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(54) LOCK WITH HOOK BOLT

(57) A lock (1) comprising: a hook bolt (8) which is mounted in the lock, pivotally movable about a pivotal axis, between a retracted position and an extended position and a forend (18) exhibiting a bolt opening (34), through which the hook bolt (8) extends in the extended position. A lock mechanism (6) is connected to the hook bolt (8) for driving the hook bolt (8) between the retracted and the extended position. The hook bolt (8) exhibits a first cross section (A) which, in the extended position, is arranged in a plane of the bolt opening (34) and which exhibits an inner portion (52) and an outer portion (54), said inner portion (52) being arranged closer to the pivotal axis than said outer portion (54). The inner portion (52) of the first cross section (A) is generally rectangular and that the outer portion (54) of the first cross section (A) is outwardly tapering.

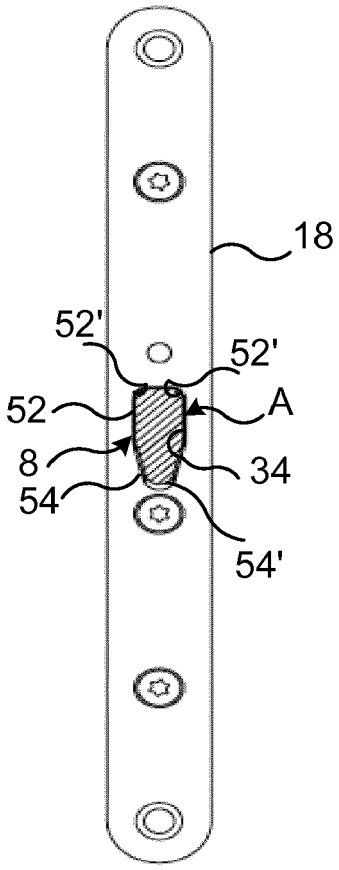

Fig. 4b

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Description

TECHNICAL FIELD

[0001] The invention relates to a lock of the hook-bolt type in which the latch or look bolt has a hook-shape and engages as such in a striking plate. The lock according to the invention can be used in various types of locks such as espagnolettes or other types of multi point or single point locks. Due to the strong and stable nature of the lock it may be possible to use the lock in a single lock system.

BACKGROUND

[0002] Locks of the described type are used in e.g. entrance doors, security doors, balcony doors and windows. Such locks typically comprise a lock housing or lock case in which at least one follower, for example a handle or key follower, is arranged. The handle or key follower is coupled to one or more lock bolts via a follower interface. The lock bolt can be moved by the follower from an unlocked position into a locked position and back by means of operating the handle or key follower. In the locked position the lock bolt extends through or passes over the forend of the lock and is engaged in a striker plate in the doorframe. It is known to use hook-shaped bolts as lock-, latch- or dead bolts and to arrange a bolt opening in the forend, which allows the lock bolt to extend through the forend in the locked position. When the hook bolt is moved from the unlocked into the locked position it is pivoted so that the free end of the hook can engage deeply in the striker plate.

[0003] When a door or window comprising a conventional lock is forced open or when it is at least tried, for example by using a crowbar, great forces, especially shear forces act on the lock, the door or window and the striker plate, respectively. The lock bolt transfers the forces to the lock case, the forend and the striker plate. The transferred forces may result in deformations or failure of the bolt, the striker plate, the lock case and/or the forend. In the bolt and the forend the forces result in compressive, shear and tensile stress within the material. Forces, in particular shear-forces, within a flat element comprising an opening or a passage with corners, such as the forend, create stress-peaks in areas with the lowest material thickness, thus normally around the corners of the bolt opening or passage, especially when this corners are sharp. Experience has shown that the forend most likely will fail in a region of the corners of the bolt opening. As soon as the forend breaks or partially breaks a burglar has an easier job to open the door and to completely destroy the lock. Also the hook bolt is prone fail when great forces are applied thereto. Several attempts has been done to strengthen the hook bolt such as to minimize the risk of failure.

[0004] EP 0 634 552 A1 discloses a lock comprising a hook bolt and a forend with a rectangular bolt opening, configured to let the hook bolt extend through in a locked position.

[0005] GB 2496992 A discloses a lock assembly comprising a lock casing and a hook bolt which is pivotally movable between a retracted and an extended position. The hook bolt has a tapered cross section such that, at the point at which it extends from the casing, its width as measured parallel to the pivot axis is at its greatest at he mid-point and narrower at the ends, such that the cross section is oval shaped.

[0006] Further, in conventional locks, the lock casing is usually composed by countersunk bolts whereby the material of the lock casing is weakened around the screw apertures of the lock case. Typically the screw apertures are turned, drilled or milled, which means material is locally removed to achieve a conical shape around the screw apertures so that the countersunk bolts can be fully inserted and screwed in. This may result in local weak points around the screw apertures.

SUMMARY

[0007] It is an object of the present invention to provide an improved lock of the hook bolt type.

[0008] Another object is to provide such a loch which is strong and secure.

[0009] A further object is to provide a lock of this kind that is difficult to force and destroy.

[0010] Another object is to provide a lock of this kind, which requires considerable efforts to be destroyed or opened by an unauthorized person.

[0011] A further object is to provide a lock of this kind, which has a reduced amount of points of failure.

[0012] A still further object is to provide such a lock which presents a comparatively low friction between the hook bolt and the forend and striking plate respectively during movement of the hook bolt between its retracted and extended position.

[0013] One more object is to provide a lock that is economic and in which the best possible stability is achieved by optimized material use.

[0014] These and other objects are achieved with a lock type which is defined in the introductory part of claim 1 and which has the special technical features defined in the characterizing part of the claim. The lock comprises a hook bolt which is mounted in the lock, pivotally movable about a pivotal axis, between a retracted position and an extended position and a forend exhibiting a bolt opening, through which the hook bolt extends in the extended position. A lock mechanism is connected to the hook bolt for driving the hook bolt between the retracted and the extended position. The hook bolt exhibits a first cross section which, in the extended position, is arranged in a plane of the bolt opening and which exhibits an inner portion and an outer portion, said inner portion being arranged closer to the pivotal axis than said outer portion. The inner portion of the first cross section is generally rectangular and the outer portion of the first cross section

is outwardly tapering

[0015] Such a design of the hook bolt has proven to effectively reduce shear forces both in the hook bolt and the forend around the bolt opening, especially in a region having low material thickness. The special design of the hook bolt thus allows constructing a lock with a high degree of security in relation to the amount of material used for forming the hook bolt and the forend. The outwardly tapering first cross section's outer portion further provides a comparatively low friction between the hook bolt and the forend and striker plate respectively, during movement of the hook bolt between its retracted and extended positions. Especially at high seal pressures, this allows for that the hook bolt may be moved between its locked and unlocked positions by applying only moderate forces and torques to the locking mechanism and the followers arranged to operate the hook bolt.

[0016] When a crowbar or the like is applied for forcing the lock, shear and tensile forces act upon the hook bolt and the forend. Forces may for example act on the hook bolt in a direction perpendicular to a plane defined by the forend but also in a direction parallel to said plane. Such forces usually result in tensile, compressive and shear stresses within the hook bolt and the forend. By giving the hook bolt the particular shape it has proven that the stress appearing in the hook bolt is greatly reduced in comparison to previously known hook bolts. Additionally be giving the bolt opening a shape which closely corresponds to the first cross section of the hook bolt also the stress appearing in the forend is greatly reduced. Especially, with such a shape of the bolt opening, the shear stress appearing in the forend around the bolt opening may be kept at significantly low levels.

[0017] The outer portion of the first cross section may be generally V-shaped.

[0018] The angle of such a V-shape may preferably lie between 25 and 35°.

[0019] The outer portion of the first cross section may exhibit an outer curved edge.

[0020] The radius of such a curved edge may lie between 2 and 5 mm, preferably at approx. 3 mm.

[0021] The inner portion of the first cross section may exhibit curved inner corners.

[0022] The edges of the first cross section may be curved at the transition between the inner portion and the outer portion.

[0023] The hook bolt may exhibit a circular arc having a constant distance to the pivotal axis and extending from the first cross section towards the free end of the hook bolt and wherein the hook bolt exhibits a region having a constant thickness radially inwards of said circular arc and an outwardly tapering thickness radially outwards of said circular arc.

[0024] The hook bolt may exhibit a rear portion which, in the extended position, is arranged inside the lock, which rear portion exhibits a thickness which is larger than the thickness at the first cross section.

[0025] The transitions between the thickness defined by the first cross section and the thickness of the rear portion may be curved at opposed side surfaces of the hook bolt.

[0026] The radius of such transitions may lie between 10 and 20 mm, preferably at approx. 15 mm

[0027] The shape of the bolt opening may closely correspond to the shape of the first cross section.

[0028] The lock may further comprise a guiding cam arranged inside the lock to guidingly receive a radially outward portion of the hook bolt during movement between the retracted and the extended position.

[0029] The shape of the guiding cam may closely correspond to the shape of the outer portion of the first cross section.

[0030] The guiding cam may form part of a mounting component which is fixed to a lock case of the lock.

[0031] The mounting component may be mechanically connected to a pivot axle of the hook bolt in order to form a rigid bolt unit.

[0032] The hook bolt may be shaped as a beak with a protruding beak forefront. Such a shape may increase the strength and resistance of the hook bolt.

[0033] The hook bolt may be configured to be received in the lock with a slight play. This may ensure a smooth operation of the hook bolt and thus the lock mechanism.

[0034] The lock case may comprise a first and second opening, whereby a first play between the bolt opening and the hook bolt, in the extended position, is the same as a second play between the first and second openings and the hook bolt, which is again the same as a third play between the hook bolt and a frame of the bolt unit, which is once again the same as a fourth play between the guiding cam portion and the hook bolt.

[0035] Having the same play between various parts of the lock case and the hook bolt ensures that forces are distributed more equally, for example in case a burglar tries to force the lock, and that the lock case is very firm and stable.

[0036] Further objects and advantages of the invention emerge from the following detailed description and from the claims.

[0037] Generally, all terms used in the claims are to be interpreted according to their ordinary meaning in the technical field, unless explicitly defined otherwise herein. All references to "a/an/the element, device, module, side, etc." are to be interpreted openly as referring to at least one instance of the element, device, module, side, etc., unless explicitly stated otherwise.

BRIEF DESCRIPTION OF THE DRAWINGS

[0038] The invention is now described, by way of example, with reference to the accompanying drawings, in which:

Fig. 1 schematically illustrates an exploded perspective view of a lock according to the invention.

Fig. 2 schematically illustrates a side view of the lock with partially broken away parts with a hook bolt in the extended position.

Fig. 3 schematically illustrates a side view of the lock of figure 2 with the hook bolt in the retracted position.

Fig. 4a schematically illustrates a side view of the lock with the hook bolt in the extracted position.

Fig. 4b schematically illustrates a cross section along line A-A in figure 4a.

Fig. 4c schematically illustrates a cross section along line B-B in figure 4a.

Fig. 4d schematically illustrates a cross section along line C-C in figure 4a.

Figs. 5a-c are perspective views from different angles illustrating a hook bolt forming part of a lock according to an embodiment of the invention.

Fig. 5d is a side view of the hook bolt shown in figs 5a-c.

Figs. 5a and 5f are cross sections along lines A-A and B-B respectively in fig. 5d.

Fig. 6 schematically shows a perspective view of a bolt module comprised in a lock according to the invention.

Figs. 7a is a schematic illustration showing the von Mises stress distribution at a previously known hook bolt and fig. 7b is a corresponding illustration for a hook bolt according to the invention.

DETAILED DESCRIPTION

[0039] The invention will now be described more fully hereinafter with reference to the accompanying drawings, in which certain embodiments of the invention are shown. This invention may, however, be embodied in many different forms and should not be construed as limited to the embodiments set forth herein; rather, these embodiments are provided by way of example so that this disclosure will be thorough and complete, and will fully convey the scope of the invention to those skilled in the art. Like numbers refer to like elements throughout the description.

[0040] Referring now to the figures, which show an exemplary embodiment of the invention, a lock 1 comprises a lock case 13, a bolt unit 2 and a lock mechanism 6.

[0041] The bolt unit 2, as best illustrated in figure 6, comprises a hook bolt 8, a mounting component 10 exhibiting a guiding cam 10a and a frame 12. The hook bolt 8 is rotatably received by the frame 12. The mounting component 10 is fixedly connected to the frame 12 so that the guiding cam 10a may guide the hook bolt 8 during a pivoting movement from a retracted position to an extended position and back, as for example illustrated in figures 2 and 3. The guiding cam 10a is configured to receive a lower periphery of the hook bolt 8, said periphery extending more or less over the entire length of the hook bolt 8. The guiding cam 10a is configured to support the hook bolt 8 and to spread and distribute side and shear forces, when the hook bolt 8 is in the extended position and when somebody tries to force the lock. The mounting component 10 and guiding cam 10a are shaped as a cradle in which the hook bolt 8 may engage. The frame 12 is configured to hold the hook bolt 8 and the mounting component 10 together and in position in the lock case 13. The bolt unit 2 may be configured to form a unit which in itself is a complete assembly unit designed to be used in various lock types, wherever suitable. The bolt unit 2 is herein illustrated by means of a single bolt lock, it may however be used in various locks. It is possible to use two or more bolt units 2 per lock. Further, the bolt unit 2 may constitute a modular part that forms part of a modular production system.

[0042] The hook bolt 8 is shaped as a hook or more in detail as a beak and it comprises a protruding beak forefront 26 and rounded edges 22. The hook bolt 8 is pivotally fixed to the frame 12 and the lock case 13 by means of a pivot element 38. It is possible and falls within the scope of the invention to make the hook bolt 8 out of one single piece of a material or to make it out of several pieces, which may even comprise various materials.

[0043] The hook bolt 8 further comprises a complementary follower interface 24 which may be in the form of a sprocket sector, as best illustrated in figures 1 to 3 and 6. The hook bolt 8 does not comprise any sharp edges, at least not in a region that is configured to engage in a striker plate of a door frame (not shown). The hook bolt 8 comprises a specially shaped cross section along its periphery that is configured to engage the guiding cam 10a.

[0044] The mounting component 10 comprises at least one fixing sleeve 44 with a fastening portion 46, which may be a thread portion, as illustrated in figure 1. The fixing sleeve 44 is configured to have a conical entry part 48 so that a countersunk bolt 36 may smoothly engage the fixing portion in the fixing sleeve 44.

[0045] The frame 12 comprises two frame plates 42 each exhibiting a seat 28 for receiving a respective protruding end of the hook bolt's 8 pivot element 38, as best illustrated in figures 1 and 6. The seats 28 and pivot element 38 may for example be a axle/hole combination as best shown in figure 1. The seats 28, the pivot element 38 and the frame 12, respectively, are configured to receive the hook bolt 8 with a slight, defined play. Such a play may ensure a smooth operation of the hook bolt 8. The frame 12 comprises preferably two side plates 42, which may comprise the complementary pivot elements 28, the side plates 42 being configured to engage the

hook bolt 8 via the pivot elements 38. The two frame plates 42 are further configured to engage the guiding mounting component 10, which may form an integral unit together with the fixing sleeve 44.

[0046] The lock case 13 comprises a first side cover 14 with a first front side 30, a second side cover 16 with a second front side 32 and a forend 18. The first and second side covers 14, 16 each comprise screw apertures 50 and countersunk bolts 36 configured to extend through the screw apertures 50, as best illustrated in figure 1. The first side cover 14 and the second side cover 16 are connected via the countersunk bolts 36 and a plurality of fixing sleeves 44, as previously described. The screw apertures 50 comprise a conical entry portion, similar to the conical entry portion 48 of the fixing sleeves 44, with the difference that around the apertures 50 no material was removed. In the illustrated example, the material of the first and second side covers 14, 16, is bent, pressed or stamped so that no local weak point (removed material) is created. Such a pressing may be achievable via pressing or stamping machines. The conical entry portion of the apertures 50 may be congruent with the conical entry portions 48 of the fixing sleeves 44 so that the countersunk bolts 36 may completely sink into the first - and second side cover 14, 16, respectively. On the first and/or the second side cover 14, 16 a cover portion 15 may be arranged, which covers most of the lock case 13. As best seen in figure 1, the first and second side cover and the cover portion 15 may comprise passages 64 configured to provide access to the lock 1 for a key follower, a follower handle or the like (not shown).

[0047] The engagement of the fixing sleeves 44 and the countersunk bolts 36 is also illustrated in figure 4d. Each fixing sleeve 44 is configured to receive two countersunk bolts 36.

[0048] The fixing sleeves 44 are further configured to comprise fastening portions 46' that are oriented perpendicular to fastening portions 46 which are configured to connect the first and second side covers 14, 16. The perpendicular oriented fastening portions 46' are configured to connect the forend 18 to the lock case 13, as shown in figure 1.

[0049] The first and second front sides 30, 32 may be arranged so that they are parallel to and facing the forend 18, as illustrated in figure 1. The first and second front sides 30, 32 both comprise openings that are configured to let the hook bolt 8 pass through in the extended position. As shown in fig. 1the shape of the openings in the first 30 and second 32 front sides may have a shape that is identical with the shape of the bolt opening 34 in the forend. However, it is also possible that the openings in the first 30 end second 32 front sides differs from the shape of the bolt opening, The first and second front sides 30, 32 of the lock case 13 provides additional stability to the lock 1.

[0050] As seen in figs. 1 and 4c, the hook bolt 8 exhibits a first cross section A which is arranged in a plane of the bolt opening 34, when the hook bolt 8 is in its fully extended locking position. The first cross section A exhibits an inner portion 52 and an outer portion as seen from the pivotal axis for the hook bolt 8, which pivotal axis is defined by the pivotal element 38 (see fig 4a). The pivotal axis extends horizontally in a plane which is parallel to the plane of the bolt opening. The inner portion 51 of the first cross section is thus arranged closer to the pivotal axis than the outer portion 54, throughout the pivotal movement of the hook bolt 8. The inner portion 52 is shaped generally as a rectangle having rounded inner corners 52'. The outer portion of the first cross section A tappers outwardly, i.e. in the direction away from the pivotal axis. The outer portion 54 thus forms a V-shape which, in the shown example presents a V-shape angle between the side lines of the cross section of approx. 29°. The V-shape angle may however be varied, preferably between approx. 25 and 35°. At the outmost end of the first cross section A, the outer portion 54 exhibits a curved edge. In the shown example the curved edge 54' exhibits a radius of approx. 3 mm. The radius may however be varied, preferably between 1 and 5 mm. The side lines or side edges defining the first cross section A are further curved at the transition between the inner 52 and outer 54 portions.

[0051] As best seen in figs. 5a-f, the hook bolt hook is symmetric with respect to a vertical symmetry plane which extends centrally through the hook bold and which is arranged perpendicular to the pivotal axis. I.e. the pivotal axis is arranged normal to the symmetry plane. The hook bolt 8 further exhibits, on both side surfaces, a circular arc 56 having a constant distance to the pivotal axis and extending from the first cross section A towards the free end of the hook bolt 8. Radially inwards of this circular arc 56, the hook bolt exhibits an inner region 56' having a constant thickness. The thickness of the hook bolt at the inner region 56' is thus equal to the thickness or width of the first cross section A at the inner generally rectangular portion 52. Radially outward of the circular arc 56, the hook bolt presents an outer region 56" with an outwardly decreasing thickness.

[0052] The hook bolt 8 further exhibits a rear portion 57 which, in the extended position, is arranged inside the lock. The rear portion 57 exhibits a thickness which is larger than the thickness of the inner region 56' and, thus than the maximum width of the first cross section A.

[0053] The transitions 57' between the thickness at the inner region 56', defined by the first cross section A and the greater thickness of the rear portion 57 are curved at opposed side surfaces of the hook bolt 8. The curvature radius of these transitions 57' are in the shown example approx. 15 mm. The curvature radius may however vary, but are preferably kept between 10 and 20 mm.

[0054] Fig. 4b illustrates how the bolt opening 34 is configured to let the hook bolt 8 extend there through in the extended position and to retract from the extended position into the retracted position. The bolt opening 34 and the first cross section A of the bolt 8 have corresponding shapes. In the extended position the first cross

section A is arranged in the plane of the bolt opening 34.

[0055] The above described hook bolt geometry has proven to provide excellent strength and security in relation to the amount of material used for forming the hook bolt.

[0056] Figs 7a and 7b illustrates the von Mises stress distribution over two different hook bolts being subject to an equal load. Fig. 7a shows the stress distribution at a previously known hook bolt having generally the shape as disclosed in GB 2496992 A and fig. 7b illustrates the corresponding distribution at a hook bolt according to the present invention. As indicated by the scales at the right hand side of the figures a higher darkness intensity represents a higher stress. As clearly seen by comparing the two figures, the hook bolt according to the invention exhibits significantly smaller regions experiencing high stress than the previously known hook bolt.

[0057] The inventive hook bolt thus provides a significantly higher degree of protection against attempts to force the lock, e.g. by inserting a crow between the door and frame and thereafter applying a bending force.

[0058] The locking mechanism 6 comprises a follower 20, follower interface 40 and a guide plate 60. The follower interface 40 is configured to engage in the complementary follower interface 24 of the hook bolt 8. The complementary follower interface 24 and the follower interface 40 may each comprise a set of two parallel sprocket sectors 58 which are spaced apart. The sprocket sectors 58 of the follower interface 40 are spaced apart by the guide plate 60, as best illustrated in figure 1, 4b and 5d. Also the two sprocket sectors 58 of the complementary follower interface 24 may be spaced apart but by a gap 62, said gap 62 being configured to receive the guide plate 60, as best illustrated in figures 1, 4b and 5d. Such an engagement between the gap 62 and the guide plate 60 provides additional sideways-stability to the look mechanism 6.

[0059] It is within the scope of the invention that the complementary follower interface and the follower interface may comprise a plurality of parallel sprocket sectors and that the invention is not limited to two parallel sprocket sectors.

[0060] The invention has mainly been described above with reference to a few embodiments. However, as is readily appreciated by a person skilled in the art, other embodiments than the ones disclosed above are equally possible within the scope of the invention, as defined by the appended patent claims.

Claims

1. A lock (1) comprising:

- a hook bolt (8) which is mounted in the lock, pivotally movable about a pivotal axis, between a retracted position and an extended position;
- a forend (18) exhibiting a bolt opening (34), through which the hook bolt (8) extends in the extended position; and
- a lock mechanism (6), which is connected to the hook bolt (8) for driving the hook bolt (8) between the retracted and the extended position, wherein
- the hook bolt (8) exhibits a first cross section (A) which, in the extended position, is arranged in a plane of the bolt opening (34) and which exhibits an inner portion (52) and an outer portion (54), said inner portion (52) being arranged closer to the pivotal axis than said outer portion (54),

characterized in that

the inner portion (52) of the first cross section (A) is generally rectangular **and that** the outer portion (54) of the first cross section (A) is outwardly tapering.

2. A lock according to claim 1, wherein the outer portion (54) of the first cross section (A) is generally V-shaped.

3. A lock according to claim 1 or 2, wherein the outer portion (54) of the first cross section (A) exhibits an outer curved edge 54').

4. A lock according to any of claim 1-3, wherein the inner portion (52) of the first cross section (A) exhibits curved inner corners (52').

5. A lock according to any of claims 1-4, wherein the edges of the first cross section (A) are curved at the transition between the inner portion (52) and the outer portion (54).

6. A lock according to any of claims 1-5, wherein the hook bolt (8) exhibits a circular arc (56) having a constant distance to the pivotal axis and extending from the first cross section (A) towards the free end of the hook bolt (8) and wherein the hook bolt exhibits an inner region (56') having a constant thickness radially inwards of said circular arc (56) and an outer outwardly tapering region (56"), radially outwards of said circular arc.

7. A lock according to any of claims 1-6, wherein the hook bolt (8) exhibits a rear portion (57) which, in the extended position, is arranged inside the lock, which rear portion exhibits a thickness which is larger than the thickness at the first cross section (A).

8. A lock according to claim 7, wherein the transitions (57') between the thickness defined by the first cross section (A) and the thickness of the rear portion (57) are curved at opposed side surfaces of the hook bolt (8).

9. A lock according to any of claims 1-8, wherein the shape of bolt opening (34) closely corresponds to the shape of the first cross section (A).

10. A lock according to any of claims 1-9, comprising a guiding cam (10a) arranged inside the lock to guidingly receive a radially outward portion (56") of the hook bolt (8) during movement between the retracted and the extended position.

11. A lock according to claim 10, wherein the shape of the guiding cam (10a) closely corresponds to the shape of the outer portion (54) of the first cross section (A).

12. A lock according to claim 10 or 11, wherein the guiding cam (10a) forms part of a mounting component (10) which is fixed to a lock case (13) of the lock (1).

13. A lock according to claim 12, wherein the mounting component (10) is mechanically connected to a pivot axle (38) of the hook bolt (8) in order to form a rigid bolt unit (2).

14. A lock according to claim 13, wherein the bolt unit (2) is fixed to the lock case (13).

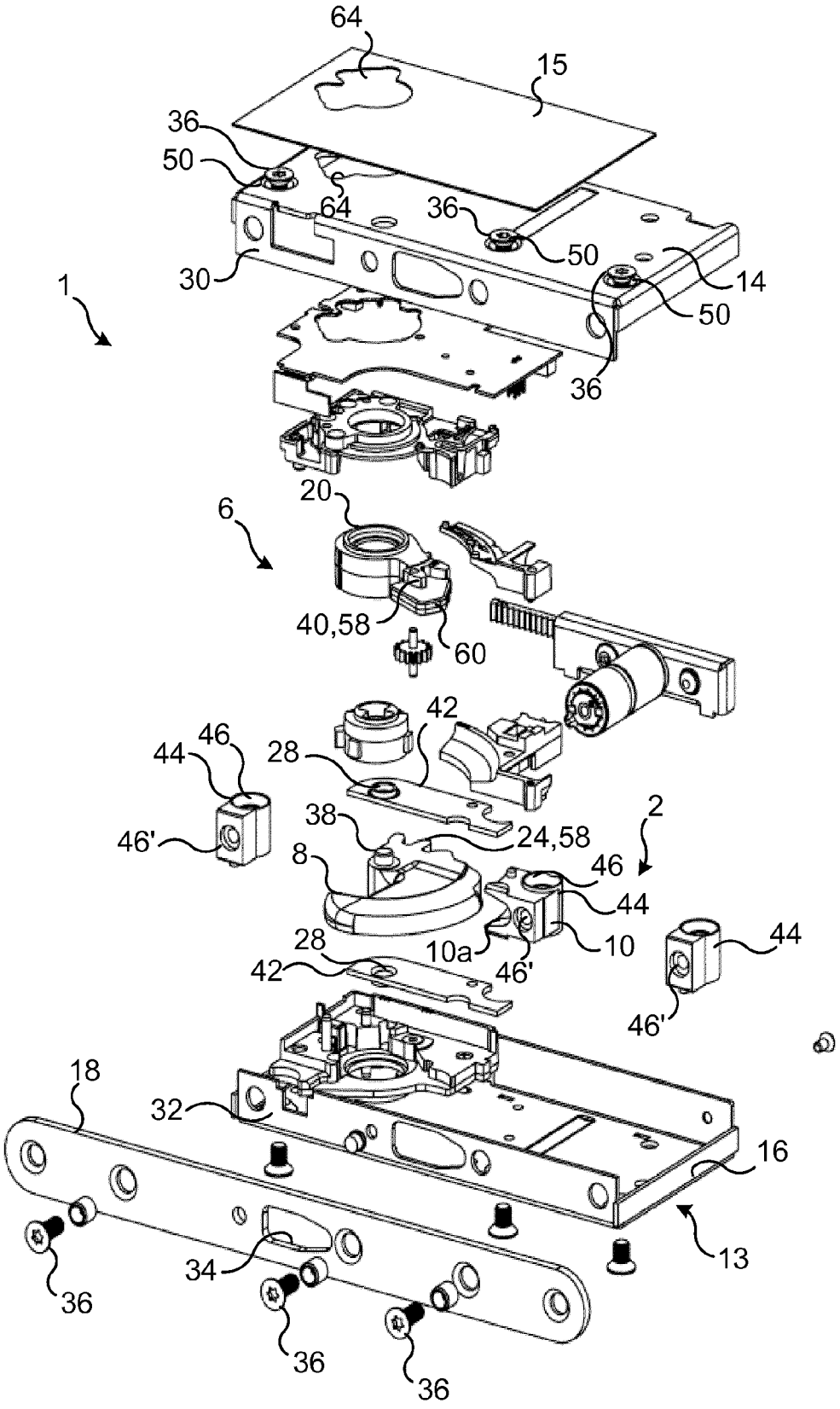
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Fig. 1

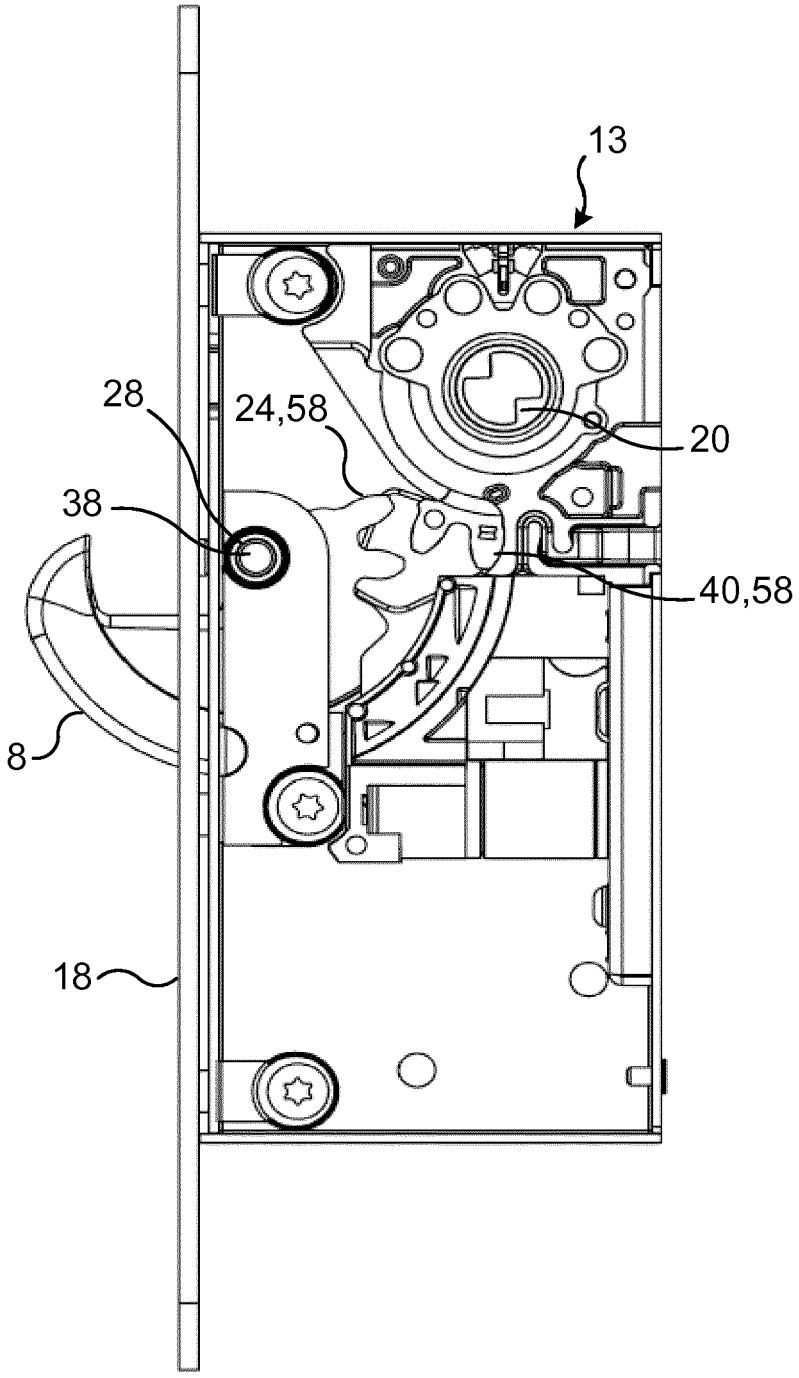


Fig. 2

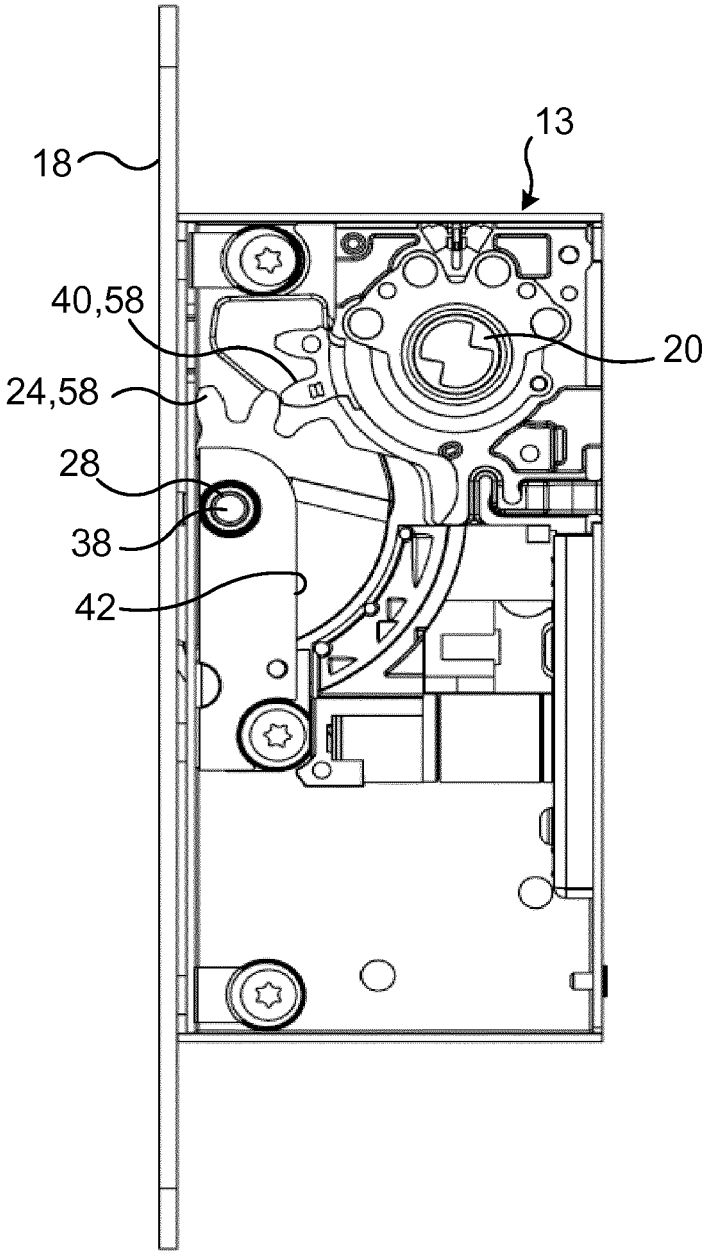


Fig. 3

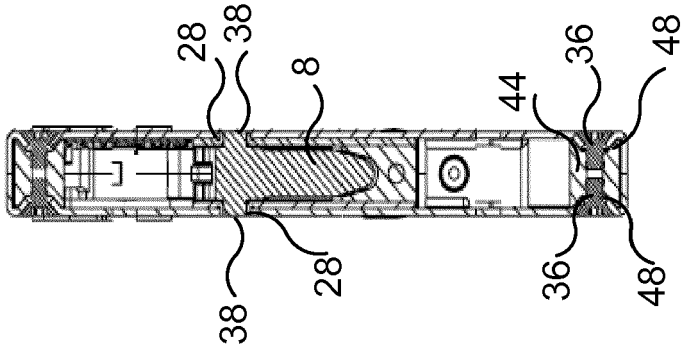


Fig. 4d

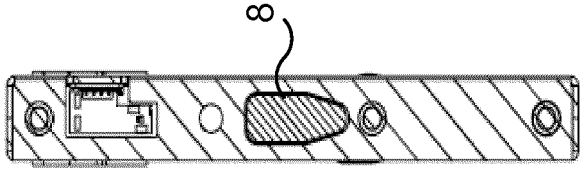


Fig. 4c

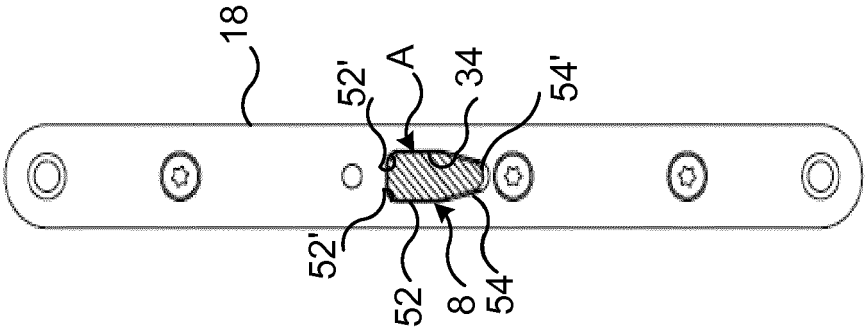


Fig. 4b

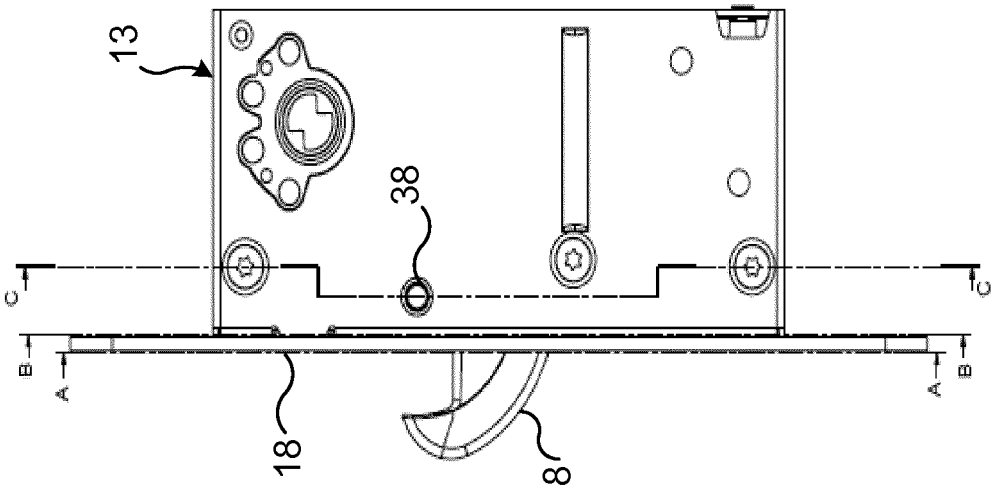


Fig. 4a

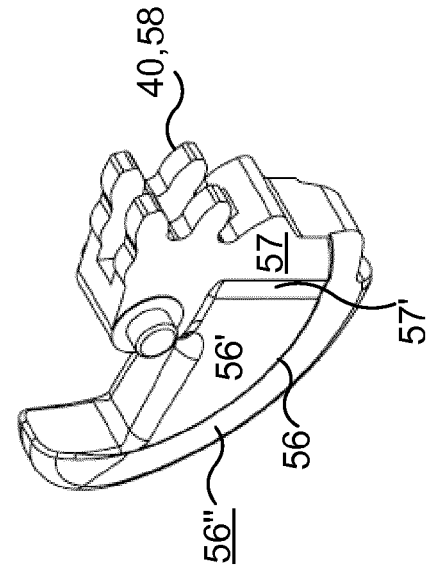


Fig. 5c

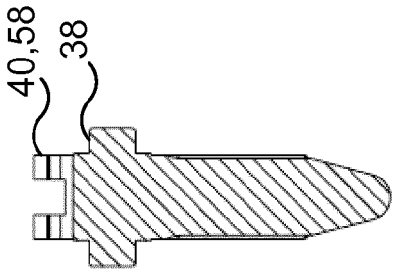


Fig. 5f

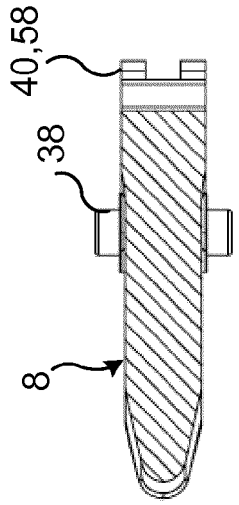


Fig. 5e

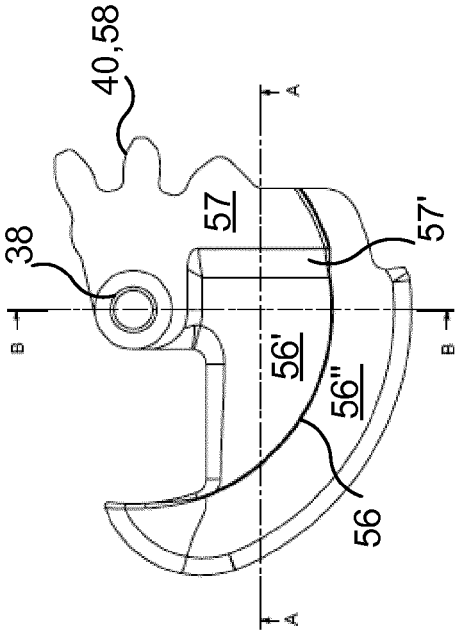


Fig. 5d

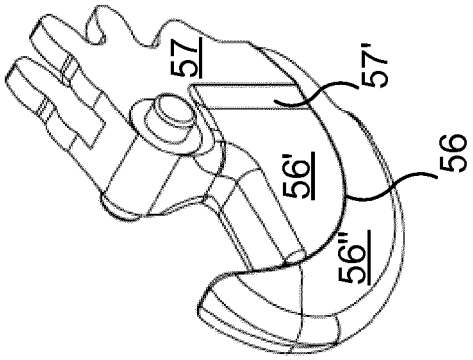


Fig. 5a

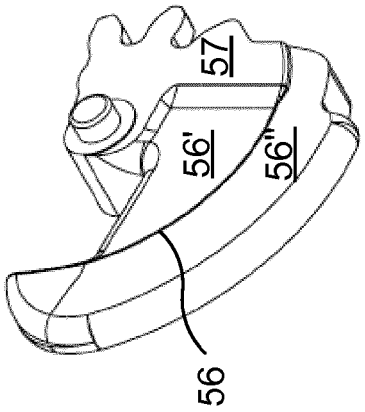


Fig. 5b

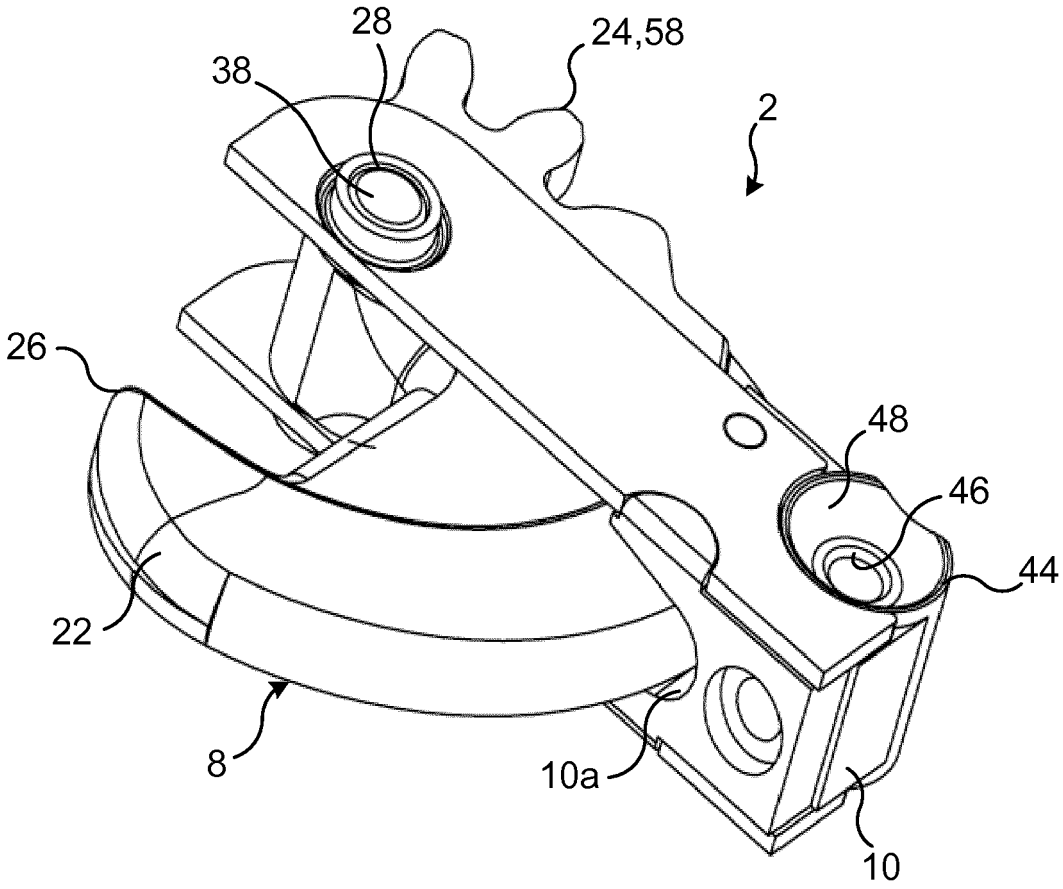
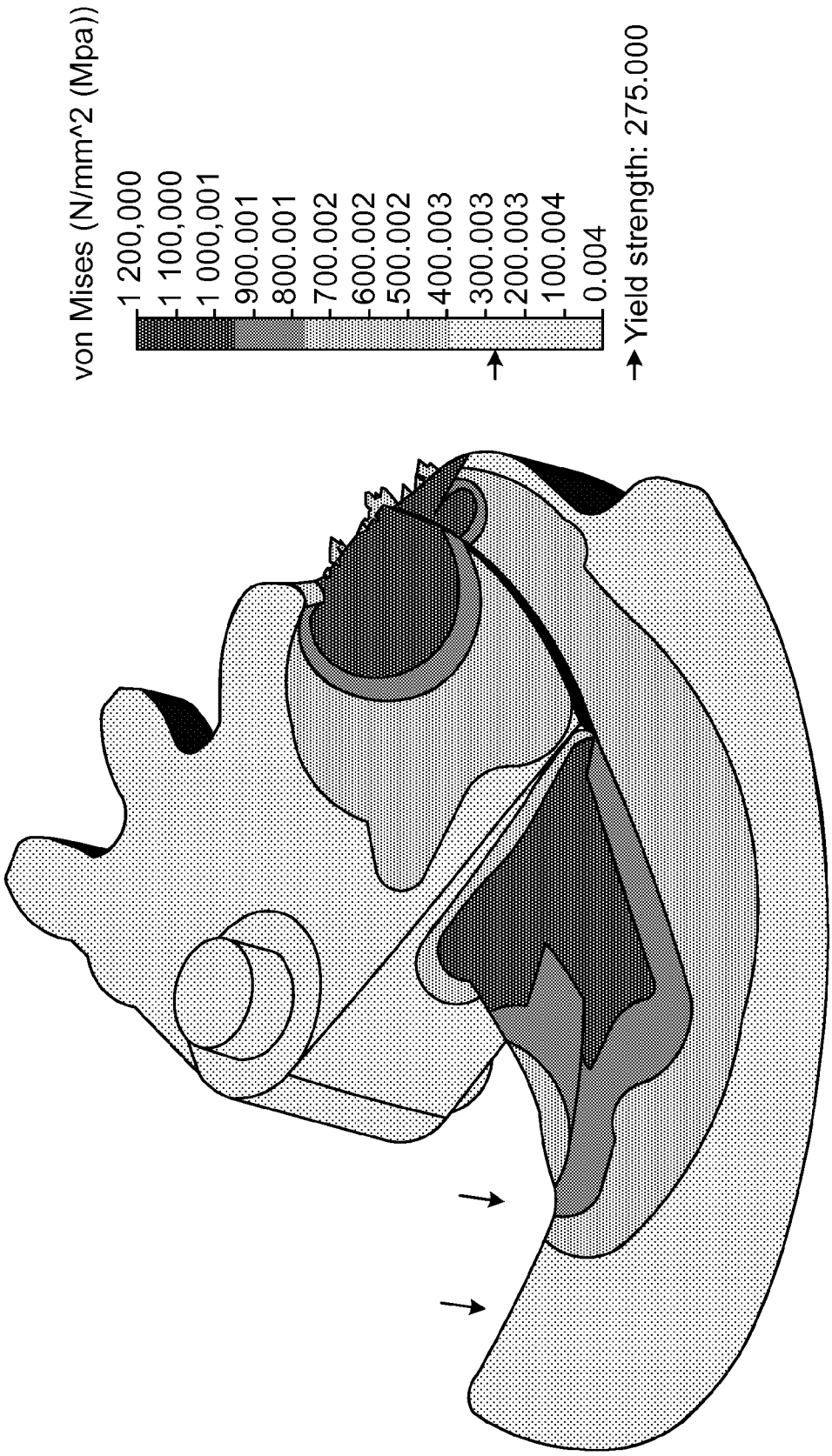


Fig. 6


von Mises (N/mm^2 (Mpa))
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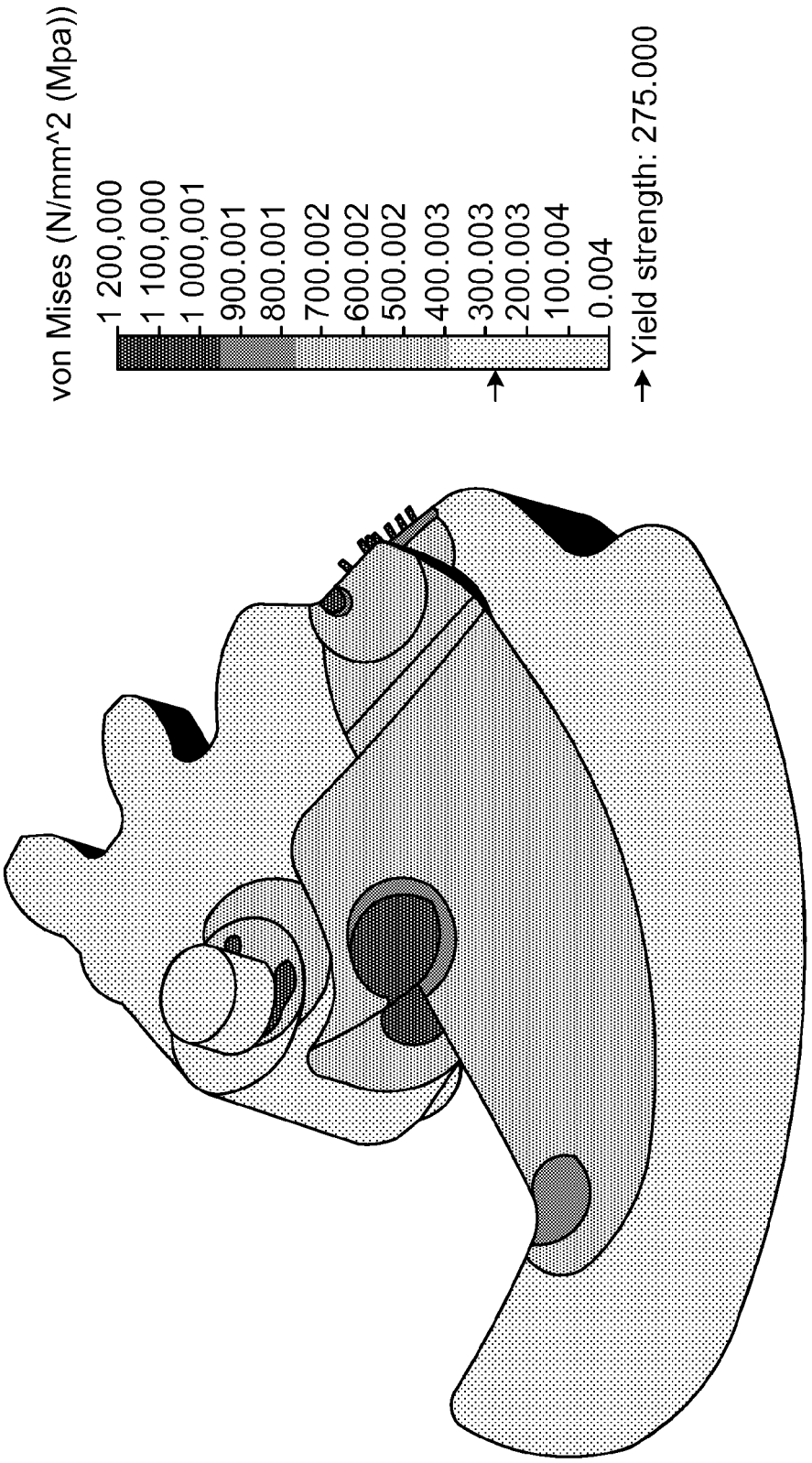
1 100,000
1 000,001
900.001
800.001
700.002
600.002
500.002
400.003
300.003
200.003
100.004
0.004
Yield strength: 275.000

Fig. 7a


von Mises (N/mm^2 (Mpa))
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500.002
400.003
300.003
200.003
100.004
0.004
Yield strength: 275.000

Fig. 7b

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EUROPEAN SEARCH REPORT

Application Number
EP 15 16 8182

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A	* paragraph [0038] - paragraph [0044]; figures 1-5 *	10-14	
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X	WO 2005/003494 A1 (YARRA RIDGE PTY LTD [AU]; WATTS JOHN RUSSELL [AU]) 13 January 2005 (2005-01-13) * figures 17-21 *	1-9	TECHNICAL FIELDS SEARCHED (IPC) E05B E05C

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Place of search	Date of completion of the search	Examiner
The Hague	1 December 2015	Robelin, Fabrice

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