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(54) **FIXING ARRANGEMENT FOR FIXING GUARDRAIL ELEMENTS, AND A GUARDRAIL**

(57) Fixing arrangement for joining guardrail elements (7) to each other, which fixing arrangement comprises anchorage parts (1) that are fittable onto the face-to-face ends (17) of the guardrail elements (7) to be joined and a joint part (5) that is fittable into the anchorage parts (1). Each anchorage part (1) comprises two side walls (3), between which a joint part (5) is fittable, and a roof (14) connecting the side walls (3), on the underside of which roof is arranged a support member (9), behind which the joint part (5) is fittable.

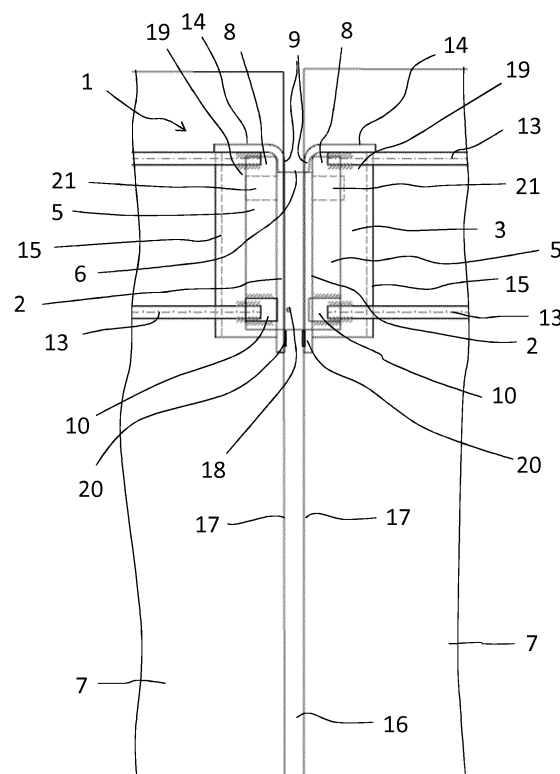


Fig. 7

Description

[0001] The object of the invention is a fixing arrangement for fixing guardrail elements to each other at their face-to-face ends. The object of the invention is a guardrail, such as a road guardrail.

[0002] Today increasingly more is invested in road safety. Center guardrails to prevent head-on collisions are built on old, narrow, two-lane roads. Swerving off the road is prevented with side guardrails, which often are simultaneously used as noise barriers, especially on new motorways. Furthermore, guardrails are used for improving worktime safety on road construction sites and in the renovation of bridge structures, when employees are protected from road traffic.

[0003] A conventional guardrail structure has been a horizontally-structured steel profile or steel wire rope, which is fixed at regular intervals to posts driven into the ground. A problem with a steel guardrail is the rigid joint to the post, which joint does not buckle in a collision but instead cuts into the car. A post structure of a steel guardrail for worktime protection, said structure to be driven into the ground, is a system that is too slow because the shape of the guardrail must be able to be changed quickly to meet the needs of the construction site. A conventional solution has been concrete barrier blocks, which are installed consecutively into a line without joints in between them.

[0004] Modern guardrails are based on experience gained from collision tests. Unlike steel guardrails, a concrete guardrail is installed directly onto the surface of the road or of the shoulder by joining individual guardrail elements to each other with joint parts that allow displacement in the lateral direction. The kinetic energy in a collision is transmitted by friction between the base and the guardrail element as well as by deformations occurring in the joints. The guardrail prevents the car from overturning and being deflected back onto the roadway. The objective is for a car involved in an accident to be guided along the guardrail and stop within a certain distance. In addition, repair of the guardrail, i.e. replacement of the broken elements, on busy roads must be as fast as possible to avoid traffic jams.

[0005] The aim of this invention is to achieve an improved fixing arrangement for fixing guardrail elements to each other, and an improved guardrail.

[0006] The aims of the invention are achieved with a fixing arrangement according to claim 1 and with a guardrail according to claim 14. The fixing arrangement according to the invention comprises anchorage parts that are fittable onto the face-to-face ends of the guardrail elements to be joined, and a joint part that is fittable into the anchorage parts. Each anchorage part comprises two side walls, between which the joint part is fittable, and a roof connecting the side walls, on the underside of which roof is arranged a support member, behind which the joint part is fittable.

[0007] Significant advantages are achieved with the

solution according to the invention. By means of the fixing arrangement according to the invention the joint between the guardrail elements can be quickly and easily assembled and disassembled, owing to which the guardrail can be installed quickly and the guardrail elements can be quickly replaced. The joint between the anchorage part and the joint part is not rigid, but instead there is a clearance between the parts, in which case the parts are able to move in relation to each other in a collision situation. This binds the collision energy and therefore dampens the collision.

[0008] According to one embodiment of the invention a locking means is arranged in the front wall of the anchorage part for fixing the joint part to the anchorage part. The locking means can be fitted on the aperture of the front wall and under the joint part when the protrusion of the joint part is fitted into position behind the support member. The locking means can be e.g. a bendable plate or tongue, which is fixed to the front wall. This speeds up the fixing of the joint part to the anchorage part. In addition, a bendable locking means flexes in a collision situation, which binds the collision energy and therefore dampens the collision.

[0009] According to one embodiment of the invention the joint part comprises a hole, into which a pin is fittable, the pin being fitted to rest on the front wall of the anchorage part when the joint part is pushed into the anchorage part. By means of the pin, pushing of the joint part too far into the anchorage part can be avoided and therefore the second protrusion of the joint part can be kept at a suitable distance from the guardrail element. This speeds up installation of the second guardrail element, because the distance of the second protrusion from the guardrail element does not need to be separately set to be suitable. By means of the pin, installation of the guardrail elements can be made easier and faster also in the other phases.

[0010] According to one embodiment of the invention the joint part comprises two bulges, at the point of which the width of the joint part is larger than the aperture of the front wall. The bulges are quite close to the side walls of the anchorage part, in which case in a collision situation the bulges come into contact with the side walls and/or the front wall, which increases the rigidity of the guardrail joint.

[0011] In one embodiment of the invention on the inner surfaces of the side walls of the anchorage part are arranged narrowing means, between which the joint part is fittable, and the distance between which narrowing means is smaller than the width of the aperture of the front wall of the anchorage part, but greater than the thickness of the joint part. In a collision situation the joint part comes into contact with the narrowing means, which also increases the rigidity of the guardrail joint.

[0012] In the following, the invention will be described in more detail by the aid of some embodiments with reference to the attached drawings, wherein

Fig. 1 shows one embodiment of a guardrail accord-

ing to the invention,

- Fig. 2 shows an end view of a guardrail element of the guardrail of Fig. 1 and an anchorage part on the end of the guardrail element,
- Fig. 3 shows a side view of the anchorage part shown in Fig. 2,
- Fig. 4 shows a top view of the anchorage part of Fig. 2,
- Fig. 5 shows the joint part of the guardrail of Fig. 1,
- Fig. 6 shows the joint part of Fig. 5 as viewed from the side, and
- Fig. 7 shows a cross-section of two guardrail elements of the guardrail of Fig. 1 at the point of the joint.

[0013] Fig. 1 shows a guardrail, such as a road guardrail, which comprises at least two guardrail elements 7, which are joined to each other at their face-to-face ends 17 with a fixing arrangement, which comprises anchorage parts 1 arranged onto the face-to-face ends 17 of the guardrail elements 7 and a joint part 5, which is fitted into the anchorage parts 1. On the ends of each guardrail element 7 to be connected is an anchorage part 1. Typically the height (H) of a guardrail element 7 is 900-1100 mm and the length (L) is 4000-6000 mm. Between guardrail elements 7 is a seam 16.

[0014] The guardrail element 7 is manufactured from concrete or from some other material suited to the purpose. If the guardrail element 7 is concrete, the anchorage part 1 can be situated in the desired location in the mold before casting the guardrail element 7. The anchorage part 1 can be fixed to the mold with fixing methods that are per se known in the art, such as with nails, screws, a magnet or by means of a support member.

[0015] The structure of the anchorage part 1 and the joint part 5 are described in more detail in Figs. 2-7. Invisible parts are shown with dashed lines to facilitate understanding. For the sake of clarity the joint part 5 in Fig. 7 is shown with an unbroken line.

[0016] The anchorage part 1 is manufactured from a material suited to the purpose, e.g. from steel. The anchorage part 1 comprises two face-to-face side walls 3, which are disposed at a distance from each other. A joint part 5 is fittable between the side walls 3. In addition, the anchorage part 1 comprises a roof 14, which connects the side walls 3. The roof 14 forms the top surface of the anchorage part 1. The anchorage part 1 also comprises a front wall 2, which connects the side walls 3. The front wall 2 is connected to the roof 14. In the front wall 2 is a vertical aperture 12, via which the joint part 5 can be fitted into the anchorage part 1. The aperture 12 is elongated. The aperture 12 is open from below. The front wall 2 is transverse to the guardrail element 7. The side walls 3

are connected to the front wall 2, e.g. to the rear surface of the front wall 2. Alternatively, the front wall 2 can be arranged between the side walls 3. In the embodiment according to the drawings the width of the front wall 2 is greater than the distance between the side walls 3. There are bevels 4 or roundings on the front wall 2 at the point of the bottom edges of the aperture 12. In this way installation of the joint part 5 into the anchorage part 1 can be facilitated. The bottom part of the anchorage part 1 is open.

[0017] The anchorage part 1 comprises a rear wall 15, which connects the side walls 3. Also the rear wall 15 is connected to the roof 14. The rear wall 15 is opposite the front wall 2. The rear wall 15 can be transverse to the guardrail element 7 or curved, as in the embodiment of the drawings. The side walls 3 and rear wall 15 can be formed from a single plate, e.g. a steel plate that is bent into a U-shape. In this case the parallel sides of the U-shape function as front walls 3 and the part in between them as a rear wall. Alternatively, the side walls 3 and the rear wall 15 can be separate parts.

[0018] The front wall 2, side walls 3 and rear wall 15 form a box-type structure. The roof 14 fully or partly covers the area bounded by the front wall 2, side walls 3 and rear wall 15. The front wall 2, side walls and rear wall are connected to the roof 14. The roof 14 is as wide as the front wall 2. In the embodiment according to the drawings the front wall 2 and the roof 14 are formed from a single plate, e.g. a steel plate, which is bent to the desired angle at the border point of the roof 14 and the front wall 2, typically to an angle of 90 degrees. Alternatively, the roof and the front wall 2 can be separate parts.

[0019] The anchorage part 1 comprises a support member 9, behind which (i.e. in the space 19 between the support member 9 and the rear wall 15) the joint part 5 is fittable for joining the guardrail elements 7 to each other. The support member 9 is arranged on the underside of the roof 14. In the embodiment according to the drawings the top part of the front wall 2 forms a support member 9. In this case the aperture 12 of the front wall 2 extends in the vertical direction a distance (d) from the bottom surface of the roof 14, in which case the part of the front wall 2 between the top edge of the aperture 12 and the bottom surface of the roof 14 forms a support member 9. In the guardrail embodiment, the distance (d) between the top edge of the aperture 12 and the bottom surface of the roof in the vertical direction is at least 10 mm, typically 25-40 mm. The thickness of the front wall 2 is typically 8-15mm.

[0020] Alternatively, or in addition to the embodiment described above, the anchorage part 1 can be provided with a separate support member 9. In this case the support member 9 can be fitted between the side walls 3. The support member 9 can be a stiffener, such as a bar that is rectangular or square in its cross-sectional shape, behind which (i.e. in the space 19 between the support member 9 and the rear wall 15) the joint part 5 is fittable for joining the guardrail elements 7 to each other. The

support member 9 extends from one side wall to the other side wall. The support member 9 is fixed to the side walls 3 and/or to the roof 14 and/or to the front wall 2.

[0021] The joint part 5 is formed from one or more plate-shaped parts. The joint part 5 comprises two protrusions 8, which are fittable into the spaces 19 behind the support members 9. The space 19 is between the support member 9 and the rear wall 15. The protrusions 8 are on the top corners of the joint part 5. The protrusions 8 are at a distance from each other and between them is a recess 6. The distance between the protrusions 8, i.e. the width of the recess 6, is selected in such a way that the installed guardrail elements 7 are at the desired distance from each other. In a collision situation the protrusions 8 are against the support members 9, in which case the support members 9 prevent the joint part 5 from coming out of the anchorage parts 1. In this way the detachment of the ends of the guardrail elements 7 from each other can be prevented. The protrusions 8 are narrower than the aperture 12 of the front wall 2, in which case they can if necessary be fitted into the anchorage part 1 via the aperture 12.

[0022] In addition, the joint part 5 comprises two bulges 10. The width of the joint part 5 at the point of the bulges 10 is greater than the width of the aperture 12. The bulge 10 can be fitted into the anchorage part 1 by bringing the bulge 10 into the groove 11 below the side wall 3 and by lifting the joint part 5 upwards in such a way that the bulge 10 displaces between the side walls 3 to behind the front wall 2. The bulges 10 are on the bottom corners of the joint part 5. The inner edges of the bulges 10 are at the same point in the vertical direction as the inner edges of the protrusions 8. Therefore the distance between the bulges 10 is equal to the distance between the protrusions 8. The bulge 10 extends to both sides of the joint part 5. In a collision situation the bulge 10 comes into contact with the side walls 3 and/or the front wall 2, and therefore increases the rigidity of the guardrail joint. The distance between the side walls 3 at the point of the bulges 10 is at most 5 mm greater than the thickness of the joint part 5 at the point of the bulges 10.

[0023] In the joint part 5 is a hole 18, into which a pin or corresponding (not shown in the drawings) is fitted, the pin being adapted to rest on the front wall 2 of the anchorage part 1 when the joint part 5 is fixed into the anchorage part 1. In this way movement of the joint part 5 to inside the anchorage part 1 in the longitudinal direction of the guardrail element 7 can be limited. By means of the pin the free protrusion 8 (the protrusion 8 that is not installed in the anchorage part of the second guardrail element) of the joint part 5 fixed to the anchorage part 1 can be kept at the desired distance from the anchorage part 1, in which case the anchorage part 1 of the second guardrail element 7 can be lowered into its position on top of the free protrusion 8. This significantly speeds up and simplifies installation of a joint part 5 into the anchorage part 1 of another guardrail element because the joint part 5 does not need to be held, e.g. by hand, at the

desired distance from the anchorage part 1 during installation of another guardrail element. The installation of the guardrail elements 7 is described in more detail herein-after. The hole 11 is made in the bottom part of the joint part 5, e.g. between the bulges 10. The hole 18 is at least the distance of the thickness of the front wall 2 from the bulge 10.

[0024] The anchorage part 1 comprises a locking means 20 for fixing the joint part 5 into the anchorage part 1 in the vertical direction. The locking means 20 has two positions: a locking position, in which the locking means 20 is on the aperture 12 of the front wall 2 and under the joint part 5 and they therefore prevent movement of the joint part 5 downwards, and a release position, in which the joint part 5 is able to move downwards in the anchorage part 1. The locking means 20 is arranged on the front wall 2. The locking means 20 can be turned, bent or slid under the joint part 5 when the protrusion 8 of the joint part 5 is fitted into position behind the support member 9.

[0025] In the embodiment according to the drawings the locking means 20 is fixed at one of its ends next to the aperture 12 of the front wall 2 and the other end of the locking means is free. The locking means 20 can be fixed to the front wall 2 by welding, with a screw or in some other manner suited to the purpose. The locking means 20 can be a bendable tongue or plate, such as a sheet steel plate, an arm or corresponding. In this case the locking means 20 can be bent, e.g. by hand or by means of a tool, from the release position into the locking position and *vice versa*.

[0026] Alternatively, at one of its ends the locking means 20 can be hinged, or fastened to the front wall 2 in a manner permitting turning, in which case it can be turned between the release position and the locking position. In this case, there can be a fastening means on the front wall 2 on the other side of the aperture 12 with respect to the fastening point, with which fastening means the second end of the locking means can be supported. Alternatively, the locking means can comprise horizontal rails fastened to the front wall 2 to both of the aperture 12, along which the locking means can be moved between the release position and the locking position.

[0027] The anchorage part 1 comprises bars 13, such as reinforcement bars, which transmit the collision forces into the reinforcement of the guardrail element 7 and onwards into the next guardrail elements 7 of the road guardrail. There are two pairs of bars 13. The bars 13 of the upper pair are fixed to the corner between the outer surfaces of the side walls 3 and the roof 14. The bars 13 of the lower pair are fixed to the outer surfaces of the side walls 3 at the same height as the bulge 10 of the joint part 5, when the joint part 5 is in its position in the anchorage part 1. In this case collision forces are transmitted from the bulge 10 directly into the bars 13. The bars 13 are horizontal, i.e. extend in longitudinal direction of the guardrail element 7. The bars 13 are also used for

fixing the anchorage part 1 to the guardrail part 7.

[0028] On the inner surface of each side wall 3 of the anchorage part 1 a narrowing means 21 is arranged below the support member 9. The narrowing means 21 are arranged at the same height. The narrowing means 21 are arranged at the same point in the longitudinal direction of a guardrail element 7. The joint part 5 is between the narrowing means 21 when it is installed into position in the anchorage part 1. The narrowing means 21 can be situated on the front edges of the side walls 3 behind the front wall 2. The distance between the narrowing means 21 is smaller than the width of the aperture 12, but greater than the thickness of the point of the joint part 5 to be fitted between the narrowing means 21. The narrowing means 21 can be e.g. plates of the desired thickness, which are fixed by welding to the side walls 3. In a collision situation the narrowing means 21 come into contact with the joint part 5 and therefore increase the rigidity of the guardrail joint. The distance between the narrowing means 21 is at most 5 mm greater than the thickness of the joint part 5 at the point of the narrowing means 21.

[0029] On the end of a guardrail element 7 below the anchorage part 1 is a vertical groove 11. The groove 11 is at the same point as the vertical aperture 12 that is in the front wall 2 of the anchorage part 1. The groove 11 is open from below.

[0030] The guardrail elements 7 are joined to each other in the following manner. At the installation site the first guardrail element 7 is placed into position on a mounting base. The pin is fitted through the hole 18 of the joint part 5. After this the joint part 5 is brought to the anchorage part 1 to below the groove 11 and the joint part 5 is lifted upwards, in which case the protrusion 8 goes into the space 19 behind the support member 9. At the same time the bulge 10 displaces between the side walls 3 to behind the front wall 2. The locking means 20 is shifted into the locking position on the aperture 12 of the front wall and under the joint part 5. In the embodiment of the drawings this is done by bending the locking means 20. The bottom edge of the joint part 5 is against the locking means 20, in which case movement of the joint part 5 downwards in the anchorage part 1 is prevented. If the joint part 5 moves deeper into the joint part 1, the pin in the hole 18 comes against the front wall 2 and thus keeps the second protrusion 8 of the joint part 5 at a sufficient distance from the anchorage part 1 for installation of the second guardrail element 7. In this case the anchorage part 1 of the second guardrail element 7 can be lowered directly onto the joint part 5 in such a way that the second protrusion 8 goes into position behind the support member 9 of the anchorage part.

[0031] After this, the second protrusion 8 of the joint part 5 is fitted into the anchorage part 1 of the second guardrail element. This occurs in such a way that the second guardrail element 7 is lifted over the first guardrail element 7 in such a way that the anchorage part 1 of the second guardrail element is above the second protrusion 8 of the joint part 5. The second protrusion 8 of the joint

part is in the groove 11 of the end of the second guardrail element. The locking means 20 of the second anchorage part 1 can, if necessary, be turned to the side of the front wall 2, in which case it does not interfere with the installation. The second guardrail element 7 is lowered downwards, in which case the joint part 5 goes into the anchorage part 1 of the second guardrail element via the aperture 12. The second guardrail element 7 is lowered farther downwards, in which case the second protrusion 8 of the joint part 5 goes behind the support member 9 of the anchorage part of the second guardrail element, i.e. into the space 19 between the support member 9 and the rear wall 15. At the same time the second bulge 10 displaces between the side walls 3 to behind the front wall 2. The second guardrail element 7 is lowered onto the mounting base and at the same time it is ensured that the distance between the ends 17 of the guardrail elements 7 is of the desired magnitude. The seam 16 between guardrail elements 7 can be jointed with conventional methods.

[0032] Other guardrail elements of the guardrail can be joined in a corresponding manner to the first and/or second guardrail elements 7, i.e. the joint part 5 is installed and fixed into position in the anchorage part 1 of a guardrail element and the next guardrail element is lowered into position on top of the joint part 5.

[0033] It is obvious to the person skilled in the art that the different embodiments of the invention are not limited solely to the examples described above, and that they may therefore be varied within the scope of the claims presented below.

Claims

1. Fixing arrangement for fixing guardrail elements (7) to each other, which fixing arrangement comprises: anchorage parts (1) that is fittable onto the face-to-face ends (17) of the guardrail elements (7) to be joined, and a joint part (5) that is fittable into the anchorage parts (1), **characterized in that**
 - each anchorage part (1) comprises two side walls (3), between which a joint part (5) is fittable, and a roof (14) connecting the side walls (3), on the underside of which roof is arranged a support member (9), behind which the joint part (5) is fittable.
2. Fixing arrangement according to claim 1, **characterized in that** a joint part (5) comprises two protrusions (8), which are fittable behind the support members (9) of the anchorage parts (1) of the face-to-face ends of the guardrail elements (7).
3. Fixing arrangement according to claim 1 or 2, **characterized in that** an anchorage part (1) comprises a front wall (2) connecting the side walls (3), the front

wall having an aperture (12) via which the joint part (5) is fittable into the anchorage part (1) between the side walls (3).

4. Fixing arrangement according to claim 3, **characterized in that** a locking means (20) is arranged in the front wall (2) for fixing the joint part (5) to the anchorage part (1). 5
5. Fixing arrangement according to claim 4, **characterized in that** the locking means (20) is fittable on the aperture (12) and under the joint part (5) when the protrusion (8) of the joint part (5) is fitted into position behind the support member (9). 10
6. Fixing arrangement according to claim 5, **characterized in that** the locking means (20) can be bent, turned or slid on the aperture (12). 15
7. Fixing arrangement according to claim 6, **characterized in that** one end of the locking means (20) is fixed to the front wall (2) and the other end is free, and **in that** the locking means can be bent on the aperture (12). 20
8. Fixing arrangement according to claim 7, **characterized in that** the locking means (20) comprises a bendable tongue, plate or arm. 25
9. Fixing arrangement according to any of the preceding claims 3-8, **characterized in that** the joint part (5) comprises a hole (18), into which a pin is fittable, the pin being fitted to rest on the front wall (2) when the joint part (5) is pushed into the anchorage part (1). 30
10. Fixing arrangement according to any of the preceding claims 3-9, **characterized in that** the joint part (5) comprises two bulges (10), which are wider than the aperture (12) of the front wall (2) and which is fittable behind the face-to-face front walls (2) of the anchorage parts (1) between the side walls (3). 35
11. Fixing arrangement according to claim 9, **characterized in that** fixed to the outer surface of one or both of the side walls (3) is a bar (13) for fixing the anchorage part (1) to the guardrail element (7), and **in that** the bulge (10) of the joint part (5) is at the same height as the bar (13) when the joint part (5) is installed into its position in the anchorage part (1). 45
12. Fixing arrangement according to any of the preceding claims 3-11, **characterized in that** the top edge of the aperture (12) of the front wall (2) is at a distance (d) from the bottom surface of the roof (14), in which case the part of the front wall (2) between the top edge of the aperture (12) and the roof (14) forms a support member (9). 50

13. Fixing arrangement according to any of the preceding claims, **characterized in that** on the inner surface of each side wall (3) of the anchorage part (1) a narrowing means (21) is arranged below the support member (9), between which narrowing means (21) a joint part (5) can be fitted, and the distance between which narrowing means (21) is smaller than the width of the aperture (12), but greater than the thickness of the joint part (5) at the point of the narrowing means (21). 55
14. Guardrail, which comprises at least two guardrail elements (7) joined to each other at their ends, **characterized in that** the guardrail elements (7) are fixed to each other at their face-to-face ends (17) with a joint arrangement according to any of the preceding claims 1-13, in which case anchorage parts (1) are arranged in the face-to-face ends of the guardrail elements (7), into which anchorage parts a joint part (5) is fitted.
15. Guardrail according to claim 14, **characterized in that** on the end of a guardrail element (7) below the anchorage part (1) is a vertical groove (11).

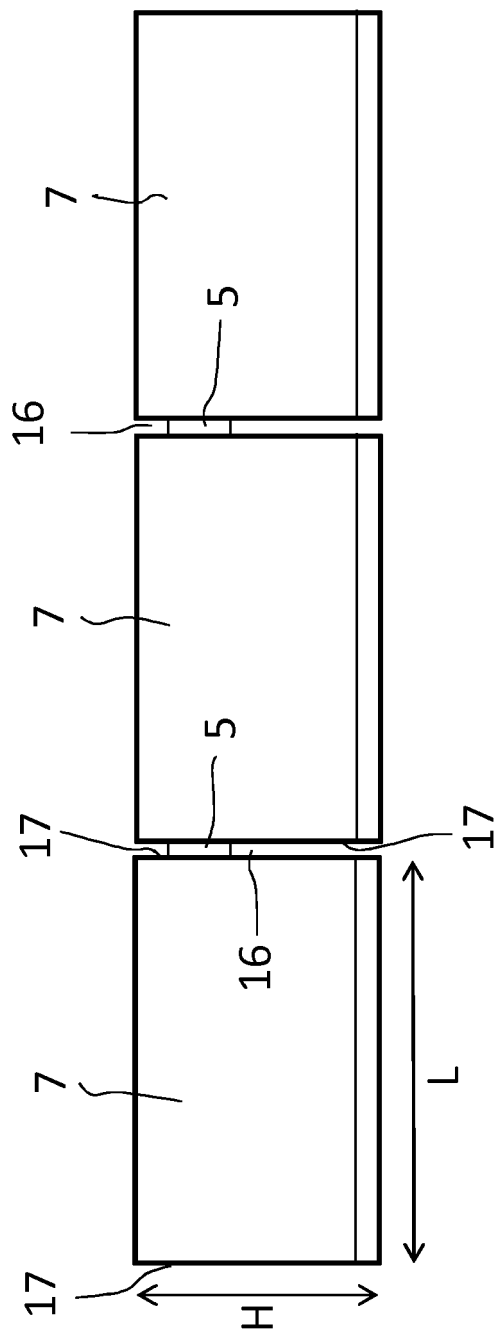


Fig. 1

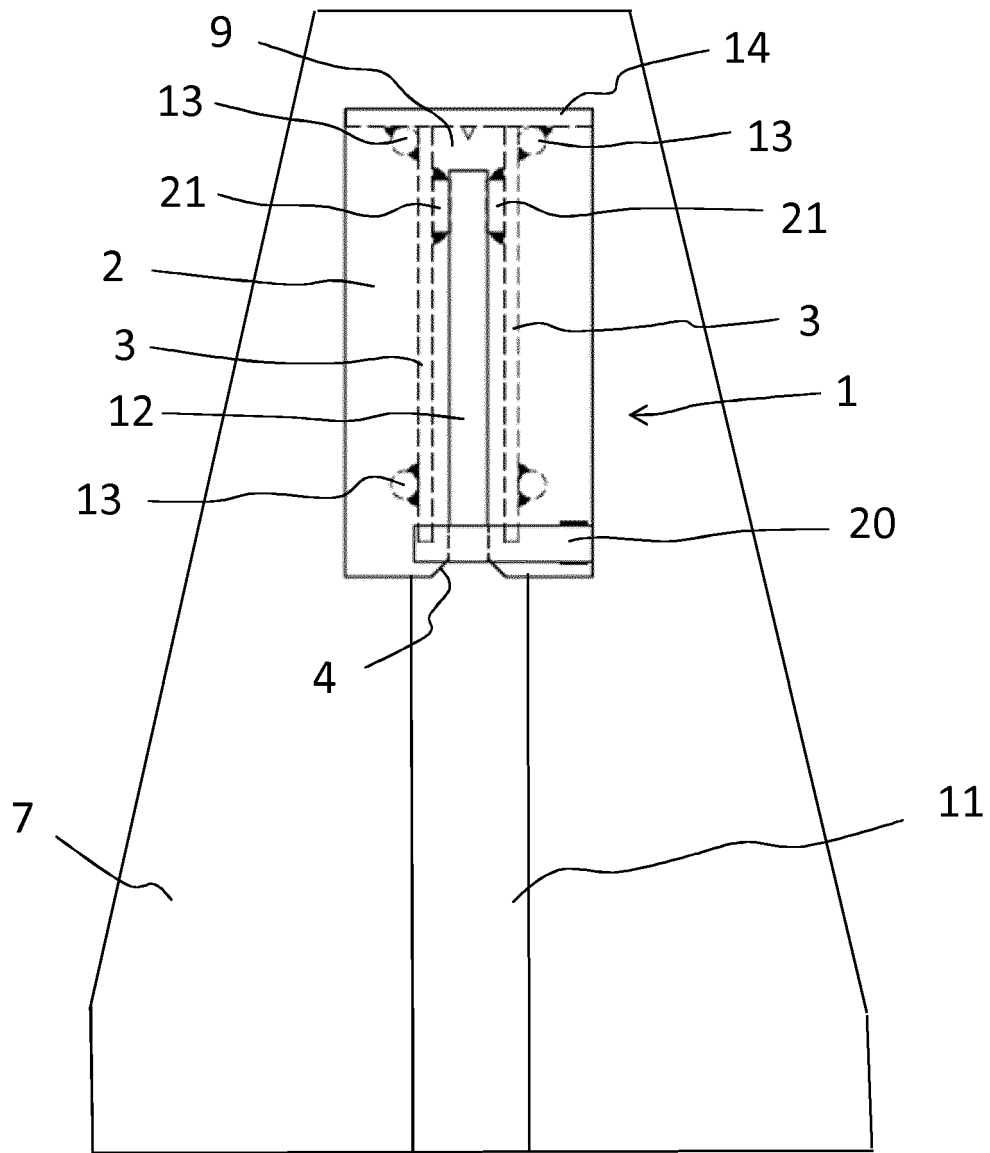


Fig. 2

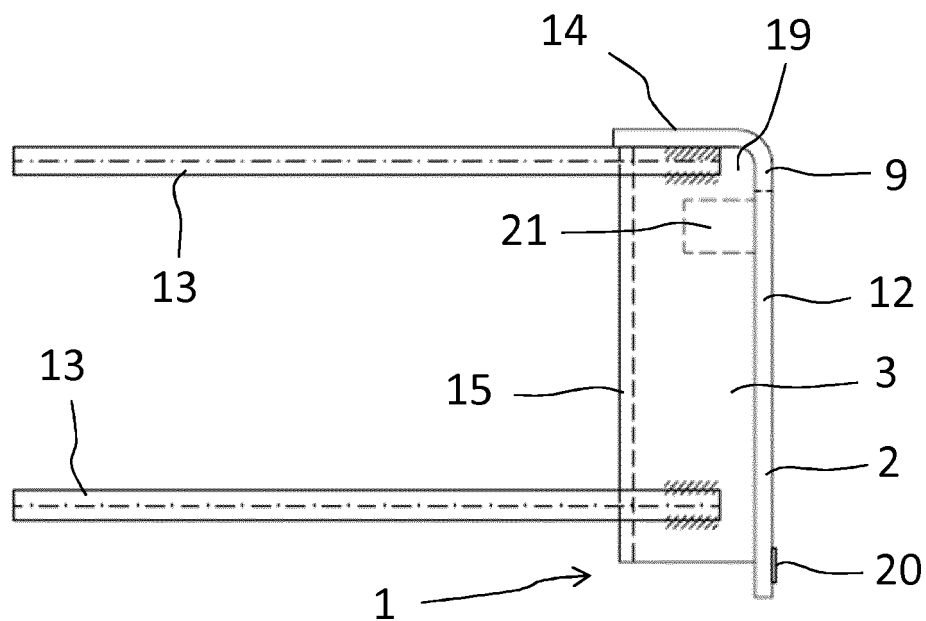


Fig. 3

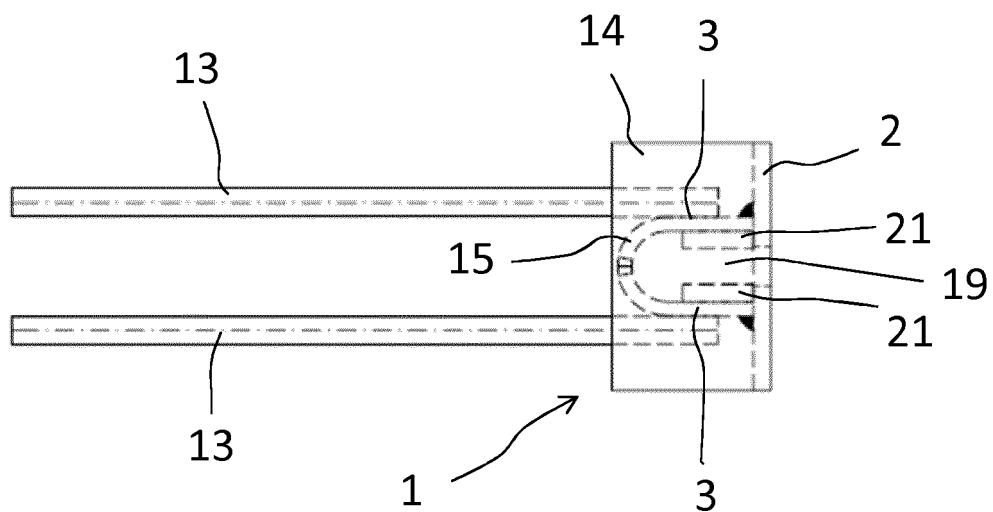


Fig. 4

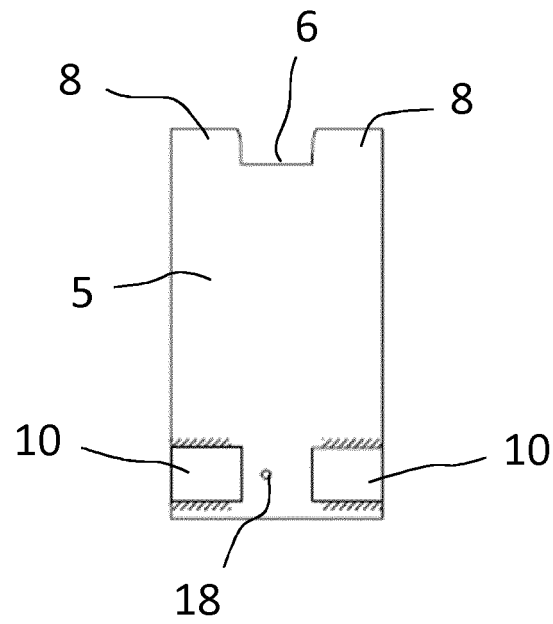


Fig. 5

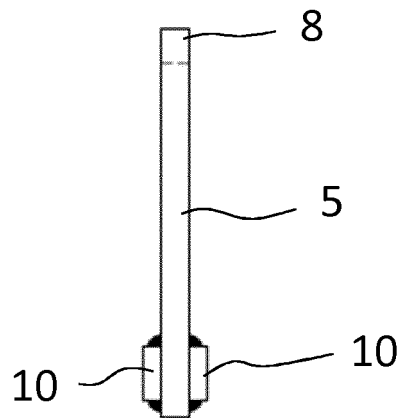


Fig. 6

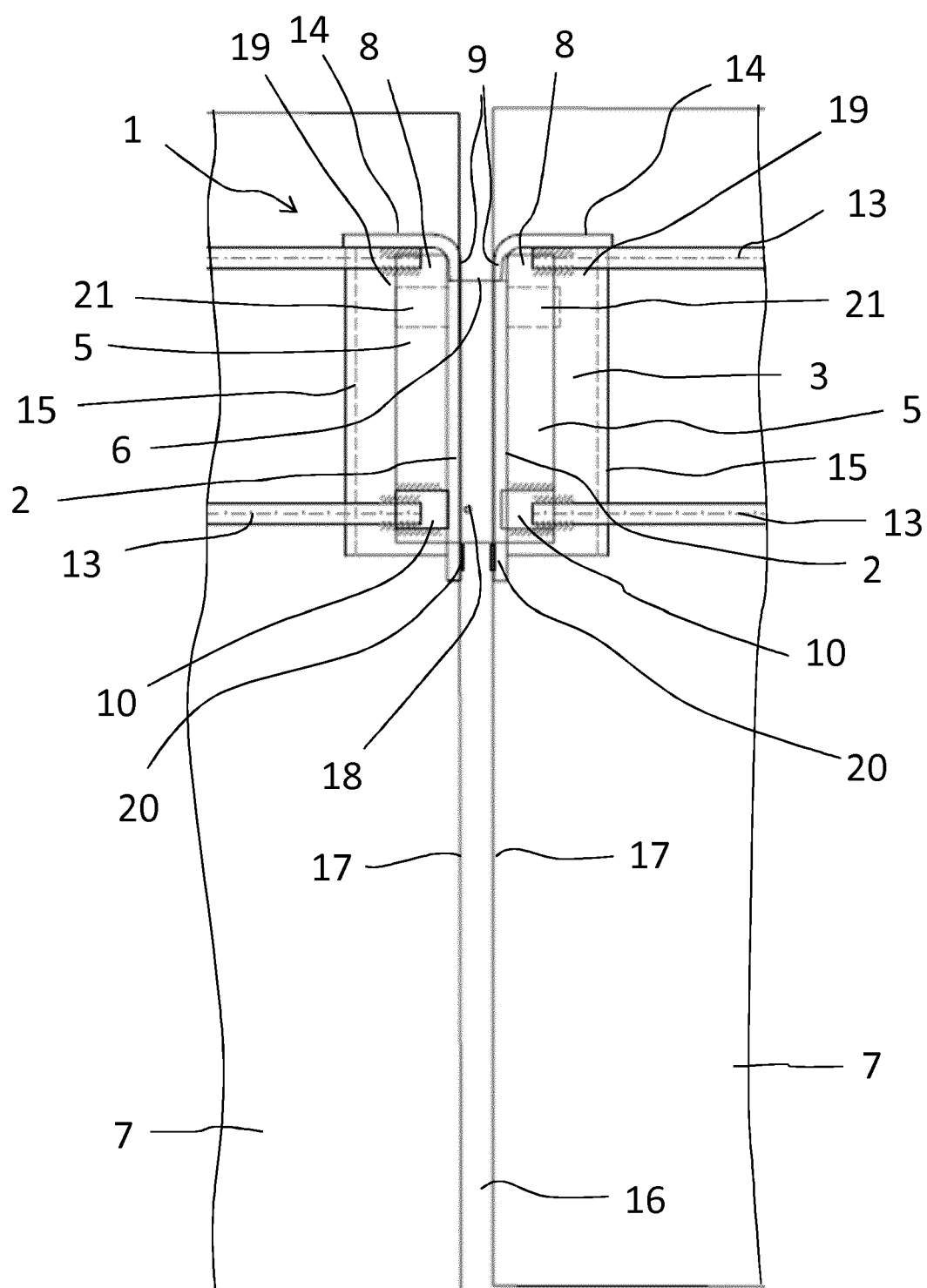


Fig. 7



EUROPEAN SEARCH REPORT

 Application Number
 EP 16 16 7034

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DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
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			E01F
The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 17 August 2016	Examiner Kremsler, Stefan
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			

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

EP 16 16 7034

5 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
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