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(54) **ENERGY ABSORBING BUMPER IN THE RAILWAY FIELD**

(57) A bumper for railway use configured to be slidingly applied to a track (100) of a rail line and comprising:
- A plank (2) which forms the barrier of the bumper, said plank being connected to a bearing structure configured to be able to be slidingly constrained to the two rails (100) constituting the track, in such a way that the whole bumper is sliding in its entirety along the track;
- A braking system (6), said braking system (6) comprising at least two braking shoes (6) and of which each one can be fixed in use to a respective rail of the track, said braking shoes being produced in at least two parts (6', 6") which form a corridor which, in use is adapted to wind up and clamp at least part of the rail head with a predetermined degree of mechanical interference, in such a way that, in the event of impact, any sliding of the bumper is braked by friction by the action of said shoes which rubs against the respective rail.

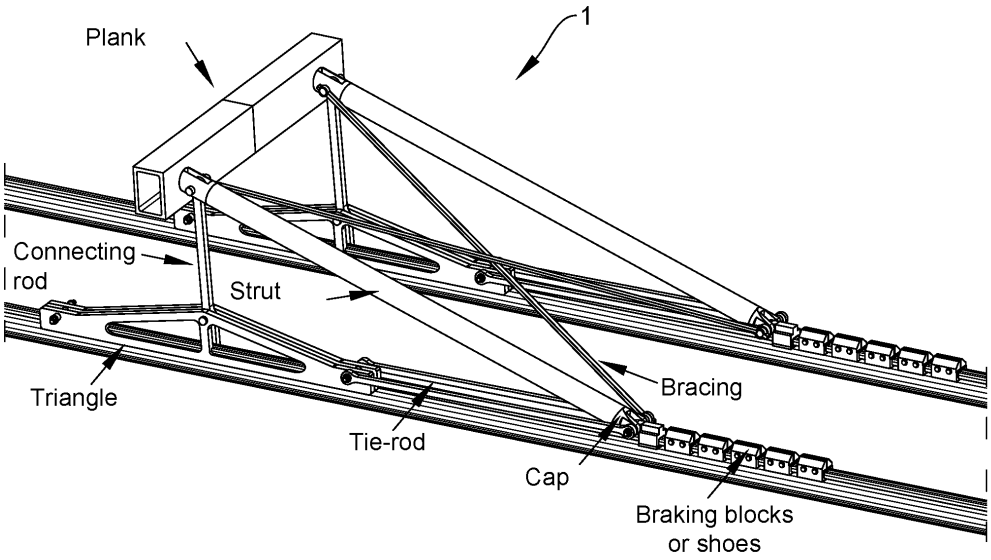

FIG. 1

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Description

Scope of the invention

[0001] The present invention relates to the technical sector of bumpers in the railway field.

[0002] In particular, the invention relates to an innovative bumper capable of enabling good absorption of energy released by the train or rail convoy in general which pushes and stops against the bumper.

Brief outline of the known art

[0003] Bumpers for rail convoys have been known for a long time. They are used to safeguard rail convoys and passengers if the train does not stop within the expected time in an interrupted section of a railway line. In fact, many stations are end or terminus stations and constitute the end of the line.

[0004] In particular, it is known that inside stations (for example end stations), as well as in ports or where there are tracks, some sections of track are "appendages" that end with a closed end. Said tracks, in technical jargon, are also called "sidings" or "dead tracks".

[0005] An example may be the main station of Florence or Milan in which tracks arrive inside the station and end just inside the station. In this way, the train arrives at the end of its journey inside the station to then leave again and be redirected, exiting the station, on the track path to be travelled.

[0006] In all these cases, for safety reasons, the end sections of the track are provided with a bumper with safety function.

[0007] If the train, due to any anomaly, cannot stop within the provided space, the bumper blocks the train and prevents, by absorbing energy, it from trespassing the track and from ruinously falling inside the station.

[0008] Therefore, the function of the bumpers is essential and prevents disasters which may also cause many victims not only inside stations but also wherever tracks are provided with interruptions (for example in ports where the tracks are used to load trains on ships).

[0009] Many types of bumpers exist.

[0010] In some solutions, they are obtained with rails suitably bent at high heat and nailed at high heat and then they are assembled by using section bars of steel on the market (with sections shaped like "L", "C", "T", and so on) suitably cut and holed and joined with bolts (screws + nuts).

[0011] Therefore, in traditional bumpers, different sections bars interact with each other by means of connections with many holes (called "flanges") pre-loaded by bolts or nails at high temperatures. These schemes generally use the theory, common in civil engineering, that the joint works with stems of slot screws or nails, given that in the event of high stresses, the friction between metallic section bars is not sufficient to guarantee maintenance of the geometry of the bumper and surfaces slide relatively.

[0012] If this way of functioning is completely correct in the civil sector (the joint with screws which work in slots is defined as "regular" by Technical Construction Standards in the civil sector), it is not used in mechanical sector, where stresses are much higher. In this case, screws never work in slots and resistance of a connection must be guaranteed either by friction (therefore by a sufficient pre-load) or by shape couplings (calibrated pins, shoulders, etc.).

[0013] In addition, many components of traditional bumpers are welded with structural welds, that is with beads which confer necessary structural resistance to external stresses. As known, welds may represent, in case of impact, particular criticalities, given that, as one says, welded joints "get unstitched", that is at the base of beads (in the thermally modified area) cracks start which cause failure of the welded structure by absorbing limited amount of energy and often causing collapse of the structure without effectively trying to impede this destruction.

[0014] Therefore, known solutions suffer from issues of relative structural weakness and they cannot always guarantee correct absorption of energy.

Summary of the invention

[0015] Therefore, the aim of the present invention is to provide a bumper in the railway field, which resolves, at least partially, said technical disadvantages.

[0016] In particular, the aim of the present invention is to provide a bumper in railway field, preferably to be applied to end parts of a track (the so-called sidings), which is very efficient and functional.

[0017] These and other aims are therefore achieved with the bumper according to claim 1.

[0018] This bumper is configured to be slidingly applied to a track (100) of a rail transport and comprises:

- A plank (2) which forms the barrier of the bumper, said plank being connected to a bearing structure configured to be able to be slidingly constrained to the two rails (100) constituting the track, in such a way that the whole bumper is sliding in its entirety along the track;
- A braking system (6),
- Said braking system (6) comprising at least two braking shoes (6) and of which each one can be fixed in use to a respective rail of the track,
- These braking shoes are constituted by (or consisting of) at least two parts (6', 6'') which can be connected to each other, and which form a corridor which, in use is adapted to wind and clamp at least part of the rail head with a predetermined degree of mechanical interference.

[0019] In this way, in the event of impact, any sliding of the bumper is braked by friction by the action of said

shoes which rubs against the respective rail.

[0020] In this way, all aforementioned technical drawbacks are easily resolved.

[0021] In particular, the braking system is a constructively simple and cheap system which efficiently facilitates braking of the bumper, which, therefore, as a whole, is slidingly mounted along the track.

[0022] Therefore, this allows further dampening of the impact with the train through said sliding.

[0023] Advantageously, said bearing structure comprises:

- At least two struts (3) fixed to the plank for supporting it;
- Said two struts being, in turn, hinged in two points spaced from each other with the remaining part of said bearing structure configured to be able to be slidingly mounted along the track.

[0024] Advantageously, thanks to this constructive solution, the two struts work by compression only because they are actually free to rotate.

[0025] Advantageously, the two struts may be two solid beams with circular shape, for example of steel.

[0026] Advantageously, in a preferred embodiment, these two struts may be beams hollow inside, that is they form an axial channel and therefore tubes.

[0027] For example, in this case, it is a mechanical tube with high thickness (therefore with axial channel).

[0028] By way of example, it may for example have an outer diameter variable in a range between 135 and 145 mm (mm=millimeters), for example 139 mm or 140 mm approximately, and with thickness for example variable between 25mm and 35mm, for example approximately 30mm. For example, it may be of steel EN 10210, S 355 J2H.

[0029] Advantageously, in all the described configurations, the two struts (3) are arranged obliquely and parallel to each other.

[0030] Advantageously, said bearing structure comprises:

- A pair of connecting rods (8) each one hinged by an end thereof with a point of a respective strut (3), and with the other end hinged with a structural base (4) configured to slidingly grasp the rail head to which in use it is fixed;
- Each strut (3) being hinged, by the opposite end to the connection with the plank (2), with a block (50) configured to be slidingly fixed in use to the rail;
- Both said structural bases (4) being each one connected to said block (50) through a tie-rod system (5) which is connected on one side, preferably is hinged, with the structural base (4) and on the opposite side it is connected, preferably hinged, with said block (50).

[0031] Advantageously, a generally triangular and isostatic structure but anyway sliding along the track is obtained.

[0032] Advantageously, each structural base may comprise two plates which can be coupled to each other and can be clamped via connection means (30), for example bolts, in such a way that when they are coupled, they shape a corridor adapted to wind the rail head in such a way that it is sliding with respect to the rail.

[0033] Advantageously, each structural base may have triangular shape.

[0034] Advantageously, the triangular configuration (triangle 4) constitutes an overturning protection shoe which distributes lifting force caused by the impact over a wide surface, thus reducing tensions in the rail and preventing installation of stiffeners on the track thus avoiding risk of it being pulled out.

[0035] This enables creation of structural bases with a long grasping base of the rail and thus having good stability.

[0036] Advantageously, the tie-rod system (5) may comprise a pair of tie-rods such that each tie-rod of the pair is connected to a respective plate constituting said structural base on one side and on the opposite side to a side of the block (50).

[0037] Advantageously, the end of the connecting rod (8) which is hinged with the structural base (4) is rotatably constrained between the two plates constituting the structural base (4).

[0038] Advantageously, said at least two parts (6', 6'') constituting the braking shoe are connected to each other in such a way as to be able to vary their reciprocal distance and with a reciprocal elastic approaching motion which enables, in use, to compensate for the shoe wear.

[0039] Substantially, elastic approaching guarantees compensation for wear with the two parts constrained to each other at such a distance as to clamp the rail with the right degree of mechanical interference, thereby guaranteeing a good braking action by friction.

[0040] The preferred constructive material for these shoes is cast iron (preferably P10 cast iron) which is sacrificial with respect to the rail, exactly like pads of a brake.

[0041] Advantageously, said shoes comprise one or a plurality of inner springs for determining a reciprocal approaching force of the two parts constituting said shoes.

[0042] Advantageously, the use of disc springs may be preferred in such a way that the force remains constant also after wear of the shoe (or pad whatever in the present description) also after many impacts.

[0043] Advantageously, a plurality of shoes which can be positioned in a row along the rail may be comprised.

[0044] Advantageously all welds present in the described structure are non-structural welds.

[0045] The object of the present invention is also the use of at least one bumper according to one or more of the previous features in the railway field for dampening the motion of a rail convoy along the track.

[0046] The object of the present invention is also a

method for dampening the motion of a rail convoy along the track by applying to the track at least one bumper according to one or more of the previous features.

Brief description of the drawings

[0047] The invention, in one or more embodiments thereof, will be described in detail hereinafter according to the following drawings:

- Figures 1 and 2 show two axonometric view of the bumper (also called buffer in the present description) according to the invention;
- Figure 2A shows the plank of the bumper in axonometric view;
- Figure 3 shows a lateral view of the whole bumper;
- Figure 3A shows a lateral view of the plank by indicating in section the connection portion between the plank 2 and the strut 3;
- Figure 4 shows both a front view from behind and a view from above;
- Figure 5 shows an axonometric detail relative to the braking blocks (also called shoes);
- Figure 6 show a detail of connection between plank and strut;
- Figure 7 shows the shape of the end part of strut;
- Figure 8 shows a detail relative to the connection part of the strut on the part opposite to the strut;
- Figure 9 shows views relative to the triangle;
- Figure 10 shows diagrams which show on the left the elastic feature of the buffer and on the right a deformation after a simulation;
- Figure 11 shows the tie-rod (8);
- Figure 12 shows the shoe 6 in axonometric view;
- Figure 13 shows in a view from above the bumper sliding along the rail with an example of braking space.

Detailed description of some configurations of the invention

[0048] Figure 1 shows, together with figure 2, an overall axonometric view of the buffer (or bumper or whatever) according to the invention.

[0049] As explained below, the buffer has been designed as an impact absorbing system with isostatic structure and with the whole buffer which can actually slide, after an impact, along the track along which it has been mounted in such a way as to dissipate energy efficiently by exerting a braking force.

[0050] As well highlighted by figures 1 and 2, the two rails 100 which form the track and to which the present buffer 1 is fixed are therefore indicated.

[0051] In this way, as well known in the technical field, the train which might not end its ride will impact with its bumper block against the buffer represented here in the figures and fixed to the track. In this way, the buffer will absorb at least part of energy derived from the impact, possibly sliding along the track if the impact is particularly strong.

[0052] Structurally, figure 1 indicates the names of the mechanical components used for production and which are shown in figure 2 with the corresponding assigned reference numbers.

[0053] In more detail, a "plank" indicated in figure 2 with number 2 is provided.

[0054] A further detail in axonometric view of this "plank 2" is also visible in figure 2A.

[0055] Therefore, the plank is a sort of beam (see for example figure 2A) applied to the bearing structure of the buffer (or bumper or whatever) and represents the active part on which the buffer of the train hit in the event of impact. Therefore, it is the part which receives impact and distributes it to the rest of the bearing structure described below.

[0056] As shown in figure 2, the buffer 2 may have shape in generally rectangular or square cross-section and made through H-shaped beam.

[0057] As mentioned, the bearing structure, is connected to the buffer and therefore it is described below.

[0058] The bearing structure comprises the two equidistant struts 3 which are connected by an end to the plank and, further, still by this end and by the opposite end, they are connected by hinging to the remaining part of the bearing structure.

[0059] The bearing structure as a whole is fixed slidingly along the track.

[0060] More in particular, first of all, the bearing structure provides this pair of struts indicated in figure 2 and in the other figures with number 3. These struts are actually beams, for example a mechanical tube of big thickness. Therefore, each strut is actually in the form of a beam, for example made of metallic materials, among them steel for example.

[0061] The strut is preferably with circular cross-section even if other shapes in cross-section are not excluded.

[0062] As one may well infer from magnification of figure 6, an end (3') of the strut penetrates a suitable seat obtained in the body of the plank 2.

[0063] Therefore, moving to figure 2, it is clear that the plank 2 is supported by said ends (3') of each strut 3 which penetrates the seat obtained in the plank as per figure 6. The plank is firmly fixed to the end (3') generally with mechanical connection means such as bolting with the help of inner section bars. For example, the end (3') may have a specific conformation, for example forming a seat through a notch (see figure 6), which is coupled with a structural part of the plank to then fix the whole with bolting.

[0064] In a preferred variant of connection, as shown in figure 3A, the end of the strut is inserted into the seat of the plank and is coupled with a cylindrical portion obtained in said seat of the plank and belonging to the plank. In figure 3A, this cylindrical portion has been indicated with number 60. Therefore, the end of the strut is levelled

to be coupled in a perfectly corresponding way with the cylindrical portion 60. As one may see in figure 3A, both said cylindrical portion 60 and the levelled end of the strut have threaded holes each one for receiving a clamping bolt, for example M24. The holes are aligned to each other when the two parts are moved close to each other such that insertion of bolts creates firm joint between the plank and the strut.

[0065] Continuing the structural description of the invention, the group formed by the two struts 3 with the plank 2 becomes as a whole. This group (struts with planks) is hinged with the rest of the bearing structure as described below. In this way, the struts are only subject to compression loads, given that they are free to rotate.

[0066] More in particular, figure 6 shows hinging (C') which rotatably connects this end (3') of the strut with the end of a vertical beam 8 (defined in figure 1 with the term "connecting rod") obviously being part of the bearing structure. On the opposite part, in correspondence of the area (3") still of the strut 3 (see figure 3) the other hinging which will be described below is provided.

[0067] The whole bearing structure of the bumper is symmetrical with respect to a longitudinal plane parallel to the two rails and arranged in the centre line between the two rails. Therefore, as shown in figure 1 and figure 2, it is evident that, as mentioned, there are two struts and two connecting rods, that is one for each part.

[0068] Therefore, the description referred to one part is identical and specular to the other part.

[0069] The connecting rod 8 is also a rod with vertical axis when it is mounted and also exclusively constrained with hinges. Thanks to this connection, and as arranged in the structure, in static conditions, the connecting rod is subject to its own weight and to the one of the arranged upper parts while, after a possible impact, works by traction.

[0070] Therefore, with reference to magnification of figure 6, the connecting rod 8 is rotatably constrained (thus hinged as mentioned) to the pin (C') in a space (a loop) obtained in the end (3') of the strut.

[0071] The end of the connecting rod 8 enters the loop (indicated as "notch" in figure 6) obtained in the end (3') of the strut 3 and the pin (C') rotatably constrains (therefore hinges) the connecting rod with the end of the strut.

[0072] The opposite end of the connecting rod 8 is rotatably fixed (therefore, hinged as well as mentioned) to the element indicated in figure 2 with number 4 (that is the one which is indicated as "triangle" in figure 1). This element (indicated as triangle in figure 1) is a structural base 4 which has preferably a lightened triangular shape (for this reason it is indicated with the name "triangle") . The magnification of figure 9 shows this structural base 4 and highlights well its conformation.

[0073] Actually, there are two symmetrical (identical) plates indicated in figure 9 with references (P1, P2). They are coupled to each other by means of bolting system 30 still indicated in figure 9 in such a way that when they are coupled, their lower part (P_inf) clamps the rail head, thus locking to it.

[0074] In fact, it is known that the rail, in section has a base, the web and a head of greater width with respect to the web to form a sort of mushroom. As one may well infer from figure 9, the conformation of the two plates (P1, P2) is such that the lower part (P_inf) is positioned below the rail head thus guaranteeing a firm hold and avoiding overturning during operation.

[0075] Substantially, the part (P_inf) is a horizontal wall placed at right angles with respect to the vertical wall which stands from it, thus forming an undercut which engages with the rail head.

[0076] Therefore, actually, the two plates when they are coupled form a "clamp-like" seat which hooks the head or rail head with the lower part (P_inf) which is positioned below the rail head. Clamping with bolts 30 guarantees robustness and stability of the structure which is thus fixed on site.

[0077] In the assembly step, the two plates (P1) and (P2) are coupled to each other by grasping the rail and clamping it by clamping the bolts 30.

[0078] Therefore, the system may be shifted if the thrust force obviously exceeds this clamping force.

[0079] The triangular shape (which is preferred but not essential) has the advantage of allowing a distribution of the lifting force, which acts on the connecting rod after impact, thus transmitting it and distributing it onto a sufficiently long portion of rail. In this way, tensions and deformations of the track are limited during intervention of the bumper. In fact, the undercut (P_inf) grasps the base of the rail head and prevents this lifting.

[0080] Continuing the structural description of the invention, still with reference to figure 9, the other end of the connecting rod is hinged to the structure (P1, P2) by means of pin (C").

[0081] In order to better stabilize the structure, figures 1-3 show the tie-rods indicated with number 5 in figure 2 and the subsequent ones.

[0082] The tie-rods are in the forms of rods hinged on one side with a relative plate (P1, P2) already described above and, on the opposite side, hinged with the end of the strut (3''). In order to hinge them, a pin is present at the ends.

[0083] In more detail, this connection of the second end (3'') of the strut (second end opposite to the previous first end (3') introduced above) is fixed with a system indicated in figure 7 and figure 8.

[0084] In particular, figure 7 shows this second end (3'') of the strut which ends with an eyelet 41 formed by two plates 42 which face at a certain distance from each other thus creating a seat for housing the eyelet 51 relative to a block 50 of figure 8. The two plates 42 are holed with an aligned hole 43. In this way, by inserting the eyelet 51 into said seat, that is the free space between the two plates 42, and taking care that the hole of the eyelet 51 is aligned with the two holes 43, then it is possible to hinge the end (3") with the block 50 with a pin.

[0085] The ends of the two tie-rods 5, equipped with

eyelet as well, retract in turn the plates 42 suitably levelled to form a coupling guide path, taking care that their hole is aligned with the hole 43.

[0086] Definitely, the ends of the two tie-rods which form a holed eyelet retract the two plates together meaning that one end of tie-rod abuts against the surface 42 and the other end of tie-rod 5 abuts against the other surface 42. The eyelet 51 is placed, as mentioned, within the space between the two plates 42 and the whole is stopped with a pin which therefore connects rotatably the end (3") with the block 50, through the eyelet 51 of the block 50 which is inserted into the space between the two plates 42.

[0087] Figure 11 shows a conformation of tie-rod.

[0088] Therefore, the two struts 3 are rotatably constrained by an end thereof to the vertical rod 8 (connecting rod) and by the other end still rotatably connected to the block 50.

[0089] In its turn, the block 50 is slidingly fixed to the relative rail as described immediately below.

[0090] Through the connecting rod there is a release of force on the plate structure 4 which, through the tie-rod, is connected to the block 50.

[0091] Therefore, the structure is isostatic as a whole.

[0092] Figure 8 describes the block 50.

[0093] The block 50 is the block intended to direct thrust onto the braking shoe described below.

[0094] More properly, the block 50 has the function of closing the truss (triangle) and transmitting, through impact, dragging force to the shoes for subsequent dissipation (braking). Substantially, it is not a braking shoe itself or a braking block but it is used to transmit energy to the braking shoes.

[0095] The block 50 provides a body formed by an upper portion (51') which ends with an eyelet 51. Two lateral walls 52 are connected to this upper portion (51') on one side and on the other side to delimit a corridor 53 whose width is such that it houses the part of rail head.

[0096] Therefore, in the assembly step, the block 50 is applied from above taking care that the part of rail head enters the space 53, thus creating a sliding connection of the block along the rail where it has been assembled.

[0097] Obviously, in order to fix the block to the rail body, thus preventing it from overturning and separating from it, the plates 54 are assembled in correspondence of the base of the lateral walls 52, with these plates which extends partially within the channel 53 to form an undercut which is engaged below the head of the rail head. In this way, the whole block 50 keeps sliding but it cannot overturn or separate from the rail. The plates 54 are connected to the base of the lateral walls 52 through fixing screws, as indicated in figure 8 (for example three for each part).

[0098] Therefore, upon assembling, as mentioned, the block 50 without the plates 54 is lowered to the rail by letting the rail head enter the channel 53 and then the plates 54 are fixed to the base of the lateral walls obtaining the block 50 (as shown in figure 8) slidingly constrained to the rail.

[0099] Downstream of said block 50, as shown in figure 1 and figure 2 or in figure 12, a succession of braking blocks or shoes is arranged to be blocked and grasp the rail like a clamp. Preferably, they do not have the same shape as the block 50 and are coupled around the rail through bolts and disc springs.

[0100] In this way, they stop forward motion of the bumper in the event of impact. More in particular, they slide and dissipate energy by friction and, with the disc springs and thanks to their conformation, compensate for their length well maintaining the rail itself firm between the two parts thereof.

[0101] More in particular, the shape of these shoes is described better in figure 12 and highlights their production in two halves (6', 6") which are coupled through bolting (6b) or the like in order to grasp and clamp the rail. Therefore, they allow good dissipation of energy by sliding along the rail.

[0102] The shoes 6 constitute a braking block. As shown in figure 12, the shoes form a channel (6c) into which the rail is inserted with this channel which forms at the base the same undercut which is engaged under the rail head. The two parts may be enlarged or narrowed through bolting (6b) and disc springs which cooperate to maintain the two parts (6', 6'') well firm to each other which however recover the play as wear of said two parts occurs, thereby well grasping the rail.

[0103] The braking blocks constitute an important component of a bumper absorbing energy given that they dissipate kinetic energy of the impacting rail convoy in the form of heat generated by friction with the contact between the blocks themselves and the rails on which they are hooked.

[0104] Therefore, as already described, the block 50 comprises:

An upper portion (51, 51') also called "upper pad" which comprises the eyelet 51;

Two "lateral sides" also defined as the lateral walls 52 which shape the channel 53 which seats the rail head.

Two "lower pads" also called plates 54 riveted to the aforesaid sides;

The fixing screws, preferably no. 3 screws (for example M24, for example zinc-coated 4.6 class with nuts and washers);

The production material of the whole block 50 is preferably steel (for example S355) .

[0105] The shoes 6 (see figure 12) comprise only two half-shells (6', 6'') of phosphorus cast iron.

In particular:

[0106] The solution is self-centering and compensates readily for size dimensions (tolerances) of the rail;

[0107] The half-shells, made by melting, are identical

and only differ by a processing (spot-facing) necessary to house bolting with the other half-shell made for hexagonal hollows adapted to house nuts:

[0108] Screws (preferably M16) coupling the half-shells are preferably of class 8.8 or 10.8, thus allowing reduction of their number and diameter with the equal clamping force;

[0109] Advantageously said coupling screws are clamped on packs of disc springs suitably sized which confer necessary elasticity to the shoe thus compensating for wear of the shoe itself while braking, thus maintaining preloading, and consequently the braking force, constant during the whole braking step. Substantially, shoes always remain with a good grip degree against the rail thus compensating for their wear itself.

[0110] The proposed solution uses preferably P10 cast iron.

[0111] It is reminded that this is cast iron with which the blocks of brakes are fabricated, which, as known, are made in such a way as not to damage considerably the braking wheels, thus representing the sacrificial element of the braking unit block-wheel. It is to be considered that rails, having a chemical composition similar to C70, are much harder than the wheels (similar to C50) and therefore would not be damaged at all by creeping blocks. In addition, wear of both blocks and (even more so) of rails is negligible, thus contributing to maintaining the clamping torque constant.

[0112] The strut 3 of the bumper is used to bring the horizontal force of impact at the level of the buffers towards the braking blocks described above.

[0113] In traditional bumpers the structure is made up by metallic section bars with different sections (L, U, T, I, etc.) cut to size, holed and bolted.

[0114] The present invention opted for a diametrically opposite solution, choosing a "mechanical" tube as strut, that is a circular tube (preferably solid), to which ends the suitable elements (also called "caps") are mounted, which realize hinges introduced above. The front end (low) of the strut ends on the block 50 which is not preloaded (that is it is free to rotate along the axis of the rail), while the rear end (high) is connected to the plank of the bumper.

The advantages of this solution are several:

[0115] The element realized accordingly, besides having a simple supply and a relatively limited cost, is exactly like a strut (that is a long rod exclusively subject to compression) constrained in an isostatic way to the rest of the structure whereby calculating the forces which act on it is very simple;

[0116] The caps are fixed to the strut only with connections which are necessary to establish the relative positioning (plugs, screws, welds, etc.) but which do not cooperate structurally with resistance of the strut itself;

[0117] The fact of having a beam with circular inertia ellipse facilitates greatly resistance tests (see below) and stability tests of elastic balance (these latter are conducted both with the omega method and with FEM codes).

[0118] Under the plank of the bumper a triangular structure ("lifting triangle" or simply "triangle") is mounted with the purpose of maintaining the plank of the bumper at the right height while braking.

[0119] The structure is made starting from steel sheets, preferably plasma-cut S355 steel. The coupling surfaces with the rail and the pins are machine shaped whereby no high precision is required during the cutting step and outer surfaces can remain rough due to cut.

[0120] The sheet is cut and lightened thus assuming a shape similar to a truss. The triangle is connected to the front end of the strut with the "tie-rods" and above the plank with the "connecting rods" already described above. Mounting of the triangle is carried out with pins and shims thereby it is not locked to the rails and therefore it can slide longitudinally along the axis of the track.

[0121] The main advantages and features of this structure are:

- The production is very simple and it is carried out by assembling two identical "sides" with suitable shims and connection elements;
- The triangle is fixed in an isostatic way, therefore determining its stresses is simple and constraints to the assembly must be excluded;
- Its long base, for example equal to 2 metres, distributes lifting force of the track on this segment, thus reducing remarkably both tensions in rails and lifting of the track itself;
- The fact that the triangle is not locked to the rails makes its longitudinal sliding resistance minimal, which is originated only by the effect of friction on its lower ends with the simultaneous presence of lifting force and longitudinal movement;
- This longitudinal force is small and contributes in an almost negligible way to required braking;
- In addition, it is small and distributed over a big surface such that damages both to surfaces of the triangle and of the rails are to be excluded.

[0122] The strut and the triangle are connected by rods subject to traction (connecting rods or tie-rods) which "close" the triangle formed by the bumper. These connecting rods can easily be made with the same equipment used for realizing the triangle, that is starting from sheets of suitable thickness.

[0123] Working is particularly simple, given that plasma can directly cut the shape of the connecting rod comprising the heads (ordinarily circular bars are used for the tie-rods which then must be connected to the ends with threads or welds) and pre-holes, which can easily be finished with drilling.

[0124] The plank of the bumper is realized starting from a HEM 340 section bar, suitably strengthened with closure plates, capable of bringing loads of buffers (whose

axes are 1750 mm apart) to the struts which are 1500 mm apart. Therefore, the structure must be capable of resisting limited bending moments but with great forces.

[0125] Concerning the rail convoys with central coupling, a suitable interface will be realized. The resistance to bending of the compound beam obtained accordingly is broadly overabundant also in the event of forces applied to the centre of it.

[0126] The bumper is constituted by two symmetrical portions with respect to the axis of the track which, in theory, should be subject to identical forces and movements. Given that this cannot be guaranteed, some reinforcement elements 7 (bracings shown for example in figure 4 from above) compel the two sides of the bumper to move by the same amount.

[0127] Given that the detailed specifications are not available and no hypothesis can be made, these reinforcing elements have been made with extremely resistant, light, metallic ropes and with a pre-load that is adjustable through traditional cable tighteners.

[0128] Therefore, in use, once it has been mounted and installed, the bumper is fixed and firm in position but sliding along the track, thereby being able to dissipate energy through action of the shoes 6.

[0129] In the event of impact, the bumper slides remaining firm along the track and dissipating energy through sliding of the shoes 6, thereby absorbing the impact of the train in an efficient manner and stopping its motion in a limited braking space.

[0130] Figure 13 from above highlights a braking space which is slightly longer with respect to the overall length of the bumper object of the invention.

[0131] According to this described solution, the bumper is isostatic and, therefore, constrictions to the assembly are excluded, given that it is assembled by simply assembling the described mechanical components joined by means of pins or the like.

[0132] This implies that working tolerances are not relevant, given that an isostatic structure has always a univocal mounting configuration.

[0133] According to this solution, welds are substantially missing as described, thus avoiding weakening points.

[0134] Constructive mechanical workings are simple.

Claims

1. A bumper for railway use configured to be slidingly applied to a track (100) of a rail transport and comprising:

   - A plank (2) which forms the barrier of the bumper, said plank being connected to a bearing structure configured to be able to be slidingly constrained to the two rails (100) constituting the track, in such a way that the whole bumper is sliding in its entirety along the track;
   - A braking system (6), said braking system (6) comprising at least two braking shoes (6) and of which each one can be fixed in use to a respective rail of the track, said braking shoes being produced in at least two parts (6', 6'') which form a corridor which, in use is adapted to wind and clamp at least part of the rail head with a predetermined degree of mechanical interference, in such a way that, in the event of impact, any sliding of the bumper is braked by friction by the action of said shoes which rubs against the respective rail.

2. The bumper, according to claim 1, wherein said bearing structure comprises:

   - At least two struts (3) fixed to the plank for supporting it;
   - Said two struts being, in turn, hinged in two points spaced from each other with the remaining part of said bearing structure configured to be able to be slidingly mounted along the track.

3. The bumper, according to claim 2, wherein said two struts (3) are arranged in an oblique way and parallel to each other.

4. The bumper, according to one or more of the previous claims, wherein said bearing structure comprises:

   - A pair of connecting rods (8) each one hinged by an end thereof with a point of a respective strut (3), and with the other end hinged with a structural base (4) configured to slidingly grasp the rail head to which in use it is fixed;
   - Each strut (3) being hinged, by the opposite end to the connection with the plank (2), with a block (50) configured to be slidingly fixed in use to the rail;
   - Both said structural bases (4) being each one connected to said block (50) through a tie-rod system (5) which is connected on one side, preferably is hinged, with the structural base (4) and on the opposite side it is connected, preferably hinged, with said block (50) .

5. The bumper, according to claim 4, wherein each structural base comprises two plates which can be coupled to each other and can be clamped via connection means (30) in such a way that when they are coupled, they shape a corridor adapted to wind the rail head in such a way that it is sliding with respect to the rail.

6. The bumper, according to claim 4 or 5, wherein each structural base has a triangular shape.

7. The bumper, according to one or more of the previous claims from 4 to 6, wherein the tie-rod system (5) comprises a pair of tie-rods such that each tie-rod of the pair is connected to a respective plate constituting said structural base on one side and on the opposite side to a side of the block (50).

8. The bumper, according to one or more of the previous claims, wherein the end of the connecting rod (8) which is hinged with the structural base (4) is rotatably constrained between the two plates constituting the structural base (4).

9. The bumper, according to one or more of the previous claims, wherein said at least two parts (6', 6'') constituting the braking shoe are connected to each other in such a way as to be able to vary their reciprocal distance and with a reciprocal elastic approaching motion which enables, in use, to compensate for the shoe wear.

10. The bumper, according to one or more of the previous claims, wherein said shoes comprise one or a plurality of inner springs for determining a reciprocal approaching force of the two parts constituting said shoes.

11. The bumper, according to one or more of the previous claims, wherein a plurality of shoes which can be positioned in a row along the rail are comprised.

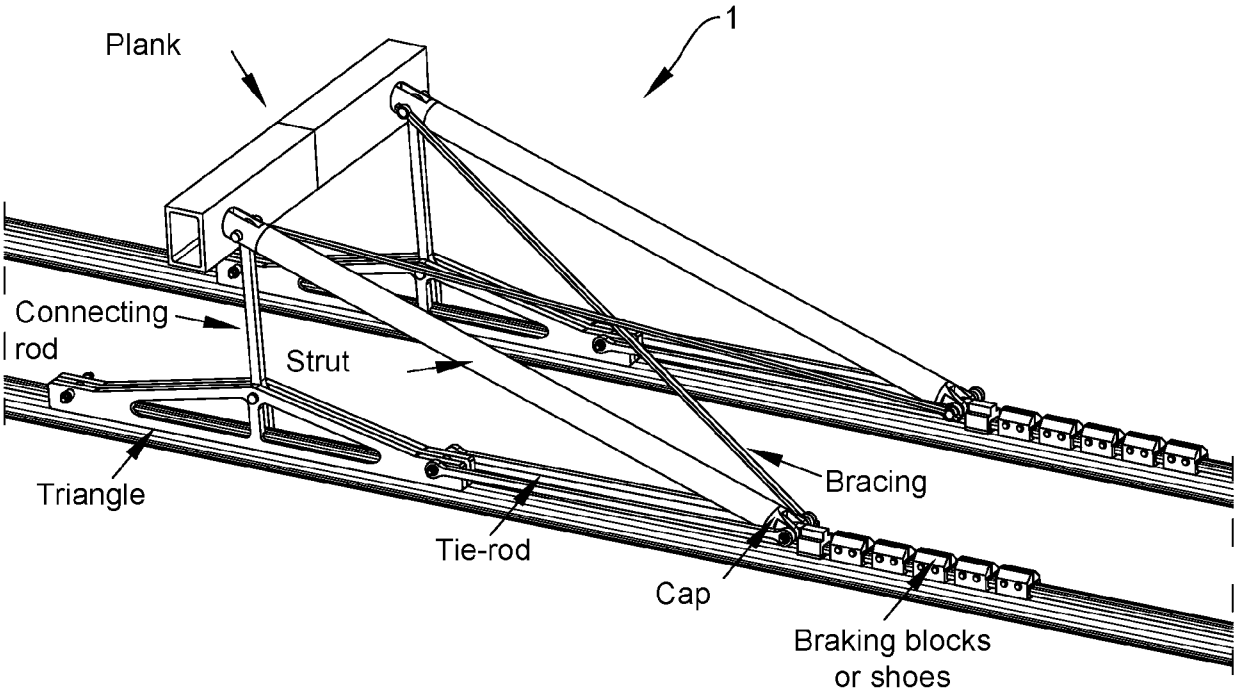

Plank
1
Connecting rod
Strut
Triangle
Bracing
Tie-rod
Cap
Braking blocks or shoes

FIG. 1

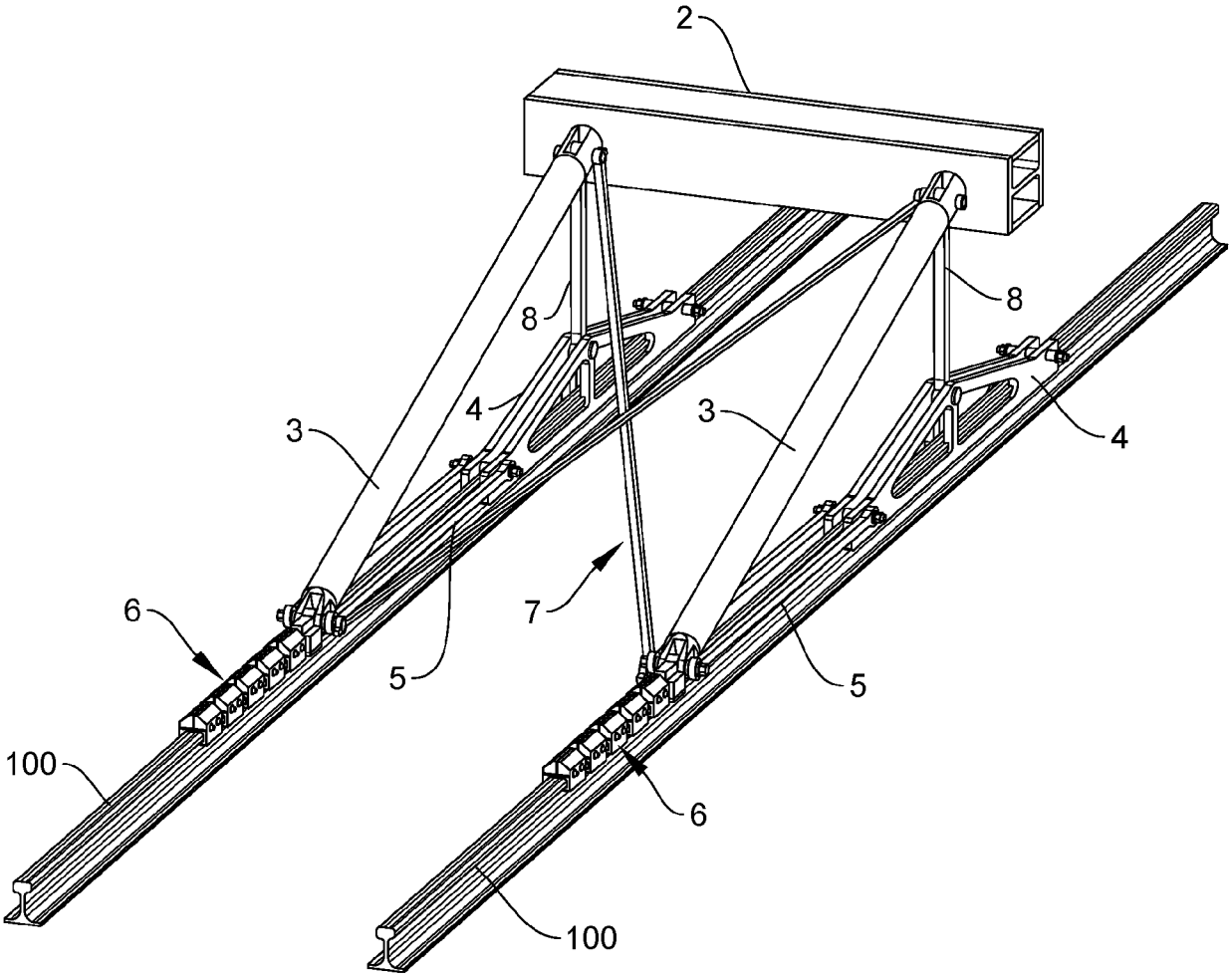


FIG. 2

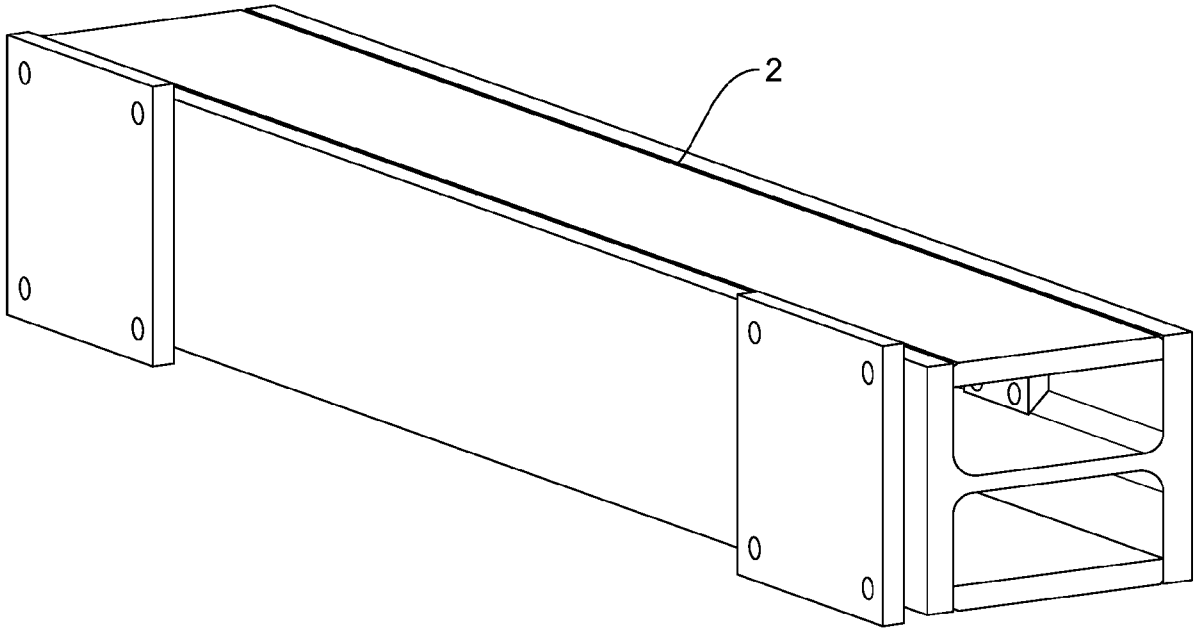


FIG. 2A

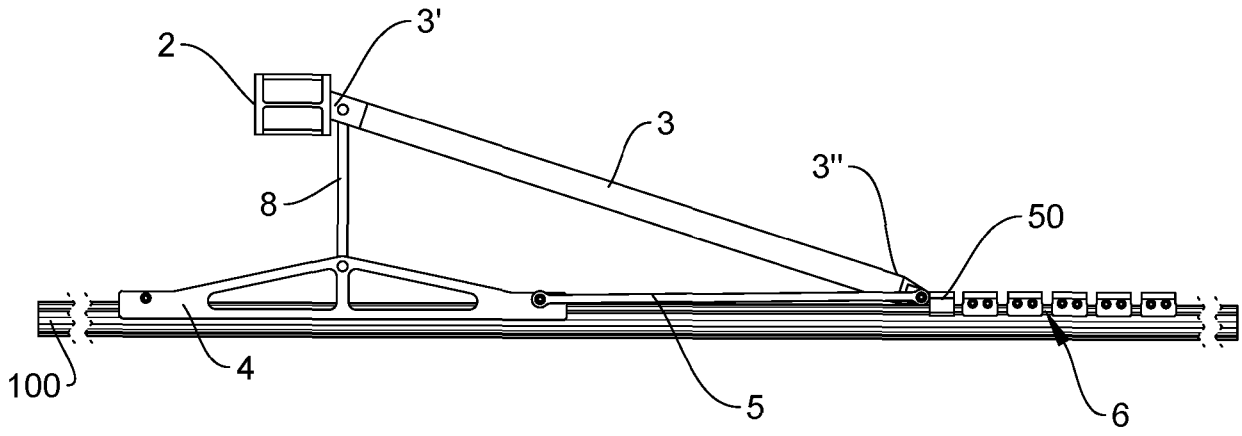


FIG. 3

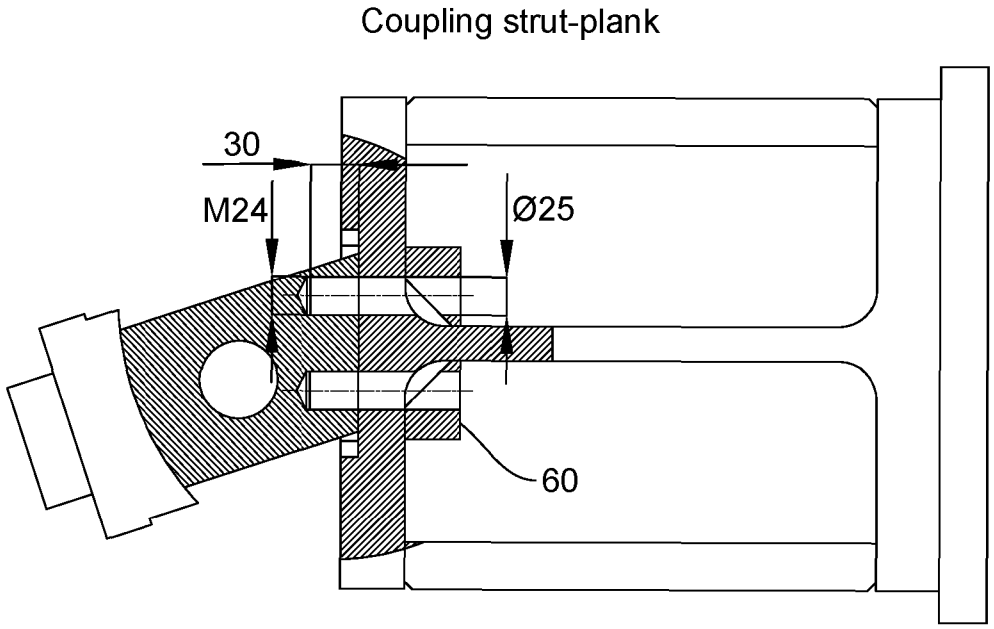


FIG. 3A

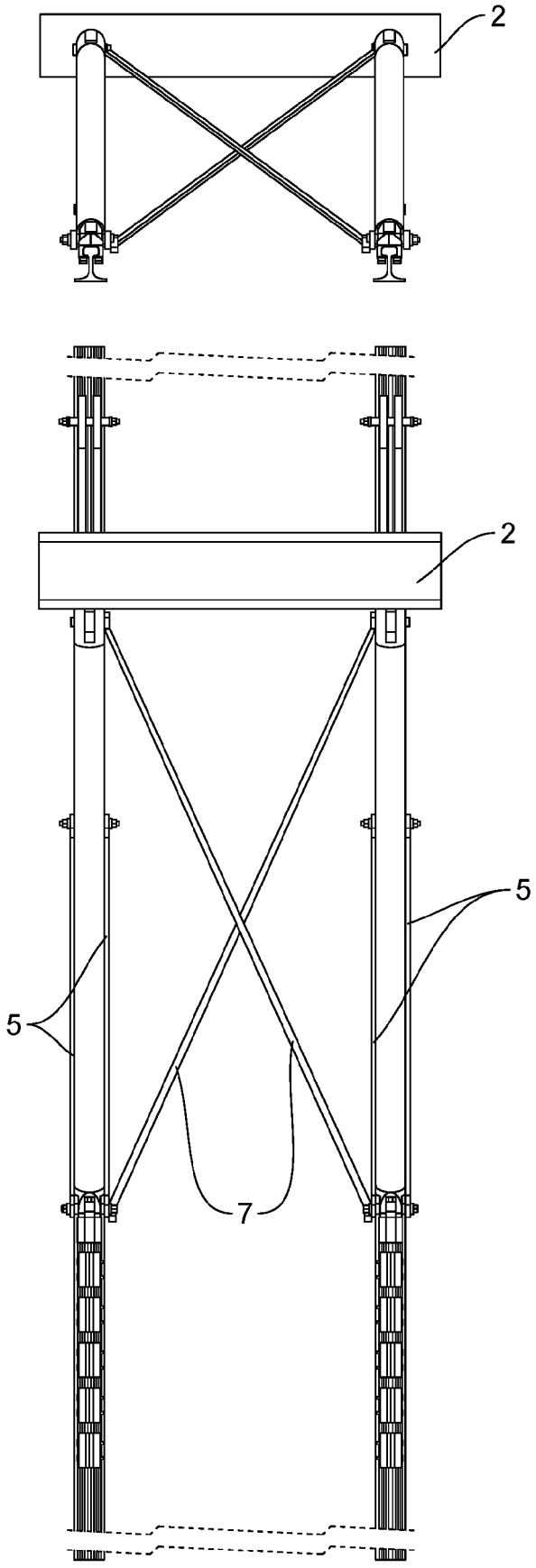


FIG. 4

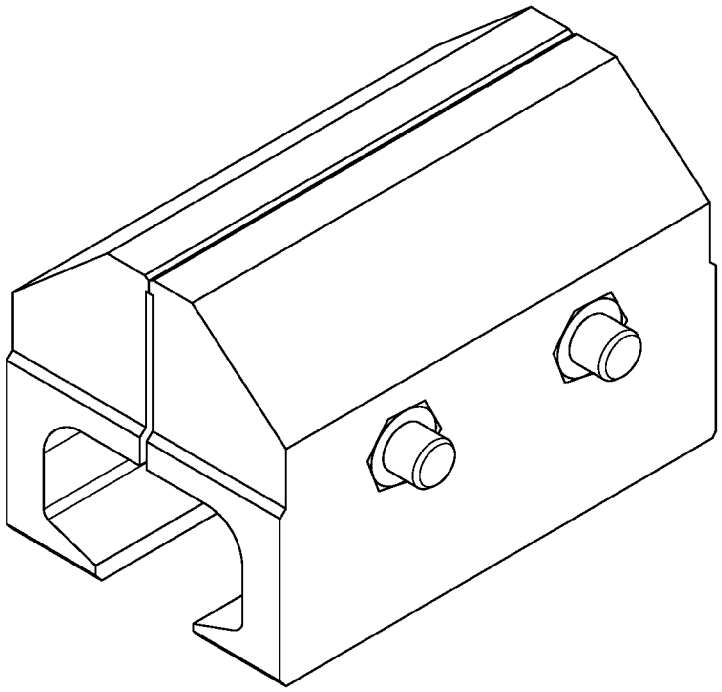


FIG. 5

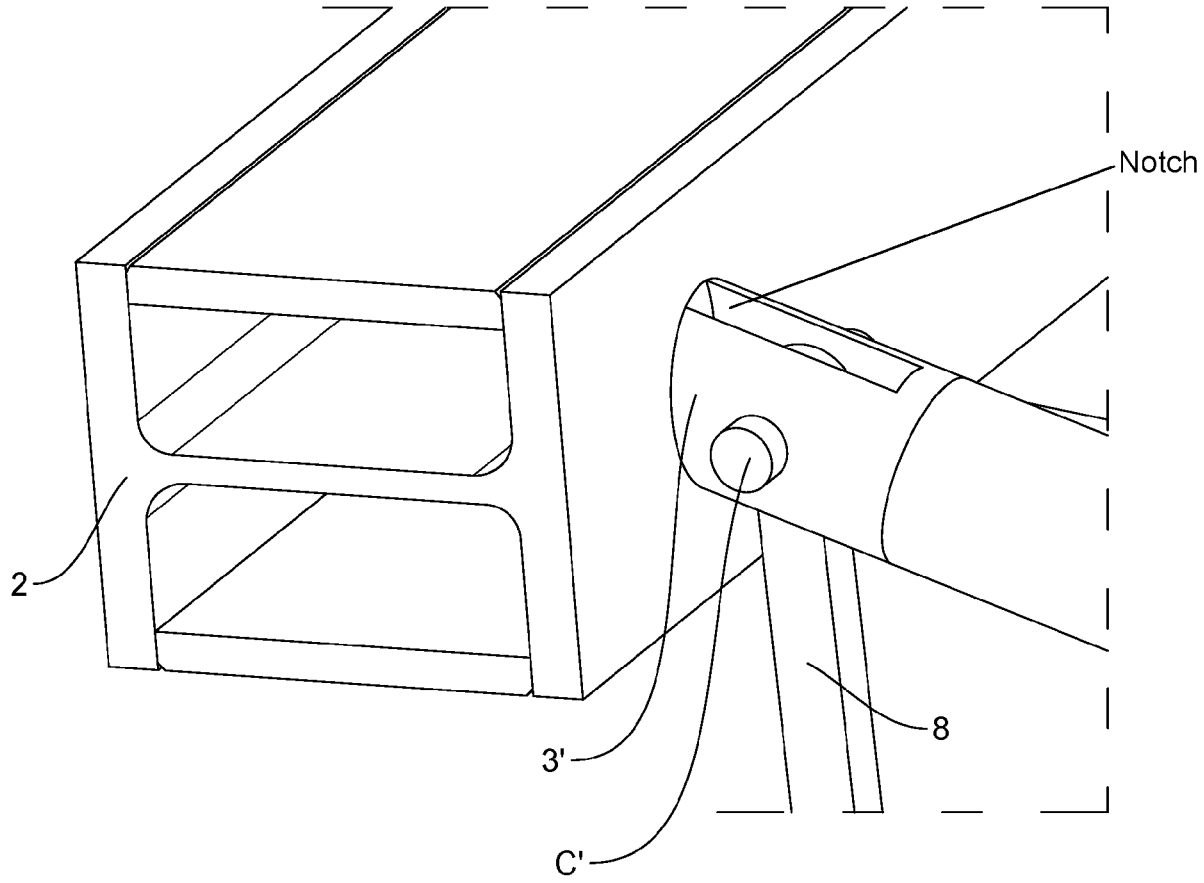


FIG. 6

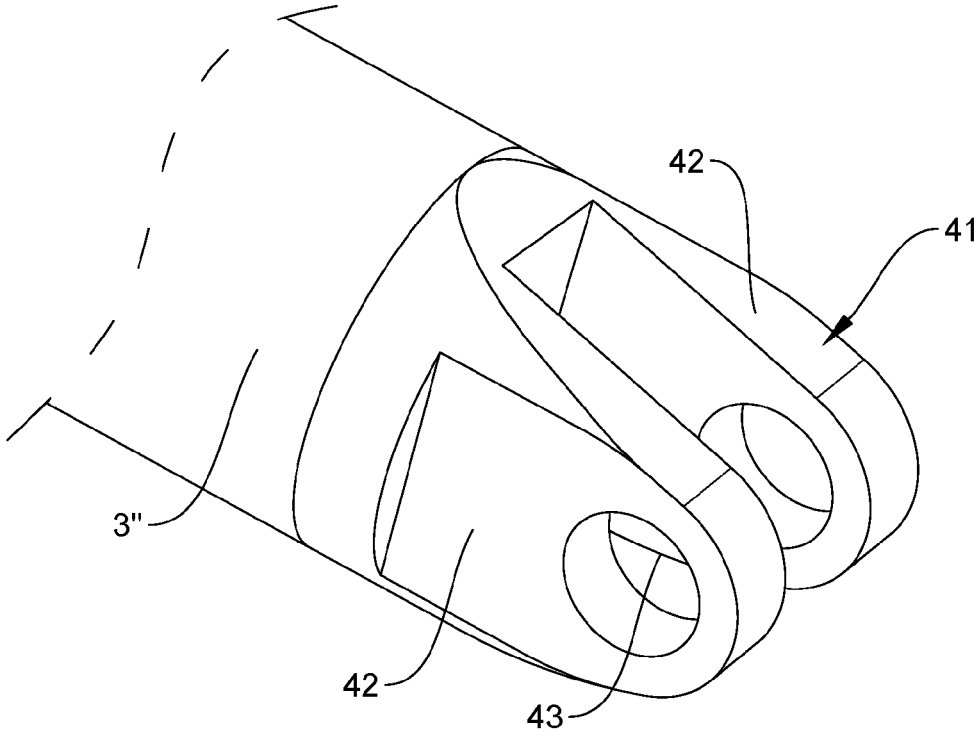


FIG. 7

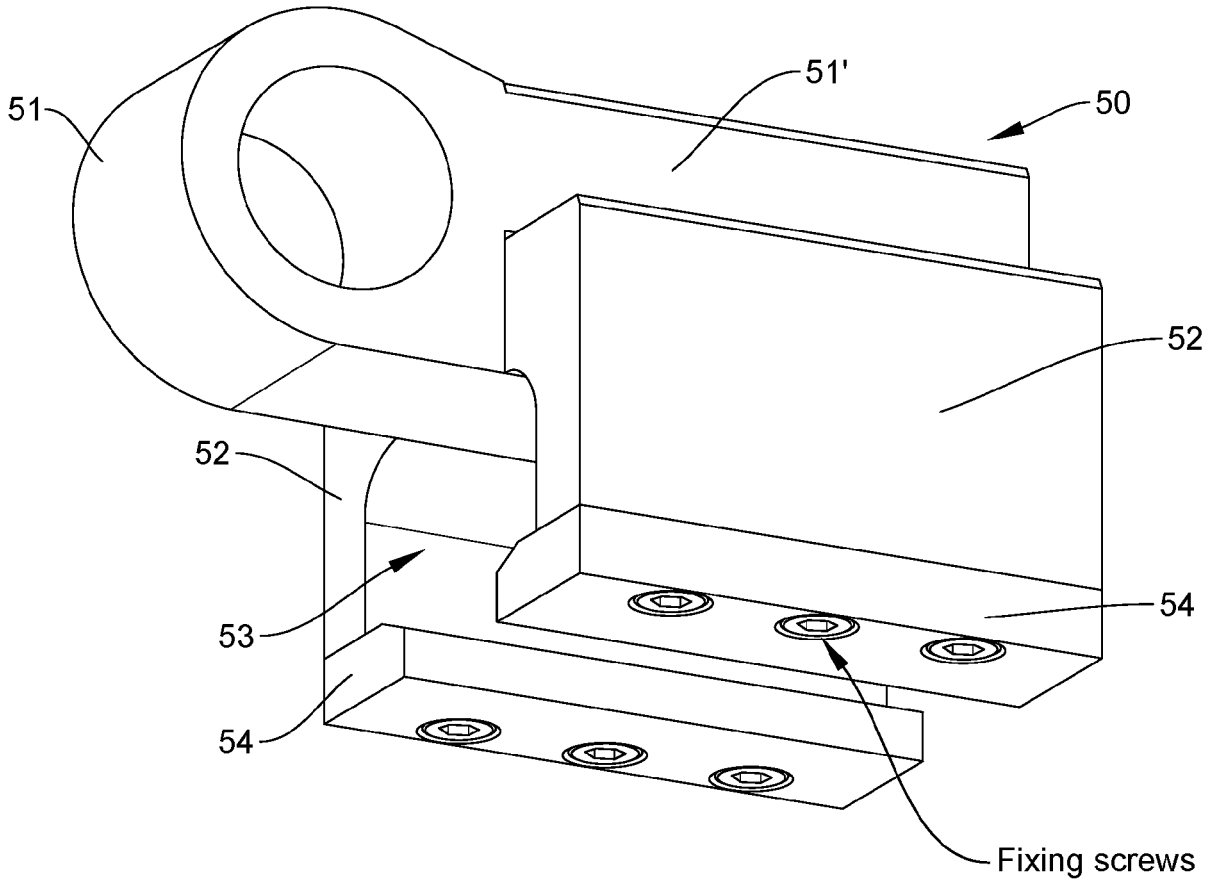


FIG. 8

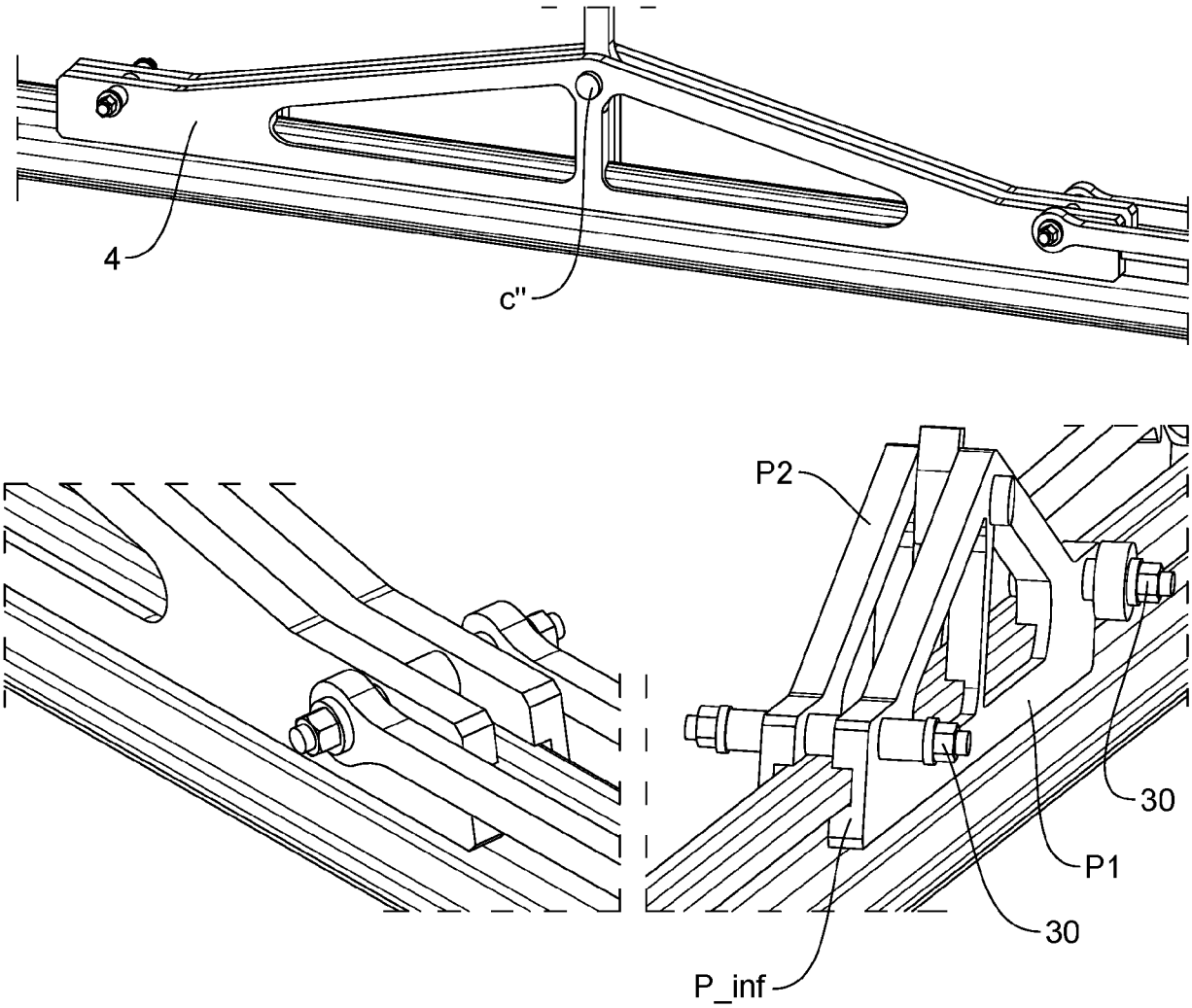
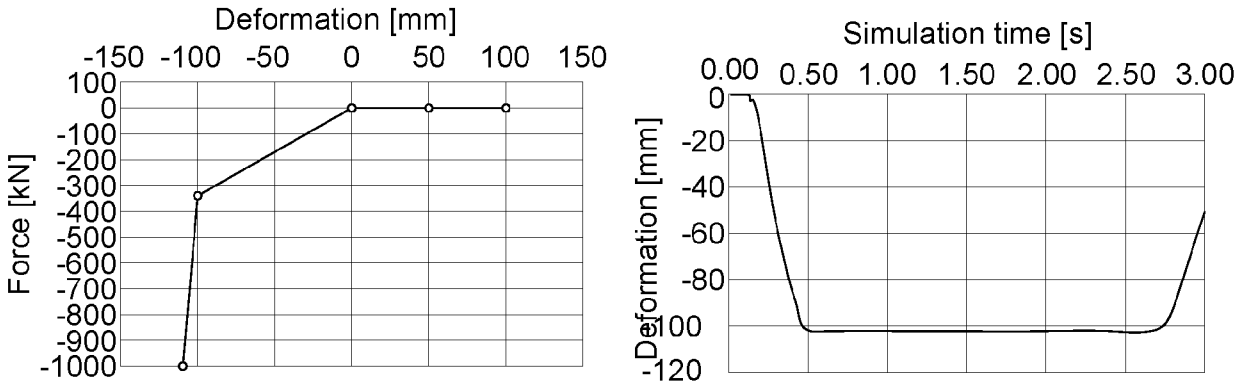


FIG. 9



Left: elastic feature of the buffer. Right: resulting deformation after a simulation

FIG. 10

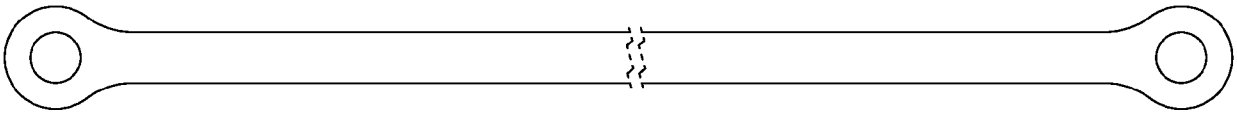


FIG. 11

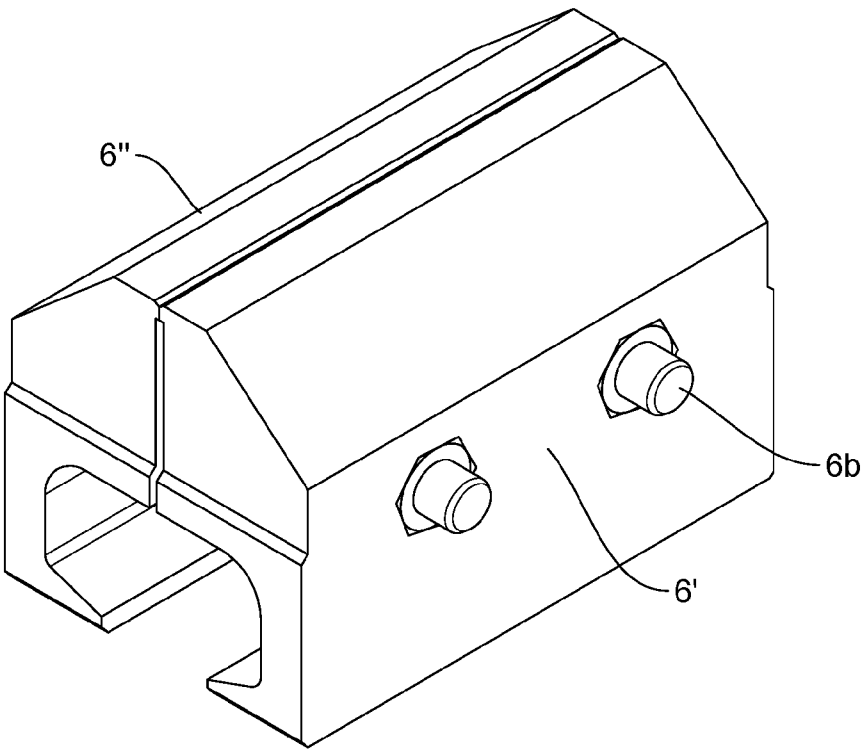


FIG. 12

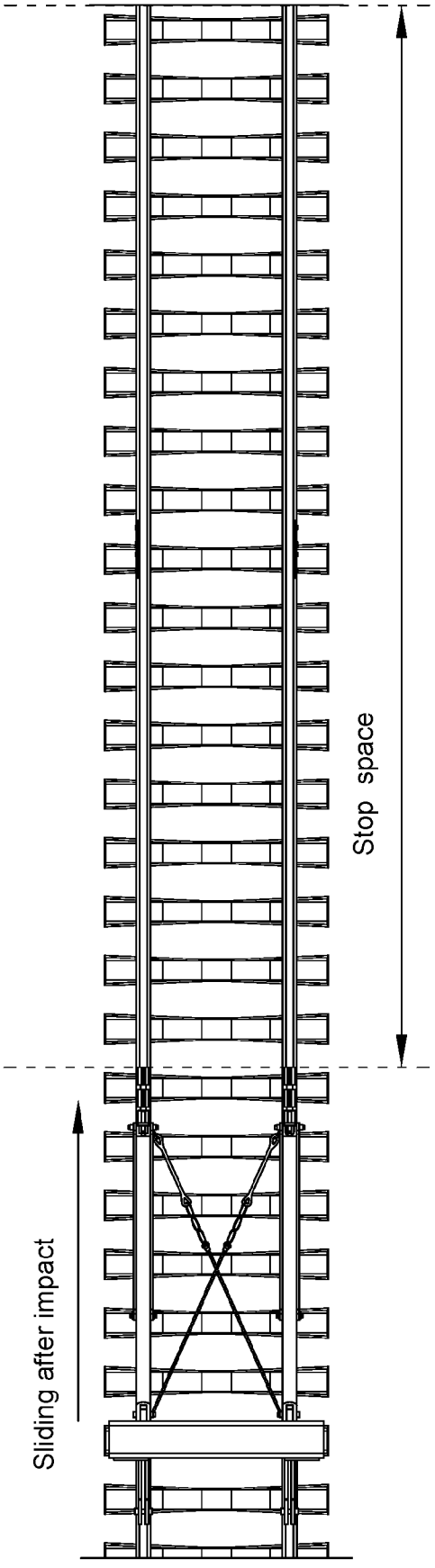


FIG. 13

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EUROPEAN SEARCH REPORT

Application Number
EP 24 21 8487

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	DE 84 34 946 U1 (WILISCH ERHART DR) 2 May 1985 (1985-05-02) * the whole document *	1-11	INV. B61K7/18
X	DE 837 396 C (WILISCH ERHART DR; BERTHOLD LOTZE) 28 April 1952 (1952-04-28) * the whole document *	1-3,9-11	
X	CH 161 723 A (RAWIE FABRIK FUER EISENBAHNBED [DE]) 15 May 1933 (1933-05-15) * the whole document *	1	

TECHNICAL FIELDS SEARCHED (IPC)

B61K

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	7 April 2025	Beucher, Stefan

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07-04-2025

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DE 8434946 U1	02-05-1985	NONE	
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For more details about this annex : see Official Journal of the European Patent Office, No. 12/82