



(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:  
**18.03.2020 Bulletin 2020/12**

(51) Int Cl.:  
**B61L 3/12** (2006.01) **E01B 26/00** (2006.01)  
**E01B 29/32** (2006.01)

(21) Application number: **19461581.1**

(22) Date of filing: **14.09.2019**

(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 MK MT NL NO PL PT RO RS SE SI SK SM TR**  
Designated Extension States:  
**BA ME**  
Designated Validation States:  
**KH MA MD TN**

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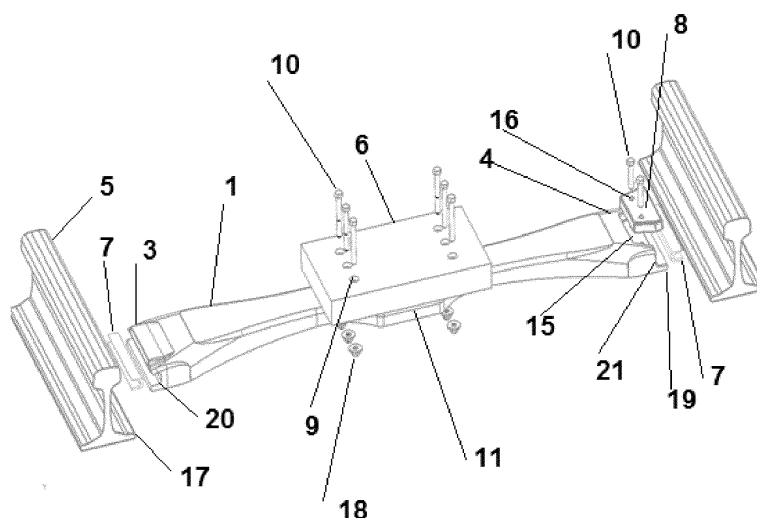
(30) Priority: **17.09.2018 PL 42702418**

(54) **BOARD FOR ASSEMBLING ELEMENTS ON RAILWAY RAIL, METHOD OF ASSEMBLING AND USE THEREOF**

(57) The subject matter of the invention is the mounting beam for the fastening of elements that are to be assembled between the rails of tracks, especially railway tracks, wherein mounting beam is made of composite material and has the shape of a longitudinal beam of variable width, wherein the width of the beam in the central part of the beam and the width of the first end of the beam and the second end of the beam at the place where they come into contact with the rails is greater than the width of the beam at the place where the beam is slimmed

down, wherein the beam is bent into an arc with the central part of the beam raised upwards, wherein the length of the mounting beam is matched to the spacing of the track rails so that after it has been assembled between the track rails it is additionally stiffened. The invention also concerns the method of assembling of such a mounting beam as well as its use for the fastening of elements to be assembled on tracks, such as railway tracks, in particular for the fastening of the balise on railway tracks.

Fig. 2 D



## Description

### FIELD OF THE INVENTION

**[0001]** This invention concerns a mounting beam (mounting arm, board for assembling elements) designed for the fastening of railway automation system elements between track rails, preferably balises, as well as the method of its assembling and use thereof. The mounting beam of the invention, designed for the fastening of elements that are to be assembled between the rails of tracks, especially railway tracks, is made of composite material and has the shape of a longitudinal beam (arm, board) of variable width, wherein the width of the beam in the central part of the beam and the width of the first end of the beam and the second end of the beam at the place where they come into contact with the rails is greater than the width of the beam at the place where the beam is slimmed down, wherein the beam is bent into an arc with the central part of the beam raised upwards, wherein the length of the mounting beam is matched to the spacing of the track rails so that after it has been assembled between the track rails (rail track) it is additionally stiffened.

**[0002]** The mounting beams for the fastening of elements are used to fasten elements such as electromagnets, preferably balises, which - in combination with an IT system - enable the tracking of train traffic, or to assemble other devices in the track. The mounting beam designed for being assembled between track rails together with the element (i.e. balise) mounted on the beam is a part of the system for increasing the safety and automating the traffic of trains on tracks. Due to its versatility, the mounting beam of the invention can also be used for the fastening of elements other than balise.

### STATE OF THE ART

**[0003]** In the state-of-the-art there are known mounting beams designed for the fastening of balises, which have limited functionality and construction that involves metal fittings as well as composite beams mass-produced by means of pultrusion, which involves the drawing of a polyester and glass profile with the cross section of a rectangular pipe. Such profiles are manufactured by many entities and are widely available on the market.

**[0004]** The common characteristics of mounting beams for the fastening of elements between track rails known in the state of the art are:

- a long time of preparation and assembling of a beam that is fixed with the use of numerous bolts;
- a relatively large number of components of the mounting beams, which necessitates the cooperation of at least two installers during assembling;
- they are made of a combination of various materials, e.g. metal + polyester and glass composite;
- they allow mounting on the mounting beam for the

fastening of balise only crosswise to the track, while longitudinal mounting requires the use of two mounting beams assembled next to each other, which radically increases the workload and the material costs of the system;

- they are not universal because a specific type of mounting beams allows the mounting of balises by only one manufacturer. Different distances between the balises' mounting points necessitate customized production of a mounting beam dedicated to the given balise by drilling appropriate mounting points;
- the mounting beams available on the market are fastened either to the springs that fix the rails to the sleepers, or on both sides under the rail foot by means of several (usually four) metal holders fastened by means of bolts made of acid-resistant steel.

**[0005]** There is also known Siemens mounting beam designed for being assembled on tracks, which involves assembling on the inner edge of the rail foot, wherein the mounting system is based on the use of the force of a metal spreading spring. In order to maintain the elasticity and to enable the assembling of such a beam, additional mechanical elastic elements are necessary, as the beam itself does not provide sufficient elasticity to ensure proper assembling of the beam to the track.

**[0006]** Mounting beams known in the state of the art have the same cross-section along their entire length, which results in an unfavourable and significant concentration of stresses at the points of fastening to the rails, which substantially reduces the durability of the structure and cause frequent maintenance and replacement.

**[0007]** The purpose of this invention is to overcome the disadvantages of the solutions known from the state-of-the-art, and to provide new, improved design of mounting beam for the fastening of devices on tracks, in particular for the fastening of balise.

**[0008]** The subject matter of this invention is the mounting beam for the fastening of elements that are to be assembled between the rails of tracks, especially railway tracks, wherein mounting beam is made of composite material and has the shape of a longitudinal beam (arm) of variable width, wherein the width of the beam in the central part of the beam and the width of the first end of the beam and the second end of the beam at the place where they come into contact with the rails is greater than the width of the beam at the place where the beam is slimmed down, wherein the beam is bent into an arc with the central part of the beam raised upwards, wherein the length of the mounting beam is matched to the spacing of the track rails so that after it has been assembled (installed) between the track rails it is additionally stiffened.

**[0009]** Preferably, the mounting beam is made of a composite material that comprises resin-bonded glass composite, wherein the resin-bonded composite is a glass-polyester, glass-vinylester, or glass-epoxy composite.

**[0010]** In a preferable mounting beam, in the compos-

ite material, glass fibres constitute 20-40% of composite weight, preferably glass fibres constitute about 30% of the composite weight, whereas resin accounts for 40-60% of composite weight, preferably resin accounts for about 70% of composite weight.

**[0011]** In a preferable mounting beam, there is an interliner (interlayer, separator) located in the central part (in the cross-sectional view).

**[0012]** In the mounting beam, the interliner is preferably made of a soft material, preferably with a porous structure or honeycomb structure.

**[0013]** In a preferable embodiment of the mounting beam, the first end of the beam has a shape resembling the letter C in the cross-section, which forms a receptive recess and allows to embrace the rail above and below a part of the rail foot.

**[0014]** In a preferable mounting beam, the second end of the beam is extended only at the bottom of the beam, wherein the length and shape of the extension allow to insert the extension under the rail foot during the assembling of the beam in the track, and the second end of the beam has a receptive protrusion that rests against the rail foot's edge during the assembling of the beam in the track thus locking at the correct place, the placement of the beam on the rail while preventing the second end of the beam from being inserted only until coming into contact with the rail foot's edge.

**[0015]** In a preferable embodiment, the mounting beam has a concavity at the second end of the beam, wherein concavity is shape is adapted to receive the fastening block, wherein preferably the concavity and the fastening block have matching mounting holes that are adapted so as to receive the fastening elements.

**[0016]** In a preferable embodiment of the mounting beam, both the beam and the fastening block that fits the concavity are made of composite material comprising resin-bonded glass composite, wherein preferably they are made of glass-polyester, glass-vinylester, or glass-epoxy composite; more preferably, both the beam and the fastening block that fits the concavity are made of the same composite material, wherein preferably the fastening block is covered with an elastic material in the area that comes into contact with the rail.

**[0017]** In a preferable embodiment of the mounting beam, the second end of the beam is covered with an elastic material on the side of the part that comes into contact with the rail.

**[0018]** In a preferable embodiment of the mounting beam, there is a flattening in the central part of the beam.

**[0019]** The mounting beam is bent into a small arc. This beam-bend arc - with the central part of the beam raised upwards - has a sagitta of approx. 20-30 mm, more preferably of approx. 23-28 mm, more preferably of approx. 25 mm.

**[0020]** In a preferable embodiment of the mounting beam, in the central part of the beam there are shaped holes adapted so as to receive the fastening elements.

**[0021]** In a preferable embodiment of the mounting

beam, the width of the first end of the beam and of the second end of the beam at the place where they come into contact with the rails is 1.5 to 2.5 times greater, preferably about 2 times greater than the width of the beam at the narrowest part at the place where the beam is slimmed down.

**[0022]** The invention also relates to the method for fastening the element, in particular the balise, to be assembled on tracks, such as railway tracks. This element to be mounted, in particular balise, is fastened to the mounting beam of the invention, which mounting beam is fastened between the rails of the track.

**[0023]** The invention also concerns the method for assembling the mounting beam for the fastening of elements that are to be assembled between the rails of tracks, especially railway tracks, which comprises the following steps:

a) the insert is slid onto the rail foot at least in the place of assembling of the first end of the beam; then, the second end of the mounting beam of the invention is slid under the rail foot until contact is made between the edge of the rail foot and the receptive protrusion of the second end of the beam; the first end of the mounting beam is pressed into the rail foot; the mounting beam is pulled in the central part so that the receptive recess of the first end (3) of the mounting beam can embrace the rail foot, wherein it is more preferable to slide the insert onto the rail foot at the place of assembling of both ends of the beam;

b) the fastening block is placed in the concavity at the second end of the beam, and the fastening block is fixed to the beam using the fastening elements.

**[0024]** In a preferable method for assembling the mounting beam, step (a) is preceded by mounting - on the beam, in the central part of the beam - the element to be mounted, wherein the element to be mounted is preferably the balise.

**[0025]** The invention also concerns the use of the mounting beam of the invention for the fastening of elements to be assembled on tracks, such as railway tracks, in particular for the fastening of the balise on railway tracks.

**[0026]** Due to its shape, variable cross-section, and the material of which it is made, the mounting beam of the invention for the fastening of elements between track rails is characterized by high resistance to torsion, whereas the mounting beams known in the state of the art, for example, those made using the pultrusion technique, are not resistant to torsion.

**[0027]** None of the mounting beams known in the state of the art allow the mounting of balises by different manufacturers both along and across the track, which is freely allowed by the mounting beam of the invention for the fastening of elements between track rails due to its shape, variable cross-section, as well as its widening and

flattening in its central part, which proves its uniqueness and versatility of use.

**[0028]** Due to use of glass-polyester and/or glass-vinylester or glass-epoxy composite for its manufacture, the mounting beam of the invention for the fastening of elements between track rails achieves natural elasticity which - after it has been assembled in the track - contributes to an improvement in the mechanical parameters of the beam and allows an easy method for assembling the beam, which involves coupling the mounting beam into the edge of the foot of the first rail on the first side of the beam, and 'clicking it in' on the second side. The elasticity of the composite guarantees proper outstretching of the beam between the rail feet, eliminates any play (clearance) in the assembling, while the fastening block bolted into place in the concavity at the second end of the beam protects the beam against falling out during operation.

**[0029]** The variable cross-section of the beam (the widening at the ends and in the central part, as well as the appropriate arc-shaped slimming/narrowing down between the end parts and the central part) results in an optimal distribution of stresses at the points of fastening, while the bending of the bottom surface of the beam into an arc (similar to a bridge span) improves the mechanical parameters of the beam and the possible maximum mechanical loads of the beam with the mounted balise.

**[0030]** The mounting beam of the invention for the fastening of elements between track rails provides the construction that allows the mounting of balises of different manufacturers, without the need for additional modification. What is more, the mounting beam of the invention allows the balise to be mounted in any convenient orientation, e.g. along or across the track. The mounting beam also allows to mount other elements to be assembled between rails.

**[0031]** The mounting beam of the invention for the fastening of elements between track rails itself - is an elastic element that ensures proper assembling of the beam in the track, and no additional mechanical elastic elements are used for its assembling, unlike in the case of the beams known in the state of the art, e.g., the beam produced by Siemens.

**[0032]** The length of the beam is properly matched to the spacing (distance) of the track rails, and is selected so that after the assembling between the feet of the track rails the beam is press fitted so as to achieve the proper rigidity (through outstretching) while maintaining sufficient elasticity.

**[0033]** In addition, the beam of the invention ensures self-levelling of the mounted elements in the central part of the beam. This effect is ensured thanks to the wide (for example, preferably approx. 180-220 mm, more preferably approx. 200 mm) of the support of the beam on the rail foot, which automatically forces the correct positioning of the beam's flat plane in the geometry of the track.

**[0034]** The mounting beam of the invention also allows to minimize the time of assembling, and to simplify it. The

assembling of the mounting beam of the invention requires only one installer, and the working time, including the mounting of the respective element on the beam, e.g., balise, is up to 10 minutes. Therefore, the assembling is possible without stopping train traffic on the route.

**[0035]** In order to manufacture the beams, many resins and glass fibres produced by many manufacturers can be used. In order to manufacture the mounting beams, glass-polyester composites can be used, while polyester resins can be replaced with vinylester or epoxy resins. The use of these resins will improve the strength parameters of the beam.

**[0036]** Methods for the making of composites from polyester resins as well as vinylester or epoxy resins and glass fibres are known and described in the state of the art.

**[0037]** The simplification of the method for the production and assembling of the mounting beam also results in the general reduction of the unit costs of the beam and the work of the installing team needed for assembling.

**[0038]** The properties of the mounting beam of the invention result from its construction, i.e., the combination of properly spatially profiled shape and the use of a homogeneous material of glass-polyester composite or glass-vinylester / glass-epoxy composite. The mounting beam is manufactured in a single technological process, as opposed to the multi-step processes of other constructions of metal-composite mounting beams known in the state of the art. The mounting beam of the invention does not have any metal elements in its structure. In order to assemble the beam to the rail, the fastening block is used, preferably made of the same material as the mounting beam, wherein fastening block is mounted using the fastening element, e.g., fastening bolts, rivets, etc. that are made of, e.g., acid-resistant steel, non-ferrous metals such as brass or bronze, or plastics such as polyamide or nylon. Therefore, the possible metal elements on the beam assembled between the rails may be the fastening elements that are made of metal, e.g. bolts that fix the fastening block on the mounting beam. The elements used to bolt balises to the beam, as well as those used to mount the beam to the rails, can preferably be made of paramagnetic non-ferrous metals such as brass or bronze, as well as of nylon or polyamide. Such assembling of the fastening block prevents the mounting beam from sliding out from under the rail foot, and additionally stiffens and stabilizes the whole construction. The other possible metal components are the bolts used to fasten the element to be assembled, e.g. metal bolts and nuts, or bolts made of plastic such as polyamide/nylon and nuts made of this material, whose purpose is to bolt (install) the element, e.g. balise, onto the mounting beam.

**[0039]** The lack of or significant reduction in metal elements - especially in the case of an embodiment where both the mounting beam and the fastening block (preferably also the fastening elements) are made of laminate / glass-polyester composite and/or glass-vinylester / glass-epoxy composite, in addition to the bolts that fasten

onto the beam the element to be assembled, e.g., balise - are an additional advantage that reduces the risk of corrosion of these elements, improves the durability, and extends the service life of the mounting beam. The composite elements that are used to make the mounting beams and preferably also the fastening blocks for properly assembling the mounting beam on track rails, as well as the fastening elements in the form of bolts made of acid-resistant steel, brass, bronze, or polyamide/nylon, do not corrode, are resistant to adverse factors such as oils, acids, weather conditions, and UV radiation. They do not require maintenance operations (e.g. painting), or greatly limit the number of the required maintenance operations.

**[0040]** What is important, the mounting beam of the invention uses the natural elasticity of composite, e.g. glass-polyester composite, to induce tensioning of the beam after assembling, which further improves its mechanical and strength parameters during operation. For example, in a free state, the mounting beam of the invention bends 25-30 mm under the load of 100 kg, but after it has been assembled (compressed) between rails, it bends only 6 mm under the load of 100 kg. Another important feature of the invention is the possibility of influencing the mechanical parameters of the beam (such as elasticity, strength, and frequency of self-resonance) by modifying the composition and structure of the composite. By increasing the content of glass fibres in the composite, its elasticity and load resistance are increased. By adding elasticizers to the surface layer, impact resistance is increased. In a particularly preferable embodiment, the composite structure incorporates materials that suppress the mounting beam's self-resonances, in the form of an interliner made of a soft material and placed between the layers of the rigid composite structure. For this purpose, the interliner made of a soft material, for example with a porous structure or a honeycomb structure, is placed centrally in the mounting beam. This material may be one of the many interliner materials available on the market, such as Coremat, Herex, or foamed PVC, which are commonly used in the production of glass-polyester composites as well as glass-vinylester and glass-epoxy composites. (for an example, go to: [www.havel-composites.pl/index.php?menu=produkt&type=materiał\\_przeładkowe](http://www.havel-composites.pl/index.php?menu=produkt&type=materiał_przeładkowe)). Preferably, the interliner is placed along the entire length and across the entire width of the beam.

**[0041]** The interliner improves the rigidity of the structure which, at the same time, beneficially increases the (self-)resonance frequency of the system.

**[0042]** The fact that the mounting beam is made of a composite material, without metal inserts, also ensures the absence of permanent deformations in the mounting beam of the invention after strong mechanical impacts occurring during operation (in contrast to the beams made of metal elements, used in the present state of the art, which get permanently deformed after impact). Moreover, the use of a homogeneous material ensures the

possibility of recycling of the mounting beams of the invention without the need for costly disassembly of components. The crushed and ground material from the disassembled beams can be recycled and reuse, for example, as a full-value filler for the production of next beams.

**[0043]** The material used in the mounting beam of the invention guarantees stability of dimensions at temperatures ranging from -40 to +70 degrees Celsius. The applied glass-polyester, glass-vinylester, or glass-epoxy composite practically does not show any thermal expansion. If polyester resins are replaced with vinylester resins, the upper temperature of utilization will increase to about 110 degrees Celsius. If epoxy resins are used, it will be even higher.

**[0044]** In addition, the functionality of the mounting beam of the invention is the result of its shape with a variable cross-section, in particular the slimming-down, as well as the widening at the ends and in the central part. After the mounting beam has been assembled in the track, when a train passes over the mounting beam, it is subjected to strong forces in various directions. Initially, there is the force of air momentum that presses the mounting beam down to the ground. Then, the central part of the beam is pulled upwards by the vacuum within the train carriage between the bogies. This rhythm is repeated with each oncoming carriage.

**[0045]** The mounting beam of the invention is designed to fasten elements, preferably railway automation elements, in tracks. Due to its special shape and the matching of its dimensions, including its length, to the spacing of rail feet, it allows to achieve the additional effect of total elimination of play (clearance) in the assembling and increase in the rigidity of the beam assembled in the track, compared to a beam from before assembling; it also allows to optimize the unfavourable, operational mechanical stresses by spreading them over a larger area than that in the state of the art, and provides automatic optimization of the position of the elements mounted to the beam in the XY axes, without the need for using any additional adjustment systems - this is accomplished thanks to the natural mechanical and functional properties of glass-polyester / glass-vinylester / glass-epoxy composite by utilizing the unique shape and method for fastening and, at the same time, the method of positioning the beam in the track. After the mounting beam has been assembled in the track, it gains additional rigidity (resistance to loads). Beams known in the state of the art have the same 'softness' / rigidity both before and after assembling.

**[0046]** The mounting beam of the invention is widened at the first and second ends of the beam as well as in the central part, where the greatest stresses occur during use. The mounting beam is narrower, i.e. 'slimmed down', where the stresses are less intense (**Fig. 2 A, C; Fig 3A**). The form of the entire produced beam is bent into a small arc, preferably with a sagitta of approx. 20-30 mm, more preferably of approx. 23-28 mm, more preferably of approx. 25 mm. In a preferable embodiment of

the mounting beam, its width in the central part is similar to the width of the first and second ends of the beam, and, at the place where the beam is slimmed down, its width is about two times smaller. The central part of the mounting beam (the plane on which the elements, e.g. balise, are mounted) is located higher than the points of support on the rails. This geometry makes the stresses spread along the mounting beam, and the forces dissipate on the rail foot's edge. This is why the width of contact of the mounting beam of the invention with the rail is larger, preferably 1.5 to 2.5 times larger, more preferably approx. 2 times larger, than the width of the beam at the narrowest part. This produces the effect of even distribution of stresses in the device of the invention (**Fig. 5**, light areas) even under extreme deformations, as well as optimization of the stresses at the points where the beam is fastened to the rails (**Fig. 5**, dark areas).

**[0047]** Also, the shape of the mounting beam of the invention ensures optimum stress distribution and maximization of the beam's resistance to dynamic loads. The results obtained in a computer simulation show that under the influence of 500 kg of pulling force, there is a minor deflection of the mounting beam of the invention. In the described computer model, the mounting beam under extreme stress that may occur during operation, works at 25-30% of its mechanical capacity (maximum strength, without visible damage). In operating conditions, the extreme forces affecting the beam will not exceed 150-200 kg (1.5-2.0 kN). In practice, under typical operation of the beam, the stresses should not exceed a dozen or so percent of the mounting beam's strength.

### Description of the figures

**[0048]**

**Fig. 1.** A-E present mounting beams known in the state of the art.

**Fig. 2.** shows an embodiment of the mounting beam of the invention, viewed from above (A) and from the side (B), C - an example of the mounting beam's diagram in the form of a drawing, viewed from above (C), an example of the exploded diagram of the mounting beam viewed at an angle (D), - an example of the mounting beam's diagram in the form of a drawing, viewed from above (E).

**Fig. 3.** A and B present preferable proportions of the sizes of the individual parts of the mounting beam, considering parameter A as the unit of length (A) view of the beam from above (B) view of the beam from the side, with a well-exposed bend of the beam into a small arc. (C) a photograph of the mounting beam assembled between track rails without inserting the fastening block, (D) a photograph of the mounting beam assembled between track rails with an element mounted on it, i.e., balise.

**Fig. 4.** A comparison of the courses of bend tests carried out on the mounting beam of the invention

and on a beam known in the state of the art (1, 1-repeated - beam\_1 of the invention, 2 - beam\_2 : Vortok).

**Fig. 5.** presents the result of a MES Solid Works computer simulation of stress distribution in the event of bending the mounting beam of the invention (1, 1\_repeated), assuming 500 kilograms of pulling force achieved through the tested load.

**Fig. 6.** A) Photograph of an example interliner made of soft material with honeycomb structure, built centrally into the mounting beam, B) cross-sectional diagram of the mounting beam in the central part of the beam, which shows the layered structure and the soft material interliner (structural interliner) (from fig. 6 A) placed between the layers of the rigid composite structure.

**[0049]** The invention is illustrated by the following examples of embodiments, which do not limit its scope.

### EXAMPLES

#### Example 1 Producing the mounting beam, and producing the fastening block

**[0050]**

**A.** Mounting beam 1 in the form of prototypes was made from glass-polyester composite (laminate) consisting of about 30% of glass fibres bonded using polyester resin (about 70%). First, a model of the prototype's mould was made. Then, the separators were manually applied onto the moulds, and the reinforcement layers were successively applied in the form of intersecting layers of glass mats and fabrics, and these were saturated with resin using brushes and rollers. In order to obtain a homogeneous composite laminate, excess resin was sucked off under vacuum. In addition, the laminate composite was optionally heated during the curing process of the resin in the furnace. After completely finishing the curing process, de-moulding was carried out, excess material was cut off, and bolt holes were cut out.

**B.** Mounting beam 1 in the form of prototypes was made (similarly to the one in item A) of glass-polyester composite (laminate) consisting of about 30% of glass fibres bonded using polyester resin (about 70%) by spraying the gelcoat onto the moulds and spraying the mixture of resin and staple glass fibre (chopped glass with resin). In order to obtain a homogeneous composite laminate, excess resin was sucked off under vacuum. In addition, the laminate composite was optionally heated during the curing process of the resin in the furnace.

**C.** The mounting beams were produced as described in items A and B except that, additionally, materials suppressing the device's self-resonances were built into the structure of the composite in the central part

of beam 1, i.e., the interliner 14 made of a soft material with a honeycomb structure (**Fig. 6 A**) placed between the layers of rigid composite structure (**Fig. 6 B**). Mounting beams produced using the sandwiching technique are characterized by increased rigidity of the structure, which favourably increases the (self-)resonance frequency of the system.

**D.** The mounting beams were produced using the combined method as described in items A and B, except that they were made using the method of lamination layer by layer in the following order: two layers of glass fabric, an 8 mm layer of dispersed glass fibres, an interliner of the 'honeycomb' type, an 8 mm layer of dispersed glass fibres, and two layers of glass fabric.

Mounting beams 1 used in the tests have a cross-section as shown in **Fig. 6 B** and were made using a method that comprises the following subsequent steps:

1. optional application of a gelcoat layer of any colour in the RAL scale (it is a surface resin that ensures quality and colouring of the beam's surface);
2. lamination of the glass fabric layer with the basis weight of 800g/m<sup>2</sup>, and filling it with polyester resin;
3. lamination of the structure of glass mat with the basis weight of 4,500g/m<sup>2</sup>;
4. the layer applied next is the 'honeycomb'-type structural interliner, as shown in **Fig. 6A**,
5. then, lamination of the next layer of glass mat with the basis weight of 4,500g/m<sup>2</sup>;
6. the lamination is finished with layers of glass fabric with the basis weight of 800g/m<sup>2</sup>;
7. in order to improve the aesthetics, the bottom of the beam can be additionally coated with gelcoat, although this is not necessary with respect to mechanical properties.

For the purposes of series production, only resin that complies with EN 45545 standard is used. This standard governs the use of composite elements in railway engineering.

**E.** The mounting beams were produced as described in items A, B, C, and D, but instead of polyester resin, vinylester or epoxy resins were used.

**F.** The fastening blocks 8 were produced using the technique described in items A, B, E, using properly prepared mould matching the shape of the fastening block 8. The shape of the fastening block 8 is matched to the concavity 15 at the second end of the mounting beam 4, and allows the fastening block 8 to be inserted into this concavity 15, wherein the fastening block 8 is wider than the depth of the concavity 15 at the second end of the beam 4 and covers the upper part of the rail foot 17 during assembling.

**[0051]** Both in the fastening block 8 and at the second end 4 of the mounting beam produced as described in items A-F, matching holes 16 were made for fastening elements 10 (e.g. bolts) allowing to fix the fastening block 8 on the mounting beam 1 after the mounting beam 1 has been slid under the rail feet 17 and thus to assemble the mounting beam 1 between the rail feet 17 of the track.

#### **Example 2. The method for assembling the beam between track rails, together with the mounting of balise on the beam**

**[0052]** The mounting beam 1 produced in accordance with **Example 1 D** and the fastening block 8 produced in accordance with **Example 1 F** were assembled on the rails 5 of a track. First, the balise 6 was bolted to the central part 2 of the mounting beam, after which the insert 7 was pressed onto both edges of the rail foot 17, wherein the insert is a soft profile matched to the edge of the rail foot 17 and the second end 4 of the mounting beam, made of an elastic material (elastomer), e.g., rubber, silicone, or polyurethane, after which the second end of the beam 4 was slid under the rail foot 17 and the first end 3 of the mounting beam 1 was pressed into the edge of the rail foot 17 with the elastomeric insert 7 already in place. Then, by forcefully pulling the mounting beam 1 at the central part 2, the first end 3 of the mounting beam 1 is 'clicked into' the rail foot 17 with a strong jerk, after which the fastening block 8 is bolted into place using two bolts, e.g. type M10. The whole assembling time takes about 5 minutes, and, including the mounting on the beam of a relevant element to be mounted, for example, the balise, it takes up to 10 minutes. The process of assembling the mounting beam of the invention in tracks only requires the connecting of two elements, which are connected using only two bolts, and can easily be carried out by one installer.

#### **Example 3. Computer simulation of stress distribution in the mounting beam of the invention**

**[0053]** The simulation was carried out for the mounting beam 1 made according to **Example 1 D** assuming 500 kg of pulling force achieved through the simulated, tested load.

The results obtained in the MES Solid Works computer simulation show that under the influence of 500 kg of pulling force, there is a minor deflection of the mounting beam 1 of the invention. In said computer model, the mounting beam 1 at extreme stress works at 25-30% of its mechanical capacity. The effect of even distribution of stresses in the mounting beam 1 of the invention was observed (**Fig. 5**, light areas) even under extreme deformations, as well as minimization of the stresses at the points where the mounting beam is fastened to the rails 5 (**Fig. 5**, dark areas).

#### Example 4. Strength tests on mounting beams

**[0054]** Strength tests (bending under load) were carried out on two types of composite beams: mounting beam 1 of the invention marked as KTK- beam\_1, produced according to **Example 1 D**, and a commercially available beam\_2 purchased from Vortok International and marked as Vortok. The Vortok beam was the composite beam with 50 by 100 mm profile made using the pultrusion technique, assembled at the measuring workstation, at room temperature.

The tests were carried out using a Zwick 250 strength testing machine. The tests were carried out at a constant beam travel speed of 50 mm/min. During the tests, a continuous digital record of the force and of the beam's displacement (deflection) was kept.

In the case of beam\_1 (KTK), after the first test was carried out until the deflection of 57.6 mm (under the load of 3,100 N) at which point the composite structure was partially destroyed, the panel was unloaded (relieved) and, in the next process, loaded again until achieving the deflection of 62.4 mm (a load of approx. 2,700 N), at which cracking in the composite structure could be heard again.

Beam\_2 (Vortok) was loaded only until the deflection of 44.2 mm (approx. 2,300 N). A greater deflection was not possible due to the construction of beam\_2 (assembling of the beam below the rail foot).

A comparison of the courses of bend tests is presented in **Fig. 4**.

The testing of both beams showed significant differences in the load courses during the bend tests. The load course of beam\_2 (Vortok) in the whole range of deflection was nearly linear, whereas a linear range for beam\_1 (KTK) occurred only until the load of approx. 1,000 N (100 kg). In this process, beam\_1 (KTK) was characterized by rigidity approx. 3 times greater than that of beam\_2 (Vortok). During the repeated loading of beam\_1 (after partial destruction of the composite caused by the overload of more than 3,000 N in the first test), the maximum force was found to be about 12% lower than that in the first test. This suggests that even after extreme loads causing micro-cracks in the laminate structure, beam\_1 fully retains its functional properties. Beam\_1 (KTK) has three times the rigidity of beam\_2 Vortok as well as deformation resistance greater than beam\_2 Vortok, thanks to which it withstands loads of more than 3,000 N.

The mounting beam 1 of the invention (Beam\_1) has excellent strength properties and is suitable for use when fastening elements, especially balises, on tracks.

#### List of designations:

**[0055]**

- 1 - mounting beam;
- 2 - central part of the beam;
- 3 - first end of the beam;

- 4 - second end of the beam;
- 5 - rail;
- 6 - element to be assembled, e.g., the balise;
- 7 - insert (an elastic element that separates the mounting beam from the rail foot, inserted onto the rail's edge);
- 8 - fastening block;
- 9 - holes (for the fixing of the element to be assembled, e.g., the balise);
- 10 - fastening element (e.g. bolt/screw);
- 11 - flattening;
- 12 - slimming down (a reduction in the beam's width);
- 13 - thickening;
- 14 - interliner/spacer- sandwiched/placed between the layers of the rigid composite structure;
- 15 - concavity at the second end of the beam (which receives the fastening block);
- 16 - holes;
- 17 - rail foot;
- 18 - washers for the fastening elements;
- 19 - extension (of the lower part of the beam at the second end of the beam);
- 20 - receptive recess (at the first end of the beam, receiving the rail foot);
- 21 - receptive protrusion (at the second end of the beam; it rests against the rail foot's edge)

#### Claims

1. A mounting beam for the fastening elements to be assembled between the rails of tracks, especially railway tracks, **characterized in that**, the mounting beam (1) is made of composite material and has the shape of a longitudinal beam of variable width, wherein the width of the beam (1) in the central part (2) of the beam and the width of the first end of the beam (3) and the second end of the beam (4) at the place where they come into contact with the rails (5) is greater than the width of the beam at the place where the beam (1) is slimmed down (12), wherein the beam is bent into an arc with the central part (2) of the beam raised upwards, wherein the length of the mounting beam is matched to the spacing of the track rails so that after it has been assembled between the track rails it is additionally stiffened.
2. The mounting beam according to claim 1, **characterized in that**, it is made of a composite material comprising resin-bonded glass composite, wherein the resin-bonded composite is selected from glass-polyester, glass-vinylester, or glass-epoxy composite.
3. The mounting beam according to claims 1-2, **characterized in that**, in the composite material, glass fibres constitute 20-40% weight of composite, preferably glass fibres constitute about 30% weight of



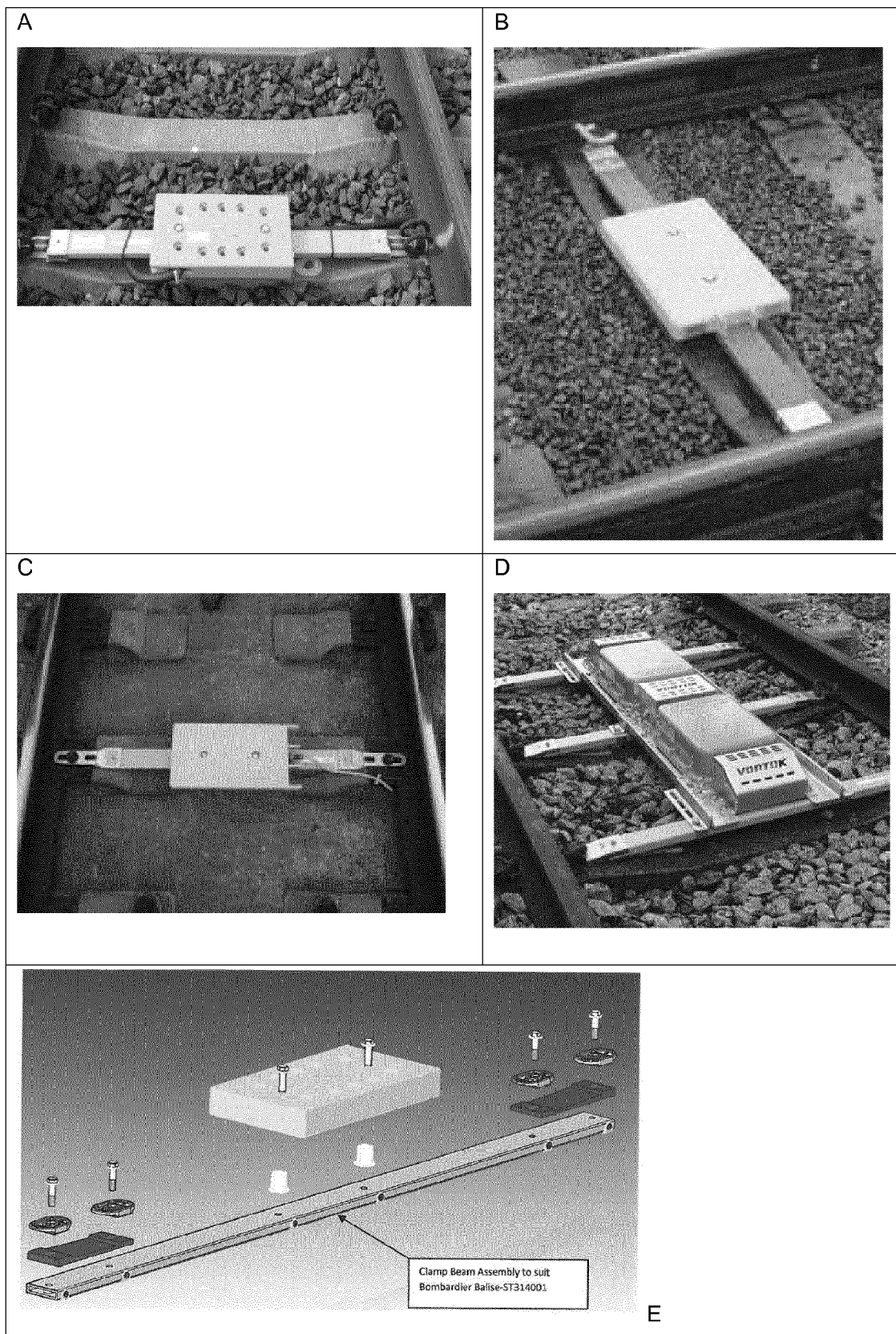
the composite, whereas resin constitute 40-60% weight of composite, preferably resin constitute about 70% weight of composite.

4. The mounting beam according to claims 1-3, **characterized in that**, in the central part of the mounting beam (1) an interliner (14) is arranged, preferably the interliner (14) is made of soft material, preferably with porous structure or a honeycomb structure. 5
5. The mounting beam according to claims 1-4, **characterized in that**, the first end of the beam (3) has a shape resembling the letter C in the cross-section, which forms a receptive recess (20) and allows to embrace the rail (5) above and below a part of the rail foot (17). 10
6. The mounting beam according to claims 1-5, **characterized in that**, the second end of the beam (4) is extended only at the bottom of the beam, wherein the length and shape of the extension (19) allow to insert the extension (19) under the rail foot (17) during the assembling of the beam in the track, and the second end of the beam (4) has a receptive protrusion (21) that rests against the edge of the rail foot (17) during the assembling of the beam in the track. 15
7. The mounting beam according to claims 1-6, **characterized in that**, at the second end of the beam (4) there is a concavity (15) in shape adapted to receive the fastening block (8), wherein preferably the concavity (15) and the fastening block (8) have matching mounting holes (16) that are adapted to receive the fastening elements (10), preferably, both the beam (1) and the fastening block (8) that fits the concavity (15) are made of a composite material comprising resin-bonded glass composite, wherein preferably they are made of glass-polyester, glass-vinylester, or glass-epoxy composite; more preferably, both the beam (1) and the fastening block (8) that fits the concavity (15) are made of the same composite material, wherein preferably the fastening block (8) is covered with an elastic material in the area that comes into contact with the rail (5). 20
8. The mounting beam according to claims 1-7, **characterized in that**, the second end of the beam (4) is covered with an elastic material on the side of the part that comes into contact with the rail (5). 25
9. The mounting beam according to claims 1-8, **characterized in that**, the mounting beam has flattening (11) in the central part of the beam (2). 30
10. The mounting beam according to claims 1-9, **characterized in that**, the beam's (1) arc of the bend, with the central part (2) of the beam raised upwards, 35

has a sagitta of about 20-30 mm, more preferably of about 23-28 mm, more preferably of about 25 mm.

11. The mounting beam according to claims 1-10, **characterized in that**, in the central part (2) of the beam there are shaped holes (9) adapted so as to receive the fastening elements (10). 40
12. The mounting beam according to claims 1-11, **characterized in that**, the width of the first end of the beam (3) and of the second end of the beam (4) at the place where they come into contact with the rails (5) is 1.5 to 2.5 times (preferably about 2 times) greater than the width of the beam at the narrowest part at the place where the beam (1) is slimmed down (12). 45
13. A method of assembling the element, especially the balise, on tracks, such as railway tracks, **characterized in that** the element to be assembled (6), in particular the balise, is fastened to the mounting beam as defined in claims 1-14, wherein mounting beam (1) is fastened between the rails (5) of the track. 50
14. A method for assembling the mounting beam for the fastening of elements that are to be assembled between the rails of tracks, especially railway tracks, **characterized in that**, it comprises the following steps: 55
  - a) the insert (7) is slid onto the rail foot at least in the place of assembling the first end (3) of the beam; then, the second end (4) of the mounting beam as defined in claims 1-13 is slid under the rail foot (17) until contact is made between the edge of the rail foot and the receptive protrusion (21) of the second end (4) of the beam; the first end (3) of the mounting beam is pressed into the rail foot (17); the mounting beam (1) is pulled in the central part (2) so that the receptive recess (20) of the first end (3) of the mounting beam have embraced the rail foot (17), wherein it is more preferable to slide the insert (7) onto the rail foot (17) at the place of assembling of both ends of the beam;
  - b) the fastening block (8) is placed in the concavity (15) at the second end (4) of the beam, and the fastening block (8) is fixed to the beam (1) using the fastening elements (10). wherein, preferably, step (a) is preceded by mounting on the beam (1), in the central part of the beam (2), the element to be mounted (6), wherein the element to be mounted is preferably the balise (6).
15. Use of the mounting beam as defined in claims 1-11 for the fastening of elements to be assembled on tracks, such as railway tracks, in particular for the fastening of the balise on railway tracks. 60

Fig. 1



State of the Art

Fig. 2

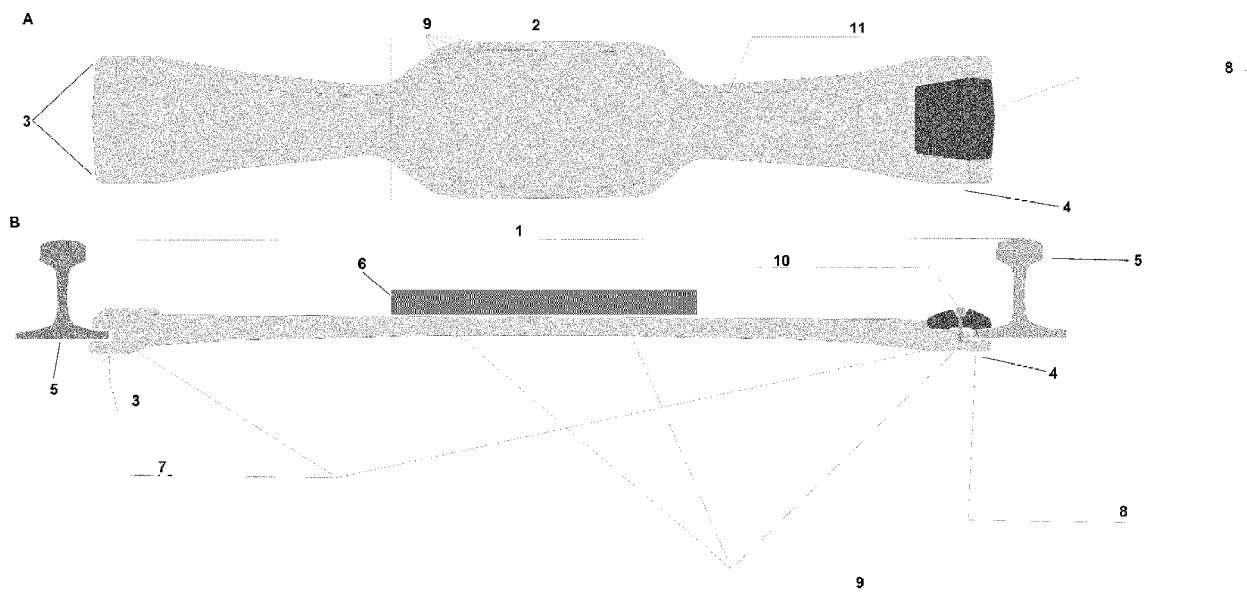
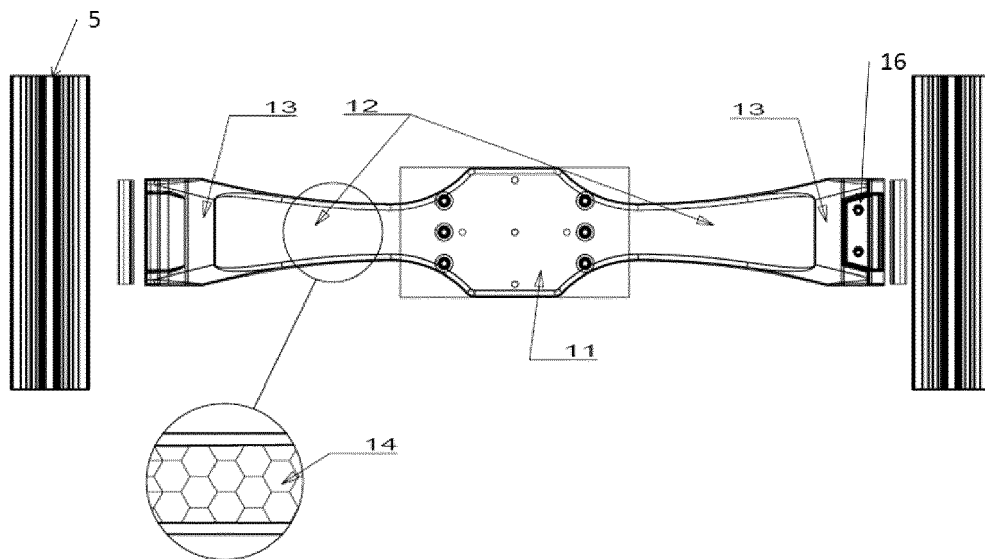


Fig. 2– continued

C



D

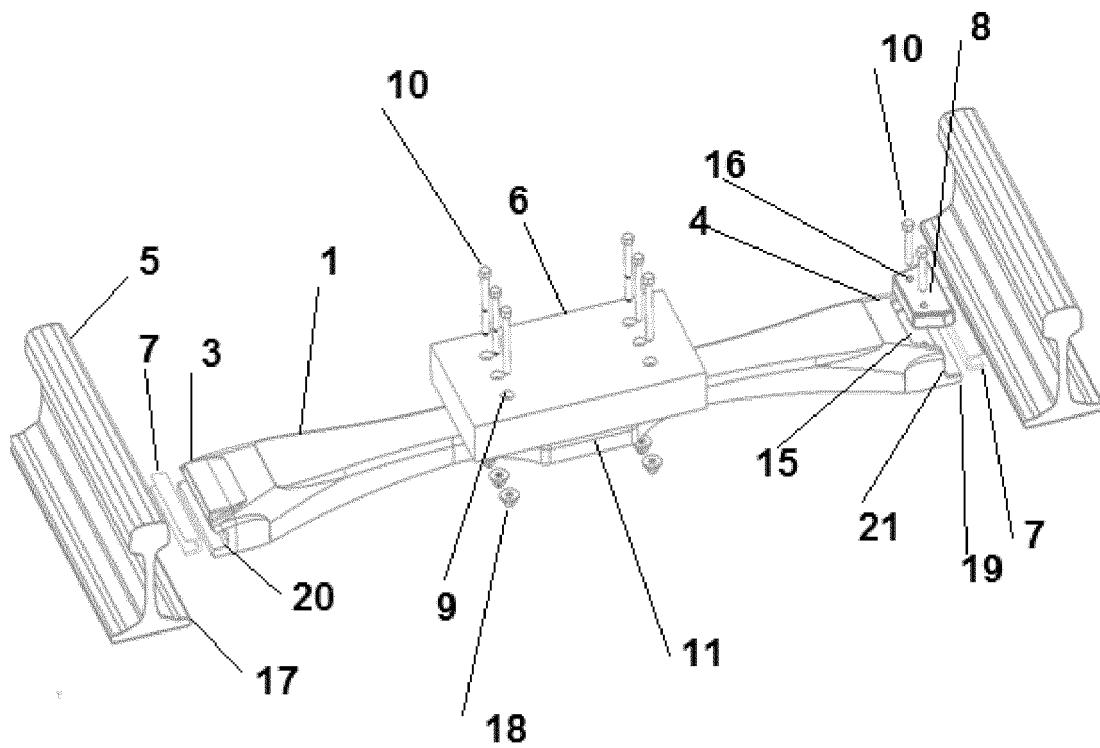


Fig. 2– continued

E

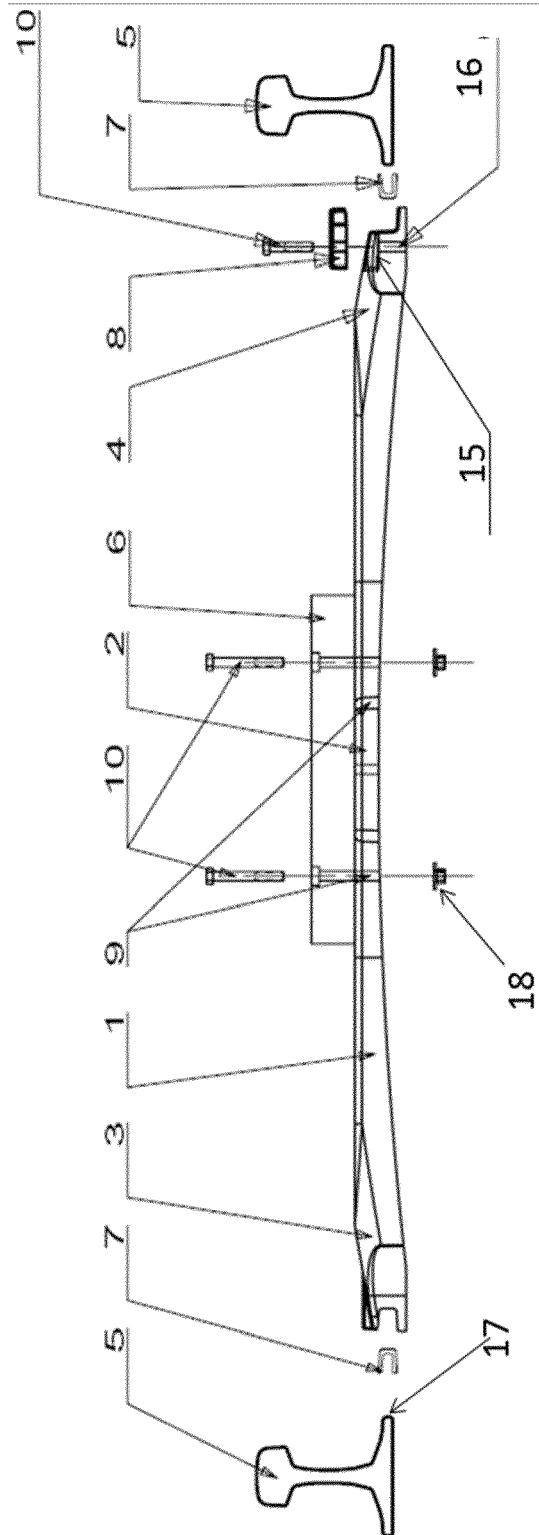
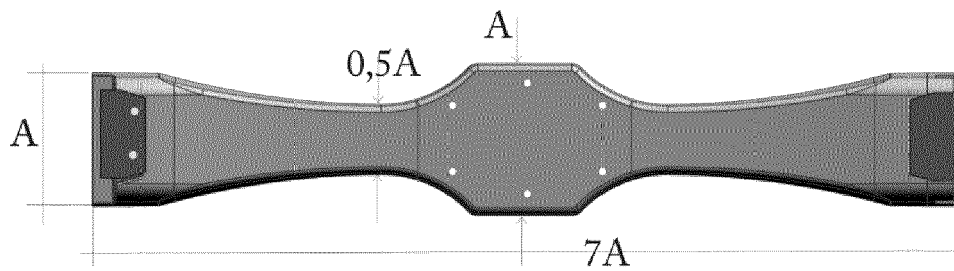
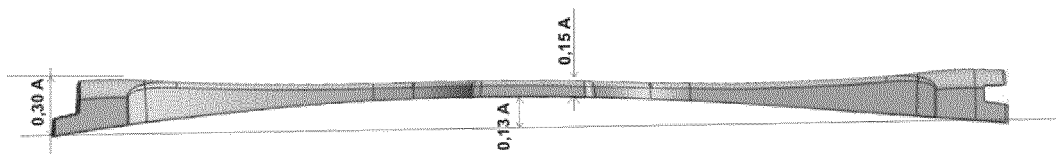


Fig. 3



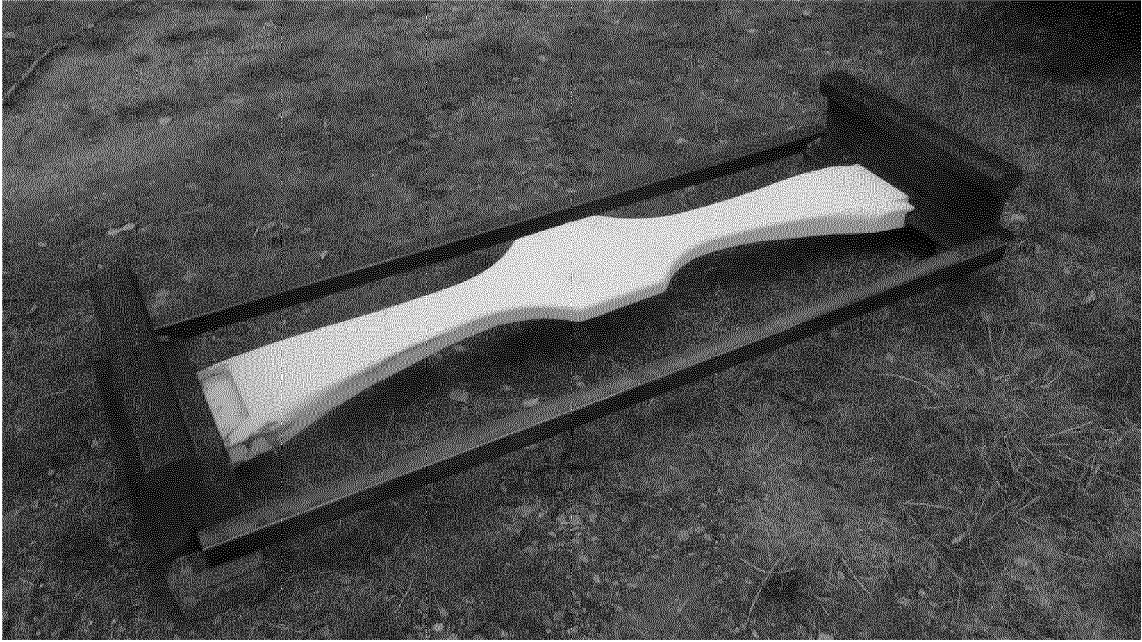
A)



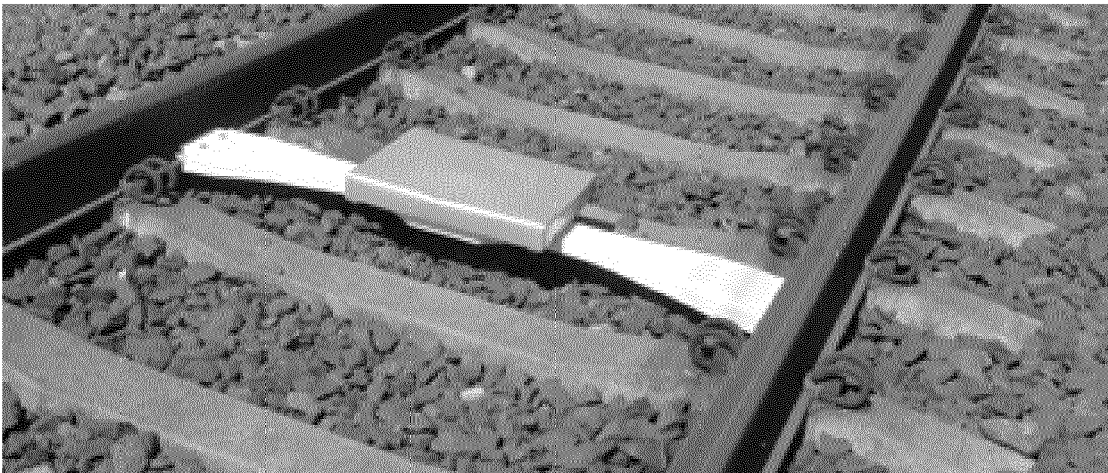
B)

Fig. 3 continued

C)



D)



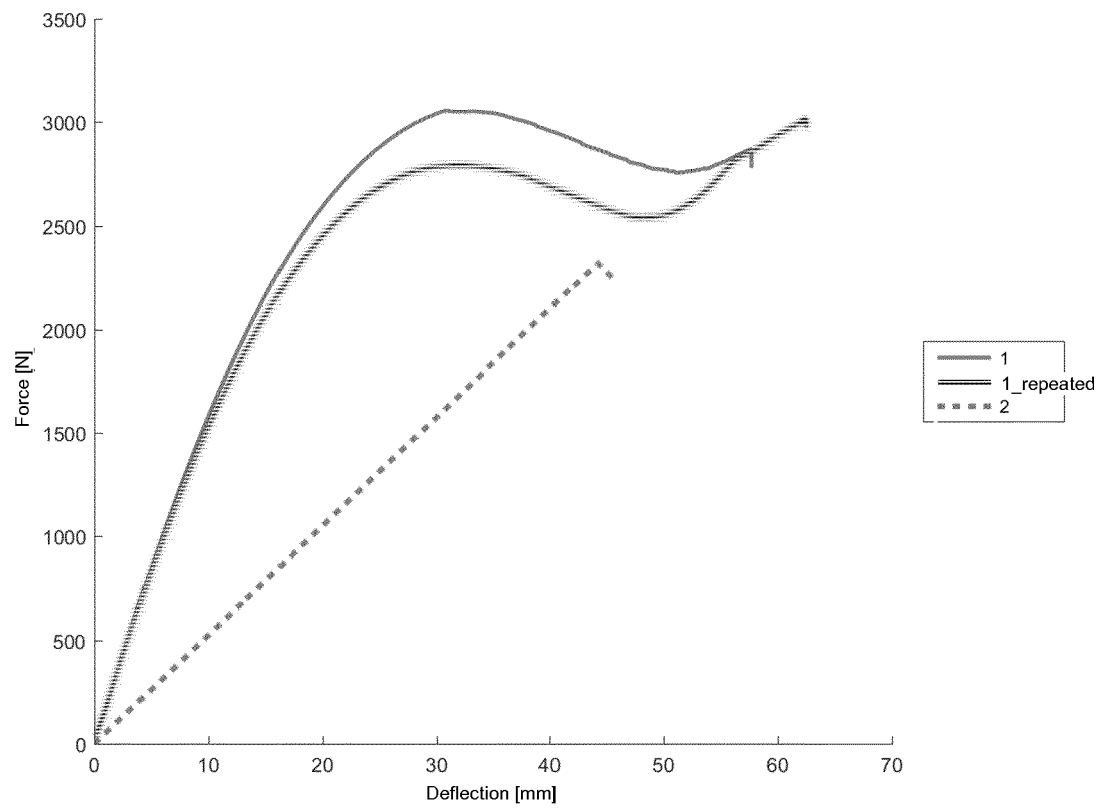


Fig. 4

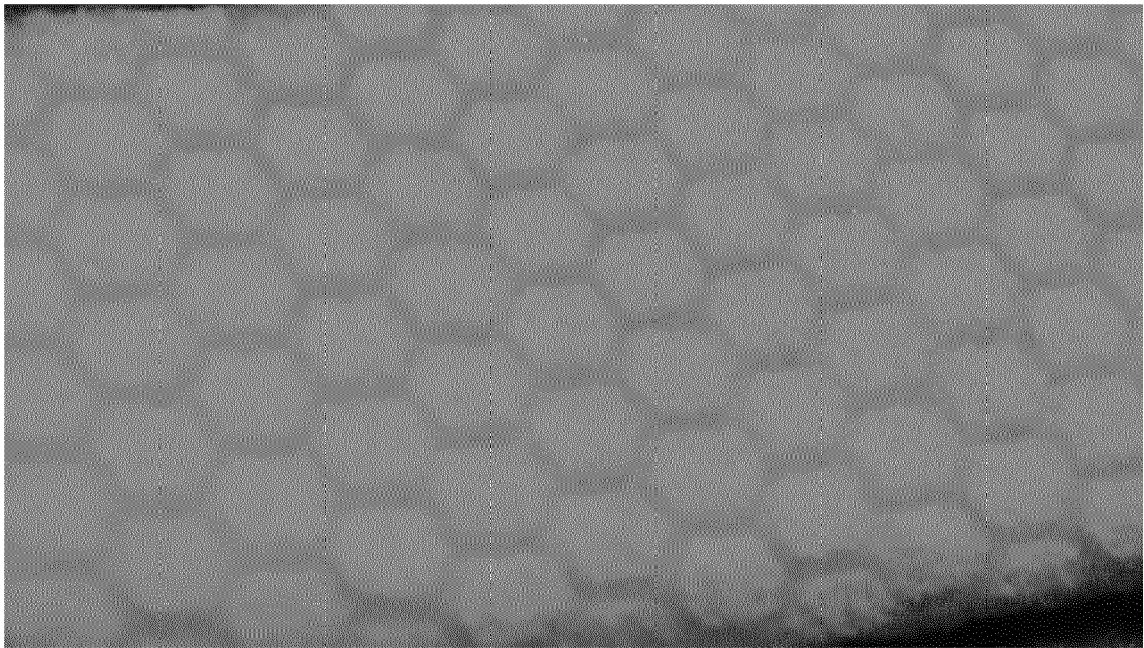


Fig. 5

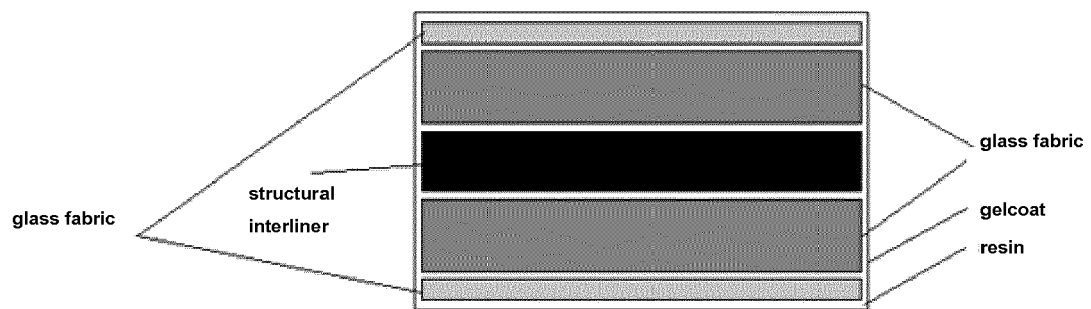


Fig. 6

A



B





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Application Number  
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| DOCUMENTS CONSIDERED TO BE RELEVANT                                                                                                                                                                                                                       |                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                                                                                                                                                                                                                                                    |                                                    |
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