extending in the longitudinal direction up till an intended folding line 25 such that the nose section 10 is able to fold around the folding line 25.

An impression 21 is provided in the free end part of the hollow profile 6. The impression 21 extends over at least a lower part 20 of the hollow profile 6. The cut 12 also extends partially 12b upwards through the lower part 20 of the hollow profile 6. The upwardly extending part 12b of the cut 12 runs through the impression 21, and an upper part 23 of the hollow profile 6 which lies substantially in line with the upwardly extending part 12b of the cut forms the folding line 25.

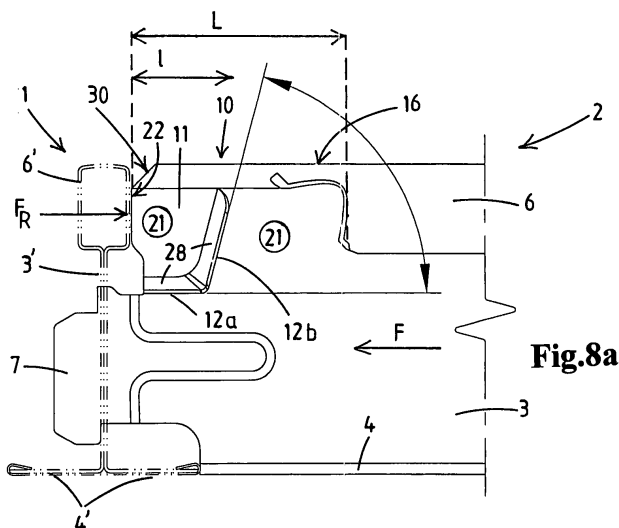


Fig.8a

Description

[0001] The present invention relates to a ceiling frame for holding ceiling panels with an integrated heat expansion system, as well as to a cross runner for use in such a ceiling frame.

[0002] From the state of the art various embodiments are known of such ceiling frames. For example EP-1 703 034 shows a ceiling frame comprising a plurality of main runners and cross runners for connecting the main runners with each other. Each runner comprises an upright longitudinally extending web having flanges extending in opposite sideways directions at its lower end for supporting edges of ceiling panels upon, and has a longitudinally extending hollow profile at its upper end for providing strength. Each cross runner comprises heat expansion nose sections at its free end parts. Each of these heat expansion nose sections comprises a free end part of the hollow profile which has been separated from the web by a first cut-out which is extending in the longitudinal direction up till an intended vertical folding line. A second cut-out has been provided in the top face of the hollow profile at the location of the intended folding line. Furthermore the remaining free end part of the hollow profile has been compressed such that its side walls have come to lie side by side whereas the remaining part of its top face has been left protruding sideways. Thus a T-shaped nose section is achieved which is able to fold sideways around said folding line, that is to say fold along a vertical axis at the location of the second cut-out.

[0003] The heat expansion nose section permits expansion of the ceiling frame in the case of for example heat and/or fire, and thus limits the risk of deformations, like buckling, of the ceiling frame. Should such a heat expansion nose section not be provided then the heat retardant properties of the ceiling would considerably be diminished, for example because the heat could then more easily penetrate the space above the ceiling panels, and because the ceiling panels would then be prone to fall down out of the frame.

[0004] A disadvantage of the ceiling frame of EP-1 703 034 is that its expansion behaviour has appeared to fluctuate considerably. Also its cross runner is somewhat difficult and expensive to produce. During mounting of the cross runners between the main runners, the mechanic needs to put a downward pressure on the nose section in order to have coupling means between the runners to properly connect with each other. With this the risk exists that the nose section is accidentally bent in an undesired direction or even becomes damaged. Furthermore the risk exists that the mechanic hurts himself because of sharp edges of the second cut-out.

[0005] The present invention aims to at least partially overcome the abovementioned disadvantages, or to provide a usable alternative. In particular the invention aims to provide a ceiling frame which is user-friendly during mounting, relatively cheap to produce, and fully reliable when subjected to excessive heat.

[0006] This aim is achieved by a ceiling frame according to claim 1. The ceiling frame comprises a plurality of main runners, and at least one cross runner having a longitudinal direction and coupling means for coupling the main runners with each other. The cross runner comprises an upright longitudinally extending web having flanges extending in opposite sideways directions at its lower end for supporting edges of ceiling panels upon, and having a longitudinally extending hollow profile at its upper end for providing strength. The cross runner further comprises a heat expansion nose section provided on one or both of its free end parts. The heat expansion nose section forms an integral part of the cross runner, and comprises a free end part of the hollow profile which has been separated by a cut from (part of) the web lying below. The cut is partially extending in the longitudinal direction up till an intended folding line. An impression is provided in the nose section. The impression extends over at least a lower part of the hollow profile. The cut also extends partially upwards through a lower part of the hollow profile. This upwardly extending part of the cut runs through the impression. The folding line is formed by an upper part of the hollow profile which lies substantially in line with the upwardly extending part of the cut.

[0007] Advantageously the nose section according to the invention is very stable and strong in the longitudinal direction, while at the same time it is flexural weak in the aimed bending direction. Thus it is optimally designed for its intended purpose. The deformation behaviour of the nose section, and thus also an important part of the expansion behaviour of the entire ceiling frame, can be kept quite constant, leading to predictable and reliable results during use, and in particular when subjected to excessive heat caused by fire. The cross runner with the nose section according to the invention is relatively easy and cheap to produce. The nose section is able to be bent away in a reliable and relatively easy way around the intended folding line. Expansions of the cross runners caused by excessive heating can be reliably absorbed without the ceiling frame in its entirety deforming too much. The expansion force in the cross runner necessary for having the nose section to bend away is relatively low. An additional advantage is that the nose section can also be bent away and back again manually relatively easy and for a number of times without the risk of damaging or even accidentally breaking of the nose section. This makes it possible for a cross runner to be removed and placed back again between main runners of an already mounted ceiling frame. Because the top face of the nose section no longer needs to be provided with a cut-out, the ceiling frame becomes more user-friendly because it does not have sharp cutting edges at places where a mechanic needs to place his fingers and needs to exert downwards and forward pressure during mounting of the system.

[0008] In a preferred embodiment the coupling means are designed in such a way that they permit sliding movement of the cross runner with respect to the main runner

in the longitudinal direction of the cross runner as soon as the nose section has been bent out of the way, that is to say as soon as the nose section is folded around its folding line. For example the coupling means may be formed by a hook shaped part at the free end of the cross profile which can be hooked into a slit which is present in the main runner. The nose section in his starting position, that is to say substantially extending parallel to the longitudinal direction of the cross runner, forms an abutment. This abutment prevents the hook shaped part to slide further into the slit than necessary for achieving the desired coupling. After the nose section has been bent out of the way, the hook shaped part has the freedom to further slide into the slit and thus take up a certain amount of expansion or displacement in the longitudinal direction of the cross runner. Thus deformations, like buckling, of the runners in the case of excessive heat are advantageously prevented.

[0009] In a first preferred embodiment the impression extends over the entire height of the hollow profile including its top face and forms the folding line around which the nose section is able to fold sideways. The intended folding line then lies in a vertical plane.

[0010] In a second preferred embodiment the impression extends over only a lower part of the hollow profile. The remaining upper part of the hollow profile at the location of the nose section including its top face then forms the intended folding line around which the nose section is able to fold downwards during expansion. The intended folding line is then substantially horizontal.

[0011] For both the first and second preferred embodiment it is not necessary to punch away large parts of the web and hollow profile. It already suffices as the respective front nose section is separated by a relatively small slit from the web lying below the front section and from the nose section lying behind this front nose section. In particular the cut may have a maximum width of 2 mm. The thus obtained cut may still be some kind of cut-out. However, it is preferred for the cut to be a sharp cut with which the respective front nose section is merely cut loose from the web lying below the front section and from the nose section lying behind this front nose section. The sharp cut then as it were has zero width since the respective wall parts have only been torn loose from each other. Such a sharp cut for example is made with some kind of sharp edged punching tool (punching knife). The relatively small cut, in particular the sharp cut, helps to keep the nose section robust enough and not to make it to fragile.

[0012] In a further embodiment edge parts of both the longitudinally and upwardly extending parts of the cut are bent sideways past one of the side faces of the upright web and past one of the side faces of the impression. This makes it possible for the nose section to more easily start its bending movement in either the sideways either the downwards direction. This is particularly important for the second preferred embodiment since there the nose section during its downward bending needs to slide

past the upright web as well as past the part of the hollow profile lying behind the upwardly extending part of the cut. It is to be understood that the width of the original cut is somewhat enlarged by this sideways bending of the edge parts. Nevertheless it might still be well recognised what the dimensions of the original cut have been and whether or not the cut originally was a sharp cut.

[0013] For the same reason with this embodiment, that is to say for the nose section being able to make a sliding movement past the upright web as well as past the part of the hollow profile lying behind the cut, it is advantageous to have the impression extend at both sides of the cut. In particular the impression extends in the longitudinal direction over a length which is greater than the distance between a front side of the free end part and the intended folding line. More in particular the impression extends over a total length which is at least 1.5 times the length of the front downwardly bendable part of the nose section, that is to say the distance between the front side of the free end part and the intended folding line. This provides for enough free space for the nose section to bend with its front section downwards and backwards while being able to slide smoothly alongside the web and alongside the impressed back section and without bumping against a non-compressed section of the hollow profile at a too early stage.

[0014] In a further variant of the second embodiment the impression extends over more than 75 % of the entire height of the hollow profile. More in particular the remaining upper part of the hollow profile at the location of the folding line then has a height of between 1-3 mm. The thickness of the remaining part of the hollow profile at the location is a measure for its bending resistance. This bending resistance may on the hand not be too big and on the other hand may not be too small. For example choosing the dimensions such that a bending resistance of 20 kg is achieved is possible.

[0015] In an embodiment the impression extends at both sides of the upwardly extending part of the cut. This makes it easier to make this part of the cut at its desired location and helps in properly creating the intended folding line.

[0016] In a particular embodiment the upwardly extending part of the cut has a longitudinal direction with an axis which extends at an angle with respect to the longitudinal direction of the cross runner. More in particular this angle lies between 70-80 degrees. This slanting position of the upwardly extending part of the cut has the advantage that the nose section during the sideways bending with the first preferred embodiment also moves upwards somewhat, and more easily starts with its downwards bending with the second preferred embodiment. This makes it more easy for the cross profile to move upwards somewhat during the expansion. This is particularly important and advantageous in the case of the flanges of the cross runners and the flanges of the main runners abutting against one another in the starting position.

[0017] With the first preferred embodiment the impression and at least part of the cut may substantially lie in each others prolongation. Thus an even more optimal folding line is obtained.

[0018] The impression with the first preferred embodiment may be achieved by locally impressing the hollow profile at the location of the intended folding line such that opposite wall parts of the hollow profile over the entire height thereof have been compressed towards one another.

[0019] Advantageously the impression with this first preferred embodiment has been provided on only one side of the nose section, in particular with a depth somewhat past the center face of said upright web. In addition or as an alternative the nose section may be slightly pre-bend towards one side, making its sideways deformation behaviour more constant and the forces necessary therefore lower. This effect can be increased if the impression has been made by a pressing operation oppositely directed to a punching direction for forming the cut. The deformations on the nose section thus are opposite. If expansion forces in the longitudinal direction of the cross runner appear, a bending moment in the nose section occurs which has the effect of bending away the nose section toward one side only. The operations of making the impression in the nose section and punching out the cut may be performed simultaneously or after one another.

[0020] Other advantageous embodiments are stated in the dependent subclaims.

[0021] The invention also relates to a cross runner according to claim 15.

[0022] The invention shall be clarified below with respect to the drawings, wherein:

Fig. 1 shows a perspective view of a preferred embodiment of a ceiling frame according to the invention during and after mounting of a cross runner and without ceiling panels being placed in the frame;

Fig. 2 is a view according to fig. 1 with ceiling panels placed in the frame;

Fig. 3a-c show an enlarged front view, top view and side view of an end part of the cross runner with heat expansion nose section of fig. 1;

Fig. 4 shows a front view and top view of two cross runners of fig. 3 coupled to a main runner;

Fig. 5 is a view according to fig. 4 in the situation that one of the cross runners is expanded and has its nose section bent sideways; and

Fig. 6-10 show views in accordance with fig. 1-5 of a second preferred embodiment.

[0023] In fig. 1-3 the main runner has been given the reference numeral 1 and the cross runner the reference numeral 2. The runners 1, 2 each comprise an upright longitudinally extending web 3 having flanges 4 extending in opposite sideways directions at its lower end for supporting edges of ceiling panels 5 upon, and having a

longitudinally extending hollow profile 6 at its upper end for providing strength. The cross runner 2 comprises a coupling hook 7 which can be hooked into a slit 8 provided in the main runner 1. In fig. 1 the situation is shown in which a cross runner 2 has already been hooked onto the main runner 1 from one side, whereas another cross runner 2 still needs to be hooked onto this main runner 1 from the other side. Both cross runners 2 hook into the same slit 8 of the main runner 1.

[0024] The cross runner 2 further comprises a heat expansion nose section 10. The nose section 10 comprises a free end part 11 of the hollow profile 6 which at its lower side is bounded by a cut 12. The cut 12 has a first part 12a extending in the longitudinal direction of the cross runner 2 through its web 3, and a second part 12b extending in a slanted upward direction of approximately 75 degrees through both the web 3 and partly into the hollow profile 6.

[0025] Furthermore the nose section 10 is provided with a concavely shaped longitudinal impression 15. The impression 15 extends over the entire height of the hollow profile 6, including its top face 16, and substantially in the same slanting direction as the second part 12b of the cut. A central axis going through the impression 15 and the second part 12b of the cut, forms a folding line 17 around which the nose section 10 can easily bent sideways.

[0026] The impression 15 preferably has been made by locally impressing the hollow profile 6 at the location of the folding line 17 by exerting pressure from one side upon the hollow profile 6 over its entire height. The pressure causes opposite wall parts of the hollow profile 6 to be compressed towards one another over the entire height of the hollow profile 6. Furthermore, the pressure causes the top face of the hollow profile 6 to be deformed upwardly at the location of the impression 15. Because the impression 15 is made by exerting pressure from one side upon the hollow profile 6, the compressed wall parts have come to lie eccentrically from the center of the cross runner 2 (fig. 3b), in particular past the center face of the web 3.

[0027] The cut 12 can be obtained by performing a punching operation on the cross runner 2. In particular the pressure for making the impression 15 is exerted in a direction opposite to a punching direction for forming the cut 12 and/or for (de-)forming other parts of the cross runner 2. This might provide for counter forces during manufacturing and/or might pre-bend the nose section 10 slightly in a desired bending direction.

[0028] In the coupled position as shown in fig. 3a and 4, the front end parts of the flanges 4 of the cross runner 2 as well as the front end part of the nose section 10 are abutting against corresponding parts of the main runner 1. A force F in the longitudinal direction of the cross runner 2, for example caused by an expansion of the cross runner 2 due to excessive heat, has the effect of introducing a bending moment in the nose section 10 around its folding line 17. This is because of the eccentric position of

the impression 15 and/or because of a pre-bend of the nose section 10. This bending moment causes the nose section 10 to bend sideways around the folding line 17. This is shown in figure 5. Because the hook 7 together with the slit 8 are constructed such that they have the freedom to slide in the longitudinal direction of the cross runner 2, the cross runner 2 is free to expand and/or move in its longitudinal direction with respect to the main runner 1 as soon as the nose section 10 has cleared the way and no longer fully abuts with its front face against the main runner 1. Since the hook 7 also has the freedom to move somewhat upwards with respect to the slit 8, the flanges 4 of the cross runner 2 have the freedom to slide over the facing flange 4' of the main runner 1. The fact that the impression 15, the second part 12b of the cut and thus the folding line 17 are positioned at an angle with respect to the horizontal aids in this upward movement, because the nose section 10 also moves upward somewhat during its sideways bending movement.

[0029] In the embodiment shown, the second part 12b of the cut goes through a lower part of the impression 15, in particular through at least the lower half of the impression 15. This has the advantage of limiting the bending force needed for the bending movement. The length of the second part 12b of the cut going through the lower part of the impression 15, may be altered in dependency of the shape, height, material, thickness, etc. of the hollow profile 6, that is to say of the original bending resistance of the hollow profile 6 which possibly needs to be limited.

[0030] In fig. 6-10 similar parts have been given the same reference numerals as with the embodiment of fig. 1-5. The main difference with this embodiment is the construction of the heat expansion nose section 10. Only a lower part 20 of this nose section 10 is now provided with an impression 21. The impression 21 starts at the front side 22 of the nose section 10, covers the upwardly extending part 12b of the cut and extends in the longitudinal direction to a position at a distance behind this upwardly extending second part 12b of the cut. Above the thus shaped impression 21 an upper part 23 of the hollow profile 6 substantially has maintained its sideways projecting shape. The top face 16 of this upper part 23 has remained substantially flat with the top face 16 of the rest of the hollow profile 6. A horizontal axis going through the upper part 23 at a position above the second part 12b of the cut, forms a folding line 25 around which the nose section 10 can easily bent downwards and backwards.

[0031] The impression 21 preferably has been made by locally impressing the hollow profile 6 at the described section of the lower part 20 by exerting pressure from both sides upon the hollow profile 6. The pressure causes opposite wall parts of the hollow profile 6 to be compressed towards one another over the described section. This locally exerted pressure causes the upper part 23 including the top face 16 of the hollow profile 6 to maintain its sideways projecting shape and if desired to even enclose a small hollow 27.

[0032] The cut 12 can be obtained by performing a

punching operation with a sharp-edged punching tool on the cross runner 2. In particular this punching operation not only has the effect of making a sharp cut, but also has the effect of bending edge parts 28 of those walls which are delimiting one side of the cut 12 to a slanted sideways projecting position, that is to say bent sideways past the respective side face of the web 3 and past the respective side face of the rest of the impression 21.

[0033] In the coupled position as shown in fig. 8a and 9, the front end parts of the flanges 4 of the cross runner 2 as well as the front end part of the nose section 10 are abutting against corresponding parts of the main runner 1. A force F in the longitudinal direction of the cross runner 2, for example caused by an expansion of the cross runner 2 due to excessive heat, has the effect of introducing a bending moment in the nose section 10 around its folding line 25. This is because the reaction force F_r lies at an eccentric position relative to the folding line 25. The fact that the front side of the upper part 23 has been provided with a bevelled part 30 aids in this effect. The bending moment causes the nose section 10 to start bending downwards and thereafter backwards around its folding line 25 as soon as a certain desired threshold value has been passed. This is shown in figure 10. The fact that the edge parts 28 of the walls delimiting the cut 12 have been bent sideways is important for this downwardly rotating movement, because it prevents those edge parts 28 from abutting against their opposing wall parts at the other sides of the cut 12.

[0034] In the embodiment shown the impression 21 extends in the longitudinal direction over a length L which is more than 1.5 times the distance l between the front edge 22 and the intended folding line 25. This provides for enough free space for the nose section 10 to be rotated over an angle of more than 90 degrees around the folding line 25 without abutting against a non-compressed part of the hollow profile 6.

[0035] In the embodiment shown, the second part 12b of the cut goes through the entire height of the lower part 20 up till the remaining upper part 23. This has the advantage of limiting the bending force needed for the bending movement. The thickness of the remaining upper part, may be altered in dependency of the shape, height, material, thickness, etc. of the hollow profile 6, that is to say of the original bending resistance of the hollow profile 6 which possibly needs to be limited. In particular the height of the remaining upper part 23 is approximately 2 mm in the embodiment shown.

[0036] The cross runner 2 can be made in several ways, but preferably is roll-formed out of a strip of steel material. After this roll-forming step, the punching operations may be performed for forming the cuts, the impressions, the hook, etc.

[0037] Besides the embodiments shown numerous variants are possible. For example the dimensions of the various parts may be different and/or the runners may be manufactured out of other materials and/or may have differently shaped webs, flanges and/or hollow profiles.

Also other kinds of coupling means are possible between the main runner and the cross runners. Instead of punching or exerting pressure, the impressions and the cuts, may also be achieved in another way. For example instead of being sharp cuts, the cuts may also be (partly) formed by small cut-outs having a width smaller than 2 mm.

[0038] Thus the invention provides a user-friendly ceiling frame which is both easy to handle during mounting and stable and reliable during use.

Claims

1. Ceiling frame for holding ceiling panels, comprising:

- a plurality of main runners;
- at least one cross runner having a longitudinal direction and coupling means for coupling the main runners with each other;

in which the cross runner comprises an upright longitudinally extending web having flanges extending in opposite sideways directions at its lower end for supporting edges of ceiling panels upon, and having a longitudinally extending hollow profile at its upper end for providing strength,

said cross runner further comprising a heat expansion nose section provided on at least one of its free end parts,

in which said heat expansion nose section forms an integral part of the cross runner in that it comprises a free end part of the hollow profile which is separate from at least a lower part of the web by a cut which is at least partially extending in the longitudinal direction up till an intended folding line such that the nose section is able to fold around said folding line, an impression being provided in the free end part of the hollow profile, which impression extends over at least a lower part of the hollow profile, **characterized in that,**

said cut also extends partially upwards through a lower part of the hollow profile, wherein this upwardly extending part of the cut extends through said impression, and wherein an upper part of the hollow profile which lies substantially in line with said upwardly extending part of the cut forms said folding line.

2. Ceiling frame according to claim 1, wherein edge parts of both the longitudinally and upwardly extending parts of the cut are bent sideways past one of the side faces of said upright web and past one of the side faces of the impression.

3. Ceiling frame according to claim 1 or 2, wherein said upwardly extending part of the cut extends at an angle with respect to the longitudinal direction, in par-

ticular at an angle between 70-80 degrees.

4. Ceiling frame according to one of the preceding claims, wherein the top face of the hollow profile is not provided with a cut at the location of the intended folding line.

5. Ceiling frame according to one of the preceding claims, wherein said impression has been achieved by locally impressing the hollow profile at least at the location of the upwardly extending part of the cut such that opposite wall parts of the hollow profile have been compressed towards one another.

6. Ceiling frame according to one of the preceding claims 1-5, wherein the impression extends over the entire height of the hollow profile including its top face and forming said folding line such that the nose section is able to fold sideways around said folding line.

7. Ceiling frame according to one of the preceding claims 1-5, wherein the impression extends over only a lower part of the hollow profile, the remaining upper part including its top face forming said folding line such that the nose section is able to fold downwards around said folding line.

8. Ceiling frame according to claim 7, wherein the impression extends in the longitudinal direction over a length which is greater than the distance between a front side of the free end part and the intended folding line, in particular more than 1.5 times said distance.

9. Ceiling frame according to claim 7 or 8, wherein the impression extends over more than 75 % of the entire height of the hollow profile, in particular leaving the remaining upper part of the hollow profile at the location of the folding line with a height of between 1-3 mm.

10. Ceiling frame according to one of claims 7-9, wherein the upwardly extending part of the cut ends just below the remaining upper part of the hollow profile.

11. Ceiling frame according to one of claims 7-10, wherein the front side of the upper part of the hollow profile is provided with a cut away portion, in particular a bevelled portion.

12. Ceiling frame according to one of the preceding claims, wherein the impression extends up till the front side of the free end part.

13. Ceiling frame according to one of the preceding claims, wherein the impression extends at both sides of the upwardly extending part of the cut.

14. Ceiling frame according to one of the preceding claims, wherein the cut has a maximum width of 2 mm, and in particular is a sharp cut.

15. Cross runner for use in a ceiling frame according to one of the preceding claims. 5

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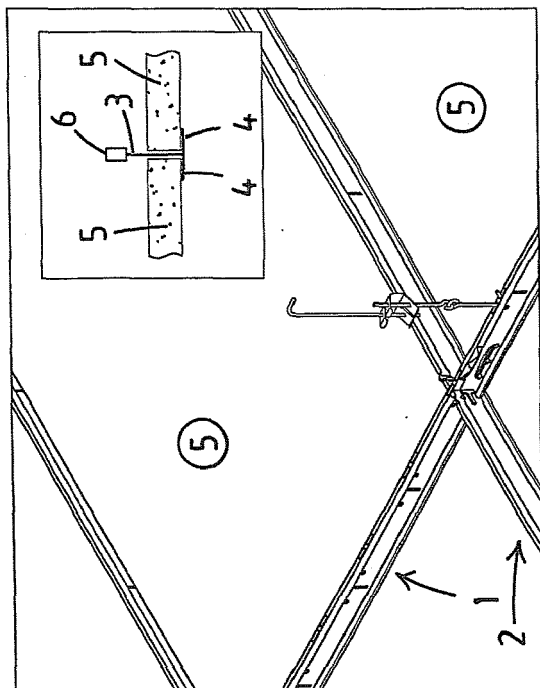


Fig. 2

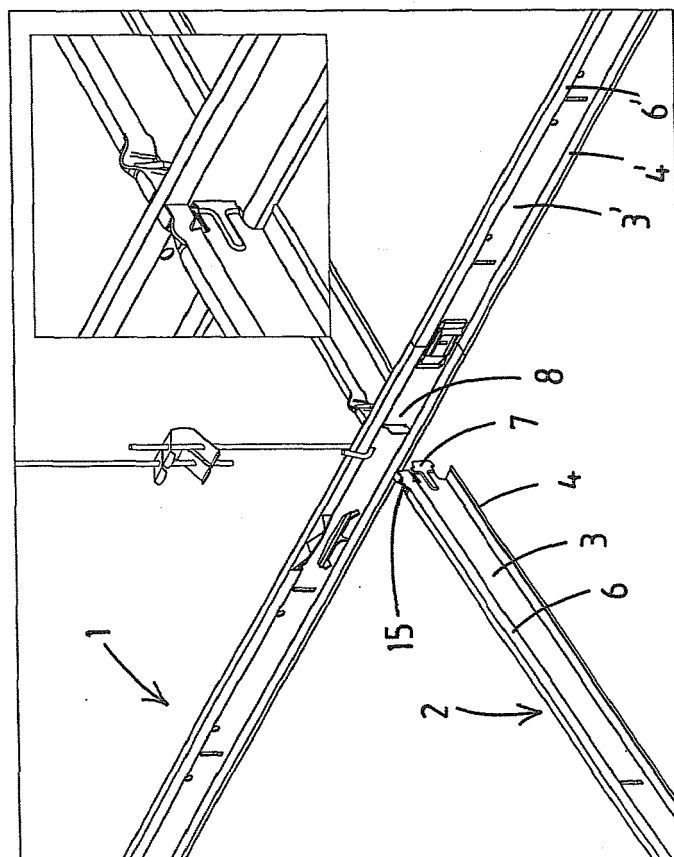
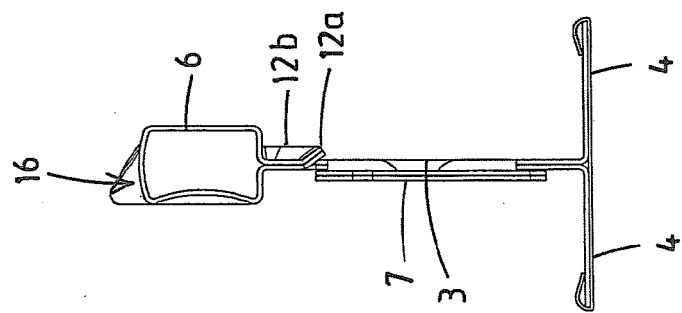
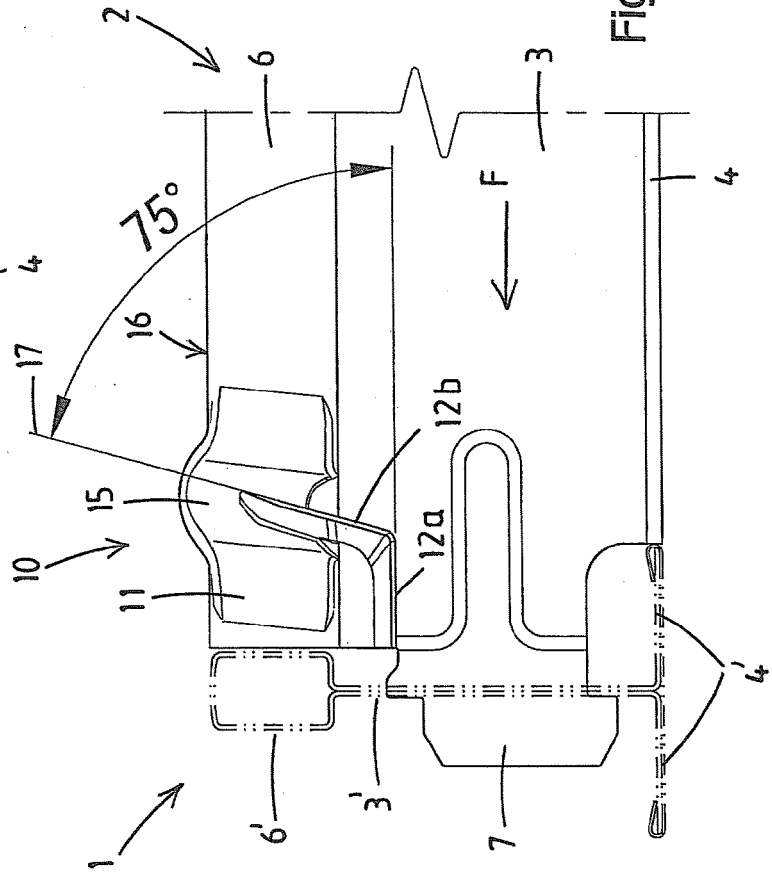
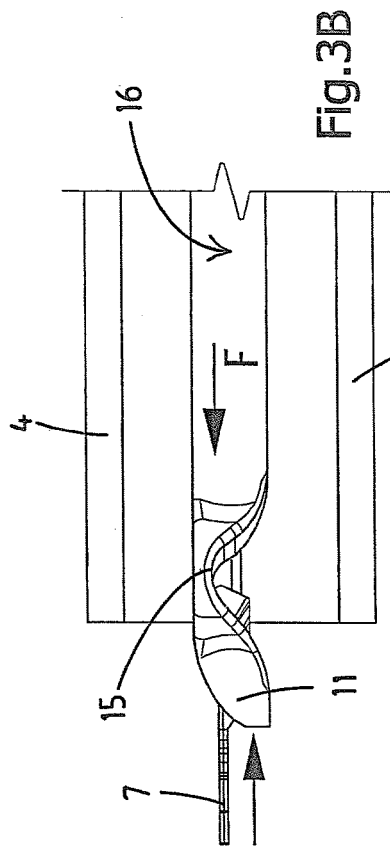


Fig. 1



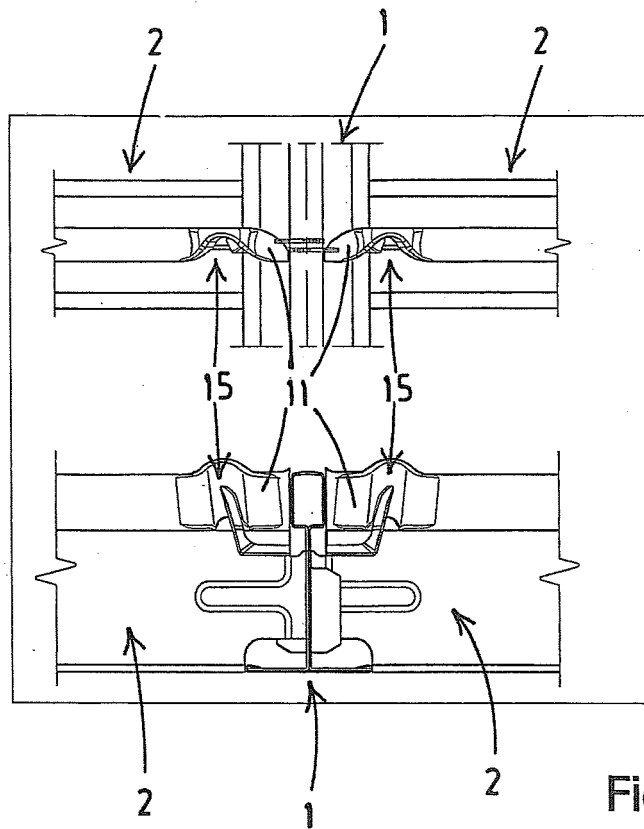


Fig.4

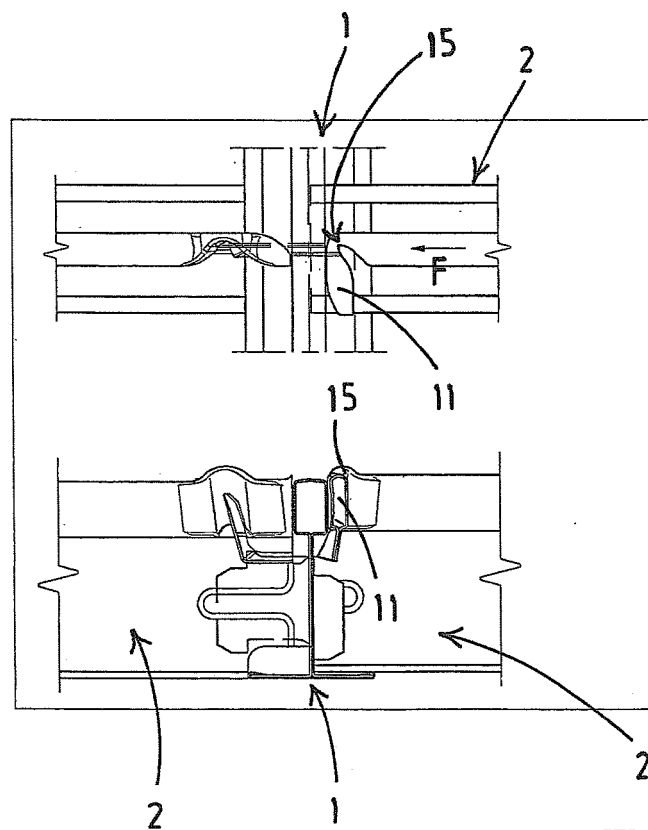


Fig.5

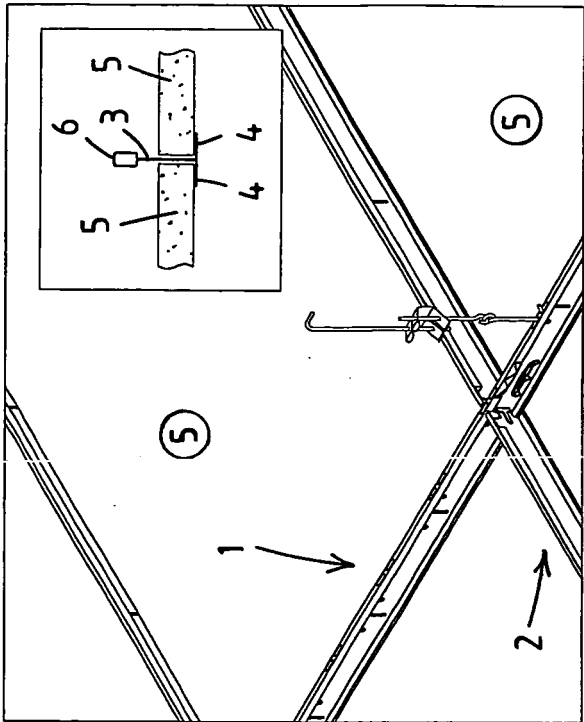


Fig. 7

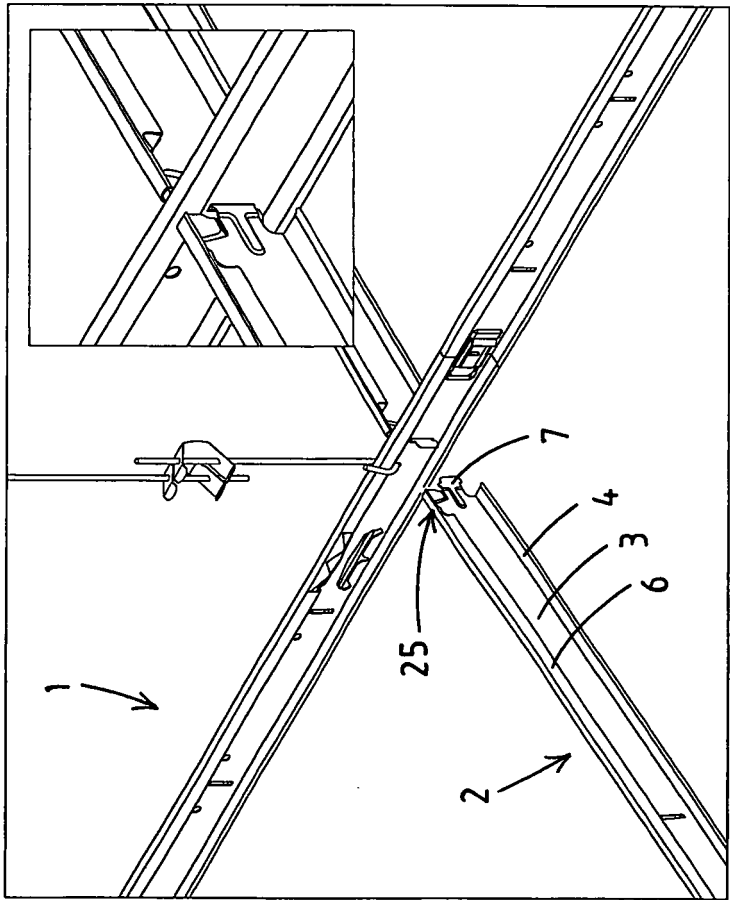
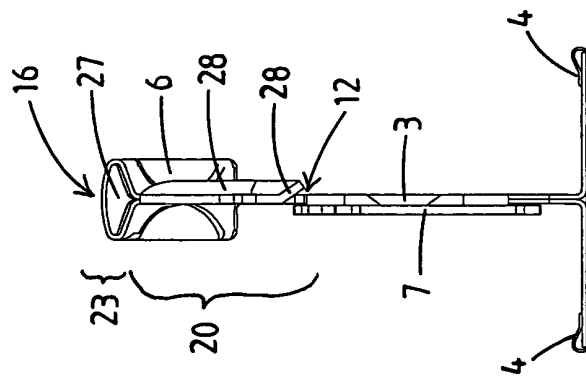
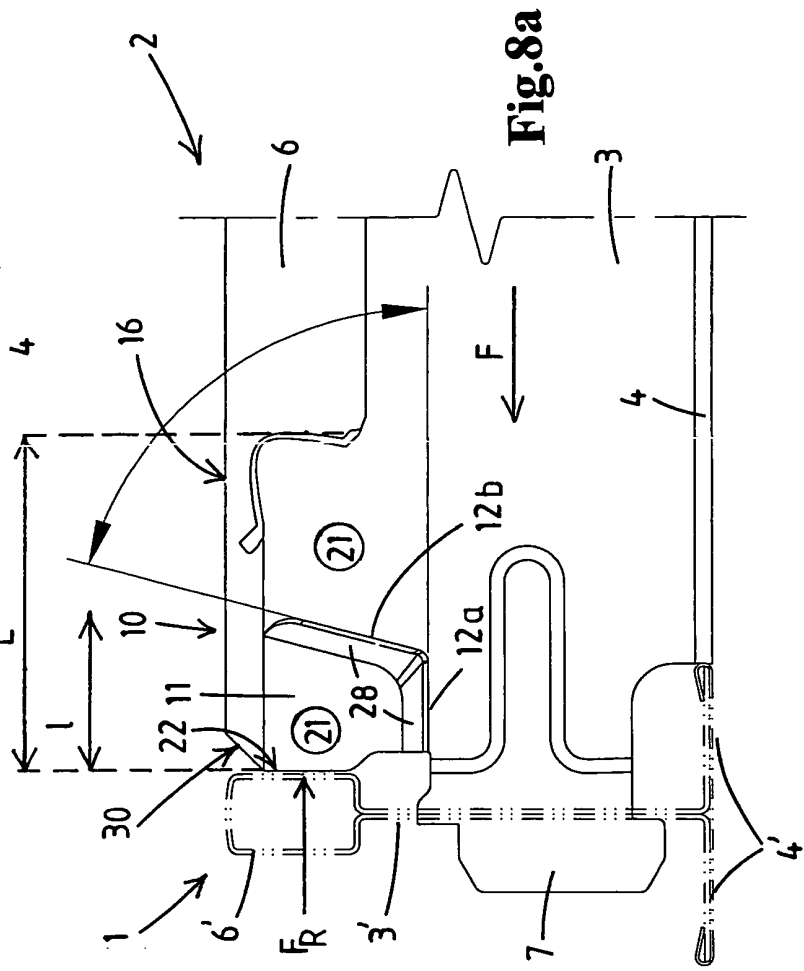
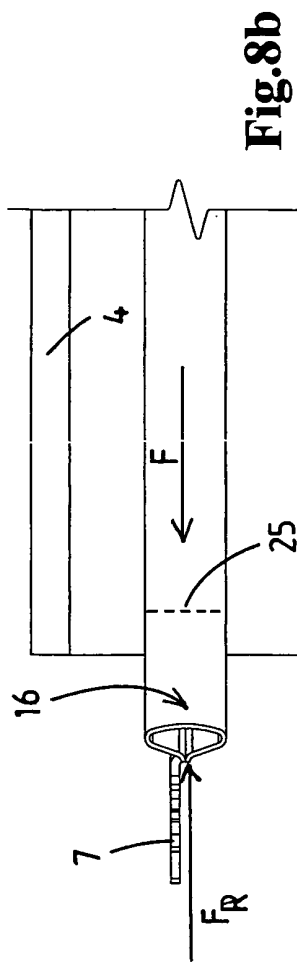


Fig. 6



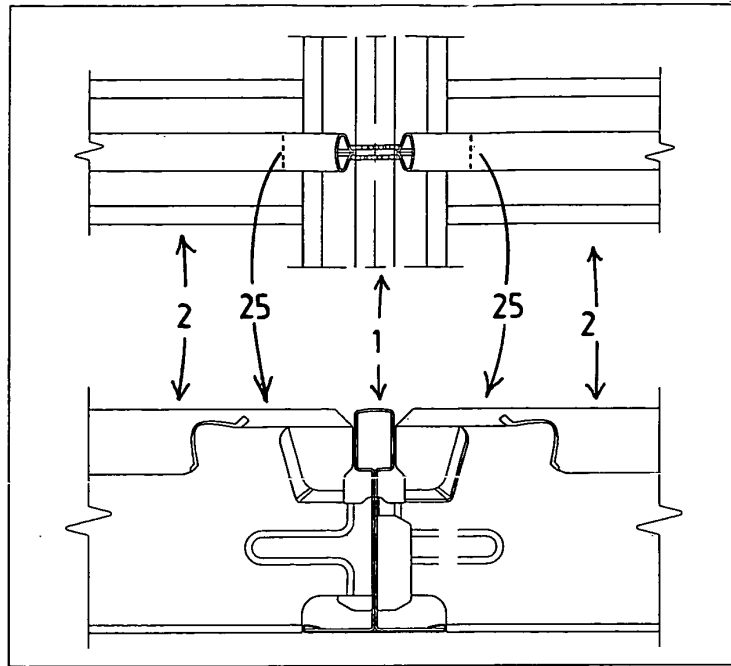


Fig.9

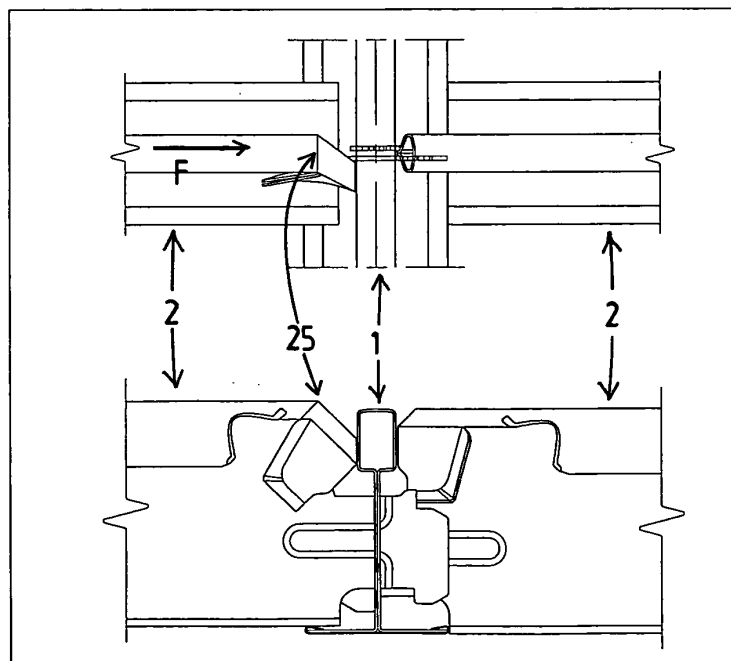


Fig.10

REFERENCES CITED IN THE DESCRIPTION

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