(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) **EP 1 988 213 A1**

(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
05.11.2008 Bulletin 2008/45

(51) Int Cl.:
E01B 19/00 *(2006.01)* ***E01B 21/04*** *(2006.01)*
E01C 9/06 *(2006.01)*

(21) Application number: **07075326.4**

(22) Date of filing: **02.05.2007**

(84) Designated Contracting States:
AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HU IE IS IT LI LT LU LV MC MT NL PL PT RO SE SI SK TR
Designated Extension States:
AL BA HR MK RS

(71) Applicant: **edilon)(sedra B.V.**
2031 CN Haarlem (NL)

(72) Inventors:
- **Van Der Houwen, Gerrit Marinus**
  2023 EL Haarlem (NL)
- **Schram, Willem Paul**
  2151 AC Nieuw-Vennep (NL)

(74) Representative: **Volmer, Johannes Cornelis**
Exter Polak & Charlouis B.V.
P.O. Box 3241
2280 GE Rijswijk (NL)

(54) **Prefabricated rail supporting element**

(57) The invention relates to a prefabricated rail supporting element for supporting a rail for rail-bound vehicles, having a longitudinal elastic body with a bottom portion having a bottom and side portions having a top side forming a rail receiving opening extending along the length of said element. The rail receiving opening is adapted to receive the rail while leaving a head of the rail exposed, which body is adapted to be embedded in a rail track base structure. The invention is characterized in that the element further comprises an elongated protective strip, which is connected to a side portion of the elastic body so as to leave the bottom of the elastic body exposed, and extends essentially over the length and in an upper corner region of said body. The strip has anchoring means protruding sideways from the protective strip.

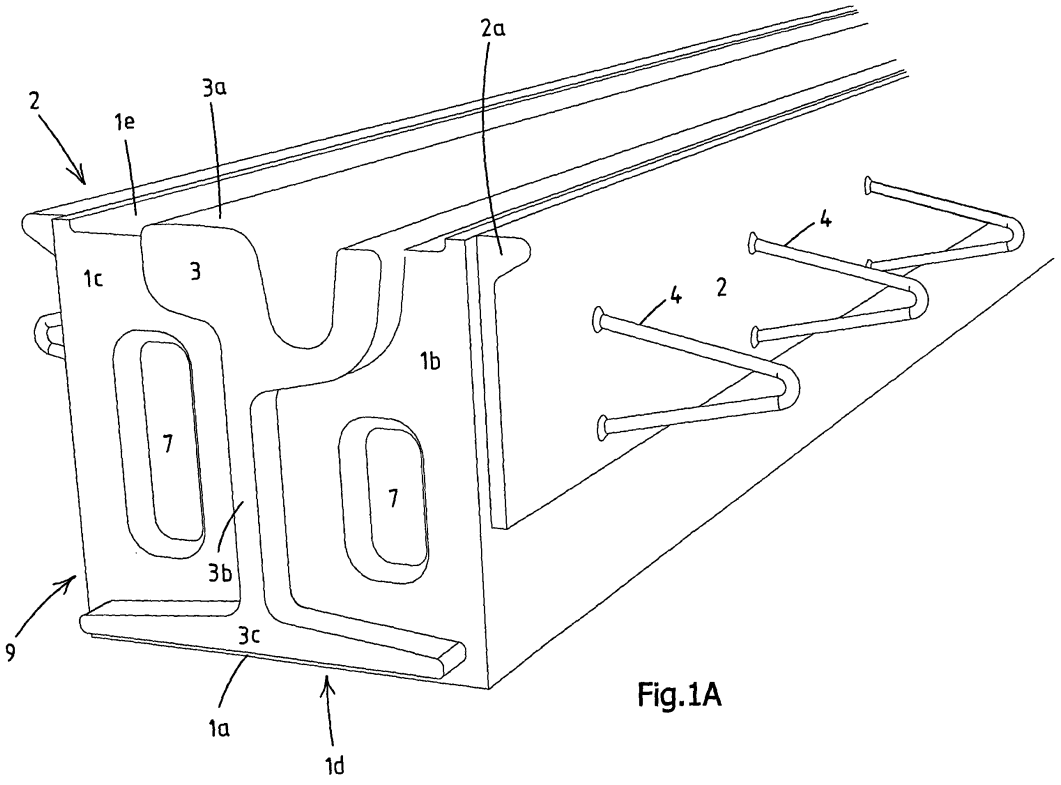

Fig.1A

EP 1 988 213 A1

Description

[0001] The present invention relates to a prefabricated rail supporting element for supporting a rail for rail-bound vehicles, having a longitudinal elastic body with a bottom portion having a bottom and side portions having a top side forming a rail receiving opening extending along the length of said element, which rail receiving opening is adapted to receive the rail while leaving a head of the rail exposed, which body is adapted to be embedded in a rail track base structure.

[0002] Such a prefabricated rail supporting element is used to hold any type of tramway rail, railway or any other type of rail. Conventionally, a rail comprises a head, a narrower intermediate portion and a base region. As an alternative to rails being fastened to sleepers they can be supported in a longitudinal elastic body, which body is adapted to be embedded in a rail track base structure. Such a socalled "paved-in embedded railstructure" is suitable for the classic forms of transport - metros, trams and trains, but are also for the infrastructure concepts of the future: light rail, heavy rail and high speeds and guided bus railsystems. Advantages of embedded rail systems are reduced vibration and noise disturbance, longlasting, maintenance free and easy to install.

[0003] As an alternative to pour the elastic material around the rail in situ, it is well known to fabricate a longitudinal elastic body with a bottom portion having a bottom and side portions having a top side forming a rail receiving opening extending along the length of said element in advance, by pouring the elastic material in a mould. Such prefabricated rail supporting elements are frequently applied for resilient mounting of a rail and well-known to the person skilled in the art. The prefabricated elastic bodies insulate against noise and vibration and are preferably made from materials having good electrical insulation from e.g. stray currents. Such a prefabricated elastic shell can easily be bent open to introduce a rail.

[0004] The longitudinal elastic body surrounding the rail is adapted to be embedded in a rail track base structure. Such a rail track base structure may be a pourable road pavement. Such a pourable road pavement may be concrete or asphalt or the like, or any combination thereof, such as a concrete basis and an asphalt top layer as road surface. In a finished configuration the road pavement level, the top level of the railhead and the top side of the elastic body is substantially the same, in which the rail is confined by the elastic body, and the elastic body is confined by the rail track base structure. Hence, the elastic body is situated between the rail and the rail track base structure and a body - road pavement interface is in contact with the open air.

[0005] A disadvantage of such an embedded rail system is fragmentation of the rail track base structure confining the elastic body. Such fragmentation at the interface possibly results from differences in elasticity or expansion coefficient between the materials, or expansion of ice in existing pores during winter.

[0006] EP 1 155 194 discloses a rail system in which a rail is surrounded by a resilient material, while leaving a head of the rail exposed, which resilient material is filled in a U-shaped profile, in this document called a 'shell'. Hence, the resilient material is situated between the rail and the profile, the profile adjoining the rail track base structure. The purpose of the U-shaped profile described in this patent was to provide a profile in which the resilient material could be poured, and not to prevent fragmentation of the road pavement confining the shell.

[0007] Among the disadvantages of this U-shaped profile are its weight and stiffness, which are disadvantageous in handling. Moreover, the subsequent mounting of a rail in a prefabricated rail system requires considerable forces, especially rail types having a narrow intermediate portion and a large, broad base. Hence, in practice this profile can only be used for very specific rail types having a relatively small base of approximately the same size as the rail head, which are custom made for this type of prefabricated rail system. Common rail types are not suitable for this system, e.g. rail types having a bulky and/ or broad base, such as a 'flat-bottom rail' or 'Vignoles rail', or a 'grooved rail'.

[0008] The object of the present invention is to provide an alternative improved embedded rail system.

[0009] The embedded rail system according to the invention is characterized in that the element further comprises an elongated protective strip, which is connected to a side portion of the elastic body so as to leave the bottom of the elastic body exposed, and extends essentially over the length and in an upper corner region of said body, which strip has anchoring means protruding sideways from the protective strip.

[0010] The elongated protective strip according to the invention enforces the interface between the elastic body and the rail track base structure and protects the edge of the rail track base structure confining the elastic body from embrittlement. The protective strip hence provides a reinforcement of the interface which can take up loads from vehicles.

[0011] The protective strip is connected to the elastic body. The protective strip can be connected to the elastic body by assembling the protective strip and the elastic body when the elastic body is made in its mould. Alternatively, the protective strip is connected to a prefabricated elastic body. The rail supporting element according to the invention comprising the elastic body with the protective strip attached to it is an improvement over conventional rail supporting elements without the protective strip. The elastic body with the protective strip can analogously be combined with a rail in situ, and subsequently embedded in a rail track base structure.

[0012] The protective strip is connected to a side portion of the elastic body and extends essentially over the length thereby reinforcing the interface between the elastic body and the rail track base structure, and so as to leave the bottom of the elastic body exposed. The pro-

tective strip is connected to an upper corner region of one or both side portions of said elastic body, which may be only at the top side of the elastic body, only at the side of the elastic body or connected to both the top side and one or both sides of the elastic body.

[0013] By leaving the bottom of the shell exposed less protective strip material is required resulting in less weight and lower prices as compared to a U-shaped profile surrounding the entire elastic body. Moreover, by only providing a protective strip comprising a maximum of one bend instead of two bends in a U-shaped profile, the combination remains more flexible and easier to handle. In practice, this means that rails held in the elastic body comprising a protective strip according to the invention may have a smaller curvature radius than with rails held in an elastic body comprising a U-shaped profile. But the most important effect of providing one or two protective strips at the upper corner region and leaving the bottom of the elastic body exposed is that the elastic body can be bend open in order to introduce the rail. Due to this the rail supporting element according to invention can be used for any rail type, even with a very bulky base. Well-known common rail types suitable to be supported in a rail supporting element according to the invention are Vignoles rails, flanged rails, grooved rails, flat bottom rails, bullhead rails, etc. etc. Yet another effect is that replacement of a rail is much easier. When replacing a rail, both the rail and the elastic body material holding the rail are removed. A new rail is embedded in elastic material poured around the rail in situ. The removal of the elastic body material is much easier when the elastic body material only adheres to the protective strips at the upper side regions, instead of adhering to a complete U-shaped surrounding profile.

[0014] Preferably, the protective strip extends up to the top side of the elastic body and prevents the elastic body - rail track base structure from being in contact with the open air. Hence, fragmentation at this interface is prevented, thereby a creating stable and solid embedded rail system.

[0015] The protective strip can have various shapes. For example: only a vertically extending strip having an upper face extending at the top side of the elastic body, or T-shaped, having the horizontal part of the 'T' extending partly over the top side of the elastic body, or alternatively bulb-shaped, having the bulb protruding from the side of the elastic body, or alternatively having the bulb extending partly over the top side of the elastic body.

[0016] The protective strip may be made of plastic, metal or composite material. Preferably, the strip extends along the entire length of the prefabricated elastic body. However, when the protective strip is made of a metal, the protective strip should be little shorter than the prefabricated elastic body to prevent any electric contact between the protective strips when interconnecting multiple elastic bodies.

[0017] In a preferred embodiment, the protective strip extends up to the top side of the body. More preferably, the protective strip extends up to the road surface after having embedded the rail supporting element in the rail track base structure, such that the upper face of the protective strip forms part of the road surface, provided between the rail track base structure and the elastic body. In this embodiment, it is prevented that the interface between the elastic body and the rail track base structure is exposed to the open air, thereby preventing the entrance of water at the interface. The upper face of the protective strip, preferably forming part of the road surface, may be provided with a wear-resistant coating, both to prevent a slippery road surface and to prevent wear of the protective strip.

[0018] The protective strip according to the invention comprises anchoring means protruding sideways from the protective strip, to be anchored to the rail track base structure. This ensures a stable position of the protective strip between the elastic body and the rail track base structure: being connected to the elastic body on one hand, and anchored to the rail track base structure on the other hand. Such anchorage may be formed by protruding pins or loops, and is preferably made out of metal, most preferably steel. Other shapes may be applied, e.g. as commonly used for ground anchors. An advantageous anchorage is formed by a dovetail, which may be rolled in a metal protective strip profile or made by protrusion of a plastic protective strip. The advantage of this anchorage is that the elastic body for holding the rail may be relatively elastic to provide an increased damping insulation for the rail, while the interface with the rail track base structure having a much lower elasticity is not damaged. Conventionally, the larger the elasticity of the elastic body, the larger the slits are that may occur at the interface. With the protective strips comprising an anchorage according to the invention, a lower stiffness of the elastic body allowing over 2 mm of compression can be realized without damaging the interface between the elastic body and the rail track base structure and causing cracks.

[0019] The elastic body may be composed of one or more elements. In a preferred embodiment, the elastic body is made as a single piece. This prefabricated elastic body has generally a U-shape to hold the rail in. The U-shape can be opened (unfolded) to allow the rail to be entered. Alternatively, the prefabricated elastic body is composed of multiple elements, e.g. two elements adjoining both sides of the rail and the bottom, or three elements, one of which adjoins the base of the rail. An advantage of an elastic body composed of more elements is that each element may have a different stiffness. The bottom portion of the elastic body is preferably more elastic to provide sufficient insulation against vibration, while the side portions may be less elastic to prevent torsion of the rail.

[0020] The prefabricated elastic body should be made of an elastic material to allow the rail to be entered in the elastic body. The elastic body material may be an elastic foam or an elastomeric material. Preferably, poly-

urethane is used. To save money and/ or weight, commonly cheap and/ or leight-weight fill elements are used in the elastic body, the fill elements being surrounded by the elastic material. Such fill elements may be tubes, blocks, chunks or profiles of foam, concrete or any other material.

[0021] Various advantageous embodiments of the rail supporting element according to the invention are described in the follow-up claims and in the following description with reference to the drawings, in which:

Figs. 1a and 1b show a perspective view of a prefabricated rail supporting element according to the invention, supporting a rail,

Fig. 2 shows a cross section of an alternative prefabricated rail supporting element according to the invention, supporting a rail,

Fig. 3 shows a cross section of yet an alternative prefabricated rail supporting element according to the invention, supporting a rail,

Figs. 4a and 4b show a cross section of yet an alternative prefabricated rail supporting element according to the invention,

Fig. 5 shows a cross section of yet an alternative prefabricated rail supporting element according to the invention, supporting a rail.

[0022] In figs. 1a and 1b a preferred embodiment of a prefabricated rail supporting element 9 according to the invention is shown. A longitudinal elastic body 1 with a bottom portion 1a having a bottom 1d and side portions 1b, 1c having a top side 1e form a rail receiving opening extending along the length of said element. The rail receiving opening receives a rail 3, while leaving a head 3a of the rail exposed. The type of rail 3 shown in this embodiment of the invention comprises a narrow web 3b and a broad flat-botted foot 3c. The elastic body 1 is made as a single piece, comprising cut-aways 7 at one end to couple the elastic body 1 with another such elastic body 1. To the upper corner region of the elastic body 1 two elongated protective strips 2 are connected. The strips 2 protect the edge of the rail track base structure in which the rail supporting element 9 shown in fig. 1a is to be embedded. Both strips 2 have a bulb-shaped profile. An elongated base of the profile is attached to the side of the elastic body 1, while a bulb 2a on the upper side of the strip protrudes away from the elastic body 1 and rail 3, in the direction of the rail track base structure 5,6 (not shown in fig. 1a). Also protruding in the direction of the rail track base structure are looped anchors 4, in the embodiment shown in fig. 1b interacting with bars 8 positioned in the loops 4, which provide a firm connection with the rail track base structure 5,6 once the rail track base structure is provided and the rail supporting element 9 is embedded in the rail track base structure. In fig. 1b the rail supporting element 9 according to the invention is embedded in a rail track base structure, here composed of a concrete bottom layer 5 and an asphalt top layer 6. It is clear from the drawing 1b that the head of the rail 3a is exposed to the open air, as well as the adjacent elastic body 2. However, the interface between the elastic body and the road pavement (asphalt layer 6) at the road surface is protected by the bulb 2a of strip 2.

[0023] Fig. 2 shows a cross section of an alternative rail supporting element 19 according to the invention. A longitudinal elastic body 10 is made as a single piece and comprises a similar bulb-shaped elongated protective strip 12 as shown in fig. 1. The protective strip is attached to a side face 10a of the shell 10, leaving the bottom side 10b of the shell exposed. The top side 10c of the elastic body 10 remains exposed to the open air. The elastic body 10 holds an alternative rail type 13, comprising a bulb-shaped head 13a which is kept exposed, a relatively broad web 13b and a broad, flat foot 13c. Also alternative anchoring means 14 are applied in this embodiment, comprising pins which will protrude from the protective strip 12 into the rail track base structure (not shown, yet not assembled).

[0024] Fig. 3 shows a cross section of yet an alternative prefabricated rail supporting element 29 according to the invention, comprising a longitudinal elastic body 20 having a bottom portion 20c and side portions 20a, 20b, forming a rail receiving opening receiving a rail 23, similar to the rail type shown in fig. 2. In side portions 20a, 20b tube-shaped fill elements 25 are provided. T-shaped elongated protective strips 22 are provided at the upper corner region of side portions 20a, 20b. The strips 22 are attached to the side portions of the shell 20 and extend up to the road surface. The protective strips will form part of the road surface and are provided with a wear-resistant top layer 24. Anchoring pins 26 protrude sideways from the protective strip 22.

[0025] In figs. 4a and 4b a prefabricated rail supporting element 39 according to the invention is shown. The rail supporting element 39 has a longitudinal elastic body 30 with a bottom portion 30a having a bottom 30d and side portions 30b, 30c having a top side 30e. Side portions 30b, 30c comprise fill elements 35, e.g. to decrease the weight of the element 30 or to lower the costs of the elastic body 30. The bottom portion 30a and side portions 30b, 30c form a rail receiving opening 33. In the embodiment shown in fig. 4b, side portions 30b, 30c are moved sideways and bottom portion 30a is bended to fold the rail supporting element 39 open, to be able to introduce a rail, not shown in fig. 4b, to obtain a rail supporting element such as shown in fig 4a comprising rail 34. A head 34a of the rail 34 is kept exposed. T-shaped elongated protective strips 32 are provided at the upper corner region of side portions 30b, 30c. The strips 32 extend up to the top side 30e of the side portions 30b, 30c, up to road surface 37. Yet another type of anchoring loops 36 protrude sideways from the protective strip 32.

[0026] Yet an alternative prefabricated rail supporting element 49 is shown in fig. 5. Rail supporting element 49 supports a rail 44 of the type previously shown in fig. 4. The rail supporting element 49 has a longitudinal elastic

body 40 shown in cross-section, with a bottom portion 40a having a bottom 40d and side portions 40b, 40c with a top side 40e. The elastic body 40 is composed of three elements 40a, 40b, 40c. Preferably the side elements 40b, 40c are more stiff than bottom element 40a, having a large elasticity to damp vibrations. Recesses 40f are provided to reduce weight of the side elements 40b, 40c. Elongated protective strips 42 are connected to side portions 40b, 40c of the elastic body 40 so as to leave the bottom of the elastic body 40d exposed. The protective strip 42 has a bulb-shaped profile with the bulb 42a extending partly over the top side 40e of the body 40. The prefabricate rail supporting element 49 is embedded in a rail track base structure, comprising a concrete bottom layer 48a, an asphalt top layer 48b extending up to a road surface 48c. Anchoring loops 46 protrude sideways from the protective strip 42. Since anchoring in concrete is more firm than in asphalt, the loops 46 extend lower than the loops 36 shown in fig. 4a. The anchoring means 36 shown in fig. 4a are more suitable for anchoring in concrete only.

Claims

1. Prefabricated rail supporting element for supporting a rail for rail-bound vehicles, having a longitudinal elastic body with a bottom portion having a bottom and side portions having a top side forming a rail receiving opening extending along the length of said element, which rail receiving opening is adapted to receive the rail while leaving a head of the rail exposed, which body is adapted to be embedded in a rail track base structure, **characterized in that** the element further comprises an elongated protective strip, which is connected to a side portion of the elastic body so as to leave the bottom of the elastic body exposed, and extends essentially over the length and in an upper corner region of said body, which strip has anchoring means protruding sideways from the protective strip.

2. Element according to claim 1, wherein the protective strip extends up to the top side of the body.

3. Element according to claim 2, wherein an upper face of the protective strip extending at the top side of the body is covered with a wear-resistant layer.

4. Element according to claim 2, wherein the protective strip has a T-shaped profile having the horizontal part of the 'T' extending partly over the top side of the body.

5. Element according to claim 2, wherein the protective strip has a bulb-shaped profile with the bulb protruding from the side of the body.

6. Element according to claim 2, wherein the protective strip has a bulb-shaped profile with the bulb extending partly over the top side of the body.

7. Element according to claim 1, wherein the protective strip is made of plastic or composite material.

8. Element according to claim 1, wherein the protective strip extends along the entire length of the elastic body.

9. Element according to claim 1, wherein the protective strip is made of metal, and has a shorter length than the elastic body to prevent electric contact between the protective strips when interconnecting the prefabricated elements.

10. Element according to claim 1, wherein the anchoring means comprise protruding pins or loops.

11. Element according to claim 1, wherein the anchoring means are made of steel.

12. Element according to claim 1, wherein the elastic body is made as a single piece.

13. Element according to claim 1, wherein the elastic body is composed of multiple elements.

14. Element according to claim 1, wherein the elastic body is composed of elastic foam.

15. Element according to claim 1, wherein the elastic body is composed of elastomeric material.

16. Element according to claim 1, wherein the elastic body is composed of polyurethane.

17. Element according to claim 1, wherein the elastic body comprises fill elements, surrounded by elastic material.

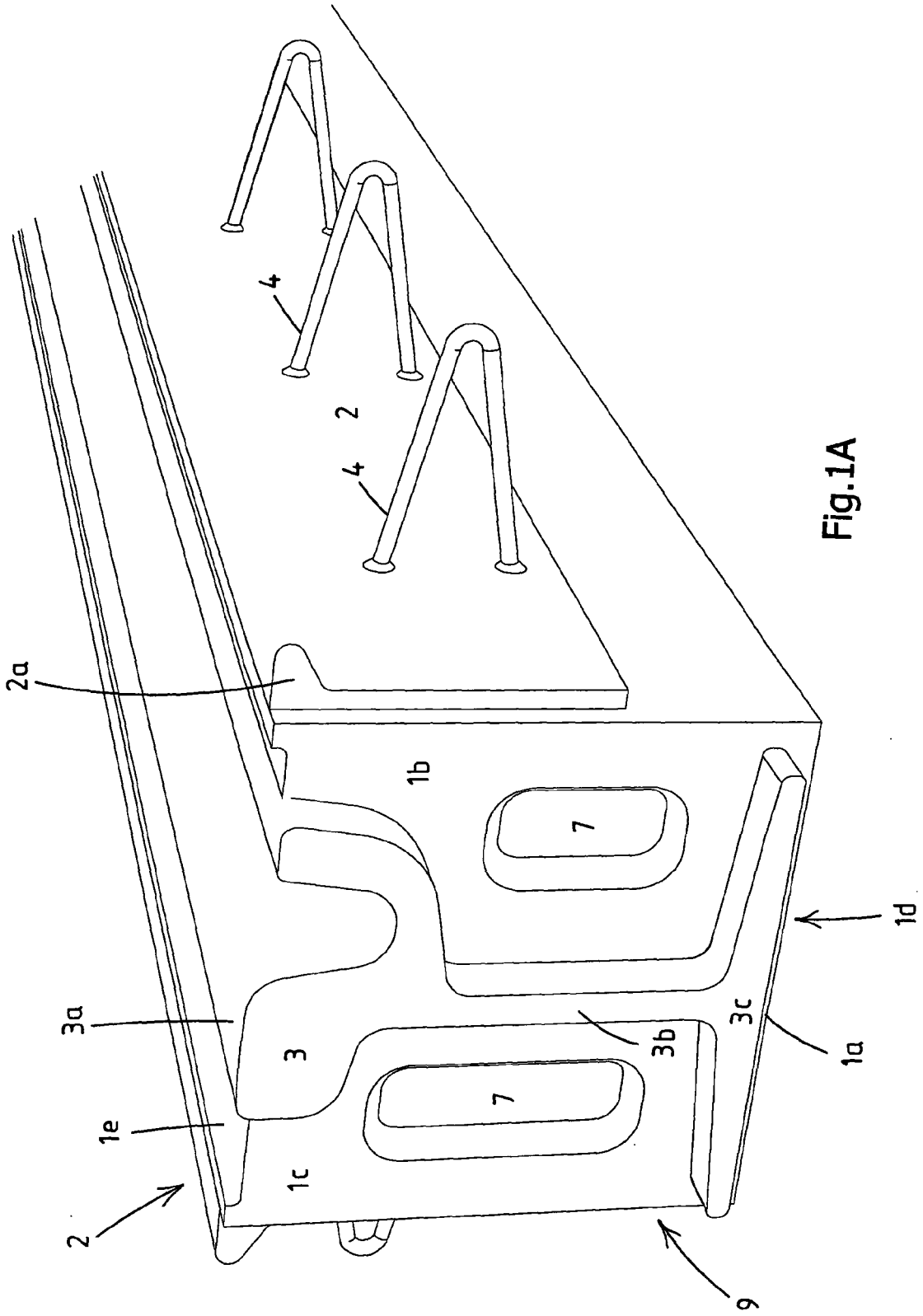

Fig.1A

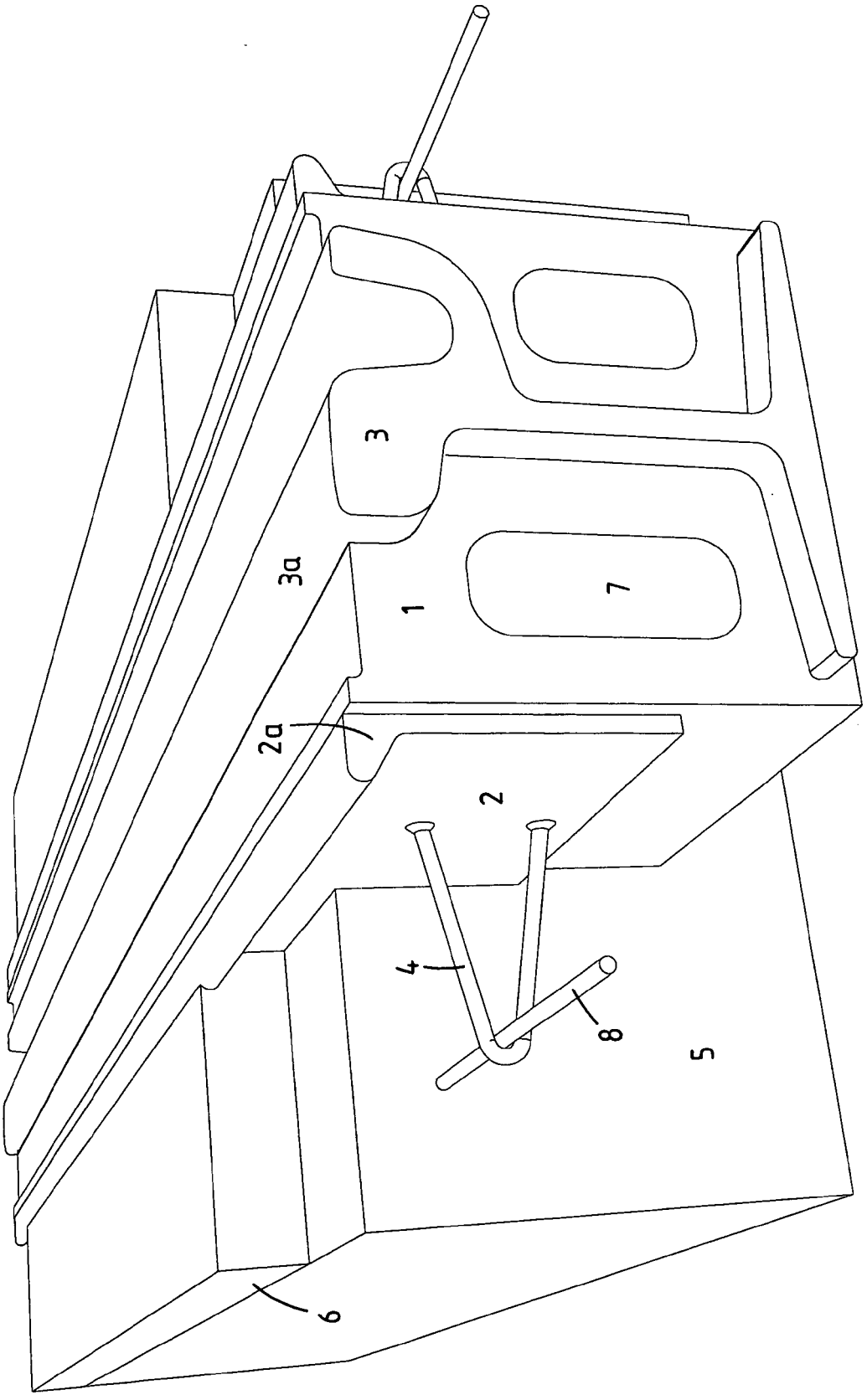

Fig.1B

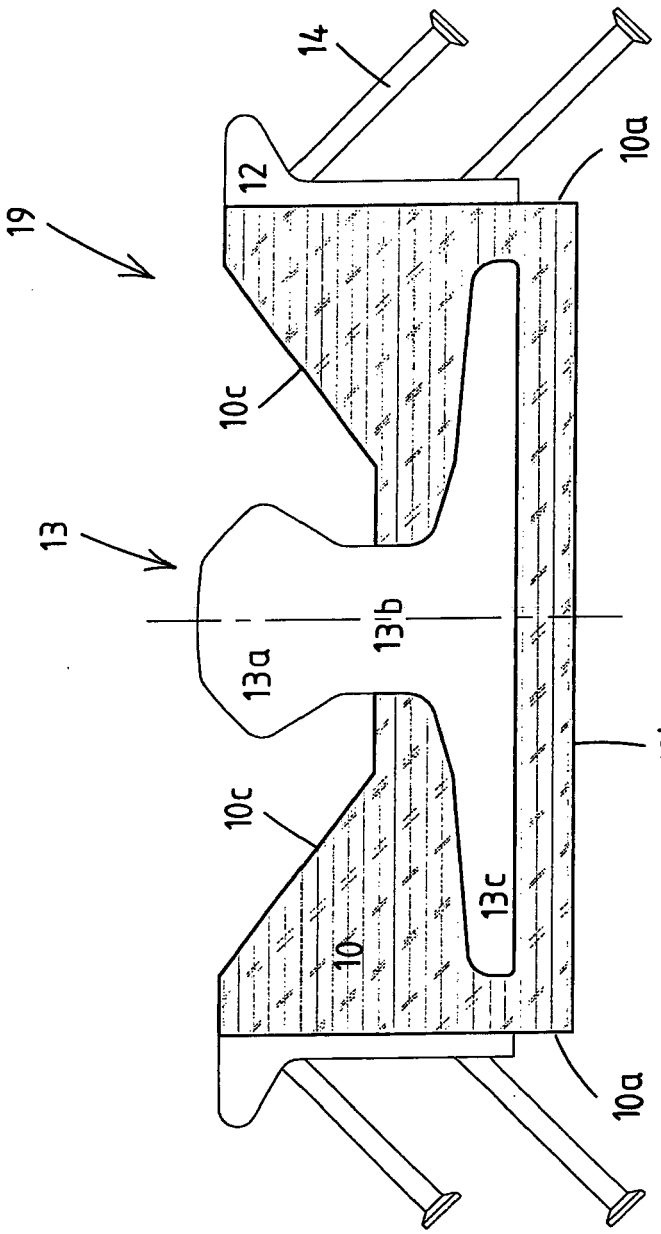

Fig.2

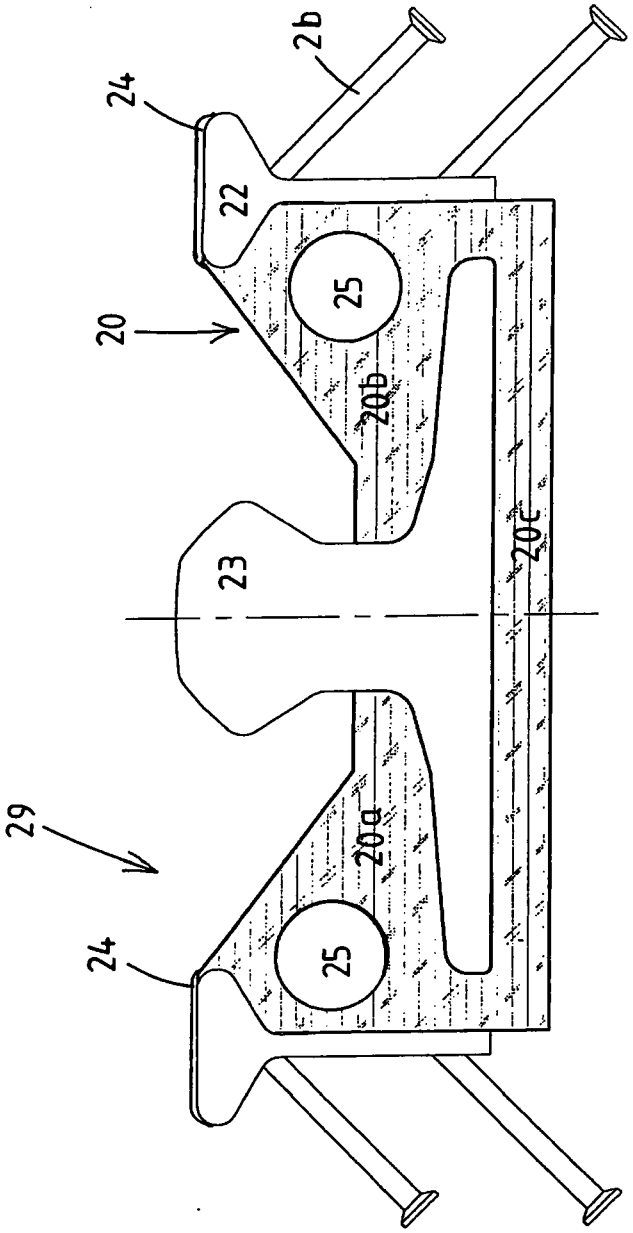

Fig.3

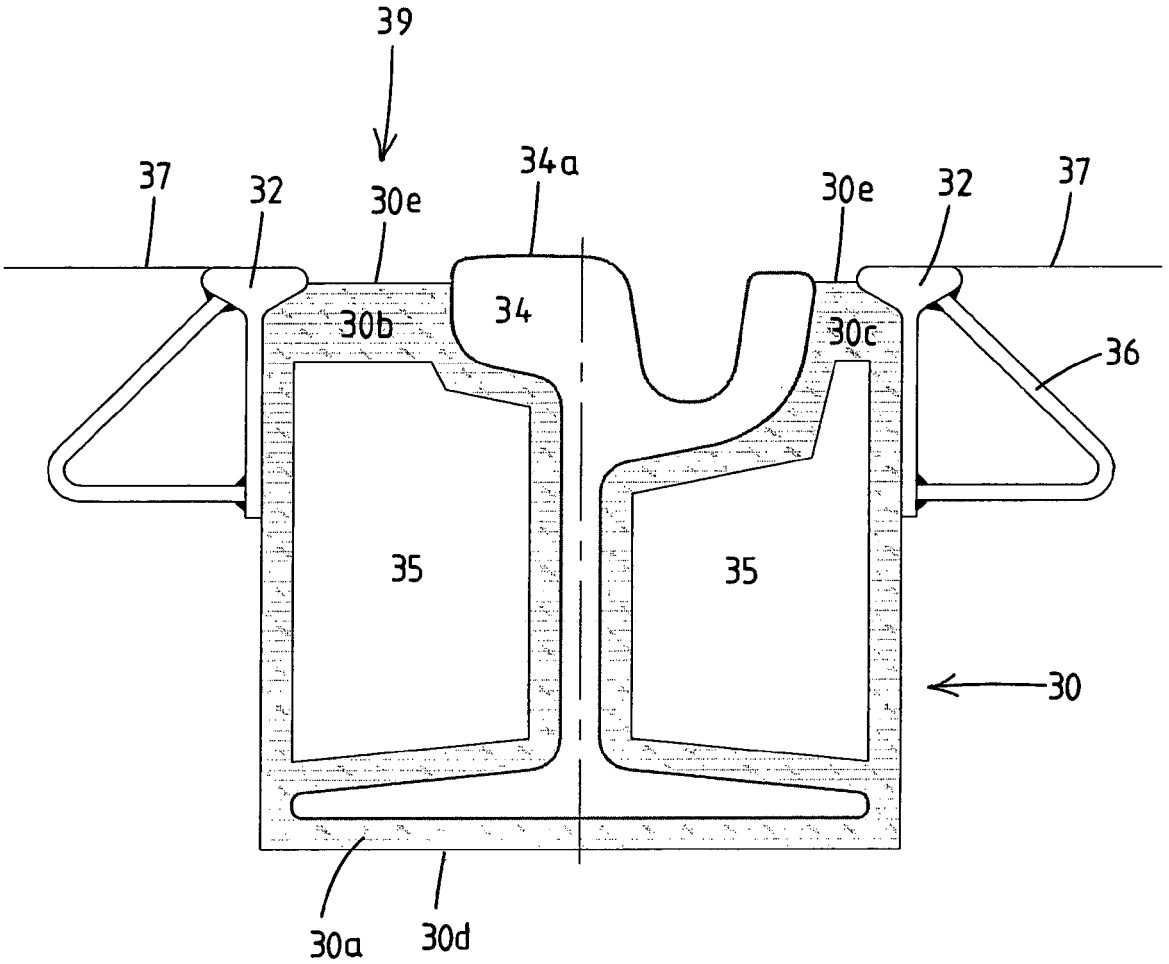

Fig.4A

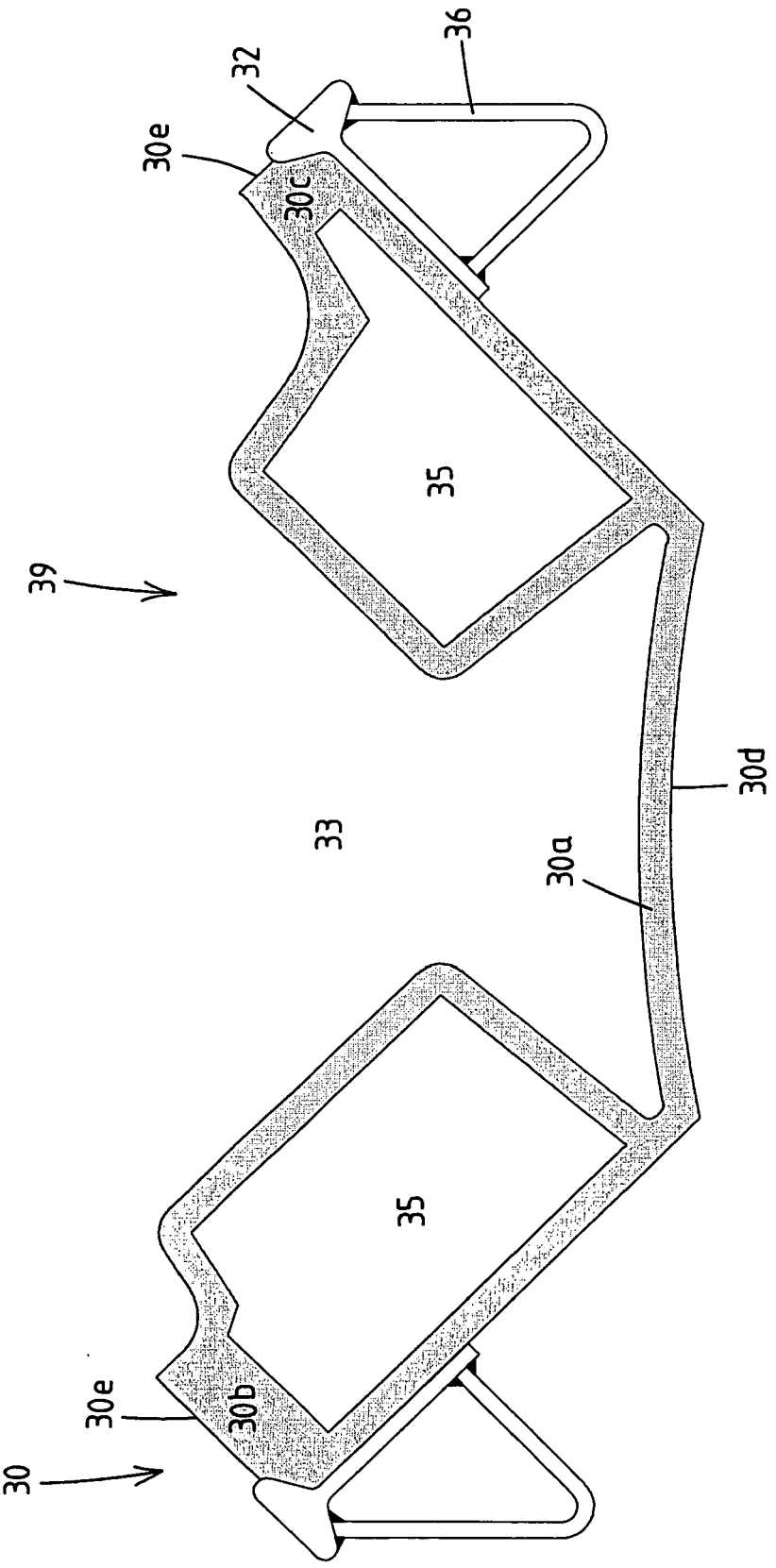

Fig.4B

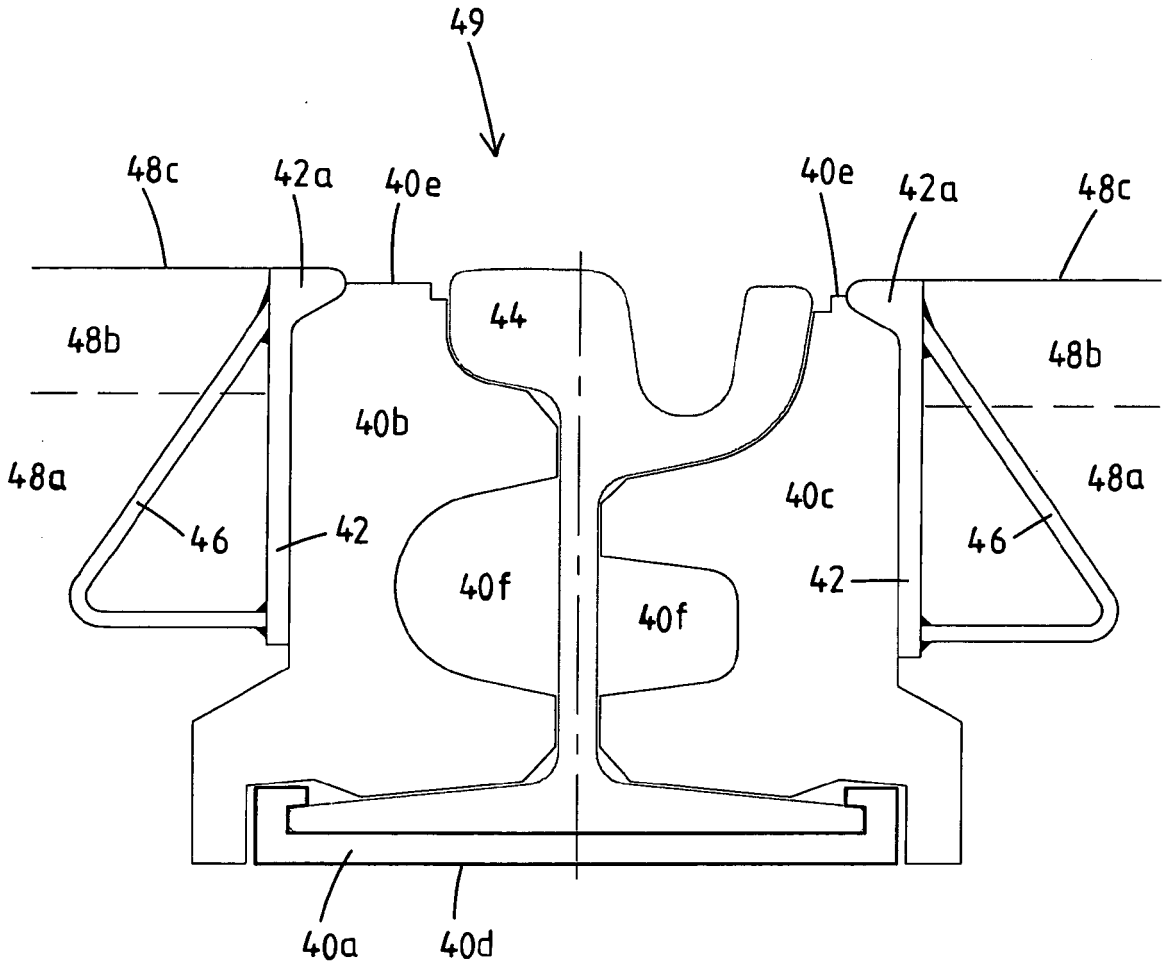
49
48c
42a
40e
40e
42a
48c
48b
44
48b
40b
48a
40c
48a
46
42
40f
40f
42
46
40a
40d

Fig.5

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 07 07 5326

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	WO 01/83889 A (IRON HORSE ENGINEERING CO [US]; HOFSTETTER DON R SR [US]; GRUNDMANN MA) 8 November 2001 (2001-11-08) * page 5, paragraph 2 - page 6 * * page 7, paragraph 1; figures *	1,2,5,7, 8,10, 12-17	INV. E01B19/00 E01B21/04 E01C9/06
A	WO 2006/032684 A (FERONIA S A [LU]; RODE JOSEPH [BE]) 30 March 2006 (2006-03-30) * page 10, paragraph 2; figure 8 *	1	
A	EP 0 854 234 A1 (DIRVEN STEPHANE [BE]) 22 July 1998 (1998-07-22) * column 3, line 54 - column 4, line 10; figure 1 *	1	
A	US 1 672 752 A (COPPOCK FRED D) 5 June 1928 (1928-06-05) * figure 1 *	1	
A	DE 195 25 325 A1 (CLOUTH GUMMIWERKE AG [DE]) 16 January 1997 (1997-01-16) * the whole document *	1	

TECHNICAL FIELDS SEARCHED (IPC)

E01B
E01C

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	19 September 2007	Movadat, Robin

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

EPO FORM 1503 03.82 (P04C01)

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 07 07 5326

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

19-09-2007

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO 0183889 A	08-11-2001	AU 774420 B2	24-06-2004
		AU 5752001 A	12-11-2001
		EP 1192315 A1	03-04-2002
WO 2006032684 A	30-03-2006	CA 2581089 A1	30-03-2006
		EP 1807569 A1	18-07-2007
		KR 20070053814 A	25-05-2007
EP 0854234 A1	22-07-1998	AT 269444 T	15-07-2004
		BE 1010355 A6	02-06-1998
		DE 69824459 D1	22-07-2004
		DE 69824459 T2	25-08-2005
		ES 2224350 T3	01-03-2005
		PT 854234 T	30-11-2004
US 1672752 A	05-06-1928	NONE	
DE 19525325 A1	16-01-1997	NONE	

EPO FORM P0459

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

REFERENCES CITED IN THE DESCRIPTION

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

Patent documents cited in the description

- EP 1155194 A **[0006]**