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(54) **LINKAGE MECHANISM HAVING A LINK WITH A WEAKENED AREA**

EIN VERBINDUNGSGLIED MIT EINEM GESCHWÄCHTEN BEREICH AUFWEISENDEN GESTÄNGEMECHANISMUS

MECANISME DE LIAISON COMPRENANT UN LIEN AVEC UN ZONE AFFAIBLIE

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Description

[0001] The current invention relates to a linkage mechanism comprising two links connected together by a fastener in such a way that the two links are pivotable with respect to each other about the longitudinal axis of the fastener.

[0002] Linkage mechanisms of this type are commonly used in many different types of applications. One example of such a linkage mechanism is shown in WO 03/018946. This document discloses a window frame assembly where the window pivots outwardly and about an axis which is arranged parallel to and close to the upper side of the window sash. A linkage mechanism is arranged on each side of the window sash. The linkage mechanisms are designed to allow the window sash to be opened as well as reversed.

[0003] However, one problem with linkage mechanisms of the type mentioned in the opening paragraph is revealed when unexpected bending moments are applied to the linkage mechanism. Consider for example, the case where the right linkage mechanism of the window frame assembly of WO 03/018946 fails. This is a rather unlikely case, but it could happen for example if one of the fasteners which is used to connect the links, breaks. In this case, the window sash, which is quite heavy, will fall downwards and to the left. This will place a number of large bending moments on the remaining linkage mechanism. Since the linkage mechanisms are not designed to absorb large bending moments, it could happen that the remaining linkage mechanism will also fail. In the case where both linkage mechanisms fail there is a risk that the window sash will fall out of the frame and fall down, thus creating a risk for anything underneath the window. A further linkage mechanism is disclosed in document GB-A-2276202.

Summary of the invention

[0004] It is therefore a first aspect of the current invention to provide a linkage mechanism as mentioned in the opening paragraph which can absorb large bending moments about axes which are not "normal" without failing.

[0005] A second aspect of the current invention is to provide a linkage mechanism as mentioned in the opening paragraph which is more "failsafe" but which does not increase the cost and/or complexity of the resulting linkage mechanism significantly.

[0006] These aspects are solved by means of the features of claim 1. In this way, the main part of the deformations of the linkage mechanism occurs at the weakened area of the link and not in the fastener or in the portion of the link which is in contact with the fastener. This prevents the joint from failing in the case where unexpected bending moments are applied to the linkage mechanism.

[0007] Please note that for the sake of this specification, the term "near to" should be understood as being close enough to the fastener such that when a load is applied to the linkage, the effect of that load on the linkage as experienced by the link at the location of the fastener is similar to the load on the linkage as experienced by the link at the location of the weakened area. In addition, it should be noted that the phrase "applied to one of said links about an axis which is perpendicular to the axis of the fastener" should be interpreted as referring to any bending moment which has at least one component about an axis which is perpendicular to the axis of the fastener.

[0008] In a preferred embodiment of the invention, the weakened area can be an area of the link where the cross section perpendicular to the longitudinal axis of the link has a reduced area moment of inertia with respect to the rest of the link.

[0009] In one embodiment, the weakened area can be an area where material has been removed from the link. For example, the weakened area could be a hole through the link. The material removal could occur through many different processes, for example milling, drilling, stamping, as well as many others.

[0010] In another embodiment, the weakened area could be an area of the link which has been reduced in thickness when compared to the thickness of the rest of the link. This reduction of thickness could occur as a result of, for example, compressing, milling, and stamping, to name just a few.

[0011] In another embodiment, the weakened area could be an area of the link where the material properties are different from the rest of the link.

[0012] In another embodiment, the weakened area could be located at a distance from the fastener which is approximately equal to the width of the link. This would place the weakened area near to the fastener, but not too close to the fastener.

[0013] One use of a linkage mechanism according to the invention, is in a window frame assembly. In a preferred embodiment, the link comprising a weakened area could be a link which is in compression during normal use.

[0014] It should be emphasised that the term "comprises/comprising" when used in this specification is taken to specify the presence of stated features, integers, steps or components but does not preclude the presence or addition of one or more other features, integers, steps, components or groups thereof.

[0015] In this respect, please note that most linkage mechanisms comprise more than two links and the current invention relates to linkage mechanisms having any number of links but where at least two of the links are arranged as described in the introductory paragraph. The introductory paragraph should therefore not be read as relating to systems having only two links. This should be obvious to the person skilled in the art.

Brief description of the figures

[0016] The invention will now be described in more de-

tail with reference to the example embodiments shown in the figures.

[0017] Figure 1 shows a schematic perspective view of a simple outwardly opening window frame assembly.

[0018] Figure 2 shows a detail view of one end of one embodiment of a link with a weakened area.

[0019] Figure 3 shows a detail view of one end of a second embodiment of a link with a weakened area.

[0020] Figure 4 shows a detail view of one end of a third embodiment of a link with a weakened area.

[0021] It should be noted that the embodiments shown in the figures are used as examples only and should not limit the scope of the current invention. Furthermore, it should be noted that the embodiments are shown schematically in order to simplify the description. Details which would be obvious to the person skilled in the art of windows have not been shown in the figures.

Detailed Description of the embodiments

[0022] Figure 1 shows a simple outwardly opening window assembly 1. The window assembly 1 comprises a window frame 2, a window sash 3 and two supporting links 4.

[0023] The supporting links 4 are connected at a first end 4a to the inside of the frame 2 via a fastener 5. The fastener 5 is of the type which allows the supporting link to pivot with respect to the frame about the longitudinal axis of the fastener.

[0024] The supporting links 4 are connected at a second end 4b to the outside of the window sash 3 via a fastener 5. As with the connection at the first end 4a of the supporting links 4, the fastener is of the kind which allows pivotable motion between the sash and the supporting links about the longitudinal axis of the fastener.

[0025] The sash 3 is furthermore slideably and pivotably connected to the frame 2 via two taps (not shown) on the sash which are arranged in two slots 6 arranged in the frame. The taps are arranged one on each side and at the top of the sash and the slots 6 are arranged one on each side of the frame 2.

[0026] The window assembly 1 shown in figure 1 can be thought of as having two separate linkage mechanisms, one on the right and one on the left side of the window. Furthermore, in the context of the current invention, the frame and the sash are considered to be links of both the left and the right linkage mechanisms. In this way, in the context of the introductory paragraph and considering each linkage mechanism separately, the frame and the supporting link can be thought of as two links of a linkage mechanism. In addition, the sash and the respective supporting link can also be thought of as two links of a linkage mechanism.

[0027] Since the supporting links 4 are under compression during normal use, the links are designed with a cross section having a rather high area moment of inertia in order to prevent the links from buckling during normal use. This makes the supporting links very stiff. Due to the high stiffness of the supporting links, when a bending moment is applied to a link, the bending moment is transferred directly to the fastener 5. This is not a problem in normal use where the bending moments are limited to moments about the longitudinal axis of the fastener.

[0028] However, in the case where one of the linkage mechanisms fails, as was discussed earlier, the resulting large bending moments applied to the links of the remaining linkage mechanism are transferred directly to the joints between the links about axes which are perpendicular to the longitudinal axis of the fastener. This can cause the fasteners to deform and/or the links to deform in the area about the fastener. When the fasteners and/or the area of the links about the fasteners deform, there is a risk that the joint will fail thereby allowing the two parts which were held together by the fastener to release each other. For example, in certain cases, the deformation of the fastener could be so large that the fastener itself breaks. In other cases, the fastener could deform slightly and the hole in the link through which the fastener is placed could deform slightly, the two deformations thus allowing the fastener to slip through the hole.

[0029] Therefore, according to the current invention, the supporting links 4 are formed with a weakened area 7 arranged near each of the fasteners 5. In the window assembly 1 shown in figure 1, the weakened area 7 is formed by stamping an oval shaped hole 7 through the supporting link 4. This embodiment of a supporting link with a weakened area is shown in more detail in figure 2.

[0030] Due to the weakened area, in the case where a large bending moment is applied to the supporting link about an axis other than the longitudinal axis of the fastener, the supporting link 4 will deform at the weakened area, thereby protecting the fastener from deformation. The deformation of the weakened area 7 of the link 4 will not cause the link to break, it will just bend or deform in another way. In this way, the linkage will just deform instead of failing. The window sash and pane will therefore be prevented from falling away from the frame since the window sash and the window frame will remain connected.

[0031] The weakened area can be formed in many different ways. Figures 3 and 4 show two other embodiments of a supporting link with a weakened area. Figure 3 shows a supporting link 10 where two slots 11 have been stamped through each side of the supporting link near the fastener 5. As should be obvious to the person skilled in the art of manufacturing, the slots in figure 3, as well as the hole shown in figure 2, could also be formed in many other ways besides stamping. For example they could be formed by milling, drilling, or they could be formed at the same time as the link is formed, for example during a forging process.

[0032] Figure 4 shows a third embodiment of a supporting link 20. In this embodiment a portion 21 of the link has been reduced in thickness. One way of achieving this reduction in thickness is by compressing a portion of the link in a press. In another embodiment, the thick-

ness could be reduced by milling a portion of one of the surfaces of the supporting link.

[0033] In the embodiments shown, the weakened area has been located at a distance from the fastener which is approximately equal to the width of the link. For example, in the links shown, the width of the links is about 1.5cm and the weakened area is located between 1 and 2cm from the fastener. However, it should be obvious to the person skilled in the art that, depending on the design of the fastener and the link, this distance could be chosen differently.

[0034] In all the above described embodiments, the weakened area has been formed by reducing the area moment of inertia of the cross section perpendicular to the longitudinal axis of the link in a portion of the supporting link. However, it could also be imagined that the weakened area could be formed in that the material properties in a certain portion of the link could be different from the rest of the link. This could for example be achieved by changing the chemical structure of the material in a certain area of the link, for example by heat treatment. It could also be achieved by assembling the supporting link from different materials. In another example,the link could be formed from a composite material wherein the structure of the composite material is different at the weakened area. For example, if the link where made from woven glass fibres in an epoxy mix, the amount of glass fibres could be reduced at the weakened area.

[0035] It should also be noted that the example embodiments described above have all shown links which are in compression. It should however be obvious to the person skilled in the art, that the same invention can also be applied to links which are exposed to other loads besides compression. For example, in a link which is typically in tension and which has a hole through the link for attaching a fastener, the weakest point of the link will be the cross section at the location of the through hole. Therefore, when loads are applied to the links, any deformation of the link will most likely take place right at the location of the through hole. Therefore, a weakened area near to the fastener which has a cross section with a smaller area moment of inertia than the cross section of the area at the through hole, would allow the link to deform mainly at the weakened area, thus reducing the risk of the linkage mechanism failing.

[0036] Finally it should be noted that the problem where the failure of a first linkage mechanism causing the failure of the second linkage mechanism is sometimes avoided by over dimensioning all the links and fasteners in both linkage mechanism. However this makes the mechanisms unnecessarily expensive, bulky and complicated.

Claims

1. A linkage mechanism (2,4;3,4) suitable for a window frame assembly, said mechanism comprising two links (2,4;3,4) connected together by a fastener (5) in such a way that the two links are pivotable with respect to each other about the longitudinal axis of the fastener, and where at least one of said two links (4;10;20) comprises a weakened area (7;11;21) near to the fastener and between the fastener and the centre point of said link, **characterized in that** the weakened area (7;11;21) of the link (4;10;20) is designed such that when a bending moment is applied to one of said links about an axis which is perpendicular to the axis of the fastener, the link deforms at the weakened area.

2. A linkage mechanism (2,4;3,4) according to claim 1, **characterized in that** the weakened area (7;11;21) is an area of the link (4;10;20) where the cross section perpendicular to the longitudinal axis of the link has a reduced area moment of inertia with respect to the rest of the link.

3. A linkage mechanism (2,4;3,4) according to claim 1 or 2, **characterized in that** the weakened area (7; 11) is a area where material has been removed from the link (4;10).

4. A linkage mechanism (2,4;3,4) according to claim 3, **characterized in that** the weakened area (7;11) is a hole through the link (4;10).

5. A linkage mechanism (2,4;3,4) according to claim 1 or 2, **characterized in that** the weakened area (21) is a area of the link (20) which has been reduced in thickness when compared to the thickness of the rest of the link.

6. A linkage mechanism (2,4;3,4) according to claim 5, **characterized in that** the weakened area (21) is an area of the link (20) which has been compressed..

7. A linkage mechanism (2,4;3,4) according to any one of claims 1-6, **characterized in that** the weakened area (7;11;21) of the link (4;10;20) is located at a distance from the fastener (5) which is approximately equal to the width of the link..

8. A window frame assembly (1) comprising a linkage mechanism (2,4;3,4) according to any one of claims 1-7.

9. A window frame assembly (1) according to claim 8, **characterized in that** the link (4;10;20) comprising a weakened area (7;11;21) is a link which is in compression during normal use.

Patentansprüche

1. Ein für eine Fensterrahmenanordnung geeigneter

Gelenkmechanismus (2,4;3,4), welcher zwei Gelenke (2,4;3,4) umfasst, welche durch ein Befestigungselement (5) miteinander derart verbunden sind, dass die beiden Gelenke um die Längsachse des Befestigungselements relativ zueinander schwenkbar sind, und wobei mindestens eines der beiden Gelenke (4;10;20) einen in der Nähe von dem Befestigungselement und zwischen dem Befestigungselement und dem Mittelpunkt des Gelenks befindlichen geschwächten Bereich (7;11;21) aufweist, **dadurch gekennzeichnet, dass** der geschwächte Bereich (7;11;21) des Gelenks (4;10;20) so ausgebildet ist, dass sich das Gelenk am geschwächten Bereich verformt, wenn eines der beiden Gelenke um eine zur Achse des Befestigungselements senkrechte Achse mit einem Biegemoment beaufschlagt wird.

2. Gelenkmechanismus (2,4;3,4) nach Anspruch 1, **dadurch gekennzeichnet, dass** der geschwächte Bereich (7;11,21) einen Bereich des Gelenks (4;10;20) darstellt, wo der zur Längsachse des Gelenks senkrechte Querschnitt relativ zum übrigen Teil des Gelenks einen reduzierten Trägheitsmomentbereich aufweist.

3. Gelenkmechanismus (2,4;3,4) nach Anspruch 1 oder 2, **dadurch gekennzeichnet, dass** der geschwächte Bereich (7;11) einen Bereich darstellt, wo Material vom Gelenk (4;10) abgetragen worden ist.

4. Gelenkmechanismus (2,4;3,4) nach Anspruch 3, **dadurch gekennzeichnet, dass** der geschwächte Bereich (7;11) ein Loch durch das Gelenk (4;10) ist.

5. Gelenkmechanismus (2,4;3,4) nach Anspruch 1 oder 2, **dadurch gekennzeichnet, dass** der geschwächte Bereich (21) einen Bereich des Gelenks (20) darstellt, bei dem die Dicke im Vergleich zur Dicke des übrigen Teils des Gelenks reduziert worden ist.

6. Gelenkmechanismus (2,4;3;4) nach Anspruch 5, **dadurch gekennzeichnet, dass** der geschwächte Bereich (21) einen Bereich des Gelenks (20) darstellt, welcher komprimiert worden ist.

7. Gelenkmechanismus (2,4;3,4) nach einem der Ansprüche 1 bis 6, **dadurch gekennzeichnet, dass** der geschwächte Bereich (7;11;21) des Gelenks (4;10;20) in einem annäherungsweise der Breite des Gelenks entsprechenden Abstand vom Befestigungselement (5) angeordnet ist.

8. Fensterrahmenanordnung (1), welche einen Gelenkmechanismus (2,4; 3,4) nach einem der Ansprüche 1 bis 7 umfasst.

9. Fensterrahmenanordnung (1) nach Anspruch 8, **dadurch gekennzeichnet, dass** das einen geschwächten Bereich (7;11;21) aufweisende Gelenk (4;10;20) ein Gelenk darstellt, welches sich beim bestimmungsgemäßen Gebrauch in Kompression befindet.

Revendications

1. Mécanisme (2, 4 ; 3, 4) de liaison approprié pour un ensemble cadre de fenêtre, ledit mécanisme comportant deux maillons (2, 4 ; 3, 4) reliés par un élément (5) d'assemblage de telle manière que les deux maillons puissent pivoter l'un par rapport à l'autre autour de l'axe longitudinal de l'élément d'assemblage, et où au moins un desdits deux maillons (4 ; 10 ; 20) comporte une zone affaiblie (7 ; 11 ; 21) près de l'élément d'assemblage et entre l'élément d'assemblage et le milieu dudit maillon, **caractérisé en ce que** la zone affaiblie (7 ; 11 ; 21) du maillon (4 ; 10 ; 20) est conçue de telle sorte que, lorsqu'un moment de flexion est appliqué à l'un desdits maillons autour d'un axe perpendiculaire à l'axe de l'élément d'assemblage, le maillon se déforme au niveau de la zone affaiblie.

2. Mécanisme (2, 4 ; 3, 4) de liaison selon la revendication 1, **caractérisé en ce que** la zone affaiblie (7 ; 11 ; 21) est une zone du maillon (4 ; 10 ; 20) où la section droite perpendiculaire à l'axe longitudinal du maillon possède un moment quadratique réduit par rapport au reste du maillon.

3. Mécanisme (2, 4 ; 3, 4) de liaison selon la revendication 1 ou 2, **caractérisé en ce que** la zone affaiblie (7 ; 11) est une zone où de la matière a été enlevée du maillon (4 ; 10).

4. Mécanisme (2, 4 ; 3, 4) de liaison selon la revendication 3, **caractérisé en ce que** la zone affaiblie (7 ; 11) est un trou traversant le maillon (4 ; 10).

5. Mécanisme (2, 4 ; 3, 4) de liaison selon la revendication 1 ou 2, **caractérisé en ce que** la zone affaiblie (21) est une zone du maillon (20) dont l'épaisseur a été réduite en comparaison de l'épaisseur du reste du maillon.

6. Mécanisme (2, 4 ; 3, 4) de liaison selon la revendication 5, **caractérisé en ce que** la zone affaiblie (21) est une zone du maillon (20) qui a été comprimée.

7. Mécanisme (2, 4 ; 3, 4) de liaison selon l'une quelconque des revendications 1 à 6, **caractérisé en ce que** la zone affaiblie (7 ; 11 ; 21) du maillon (4 ; 10 ; 20) est située à une distance de l'élément (5) d'assemblage approximativement égale à la largeur du

maillon.

8. Ensemble cadre (1) de fenêtre comportant un mécanisme (2, 4 ; 3, 4) de liaison selon l'une quelconque des revendications 1 à 7.

9. Ensemble cadre (1) de fenêtre selon la revendication 8, **caractérisé en ce que** le maillon (4 ; 10 ; 20) comportant une zone affaiblie (7 ; 11 ; 21) est un maillon qui se trouve en compression pendant son utilisation normale.

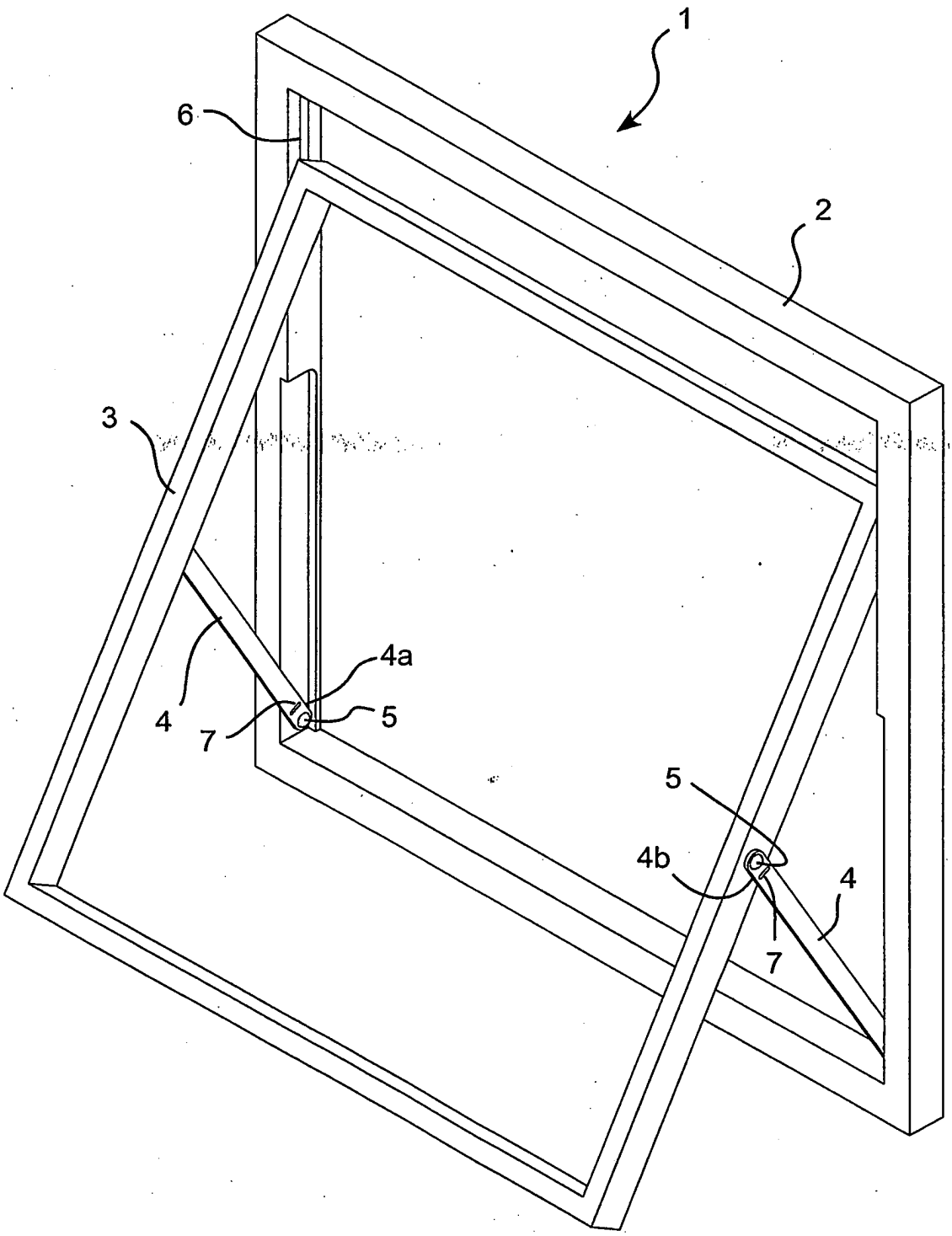

Fig. 1

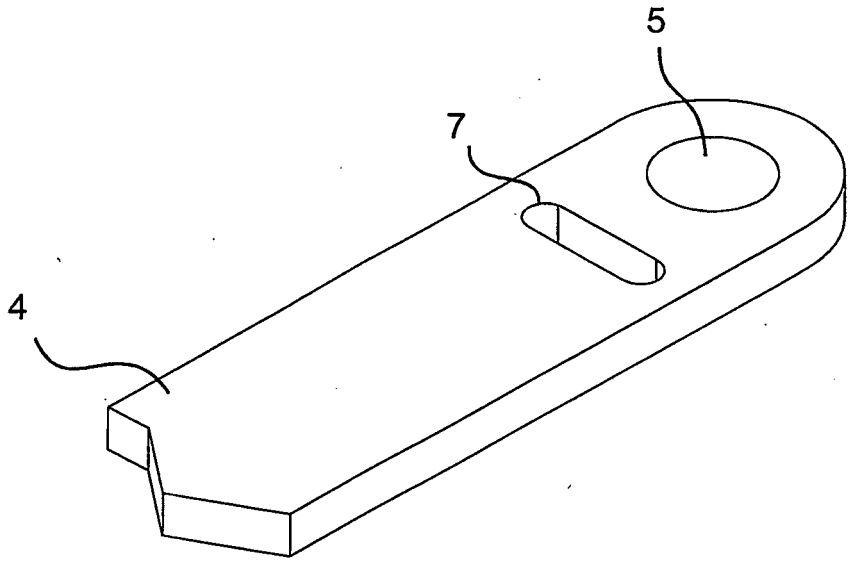

Fig. 2

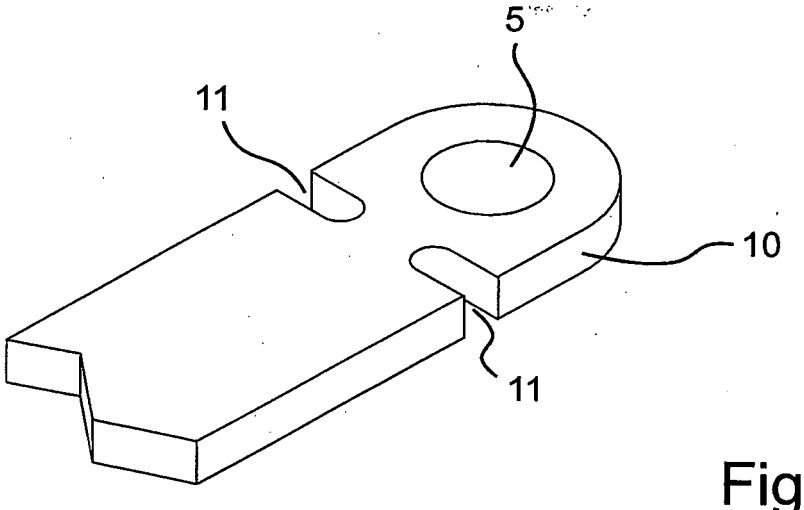

Fig. 3

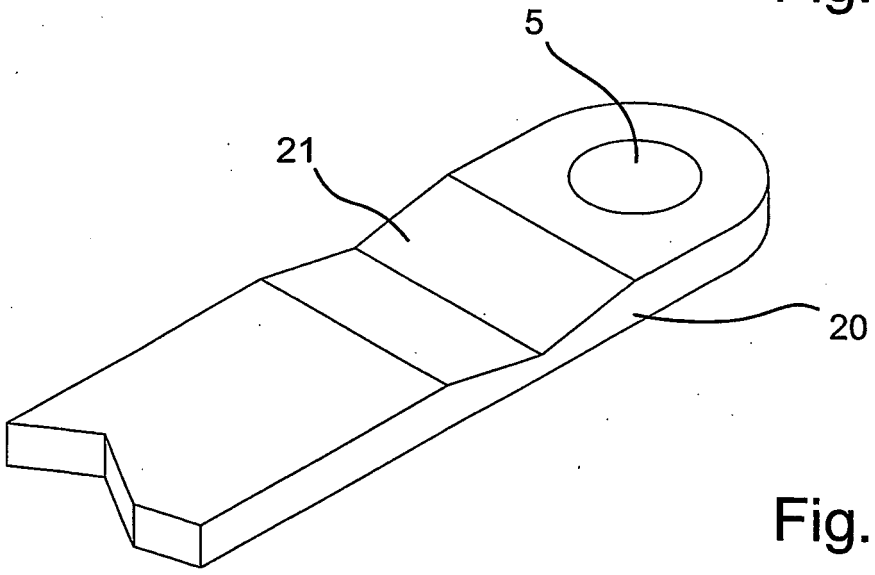

Fig. 4

REFERENCES CITED IN THE DESCRIPTION

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