

(19)



(11)

EP 4 474 574 A1

(12)

EUROPEAN PATENT APPLICATION

(43) Date of publication:
11.12.2024 Bulletin 2024/50

(51) International Patent Classification (IPC):
E01B 9/30 (2006.01) E01B 9/28 (2006.01)

(21) Application number: **23020276.4**

(52) Cooperative Patent Classification (CPC):
E01B 9/303; E01B 9/28; E01B 9/30

(22) Date of filing: **05.06.2023**

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC ME MK MT NL NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA
Designated Validation States:
KH MA MD TN

(72) Inventors:
• **Stanislawski, Przemyslaw Myslowice (PL)**
• **Piech, Piotr Katowice (PL)**
• **Chudyba, Lukasz Kraków (PL)**

(71) Applicant: **Track Tec S.A.**
00-124 Warszawa (PL)

(74) Representative: **Radlowski, Jakub Kancelaria Optimas Radlowski i Wspólnicy Sp. k Ul. G. Zapolskiej 9 30-126 Krakow (PL)**

(54) ANGULAR GUIDE PLATE

(57) The angular guide plate for systems for fastening rails to the support, having a front part, a central part and a bearing part, a through hole in the central part, a local elevation in the front part forming a pedestal and, on the bottom side in the bearing part, a half-cylinder bulge having in the middle part a local narrowing forming a stress-relieving recess. The angular guide plate has a strengthening platform (5) running from the pedestal (6) towards the bearing part (3), and, on the upper side, the strengthening platform (5) has the shape of an isosceles trapezoid, the arms of which are the edges (14). Lines

being the extensions of these edges (14) are crossing at an angle α of $40^\circ - 70^\circ$, preferably $53^\circ - 59^\circ$. On the underside in the front part (2) there are at least two stress-relieving openings (10a, 10b) having the form of recesses extending along a line substantially parallel to the longer edge of the guide plate (1). At the top on the edge of the bearing part (3) there is a recess forming stress-relieving arch (16). Preferably, width (L2) of this stress-relieving recess (12) and width (L1) of the stress-relieving arch (16) are 41-59% of width (L) of the longitudinal channel (15).

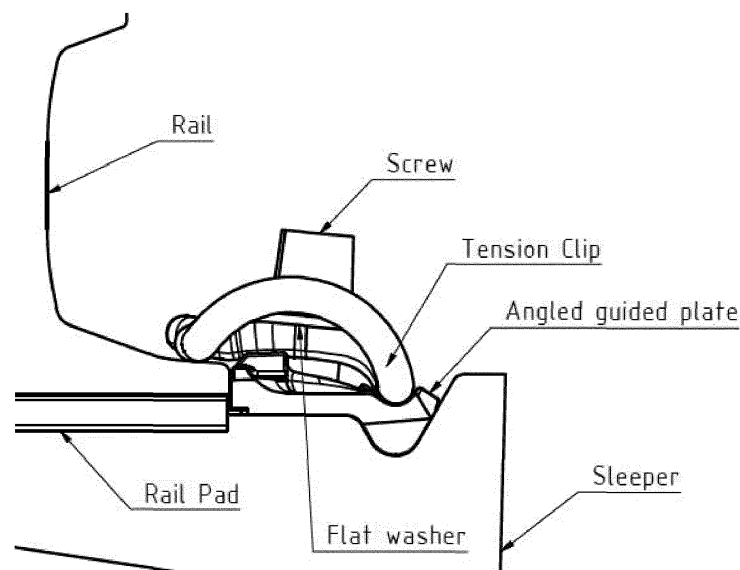


Fig. 9

Description

[0001] The invention relates to an angular guide plate which is an element of rail fastening systems that keeps rail fastened to the support in railroad superstructures.

[0002] Angular guide plates, also referred to as guide plates, are one of the basic components of rail fastening systems that are fixing rail to the support, which is usually concrete sleeper or slab element. In common rail fastening systems, rail pads and angular guide plates placed between the rail foot and the sleeper are used. The rail foot is clamped to the sleeper by a spring element, usually a properly shaped tension clip, fixed to the sleeper by a dowel or fastening screw, that is inserted into precast through or threaded hole in the concrete sleeper. On both sides of the rail foot, guide plates are placed, usually made of elastic material, with central opening through which the above-mentioned dowel or fastening screw of the tension clip can pass.

[0003] The known angular guide plates have an appropriately shaped upper and lower surfaces. There are usually recesses or sockets in the upper part where the arms or middle bend of the tension clip are seated when completely assembled. The lower surface is designed to fit into the recesses in the sleeper or slab plate to ensure that the angular guide plate remains in a fixed position towards the sleeper and the rail foot, fulfilling its primary function which is to prevent transverse displacement of the rail.

[0004] Angular guide plates are usually placed on both sides of the rail, pressing their front parts against the rail foot so that a rail channel is formed in which the rail is stabilised laterally.

[0005] There are numerous descriptions of angular guide plates with different design features, as per the state-of-the-art. In the description of European patent no. EP2672007 B1 "*Guide plate for fixing rails for rail vehicles*" is presented the guide plate for attachment of rails which is made of plastic material and has an upper side formed as a supporting surface for a spring element holding down the rail. An abutment surface is formed on an end side of the plate and extends in longitudinal direction of the plate. At the upper side of the plate, there is formed a reinforcing rib that rises up beyond the supporting surface and extends transversely to the abutment surface. A bottom part of the plate is formed with an aperture extending into a region of the plate in which the reinforcing rib is formed.

[0006] In another European patent no. EP 2643519 B1 "*Guide plate for laterally guiding a rail and system for attaching a rail*" there's described a guide plate for lateral guidance of a rail, which has contact surface and supporting section which is assigned to the counter bearing and has a supporting face. The guide plate according to this document has also a shoulder associated with the counter bearing, where the shoulder is configured projecting in the direction of its end face associated with the counter bearing and in that the end face of the shoulder

associated with the counter bearing and the region adjoining it of the support face is curved in the manner of a groove.

[0007] Another European patent no. EP 2984231 B1 "*Angular guide plate for a railway profile*" discloses angled guide plate for rail-fastening systems, having a basic body with an upper side and an underside designed for arranging on a railway sleeper. The angled guide plate has a guide region and a supporting region. The guide region and the supporting region extend substantially parallel and adjacent to each another in a direction transverse to a track direction. The upper side and the underside are spaced apart from each another so that thickness of the supporting region is larger, at least partially, than thickness of the guide region. The basic body of the plate is designed to taper substantially in wedge form from the supporting region to the guide region transversely to the track direction and minimum thickness of the guide region is less than 10 mm.

[0008] The angled guided plate has been described also in a European patent no. EP2318587B1 "*Angular guide plate and system for fixing a rail*". According to this description angle guide plate for the fitting of a rail on a foundation has a recess serving as a seat for a free end section of a tension clamp if said tension clamp is in the pre-assembly position. The recess surrounds the end section by less than half of its circumference and the transition between the recess and the section of the angle guide plate that follows on from the recess in the direction of the rail is formed to be free of any abrupt change. The angle guide plate may additionally have a rib extending along the contact surface, and the recess is formed into the rib.

[0009] The state-of-the-art solutions are designed to increase the stiffness of this component of the rail fastening system and to prevent, in the best possible way, the lateral displacement of the rails towards the direction of the movement of the train, while ensuring at the same time that the plate is strong enough so that it is neither deformed nor broken by the dynamic forces applied to it by the rail, nor by the static forces resulting from the tension clip interaction. Undoubtedly, the material from which the component is made has an impact on the performance properties of the guide plates. However, the elements of the rail fastening system are mass-produced in industrial quantities, which results from the scale of demand in the construction and renovation of rail roads. It should be noted that four guide plates (two for each rail) are required per sleeper. For these reasons, relatively easily available thermoplastics, in particular polyamide (PA6) and composites based on polyamide and glass fiber, are most commonly used for the production of this element. In addition to the material itself, the performance characteristics of an angular guide plate are also influenced by the shape and formation of the individual components, especially those exposed to high stresses during operation. By forming the guide plate properly, the strength and functional properties of the

guide plate can be improved or kept at an appropriate level, while reducing the weight of the plate and the amount of material required for its production, at the same time. Since these aspects interact with each other, thus evaluating the shape of the guide plate is not a straightforward task, yet even small differences in its formation can turn out to be very significant over many years of operation.

[0010] The angular guide plate as per the presented solution has been developed by using digital models to analyse the stresses resulting from static and dynamic forces on this component of the rail fastening system during its operation. The basic idea was to reduce the weight of the angular guide plate when compared to similar components used on the European market, while keeping the stiffness and strength (durability) of the guide plate. To an expert, it is understandable that a reduction in the weight of a specific component made of a specific material usually results in a weakening of the component and a reduction of its strength. Although it may, at the same time, improve other parameters, such as elasticity, impact strength, etc. These aspects must be considered when designing a guide plate. Zones most vulnerable to mechanical damage because of the impact of the rail foot on the guide plate and the shear forces were identified, taking also into account the influence of the pressure of the tension clip on the distribution of forces and stresses. Using a sufficient number of cycles simulating the train passages, both on straight and curved track and at different speeds, it was possible to develop a shape of the guide plate that ensures optimum stress distribution in the material from which the plate is made.

[0011] The angular guide plate according to the presented invention is a structural element of a rail fastening system, having a bottom side which, when completely assembled, is seated on the railway sleeper and an upper side that supports a tension clip that holds down the rail foot to the rail pad and to the sleeper. The guide plate has features that are partly known from the state-of-the-art. On one side, it adheres with a front side against the vertical edge of the rail foot and, on the other side, it has a bearing part on which there is a longitudinal half-cylinder on the underside, which, when completely assembled, entering into a matching recess in the railway sleeper, locking in this position. On the other side, at the top, above the said bulge, a longitudinal channel is running parallel to the recess in the railway sleeper, into which the tension clip loops (sections) enter after being assembled, as shown in fig. 8 and fig. 9.

[0012] At the underside of the front part, a longitudinal undercut may be made in the guide plate, into which, once completely assembled, a part of a rail pad is inserted.

[0013] Between the front side and the bearing part there is a central part having a through hole made in the middle, through which the screw or dowel that fastens the tension clip to the sleeper is inserted. When seen from above, the guide plate is rectangular or trapezoidal at its

outline. (Trapezoidal shaped guide plates can be installed on tracks running along curves with relatively short radii).

[0014] In the front part, located at the rail foot, the guide plate has a flange at the top that extends along its edge, protruding above the surface of the guide plate. Additionally, in the middle of the front part there is a pedestal reaching the through hole. There are shelves formed on both sides of the pedestal, on which the tension clip sections, which are extensions of the middle bend, are seated, and further - also symmetrically located on both sides - there are steps that extend above the surface of the central section but are slightly lower than the above-mentioned shelves.

[0015] The essence of the presented solution comprises the following features. On the upper side of the angular guide plate, beginning from the pedestal in the front part, through the central part of the guide plate, up to the longitudinal channel in the bearing part, a strengthening platform is made, which tapers and descends towards the bearing part, surrounding the through hole. When seen from the side, the strengthening platform has the shape of a wedge pointing towards the bearing section. The strengthening platform makes up the core of the guide plate, transferring a significant part of the forces being generated by the rail pushing against the front section.

[0016] On the underside of the guide plate, between the front and the central part, there are stress-relieving openings on both sides having the form of recesses extended longitudinally in an axis substantially parallel to the rail. The stress-relieving openings in the section located under the strengthening platform or steps, are wider and deeper than in those sections which are closer to the outer edges of the guide plate.

[0017] In the bearing part, where the guide plate has a half-cylinder on the underside, a stress-relieving recess is made in the middle section. When completely assembled, the sections (loops) of the tension clip hold down the bearing section of the guide plate to the sleeper on both sides of the longitudinal channel, while there is no static pressure from above in the middle section, it is therefore possible to construct the above-mentioned recess without any noticeable reduction in the strength of the component being described. The stress-relieving recess does, however, need to be strengthened at certain sections, as the dynamic forces acting on the rail foot, e.g., transmitted by the strengthening platform, also cause pressure on the central area of the front part, and any excessive weakening of the guide plate structure in this area would result in the risk of micro-cracking. To prevent too much deflection of the central part of the bearing section, where the stress-relieving recess is located, a stiffening rib passes through the centre of the rail seat area, having a cross-section like a semi-circle and, when viewed from the front of the front section - having the form of a vault (arch) that connects the two sides of the half-cylinder. The stiffening rib is a sectional

strengthening that acts as a connector between the half-cylinders, thereby increasing the stability of the guide plate. This is particularly important if there is any displacement of the rail along the track, which, as a result of friction in the contact area between the rail and the tension clip and then the tension clip and the guide plate, generate forces on the guide plate in the same direction, i.e. longitudinally to the axis of the track, while the stiffening rib increases the resistance of the guide plate against such forces in the bearing section. The width of the stress-relieving recess shall not exceed 59% of the width of the angular guide plate at the point where a longitudinal channel is made at the top of the bearing section. If the width of the stress-relieving recess was too large, it would weaken it significantly at the points where the tension clips are seated in the longitudinal groove, which holds down the half-cylinder of the guide plate to the concrete sleeper. The stress-relieving recess preferably takes the shape of a trapezoidal prism (with rounded edges and tops), through the centre of which passes the above-mentioned vault-shaped stiffening rib along the long axis. Shaping the recess in such a way that it is wider at the bottom and narrows towards the top is a consequence of the fact that most of the loads coming from the clip appear on the outer part of the bearing section. By making a stress-relieving recess, it is possible to reduce the weight of the guide plate as well as the carbon footprint left in the production process of this element. Tests have shown that making the above-described recess along with a stiffening rib does not significantly affect the strength of the guide plate.

[0018] Furthermore, it is possible to make still in the half-cylinder additional material recesses, but they should be located on the inner side of the half-cylinder, i.e. in those parts of the half-cylinder which are facing the rail. The reason for this is the distribution of dynamic forces, the vector of which is generally directed outwards from the rail, so the half-cylinders on the outside should be uniform and their structure shall not be weakened in these sections. The additional recesses in the half-cylinder, as indicated above, allow for material savings in the production of the described detail.

[0019] An additional recess in the form of a wide and gentle stress-relieving arch may be made on the upper side of the bearing part, above the stress-relieving recess. The section between the outermost points of this arch represents up to 59% of the width of the entire bearing part. Consequently, in an advantageous variant of the solution according to the invention, the bearing part has at more than half of its width, a recess both at the bottom, where there is a stress-relieving recess, and at the top, in the form of a stress-relieving arch.

[0020] As indicated above, the strengthening platform, in its profile view, has a shape similar to a wedge, the sharp part of which points towards the bearing part, while in its top view the platform looks similar to an isosceles trapezoid, the long base of which connects to a pedestal being part of the front part, and the short base is adjacent

to a longitudinal channel located at the top of the bearing part of the guide plate. Advantageously, the side edges of the strengthening platform (forming the arms of an isosceles trapezoid) at the crossing point of the lines being an extension thereof, form an angle α , the measure of which is between 40° and 70°, advantageously between 53° and 59°. The measure of the above-mentioned angle α determines the crossing point of the lines being the extension of the arms of the trapezoid, which is defined by the outline of the strengthening platform. It is advantageous if these lines are crossing in the area of the stress-relieving arch. In a particularly advantageous version, the measure of the angle α is 58.3°, and the width of the stress-relieving recess at the base is similar to the width of the stress-relieving arch above and also to the width of the pedestal in that part where the shelves designed to support the tension clip arms are made.

[0021] Thanks to the described design of the guide plate, the desired dissipation of the stresses generated by the rail moving transversely to the track under operating load is achieved. It should be clarified that the above-mentioned forces act not only on the front section of the guide plate, but also on the bearing section, by means of the tension clip, the free ends of which are seated on the rail foot pressing it down from above. As the train passes, the first stresses are generated in the tension clip and are being transferred to the bearing section of the guide plate where the loops of the tension clip are adjacent to the longitudinal channel of the bearing section. The rail foot then pushes against the front part of the guide plate and stresses develop over the entire width of the front section. These stresses are transmitted through the central part of the guide plate to the bearing part, which is wedged into the recess of the concrete sleeper. This results in deformation of the guide plate. Stresses occurring in this second phase are to a great extent taken up by the strengthening platform, by redirecting them downwards and towards the middle of the guide plate. The stress-relieving openings make it at the same time possible to dissipate forces which, if there were no such openings, would have accumulated in the central part on both sides of the through-hole.

[0022] By using the described shape of the angular guide plate, it is possible to reduce the quantity of material required to manufacture this component, while keeping the strength parameters that are characteristic for more massive guide plates. This has been achieved by appropriately dissipating the stresses generated by the interaction of static and dynamic forces on the presented component of the rail fastening system. By reducing the amount of material required to produce the guide plate according to the invention, there are measurable benefits in both the material and the energy that is necessary in the production of the element to form the thermoplastic material of a certain weight. Additionally, the carbon footprint left in the production process of the guide plate according to the described solution is reduced. Application of the solution also increases the

durability of the guide plate, since the design which has been used removes the stress centres where most micro-cracks, that shorten the useful life of the guide plates, were formed.

[0023] The subject of the invention has been presented in an embodiment in the drawings, showing:

- Fig. 1 guide plate in axonometric projection, top view
- Fig. 2 guide plate in axonometric projection, bottom view
- Fig. 3 guide plate - top view
- Fig. 4 guide plate - bottom view
- Fig. 5 guide plate - bearing part view
- Fig. 6 guide plate - front part view
- Fig. 7 guide plate - profile view

[0024] In addition, fig. 8 shows a section of the rail fastening system completely assembled, with the sleeper, rail, rail pad, angular guide plate, tension clip and fastening screw visible, while fig. 9 shows the same section of the system when viewed from the side.

[0025] The elements shown on the drawings are indicated as follows:

1 - angular guide plate; 2 - front part; 3 - bearing part; 4 - central part; 5 - strengthening platform; 6 - pedestal; 7, 7a, 7b - shelves (of the pedestal); 8, 8a, 8b - steps (of the pedestal); 9 - through hole; 10, 10a, 10b - stress-relieving openings (non-through holes); 11 - half-cylinder; 12 - stress-relieving recess; 13 - stiffening rib; 14, 14a, 14b - edges of strengthening platform; 15 - longitudinal channel; 16 - stress-relieving arch; 17, 17a, 17b - recesses (in the half-cylinder 18 - longitudinal groove; 19 - flange of the front part; L - width of the longitudinal channel (15); L_1 - width of the stress-relieving recess (12); L_2 - width of the stress-relieving arch (16); α - angle at which the lines forming the extension of the edges (14) of the strengthening platform are crossed.

[0026] EXAMPLE 1: In the first embodiment of the subject of the invention, the guide plate (1), having a front part (2) in the assembled state located at the rail side, a bearing part (3) located on the opposite side to the front part (2) and a central part (4) connecting them, has a through hole (9) made in the middle designed to be used for inserting a screw that fastens the guide plate (1) to the prestressed concrete sleeper. In the front part (2) there is a flange (19) running along the entire width of the angular guide plate (1) and extending above its surface. In the middle of the front part (2), the flange (19) turns into a pedestal (6), which is the uppermost part of the guide plate (1) when assembled. The pedestal (6) meets the through hole (9) and, on both sides, the pedestal (6) has recesses made as shelves (7a, 7b), on which, in the completely assembled state, the arms of the tension clip that form the extension of the middle bend at the rail foot side are seated. On the outer sides of the shelves (7), there are steps (8a, 8b), which are local elevations of the surface of the guide plate (1) at the contact area between the front part (2) and the central part (4), however, the

steps (8) are positioned lower than the shelves (7) when completely assembled. The pedestal (6) passes towards the bearing part (3) into a strengthening platform (5) located in the central part (4) on the upper side of the guide plate (1). The pedestal (6) passes towards the bearing part (3) into a strengthening platform (5) located in the central part (4) on the upper side of the guide plate (1). The surface of the strengthening platform (5) progressively descends towards the bearing part (3), whereas when viewed from above, it narrows in the same direction, defining an approximately isosceles trapezoidal shape, the longer base of which connects to the pedestal (6) and the shorter base meets the bearing part (3). The edges (14a, 14b) of the strengthening platform (5) when viewed from the top, which outline the arms of an isosceles trapezoid, are running towards the bearing part (3) and the straight lines which are the extensions of the edges (14) are crossing each other at an angle α of 41° , whereby the point of their crossing is located outside the body of the guide plate (1). On the underside of the bearing part (3), there is a longitudinal bulge running along the edge of the guide plate (1) forming a half-cylinder (11), which, when the guide plate is completely assembled, fits into a channel made in the concrete sleeper. The half-cylinder (11) in its central section has a local stress-relieving recess (12), which divides the half-cylinder (11) into two parts, whereas these two parts are connected by a stiffening rib (13) running centrally through the stress-relieving recess (12) and having the form of a vault with gentle arc. When viewed from the bottom, the strengthening rib (13) runs longitudinally through the centre of the stress-relieving recess (12). On the top, a longitudinal channel (15) extending along the edge of the angular guide plate (1) over the half-cylinder (11) is formed in the bearing part (3). The channel (15) is used for the tension clip loop to be seated in, when the system is completely assembled, preventing the clip bends from falling out of the guide plate (1). The width of the stress-relieving recess (L_1) is 55% of the width (L) of the longitudinal channel (15). At the upper edge of the guide plate (1), a concave shaped recess is made in the centre of the bearing part (3), forming a stress-relieving arch (16). The width (L_2) of the stress-relieving arch (16) is 52% of the width (L) of the longitudinal channel (15). On the underside of the guide (1), two recesses are made in the front part (2), being the stress-relieving openings (10a, 10b). Stress-relieving openings (10a, 10b) are placed on both sides of the through hole (9) and extend along the edge of the front part (2), whereby these openings are approximately "L" shaped when viewed from the bottom of the guide plate. At the areas that are closest to the through opening (9), the stress-relieving openings (10) are deeper and wider than those further away from the centre. There is also on the underside, along the edge of the lower front part (2), a longitudinal undercut (18) of rectangular cross-section, intended for inserting into this space a part of the rail pad.

[0027] EXAMPLE 2. In the second embodiment, the

angular guide plate (1) is formed analogously to example 1, whereby the straight lines forming the extension of the edge (14) of the strengthening platform (5) are crossing at an angle α of 58.3° and the point of their crossing is located inside the material from which the guide plate (1) is formed, slightly below the centre of the longitudinal channel (15). The width of the stress-relieving recess (L_1) is 42% of the width (L) of the longitudinal channel (15), and the width (L_2) of the stress-relieving arch (16) is 46% of the width (L) of the longitudinal channel (15). In the half-cylinder (11), on its both sides, there are recesses (17a, 17b) formed on the inner side representing locally defined material recesses. The object of the invention is applicable to systems for fastening rails to sleepers, for the construction of rail roads, primarily railway tracks, but also other types of tracks (e.g., tramways, mountain railways, etc.).

Claims

1. The angular guide plate for systems for fastening rails to the support, having a front part, a central part and a bearing part, a through hole in the central part, a local elevation in the front part forming a pedestal and, on the bottom side in the bearing part, a half-cylinder running longitudinally to the edge of the guide plate, where in the middle part of the half-cylinder there is a local narrowing forming a stress-relieving recess **wherein** it has a strengthening platform (5) running with downward slope from the pedestal (6) towards the bearing part (3), and on the upper side, the strengthening platform (5) has the shape of an isosceles trapezoid, the arms of which are the edges (14), whereby the lines being the extensions of these edges (14) are crossing at an angle α of 40° - 70°, preferably 53° - 59°, while on the underside in the front part (2) there are at least two stress-relieving openings (10a, 10b) having the form of recesses extending along a line substantially parallel to the longer edge of the guide plate (1);
2. The angular guide plate according to claim 1 **wherein** the stress-relieving openings (10a, 10b) are deeper and wider at locations close to the through hole (9) than at locations further away from this through hole (9);
3. The angular guide plate according to claim 1 or 2 **wherein** the stress-relieving recess (12) made in the middle of the half-cylinder (11) has a strengthening in the form of a vault-shaped stiffening rib (13) connecting both sides of the half-cylinder (11);
4. The angular guide plate according to any one of the above-mentioned claims, **wherein** there is a recess forming a stress-relieving arch (16) at the top at the edge of the bearing part (3);
5. The angular guide plate according to any one of the above-mentioned claims, **wherein** the width (L_1) of the stress-relieving recess (12) is 41 - 59% of the width (L) of the longitudinal channel (15) of the guide plate (1);
6. The angular guide plate according to any one of the above-mentioned claims, **wherein** the width (L_2) of the stress-relieving arch (16) is 41 - 59% of the width (L) of the longitudinal channel (15) of the guide plate (1);
7. The angular guide plate according to any one of the above-mentioned claims, **wherein** the angle value α is 58.3°, the width (L_1) of the stress-relieving recess (12) is 50% of the width (L) of the longitudinal channel (15) and the width (L_2) of the stress-relieving arch (16) is 50% of the width (L) of the longitudinal channel (15);
8. The angular guide plate according to any of the above-mentioned claims, **wherein** there in the half-cylinder (11) in its inner part on both sides there are recesses (17a, 17b) being locally defined cavities in the material.

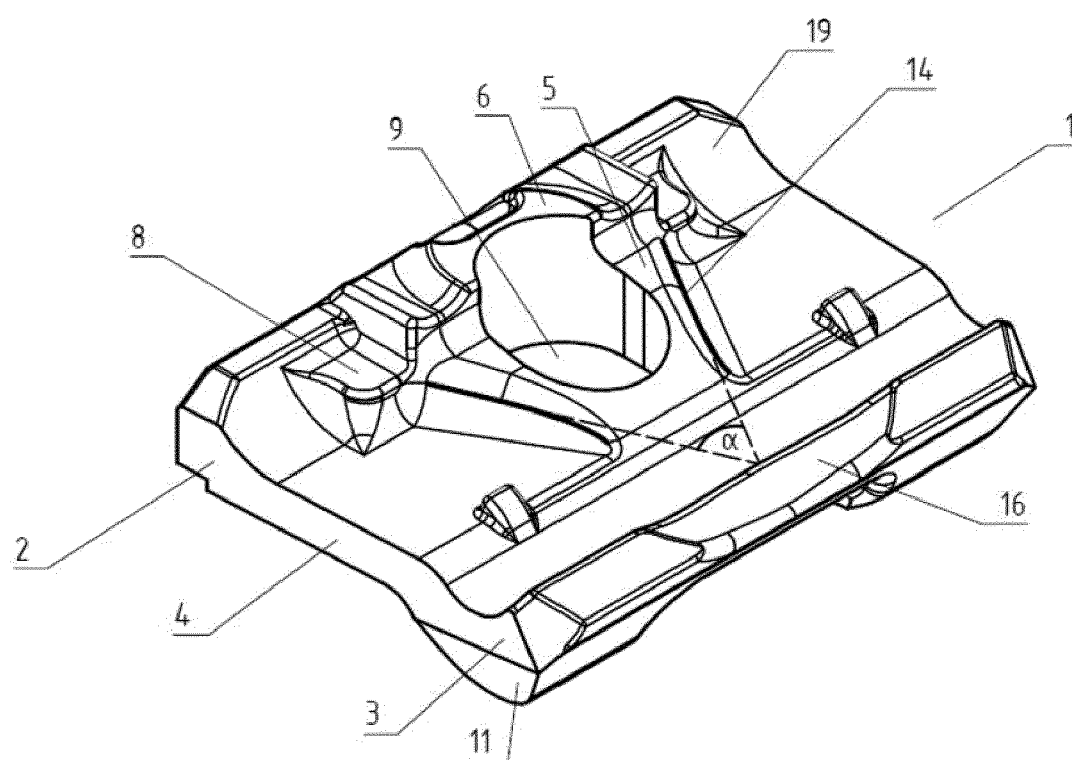


Fig. 1

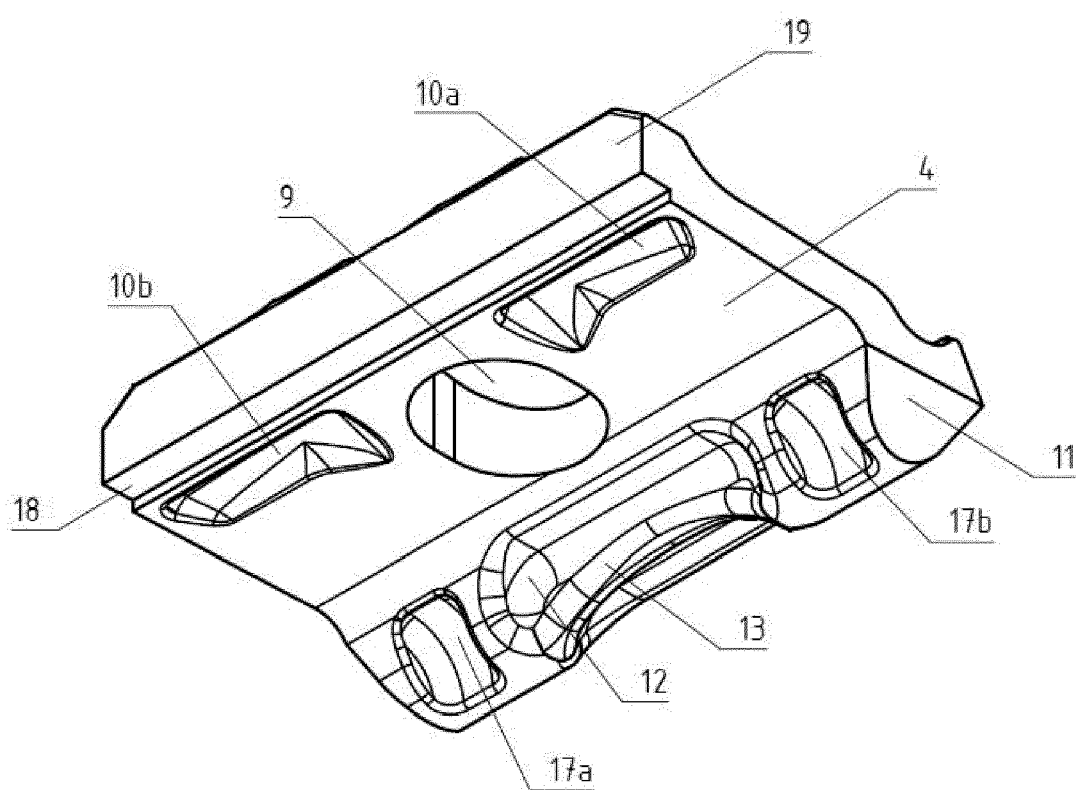


Fig. 2

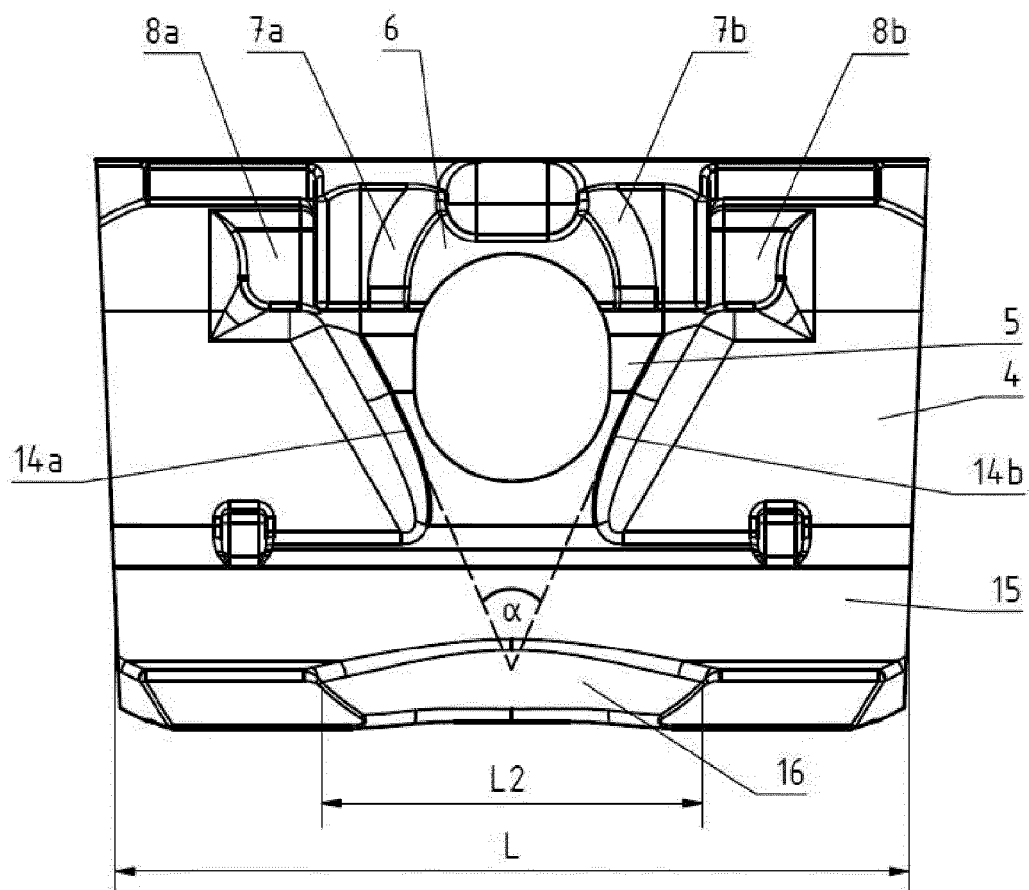


Fig. 3

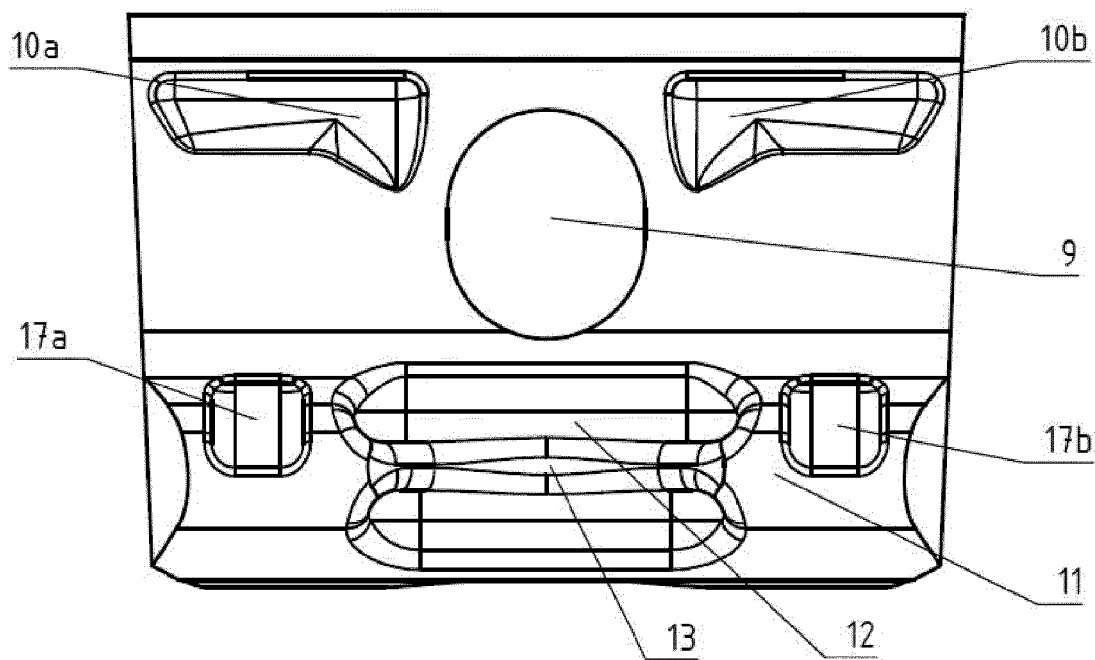


Fig. 4

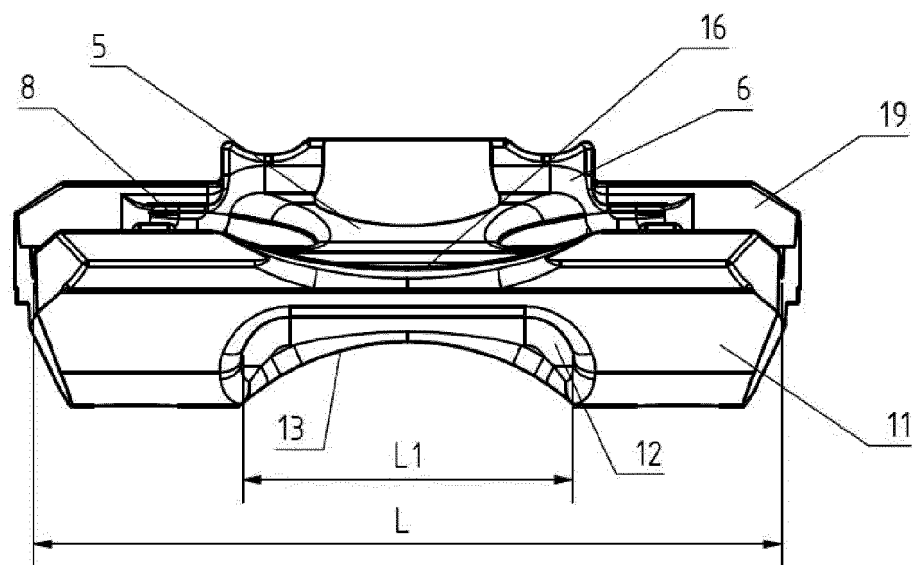


Fig. 5

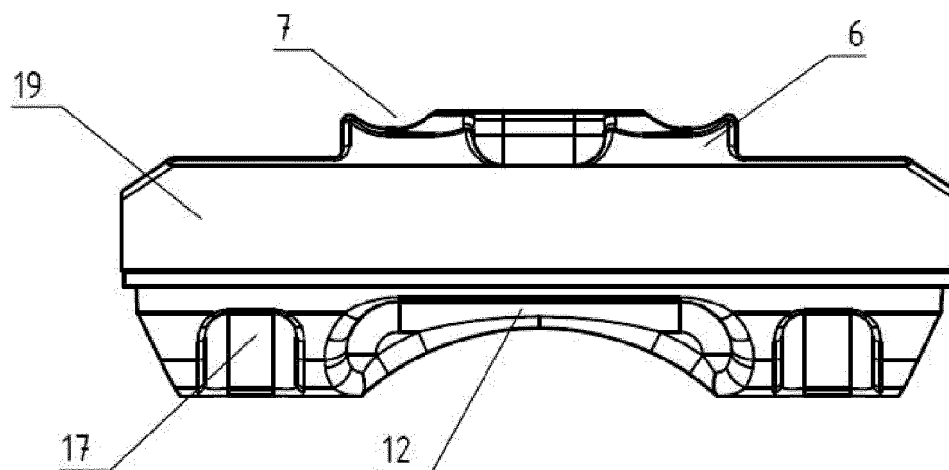


Fig. 6

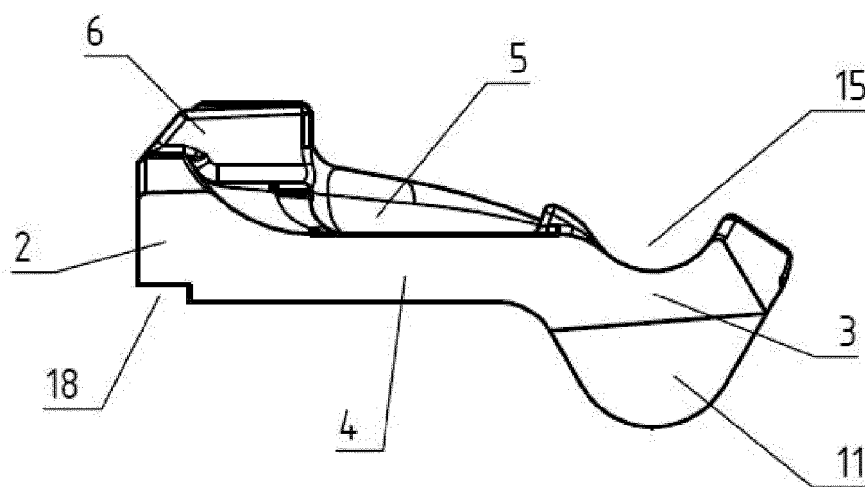


Fig. 7

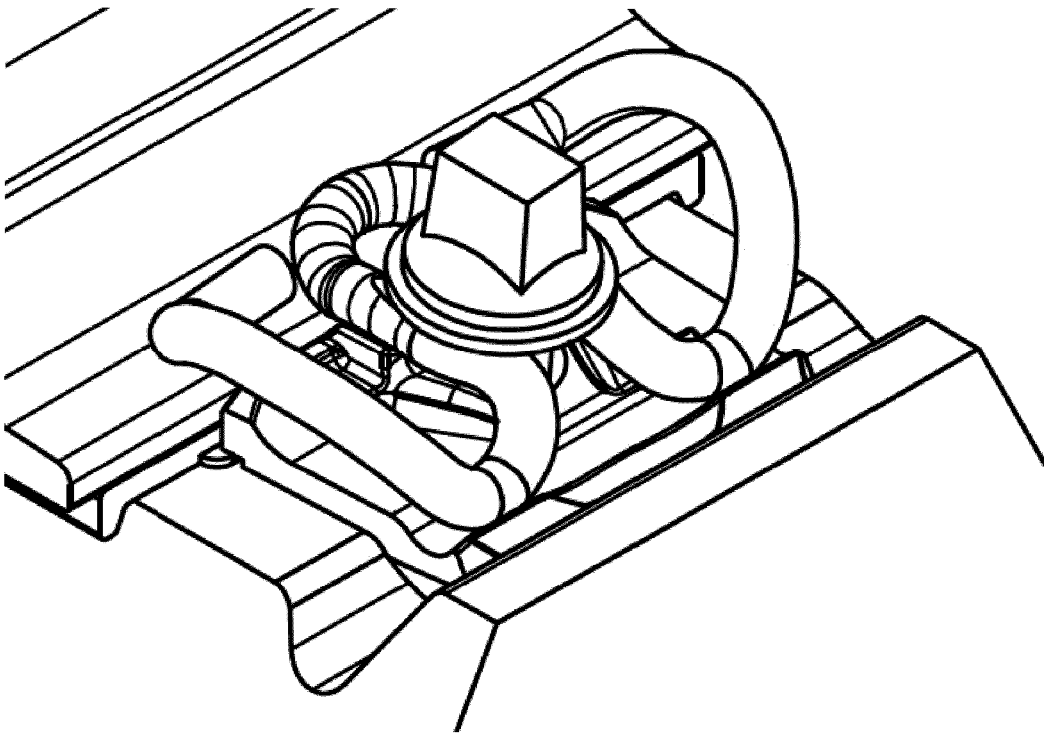


Fig. 8

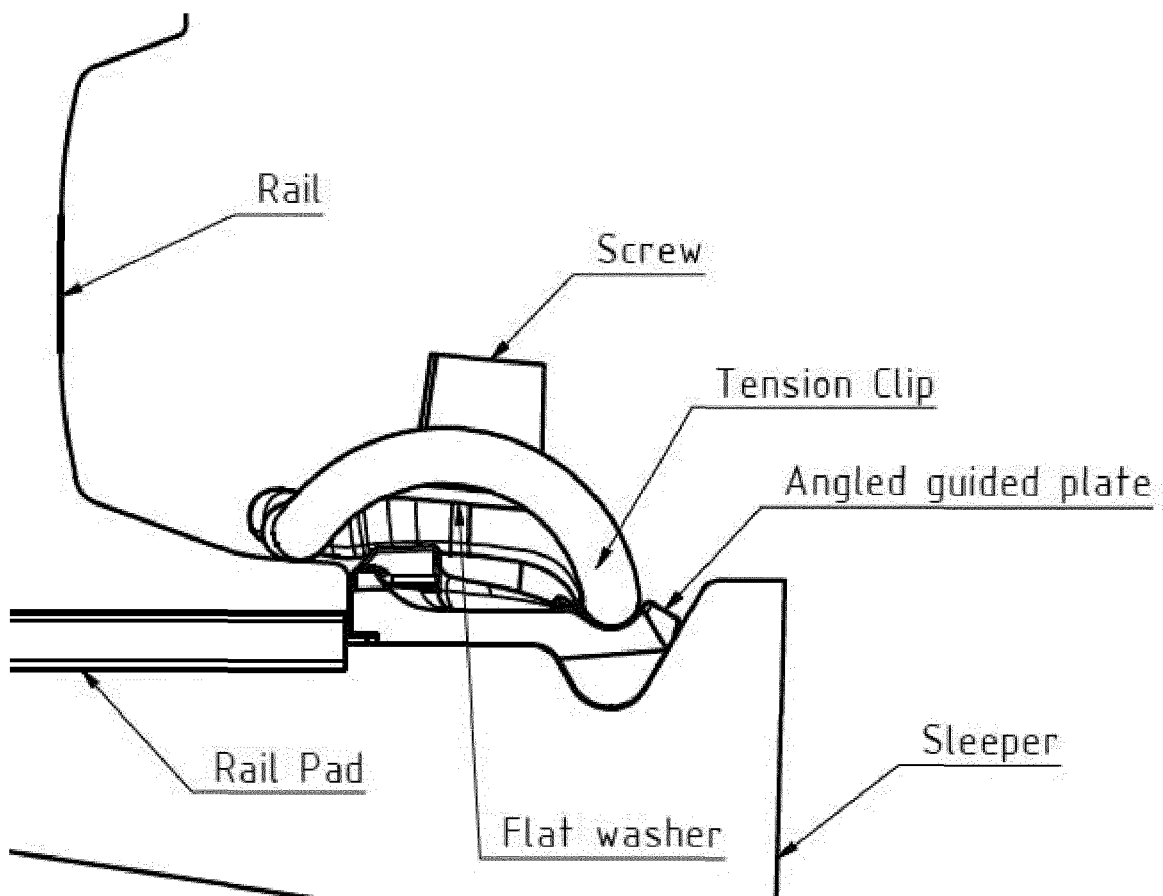


Fig. 9



EUROPEAN SEARCH REPORT

Application Number

EP 23 02 0276

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A, D	EP 2 984 231 B1 (SEMPERIT AG HOLDING [AT]) 22 March 2017 (2017-03-22) * figures 1-8 * * claim 2 * * the whole document *	1-8	INV. E01B9/30 E01B9/28
A	US 2014/103132 A1 (LIENHARD STEFAN [DE] ET AL) 17 April 2014 (2014-04-17) * figures 1-4 * * the whole document *	1-8	
A, D	EP 2 672 007 B1 (VOSSLOH WERKE GMBH [DE]) 9 September 2015 (2015-09-09) * figures 1-4 * * the whole document *	1-8	
A, D	EP 2 643 519 B1 (VOSSLOH WERKE GMBH [DE]) 9 September 2015 (2015-09-09) * figures 1-4 * * the whole document *	1-8	
A, D	EP 2 318 587 B1 (VOSSLOH WERKE GMBH [DE]) 19 August 2015 (2015-08-19) * figures 1-6 * * the whole document *	1-8	TECHNICAL FIELDS SEARCHED (IPC) E01B
The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 23 October 2023	Examiner Klein, A
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document	

EPO FORM 1503 03.82 (P04C01)

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO.

EP 23 02 0276

23-10-2023

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 The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
EP 2984231 B1	22-03-2017	AT 14709 U1	15-04-2016
		AU 2014336365 A1	28-04-2016
		BR 112016008252 A2	12-09-2017
		CN 106062277 A	26-10-2016
		DE 102013221175 A1	23-04-2015
		DE 202014105818 U1	22-01-2015
		EP 2984231 A1	17-02-2016
		ES 2627273 T3	27-07-2017
		HR P20170853 T1	25-08-2017
		HU E034383 T2	28-02-2018
		JP 6741577 B2	19-08-2020
		JP 2016537531 A	01-12-2016
		KR 20160102393 A	30-08-2016
		LT 2984231 T	11-09-2017
		MY 175363 A	22-06-2020
		PL 2984231 T3	31-08-2017
		PT 2984231 T	12-06-2017
		US 2016237627 A1	18-08-2016
		WO 2015055540 A1	23-04-2015
US 2014103132 A1	17-04-2014	AU 2012266790 A1	09-01-2014
		BR 112013031605 A2	06-12-2016
		CA 2838423 A1	13-12-2012
		CN 103748285 A	23-04-2014
		DK 2718498 T3	25-07-2016
		EP 2718498 A1	16-04-2014
		ES 2574419 T3	17-06-2016
		HU E027747 T2	28-10-2016
		JP 6095650 B2	15-03-2017
		JP 2014516126 A	07-07-2014
		KR 20140028048 A	07-03-2014
		MA 35248 B1	03-07-2014
		MX 339653 B	02-06-2016
		PL 2718498 T3	30-09-2016
		PT 2718498 T	14-07-2016
		RU 2013158333 A	20-07-2015
		UA 113521 C2	10-02-2017
		US 2014103132 A1	17-04-2014
		WO 2012167947 A1	13-12-2012
		ZA 201308374 B	30-07-2014
EP 2672007 B1	09-09-2015	BR 112014029983 A2	27-06-2017
		CA 2872885 A1	12-12-2013
		CN 104379837 A	25-02-2015
		EA 201401128 A1	29-05-2015
		EP 2672007 A1	11-12-2013

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.

EP 23 02 0276

23-10-2023

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 The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

Patent document cited in search report	Publication date	Patent family member(s)	Publication date	
		ES 2552986 T3	03-12-2015	
		JP 5856356 B2	09-02-2016	
		JP 2015518929 A	06-07-2015	
		KR 20150009595 A	26-01-2015	
		PL 2672007 T3	31-03-2016	
		PT 2672007 E	26-11-2015	
		SG 11201407719X A	30-12-2014	
		UA 110888 C2	25-02-2016	
		US 2015129670 A1	14-05-2015	
		WO 2013182550 A2	12-12-2013	
		ZA 201408264 B	23-12-2015	

EP 2643519	B1	09-09-2015	AR 083923 A1	10-04-2013
			CN 103270219 A	28-08-2013
			DE 102010060745 A1	24-05-2012
			DE 202011107123 U1	18-01-2012
			EA 201300482 A1	29-11-2013
			EP 2643519 A1	02-10-2013
			ES 2553607 T3	10-12-2015
			KR 20130095307 A	27-08-2013
			PL 2643519 T3	31-03-2016
			PT 2643519 E	01-12-2015
			SA 111320941 B1	30-03-2015
			US 2013284819 A1	31-10-2013
			WO 2012069246 A1	31-05-2012

EP 2318587	B1	19-08-2015	AR 072862 A1	29-09-2010
			AU 2009268236 A1	14-01-2010
			CA 2727108 A1	14-01-2010
			CL 2011000005 A1	15-07-2011
			CN 102089478 A	08-06-2011
			DE 102008032353 B3	15-10-2009
			DE 202008012236 U1	23-04-2009
			DK 2318587 T3	19-10-2015
			EA 201001830 A1	31-10-2011
			EP 2318587 A1	11-05-2011
			ES 2547078 T3	01-10-2015
			IL 209765 A	31-08-2014
			JP 5607619 B2	15-10-2014
			JP 2011527391 A	27-10-2011
			MA 32541 B1	01-08-2011
			MY 169780 A	15-05-2019
			PL 2318587 T3	30-11-2015
			SA 109300451 B1	16-10-2014
			TW 201009166 A	01-03-2010
			UA 103484 C2	25-10-2013

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.

EP 23 02 0276

23-10-2023

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
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
		US 2011138734 A1	16-06-2011
		UY 31967 A	29-01-2010
		WO 2010003817 A1	14-01-2010

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

- EP 2672007 B1 [0005]
- EP 2643519 B1 [0006]
- EP 2984231 B1 [0007]
- EP 2318587 B1 [0008]