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(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 sec-

tion 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 extending in the longitudinal direction up till an intended folding line 17 such that the nose section 10 is able to fold sideways around the folding line 17.

An impression 15 is provided in the free end part of the hollow profile 6 at the location of the folding line 17. The impression 15 extends over the entire height of the hollow profile 6 including its top face 16 and forms the folding line 17.

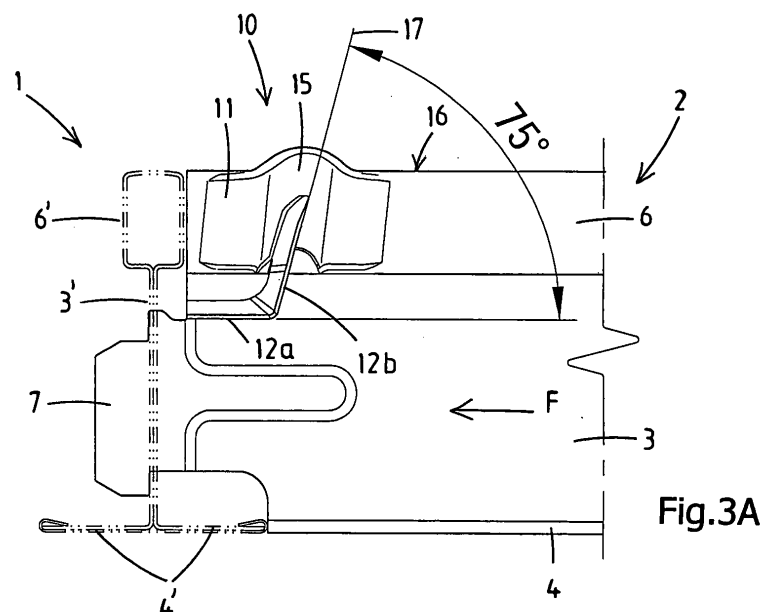


Fig.3A

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 method for producing 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 at least partially extending in the longitudinal direction up till an intended folding line. An impression is provided in the nose section at the location of this folding line. The impression extends over the entire height of the hollow profile of the nose section including its top face. The impression itself forms the folding line around which the nose section is able to bend sideways relatively easily.

[0007] Advantageously the nose section according to the invention is very stable and strong in the longitudinal and downward direction, while at the same time it is flexural weak in the sideways 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 sideways in a reliable and relatively easy way around the provided impression. 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 sideways is relatively low. An additional advantage is that the nose section can also be bent away sideways and back again manually relatively easily 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 sideways around its impression forming the 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 sideways, 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 is advantageously prevented.

[0009] In a particular embodiment the impression 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 impression has the advantage that the nose section during the sideways bending also moves upwards somewhat. 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.

[0010] In another embodiment the cut is not only extending in the longitudinal direction of the cross runner, but also partially extending in the direction of said impression forming said folding line. By having the impression and at least part of the cut substantially lying in each others prolongation, an even more optimal folding line is obtained.

[0011] The impression 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.

[0012] Advantageously the impression 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.

[0013] Other advantageous embodiments are stated in the dependent subclaims.

[0014] The invention also relates to a cross runner according to claim 10, and to a method for producing such a cross runner according to claim 11.

[0015] 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; and

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.

[0016] 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.

[0017] 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.

[0018] 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.

[0019] 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.

[0020] 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.

[0021] 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.

[0022] 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.

[0023] 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.

[0024] 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 the cuts may also be formed by cut-outs. Also it is possible for the cut to only extend in the longitudinal direction of the cross runner, and not to also partially extend in the direction of the impression.

[0025] 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 sideways around said folding line,

characterized in that,

an impression is provided in the free end part of the hollow profile at the location of said folding line, the impression extending over the entire height of the hollow profile including its top face and forming said folding line.

2. Ceiling frame according to claim 1, wherein said im-

pression forming said folding line extends at an angle with respect to the longitudinal direction, in particular at an angle between 70-80 degrees.

3. Ceiling frame according to one of the preceding claims, wherein said cut is partially extending in the direction of said impression forming said folding line. 5
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 impression forming said folding line. 10
5. Ceiling frame according to one of the preceding claims, wherein said top face of the hollow profile has been deformed upwardly at the location of the impression forming said folding line. 15
6. Ceiling frame according to one of the preceding claims, wherein said cut part extending in the direction of said impression forming said folding line goes through a lower part of said impression, in particular through at least the lower half of said impression. 20
7. Ceiling frame according to one of the preceding claims, wherein said impression forming said folding line has been made in a sideways direction, in particular past the face of said upright web. 25
8. Ceiling frame according to one of the preceding claims, wherein said impression forming said folding line has been made in a sideways direction, in particular opposite to a punching direction for forming said cut. 30
9. Ceiling frame according to one of the preceding claims, wherein said impression forming said folding line has been achieved by locally impressing the hollow profile at the location of the folding line such that opposite wall parts of the hollow profile over the entire height have been compressed towards one another. 35 40
10. Cross runner for use in a ceiling frame according to one of the preceding claims. 45
11. Method for producing a cross runner according to claim 10, comprising the steps:
 - roll-forming a strip of material into said cross runner having said web, hollow profile and flanges; 50
 - forming said nose section by making said cut;
 - forming said impression in said hollow profile of said nose section at the location of said intended folding line. 55

12. Method according to claim 11, wherein the forming

of said impression is performed by locally impressing the hollow profile at the location of the folding line such that opposite wall parts of the hollow profile over the entire height are compressed towards one another.

13. Method according to claim 11 or 12, wherein the making of said cut is performed by punching.
14. Method according to claims 12 and 13, wherein the punching out of said cut is performed in a direction opposite to the direction of locally impressing said hollow profile.

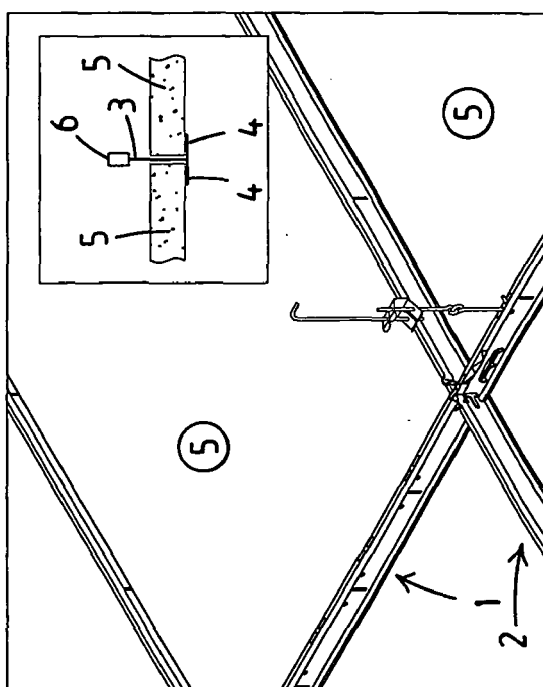


Fig. 2

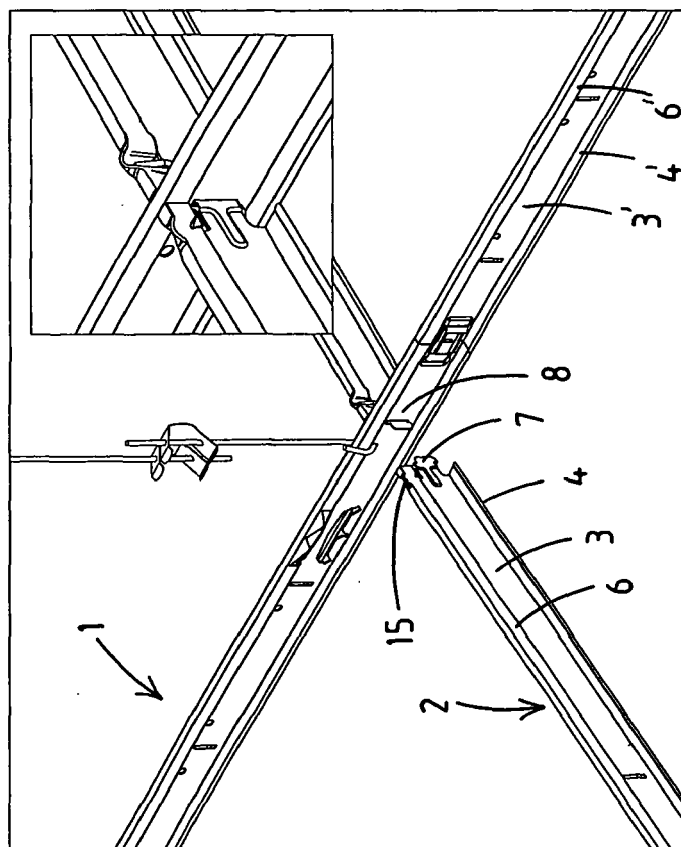


Fig. 1

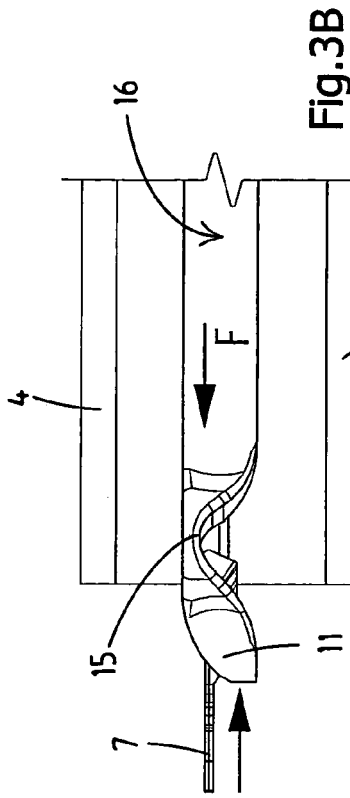


Fig. 3B

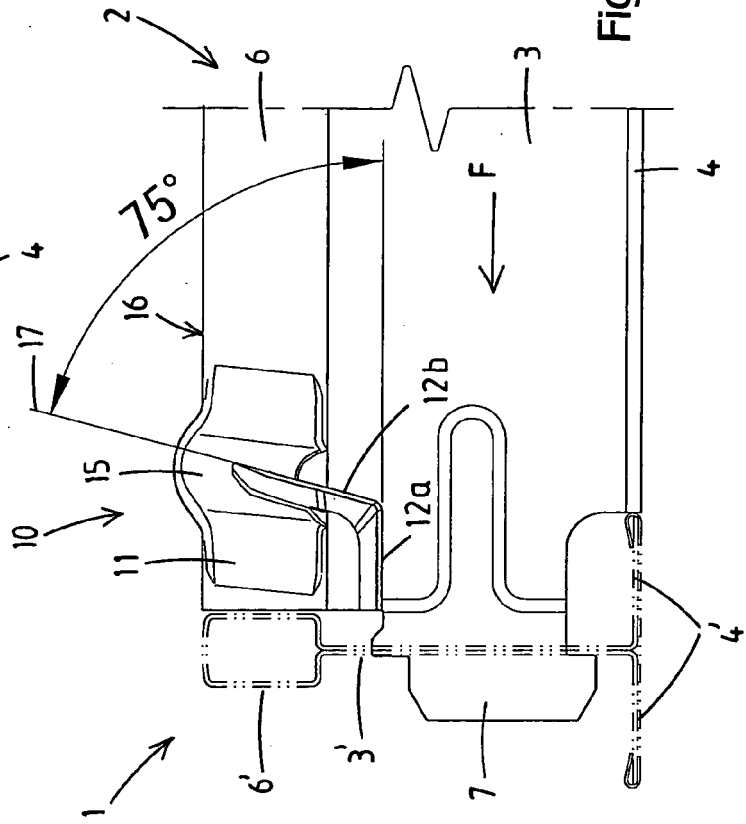


Fig. 3A

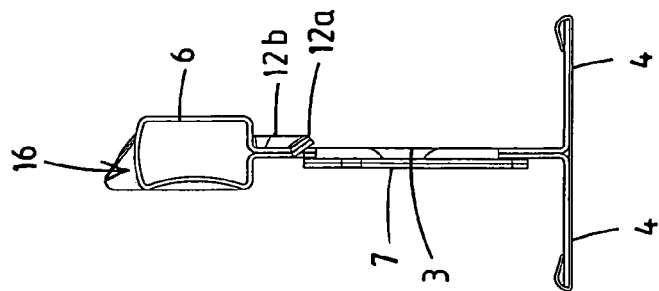


Fig. 3C

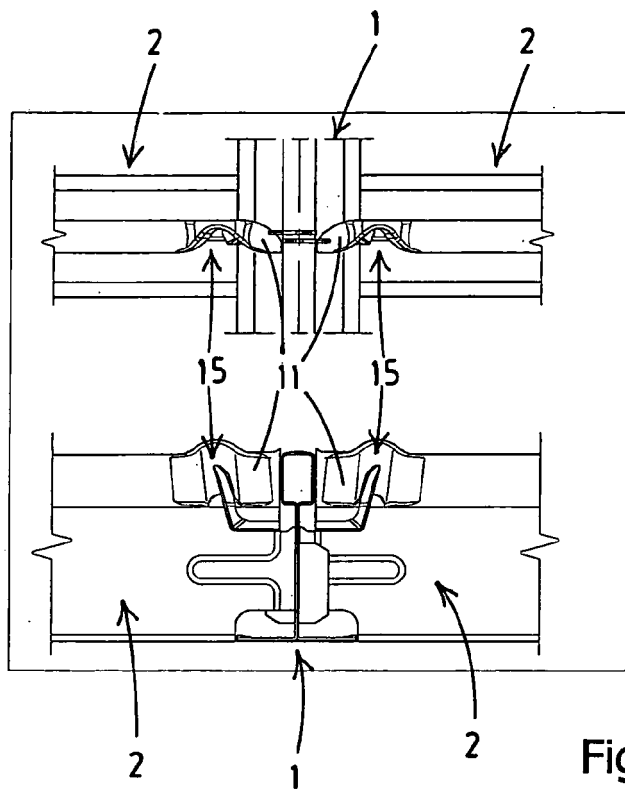


Fig.4

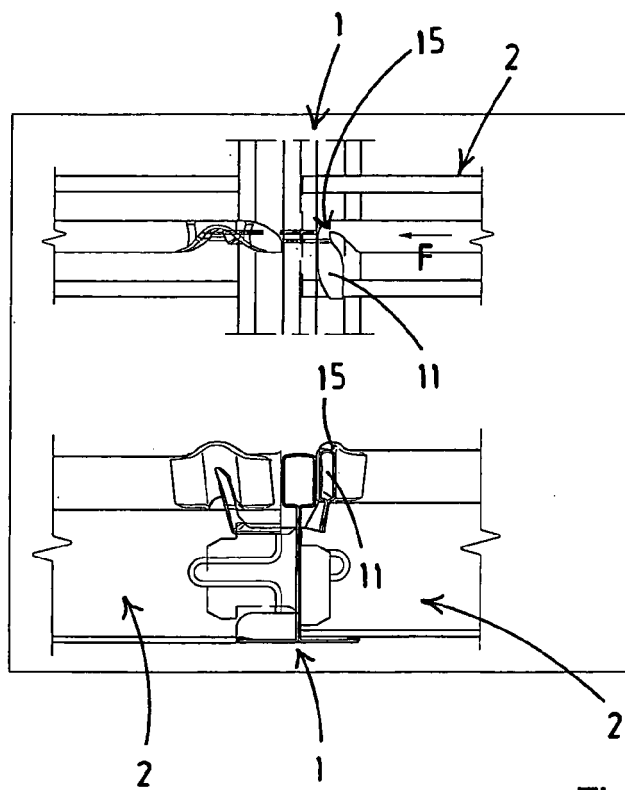


Fig.5



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EUROPEAN SEARCH REPORT

Application Number
EP 08 07 5069

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Place of search The Hague		Date of completion of the search 9 July 2008	Examiner Tran, Kim-Lien
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**ANNEX TO THE EUROPEAN SEARCH REPORT
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This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
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