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(54) RAIL FASTENING ELEMENT FOR A FIXED SLAB TRACK

SCHIENENBEFESTIGUNGSELEMENT FÜR EINE FESTE FAHRBAHN

ÉLÉMENT DE FIXATION DE RAIL POUR UNE VOIE FERRÉE SANS BALLAST

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Description

[0001] The invention relates to a rail fastening element for rails of a fixed slab track according to the preamble of claim 1 and, furthermore, is directed to a fixed slab track for rail vehicles according to the preamble of claim 5, comprising the rail fastening element of the type according to the invention.

[0002] In the construction of railway tracks, the classic roadbed represented the usual solution over a long time period of approximately 200 years, because the main components for tracks which are laid in the ballast bed are simple and comparatively inexpensive. In particular with the pronounced development, however, of high-speed traffic, the requirements for the railway top bed have increased considerably and the "floating mounting" of a track which is laid in the ballast bed is reaching its technical and economic limits in many areas. Various concepts for ballast-less track designs with fixed mounting have therefore been developed in the past decades, which are subsumed under the generic term "fixed slab track". Here, there are many different rail track concepts, designs and installation methods, the only common feature of which is that a rail which is laid in a fixed slab track does not actually have floating mounting as in the case of the ballast bed.

[0003] In the various construction principles for a rail in a fixed slab track, the spectrum reaches from track segments which are prefabricated almost completely in the factory as far as solutions which are produced practically completely at the construction site. In the installation principles, in principle a distinction can be made between two main categories. In the installation of the track from the top to the bottom (top-down principle), the running rails and a part of the track structure (sleepers) which are attached to them are oriented exactly into the desired vertical and lateral position by way of special apparatuses. Subsequently, the clearance which remains between this sleeper framework and the track substructure is filled with liquid construction materials which harden. Here, although all the inaccuracies which are produced during the installation of the lower support layers of the track can be neutralized in the final, decisive working step, namely the underpouring of the sleeper framework, there is a problem in the fact that massive, rough working steps frequently have to be carried out immediately after the precise orientation of the sleeper framework and therefore under usually considerable time pressure, which working steps can endanger the previously exactly set track position. Rough working steps of this type can be, for example, relatively large transports and the installation of site-mixed concrete in order to underfill the sleeper framework. This problem is intensified even further if the track to be installed is also to serve as a path for supplying the construction site, which is frequently the case in tunnel projects. After the underfilling of the sleeper framework, the track cannot be driven along or can only be driven along to a restricted extent for a comparatively long time, because the construction materials which are used for underfilling, as a rule concrete, partly require several days, in order to achieve sufficient strength to allow the track to be driven along.

[0004] In the case of the second main category of installation methods, all support layers and components are built on one another step-by-step from the bottom to the top (bottom-up principle) . An attempt is made here to work more exactly with every further step, in order that the track accuracy meets all requirements after the final mounting of the running rails. This construction principle of a fixed slab track from the bottom to the top may well permit many degrees of freedom during the installation of the track, because the individual working steps can be carried out comparatively simply and temporally independently of one another and permit a high degree of mechanization. Moreover, the track to be installed can be utilized relatively satisfactorily and also after a short time as a transport path in almost all construction phases. The principle is therefore preferably used, in particular, where supplying material from the sides is not possible, for example via the neighbouring track. However, the disadvantage of this method of construction is that it is comparatively imprecise and that a subsequent positional and, above all, vertical adaptation of the running rails to the rail fastening elements therefore has to be performed in most cases despite great efforts and production accuracy. These adaptations are not only complicated, but lead to the possibilities of subsequent adjustment of the track position, which are required by the constructor for the later operating phase, already having to be utilized during the initial adjustment and then later not being available or no longer being available to the required extent.

[0005] DE 199 32 991 A1 discloses a rail fastening element comprising a mounting base body and a rail holder which interacts with the mounting base body on the upper side thereof. The monting base body has bores which constitute receptacles for fastening bolts which are palced in studholes provided in a supporting layer underneath the mounting base body. Synthetic resin is filled inbetween the lower parts of the bolts and the surrounding stud holes.

[0006] EP 0 676 504 A1 discloses a similar fixed slab track for rail vehicles having a base layer formed by an underlying substrate, and a plurality of support elements mounted theron, which are secured in their position on the substarte by means of fastening elementswhich are secured in cut-outs in the substrate by means of a pourable concrete which is pured underneath the support elements.

[0007] DE 44 15 363 C discloses a rail fastening element for a fixed slab track according to the preamble of claim 1.

[0008] It is an object of the invention to provide a system for a fixed slab track, by way of which system the said fixed slab track can be installed simply, rapidly and with high accuracy. According to the invention, this object is achieved by a rail fastening element for a fixed slab

track for rail vehicles according to independent claim 1 and a fixed slab track comprising such rail fastening element according to claim 5.

The combination according to the invention combines in a particularly advantageous way the installation principles firstly of bottom-up and secondly of top-down, by the base layer first of all being set up on the rail track substrate in the bottom-up construction principle, which base layer can preferably be an asphalt layer or else a hydraulically bound support layer. Subsequently, the support elements are mounted next to one another or behind one another on the said base layer, likewise in the bottom-up construction principle, it being possible for both working steps to be carried out with comparatively large tolerances. The main requirement of the base layer namely consists principally in ensuring the required load-bearing capability for the track, which is achieved by the asphalt or concrete which is preferably introduced for the base layer, without the layer being set up in a millimetre-precise manner. For the invention, the support elements which are mounted on the base layer also do not have to be produced with the very highest dimensional accuracy, but principally have to have a required strength, to which end they can be produced as prefabricated components under consideration of the required material qualities, but actually with comparatively large tolerances with regard to their dimensions. Whereas therefore the lower base layer and the support elements which are placed onto it can have a positional and vertical accuracy with comparatively large tolerances which lie in the centimetre range, in the rail track according to the invention, the required high final accuracy is not achieved until the end of the works to be carried out, after all rough work has been ended, with comparatively low effort, by the rail fastening elements namely then being inserted according to the construction principle from the top to the bottom into the cut-outs in the support elements, being oriented in the desired vertical and lateral position and then being fixed in this position, by a hardening sealing compound being introduced below and/or around the rail fastening elements and into the cut-outs. Here, the quantity of the sealing compound to be used is also considerably less than in cases, in which an entire sleeper framework comprising rails and sleepers is underpoured completely with site-mixed concrete, as is regularly the case in known "top-down" construction methods. On account of the comparatively low quantity of sealing compound which is used, it is economically justifiable to also use expensive materials for this purpose which can have the advantage of higher strengths and more rapid hardening in comparison with conventional site-mixed concrete.

[0009] It is possible that at least part of the support elements is formed by sleeper-like transverse support elements which are oriented transversely with respect to the longitudinal direction of the rail track and are provided on their upper side with cut-outs which are intended in pairs for rail fastening elements of a right-hand and a left-hand rail of the track. However, it is also possible that at least part of the support elements is formed by longitudinal support elements which are oriented in the longitudinal direction of the rail track and are arranged below a right-hand or a left-hand rail of the track, each of the longitudinal support elements having a plurality of cut-outs for rail fastening elements for fastening the left-hand or the right-hand rail. Both transverse support elements and longitudinal support elements will frequently be used as support elements for a fixed slab track according to the invention.

[0010] According to the invention, the rail fastening elements have a mounting base body which is arranged or can be arranged in the cut-outs or above the latter and at least one rail holder which interacts with the said mounting base body on the base-body upper side in a positively locking manner. As, according to the invention, the mounting base body is provided with at least one filling channel which penetrates it substantially vertically, the sealing compound can be filled through the said filling channel and, as a result, can be filled particularly reliably into the intermediate space between the mounting base body and the support element which lies below it or the cut-out which is provided in it, whereby it becomes possible to limit the quantity of sealing compound which is used to a minimum.

[0011] On its underside, the mounting base body can be provided with reinforcing ribs which, between themselves, delimit at least one chamber which can be filled from below at least partially with sealing compound, the ribs preferably being enclosed on all sides by the sealing compound after hardening of the latter, and a particularly firm connection between the mounting base body and the support element which lies below it being ensured as a result.

[0012] On the base-body upper side, the mounting base body has a holder guide which receives the rail holder or holders in a positively locking manner, preferably transversely with respect to the rail longitudinal direction, which holder guide ensures that the transverse forces which act on the rails which are fastened to the rail fastening elements are dissipated reliably into the mounting base body and, from the latter, into the support elements and the further track substructure.

[0013] According to the invention, the rail fastening elements are provided with downwardly projecting anchor elements which engage into the cut-outs from above. Here, the arrangement is preferably provided in such a way that the anchor elements are formed substantially by anchor sleeves for sleeper bolts which penetrate the rail holders and mounting base body.

[0014] Connection reinforcements which are provided in the cut-outs serve for a further increase in the strength of the connection between the support elements and the rail fastening elements, which connection reinforcements are enclosed by the sealing compound after the track is finished. In order to further reduce the quantity of sealing compound which is required for underfilling the rail fastening elements, it can be provided that the cut-outs are

divided into a plurality of, preferably two chambers, with the result that the entire volume to be filled can be limited to a minimum quantity. In order to aid the filling of sealing compound into the cut-outs, the latter can be provided with pouring bevels on at least one edge side.

[0015] As already indicated, the rail fastening element according to the invention which can be used in a fixed slab track according to the invention comprises a mounting base body and at least one rail holder which interacts with the said mounting base body on the base-body upper side in a positively locking manner, the rail fastening element further comprising downwardly projecting anchor elements adapted to engage into cut-outs from above, said cut-outs being provided within a support element of a fixed slab track, the mounting base body being provided with at least one filling channel which penetrates it substantially vertically for the sealing compound which can be filled in in order to lock it. With such a rail fastening element according to the invention, it becomes possible to arrange casing elements along the edge sides of the rail fastening elements or their mounting base bodies above the cut-out in the support elements, which casing elements then, during the pouring of the sealing compound through the filling channel, prevent lateral discharging of sealing compound from the intermediate space between the support element and the rail fastening element below the mounting base body. Here, the sealing compound flows into the cut-out which is provided below the respective rail fastening element and into the intermediate space between the support element and the underside of the mounting base body, which intermediate space is delimited by the casing elements, the chambers which are accessible from underneath and are delimited by the reinforcing ribs also being filled with sealing compound there.

[0016] A holder guide is formed on the base-body upper side of the mounting base body and receives the rail holder or holders in a positively locking manner transversely with respect to the rail longitudinal direction. It preferably tapers in a downward direction in one preferred refinement and is delimited laterally by oblique guide faces, whereas the rail holder or holders is/are provided with corresponding oblique faces, the inclination of which is adapted to the guide faces. This achieves a self-centring action of the rail holders during their mounting on the holder guide when the rail holders are tightened by means of the sleeper bolts or the like in order to fasten the rail. Here, the holder guide can have at least one guide groove which is formed on the base-body upper side, runs in the rail longitudinal direction, and into which an adapted guide projection which is formed on the rail holder engages in a positively locking manner.

[0017] Each of the rail fastening elements can preferably have two rail holders which, between themselves, leave a receptacle exposed for the rail foot of the rail and optionally for setting and/or compensating plates which are to be arranged below the rail foot on the base-body upper side.

[0018] A method is shown for setting up a track in a fixed slab track, according to the method first of all a base layer being provided which is preferably arranged as an asphalt layer on an underlying substrate or is formed by the underlying substrate which is configured, for example, as a hydraulically bound support layer. In the next method step, a multiplicity of support elements which have in each case at least one cut-out on their upper side are mounted on the base layer. The said support elements which can be configured as sleeper-like transverse support elements which are oriented transversely with respect to the longitudinal direction of the rail track or else as longitudinal support elements which are oriented in the longitudinal direction of the rail track and are arranged below a right-hand or left-hand rail of the track are preferably prefabricated components, the dimensional tolerances of which do not have to be subjected to any particularly high requirements. A sleeper framework which can comprise the two running rails, (possibly temporary) gauge tie bars which connect them to one another and rail fastening elements which are connected to the rails can then be oriented in its vertical and lateral position on the said track substructure which is therefore set up from the bottom to the top (bottom-up), in such a way that the rail fastening elements are situated above the cut-outs in the support elements and engage at least partially from above into the latter. After the desired vertical and lateral orientation of the track on the track substructure which is set up in the bottom-up process has taken place, the rail fastening elements are locked by introduction of a hardening sealing compound into the intermediate spaces which remain between the rail fastening elements and the support elements and into the cut-outs.

[0019] Further features and advantages of the invention result from the following description and the drawing, in which preferred embodiments of the invention are explained and shown by way of example. In the drawing:

Fig. 1 shows a section of a first embodiment of the fixed slab track according to the invention in a perspective illustration,

Fig. 2 shows a second embodiment of the fixed slab track according to the invention in a perspective illustration,

Fig. 3 shows a rail fastening element according to the invention which is mounted on a rail, in a state before it is poured on the substructure of the fixed slab track, in a perspective illustration,

Fig. 4 shows the subject matter of Figure 3 in cross section, and

Fig. 5 shows a cross section through a rail fastening element which is underpoured on a support element, in a simplified illustration with the omission of the rail holders and the rail which is

mounted thereon.

[0020] Fig. 1 shows a perspective illustration of a section of a fixed slab track for rail vehicles which is denoted in its entirety by 10, as can also be used, in particular, for high-speed lines.

[0021] The rail track 10 has a base layer 12 which is arranged on an underlying substrate 11, which can be, for example, a hydraulically bound support layer, and is produced as an asphalt surface which is manufactured without joints in the preferred exemplary embodiment which is shown. In the preferred exemplary embodiment which is shown, this is an asphalt support layer (B70/100) which is approximately 15 cm thick and 270 cm wide, is applied on the underlying substrate 11 by way of a conventional asphalt road finishing machine according to the bottom-up construction principle, and is rolled if required in order to achieve an increased strength. Here, comparatively low accuracy requirements are made which permit tolerances in the vertical position of the surface of the base layer 12 of +10/-20 mm and of the lateral edges of ±5 cm and more, whereby the accuracy requirements are lower than in the case of most roadbuilding projects and can therefore be maintained without problems by most roadbuilding companies. A multiplicity of support elements 13 are mounted on the asphalt base layer 12 which can already be loaded a few hours after it is installed. In the first embodiment which is shown in Fig. 1, the said support elements 13 comprise transverse support elements 15 which are oriented transversely with respect to the longitudinal direction 14 of the rail track 10, are of sleeper-like design and are produced as concrete prefabricated parts. The said concrete prefabricated parts can also be produced with comparatively large tolerances, for example can be produced vertically with ±6 mm, as long as they meet the requirements made of them with regard to their concrete quality/strength. Each of the transverse support elements is provided with two cut-outs 17 (Fig. 4) which are arranged in pairs on the left and right in the region below the rails 16, each of the cut-outs 17 having two chambers 19 which are separated by a dividing wall 18. Rail fastening elements for the rails 16 are situated above the cut-outs 17, which rail fastening elements are denoted in their entirety by 20, are inserted from above with downwardly projecting anchor elements 21 into the chambers 19 of the cut-outs 17, and are locked on the support elements 13, as will still be described in the following text, by means of a hardening sealing compound 22.

[0022] The second embodiment (shown in Fig. 2) of the fixed slab track according to the invention differs from the first embodiment initially in the fact that the underlying substrate 11 is formed by an artificial edifice, in the present case a reinforced concrete bridge 23. Whereas the transverse support elements 15 in the first embodiment are laid in a more or less floating manner, longitudinal support elements 24 which are connected fixedly by means of underpoured site-mixed concrete 25 to the underlying substrate 11 which is formed by the reinforced concrete bridge 23 are used in the second embodiment. The fixed connection between the longitudinal support elements 24 and the underlying substrate 11 can be aided by connection reinforcements (not shown) which protrude from the said underlying substrate 11 and project downward from the longitudinal support elements on their undersides, and which are enclosed by the site-mixed concrete 25 during pouring with the latter. In the embodiment according to Fig. 2, each of the longitudinal support elements 24 has three cut-outs 17 for rail fastening elements 20 which are arranged one behind another in the longitudinal direction 14 of the rails 16 and in each case serve to fasten one of the two rails.

[0023] If one now turns to Figs 3 and 4 which show the rail fastening elements in a construction state of the fixed slab track immediately before the introduction of the sealing compound into the intermediate space which is produced between the rail fastening elements and the support elements, it is seen that the rail fastening elements 20 in each case have a mounting base body 26 which is arranged above the cut-outs 17 and from which the anchor elements 21 project downwards and engage into the two chambers 19 of the associated cut-out 17. On the base-body upper side 27 of the base body 26, the latter is provided with a holder guide 28 which serves to interact in a positively locking manner with two rail holders 29 of the rail fastening element 20 and to fix the latter transversely with respect to the rail longitudinal direction 14. To this end, on its right-hand and left-hand edge region, the holder guide 28 has two upwardly projecting guide flanges 30 with downwardly converging, oblique guide faces 31 which taper into guide grooves 32 which are formed on the base-body upper side 27 and run in the rail longitudinal direction 14. The rail holders 29 are provided with corresponding oblique faces 13, the inclination of which is adapted to the guide faces 31, and, on their underside, have a guide projection 34, with which they engage in each case into one of the guide grooves 32.

[0024] The rails 16 are fixed on the rail fastening elements 20 in a substantially known way by means of holding clips 35 which engage over the rail foot 36 and are pressed by sleeper bolts 37 against the rail foot 36 and the rail holders 29, which sleeper bolts 37 penetrate the rail fastening elements 20 and are screwed into the anchor sleeves 21 which project below the rail fastening elements 20 into the cut-outs 17 in the support elements 13.

[0025] Filling channels 38 which penetrate the mounting base bodies 26 vertically from top to bottom are provided in the guide flanges 30 of the said mounting base bodies 26, through which filling channels 38 the sealing compound 22 can be filled for underfilling the fastening elements and for locking purposes, as is indicated by the arrow 39 in Fig. 3, after the orientation of the rail fastening elements or the rail, to which the former are attached. On its underside, the mounting base body 26 is provided

with a plurality of anchor ribs 40 which, after the underfilling of the base body with the sealing compound 22, are enclosed completely by the latter, with the result that the anchor ribs 40 lock the mounting base body in the hardened sealing compound in a positively locking manner transversely with respect to the rail longitudinal direction. In addition to the said anchor ribs which can be seen in Fig. 4, the mounting base body 26 has, on the underside, a ribbed structure 41 which can be seen satisfactorily in the sectional illustration in Fig. 5 and which is likewise enclosed partially by sealing compound.

[0026] In order that the sealing compound 22 which is filled through the filling channel 38 into the clearance between the rail fastening element 20 and the support element 13 cannot run out again laterally, the rail fastening element is surrounded before the pouring on the edge side with casing elements 42 which can comprise simple wooden frames which are nailed together and can be removed again after the hardening of the sealing compound 22. In order that the sealing compound which is introduced through the filling channel 38 can run without problems into the chambers 19 of the cut-outs 17, the latter are provided in each case with a pouring bevel 43 on a side of their upper edge. It can also be seen from Fig. 4 that connection reinforcements 44 which project from the bottom to the top and give the filled sealing compound even higher strength are provided in the chambers of the cut-outs 17.

[0027] It can be seen that, in order to lock the rail fastening elements 20 to the support elements, only a comparatively small quantity of sealing compound is required which has to fill merely the cut-outs 17 and the gap 45 which is formed below the mounting base body 26 after the orientation of the rail. Even if a particularly high-quality and therefore expensive sealing compound is used, the costs which are to be attributed to this remain low, since the material requirement overall is low.

[0028] It goes without saying that the rail fastening elements 20 are not oriented individually in each case on their own before pouring, but rather for this purpose are connected to the sleeper framework which is formed by the rails 16 and gauge tie rods (not shown), as is known. Readjustment of the rail position even after hardening of the sealing compound, for example after relatively long travel operation, is possible without problems by way of the exchange of setting or compensating plates 46 which can be arranged between the two rail holders 29 below the rail foot 36 on the base-body upper side 27, as can be seen best in Fig. 4.

[0029] By way of the arrangement according to the invention, working steps of different construction methods are advantageously combined with one another, by the base layer which is arranged on the underlying substrate 11 and the support elements 13 which are mounted thereon being produced in a construction method from the bottom to the top (bottom-up), large tolerances consciously being permitted here and rapid construction progress therefore being achieved by way of simple means, machines and prefabricated parts, whereas subsequently the required high accuracy of the rail position is achieved by the installation of the rail fastening elements (which are connected to the sleeper framework) from the top to the bottom (top-down construction method), it also being possible for this construction step to be ended within a short time by the use of high-strength and rapidly hardening sealing compounds and the ability of the track to be driven along being achieved quickly. The transverse forces which are exerted on the rails by the rail vehicles during travel operation and occur transversely with respect to the longitudinal direction 14 of the rails are dissipated by the rail holders which are guided in a positively locking manner in the holder guide 28 into the base body 26 and from the latter via the downwardly projecting anchor ribs 40 and the hardened sealing compound 22 which encloses them uniformly over the entire underpoured foundation. The anchor elements 21 which project deeply into the transverse support elements and are poured at the same time in the cut-outs ensure that the sleeper bolts 27 can be loaded with high tightening strengths and therefore fix the rails reliably and permanently to the rail fastening elements.

Claims

1. Rail fastening element (20) for rails (16) of a fixed slab track (10), comprising a mounting base body (26) and at least one rail holder (29) which interacts with the said mounting base body (26) on its upper side (27) in a positively locking manner in a mounted state, transversally with respect to the rail (16) longitudinal direction (14), the rail fastening element (20) further comprising downwardly projecting anchor elements (21) adapted to engage into cut-outs (17) being provided within a support element (13) of the fixed slab track (10), the mounting base body (26) being provided with at least one filling channel (38) which penetrates it substantially vertically from top to bottom for a sealing compound (22) which can be filled though for locking purposes into the intermediate space between the mounting base body (26) and the support element (13) which lies below it or the cut-out (17) which is provided in it, **characterized in that** the mounting base body (26) being arrangeable in the cut-outs (17) or above the latter and forming on the upper side (27) a holder guide (28) having two upwardly projecting guide flanges (30) with downwardly converging, oblique guide faces (31) which taper into guide grooves (32) formed on the upper side (27) and running, in a mounted state, in the rail (16) longitudinal direction (14) to interact in the positively locking manner with the rail holder (29), said rail holders (29) being provided with corresponding oblique faces (13), the inclination of which being adapted to the guides faces (31), and, on their underside, having a guide projection (34),

with which they engage in each case into one of the guides grooves (32), said at least one filling channel (38) being provided in said at least one guide flange (30), whereas the rail fastening elements (21) are insertable into the cut-outs (17) from above and can be locked after their vertical and lateral orientation by means of the hardening sealing compound (22).

2. Rail fastening element (20) according to Claim 1, **characterized in that**, on its underside, the mounting base body (26) is provided with anchoring ribs (40) which are enclosed by the sealing compound (22) in the state of the base body (26) in which it is installed in the track.

3. Rail fastening element (20) according to Claim 1 or 2, **characterized in that** the holder guide (28) receives the rail holder or holders (29) transversely with respect to the rail longitudinal direction (14).

4. Rail fastening element (20) according to any one of Claims 1 to 3, **characterized in that** the anchor elements (21) are formed substantially by anchor sleeves for sleeper bolts (37) which penetrate the rail holders (29) and mounting base body (26).

5. Fixed slab track (10) for rail vehicles having

- a base layer (12) which is arranged on an underlying substrate (11) or is formed by the underlying substrate (11);
- a multiplicity of said support elements (13) which are mounted on the base layer (12) and have in each case at least one of said cut-outs (17) on their upper side; and having
- rail fastening elements (20) according to any one of Claims 1 to 4 **whereas** the sealing compound (22) being filled in the cut-outs (17) for locking the rail fastening elements (20) therein.

6. Fixed slab track (10) according to Claim 5, **characterized in that** the base layer (12) is an asphalt layer or hydraulically bound support layer.

7. Fixed slab track (10) according to Claim 5 or 6, **characterized in that** at least part of the support elements (13) is formed by sleeper-like transverse support elements (15) which are oriented transversely with respect to the longitudinal direction (14) of the slab track (10) and are provided on their upper side with the cut-outs (17) which are arranged in pairs intended for the rail fastening elements (20) of a right-hand and a left-hand rail (16) of the track.

8. Fixed slab track (10) according to any one of Claims 5 to 7, **characterized in that** at least part of the support elements (13) is formed by longitudinal support elements (24) which are oriented in the longitudinal direction (14) of the slab track (10) and are arranged below a right-hand or a left-hand rail (16) of the track, each of the longitudinal support elements (24) having a plurality of said cut-outs (17) for the rail fastening elements (20) for fastening the left-hand or the right-hand rail (16).

9. Fixed slab track (10) according to any one of Claims 5 to 8, **characterized by** casing elements (42) which are arranged or can be arranged along the edge sides of the rail fastening elements (20) or their mounting base bodies (26) above the cut-out (17).

10. Fixed slab track (10) according to any one of Claims 5 to 9, **characterized in that** the support elements (13) are provided in the cut-outs (17) with connection reinforcements (44) which are enclosed by the sealing compound (22).

11. Fixed slab track (10) according to any one of Claims 5 to 10, **characterized in that** the cut-outs (17) are divided into a plurality of, preferably two chambers (19).

12. Fixed slab track (10) according to any one of Claims 5 to 11, **characterized in that** the cut-outs (17) are provided with a pouring bevel (43) on at least one edge side.

Patentansprüche

1. Schienenbefestigungselement (20) für Schienen (16) einer festen Fahrbahn (10), umfassend einen Montagegrundkörper (26) und mindestens einen Schienenhalter (29), der mit dem Montagegrundkörper (26) auf seiner Oberseite (27) in einem montierten Zustand quer zur Längsrichtung (14) der Schiene (16) formschlüssig zusammenwirkt, wobei das Schienenbefestigungselement (20) ferner nach unten vorstehende Ankerelemente (21) umfasst, die ausgelegt sind, in Ausschnitte (17) einzugreifen, die in einem Tragelement (13) der festen Fahrbahn (10) bereitgestellt sind, wobei der Montagegrundkörper (26) mit mindestens einem ihn im Wesentlichen vertikal von oben nach unten durchdringenden Füllkanal (38) für eine Vergussmasse (22) versehen ist, die zu Verriegelungszwecken in den Zwischenraum zwischen dem Montagegrundkörper (26) dem darunter liegenden Tragelement (13) oder dem darin bereitgestellten Ausschnitt (17) gefüllt werden kann, **dadurch gekennzeichnet, dass** der Montagegrundkörper (26) in den Ausschnitten (17) oder darüber anordbar ist und an der Oberseite (27) eine Halterführung (28) mit zwei nach oben vorstehenden Führungsflanschen (30) mit nach unten konvergieren schrägen Führungsflächen (31) bildet, die sich zu Führungsnuten (32) verjüngen, die auf der Ober-

seite (27) gebildet sind und in einem montierten Zustand in der Längsrichtung (14) der Schiene (16) verlaufen, um formschlüssig mit dem Schienenhalter (29) zusammen zu wirken, wobei die Schienenhalter (29) mit entsprechenden schrägen Flächen (13) versehen sind, deren Neigung an die Führungsflächen (31) angepasst ist, und an ihrer Unterseite einen Führungsvorsprung (34) aufweisen, mit dem sie jeweils in eine der Führungsnuten (32) eingreifen, wobei der mindestens eine Füllkanal (38) in dem mindestens einen Führungsflansch (30) vorgesehen ist, wobei die Schienenbefestigungselemente (21) in die Ausschnitte (17) von oben einführbar sind und nach ihrer vertikalen und lateralen Ausrichtung mittels der aushärtenden Vergussmasse (22) festgelegt werden können.

2. Schienenbefestigungselement (20) nach Anspruch 1, **dadurch gekennzeichnet, dass** der Montagegrundkörper (26) an seiner Unterseite mit Verankerungsrippen (40) versehen ist, die von der Vergussmasse (22) in dem Zustand des Grundkörpers (26) umschlossen sind, in dem er in dem Gleis installiert ist.

3. Schienenbefestigungselement (20) nach Anspruch 1 oder 2, **dadurch gekennzeichnet, dass** die Halterführung (28) den oder die Schienenhalter (29) quer zur Schienenlängsrichtung (14) aufnimmt.

4. Schienenbefestigungselement (20) nach einem der Ansprüche 1 bis 3, **dadurch gekennzeichnet, dass** die Ankerelemente (21) im Wesentlichen von Ankerhülsen für Schwellenbolzen (37) gebildet werden, die die Schienenhalter (29) und den Montagegrundkörper (26) durchdringen.

5. Feste Fahrbahn (10) für Schienenfahrzeuge, aufweisend

- eine Grundschicht (12), die auf einem darunter liegenden Substrat (11) angeordnet ist oder von dem darunter liegenden Substrat (11) gebildet ist;
- eine Vielzahl der Tragelemente (13), die auf der Grundschicht (12) montiert sind und jeweils mindestens einen der Ausschnitte (17) auf ihrer Oberseite aufweisen; und aufweisend
- Schienenbefestigungselemente (20) nach einem der Ansprüche 1 bis 4 **wobei** die Vergussmasse (22) in die Ausschnitte (17) zum Verriegeln der Schienenbefestigungselemente (20) darin eingefüllt ist.

6. Feste Fahrbahn (10) nach Anspruch 5, **dadurch gekennzeichnet, dass** die Grundschicht (12) eine Asphaltschicht oder eine hydraulisch gebundene Tragschicht ist.

7. Feste Fahrbahn (10) nach Anspruch 5 oder 6, **dadurch gekennzeichnet, dass** wenigstens ein Teil der Tragelemente (13) durch schwellenartige Quertragelementen (15) gebildet wird, die in Bezug auf die Längsrichtung (14) der Fahrbahn (10) quer ausgerichtet sind und auf ihrer Oberseite mit den Ausschnitten (17) versehen sind, die paarweise angeordnet sind und für die Schienenbefestigungselemente (20) einer rechten und einer linken Schiene (16) des Gleises bereitgestellt sind.

8. Feste Fahrbahn (10) nach einem der Ansprüche 5 bis 7, **dadurch gekennzeichnet, dass** mindestens ein Teil der Tragelemente (13) von Längstragelemente (24) gebildet wird, die in Längsrichtung (14) der Fahrbahn (10) ausgerichtet sind und unterhalb einer rechten oder einer linken Schiene (16) der Bahn angeordnet sind, wobei jedes der Längstragelemente (24) mehrere Ausschnitte (17) für die Schienenbefestigungselemente (20) zum Befestigen der linken oder rechten Schiene (16) aufweist.

9. Feste Fahrbahn (10) gemäß einem der Ansprüche 5 bis 8, **gekennzeichnet durch** Gehäuseelemente (42), die entlang der Kantenseiten der Schienenbefestigungselemente (20) oder ihrer Montagegrundkörper (26) oberhalb des Ausschnitts (17) angeordnet sind oder angeordnet werden können.

10. Feste Fahrbahn (10) nach einem der Ansprüche 5 bis 9, **dadurch gekennzeichnet, dass** die Tragelemente (13) in den Ausschnitten (17) mit Verbindungsverstärkungen (44) versehen sind, die von der Vergussmasse (22) umschlossen werden.

11. Feste Fahrbahn (10) nach einem der Ansprüche 5 bis 10, **dadurch gekennzeichnet, dass** die Ausschnitte (17) in eine Mehrzahl, vorzugsweise zwei Kammern (19) unterteilt sind.

12. Feste Fahrbahn (10) nach einem der Ansprüche 5 bis 11, **dadurch gekennzeichnet, dass** die Ausschnitte (17) an mindestens einer Kantenseite mit einer Gießschräge (43) versehen sind.

Revendications

1. Élément de fixation de rail (20) pour des rails (16) d'une voie ferrée sans ballast fixe (10), comprenant un corps de base de montage (26) et au moins un support de rails (29) qui interagit avec ledit corps de base de montage (26) sur son côté supérieur (27) d'une manière à autoverrouillage dans un état monté, transversalement par rapport à la direction longitudinale (14) du rail (16), l'élément de fixation de rail (20) comprenant en outre des éléments d'ancrage (21) faisant saillie vers le bas adaptés pour venir en

prise dans des découpes (17) étant prévues à l'intérieur d'un élément de support (13) de la voie ferrée sans ballast fixe (10), le corps de base de montage (26) étant doté d'au moins un canal de chargement (38) qui pénètre dans celui-ci sensiblement verticalement de haut en bas pour un composé d'étanchéité (22) qui peut être chargé à travers à des fins de verrouillage dans l'espace intermédiaire entre le corps de base de montage (26) et l'élément de support (13) qui se situe en dessous de celui-ci ou la découpe (17) qui est prévue dans celui-ci, **caractérisé en ce que** le corps de base de montage (26) étant apte à être agencé dans les découpes (17) ou au-dessus de ces dernières et formant sur le côté supérieur (27) un guide de support (28) comportant deux brides de guidage (30) faisant saillie vers le haut avec des faces de guidage (31) obliques, convergeant vers le bas, qui s'effilent dans des rainures de guidage (32) formées sur le côté supérieur (27) et s'étendant, dans un état monté, dans la direction longitudinale (14) du rail (16) pour interagir de la manière à autoverrouillage avec le support de rails (29), lesdits supports de rails (29) étant dotés de faces obliques (13) correspondantes, dont l'inclinaison est adaptée pour les faces de guidage (31), et, sur leur côté inférieur, comportant une saillie de guidage (34), dans laquelle ils entrent en prise dans chaque cas dans l'une des rainures de guidage (32), ledit au moins un canal de chargement (38) étant prévu dans ladite au moins une bride de guidage (30), tandis que les éléments de fixation de rail (21) sont insérables dans les découpes (17) à partir du dessus et peuvent être verrouillés après leur orientation verticale et latérale au moyen du composé d'étanchéité (22) durcissable.

2. Élément de fixation de rail (20) selon la revendication 1, **caractérisé en ce que**, sur son côté inférieur, le corps de base de montage (26) est doté de nervures d'ancrage (40) qui sont entourées par le composé d'étanchéité (22) dans l'état du corps de base (26) dans lequel il est installé dans la voie ferrée.

3. Élément de fixation de rail (20) selon la revendication 1 ou 2, **caractérisé en ce que** le guide de support (28) reçoit le support ou les supports de rails (29) transversalement par rapport à la direction longitudinale (14) du rail.

4. Élément de fixation de rail (20) selon l'une quelconque des revendications 1 à 3, **caractérisé en ce que** les éléments d'ancrage (21) sont formés sensiblement par des manchons d'ancrage pour boulons de traverse (37) qui pénètrent dans les supports de rails (29) et le corps de base de montage (26).

5. Voie ferrée sans ballast fixe (10) pour véhicules ferroviaires comportant

- une couche de base (12) qui est agencée sur un substrat sous-jacent (11) ou est formée par le substrat sous-jacent (11);
- une multiplicité de dits éléments de support (13) qui sont montés sur la couche de base (12) et ont dans chaque cas au moins l'une desdites découpes (17) sur leur côté supérieur; et comportant
- des éléments de fixation de rail (20) selon l'une quelconque des revendications 1 à 4 **tandis que** le composé d'étanchéité (22) étant chargé dans les découpes (17) pour verrouiller les éléments de fixation de rail (20) dans celles-ci.

6. Voie ferrée sans ballast fixe (10) selon la revendication 5, **caractérisée en ce que** la couche de base (12) est une couche d'asphalte ou une couche de support liée par voie hydraulique.

7. Voie ferrée sans ballast fixe (10) selon la revendication 5 ou 6, **caractérisée en ce qu'**au moins une partie des éléments de support (13) est formée par des éléments de support (15) transversaux de type traverse qui sont orientés transversalement par rapport à la direction longitudinale (14) de la voie ferrée sans ballast (10) et sont dotés sur leur côté supérieur des découpes (17) qui sont agencées en paires destinées aux éléments de fixation de rail (20) d'un rail (16) côté droit et côté gauche de la voie ferrée.

8. Voie ferrée sans ballast fixe (10) selon l'une quelconque des revendications 5 à 7, **caractérisée en ce qu'**au moins une partie des éléments de support (13) est formée par des éléments de support (24) longitudinaux qui sont orientés dans la direction longitudinale (14) de la voie ferrée sans ballast (10) et sont agencés sous un rail (16) côté droit ou côté gauche de la voie ferrée, chacun des éléments de support (24) longitudinaux comportant une pluralité desdites découpes (17) pour les éléments de fixation de rail (20) pour maintenir le rail (16) côté droit ou côté gauche.

9. Voie ferrée sans ballast fixe (10) selon l'une quelconque des revendications 5 à 8, **caractérisée par** des éléments de coffrage (42) qui sont agencés ou peuvent être agencés le long des bordures des éléments de fixation de rail (20) ou de leurs corps de base de montage (26) au-dessus de la découpe (17).

10. Voie ferrée sans ballast fixe (10) selon l'une quelconque des revendications 5 à 9, **caractérisée en ce que** les éléments de support (13) sont dotés dans les découpes (17) de renforts de raccordement (44) qui sont entourés par le composé d'étanchéité (22).

11. Voie ferrée sans ballast fixe (10) selon l'une quelconque des revendications 5 à 10, **caractérisé en**

ce que les découpes (17) sont divisées en une pluralité de, de préférence deux chambres (19).

12. Voie ferrée sans ballast fixe (10) selon l'une quelconque des revendications 5 à 11, **caractérisée en ce que** les découpes (17) sont dotées d'un biseau de coulage (43) sur au moins une bordure.

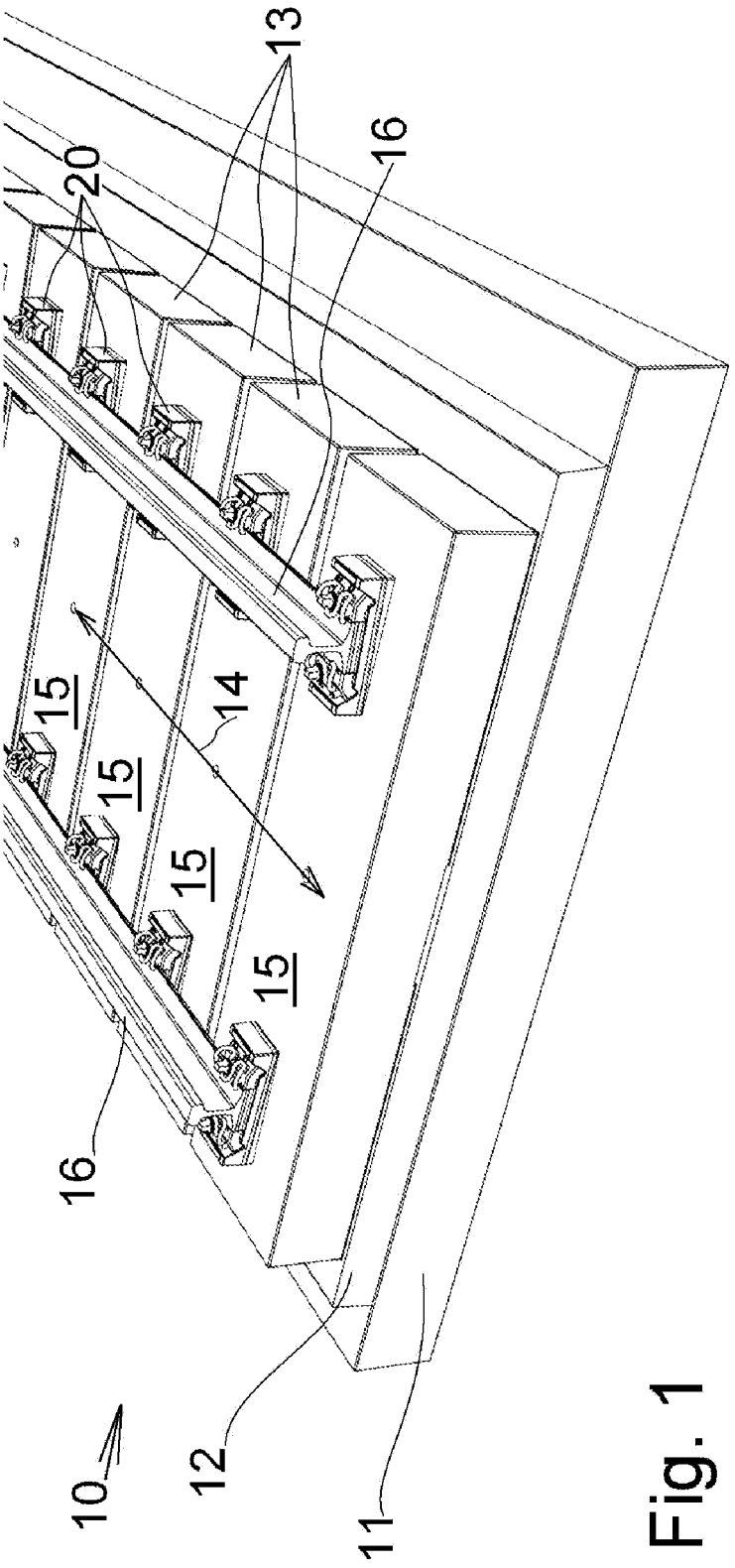


Fig. 1

Fig.2

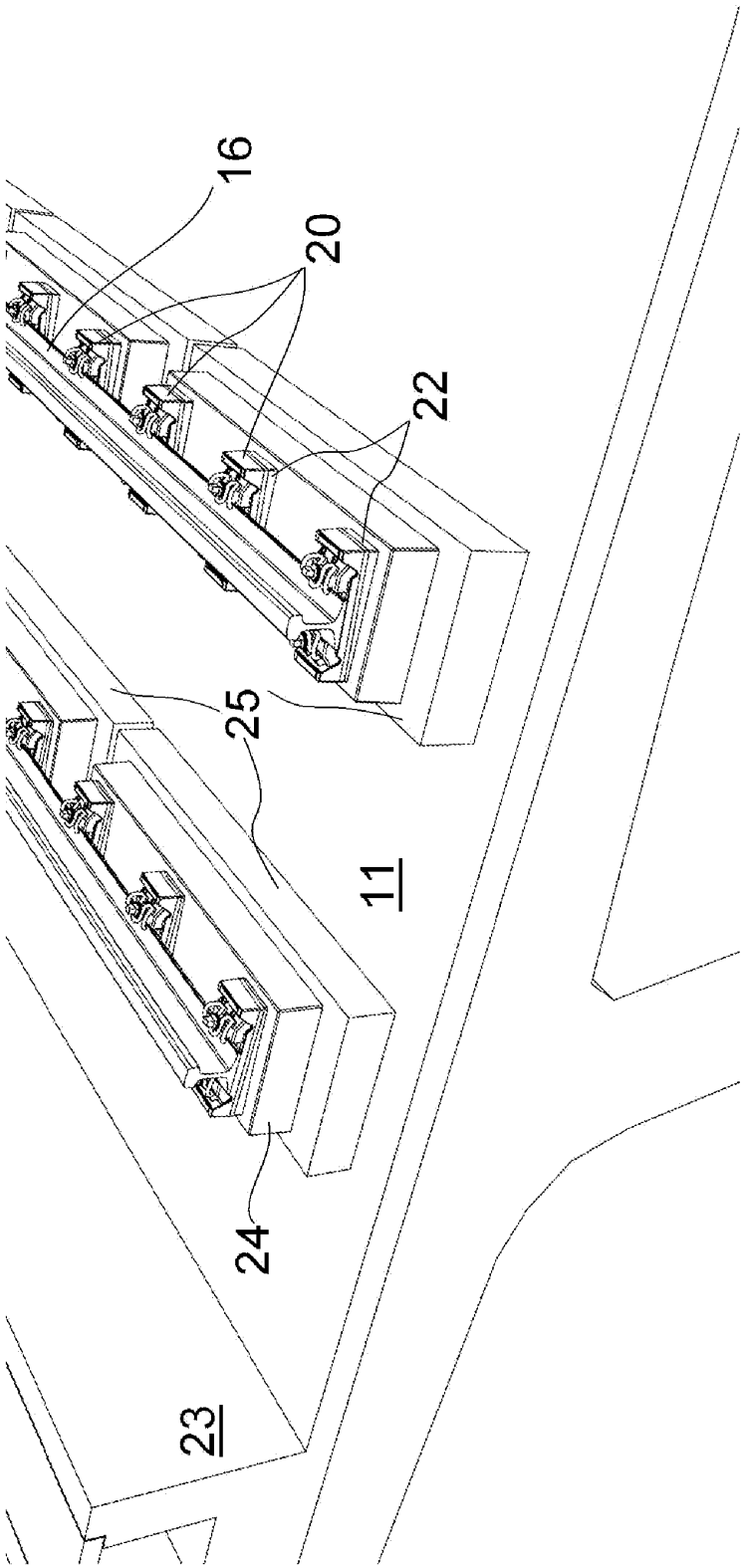
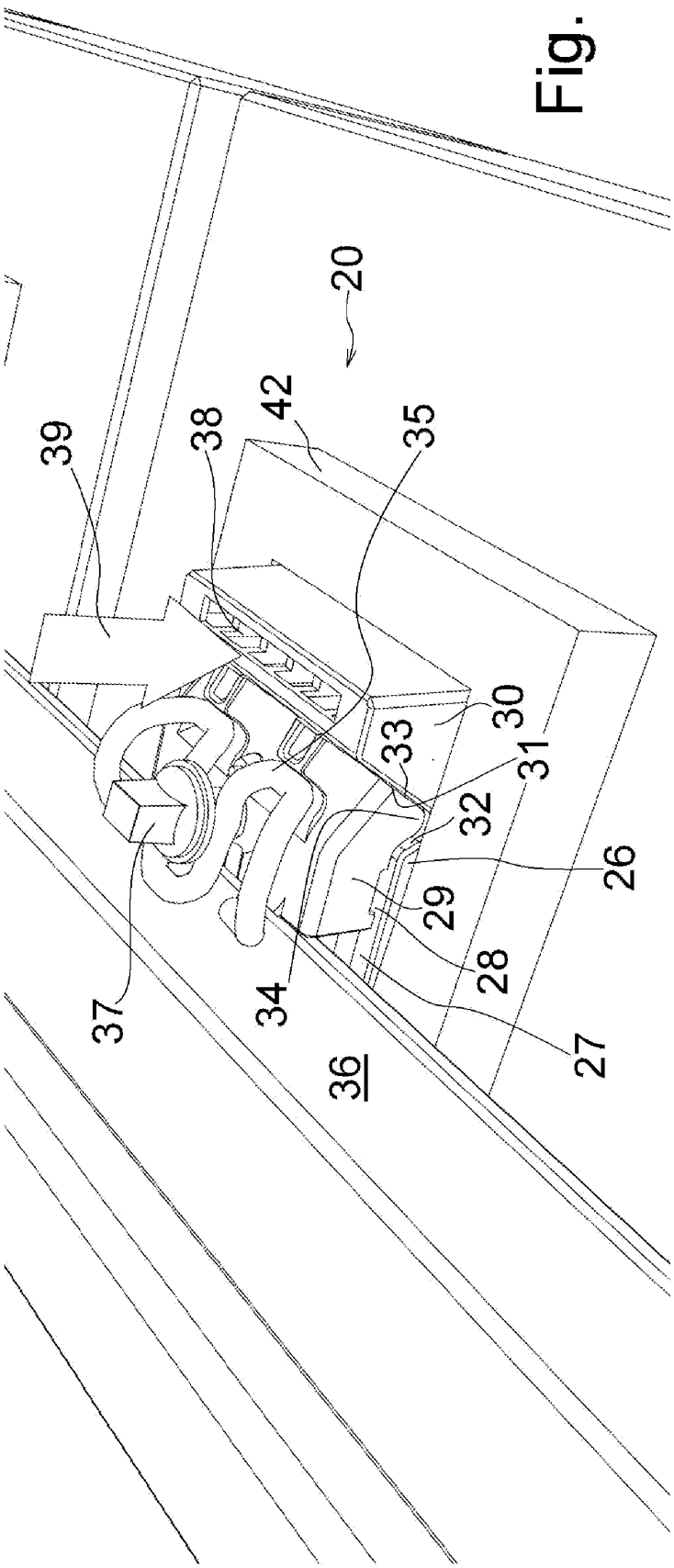


Fig. 3



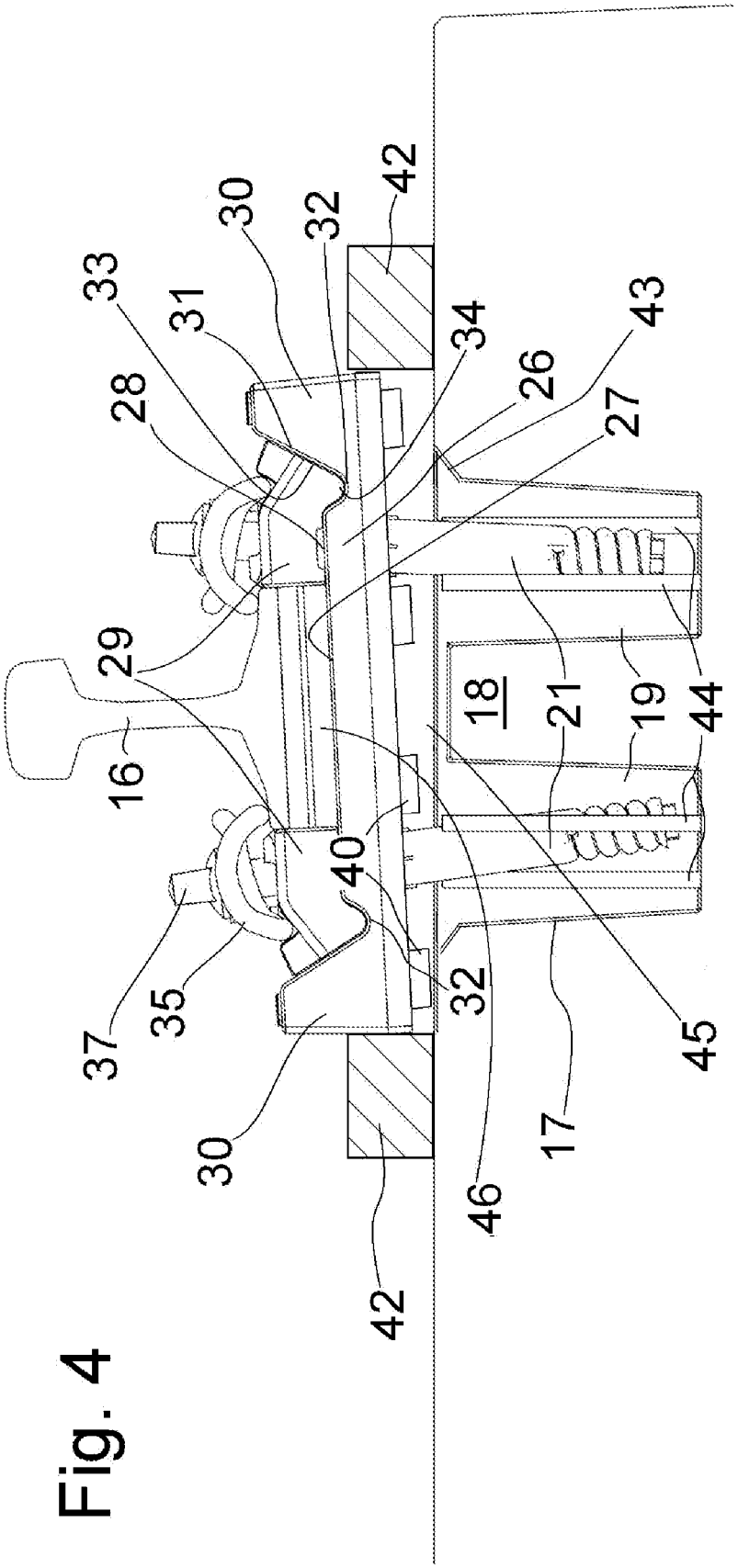

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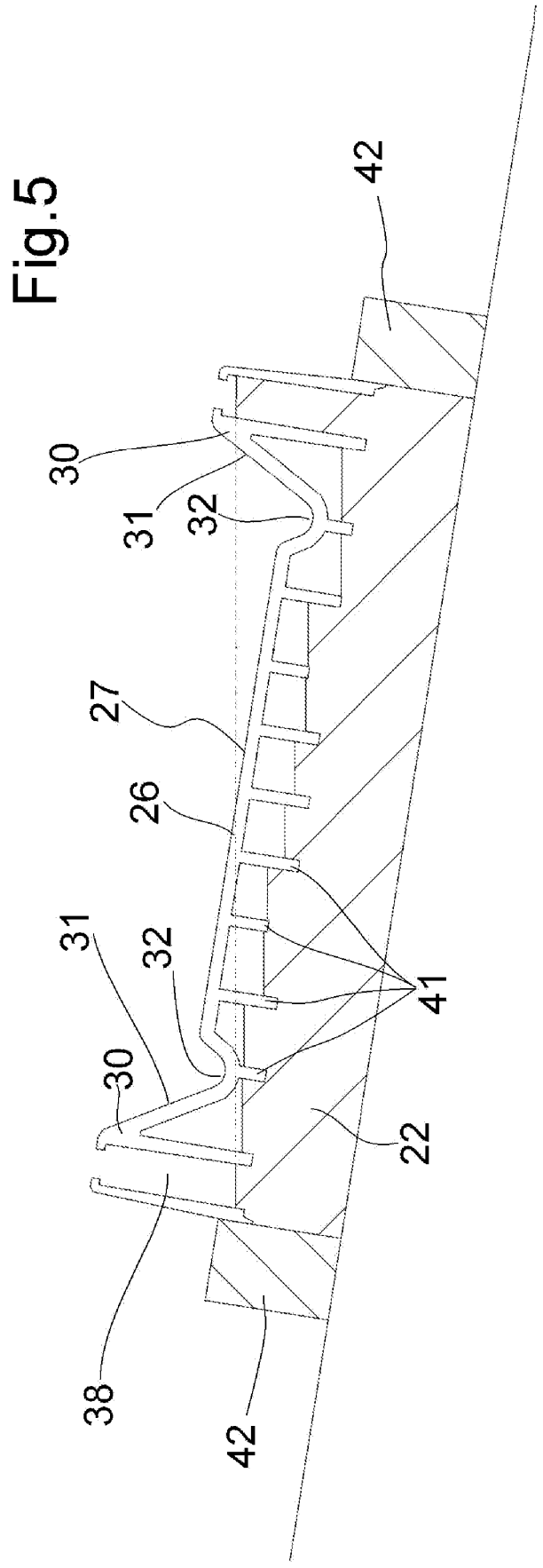
Fig. 4

Fig.5



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