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

(11) **EP 3 974 582 A1**

(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
30.03.2022 Bulletin 2022/13

(21) Application number: **20198448.1**

(22) Date of filing: **25.09.2020**

(51) International Patent Classification (IPC):
E01B 19/00 *(2006.01)*

(52) Cooperative Patent Classification (CPC):
E01B 19/003

(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

(71) Applicant: **Vitrea AB**
104 30 Stockholm (SE)

(72) Inventor: **Frantzich, Mats**
183 52 Täby (SE)

(74) Representative: **Groth & Co. KB**
P.O. Box 6107
102 32 Stockholm (SE)

(54) **RAIL DAMPER SYSTEM**

(57) Disclosed herein a rail damper system (1, 1') comprising at least one elastic damper element (4, 4') made of a vibration absorbing material and a fastening mechanism (6) configured to fasten the at least one elastic damper element (4, 4') to a web (20) of a rail (2). The fastening mechanism (6) comprises at least one rod (28) and at least one fastener (30), wherein the rod (28) or bolt is designed to extend through a hole (40) in the web (20) of the rail (2) and through a hole (26) in the elastic damper element (4, 4') so that it can fasten the elastic damper element (4, 4') snug to the web (20) via the at least one fastener (30) arranged on a side of the elastic damper element (4, 4') that is facing away from the web (20) when the at least one elastic damper element (4, 4') is installed on the rail (2).

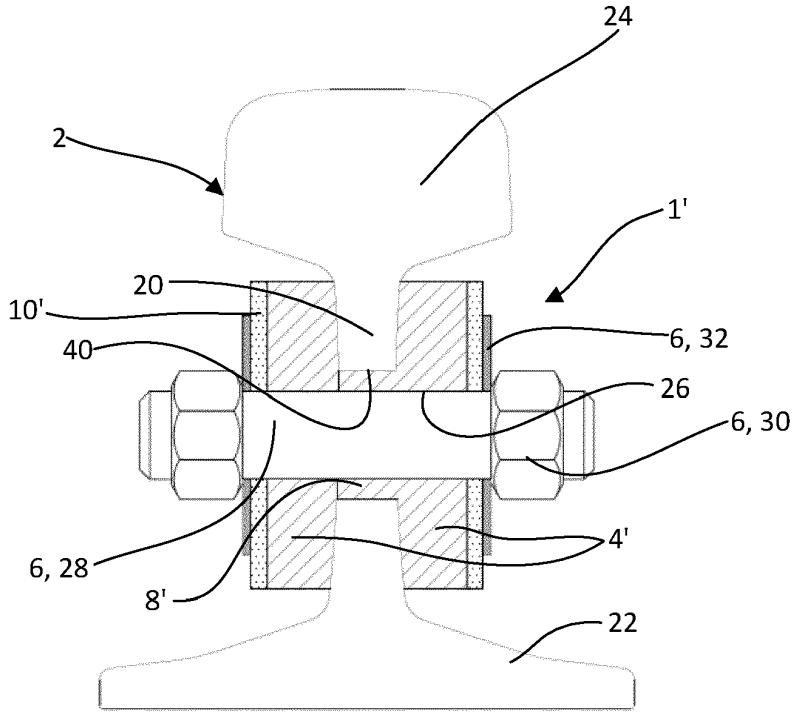

Fig. 3

EP 3 974 582 A1

Description

Technical Field

[0001] The invention relates to the field of damper systems for rail tracks, in particular to a rail damper system that is smart, easy to install and durable. Railways and rails can generate a lot of noise due to oscillations and small vibrations in the rails and it is usually a requirement to provide and install rail damper systems in densely populated areas.

Background of the Invention

[0002] Typical rail damper systems comprise a clamp or the like that extends under the foot of the rail and clamps or pushes damper elements towards the web of the rail. These clamps are typically made of a flexible and durable metal and connected to damper elements made of a softer material, which is capable of absorbing noise generating oscillations and noise generating vibrations from the rail and therewith reduce noise. The clamps are in some cases screwed to the foot of the rail and also to the damper element(s). Figure 1 illustrates a damper element 100 according to the prior art. The damper element 100 is held by a metal clamp 102 and pressed towards the web 104 of the rail 106 in order to reduce noise generation when a train or streetcar is passing over the rail. The clamp 102, which is typically made of a resilient and durable metal, extends under a base 108 of the rail 106 and presses a pair of dampers 110 towards the web 104 of the rail 106 on each side of the web 104. Thereby the clamp 102 extends over the pair of dampers 110 on both sides and the dampers 110 are held in place by screws 112 and washers 114. The screws 112 are thereby anchored in the dampers 110 via some sort of anchors 116, which are schematically illustrated in figure 1. The anchors 116 typically comprise a thread or the like to hold the screws 112 so that the dampers 110 are tightened toward the clamp 102. The clamp 102 generates pressure that keeps and presses the dampers 110 towards the web 104 in order to dampen oscillations and therewith reduce noise.

[0003] One problem with such rail dampers is that the clamps and the dampening elements are typically difficult to install. They require a substantial amount of material, such as the clamp, typically made of metal, the damper elements and various screws and plates for fixing of the damper elements to the clamp and in some cases also fixing the clamp to the rail. Such an installation requires a substantial amount of labour and the work is rather heavy since the clamp constantly pushes towards the web of the rail in particular during installation of the damper elements, which means that a worker needs to constantly press against the clamps push towards the web, even if she/he uses tools for installation. In addition, it is difficult to install such dampers on existing railway systems, since rail sections need to be lifted of the gravel bed in order to install the metal clamp and the damper elements on the rail since the clamp goes under the foot of the rail. Another problem that can surface with these types of damper elements is the anchoring of the screws in the comparably soft damper. These dampers and damper elements are exposed to high temperature variations, wind, rain and vibrations and therefore in some cases the anchoring poses challenges and problems.

[0004] Typically, damper elements are fastened towards the web of the rail so that they are pressed towards the web of the rail for instance via a clamp or the like, as illustrated in figure 1. Other ways of fastening the damper elements to the web include the use of an adhesive or alternatively to screw an arched element or clamp or the like into the foot or base of the rail so that the arched element presses the damper element towards the web. If adhesive is used, the adhesive is typically a very strong adhesive and the damper element is not of the type described further herein but of a very heavy type comprising metal parts or the like, so that the heavy damper element changes the characteristic frequency of the rail due to its mass.

[0005] In addition to the above it is to be noted that traditional dampers comprise typically steel or other heavy material in the actual damper elements in order to make them heavy so that they can dampen vibrations and to change the characteristic frequency in the rails by changing the mass.

Summary of the Invention

[0006] An object of the present invention is to provide a rail damper system that is effective, easy to handle, simple and quick to install.

[0007] Another object is to provide a rail damper system that is free of the above-mentioned drawbacks.

[0008] The inventor of the present invention has discovered that it is possible to design a rail damper system much simpler than ever done before by using at least one rod, fasteners and damper elements made of a soft, vibration absorbing material and placing the damper element on one side of the web of a rail and fastening it to the web via the rod and the fasteners through a hole in the web of the rail. The damper element is thus fastened and pressed towards the web via the rod and the fasteners so that vibrations and therewith oscillations and noise generating vibrations, in particular oscillations generated in a direction perpendicular to a plane defined by the web of the rail and oscillations in the longitudinal direction of the rail, can be absorbed efficiently and in a very simple manner. In the optimal case two damper elements are provided, one on each side of the web.

[0009] Such a rail damper system provides several advantages compared to the prior art, such as:

- Easy to install
- Easy to handle
- Fast mounted

- Good noise-reducing effect
- Works for aftersales and installation on existing rail systems
- Economic compared to the prior art solution.

[0010] In particular is such as rail damper system also easy to install on existing rails, since the rails do not need to be lifted from the gravel bed for installation.

[0011] Disclosed herein is a rail damper system comprising at least one elastic damper element made of a vibration absorbing material and a fastening mechanism configured to fasten the at least one elastic damper element to a web of a rail. The fastening mechanism comprises at least one rod and at least one fastener, wherein the rod is designed to extend through a hole in the web of the rail and through a hole in the elastic damper element so that it can fasten the elastic damper element snug to the web via the at least one fastener arranged on a side of the elastic damper element that is facing away from the web when the damper element is installed on the rail.

[0012] The above described rail damper system has the advantages listed above. The fastening mechanism and the rod and fastener may be anchored in the web via a thread on the rod and in the web. Alternatively the anchoring may be achieved by providing a head on the rod, which head is then preventing the rod from slipping through the hole in the web, while the fastener tightens the head of the rod towards the web when screwed in.

[0013] Another alternative to the above is to provide a fastening mechanism that actually glues the at least one elastic damper element to the web using an adhesive or the like.

[0014] In an embodiment the rail damper system comprises a pressure distribution plate arranged in between the fastener and the damper element for distributing the pressure generated by the fastener and the rod onto the at least one elastic damper element.

[0015] This optimizes the fastening of the at least one elastic damper element to the web and increases durability for the at least one elastic damper element, since the pressure distribution plate reduces wear and tear on the at least one elastic damper element.

[0016] In addition to the above the pressure distribution plate mayhave a thickness of at least 3 to 35 depending on the material used. The pressure applied onto the at least one elastic damper element towards the web optimizes the dampening effect and thus further reduces oscillations and vibrations in the rail when a train is passing over it.

[0017] The pressure distribution plate may be made of metal, plastic or fiber reinforced material/plastic.

[0018] In an embodiment several pressure distribution plates may be installed in the at least one damper elements in order to change the mass of the at least one damper element. Thereby a sandwich construction using a material combination that follows a soft-hard-soft-hard etc. arrangement for adding mass to the elastic damper elements may be used. Thus at least two pressure distribution plates may be arranged within the at least one elastic damper element so that a sandwich construction can be provided.

[0019] The at least one elastic damper element(s) may have a thickness of about 15 mm to 70 mm, preferably 20 mm to 60 mm and more preferably about 20 mm to 50 mm.

[0020] The pressure distribution plate(s) may correspond in length and amount of holes to the elastic damper elements but they do not have to. The pressure distribution plate may have 1 or more holes and extend over one or several damper element(s).

[0021] In another embodiment at least two elastic damper elements one arranged on each side of the web are provided. Thereby the rod extends through the hole in the web and the holes in the elastic damper elements and the fasteners are arranged to be installed on either sides of the at least two elastic damper elements, which sides face away from the elastic damper elements, on the rod so that the elastic damper elements are arranged snug towards the web when the rail damper system is installed on the rail.

[0022] This further enhances the dampening effect so that the noise resulting from the oscillations and vibrations in the rail upon a passing train can be further reduced.

[0023] In a further embodiment the rail system may comprise a sleeve made of a soft vibration absorbing material, whereby the sleeve is designed to extend into the hole in the web so that it prevents the rod from having direct contact with the web when the rail damper system is installed on the rail.

[0024] The sleeve further enhances the reliability of the rail damper system in that it makes sure that the rod, which is preferably made of metal, cannot come into physical contact with the web and therewith with the rail.

[0025] The rod and the fasteners may be made of a durable and corrosion resistant metal but alternatively they may also be made of a high resistant and durable plastic or fibre reinforced material. Such a plastic may for example comprise fibres or other reinforcement.

[0026] The sleeve may be integrally formed with one of the elastic damper element(s).

[0027] In construction environment it is in many cases better with less moving elements and if the sleeve is integrally formed with one of the elastic damper element(s).

[0028] In another embodiment an inner diameter of the sleeve and a diameter of the hole in the elastic damper element are designed so that the rod fits snug and well-fitting into the hole in the elastic damper element and the sleeve.

[0029] The rod may have play in the sleeve when the elastic damper element is mounted onto the web of the rail. Play means that the rod or bolt has at least a slightly smaller outer diameter than the inner diameter of the sleeve.

[0030] In a further embodiment an outer diameter of

the sleeve and a diameter of the hole in the web of the rail are designed so that the sleeve fits snug and well-fitting into the hole in the web.

[0031] The tight and snug fitting of the sleeve in the hole in the web and the tight and snug fitting of the rod in the sleeve create a system that is secure and held in place even during installation/assembly. This reduces the risk for false assembly or mounting of the rail damper system since the one or more sleeve, the at least one (or more) elastic damper element, the one or more rod or bolt and the one or more pressure distribution plate are all in a predetermined relationship with one another when they are assembled.

[0032] The hole in the pressure distribution plate may be chosen so that the rod fits well-fitting, snug and tight into it.

[0033] In case several holes are provided in the elastic damper element(s), the web and pressure distribution plate all of these holes may be chosen so that a tight and snug fitting can be performed during assembly.

[0034] The elastic damper element(s) may be tightened to the web with one fastening mechanism, thus one hole, one rod and one fastener. However several fasteners and rods or bolts may be used for each pair of elastic damper elements.

[0035] The elastic damper element may have a length, as measured in the longitudinal direction of rail, of around 6 to 55cm, preferably 6 to 45cm and more preferably about 7 to 45cm.

[0036] In the above case, thus when the elastic damper element is fastened with a fastening mechanism to the web of the rail, the holes in the web of the rails may be spaced at an interval of 15 to 55cm, preferably 35 to 45cm, as measured in a longitudinal direction of the rail. Several fastening mechanism may be used per elastic damper element or per pair of eleastic damper elements.

[0037] In an embodiment, the elastic damper elements of the rail damper system may be fastened to the web via at least two (or more) fastening mechanisms, thus two (or more) rods and corresponding fasteners and holes in the elastic damper element(s), the web and the pressure distribution plate, whereby the rods and the corresponding holes are arranged at an interval of about 15cm to 55cm, preferably 35cm to 45cm.,. The elastic damper element(s) may also comprise three, four or more holes for receiving three, four or more fastening mechanisms and rods, respectively. Such combinations of elastic damper element(s) and several rods and fasteners may be called an elastic damper element unit. The distance or interval between the holes in the web of the rail, as measured in the longitudinal direction of the rail, may be adapted according to the length of the elastic damper element and/or the length of the pressure distribution plate(s).

[0038] The pressure distribution plate may extend over one elastic damper element or alternatively over a plurality of elastic damper elements or elastic damper element units.

[0039] Similarly to the above, the elastic damper element(s) may extend along the rail, while a plurality of pressure distribution plates may not be extending in a similar manner but may be arranged in intervals covering one or several holes along one long elastic damper element.

[0040] The rod may be a threaded rod and the fasteners may comprise nuts and washers.

[0041] Alternatively, to the above the rod may be a bolt where fasteners can be attached on either end in order to fix the elastic damper element to the rail.

[0042] The washers may have a thickens of 1 to 2 mm.

[0043] If threaded rods, nuts and washers are used, then standard fastening tools and material may be used, which facilitates installation and repair.

[0044] The shore A hardness of the elastic damper elements may be between 20 to 100, preferably 40 to 100 and more preferably 60 to 100.

[0045] This range achieves good dampening effects.

[0046] In a further embodiment the rail damper system may comprise at least one sound shield that is designed to extend along the rail and upwards towards the head of the rail. The at least one sound shield may comprise at least one hole for receiving the rod and the sound shield being arranged in between the pressure distribution plate and the fastener or in between the pressure distribution plate and the at least one elastic damper element

[0047] The sound shield may extend along the rail over several elastic damper element(s) and or several elastic damper element units.

[0048] The sound shield further comprise the noise reduction capability of the rail damper system in that it guides noise coming from the wheels of the train or streetcar upwards and since it prevents the noise caused by the wheels of the train or streetcar to distribute horizontally.

[0049] The sound shield may be formed so that it also covers the base of the rail. In this case there may be a lower extension shield provided that covers the base of the rail when the sound shield is mounted on the rail.

[0050] In addition to the above it may be possible to mount the sound shield without the elastic damper element and in some embodiments even without the pressure distribution plate, directly onto the web of the rail via a rod and fastener combination. The shape of the sound shield may be adapted accordingly.

[0051] The sound shield may be arranged on both sides of the rail, such that both sides of the rail are noise shielded as good and efficient as possible.

[0052] The at least one elastic damper element(s) may be made of other material, such as soft metal, wood, fibre plastic, rubber, plastic or a combination thereof.

Brief Description of the Drawings

[0053] The present invention will now be described, for exemplary purposes, in more detail by way of an embod-

iment(s) and with reference to the enclosed drawings, in which:

Fig. 1 illustrates a cross sectional view onto a rail comprising a rail damper system according to the prior art;
Fig. 2 schematically illustrates a cross sectional view onto a rail comprising a rail damper system according to the invention,
Fig. 3 schematically illustrates a cross sectional view onto a rail comprising a rail damper system according to another embodiment of the invention; and
Fig. 4 schematically illustrates a cross sectional view onto a rail comprising a rail damper system with a sound shield according to another embodiment of the invention.

Detailed Description

[0054] Figures 2 and 3 illustrate a cross sectional view onto a rail 2 with a rail damper system 1 according to the present invention. The rail 2 comprises a head 24 a web 20 and a foot or base 22. The web 20 comprises a hole 40 for receiving a fastening mechanism 6 of the rail damper system 1.

[0055] The rail damper system 1 comprises two elastic damper elements 4, 4', a sleeve 8, 8', a pressure distribution plate 10, 10' and a fastening mechanism 6. The fastening mechanism 6 comprises a rod 28, fasteners 30 and washers 32. The fasteners 30 are embodied as nuts and the rod 28 is embodied as a threaded rod 28. Other solutions may however be possible, such as clamping systems that use a rod without a thread. The rod 28 extends through holes 26, 40 in the pressure distribution plate 10, 10' both elastic damper elements 4, 4' the sleeve 8, 8' and the web 20 of the rail 2 and the fasteners 30 are arranged on either end of the rod 28 so that they press the pressure distribution plates 10, 10' via washers 32 towards the web 20 of the rail 2 when the fasteners are tightened. The sleeve 8, 8' is arranged in a hole 40 of the web 20 of the rail 2 in order to make sure that the rod 28 is not coming into physical contact with the rail 2. The elastic damper elements 4, 4' the pressure distribution plates 10, 10' and the web 20 of the rail 2 may comprise several holes for receiving several rod and fastener combinations. At least two rods 28 are arranged with a pair of elastic damper elements 4, 4'. The distance between the two rods 28 and the according holes may be in a range of 15 to 55 cm.

[0056] The sleeve 8, 8' and the elastic damper elements 4 are made of a material that is able to dampen oscillations. Preferably the material should be elastic such as a plastic or rubber. The plastic or rubber is thereby preferably UV-light, wind and weather resistant. The pressure distribution plate 10, 10' the rod 28, the washers 32 and the fasteners 30 are made of a metal that is durable and can withstand wind and weather. When the elastic damper elements 4, 4' are pressed towards the web 20 of the rail 2, then a good dampening effect is achievable when trains are passing over the rail.

[0057] In the example illustrated in figures 2 and 3 the sleeve 8, 8' is integrally formed with one of the elastic damper elements 4, 4'. It may however be a separate element 8 that extends into the hole 40 in the web 20.

[0058] As illustrated in figure 2, the sleeve 8 may be chosen to so that an outer diameter corresponds to an inner diameter of the hole 40 in the web 20 so that the sleeve 8 fits snug and tight into the hole 40.

[0059] An inner diameter of the sleeve 8 may be chosen so that it leaves room to the diameter of the rod 28 and/or bolt so that the rod 28 can easily be fitted and pushed through the sleeve 8 and the elastic damper elements 4. The holes 26 in the elastic damper elements 4 and the holes in the pressure distribution plates 10 are chosen to be of the same diameter as the one in the sleeve as illustrated in figure 2. This allows an easy fitting and assembly but makes it a bit more challenging to provide a centered arrangement during assembly. This can be solved according to the embodiment of figure 3.

[0060] In figure 3 the outer diameter of the sleeve 8' is chosen to fit tightly and snuggly into the hole 40 in the web 20 as explained referring to figure 2, while an inner diameter is chosen so that it corresponds to the diameter of the rod 28 and provides for a tight and snug fitting of the rod 28, that leaves no play in the hole 40 in the web 20.

[0061] The holes in the elastic damper elements 4' and the pressure distribution plates 10' may be chosen to have the same diameter as the inner diameter of the sleeve 8' as illustrated in figure 3. Alternatively the holes in the elastic damper elements 4' and the pressure distribution plates 10' may be chosen to have a different diameter that is bit bigger (similar to figure 2) than the inner diameter of the sleeve 8'. The rail damper system 1' illustrated in figure 3 allows for a centered arrangement during assembly.

[0062] Figure 4 shows a similar rail damper system 1" as figure 3 but with sound shields 12, 12a, 12b. The sound shields comprise of two longitudinal elements 12a, 12b that comprise a curved upper extension 42a, 42b, whereby the curved upper extensions 42a, 42b are formed to extend upwards towards the head 24 of the rail 2 and away from the head 24. One of the sound shields 12 a comprises an upper extension 42a that is extending further away from the head 24 of the rail 2 as the other sound shield's 12b upper extension 42b. This in order to leave space for a flange of passing train wheel.

[0063] The sound shields 12a, 12b, further comprise a lower flat part 44a, 44b, which comprise holes that correspond to holes 26, 40, in the web 20, the pressure distribution plates 10', the elastic damper elements 4' and the sleeve 8'. The sound shields 12a, 12b may extend along a longitudinal direction of the rail 2 over several elastic damper elements 4'.

[0064] It is further conceivable to provide only one sound shield (not shown) per rail in order to only shield in one direction perpendicular to a longitudinal direction

of the rail. The sound shields may be made of metal or a durable plastic.

[0065] The sound shields 12a, 12b may also be arranged on an embodiment according to figure 2 or any combination of the embodiments shown in figure 2 and figure 3. The idea of the invention has now been shown according to figures 2 to 4. Any feature combination of the embodiments illustrated in the figures may herewith be within the scope of the invention and be seen as a possible combination of features.

[0066] In general, the rod described herein may be a bolt having fasteners that can be fixed to the bolt for holding various elements together or fixed to the web of the rail. Alternatively the bolt may have bolt heads for fixing to other elements.

Claims

1. A rail damper system (1, 1') comprising at least one elastic damper element (4, 4') made of a vibration absorbing material and a fastening mechanism (6) configured to fasten the at least one elastic damper element (4, 4') to a web (20) of a rail (2), the fastening mechanism (6) comprising at least one rod or bolt (28) and at least one fastener (30), wherein the rod (28) is designed to extend through a hole (40) in the web (20) of the rail (2) and through a hole (26) in the elastic damper element (4, 4') so that it can fasten the elastic damper element (4, 4') snug to the web (20) via the at least one fastener (30) arranged on a side of the elastic damper element (4, 4') that is facing away from the web (20) when the at least one elastic damper element (4, 4') is installed on the rail (2).

2. The rail damper system according to claim 1, comprising a pressure distribution plate (10, 10') arranged in between the fastener (30) and the at least one elastic damper element (4, 4') for distributing the pressure generated by the fastener (30) and the rod (28) onto the at least one elastic damper element (4, 4').

3. The rail damper system according to claim 1 or 2, comprising at least two elastic damper elements (4, 4') one arranged on each side of the web (20), whereby the rod (28) extends through the hole (40) in the web and the holes (26) in the elastic damper elements (4, 4') and whereby the fasteners (30) are arranged to be installed on either sides of the at least two elastic damper elements (4, 4'), which sides face away from the elastic damper elements (4, 4'), on the rod (28) so that the elastic damper elements (4, 4') are snug arranged towards the web (20) when the rail damper system is installed on the rail (2).

4. The rail damper system according to any of claims 1 to 3, comprising a sleeve (8, 8') made of a soft vibration absorbing material, whereby the sleeve (8, 8') is designed to extend into the hole (40) in the web (20) so that it prevents the rod (28) from having direct contact with the web (20) when the rail damper system is installed on the rail (2).

5. The rail damper system according to claim 4, wherein the sleeve (8, 8') is integrally formed with one of the elastic damper element(s) (4, 4').

6. The rail damper system according to any of the previous claims 4 or 5, wherein an inner diameter of the sleeve (8') and a diameter of the hole (26) in the elastic damper element (4') are designed so that the rod (28) fits snug and well-fitting into the hole (26) in the elastic damper element (4') and the sleeve (8').

7. The rail damper system according to any of claims 1 to 6, wherein an outer diameter of the sleeve (8, 8') and a diameter of the hole (40) in the web (20) of the rail (2) are designed so that the sleeve (8, 8') fits snug and well-fitting into the hole (40) in the web (20).

8. The rail damper system according to any of the preceding claims 1 to 7, wherein the rod (28) is a threaded rod and the fasteners (30) comprise nuts (30) and washers (32).

9. The rail damper system according to claim 8, wherein the shore A hardness of the elastic damper elements (4, 4') is between 20 to 100.

10. The rail damper system according to any of the previous claims 1 to 9, further comprising at least one sound shield (12a,12b) that is designed to extend along the rail (2) and upwards towards a head (24) of the rail (2), the at least one sound shield (12a, 12b) comprising at least one hole for receiving the rod (28) and the sound shield (12a, 12b) being arranged in between the pressure distribution plate (10') and the fastener (30) or in between the pressure distribution plate and the at least one elastic damper element.

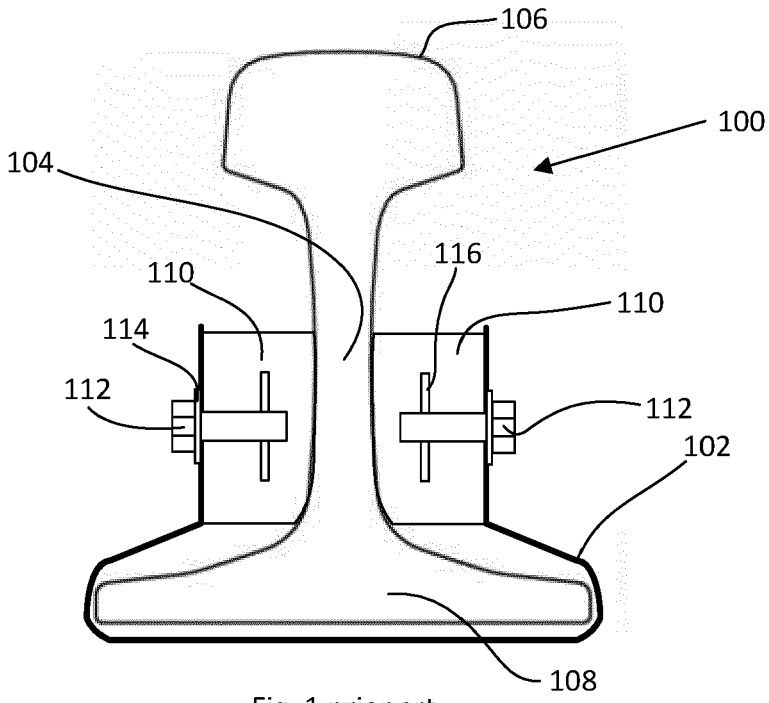

Fig. 1 prior art

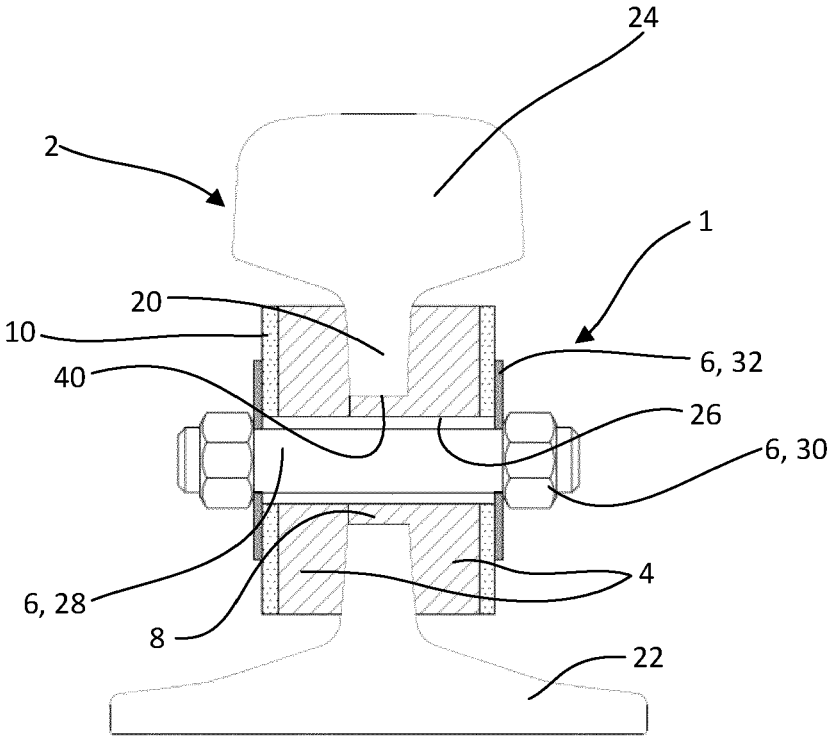

Fig. 2

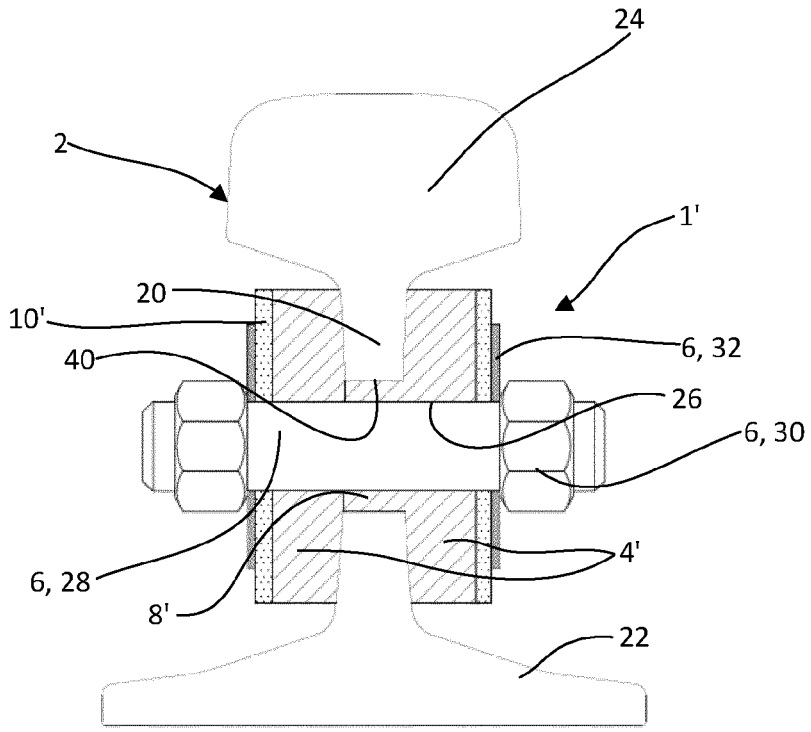
24
2
1'
20
10'
6, 32
40
26
6, 30
4'
6, 28
8'
22

Fig. 3

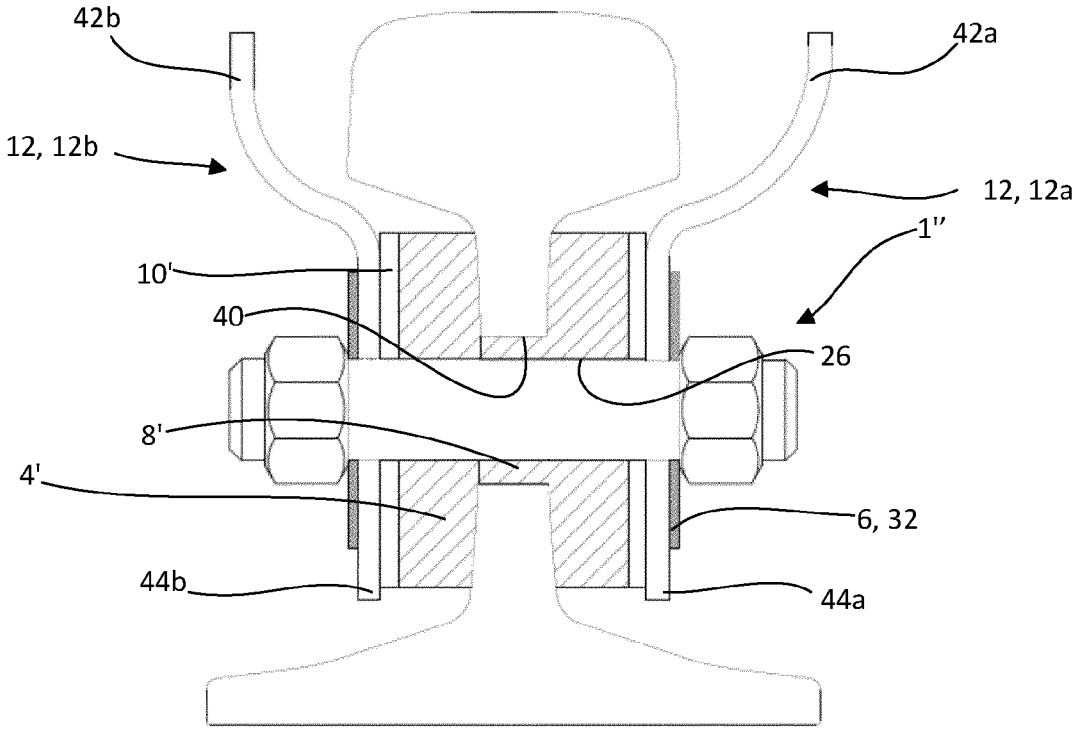
42b
42a
12, 12b
12, 12a
1''
10'
40
26
8'
4'
6, 32
44b
44a

Fig. 4

Europäisches Patentamt
European Patent Office
Office européen des brevets

EUROPEAN SEARCH REPORT

Application Number
EP 20 19 8448

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 43 22 468 A1 (DRAEBING KG WEGU [DE]) 19 January 1995 (1995-01-19) * pages 4-6; figures * -----	1-10	INV. E01B19/00
X	BE 1 010 354 A6 (DIRVEN STEPHANE [BE]) 2 June 1998 (1998-06-02)	1	
A	* pages 6,7; figure 3 * -----	2-9	

TECHNICAL FIELDS SEARCHED (IPC)

E01B

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	28 January 2021	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 20 19 8448

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.

28-01-2021

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
DE 4322468 A1	19-01-1995	NONE	
BE 1010354 A6	02-06-1998	NONE	

EPO FORM P0459

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